XLIV National Congress of the Italian Society for the History of Physics and Astronomy

Florence, 17-20 September 2024

SISFA

Società Italiana degli Storici della Fisica e dell'Astronomia

Book of Abstracts

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Congress opening

Venue: Department of Physics and Astronomy, Garbasso Building, room A

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Giovanni Passaleva - *Director Division INFN - Florence*

Section:

100 Years since the Birth of the University of Florence

Venue: Department of Physics and Astronomy, Garbasso Building, room A

The history of Florence Institute of Physics from the 1920s to the end of the 1960s

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The history of the Institute of Physics at the University of Florence is traced from the beginning of the 20th century, with the arrival of Antonio Garbasso, to the 1960s. Thanks to Garbasso's expertise, not only did the Institute gain new premises on Arcetri hill, but it also formed a brilliant group of young physicists made up of Enrico Fermi, Franco Rasetti, Enrico Persico, Bruno Rossi, Gilberto Bernardini, Daria Bocciarelli, Lorenzo Emo Capodilista, Giuseppe Occhialini and Giulio Racah, who were engaged in the emerging fields of Quantum Mechanics and Cosmic Rays. This Arcetri School disintegrated in the late 1930s for the transfer of its protagonists to chairs in other universities, for the environment created by the fascist regime and, to some extent, for the racial laws. After the war, the legacy was taken up by some students of this school who formed research groups in the field of nuclear physics and elementary particle physics. As far as theoretical physics was concerned, after the Fermi and Persico periods these studies enjoyed a new expansion with the arrival in 1962 of Raoul Gatto, who created the first real Italian school of Theoretical Physics at Arcetri.

Waiting for another centennial: first ideas for Astrophysics at the Arcetri Astronomical Observatory (1872-1921)

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In 2025 we will celebrate 100 years from the inauguration of the Solar Tower, a landmark of the Arcetri Observatory and the symbol of its full dedication to Astrophysics. Yet ideas to dedicate Arcetri, in full or in part, to the new science have been expressed already since its foundation in 1872 as an Astronomical Observatory. I will review these earlier suggestions and highlight the role of the director Antonio Abetti in setting the new course.

History of the National Institute of Optics in Arcetri

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The National Institute of Optics, now part of the CNR, has undergone significant development since its foundation in 1927. Initially led by Vasco Ronchi, the Institute aimed at designing and testing optical devices and training specialized technical personnel, particularly for military applications. Following World War II, optical devices were largely supplanted by electronic sources, which were more controllable and easier to handle than traditional optical sources, which were inherently limited in terms of spectral coherence and output power. In 1946, the Institute was renamed the National Institute of Optics (INDO), still under the direction of Prof. Vasco Ronchi. The advent and development of lasers and opto-electronic devices restored optics to the prominent role it enjoyed in the early decades of the century. Since 1975, the Institute, now known as the National Institute of Optics (INO), has been restructured to meet new scientific challenges. Under the leadership of Prof. F. Tito Arecchi, initially as Commissioner and later as President, INO achieved excellence in various areas, including Quantum Optics, Optical Metrology, and Optoelectronics over the next two decades. Throughout its history, the Institute has maintained a strong focus on research and teaching. For many years, it was the principal site for teaching optometry and hosted a specialization school in optics at the University of Florence. Telling its history could be an interesting perspective for the history of optics in the 20-th century in Italy.

The city of stars: astronomy and science communication in Florence between the nineteenth and twentieth centuries

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Following the unification of Italy in 1861, numerous publishing houses expanded their catalogues of popular science, with a particular focus on astronomy. The Florentine publishing houses also contributed to the development of science communication, with numerous initiatives. However, astronomical culture did not spread solely through popular science. Indeed, literature played a significant role, particularly due to the contributions of Enrico Novelli, better known as Yambo, and the dissemination of adventure comics, which was spearheaded by the Nerbini publishing house.

Section:
In Memory of Giuseppe Occhialini and Bruno Rossi

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Bruno Rossi and the magical years in Arcetri: 1929-1932

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The short period that Bruno Rossi spent in Arcetri marked the beginning of his brilliant scientific activity in the field of cosmic ray studies. His pioneering research was immediately appreciated by the brightest young theoretical physicists of the time, notably Enrico Fermi and Werner Heisenberg. By laying the methodological and instrumental foundations for studying the nature of cosmic rays and their interactions with matter, Rossi paved the way for the study of physics at the subnuclear scale and set the stage for developments that made him one of the initiators and major players in the transition from cosmic ray physics to high-energy astrophysics in the 1950s.

