Monday, 8:50–9:00, Festsaal

Zeit Time	ID	
		Opening of conference, P.M. Schuster, Echophysics, Pöllau, Austria

Monday, 9:00–10:40, Festsaal

Zeit Time	ID	
		Morning Session Part 1 Chair: Denis Weaire, Trinity College Dublin, Ireland

9:00 Mo1-1

Why celebrate accident? Ernst Mach's 1895 account of invention and discovery

•Richard Staley

University of Cambridge, Cambridge, UK

On taking up what is usually described as the first chair dedicated to the history and philosophy of science in Vienna in 1895, the physicist Ernst Mach chose to devote his inaugural lecture to discussing the role of accident in invention and discovery [1]. This lecture will consider why he emphasised chance, what Mach thought was required to take advantage of it, and why he linked the search for useful inventions and knowledge so closely together. Drawing on Christoph Hoffmann's fine study of the research and writing processes visible in Mach's preparatory notes for this lecture [2,3], I will pay close attention to one of the primary examples of accident and discovery that Mach referred to from his own theoretical and experimental work, his 1873 identification of the role of the inner ear in our sense of orientation. My aim will be to examine the extent to which Mach's 1895 analysis reflects his own experience, as well as to characterise the role of this lecture in the development of his philosophical approach to the sciences.

[1] E. Mach, in Popular Scientific Lectures, (Open Court, Chicago, 1898). [2] C. Hoffmann, in Improvisation und Invention: Momente, Modelle, Medien, S. Zanetti ed. (Diaphanes, Zürich, 2014). [3] C. Hoffmann, "Processes on Paper: Writing Procedures as Non-Material Research Devices," Science in Context 26, 279 (2013).

9:40 Mo1-2

Finding reality of nature through irreality of mathematics: Fresnel's original interpretation of complex numbers

•Ricardo Karam

University of Copenhagen, Copenhagen, Denmark

Complex numbers were primarily conceived in the sixteenth century as a tool to solve cubic equations. At a first glance, it seems unlikely that complex numbers could be useful for understanding the physical world. However, more than two centuries after their invention, physicists gradually began to utilize complex numbers to model different kinds of physical phenomena, a process that has been called "complexification of physics" by Salomon Bochner [1]. In this work, I present a detailed analysis of arguably the first physical interpretation of complex numbers, made by Fresnel in 1823 [2,3]. When studying the changes in polarized light due to reflection, or more specifically when deriving equations relating the amplitudes of the reflected and incident waves (nowadays known as Fresnel's equations), Fresnel encountered a situation where the square root of a negative number appeared. Instead of disregarding any physical meaning to that result, he evoked a general law of continuity (loi générale de contituité) and demanded some physical interpretation to the complex expression, which eventually led him to predict a phase shift due to reflection. Although phase shift associated with reflection was a known phenomenon at the time, his calculations with complex numbers provided Fresnel with an accurate numerical description that enabled him to design precise optical instruments (Fresnel Rhomb) to produce circularly polarized light. This episode is not only interesting due to the fact that abstract mathematical reasoning revealed a hidden physical reality, but also because this particular geometric interpretation of complex numbers was not widely known at the time, so that one can also possibly say that Fresnel made an original independent interpretation of complex numbers himself.

[1] S. Bochner, The role of mathematics in the rise of science, 4th ed., (Princeton University Press, Princeton, 1981).
[2] A. J. Fresnel, "Mémoire sur la loi des modifications que la réflexion imprime à la lumière polarisée," Read in 7 January 1823. In Oeuvres, 1: 767-99.
[3] J. Z. Buchwald, The Rise of the Wave Theory of Light: Optical Theory and Experiment in the Early Nineteenth Century, 1st ed., (The University of Chicago Press, Chicago, 1989).

10:00 Mo1-3

The Dilemmas of an Industrial Physicist: Carl Ramsauer and Physics Research at the AEG-Research Institute

•Falk Müller

Department of History, Goethe-University, Frankfurt, Germany

"Innovation itself need not be a prime value for scientists, and innovation for its own sake can be condemned. Science has its elite and may have its rear guard, its producers of Kitsch. But there is no scientific avant-garde, and the existence of one would threaten science." (Thomas S. Kuhn)

Carl Ramsauer would have consented to Thomas Kuhn's demarcation: science and especially physics were not like art. He himself knew, though, that the management of AEG expected inventions and the development of innovative technologies. Physicists working in an industrial environment had to make compromises and adopt new practices and new styles of reasoning: "The embodiment of something practical and functional is an act of creation just like the completion of a great work of art."

Ramsauer had left his professorship in experimental physics at Danzig Technical University in 1928 to become founding director of the central Research Institute at the electro-technical company AEG in Berlin. Starting with a handful of researchers, under his direction the institute's staff-number increased to almost 900 scientists and workers at the end of the war – a growth that was mainly due to the rise and expansion of the German war machine.

During the National Socialist Regime Ramsauer became one of the leading figures in the German physics community. He served as president of the German Physical Society from 1941-1945 and took up a position as intermediator between "modern" theoretical physics and the so-called "German Physics" community, as well as between the physics community, politics and the military. The focus of this talk, though, will not be on Ramsauer's ambivalent position during the Nazi Regime but on dilemmas connected to his position as an industrial physicist.

Using electron physics and the construction of electronic devices as an example, I want to show how Ramsauer managed to transform AEG into a science based industrial company, and how he and his staff tried to navigate among and bridge between different positions in the field of physics.

Monday, 10:40–11:00, Foyer

Zeit Time	ID	**Coffee Break**

Monday, 11:00–12:00, Festsaal

Zeit Time	ID	**Morning Session - Part 2** Chair: Denis Weaire, Trinity College Dublin, Ireland

11:00 Mo2-1

Einstein's blackboard solves a cosmological riddle

•*Cormac O'Raifeartaigh*

Waterford Institute of Technology, Waterford, Ireland

We find that a blackboard used by Albert Einstein during a lecture at Oxford University in 1931 casts useful light on a puzzling error in his cosmology. The blackboard, a well-known exhibit at the Oxford Museum for the History of Science, displays an analysis based on a seminal paper on cosmology published by Einstein in 1931, the so-called Friedman-Einstein model of the expanding universe [1]. We have recently reported some numerical errors in this paper [2], associated with Einstein's estimates of cosmological parameters such as the radius of the cosmos, the mean density of matter and the timespan of the expansion. While the source of these errors is somewhat unclear in the published article, one equation on Einstein's blackboard clarifies the mistake. We note the importance of contemporaneous records such as blackboards and diaries in historical studies; we also note that Einstein's error might have been avoided had his paper been refereed.

[1] A. Einstein, "Zum kosmologischen Problem der allgemeinen Relativitätstheorie", Sitz. König. Preuss. Akad. 235-237 (1931).

[2] C. O'Raifeartaigh and B. McCann, "Einstein's cosmic model of 1931 revisited: an analysis and translation of a forgotten model of the universe", Eur. Phys. J.(H) 39(1), 63-85 (2014).

11:20 Mo2-2

Saussure's Cyanometer: between science and poetry

•*Stéphane Fischer*

Musée d'histoire des sciences Genève, Switzerland

In the 18th century, the Geneva naturalist Horace Benedict de Saussure invented a new meteorological instrument for measuring the blue sky he calls cyanometer. According to him, the color blue is an important meteorological element which closely follows the amount of water and dust in the atmosphere vapors. Saussure takes a first rectangular model of 16 tons on the summit of the Mont-Blanc in august 1787. After that, he improved it to a circular model of 52 blue shades from white to black. He tested his instrument during a three-week measurement campaign in the mountains above Chamonix. Saussure's cyanometer will be used in the beginning of the 19th century by Alexander von Humboldt during his expeditions in South America. Later, french physicist Arago designs a much more elaborate version of the instrument.

225 years after its invention, the cyanometer is one of the most iconic objects from the Museum's collections. Simple piece of cardboard hand-painted, and devoid of ornament, it reflects the tireless scientific curiosity of the author. It fascinates many visitors and inspires artists for their projects and creations. In its way, the cyanometer reminds a poetic, romantic and a little naïve science closed

to the nature. This caricatured vision contrasts with the scientific approach of Saussure who considered his cyanometer as useful and efficient as the other meteorological instruments of his invention like the hygrometer, the electrometer or the magnetometer. . .

11:40 Mo2-3

History of science activity of the Academia Europaea Bergen Hub

•Jan S. Vaagen and Laszlo P. Csernai

Academia Europaea Bergen Knowledge Hub, Bergen, Norway

We report the activity of Bergen Hub, including public dissemination of physics and science related publications in TV, newspapers, and other channels. In addition, the work on establishing a museum of the old Van de Graaff accelerator built in the early 1950s, which was the most powerful accelerator at that time in Europe. [1]
Complementing the past physics activity in Bergen, we will continue with the present special focus field of the hub: “Energy and Sustainable development”. Development on fundamental physical basis was discussed by E. Schroedinger, in his lectures in Trinity College in Dublin. Later these lectures appeared as a book, “What is Life?” [2].
The book provided surprising insight and foresight anticipating much of the future development. Now, one of our activities is to make the development towards increasing complexity based on the entropy content of the matter in increasingly complex systems at all levels, from physics, chemistry, biology, physiology, technology, and even society. It is a novel attempt to do this quantitatively, and it is marvellous how well we can underpin Schroedinger’s early ideas.
We can also see now what the limits of a precise quantitative assessment are, and give a quantitative measure, which type of processes lead to sustainable development, and which changes (e.g. which forms of energy production) are counter-productive. Some advocated ideas (and even practices) even counteract development.

[1] http://www.bt.no/nyheter/lokalt/Uatskillelige-i-et-halvt-hundrear-2513399.html
[2] Ervin SCHROEDINGER: WHAT IS LIFE? - The Physical Aspect of the Living Cell, Cambridge University Press (1944).

Monday, 12:00–14:00, Festsaal

Zeit Time | ID

Lunch Break at the Local Gasthöfe

Zeit Time	ID	**Afternoon Session - Part 1** Chair: Heinz Krenn, University of Graz, Austria

14:00 Mo3-1

Three Centuries of Physics in Trinity College Dublin

•Eric Finch

School of Physics, Trinity College, University of Dublin, Ireland

Trinity College Dublin, the only college in the University of Dublin, Ireland, was founded in 1592. Physics has existed within its walls as a subject of study for over three centuries, and the paper focuses on some of the diverse and often surprising ways in which its study has developed over these years. In particular, attention is paid to the less well documented period of decline during the earlier part of the 20th century and the subsequent remarkable revival [1].

Despite Ireland's insular geographical location, physics in Trinity initially flourished for over 200 years, beginning in 1683 with the work of Molyneux and Marsh and continuing throughout the 18th and 19th centuries. Among others in this extended period Richard Helsham, Hugh Hamilton, William Rowan Hamilton, Humphrey Lloyd, MacCullagh, Jellett and Fitzgerald were some of the best known physicists in the College.

Fitzgerald attracted a particularly remarkable cluster of pupils, including Joly, Townsend, Lyle, Preston and Trouton. All became Fellows of the Royal Society of London, yet, except for Joly, all left Trinity to work elsewhere. When Fitzgerald died unexpectedly in 1901 aged only 49, Trinity physics went into a steep decline. Despite the labours of a few physicists such as Robert Ditchburn and the Nobel Laureate E.T.S. Walton, better times did not arrive until the 1960s and 1970s.

After 1921 Trinity found itself in the newly independent state of Ireland, outside the United Kingdom and starved of proper funding, yet this was only one of several reasons contributing to the parlous state of physics in the College in this period. The roots of the decline lay in 19th century general Irish history, and also in what had become for peculiar reasons an archaic system of College government that in earlier centuries had served well. Physics in Trinity was one of the disciplines affected by these factors, and among other objectives the paper seeks to explore and explain the dramatic changes in fortune that resulted for the subject.

Reference:

[1] Eric Finch, Three Centuries of Physics in Trinity College Dublin, (Living Edition, Pöllauberg, Austria, 2016).

14:40 Mo3-2

Nuclear Physics and Innovation

•*Christian Forstner*

Friedrich-Schiller-University, Jena, Germany

The entanglement of physical research with government, politics and industry as well as the public negotiation of science, reached a qualitative new dimension during the Cold War. To draw a “big picture”, which includes all aspects of this process in its entirety without reducing its complexity, is only possible with a clearly defined analytical item. Therefore an exemplary investigation of nuclear research in Austria during the second half of the 20th century will be conducted in form of an analysis, which equally traces the historic development of the discipline as well as its social, cultural and political background. As a small politically neutral state in the Cold War, the characteristics of this process are significantly more pronounced in Austria than other countries. First, the interdependence of national research programs with transnational organizations as the International Atomic Energy Agency, which is based in Vienna, second, new research concepts beyond academic laboratory science, which lead to new interaction examples between government, science, industry and society and third, major technologies that have been subject to new social evaluation criteria up to now. These emerging structures can be traced in the defined framework of Austria in a detailed manner, ranging up to the establishment of a national nuclear energy program. As John Krige pointed out, a transnational network with the United States as a hegemonic junction was dominant at the beginning of the Cold War, but the smaller inner European networks experienced an upward revaluation in comparison to the transatlantic networks within the scope of the construction of Austria’s first nuclear plant at the end of the 1960s. The completed nuclear plant in Zwentendorf however, never became operational due to a public vote in 1978. All further nuclear energy projects were frozen. Today, Zwentendorf is still a central place of remembrance of the Austrian ecology movement. In order to draw an integrated picture however, the Austrian development cannot stand alone. In a conclusive comparison with Danish nuclear energy program the factors for a successful transfer from invention to innovation will be determined..

15:00 Mo3-3

Medieval cosmology and the evolution of the early modern scientific knowledge system

•*Matteo Valleriani*

Max Planck Institute for the History of Science, Berlin, Germany

During the 13th century, a reshaping of the ancient knowledge tradition on cosmology took place and new tracts as opposed to new commentaries were produced. Such process materialized in the frame of the arising new educational institutions in Paris and Oxford. This is also the background, against which Johannes de Sacrobosco’s treatise De sphaera was compiled. Originally, De sphaera denotes a well-defined cluster of notions that qualitatively describe the cosmos according to a geocentric conception. Such a conception clearly originated in ancient cosmology and in particular in the Aristotelian worldview according to which the cosmos is constituted of concentric spheres. During the process of a re-elaboration of both ancient and Arabic scientific knowledge in the western 13th century, this knowledge tradition was reshaped. 13th-century authors engaged in producing new treatises on De sphaera which were characterized by giving the content a new structuring rather than introducing new content. With one of these treatises, namely Johannes de Sacrobosco’s, a new tradition of knowledge began that continued for four centuries. The tract survived this long period unchanged, though its position in the evolving knowledge system changed dramatically. Beginning with an overview of the major steps of the history of the knowledge system based on cosmology, the period that commenced with the diffusion of printing technol-

ogy and lasted until the end of the 17th century will be further analyzed by means of a qualitative and quantitative approach dictated by the rules of network theory. It will be shown that the treatise entitled De sphaera of Sacrobosco together with its long lasting tradition represent the virtual place in which a shared scientific identity was shaped over the European continent as it mirrors the fundamental early modern scientific knowledge system and its evolution.

Monday, 15:40–16:00, Festsaal

Zeit Time	ID	
		Coffee Break at the Foyer of the Festsaal, 2nd Floor

Monday, 16:00–17:00, Festsaal

Zeit Time	ID	
		Afternoon Session - Part 2 Chair: Heinz Krenn, University of Graz, Austria

16:00 Mo4-1

oliver heaviside - a tragic genius

•peter ford

university of bath, bath, uk

Oliver Heaviside was born in London in 1850. his mother's sister had married Charles Wheatstone, one of the inventors of the telegraph, and through him he was drawn into working in the telegraphy industry. Oliver went to Newcastle in 1867 and was involved in the laying of the telegraph cable between Britain and Denmark. This was a time of rapid development of a global telegraph network and his work brought him into contact with advanced electrical technology. Although entirely self taught, he became a leading authority on electromagnetic theory particularly in the areas of telegraphic propagation and Maxwell field theory. The discovery of electromagnetic waves in air by Oliver Lodge in Liverpool UK and Heinrich Hertz in Germany in 1887-8 was of great excitement and hotly debated at the British Association meeting in Bath in 1888. Heaviside's genius was recognised by luminaries as James Clerk Maxwell, Lord Kelvin, Sir Oliver Lodge and others. His tragedy is that he became a very isolated and eccentric person with few friends and a tendency towards mental instability. He died in 1925.

16:20 Mo4-2

On the Changing Form of Maxwell's Equations During the Last 150 Years

***Alberto Favaro*[1], •*Friedrich W. Hehl*[2], *and Jonathan Lux*[3]**

[1]*Imperial College, London, UK*

[2]*Univ. of Cologne, Germany and Univ. of Missouri-Columbia, MO, USA*

[3]*Univ. of Cologne, Germany*

Maxwell's five decisive papers on the fundamental equations of electrodynamics were written from 1862 to 1868. We study, on the basis of the primary literature, how these equations developed over the last 150 years. We find essentially twelve different versions of Maxwell's equations. These different versions are critically characterized and their pros and cons discussed. We eventually express our preference for the so-called premetric (or topological) version of the Maxwell equations. Those are particularly useful for understanding an axiomatic structure of electrodynamics based on operationally determined quantities. Some selected applications are addressed.

16:40 Mo4-3

The Reception of Ensemble Theory, 1902-1911

•Hajime Inaba

The University of Tokyo, Tokyo, Japan

Ensemble theory is a branch of statistical physics that explains properties of macroscopic matter in terms of microscopic constituents. While its emergence has been investigated in some literature [1, 2], its reception still needs to be historically explored. This paper examines how Gibbs' ensemble theory, which is represented by Elementary Principles in Statistical Mechanics (1902), was received in the 1900s. Early reviewers such as S. H. Burbury (1831–1911) and H. A. Bumstead (1870–1920) intensively discussed statistical definitions of entropy and the derivation of the second law of thermodynamics, disputing the way to justify applying to a single body quantities defined on the whole ensemble. Others compared ensemble-theoretic definitions of entropy with Boltzmann's combinatorial definition. While there were some positive responses, M. Planck (1858–1947), P. Ehrenfest (1880–1933) and T. Ehrenfest (1876–1964), who preferred Boltzmann's kinetic theory, were critical of Gibbs' approaches. In the Netherlands, however, H. A. Lorentz (1853–1928) and L. S. Ornstein (1880–1941) advocated Gibbs' ensemble theory, applying it to a broad range of phenomena. For foundational issues, the Dutch adopted statistical approaches to the foundation of ensemble theory, while P. Hertz (1881–1940) appealed to the mechanical behavior of systems. Following this program of the mechanical foundations of ensemble theory, the Ehrenfests formalized a (quasi-)ergodic hypothesis in their widely-read article in Encyklopädie der mathematischen Wissenschaften. Although its foundational issues were far from settled, Gibbs' ensemble theory was well-known among physicists by the time of the opening of the first Solvay conference in 1911.

[1] M. J. Klein, "Some Historical Remarks on the Statistical Mechanics of Josiah Willard Gibbs," in From Ancient Omens to Statistical Mechanics: Essays on the Exact Sciences Presented to Asger Aaboe, J. L. Berggren and B. R. Goldstein ed. (University Library, 1987), 281.

[2] H. Inaba, "The Development of Ensemble Theory: A New Glimpse at the History of Statistical Mechanics," Eur. Phys. J. H 40, 489 (2015).

Zeit Time | ID

Poster Session in the Refectorium, 1st Floor

17:00 Po1-1

Inventive application of newly exploited approaches of Habsburg Monarchy Jesuits of their old society

•***Stanislav Južnič***

Head of Archives of Slovenian Jesuit Province, Ljubljana, Slovenia

Austrian and Bohemian Jesuit provinces developed the unique network of over 1500 professors of physics within philosophy and mathematics. Technically trained Professors of Jesuit Colleges were mostly the professors of mathematics of Bošković's sort. After the abandonment of Aristotle's Philosophy with Theresian reforms, the technical experts included the professors of philosophy. In the mid-18th century their field was professionally divided among professors of logic-metaphysics, and the professors of physics. In spite of those reforms in all colleges except Graz and Vienna professors of philosophy still rotated, but not any more in three-year cycle by on dual one between physics and logics-metaphysics which still made them just partly professionals in a chair of philosophy where the studies were shortened from three to two years. In Austrian province the situation was slightly better compared to the Bohemian province, because Austrian province developed much more university-level chairs for mathematical-physical research where an expert had much more chances for his employment. As the Bohemian province in Czech Prague, Moravian Olomouc-Brno, and Silesian Wroclaw after 1702, the Austrian province also commanded three main colleges in Duchy-Austrian Vienna, Inner-Austrian Graz, and Hungarian-Slovakian Trnava. Many later professors of physics and mathematics studied in Graz especially before the Thirty Years War while Prague or Olomouc were not that much popular among the future professors of Austrian province which proves that Graz as the completely Jesuit university had the unique role in mid-European Jesuits' milieu. During the courses of mathematics, physics within philosophical course, and specialized-repeated mathematics after graduation in philosophy, Graz experts trained most of the Jesuits who were able to teach newly-popularized R.Boscovich's physic. Extremely quickly Boscovich followers took most of the important chairs in Austrian-Bohemian provinces with exception of J.Stepling's Prague and M.Hell's astronomic-circles. The success of Boscovich's followers could be compared only with a century later events in the same milieu when J.Stefan's followers of the similar kinetic theory of atoms quickly took over most the important positions in Habsburg monarchy, again with the important exception of Prague of E.Mach. With some imagination we could predict the similar quick transformation repeated again in modern mid-Europe.