L'influenza dell'ambiente fisico e astrofisico di Firenze sui contributi di Occhialini allo studio dei raggi cosmici

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G.P.S. Occhialini, Beppo ma anche Beppino per gli amici fiorentini, si laureò in fisica presso l'Università di Firenze nel 1929. Bruno Rossi fu il suo relatore oltre che l'ispiratore dell'argomento di tesi. L'Istituto di Fisica, insieme a quello di Roma, costituiva un avanzato centro di ricerca, sebbene ambedue in condizioni di difficoltà economiche rispetto ad alcuni centri europei e statunitensi. Nel periodo nel quale Occhialini fu studente - e fino al suo ritorno nel 1934 a Firenze dopo tre anni a Cambridge (UK) con una borsa di studio del CNR ottenuta su suggerimento di Bruno Rossi - avevano lavorato a Firenze eminenti fisici. Inoltre il Seminario Matematico-fisico-astrofisico, attivo dal 1928, sotto la direzione di Giorgio Abetti favoriva i contatti con scienziati, non solo fisici o astrofisici, italiani e stranieri. Garbasso era il direttore del Dipartimento di Fisica. Nella sua veste di Podestà, Sindaco di nomina reale, era stato il promotore del passaggio, nel 1924, dell'Istituto Superiore di Studi Pratici e di Perfezionamento ad Università degli Studi di Firenze. Garbasso promosse la costituzione di un avanzato centro di ricerca presso l'Istituto di fisica, realizzato sulla collina di Arcetri, non lontano della villa "Il Gioiello" dove Galileo aveva trascorso l'ultimo decennio della sua vita. Garbasso fu un fervido promotore della sinergia tra ricercatori dell'Università e dell'Osservatorio astrofisico. Nella relazione esporrò l'influenza che l'ambiente fiorentino esercitò su Occhialini e la connessione con i più importanti contributi allo studio dei raggi cosmici che lo scienziato italiano diede prima a Cambridge e poi a Bristol.

Section:
1924–2024: From Quantum Statistics to Condensed Matter Physics

Venue: Department of Physics and Astronomy, Garbasso Building, room A

When condensed matter physics became king

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Neither solid state nor condensed matter physics existed at the end of World War II. Physical problems related to the properties of materials, of course, have a much longer history, but the physics community was not yet subdivided in a way that recognised those efforts as distinct branches of physics. By the time condensed matter physics became the preferred term in the late 1970s, it was far and away the largest subfield of physics. As condensed matter physics grew, it nevertheless struggled for popular recognition and professional prestige. The reputation for uncovering nature's deepest secrets resided with high energy physics and cosmology. Condensed matter physics did, however, become king in another sense. Its rise reconfigured how the field of physics itself was defined and internally organised. It reflected new ideas about what it meant to be a physicist and challenges to the cherished ideals upon which the twentieth-century physics community had been founded. By tracing the emergence of solid state and condensed matter physics as new ways of organising physicists' labour, this talk will argue that further attention to the sciences of materials is necessary to encourage a thoroughgoing understanding of the history of physics in the twentieth century.

The origins of solid state physics in Italy: 1945-1960 circa

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The Italian physicists who devoted themselves to the study of solid-state physics in the early post-war period could not rely on a solid cultural heritage such as that left by Fermi and Rossi in the fields of nuclear, subnuclear, and cosmic ray physics. Solid state physics in Italy resulted from a polycentric process stimulated by local situations and contacts with foreign research groups, primarily American. Many factors hindered this process. Among them was a cultural, political, and industrial context unconcerned with a discipline whose theoretical foundations and possible technical applications appeared uncertain, the disciplinary formation of new physicists until based on a curriculum established in 1936, and the scarce financial support. The topics studied in those years covered many fields: magnetic properties of materials (Torino), color centers in alkali halides (Pavia, Milano), semiconductors (Roma, Pavia), electron magnetic resonance (Palermo), imperfections in solids (Milano, Ispra), neutron diffraction (Roma, Ispra), and superconductivity (Genova). On the theoretical side, the main contributions were to the theory of bands in semiconductors and to the structure and defects of alkali halides (Pavia).