17:00 Po1-2

Ukrainian worldwide contribution to natural sciences (second half of XIX – XX centuries)

***Iryna Babichuk*[1]*, Wolodymyr Kozyrski*[2]*, •Vasyl Shenderovs'kyj*[1]*, and Oles' Rokickyj*[3]**

[1]*Institute of physics, Ukrainian National Academy of Sciences, Kiev, Ukraine*

[2]*The Bogolubov Institute for theoretical physics, Ukrainian National Academy of Sciences, Kiev, Ukraine*

[3]*The Iwan Puluj Terrnopil National Technical University, Ternopil, Ukraine*

Knowledge of the past is life determining factor in human community, especially when a state is forming. World-renowned Wolodymyr Vernadsky emphasized that "knowledge of science history is a major factor in spiritual consciousness change ..." and "... no idea, no scientific thought, no scientific work, no scientific discovery exists without a person..." The fact that Ukrainian land gave mankind a gallery of geniuses isn't in doubt. However, for many reasons, most of them were hushed up or removed by Soviets from encyclopedias and all textbooks. Here are some names: Iwan Puluj, the pioneer of X-rays; Alexander Smakula, the renowned physicist-optician of whom Carl Zeiss in Jena and the Massachusetts Institute of Technology in Boston were proud; the world's first Minister of health prominent chemist and biologist Iwan Horbaczewski. Son of distinguished poet Pawlo Hrabowski Borys created first completely electronic television system. mathematician Michael Ostrogradsky, engineer Stepan Tymoshenko, a prominent economist Michael Tuhan-Baranowski, and mathematician Michael Kravchuk also occupy their places of honor in this glorious gallery. Global scientific community recognized Ukrainian scientists and naturalists: Wolodymyr Vernadsky, Nicholas Hryshko, Danylo Zabolotny, Wolodymyr Lipsky, Nicholas Melnyk, Eugene Oppokiv, Paul Tutkovsky, Nicholas Kashchenko, Boris Balinski, Vasyl Omelianski, Nobel Prize 2007 winner hydrologist Eugene-Zenon Stachiw, and one of the greatest microbiologists "hunter of microbes from Golden-Domed Kiev" discoverer of chemosynthesis Sergei Winogradski; physicists George Gamow, Dmytro Ivanenko, Yuriy Kistyakovsky that made significant contributions to nuclear physics; founder of the Institute of Biophysics in Germany Boris Rajewski, founder of the Institute for crystal physics in Berlin Ostap Stasiw, and the founder of the Institute for Molecular Biophysics at the University of Florida Michael Kasha. This is only a small part of Ukrainian scientific constellation in the field of natural science.

17:00 Po1-3

The tag of war between physics and metaphysics during the long 18th century

•GEORGE N. VLAHAKIS

Hellenic Open University, Patras, Greece & Institute of Historical Research, SOW Project, National Hellenic Research Foundation, Athens, Greece

During the long 18th century Newtonian physics seemed to won all the battles, not only against antagonistic theories but also against metaphysics. For many scientists of the Enlightenment God became actually an unnecessary hypothesis for the explanation of the laws governing nature. Nevertheless, this big picture is rather vague as there was not just a Newtonian theory but many, concerning the interpretation of original Newton's work by its popularizers, disseminators and analyzers. In our paper we aim to discuss the dispute between physics and metaphysics within the body of Newtonian scientists during the Enlightenment and to see how this dispute was affected by arguments based on the works of scholars like Leibniz, La Mettrie, Desaguliers and others.

17:00 Po1-4

The introduction of the Physical Sciences to the two countries of the sun: Greece and Japan

•Maria Terdimou

Hellenic Open University, Patras, Greece

This paper discusses the introduction of the physical sciences in two contexts: to Greek thought during the period of Ottoman rule, and to Japan, the Land of the Rising Sun, comparing and contrasting the two. In the first case, Greece, Astronomy was introduced by Chrysanthos Notaras, some of whose manuscripts on Astronomy and Geography are dated as early as 1680, while textbooks on the subject circulated in 1718 and 1720. Newtonian physics was introduced by Nikolaos Zerzoulis, Nikiforos Theotokis and EugeniosV oulgaris, whose manuscripts and printed works circulated from approximately the mid-18th century onwards. The works of all three are compilations, mainly drawn from the work of the Dutch physicist Musschenbroek. All three are preceded, of course, by Vikentios Damodos, although his circulating physics manuscripts cover not only Newtonian but also Aristotelian and Cartesian physics. In Japan, the introduction of Astronomy through European textbooks started circa 1720, but it was only from 1740 onward that such works began to be translated from Dutch into Japanese. Only the nobility were allowed to possess them, while they were forbidden knowledge for commoners. After Astronomy and Geography, there followed a flourishing period (1778-1785) for medicine, during which Japanese doctors were persuaded to also adopt a European understanding of their science, setting aside their traditional medicine, which was based on the Chinese view of the human body and largely ignorant of physiology. We then have the introduction of Western Mathematics, based on the traditional Japanese mathematical viewpoint until 1857. As regards Newtonian physics, it started to be disseminated from the early 19th century, with the first printed physics book, by Dr Aoki Rinsho, circulating in 1827. The Western texts via which physics was introduced were based on the works of the Dutch physicist Musschenbroek, mentioned above, and of J.-J. Lalande. Twenty-five years later the 1827 work was published in 15 volumes, intended chiefly for doctors, by Dr Kawamoto Komin. For a long time, physics was mainly addressed to doctors, since it did not exist as a science in its own right.

17:00 Po1-5

Julius Planer. A pioneer in the study of liquid crystals.

•Vasyl Shenderovs'kyj[1], Bogdan Kozhushko[1], Longin Lisetski[2], Andrij Trokhymchuk[3,4], and Igor Gvozdovskyy[1]

[1]*Institute of Physics of the National Academy of Sciences of Ukraine, Kyiv, Ukraine*

[2]*Institute for Scintillation Materials of STC "Institute for Single Crystals" National Academy of Sciences of Ukraine, Kharkiv, Ukraine*

[3]*Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine, Lviv, Ukraine*

[4]*National University Lviv Polytechnic, Lviv, Ukraine*

It is well known that the usage of liquid crystals in various devices is common in our everyday life due to their sensitivities to external influences (i.e., temperature, pressure, electric and magnetic fields etc.). The history of the discovery of the liquid-crystal state goes back century and a half; however the majority of textbooks on this topic provides another – shorter – period of time. Until the recent time, the history of science considered that this discovery is dated by 1888 and its priority belongs to the botanist Friedrich Reinitzer from the Institute of Plant Physiology at the University of Prague and the physicist Otto Lehmann from the Rhenish-Westphalian Technical University in Aachen. However, on the basis of

recent information in Refs. [1-4], we carried out a detailed investigation of the history of the discovery of the liquid crystalline state due to the archival documents and scientific periodicals. Such investigation reveals a discoverer who for the first time observed the mesophase (later called liquid crystals) between solid and liquid phases of the substance during heating and cooling of some chemicals. It can be concluded that it was the Professor of Anatomy and Physiology Julius Planer from the University of Lemberg (now Lviv) who made this fundamental discovery in 1861. A supporting evidence concerns the fact that Friedrich Reinitzer in [5] referenced the paper [6] by Julius Planer, where for the first time the interesting phenomena during cooling and crystallization of some cholesterol derivatives were described. In the present work, the brief biography of Julius Planer and his role in the science will be presented.
1. A. Trokhymchuk, “On Julius Planer’s 1861 paper ”Notiz über das Cholestearin” in Annalen der Chemie und Pharmacie,” Condensed Matter. Physics, 13, 37002:1-4, (2010) 2. B. V. Kozhushko and V. A. Schenderovskiy, “Julius Planer: The Discoverer of Liquid Crystals (renewal of the priority),” Science and Science of Science, 4, 41, (2010) (in Ukarinian) 3. L. Lisetski, “What was observed by Julius Planer in 1861?” Condensed Matter. Physics, 13, 33604:1-4, (2010) 4. State Archives of Lviv region, Fund 26, Description 5, Case 1472, P 14 (in Ukrainian) 5. F. Reinitzer, “Beiträge zur Kenrniss des Cholesterins,” Monatshefte für Chemie, 9, 421, (1888) 6. J. Planer, ”Notiz über das Cholestearin”, Annalen der Chemie und Pharmacie, 118, 25 (1861)

17:00 Po1-6

Liber Floridus – a medieval encyclopaedia with astronomical treatises

•Max Lippitsch and Sonja Draxler

Institute of Physics, Karl-Franzens University Graz Austria

The Liber floridus is a medieval encyclopaedia, authored by a certain Lambert, Canon of Saint-Omer. The work was finished in 1121 and deals with a multitude of different topics, from religion and history to geography and astronomy. The Gent manuscript, Lambert’s original autograph, contains 287 folios of parchment. About 30 % of the content is devoted to religious topics. 25 % deal with historical matter. Geography makes up about 12 %, natural history 10 % and astronomy 8 %. Interestingly, only 4 % are related to computus and calendar. Thus a widespread believe, that medieval astronomers were only interested in fixing the Easter date, is rejected. The topics of Lambert’s astronomy are divers. The movement of the sun and moon, the calendar, and the constellations are described. Several planetary diagrams are given, followed by astrological drawings as well as various geographical, meteorological, and astronomical remarks. These astronomical texts and figures so far have not been the object of detailed studies. In this presentation, besides an overview on the astronomical topics of the manuscript, the sources of Lambert’s knowledge and the astronomical worldview in the 12h century are discussed.

17:00 Po1-7

Science and fiction in Gulliver's travel to the Laputa island

•Peter Holmberg

University of Helsinki. Helsinki, Finland

Jonathan Swift (1667-1745) worked for some time as a secretary to the influential diplomat William Temple. During these years Swift came in close contact with the political system and he started to write satirical pamphlets and books. Perhaps his best known book is “Travels into several remote nations of the World” published in 1726. In this book Lemuel Gulliver, the traveller, visited four fictional remote countries. After two voyages, to Lilliput and Brobdingnag, Gulliver was ready to travel again. The Hope-well, 300 tons, set sails in August 1706 on a voyage to the Far East. In the records only one nautical position was reported, 46 N, 183 E, but in heavy storms the ship drifted far away from that point. Finally Gulliver came to an unknown island. There he observed a large flying island, Laputa, maneuvered by strong magnets. The people in Laputa were highly educated in mathematics and astronomy. They constructed a strong telescope and they made a catalogue of 10 000 stars. They also observed that the planet Mars hade two moons orbiting according to Kepler's laws. In 1600 William Gilbert wrote the book De Magnete, in which he described the Earth as a big magnet with the compass needle orientating in the magnetic field. Galilei constructed the telescope in 1609 and observed the four largest moons of Jupiter 1610. Kepler published his first two laws for planetary motion in 1609, followed by the third law in 1619. Asaph Hall discovered 1877 two small moons orbiting around Mars very close to the predictions of the Laputa astronomers. Jonathan Swift was familiar with the achievements in natural sciences and his story about the voyage to Laputa is both science and fiction. Jonathan Swift was an early Jules Verne.