SISFA Prize 2024 & Cartacci Prize 2024

Award ceremony of the Sisfa Prize, financed by the sustaining member Leonardo Gariboldi in memory of his parents.
Award ceremony of the Cartacci Prize, financed by the Department of Physics and Astronomy of the University of Florence in memory of Prof. Annamaria Cartacci.

Documentary: *Giù nell'abisso, fino alle stelle – Le scoperte di uno scienziato, le esplorazioni di uno speleologo*

In memory of Beppo Occhialini, 30 years after his death.
The film was directed by Roberto Tronconi, speleologist and filmmaker.

18 September

Section:
From Information to AI: More Than 100 Years of Communication and Computation

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Information transmission as artificial intelligence

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Artificial intelligence (AI) emerged from the convergence of several ideas and theories developed over a significant period in the first half of the twentieth century. Among these, information theory holds a prominent place, achieving its complete formulation with Claude Shannon in the 1940s. Shannon is considered one of the founding fathers of AI, being a key contributor to the 1956 Dartmouth seminar that officially launched the field. However, some aspects of this origin and the influence of information theory seem somewhat inconsistent from a broader perspective. Notably, information theory primarily deals with the transmission of signals rather than directly addressing the transmission of meaning—a key element of intelligence. At the same time, Nyquist's earlier work, which anticipated and facilitated the construction of a solid theory of information, concerned the transmission of intelligence, as per the author's terms. In my talk, I will attempt to trace the historical and theoretical connections between information theory and AI, exploring their mutual influence through the shared notion of "intelligence". I will demonstrate that while this shared usage does not signify a perfect conceptual overlap, it has nevertheless sparked numerous advancements in AI. These developments have far exceeded the initial expectations of those who first provided a technical and formal foundation for AI, and they have done so despite the great expectations generated in public opinion by early AI slogans.

Il 'sistema Marconi' e il suo sviluppo, fra scienza, società e politica

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Negli anni 1894-1896 Marconi mise a punto e brevettò un sistema per la trasmissione senza fili di segnali telegrafici (Wireless Telegraphy), e continuò a sviluppare l'invenzione risolvendo i diversi problemi tecnici che man mano si ponevano, brevettando le proprie soluzioni e/o integrando nel suo sistema componenti inventate e brevettate da altri. In seguito, muovendo da

problemi di interesse militare, mise a punto un nuovo sistema di trasmissione basato sulle ‘onde corte a fascio’, in inglese ‘beam system’: con esso veniva risolto anche il problema dei costi non competitivi della telegrafia senza fili basata sul suo brevetto precedente, e si incentivava lo studio della ionosfera, sulle cui proprietà riflettenti il sistema si fondava. Infine, partendo dall’intuizione di David Sarnoff della Marconi Wireless Telegraph Company of America, ebbe l’idea del ‘broadcasting’, cioè della ‘radio’ nel senso che diamo oggi alla parola. Marconi si impegnò a fondo anche come organizzatore culturale e politico, in un complesso rapporto col governo italiano dal periodo giolittiano al fascismo: tanto Nitti quanto Mussolini avevano compreso bene come le sue capacità non fossero soltanto tecnologiche e imprenditoriali. La priorità di Marconi sul wireless è stata più volte messa in dubbio, costringendolo a difendersi davanti all’opinione pubblica e talora in tribunale. Ancora oggi i suoi meriti scientifici non sono riconosciuti da tutti. Per questo è preferibile parlare di ‘sistema Marconi’, su cui la sua priorità non può essere negata, e il suo lascito può essere visto nella giusta dimensione.

The art of communicating: from the theory of information transmission to the Shannon-Fano Code

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A sincere friendship began between the Italian-American Robert Fano and Claude Shannon around a common theory, which had as its object Information as a representation of thought and a measurable object of communication. Shannon published his A Mathematical Theory of Communication in 1948, while Fano published The Transmission of Information a few months later in 1949.
Fano and Shannon together conceived an advantageous technique for generating uniquely decodable codes to solve information transmission problems in noisy channels.
Around the concepts of information, entropy, noisy channel, transmission codes, a group of researchers led by Robert Fano was created at the Massachusetts Institute of Technology and laid the foundations for the establishment of the MIT Computer Science & Artificial Intelligence Laboratory.

From Shannon to Von Neumann: a partial understanding of information

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The talk aims to analyse the definition of information by comparing the crucial definitions formulated by Shannon and Von Neumann and highlighting some of their criticalities.
Statistical mathematics poses the basis of the understanding of information in the form of Shannon’s proposal in *A Mathematical Theory of Communication*. In this work, information is explained by the concept of **Information Entropy**. However, it creates confusion in understanding what information is, first because of its comparison to the thermodynamic counterpart and second because Shannon’s definition is very precise, as it analyses entropy as the quantity of uncertainty in a transferred message.
Instead, the advent of quantum mechanics also posed a turning point in the definition of information and, more precisely, in the exchange of information. Von Neumann proposed a new definition that, at first glance, seems pretty near to the definition of Shannon; in fact, the shape of both formulas are very similar, and the **Von Neumann Entropy** seems to

be the same equation of the Information Entropy but for the microscopic world. However, the Von Neumann definition captures something different: the entanglement property. The two equations coincide in some situations, but the same applies to Shannon Entropy and thermodynamics. We will investigate if the definitions are specular.
The seminar will be structured as follows: in the first part, we will analyse Shannon's definition; in the second part, we will discuss Von Neumann's definition; and in the last section, we will compare them using recent works on this topic.

Section/1: *History of Physics and Astronomy (until 19th century)*

Venue: Astrophysics Observatory of Arcetri, Library

William Rowan Hamilton, poet and mathematician

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Since the advent of Quantum Mechanics the name of William Rowan Hamilton is familiar to every physicist. However, for multiple reasons the very original conceptions underlying Hamilton's work went largely unnoticed during the XX century and today are practically forgotten. In this communication I will trace a portrait of Hamilton's life and work, emphasizing how his Kantian philosophy of mathematics impressed a peculiar character to his more mature mathematical works. In particular, I will make a focus on the conceptions underlying Hamilton's geometric theory of quaternions, the first theory of a four-dimensional space-time.

Earliest meteorological observations in Naples in the 18th century

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The 18th century marked the beginning of a widespread diffusion of thermometers and other meteorological instruments, fostering the birth of the first correspondence networks in Europe (including Italy), aimed at collecting and comparing meteorological observations from different sites. An active role was played starting from 1723 by the secretary of the Royal Society, James Jurin, who built one of these networks. Participants were requested to record daily observations concerning temperature, barometric pressure, direction and strength of winds, description of clouds and amount of rain or snow. The Neapolitan Niccolò Cirillo was among Jurin's correspondents; he carried out a variety of observations, ranging from weather conditions and wind directions to rainfalls and the activity of Mount Vesuvius, also including an account on the eruption during March 1730. A handful of original documents from the Royal Society historical archives testifies the activity carried out by Cirillo within Jurin's network, including excerpts of his meteorological diary. The emerging feature is a unifying vision of meteorology, as a comprehensive science including any Earth phenomenon, which was widespread among scientists and naturalists in 18th and 19th century, leading to a common belief of a deep relationship between earthquakes, eruptions and atmospheric phenomena.

The first meteorological series of southern Italy. Report on a rediscovered archive

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In Southern Italy, the naturalist Giuseppe Maria Giovene (1753-1837) was one of the first to make regular observations of meteorological phenomena. From 1788 to 1797, he published annual reports of his observations, which also included his opinions on the outcomes of meteorological conditions on agriculture and human health. He was considered in his time the founder of meteorology applied to agriculture. Giovene observed meteorological phenomena for about forty years. He also established a network of scientists who collected meteorological data in some cities of the Kingdom of Naples. Many notebooks of observations, many scientific letters and other manuscripts are in a fund, which historians have not yet explored. This documentation needs to be appreciated, because it represents very important material for reconstructing the history of the first meteorological observations in Southern Italy. Furthermore, it would allow us to make an evaluation of climate changes based on the comparison of historical data with current data.

On the "last discovery of Cavalier Melloni"

Author: Rosanna Del Monte[1]

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The Italian physicist Macedonio Melloni (1798-1854), who is best known for his work on "radiant heat", devoted the last years of his life to the field of electricity and magnetism. As part of his research, he designed and built an innovative induction electrometer shortly before his death. This apparatus was presented to the Royal Academy of Sciences of Naples a few days after the scientist's death. One of the three existing pieces of this apparatus is kept at the Museum of Physics of the Museum Center of Natural and Physical Sciences at the University of Naples Federico II. This paper provides an in-depth analysis of the structure and functioning of this electrometer, which, as the inscription on the apparatus states, was the "last discovery of Cavalier Melloni".