17:00 Po1-8

Pliny the Elder on Physics

•Sonja Schreiner

Institut für Klassische Philologie, Mittel- und Neulatein, Philologisch-Kulturwissenschaftliche Fakultät, Universität Wien, Universitätsring 1, 1010 Wien

In his famous encyclopedia, the so called ”Naturalis Historia”, consisting of no less than 37 books, Pliny the Elder (23/24 AD – 79 AD) is dealing with the broad variety of disciplines being integral parts and important branches of the natural sciences. The author does not explicitly define physics as an independent part of those very sciences, but – nevertheless – discusses many physical phenomena throughout his opus magnum. A lot of work has been done on defining Pliny's sources, due to the fact that ancient authors rarely are completely independent writers, not to say autonomous inventors, but rather closely linked to other publications, written by authorities and belonging to quite different genres. Following the principle of the enkyklios paideia Pliny has a close look on (mother) nature as a whole and on its single elements: anthropology, astronomy, botany, geology, geography, medicine, metallurgy, volcanology, zoology and a countless number of other sciences are treated by him, who, as a curious and altruistic man, died in the aftermath of the catastrophic eruption of Mount Vesuvius in August 79 AD, after having rescued endangered people and as a consequence of his close inspection of that what was known and feared as pyroclastic flow later on. In the very centre of my presentation will be the detailed interpretation of a selection of texts taken from the ”Naturalis Historia” and an outlook on Pliny's vast influence on physics throughout the centuries.

17:00 Po1-9

How Charles Galton Darwin Un-Invented the Conservation of Energy

•Benjamin Johnson

Max Planck Institute for the History of Science

Often an innovation or invention in science stands the test of time and is applied until proven untrue. This is so with the conservation of energy – although it made a comeback. The discovery of quantum mechanics by Werner Heisenberg in 1925 was the culmination of a quarter century of groundbreaking theories and scientific misadventures, some accusing nature of scandalous behavior – especially during the interaction of light with atoms. And the question of the nature of light divided the physics community by the late 1910s: some considered the consequences of the corpuscle of light (photons) while others alleged light displayed strictly wave properties. One of the latter was Charles Galton Darwin. Born in 1887 into a scientific dynasty, he began to critically consider the consequences of the debate in 1918. Siding with prominent physicists like Niels Bohr, Darwin chose to abandon the conservation of energy in atomic processes – a concept that had reached maturity in the prior century and formed the fundament of classical physics and its application. In order to uphold the wave theory of light while allowing atoms to absorb and emit discrete amounts of energy, Darwin stated energy was only conserved on average, but not in any single atomic event. Into the mid-1920s, ever more intricate and cryptic models allowed him to maintain the wave picture despite growing experimental evidence to the contrary. It took the revolutionary insight of Louis de Broglie in 1924 that light had both particle and wave characteristics to end the debate and fully re-instate the conservation of energy. But some of Darwin's ideas survived and were incorporated into the new quantum theory. In attempting to drastically alter one of science's most central concepts, Darwin contributed to the invention of a new way of describing matter and its interaction with the electromagnetic field. Just not exactly in the way he had expected at the outset – but sometimes that is the nature of invention.

17:00 Po1-10

Some Evidence for Links between the Former Augustinian Chorherren Stift Pöllau and Physical Sciences

•Bruno Besser

Space Research Institute, Austrian Academy of Sciences, Graz, Austria

The "Augustinian Chorherren Stift Pöllau" (House of Canons Regular) was founded in 1504 by friars of the nearby monastery Vorau. The "new" canonry building construction started only in 1690 and finished in its "present" form around 1779. Only few years later (in 1785) the monastery was dissolved in the so-called "'Klostersturm' of Emperor Joseph II.", secularised and the property auctioned to become the nowadays "Schloss Pöllau" (Pöllau castle).

There is only little evidence left on the monastery's relationship to physics and we elaborate on this topic on the basis of some archival sources and remnants. On the one hand, the nowadays festival room on the second floor, being the former library, shows a fresco programme with some allusion to physical sciences. The other hint comes from a few books mentioned in the library catalogue. The occupation with physical sciences was rather limited but not completely negligible, as two scientific books written by members of the canonry show.

Some additional evidence for the relationship of the monastery with physics in general can be found in frescos in the vicinity of the monastery buildings depicting physics/technical instruments.

The accommodation of a physics history museum in the Pöllau castle therefore seems to be a timely climax of activities in the field.

17:00 Po1-11

Discussion of the Michelson-type-II Device (Apexmeter) Measurement Data, and Reinforcement of the Theory of the Michelson-type-I device (Interferometer) on Euclidean Grounds.

•Karl Mocnik

Austrian Academy of Sciences, Institut for Space Research, Graz, Austria

The second proposal of Michelson and Morley in their publication (1887) suggests constructing a rectangular “Light-coil”, implying a violation of the law of reflection, the potential of which is to determine experimentally the absolute motion and direction of our Sun in the Ecliptic co-ordinate system. The null-result observed in the “Michelson-type-I-device” (interferometer) in conjunction with the Etherdrift measurement in the “Michelson-type-II-device” perfectly confirm both the principles of Classical Optics and the Euclidean track for the Light Trajectories.[1] Both ‘Aether-drift prediction’ in the “Michelson-type-I-device” (interferometer) as well as the ‘length-contraction’ proposed in the past is excluded, being mere hypotheses which aren’t elements of physical reality. [1] Karl Mocnik: „Ein verkapptes Geometrieproblem und seine sieben Syllogismen“; 45. Tagung Didaktik der Mathematik, Freiburg 2011.

17:00 Po1-12

Bulgarian Textbooks on Physics up to 1878

•Ganka Kamisheva

Institute of Solid State Physics, Sofia, Bulgaria

Education on physics in Bulgaria has a short history. It started in the beginning of 19 century when Bulgarian schools were organised in a Greek style. They had two levels. Physics was a subject in the programe of second stage of Bulgarian schools in Svishtov (1817 – 1846) and Sliven (1828 – 1831) [1]. Bulgarian schools adopted a new organisation since 1835 when one, two, three or four classes above elementary level (fifth, sixth, seventh or eighth grade according classification today) were initiated in Gabrovo [2]. Textbooks on physics published in Bulgarian language before 1878 are analyzed. Their level is determined. Content of primary, basic, high school and college textbooks on physics is examined. Basic education on physics in the 20s of 19 century and high school education on physics in the 40s of 19 century are found. Textbooks on physics published in Bulgarian language before Liberation were written by N. Gerov (1849), A. Ganot (1868), D. Shubert (1872) and I. Gjuzelev (1874). Secondary textbook published by D. V. Manchov (1862), high school astronomy textbook translated by Dimitar Enchev (1873), and a college level textbook translated by N. Marcoff (1871) are found [3]. [1] G. Kamisheva Bulgarian physical and mathematical culture in 19 century. – Proceedings Sixth International Conference of the Balkan Physical Union, Istanbul, 2006, AIP CP No 899 (2007) 521-522. [2] Borissov, M., A. Vavrek, G. Kamisheva. Survey of the history of education in physics in Bulgaria. – Proceedings of the 1st General conference of BPU (1991) p. 21-23. [3] G. F. Olivier, Geometrie Ussuele et Trigonometrie Rectiligne Precedees des premiers principes de l’Algebre, de la Theorie des Equations des Puissances et Racines des Proportions et Progressions des Logarithmes et suivies d’elements de Statique, avec application usuelle nux diverses machines le tout accompagne de problemes, Cinquieme edition, Paris (1843).

17:00 Po1-13

The Archives of the German Physical Society

•***Ralf Hahn***

Deutsche Physikalische Gesellschaft e.V., Berlin, Germany

The German Physical Society is the oldest national physical society in the world, founded on 14th January, 1845. Oddly enough, it never kept central archives until the year 1996 when I was appointed archivist and started to establish such archives in the historical Magnus-Haus in the center of Berlin.
The oldest documents were preserved by the Physikalische Gesellschaft zu Berlin, which was the original name when the society was founded and which is now an independent regional division of the Deutsche Physikalische Gesellschaft (DPG). The oldest document are the minutes of the inaugural meeting. Also preserved were some record books from the 1860s, 1870s, 1880s, and 1890s up to 1901 and a last one covering the time from 1910 to 1921. These books contain information about the lectures which were held at the meetings (author and title) and about the election of new members. The best known entry in these books concerns the meeting on 14 December 1900 where Max Planck lectured on ? Zur Theorie des Gesetzes der Energievertheilung im Normalspectrum ? - the birth hour of quantum theory. Moreover, one can see from these records who presided at the meeting (Albert Einstein did this several times) and who was secretary.
Unfortunately, these books are not complete, some of them are missing. And there has virtually no correspondence survived from the first 80 years. There is some correspondence from the 1920s and a little bit more from the 1930s, but the vast majority of all records preserved comes from the time after 1946. Regarding the historical importance, the records regarding the Max-Planck-Medal are most interesting and there are several other files which were used by historians from all parts of the world during the last 20 years. Some records of the Physical Society of the German Democratic Republic are also kept, mainly concerning the organization of conferences.
An electronic version of the finding aid can be found here : http://www.dpg-physik.de/veroeffen
and I will be happy to answer your questions, not only at the poster session.
Ralf Hahn M.A. Archivar Deutsche Physikalische Gesellschaft e.V. Magnus-Haus Am Kupfergraben 7 10117 Berlin Tel.: +49 (30) 201748-41 Fax: +49 (30) 201748-50 Email: hahn@dpg-physik.de www.dpg-physik.de

Monday, 18:30–19:55, Festsaal

Zeit Time | ID

Evening Events, Musical Intermezzi, Welcome and celebratory addresses, Conferring of the Best Poster Award, Conferring of the 2016 Physicsestoire Award

19:15 5-1

The Antikythera Mechanism: no longer an anomaly in the history of science and technology?

•***Yanis Bitsakis***

National Hellenic Research Foundation - University of Athens

In 1901, a geared mechanism was found by sponge divers at the bottom of the sea near the island of Antikythera. It was identified as an astronomical mechanism in 1902, at the National Archaeological Museum in Athens. But its functions were not obvious: was it an astrolabe? Was it an orrery or an astronomical clock? Or something else? Until the mid 1970s, scientific investigation failed to yield much light and relied more on imagination than the facts. Derek de Solla Price, who was the first scholar to study X-rays of the device, considered that it was a "calendrical computer". But he was not able to design a working model of the mechanism, and his outstanding work was to a great extent ignored by the historians of science and technology. The wide audience knew about the mechanism as a device which came from the outer space. However research over the last decade has revealed its functions, and many working models are now being designed. The Antikythera Mechanism is now understood to be dedicated to astronomical phenomena and operates as a complex mechanical calculator which tracks the cycles of the Solar System. The renewed interest in the Antikythera Mechanism resulted in a series of exhibitions, books, textbooks and documentaries. We can now write that it has found his place within the history of science and technology, and is well-placed within the context of ancient astronomy and mechanics.

Monday, 20:00–22:00, Festsaal

Zeit Time | ID

Welcome Reception

Tuesday, 9:00–10:40, Festsaal

Zeit Time | ID

Morning Session Part 1

Chair: Edward A. Davis, University of Cambridge, United Kingdom

9:00 Tu1-1

From Helmholtz to Bethe: Aspects of the Solar Energy Problem 1854-1939

•Helge Kragh

Niels Bohr Institute, Copenhagen, Denmark

Interestingly, as far back as 1785 Immanuel Kant offered a qualitative explanation of the Sun's heat in terms of his cosmic nebular hypothesis. However, it was only with Hermann von Helmholtz's contraction theory of 1854, based on the new law of energy conservation, that a credible and authoritative theory of solar heat was suggested. The theory was later adopted and developed by William Thomson and became known as the Helmholtz-Thomson (or Helmholtz-Kelvin) theory. Although not without rival theories, for half a century it was generally accepted by the large majority of physicists and philosophers. By 1900 the theory was recognized to be problematic and possibly wrong, in particular because it was inconsistent with a Sun of age one billion years or more. For a decade or so physicists speculated that the Sun's energy might be due to radioactivity. These speculations were premature but indicated that an explanation might be found in transformations of atomic nuclei or other subatomic processes. From about 1920 Arthur Eddington developed this idea which by 1926 had largely replaced the contraction theory. Still, it was only with progress in nuclear physics and quantum mechanics that Eddington's insight could be transformed into a proper theory. This took place in a series of steps in the decade following 1929, the year when Fritz Houtermans and Robert Atkinson published a pioneering paper in nuclear astrophysics. Nonetheless, solar energy (and stellar energy generally) was shrouded in mystery and even led to suggestions of energy non-conservation in the stars. The breakthrough occurred in the period 1937-1939 when Friedrich von Weizsäcker in Germany and Hans Bethe in the United States attacked the problem. The culmination was two seminal papers by Bethe of which one was co-authored by Charles Critchfield. Bethe's celebrated work was belatedly honoured with a Nobel Prize. The lecture will give a structured overview of the nearly century-long development in attempts to understand why the Sun shines.

9:40 Tu1-2

Absolute Measurement and the Rise of the Physics Discipline in Britain 1863-1881

•Daniel J Mitchell

University of Cambridge, Cambridge, UK

Historians have written much about the cultural and economic roles of measurement in the Victorian period [1], and precision measurement in particular [2], but have missed the unique characteristics of absolute measurement that enabled it to bridge high theory and concrete practice. I argue that the *invention* of a system of absolute units provided the unifying link, whether theoretically, ideologically, rhetorically, or in practice, between the socio-institutional, pedagogical and conceptual processes implicated in the disciplinary formation of physics in Britain.
'Absolute' measurement consists of the reductive measurement of quantities in terms of units 'derived' from a set of base units–typically length, mass, and time–via a network of experimental laws. By devising experimental procedures to enable these derived units to be represented materially, and by *applying* theoretical principles to the design of 'absolute' instruments, William Thomson, James Clerk Maxwell, and their followers constructed a quantitative link between each domain of physical phenomena, and hence successfully operationalized their novel energy doctrines.
To extend this success to the formation of an integrated mathematical and experimental physics discipline, they *exploited* the purported accuracy and universality of absolute measurement, in an attempt to assimilate the successes of a qualita-

tive tradition of natural philosophy, discredit it publicly, and subvert it from within, across multiple fronts ranging from the nomenclature and pedagogy of physical science to its history of discovery. I follow this common thread to their campaign through the writing of Thomson and Peter Guthrie Tait's epoch-making Treatise on Natural Philosophy (1867) [3], the laboratory revolution of the late 1860s and early 1870s [2], the rapid introduction of physics courses into schools and universities during the same period, the founding of the Physical Society in 1873-4, and the rise of a science-based telegraph engineering [2, 3, 4].

[1] S. Schaffer in, Victorian science in context, B. Lightman ed. (University of Chicago Press, Chicago/London, 1997). [2] G. Gooday, "Precision Measurement and the Genesis of Physics Teaching Laboratories in Victorian Britain," British Journal for the History of Science **23**, 25-51 (1990). [3] C. Smith, The Science of Energy (Athlone, London, 1998). [4] B. Hunt, "The Ohm is Where the Art is: British Telegraph Engineers and the Development of Electrical Standards," Osiris **9**, 48-63 (1994).

10:00 Tu1-3

The Second Golden Age of Cosmic Ray Research

•Olaf Reimer

University of Innsbruck, Innsbruck, Austria

From a perspective of an active researcher in high-energy particle astrophysics, I'll discuss recent developments in Cosmic Ray astrophysics. Following decades where accelerator-based particle physics and photon-based high-energy astrophysics pursued independent exploratory endeavors, we presently witness increasing stimulation where particle astrophysics seem to connect decade-long separated research topics. I'll transition from the first golden age of cosmic ray research - that of air-shower related particle physics - to present day research in ground- and space-based cosmic ray astrophysics, very high energy gamma-ray astronomy and observational cosmology.

Tuesday, 10:40–11:00, Festsaal

Zeit Time | ID

Coffee Break at the Foyer of the Festsaal, 2nd Floor

Tuesday, 11:00–12:00, Festsaal

Zeit Time | ID

Morning Session Part 2

Chair: Edward A. Davis, University of Cambridge, United Kingdom

11:00 Tu2-1

The atomic clock of the German Democratic Republic – high tech without ‘happy end‘

•Peter Bussemer and Jürgen Müller

Duale Hochschule Gera-Eisenach

Paul Forman studied in several papers the development of atomic frequency standards as an important example of the conversion of basic science after World War II into technology and industrial production yielding a commercial product (1). We will here give a counterexample that demonstrates some peculiarities of scientific research and development on the conditions of the Cold War and Western embargo when the late GDR (DDR) tried to construct its own atomic clock to assert the claim as one of the leading economic powers. The metrological institute of the GDR in East-Berlin (ASMW) used first the quartz clocks of Scheibe and Adelsberger constructed in the mid-1930s in Helmholtz’ PTR (Physikalisch-Technische Reichsanstalt) and confiscated in 1945 by the Americans. The new definition of the time standard required in the GDR the realization of its own equipment due to lack of support from the Soviet Union declining any kind of sale of atomic clocks on grounds of secrecy. In the mid-1970s the ASMW started the atomic-clock-project within the framework of governmental R&D but despite its high priority only with scant help from industry and institutions. In a top secret cellar laboratory in the ASMW only five scientists conceived and constructed a cesium beam apparatus entering into the experimental phase as a primary normal after 1985 but missing the use as a permanent official timer by the end of the GDR in 1990. For military purposes three transportable clocks also had been made. After reunification of Germany in 1990 the cesium clock was delivered to the metrological institute of Slovakia in Bratislava where it was possible to put it into operation and use it for some years as time normal. Later it was taken out of service and the authors saved it from destruction as a unique example of socialist high tech that demonstrates the knowledge and creativity of its constructors but unfortunately without gain for economic development (2). (1) P. Forman, ”Atomichron”, Proc. IEEE 73 (1985), 1181-1204. (2) PTB-Mitteilungen 123 , No.1, 2013.

11:20 Tu2-2

The Chladni Figures and their ubiquity in the field of research in acoustics through the 19th century

•Jasmin Janka

Europa Universität Flensburg, Flensburg, Germany

One of the classical experiments first done in the late 18th century was developed by E.F. Chladni. The sound figures, later known as Chladni figures, were an important impulse to the research in the young field of physics called ‘acoustics’. Most of the scientist working on acoustics started their research with comprehending the experiments of the sound figures. And they worked on them, modified them, improved them and developed additional features. For over 60 years this simply breadboard brought one new idea after the other in the understandings of acoustic phenomena. In my talk I will give an overview about the protagonists and their work with plates, sand and violin bows from Chladni (1789) till Kundt (1862). The history of the experiment over the years is the main subject, on which around a part of the development in acoustics will be presented. The perspective around one single experiment, done by many participants who change it and the resulting discussions and discoveries give a new view on how a physic field was explored. Using the method of replication, I try to aim at developing and understanding, how the experiment evolved and how it brought many different insights in the field of acoustics.

11:40 Tu2-3

Contribution of Greek physicists in the European scientific milieu of the 19th century. The cases of Dimitrios Stroumbos and Timoleon Argyropoulos.

***•Panagiotis Lazos*[1] *and George N. Vlahakis*[2,3]**

[1]*National University of Athens, Department of Education, Athens, Greece*

[2]*Hellenic Open University. School of Humanities, Patras, Greece*

[3]*Insititute for Historical Research/National Hellenic Research Foundation, Athens, Greece*

The Greek state was founded in 1829 and the first Greek University was founded in Athens in 1837. However the first graduate of the Faculty of Philosophy specialized in physics graduated in 1868, while the Physics department became autonomous only in 1905. At the same time, Greece was both geographically and scientifically on the periphery of Europe. Therefore, it would be expected to be almost no contribution of Greek physicists in European scientific scene throughout the 19th century. However there were some notable exceptions including the invention of scientific instruments by Greek physicists. These apparatuses were presented at scientific societies in Europe and they were manufactured by well-known manufacturers of scientific instruments like Ducretet and Pellin. Dimitirios Stroumbos (1806-1890) was the first professor of physics at Athens University teaching from 1839 to 1889. He had studied Natural Sciences in Geneva and at the Polytechnic School in Paris. He invented two apparatuses, the best known of which is the Stroumbos compass. This instrument bears two compasses, one horizontal on a goniometer circle with a viewfinder and the other vertical with a goniometric semicircle. It was used to measure the azimuth and the height of a star or a point on the Earth’s surface. Stroumbos also designed a device for performing experiments in double refraction. The special asset of his design was that the audience could observe the ordinary and the extraordinary rays through projection. Timoleon Argyropoulos (1847-1912) graduated with a doctorate in mathematics from the University of Athens and continued his studies at Sorbonne. He worked as a professor at the University of Athens and organized the first physics laboratory in the University. Argyropoulos made a device in which an electric current of high intensity was running through a thin platinum wire making it glow. By suitable arrangement the current was interrupted at regular intervals and the wire begun to vibrate, because of successive expansions and contractions, creating standing waves. These cases are indications that to think that even if we think that we have acquired a good knowledge of recent scientific past, there are still many aspects to be studied and perhaps as small pebbles when they will be synthesized they will give us another ”big picture” than the one we have adopted today.