The passage of the Comet C/1861 J1 in 1861. Angelo Secchi's drawings and the Cometa San Pietro tempera, history and restoration

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On 30 June 1861, astronomer Angelo Secchi observed and made in tempera the passage of the Great Comet. He saw the intense light appeared above Rome during the celebrations of patron Saints, from which the drawing Cometa San Pietro took the name. In his notebooks, he describes its extreme glow, calculates size and position, defining the tail as the longest in

history and he traced some graphite drawings. Giovanni Della Longa engraved an etching from these sketches, and they were also preparatory studies for the Secchi's tempera. On 12 August, Angelo Secchi illustrated a "Storia delle apparenze della cometa", in his talk to the Pontificia Accademia Tiberina, published in the pamphlet: Osservazioni e ricerche astronomiche sulla grande cometa del giugno 1861". The event was also observed by both Giovanni Plana in Turin and Caterina Scarpellini, who describes the comet in a letter to the Album of Roma Director. The first sighting of the comet was on 13 May 1861, by an Australian amateur astronomer, John Tebbutt who wrote to the Sydney Observatory about the discovery. The news came later in the Northern Hemisphere and the comet was an unexpected surprise. Cometa San Pietro, conserved at Inaf-Oar, was in a bad state of conservation and it was restored during a workshop at the University of Turin. It was conducted also a test, supported by diagnostic investigations, to identify a fixative agent useful to protect the pulverulent surface.

Enrico Dal Pozzo un fisico del risorgimento tra eresia e innovazione

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Enrico Dal Pozzo was born in Turin in 1822 and died in Perugia in 1892, he was the first holder of the Chair of Physics at the Free University of the city of Perugia which had just become part of a unified Italy. His scientific path intersected with the radical political upheavals of the Risorgimento and with the first years of Italian unification. He combined a rather controversial interest in mesmerism with rigorous studies on innovative themes, which made him a personality on the border between heresy and innovation, but definitely of importance in the panorama of Risorgimento physics. I will examine among the many study topics on which Dal Pozzo concentrated his interest, some particularly innovative for his time. These topics also allow us to carry out a survey of the state of the art of some physics topics as they appeared in the midst of the Italian Risorgimento, such as the study of physiological optics and the theme of unification of the fundamental forces.

Section/2:
History of Physics and Astronomy (20th century)

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Theoretical patterns for understanding scientific collaborations

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In recent years, two distinct accounts of collaborative knowledge have been proposed: the commitment model and the distributed cognition model. The commitment model emphasizes the importance of joint commitment among group members to shared beliefs in order that the group results can be regarded as collective achievements. In contrast, the distributed cognition model involves breaking down a task into components assigned to different group members, with a focus on how these components contribute to the overall task.
At first glance, these models seem opposed, particularly regarding the necessity of commitment

to specific beliefs in collaborative efforts. However, in this presentation I will adopt a compatibilist perspective, arguing that both models capture essential aspects of scientific collaboration. Drawing on Laudan's distinction between accepting and pursuing a hypothesis, I will suggest that a compatibilist account can effectively understand real cases of scientific collaboration, provided that we consider as fundamental not the commitment to believe or accept certain tenets, but rather the commitment to pursue the objectives of a given research project.

Presentation of a 'Mach Corpus' and its preliminary analysis

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In recent years, an increasing amount of digitally available historical texts has become available, and the use of computational tools to explore such masses of sources can be of invaluable help to historians of science. The computational approach has made new tools and models available for historical analysis which have allowed an interpretation of historical texts less linked to the preferences of the scholar. For example, in the history of ideas/concepts, the computational approach has allowed the interpretative models constructed by science historians to be verified in a more precise manner.

In this presentation we want to introduce a corpus of Mach's english-language writings in such a way that it can be used for computational analysis. In particular, the corpus will be annotated for subsequent conceptual analysis.

Furthermore, we will try to highlight some characteristics of the corpus as a whole and its initial representation with semantic spaces using depp-learning tools such as the Word2Vec algorithm. Finally, we will indicate some analysis models that can facilitate the conceptual study of Mach's work.

At home in a Super-Copernican Cosmos: the nature of the observer and Wheeler's 'It from Bit'

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In the previous congress we outlined the genesis of John Wheeler's "participatory universe" in the early 1970s and explained the meaning of the enigmatic expression "super-Copernican", which refers to the effect that, according to Wheeler, the community of observers across spacetime (not limited by "now-centeredness") is supposed to have on cosmogony itself. If we then focus on the late 1970s and the 1980s, it is possible to notice a series of subtle shifts in his ideas, which however seem to be characterized by a double tendency. On the one hand, when the "observer" is placed within the context of quantum foundations, Wheeler was clearly leaving behind a Wigner-like conscientialism (as well as a form of anthropomorphism), which had some influence on him in the early 1970s. On the other hand, however, consciousness and mankind are not demoted or downgraded to a marginal accident in the economy of the universe, but are a crucial link in what Wheeler now called "the meaning circuit". In the light of his papers and notebooks, we will contextualize and clarify these tensions and, at the same time, get better insights on the slogan that would summarize Wheeler's late vision: "it from bit".

Fusing Europe from EURATOM to ITER: A network analysis of European techno-scientific cooperation in controlled thermonuclear research

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Scholars and policymakers consider techno-scientific cooperation as central in the process of European integration. However, few historical cases have explored this role in detail. In particular, the role of cooperation on fusion energy research remains largely unexplored, apart some preliminary studies suggesting that it had played a major role in some key moments of European integration. In the context of the project FusEurope: European cooperation in nuclear fusion research: from history to future policy design—which aims at addressing this shortcoming from an interdisciplinary perspective—the talk discusses the change over time of technoscientific cooperation in fusion research in Europe against the background of global developments by applying concepts and tools of network analysis. In different European countries, scientific research that would flow into controlled fusion research was initiated under various circumstances depending on the political conditions of the immediate post-World War II period. Different research streams research, often related to domains apparently unconnected to nuclear matters—notably, on astrophysical plasma—provided both expertise and knowledge essential to produce advances in controlled thermonuclear research. Using information available in reports, published literature, and archival materials the talk will produce a temporal social network analysis of techno-scientific cooperation on topics related to fusion research, identifying particularly central scientists, subcommunities and topics. By understanding the relations between persons and knowledge across national borders we aim to clarify in what specific ways fusion research became progressively international in the European context.

The diplomacy of standardization: how the SUN commission negotiated electrical units during the interwar period

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Standardization has been recognized by historians as a major undertaking of international scientific organizations during the interwar period. Despite the undeniable relevance of this endeavor, the discussions driving these standardization activities have received limited attention. In my talk, I aim to explore these discussions by focusing on the International Union of Pure and Applied Physics (IUPAP), the foremost organization of physicists active in the international arena between the World Wars. Specifically, I will examine the debates surrounding electrical units within IUPAP's Working Commission on Symbols, Units, and Nomenclature (SUN), established in 1931. This commission navigated a complex landscape of political, economic, and scientific tensions. Achieving international agreement on electrical units was challenging due to scientific debates among physicists and the involvement of engineers and politicians with industrial interests. Using archival documents from national and international physical institutions participating in these activities, I will shed light on the key players (scientists, organizations, countries), the interests involved, the instruments used, and the goals achieved in the process of standardizing international electrical units during the interwar period.

Percepire, comprendere e comunicare i luoghi storici della meteorologia ferrarese attraverso la multisensorialità. A public engagement project of the University of Ferrara

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The scientific content of this Public Engagement Project is drawn from Anna Maragno's PhD Thesis, concerning the history of meteorology in Ferrara from the end of the eighteenth century to the first two decades of the twentieth and, in particular, focusing on the figure and on the work of Giuseppe Bongiovanni (1851-1918), director of the Meteorological Observatory in Ferrara.
The aim of the Project is to present the places and the protagonists of this story to a non-specialist public, with a specific focus on creating an immersive experience via multi-sensory activities. The methodologies designed to achieve this goal will be highlighted, together with a description of the planned display of the Project: seminars, cultural events and workshops all including innovative aspects of "hands-on" didactics.

Section/1:
Strumentaria

Venue: Astrophysics Observatory of Arcetri, Library

The Belli-Babinet tap: an innovation in pneumatic technology in the first half of the 19th century

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This talk examines the development of the Belli-Babinet tap, a key innovation in pneumatic technology during the 1830s. In 1827, Giuseppe Belli (1791-1860), an Italian physicist then lecturing at the Imperial Regio Liceo of "Porta Nuova" in Milan, published an article in a scientific journal edited in Pavia by Pietro Configliachi and Gaspare Brugnatelli. Belli described a novel and intriguing mechanical solution for double-barreled air pumps in this paper. Belli's design involved modifying the stopcock at the base of the pump's cylinders with a special mechanical tap that, when rotated, achieved a "double-exhaustion" effect. The rotation modified the connections between the plate and the two cylinders, allowing the creation of a higher vacuum. French physicist Jacques Babinet (1794-1872) independently proposed the same solution two years later. This innovation, known as 'Babinet's tap', was described in some successful French physics treatises and included in the trade catalogues of most French manufacturers of scientific instruments. As a result, this modification quickly spread worldwide.