Tuesday, 12:00–14:00, Festsaal

Zeit Time	ID	
		Lunch Break at the Local Gasthöfe

Tuesday, 14:00–15:40, Festsaal

Zeit Time	ID	
		Afternoon Session Part 1 Chair: Helge Kragh, Niels Bohr Institute, Copenhagen, Denmark

14:00 Tu3-1

The legacy of the Third Baron Rayleigh

•Edward A. Davis

Department of Materials Science and Metallurgy, University of Cambridge, Cambridge, UK

The legacy of the Third Baron Rayleigh (1842-1919) is reflected in the association of his name with the Rayleigh-Jeans law, Rayleigh scattering, the Rayleigh disc, Rayleigh waves, and the Rayleigh criterion, to mention just a few of his achievements. Furthermore, he was awarded the Nobel Prize in Physics for his discovery of the gas argon.

The knowledge he gave to the world is still at work today in acoustics, in the design of optical instruments and antennae, in the use of surface acoustic wave (SAW) devices, in seismology, and in studies of convection in fluids, atmospheric turbulence, ink-jet technology and solitary waves. His mathematical methods, developed principally to describe wave motion, are frequently used today by quantum theorists.

The laboratories and equipment used by Rayleigh are still extant at the family seat in Terling, Essex and provide a wonderful and unique insight into the life and work of this great Victorian scientist.

Rayleigh's work on electrical standards was undertaken when Cavendish Professor of Experimental Physics at the University of Cambridge (1879-1884). His determination of the unit of resistance, with a precision of a few tenths of one percent, was achieved with relatively primitive equipment. It provides a classic example of ingenious design, careful experimentation and meticulous analysis, coupled with a strong theoretical understanding. The method involved measurement of the deflection of a small magnet suspended at the centre of a rotating coil, the resistance of which could then be determined from the angular deflection, the rate of rotation of the coil and its radius. In a second type of experiment, involving the rotation of a circular disc in a magnetic field generated by two coils above and beneath the plate (the Lorenz method), Rayleigh obtained a value very similar to the one he had determined by the rotating coil method.

The ohm, as determined by Rayleigh, was then calibrated in terms of the length of a column of mercury, a standard that was adopted internationally as a secondary standard for many decades.

14:40 Tu3-2

The Ether in Physics after the Death of the Ether

•*Jaume Navarro*

University of the Basque Country, Donostia, Spain

Contrary to the received view among physicists, historians of science commonly agree that the results of Michelson and Morley with the interferometer did not act as an experimentum crucis to reject a notion of the ether at the end of the nineteenth century. But few scholars have actually delved on the role the ether had among physicists, engineers, and popularisers in the early twentieth-century and the process by which this epistemic object was gradually dismissed. In this paper I intend to present some of the results of an international project called “Ether and Modernity”, which I am coordinating, so as to show the diversity of uses of the ether in esoteric and exoteric circles of science, as well as in the culture of physics at large.

The battleground for the ether in the early twentieth century was wider than the limited scope of early relativity. The development of quantum theory was also a field for debates on the ether. At a cultural level, the ether was largely present in the public sphere through the raise of wireless communications and radio broadcasting, the popularity of spiritualism, the surge of new philosophical arguments, or the new literary and artistic forms of modernism. Indeed, the mysterious, largely undefined ether became a trope in the new pictorial, literary and cultural experiments of the early twentieth century.

The excessively theory-centeredness of the historiography of physics, with a disproportionate emphasis on relativity and the quantum theory, gives us only one face of the picture of the demise of the ether. But there is also a problem with any history of the ether: the need to define, in actors’ categories, what the ether actually was. From this point of view, historians find themselves with the problem of chasing a polysemic term with multiple uses that need to be clarified before a comprehensive history of the decline of the ether may be written.

15:00 Tu3-3

The life and cosmology of Arthur Haas at Notre Dame

•*Michael Wiescher*

Joint Institute for Nuclear Astrophysics, University of Notre Dame, Notre Dame, IN, USA

The presentation will focus on the last decade in Arthur Haas life. He was a well-known theoretical physicist, professor at the University of Leipzig and later at the University of Vienna. Haas was known for his early contributions to quantum physics and as author of several textbooks on topics of modern physics. During the last decade of his life he turned his attention to Cosmology [1]. In 1935 he emigrated from Austria to the United States. After one year as visiting professor at Bowdoin College in Maine he assumed in 1936 on recommendation of Albert Einstein, a faculty position at the University of Notre Dame. There he continued his work on Cosmology where he tried to establish relationships between the mass of the universe and the various fundamental cosmological constants to develop concepts for the early universe. Together with Fr. Lemaitre he organized in 1938 the first international conference on Cosmology which drew more than 100 attendants to Notre Dame [2]. Haas died in February 1941 after suffering a stroke during a visit in Chicago. The presentation will discuss his scientific interests and achievements during these last years of his life. Most of the presented material comes from the archives of the University of Notre Dame and from the family estate and papers. [1] A. Haas, “Kosmologische Probleme der Physik,” (Akademische Verlagsgesellschaft Leipzig, 1934) [2] “The Notre Dame Symposium on the physics of universe and the nature of primordial particles,” Science 87, 487, (1938)

Tuesday, 15:40–16:00, Festsaal

Zeit Time	ID	**Coffee Break at the Foyer of the Festsaal, 2nd Floor**

Tuesday, 16:00–17:00, Festsaal

Zeit Time	ID	**Afternoon Session Part 2** Chair: Helge Kragh, Niels Bohr Institute, Copenhagen, Denmark

16:00 Tu4-1

The early years of QED (1928-1932) – in retrospect from the 21st century

•***György Darvas***

Symmetrion, Budapest, Hungary

Quantum Electrodynamics was formulated by several authors in 1928-32. Most textbooks cite the first two papers [1], although others formulated their versions too [2-5]. Dirac's most cited version [1] formulated in its preamble four preliminary limits of his theory - including that it was only an approximation - which are generally not mentioned. Later, he made two other attempts [6] to formulate the "theory of the electron", but those are more rarely mentioned. The „classical" QED theories applied two approaches to describe interaction between two electrons: (a) first, the scalar potentials of the two electrons interacted, and then, they considered the interaction between the vector potentials as perturbation; (b) first, the vector potentials of the two particles interacted, and then, they considered the interaction between the scalar potentials as perturbation. All they insisted on the paradigm that the roles of two interacting particles should be symmetrical, but C. Møller (type b). He calculated scattering matrix elements between two interacting electrons, and those were asymmetric in respect of the two interacting particles. Bethe and Fermi [7] tried to demonstrate that the two types of approaches led to the same results. As a "side-result", they introduced a correction to Møller's scattering matrix: they artificially "symmetrised" the asymmetric component in the original formula. This voluntary involvement in the equation has been justified by the symmetry paradigm only. Due to the later high respect of both authors the legitimacy of this artificial symmetrisation was not questioned for seven decades. Its history appeared again in the physical literature only in the early 2000s. The paper will show a few consequences [8] in present-day field-theory of the neglect of the difference between the physical states of interacting two electrons presented by C. Møller. [1] Dirac, P.A.M. (1928) and (1929) Proceedings of the Royal Society A. [2] Heisenberg, W. (1931) Ann. d. Phys. [3] Fermi, E. (1932) Rev. of Mod. Phys. [4] Breit, G. (1929) Phys. Rev.; and (1932) Phys. Rev. [5] Møller, C. (1931), Zeitschrift für Physik. [6] Dirac, P.A.M. (1951) and (1962) Proc. Roy. Soc. A. [7] Bethe, H., Fermi, E. (1932) Zeitschrift für Physik. [8] Darvas, G, (2013) and (2014) Int J Theor Phys.

16:20 Tu4-2

A modern physics communicator: Erwin Schrödinger in Berlin (and in press)

•Arne Schirrmacher

Humboldt-Universität zu Berlin, Berlin, Germany

Erwin Schrödinger's succession of Max Planck on the Chair of Theoretical Physics at Berlin University in 1927 constituted a decisive turn, both in personality and in the way a broader public was educated about modern physics. While Planck had perfected a philosophical – at times even transcendental – vantage point on the (world) picture of modern physics, Schrödinger directly approached modern man and woman with her experiences in the daily world. Starting from Schrödinger's writings in the emergent market of modern popular science/popular culture journals (e.g. his writings in Ullstein's Koralle and Uhu as distinct from his earlier overview articles in Naturwissenschaften), I will demonstrate how he stood out from many colleagues who were trying to ”go public” with modern physics in Weimar Germany.

16:40 Tu4-3

Biographies of scientific instruments: the transformation of the Wilson cloud chamber from an instrument for research into an instrument for physics teaching

•Eugenio Bertozzi

Europa-Universität, Flensburg, Germany

The paper reports the results of a project supported by the Humboldt Foundation and developed at the Europa-Universität in Flensburg (DE). The project focuses on a milestone of experimental physics: the cloud chamber. Introduced by CTR Wilson in 1911, the instrument is well-known for allowing the first visualization of alpha-particles trajectories. Within the history of science and instruments, its genesis has been investigated [1] and its impact on research carefully studied [2]. Moreover, the instrument has been replicated and Wilson's experiments re-enacted [3].

The project re-traces the transformation of the cloud chamber from the context of physics research into the context of teaching, by investigating three distinct categories:

a) the material and technological transformation. Soon after its invention, the adaptation of the instrument for teaching purposes assumed a global dimension. Different models have been produced in UK, US, Italy and Germany by Universities, Laboratories and Instrument Companies. The different constructive choices adopted in each case are studied as materialization of local historical factors.

b) the instrument-grounded discourse. If the cloud chamber is associated to particle physics research, its exploitation in teaching is not so straightforward: an analysis of textbooks shows that it has been used for introducing radioactivity or particle physics but also for reasoning on thermodynamic, electrostatic and history of physics. In each case the key-elements are different: photos of tracks, schema of the instrument, photos of the historical apparatus.

c) the transformation of the practise. The expert skills required in the use of the original Wilson cloud chamber have been already identified [3]. By operating with currently available teaching instruments, the project identifies which skills are still required in “use-friendly” instruments and which historical experimental insights can be derived from them.

[1] Galison P. and Assmus A. (1989) Artificial clouds, real particles, The Uses of Experiment: Studies in the Natural Sciences, 225–74.