Hidden treasures: The tale of Florentine thermometers 150 years after their crafting

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The rediscovery of seventeenth-century Florentine thermometers in a warehouse of the Pitti Palace in Florence in 1829 marked a significant point in preserving scientific heritage. Uncovered by the physicist Vincenzo Antinori, these artifacts, presumed lost, miraculously survived over 150 years. Antinori identified these thermometers as formerly belonging to the Accademia del Cimento's meteorological endeavours, based on drawings left by the academicians. This rediscovery prompted a resurgence of interest among scholars outside Italy, and many thermometers left Florence. The transfer of instruments and objects between scientific communities was not uncommon at the time. However, the concept of "historical-scientific heritage" still did not exist, and objects were transferred with utmost ease. It is noteworthy that in few cases, an original manuscript proves the dispatch of these thermometers.
In this paper, I will present the journey of a small Florentine "*termometro cinquantigrado*" which is now housed at the Whipple Museum of the University of Cambridge. Donated by Henry Babbage in 1872, it was strongly sought by the visionary James Clerk Maxwell for the new Cavendish Laboratory, of which he was director. This case study highlights the collaborative nature of scientific networks in the nineteenth century and the pivotal role of individuals like Antinori and Maxwell in preserving and promoting scientific heritage. Furthermore, it underscores the cultural significance of integrating historical artifacts with experimental apparatus and their role in understanding the evolution of thought and methodology, bridging the gap between theoretical knowledge and practical experimentation.

Lippmann: history, art and science in one photo

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Gabriel Lippmann was awarded the Nobel Prize in Physics in 1908 for the invention of a method of colour photography exploiting the phenomenon of reflection interference, a rather unknown method today. The original Lippmann plates are very beautiful and extremely rare and, to our knowledge, only one exists in Italy at the Department of Physics and Astronomy in Florence.
The history of the Italian plate is interesting and tortuous: in 1914 Gabriel Lippmann sent three interferometric plates to Augusto Occhialini, director of the physics department of Florence. Two were lost but one was found and saved by the Fondazione Scienza e Tecnica (FST), a scientific and cultural institution based in Florence. A meticulous search in the department's archives followed which brought to light a correspondence between Lippmann and Occhialini. Lippmann's autograph letter made it possible to date the plate, learn its history, learn about the landscape portrayed and certify its authenticity. This artistic, scientific and technical jewel is permanently exhibited within the Enlighting Mind exhibition of the Department of Physics and Astronomy in Sesto Fiorentino.
This contribution will report on the ancient, unknown and brilliant Lippmann methods to produce interferometric photography (which is an ante-litteram nanophotonic approach), as well as history, conservation, and preservation issues of our plate.

Sacred alignments of early christian churches and baptisteries in Ravenna, Italy

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In this transdisciplinary archaeoastronomical project, the researcher examined the hypothesis put forward by the historian Giuseppe Gerola (1877-1938) who postulated at the beginning of the 20th century that the early Christian sacred buildings in Ravenna, Italy, were oriented towards the sunrise on a specific day. His methodology, however, did not allow him to determine the orientation with accuracy so his hypothesis had to remain speculation.
The researcher analysed the early Christian sacred buildings in Ravenna (mentioned by Gerola) and that are still extant today in their (partial) original form (about 18), by conducting georeferenced surveys with astronomical, trigonometric calculations combined with the study of primary and secondary sources. The author's methodology allowed her to obtain with high precision azimuths and declinations of these sacred architectures and in combination with written evidence realistic hypothesis can be expressed.
She aimed to verify or falsify Gerola's hypothesis concerning the existence of an ancient building tradition regarding the alignments of early sacred buildings toward sunrise on a specific day.
Her study confirms Gerola's early theory: some sacred architectures in Ravenna were indeed aligned toward the sunrise on a significant day, but some also with the sunset and few of them with the moon.