[2] Chaloner, C. (1997) The most wonderful experiment in the world: a history of the cloud chamber BJHS, 30, 357–74.

[3] Engels, W. (2006). Die Nebelkammeraufnahme - das automatisch generierte Laborbuch? Konstruierte Sichtbarkeiten : Wissenschafts- und Technikbilder seit der Frühen Neuzeit, 57-74.

Tuesday, 17:00–18:00, Festsaal

Zeit Time | ID

Visit to Echophysics Museum

Tuesday, 18:00–19:30, Festsaal

Zeit Time | ID

Plenary Evening Lectures

18:00 11-1

The German “Energiewende”: Euphoria versus Technology

•***Friedrich Wagner***

Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald, Germany

Germany has nearly doubled its electricity supply system because about 80 GW of wind and photovoltaic (PV) power have been added to the traditional supply forms. The peak demand in Germany is about 83 GW. Under these circumstances the major characteristics of this new technology based on intermittent sources can be identified. The following topics will be addressed: - How much wind and PV power is needed to come to a nominally 100% supply? - How much surplus energy is produced and how much back-up capacity is needed? - How can the surplus power be used? - Storage technologies and the economy of their operation. - On the potential of demand-side-management. - The overall CO_2-reduction Germany can achieve. - The costs for installing a large wind and PV power system. - The benefits of an EU-wide use of renewable energy. There are not many options for a sustainable electricity supply system. Electricity production by intermittent sources – one of them - has many negative aspects – low power density, overproduction in active periods, and a need for large-scale storage. Such a system causes many technical and economic problems and the consequences of a national implementation do not stop at the national borders. Therefore, its nation-wide implementation has to be done with the necessary understanding - specifically for the technical complexity. Euphoria cannot be the only guideline.

18:50 11-2

Nuclear Weapons and Morality

•*Eric Finch*

School of Physics, Trinity College, University of Dublin, Ireland

The advent of nuclear weapons during the 1940s threw into the sharpest relief profound matters of right and wrong both for the scientists involved in their development and for ourselves now. Should the scientists have participated in the work? Was this the correct thing to do in the face of terrible brutality? Should these weapons have been actually used against Japan? What is the legacy that these issues have left for us, and is this legacy for better or for worse? In the talk some features of the key events and the various viewpoints that have evolved are outlined, and an attempt is made to summarise the questions that tortured the consciences of some of the early scientists involved. Such concerns remain highly relevant for us today.

Wednesday, 9:00–10:40, Festsaal

Zeit Time | ID

Morning Session Part 1

Chair: Christian Forstner, Friedrich-Schiller University Jena, Germany

9:00 Wed1-1

Applied Science

•*Robert Bud*

The Science Museum, London, UK

For two hundred years the term “applied science” has been used to give meaning to vertiginous experiences of rapid change in ways of life. The concept has therefore been deployed by press, politicians and the public to structure narratives accounting for the developments in the gadgets through which we live our lives, and to interpret the links between understanding and practice. I shall interpret the concept’s appeal by exploring the interplay of its uses in political debate, institutional promotion, and educational and research policy over two centuries from the late 18th century promotion of a revolutionary rational and militant society in France, symbolised by the storming of the Bastille on 14th July 1789, by the onset of industrial society in Britain and by a new social structure for science as a whole. The opening of the Berlin Wall in November 1989 provides a convenient bookend to the period, decisively marking the conclusion of the Cold War. Although an extensive period by the standards of much history of science, this era spanned just three long lifetimes. Over this period, such dyads as ”pure and applied science” and ”science and technology” have jostled for pre-eminence as the unique natural description of very much the same set of things. The promoters of the competing terms “applied science” and “technology” saw important epistemological differences between them and important questions of what constituted core competences in the future and narratives in the past. This is of particular importance in the history of physics as the discipline has been characterised as both dealing with the fundamental nature of matter and the expertise underlying some of our most important technologies. Although the term “applied science” is English, it began its life as the translation of a German term and I shall explore its roots in Enlightenment German-speaking lands. From the earliest introduction to Britain its meaning was deeply affected by French. In recent years its most influential uses have been in the United States. So although, this account will focus upon the English usage in Britain, it deals essentially with the circulation of concepts across cultures and borders.

9:40 Wed1-2

Josef Schintlmeister - from rock climbing to exotic activity

•***Walter Kutschera*[1] *and Wolfgang L. Reiter*[2]**

[1]*Fakultät für Physik, Universität Wien, Wien, Austria*

[2]*Historisch-Kulturwissenschaftliche Fakultät, Universität Wien, Wien, Austria*

In the late 1920s, Josef Schintlmeister (1908-1971) was a young student of physics at the University of Vienna, and also an enthusiastic rock climber. In 1931 he finished his PhD thesis on the ionization of protons in different gases. In the same year he also made the first ascent of the most difficult climb of the "Gesäuse", a limestone montain range in Styria with steep walls inviting daring climbs, the "Dachl Nordwand". From 1932 to 1939 he pursued research at the Institute for Radium Research of the Austrian Academy of Sciences and the II. Physikalisches Institut of the University of Vienna, and from 1934 to 1938 he held a job as a technical expert at the Patent Office in Vienna. In 1938 he passed his "Habilitation" at the University of Vienna, where he already discussed the possibility of unknown radioactive elements.
During years 1939 to 1945 Schintlmeister was one of the leading members of the "Vierjahresplaninstitut für Neutronenforschung" at the II. Physikalisches Institut, which was operated under the auspices of the German nuclear energy project "Uranverein". From 1940 to 1942 Schintlmeister produced four classified reports for the Uranverein, hinting on the existing of a radioactive element with Z = 94 (now Pu) in Zinc minerals due to the observation of an alpha activity with 1.8-cm range in air. The last report mentions that this new element may also be fissionable.
After the war, Schintlmeister went to Russia and worked for 8 years as a 'specialist' at the Laboratory Nr. 2 in Moscow, which later became the Kurchatov Institute. There, the first Russian nuclear bomb was developed. In 1953 he was sent for two years to Suchumi for a 'cool-down' period from his bomb-related activity. In 1955, he became a Professor at the Technical University in Dresden, and spent the rest of his life as a nuclear physicst at the TU Dresden and later also as one of the directors at the new "Zentralinstitut für Kernphysik Rossendorf".
In the present talk, we will concentrate on Schintlmeister's search for the unknown radioactivity in nature, which occupied him throughout his life.

10:00 Wed1-3

Application as policy and politics

•***Gábor Palló***

Budapest University of Technology and Economics, Visual Learning Lab, Budapest, Hungary

The term 'application' or 'applied science' is mostly used as logical term. Science, in our case physics is assumed to be basic science purported to gain true knowledge about nature and this acquired knowledge can be used in particular cases to solve practical problems. In this paper, however, I will show another character of applied physics: its political and policy role. The case to be analyzed goes back to cold war times. Nuclear physics and reactor physics grew out in Hungary from the Stalinist approach to science. It was dogmatic and pushy but, in a strange way, it proved to be successful. In Hungary, there was not much nuclear science before the Soviets offered to build a nuclear plant. But following some important steps of the construction, we can see how basic and applied science worked together. In this field we can see the birth of knowledge in cooperation instead of division of 'basic' and 'applied'. In this history, we can see an early example of mode 2

and network approach to scientific research which surpasses the cartographical approach. This latter assumes that basic physics and applied physics belong to different territories with sharp borders. According to the thesis of this paper, these divisions are rather of political and policy nature than logical.

Wednesday, 10:40–11:00, Festsaal

Zeit Time | ID

Coffee Break at the Foyer of the Festsaal, 2nd Floor

Wednesday, 11:00–12:00, Festsaal

Zeit Time | ID

Morning Session Part 2

Chair: Christian Forstner, Friedrich-Schiller University Jena, Germany

11:00 Wed2-1

The Einstein-Reichenbach Correspondence on the Geometrization of the Electromagnetic Field

•Marco Giovanelli

Forum Scientiarum, Universität Tübingen, Tübingen, Germany

This paper analyzes a correspondence between Reichenbach and Einstein from the spring of 1926, concerning what it means to ‘geometrize’ a physical field. The content of an unpublished typewritten note that Reichenbach sent to Einstein on that occasion is reconstructed, showing that it was an early version of §49 of the untranslated Appendix to Philosophie der Raum-Zeit-Lehre [1], on which Reichenbach was working at the time. In the note Reichenbach proposed a toy-geometrization of the electromagnetic field: general relativistic equations of motion are rewritten in a way that also charged particles, under the influence of an electromagnetic field, follow their ‘natural path’ defined by a non-symmetric affine connection. Einstein criticized Reichenbach’s note from a technical point view (in particular charged particles cannot all move on geodesics of a single connection), but agreed with its philosophical point: the geometrization does not mean something essential. The paper draws two lessons from this episode: From a historical standpoint, the correspondence inaugurated a philosophical reflection about the role played by geometric considerations in physical theories [2]. From a systematical standpoint, contrary to Reichenbach’s intentions, Reichenbach’s toy-theory shows the intrinsic limitations of any attempt to impose a geodesic equation of motion to a non-universal interaction in a four-dimensional setting. Similar attempts made around 1970s present the very same drawbacks of Reichenbach’s theory [3].

[1] H. Reichenbach. Philosophie der Raum-Zeit-Lehre. Berlin/Leipzig: Walter de Gruyter, 1928. [2] D. Lehmkuhl. “Why Einstein did not Believe that General Relativity Geometrizes Gravity”. Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics 46 (2014), 316-326. [3] P. Droz-Vincent. “Electromagnetism and Geodesics”. Il Nuovo Cimento B 51 (2 1967), 555—556.

11:20 Wed2-2

Felix Ehrenhaft's measurement of the elementary electrical charge and other stories

•***Franz Sachslehner***

University Vienna, Faculty of Physics, Austria

At the beginning of the 20th century, Felix Ehrenhaft was an expert in ultramicroscopy as he investigated light scattering of metal colloids. Responding to the works of Einstein and Smoluchowsky and others on the Brownian motion in liquids, Ehrenhaft demonstrated the Brownian motion also for gases using silver particles suspended in air. Using similar particles between the plates of a tiny capacitor, 1909 he published his first experimental results for the elementary electrical charge, which fitted quite well to other researcher's results and methods. While Millikan with his oil drop experiment relied on the actual theories of the electron and won the Nobel prize 1923, Ehrenhaft – although knowing the current theoretical details – trusted in his extended experiments and postulated "subelectrons". Some original parts of Ehrenhaft's experiment for electrical charge measurement are still preserved at the University Vienna. As this experiment was permanently used for advanced lab courses until recent years, especially the housing of the capacitor was improved. So it was suitable for suspended particles as well as for the oil drop method. Ehrenhaft's deviation from the mainstream of physics had consequences, although his house was open to many scientists and there were ties of friendship to Albert Einstein. Instead of getting head of the II. Physikalisches Institut 1920, Ehrenhaft got a small institute of his own, the III. Physikalische Institut, where he should not cause much harm. Having a letter of recommendation from Albert Einstein, 1933 he acquired the third largest magnet of the world in order to extend his studies of magnetophoresis and photophoresis. Unfortunately, in the same year his wife died and 1938 he was forced to emigrate. His magnet was brought to the Hafele-Kar near Innsbruck and was used for the studies of cosmic rays. 1964 this magnet was again installed at the University Vienna. 1946 Ehrenhaft returned to the University Vienna and got his old position. Six years later he died, however, his photophoresis formed the basis of modern aerosol physics at the University Vienna.

11:40 Wed2-3

Geophysical Data of two Austrian (Research) Vessel Expeditions in the 19th Century

•***Bruno Besser, Hans Eichelberger, Konrad Schwingenschuh, and Manfred Stachel***

Space Research Institute, Austrian Academy of Sciences, Graz, Austria

The Austrian-Hungarian Empire organised only few exploring expeditions in the 19th Century. The reasons were that Austria had no historical background as a colonial power and only limited access to the open sea. Therefore it had no well-equipped navy to support such endeavours.
Mid of the Century first plans for a (research) ship expedition were circulated and due to support by influential peers in the Emperors family such an undertaking was finally realized. During the Earth circumnavigation of the Novara vessel (1857 - 1859) measurements of several geophysical/meteorological parameters have been performed routinely, including geomagnetic as well as atmospheric/sea surface temperature and wind field records.
The second research expedition performed by Austrian mariners (in the second half of the 19th Century) was directed towards the North of the European continent. Being stuck in the polar ice for one and a half years, Captain Carl Weyprecht and his crew carried out extensive geophysical measurements (1872-1874) in this harsh polar environment. At least some of the records could be preserved during the odyssey on the way back across the drifting ice after abandoning the ship.

We are presenting historical measurements of these two expeditions and compare them with data collected concurrently by observatories on the ships route and other places. Additionally, we contrast the records with satellite data gathered in the 20th Century and available geophysical models.

Wednesday, 12:00–14:00, Festsaal

Zeit Time | ID

Lunch Break at the Local Gasthöfe

Wednesday, 14:00–15:20, Festsaal

Zeit Time | ID

Afternoon Session Part 1

Chair: Peter Maria Schuster, Echophysics, Pöllau, Austria

14:00 Wed3-1

Bruno Touschek and the emergence and development of colliding-beam physics in Europe

***Luisa Bonolis*[1] *and •Giulia Pancheri*[2]**

[1]*Max Planck Institute for the History of Science, Berlin, Germany*

[2]*INFN Frascati National Laboratories, Frascati, Italy*

We shall present the emergence and development in Europe of colliding-beam physics, which followed the invention, and construction in 1960, of the first electron-positron collider by the Austrian theoretical physicists Bruno Touschek. Touschek was born in Vienna in 1921. During the period 1942-1945, he moved to Germany, where he learnt the physics of accelerators with the Norwegian engineer Rolf Wideroe. We shall present this period of Touschek's life through yet unpublished correspondence with Paul Urban and with Arnold Sommerfeld, preserved at the Deutsches Museum in Munich, and through Touschek's unpublished letters to his family. It will also be shown that the Wideroe's paper, which set in motion the betatron project financed by the Reich Aviation Ministry in 1943, was never published, contrary to what is claimed in the literature. In early 1950s, Touschek moved to Rome. In March 1960, he proposed the construction of AdA, the first matter-antimatter accelerator. AdA then was transferred in 1962 to the Linear Accelerator Laboratory in Orsay, France, where it was shown for the first time that electron and positrons created in a laboratory would collide, opening the road to a whole series of new particle colliders and discoveries. The talk will be based on recent articles [1,2,3] and two documentaries [4,5] about Touschek's contribution to the development of particle accelerators, spanning a period from after the war up to the Higgs discovery.

[1] L. Bonolis and G. Pancheri, “Bruno Touschek: particle physicist and father of the eplus-eminus collider”, Eur. Phys. Jour. H36 (2011) 1-61, arXiv:1103.2727.
[2] L. Bonolis and G. Pancheri, “Birth of colliding beams in Europe, two photon physics at ADONE”, Photon 2015, 15-19 Jun 2015, Novosibirsk, Russia. arXiv:1511.00453.
[3] C. Bernardini, G. Pancheri and C. Pellegrini, “Bruno Touschek: from betatron to electron-positron colliders”, Rev. Accel. Sci.Tech. 08 (2015) 269-290.
[4] E. Agapito and L. Bonolis, “Bruno Touschek and the art of physics”, INFN 2003, Italy.
[5] E. Agapito, L. Bonolis and G. Pancheri, ”Touschek with AdA in Orsay”, INFN 2013, Italy.

14:20 Wed3-2

Carl Auer von Welsbach and his contribution to the early quantum theory

•*Gerd Löffler*

Auer von Welsbach Museum, 9330 Althofen, Austria

Carl Auer von Welsbach (1858–1929) is regarded as one of the great entrepreneurs, inventors and researchers of his time. He had received worldwide recognition. In the second half of the 20th century, however, he was all but forgotten even in his native Austria, although his memory was revived during the celebrations for his 150th birthday (2008). He was trained as a chemist by Robert Bunsen in Heidelberg (1880/82). His focus as a researcher was the spectral analysis, which he used for the study of the rare earth elements. He also discovered four of these elements (neodymium, praseodymium in 1885, ytterbium, lutetium in 1905). Niels Bohr and other physicists were highly interested in the chemical and physical properties of these elements for the development of early quantum theory. To advance their research, Auer von Welsbach made highly pure preparations available. Since 1900 he had the magnetic properties of the rare earth elements determined by Stefan Meyer (II. Institute of Physics, University of Vienna). Through his contacts to physicists, he not only contributed to the representation of the element hafnium by George Hevesy and Dirk Coster (predicted by Bohr), but also to physicist Friedrich Hund's first quantum-theoretic approach to establishing the magnetic properties of the rare earth elements in 1925 (Hund's rules). Auer von Welsbach made over 500 preparations available to various physicists and chemists. Long after his death, his preparations continued to play an important role in physics. An important source for this study was the extensive correspondence between Carl Auer von Welsbach and many physicists and chemists of his time as well as the shipping lists of his rare earth preparations that are archived in the Carl Auer von Welsbach Museum (Althofen, Austria). An invaluable help were the archived documents (e.g. the reports from the Institute for Radium Research, e.g. correspondence etc.) from the archives of the Institute for Radium Research of the Austrian Academy of Sciences (Vienna) and the German National Library (Leipzig). Details are taken from the following publication: Carl Auer von Welsbach and his contribution to early radioactivity research and quantum theory (ISBN 978-3-200-04400-5).

14:40 Wed3-3

Physics, astronomy and Religion: The Greek calendar reformation of 1923

•*Kostas Tampakis*

National Hellenic Research Foundation, Athens, Greece

The emergence and establishment of calendars are complex endeavors, which combine scientific, political and religious considerations. At times, such as during the French Revolution in 1793 or in Soviet Russia in 1929, calendars have been used as tools concurrent with social revolution. However, for most of European space, the last calendar reformation to take place was the adoption of the Gregorian calendar, which happened gradually from 1582 for the Papal States to 1752 for Great Britain and 1753 for Sweden. In Turkey, the fiscal year became Gregorian in 1917, and its use was extended for all purposes in 1926.
The Greek state was an exception to the general European rule. Being part of the Ottoman Empire until the Greek Revolution of 1821, Greek space coalesced into a state in 1828 and continued to use the older Julian calendar until 1923. This paper aims how and why such a late reformation took place, the factors that led to its adoption and the various debates and ramifications it brought about both within Greece and abroad. It will also show how physicists and astronomers took part in its institution and discuss the role of the Greek Orthodox Church in the calendar's

acceptance and rejection. In the end, the Greek calendar reformation was a local event that mobilized international networks and institutions across autocephalous Churches, Orthodox Patriarchates and international scientific unions. Finally, it led to a schism within the Greek Orthodox Church whose ramifications are still felt today.

15:00 Wed3-4

Exploiting physics concepts on the cultural level: how to making more of physics.

*•**Leonardo Colletti***

Liceo "G. Carducci", Bolzano, Italy and Dipartimento di Fisica, Università di Trento, Italy

Even if characterized by its own method for pursuing knowledge, physics is not impermeable to the other human activities. Specific historical cases have been investigated by Forman [1], Gower [2] and many others, not to mention Hessen's thesis which started externalism [3]. Notice that in all the above cases the ascendancy exposed goes from society to science rather than vice versa. The same directionality characterizes the trick exploited by popularizers, when analogies with everyday life are devised in order to explain scientific concepts. In such kind of rhetoric operation, one takes advantage of the meaning loaded in a word of common use to make a scientific context more familiar. But what about the reverse direction of this relationship, i.e. from physics to everyday life? Of course the technological consequences of physics do effect society, but they are usually not considered culturally relevant as art and literature, i.e. they don't meet the criticism raised against mutism of scientific rationality when it comes to all "that is really near to our heart" [4]. So, the fundamental question is: could physics be considered more culturally relevant? In this talk, I'll suggest the possibility of using physics concepts as metaphors bearing new meanings for everyday life, thus inverting the usual paths taken by science popularizers. By characterizing physics concepts as semantic-increment generators we may enhance the cultural relevance of physics, i.e. its ability to shed meaning to our lives, and bring it a step closer to the so-called humanities.

[1] P. Forman, "Weimar culture, causality, and quantum theory, 1918-1927: adaptation by German physicists and mathematicians to a hostile intellectual environment," Hist. Stud. Phys. Sci. 3, 1 (1971). [2] B. Gower, "Speculation in physics: the history and practice of Naturphilosophie," Stud. Hist. Phil. Sci., 3 (4), 301 (1973). [3] B. Hessen, "The social and economic roots of Newton's Principia" in Science at the Crossroads, Ed. N. I. Bukharin (F. Cass & Co., London, 1971). [4] E. Schrödinger, Nature and the Greeks. Shearman Lectures delivered at University College, London on 24, 26, 28, and 31 May 1948 (Cambridge University Press, London, 1954).

Wednesday, 15:20–15:30, Festsaal

Zeit Time	ID	**Closing Remarks and Conclusions**

Wednesday, 15:30–15:40, Festsaal

Zeit Time	ID	**Outlook for the Next International HoP Conference(s) of this Series** Chair: P.M. Schuster

Wednesday, 15:40–19:00, Festsaal

Zeit Time	ID	**Visit to Echophysics Museum and Excursions**

Wednesday, 19:00–21:00, Festsaal

Zeit Time	ID	**Theatre Evening at the Audience Hall, 2nd Floor**