The celestial Weigel Globe in the Stibbert Museum: restoration and valorisation

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Erhard Weigel (1625-1699) was professor of mathematics at the University of Jena from 1653 until his death. As a convinced and passionate educator, he conceived instruments for the popularization of astronomy including a celestial globe that was produced in several copies. These celestial globes were made of copper and had certain peculiarities, the most obvious of which was the series of new figures used to represent the constellations. Instead of traditional constellations, Weigel offers heraldic figures, symbols of corporations, cities and European countries. Today eighteen of these globes have been surveyed that are still extant, one of which was purchased in the late nineteenth century by Frederick Stibbert (1838-1906) and is preserved in Florence in the museum that bears his name and preserves his collections composed mainly of valuable arms and armor from various eras and origins. Preserved probably without comprehend its meaning, the globe shows signs of many improper repairs and was mounted in a way that did not allow it to be properly understood.
Thanks to a funding from association YOCOCU (Youth in Conservation of Cultural Heritage) a conservation treatment was undertaken. The presentation will outline crucial aspects of the restoration and strategies now possible for more effective enhancement.

Un quadrante lunare, forse cosmologico, nell'Abbazia di San Martino delle Scale

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Sulla parete orientale della Chiesa abbaziale di San Martino delle Scale esistono due quadranti incisi nel muro, entrambi riconducibili a tracciati lunisolari. Uno dei due, più evidente e oggi restaurato, è stato già oggetto di una mia relazione al Convegno di Storia dell'Astronomia di Cagliari nel 1999. L'altro quadrante, inciso con un tratto sottilissimo, si manifesta appena riproponendo lo stesso schema grafico del precedente, ma inducendo a stimare finalità diverse. La parete fortemente declinante e con un orientamento insolito per una chiesa benedettina, permette un'analisi della sua sensibilità alla ricezione della luce, compatibile con la verifica di eventuali fibrillazioni del sistema Sole-Terra–Luna. Questa interpretazione è stata da me proposta in una mia recente pubblicazione, in cui considero il verso di rotazione della Terra e della Luna rispetto ai loro moti di rivoluzione, nel passaggio della superficie terrestre dalla notte al dì (e viceversa) e in specifiche condizioni di lunazione. In tali circostanze, la nutazione dell'asse terrestre risente di un minimo effetto aggiuntivo, legato a condizioni peculiari di deformazione dello spazio/tempo. Tale effetto è compatibile con la sensibilità del tracciato in questione rendendo plausibile un suo utilizzo all'interno di uno studio cosmologico.

Section/2: *History of Physics and Astronomy (20th century)*

Venue: Department of Physics and Astronomy, Garbasso Building, room A

The first electron charge measurement: status, meaning and implications of J.J. Thomson's and R. Millikan's respective research

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In this study we will analyse the status, meaning and implications, also at the educational level, of J.J. Thomson's and R. Millikan's respective research concerning the discovery of the electron and the measurement of its electric charge. In this regard, two experiments are usually addressed in secondary school and university textbooks as well as in many websites and Encyclopaedic entries: the measurement of the e/m ratio in the case of cathode rays in 1897 by the English physicist Sir J.J. Thomson, labelled as the "discovery of the electron" experiment, and the oil-drop experiment in 1911 by the American physicist R. Millikan, labelled as the "measurement of the electron charge". Filling this 14 years' jump against the background of the historical conceptual difference between the terms "electron" (already coined by G.J. Stoney in 1891) and "corpuscle", we will show that Thomson was in fact the first one to measure the electron (his "corpuscle") charge in 1899, and that Millikan was not even the first one to use an experimental method consisting in catching ions on droplets and measuring their speed inside vertical electrical and gravitational fields. This does not mean, of course, that Millikan's

role was not fundamental: his interest was in the elementary charge and his great merit was that of demonstrating that all charges are integer multiples of an elementary charge, which is the same as the charge of the electron. Thus, Thomson and Millikan had two completely different research programs and as such they should therefore be disentangled.

Dirac's quantum time

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In 1926, Dirac had attempted to give a relativistic generalization of his mechanics of q-numbers, defining a new *quantum time* starting from the relation: tW - Wt = -ih
In the 1927 article, Heisenberg will start from this relationship by Pauli and Dirac which implies this new concept of quantum (relativistic) time. All the historical formulations of quantum mechanics were time irreversible. Time was a matrix in Heisenberg matrix mechanics and all the physical variables obeyed a matrix evolution, time irreversible equation. Schrödinger equation was written as representing the propagation of an irreversible physical wave.
One has been able to state that quantum mechanics is time reversible only by defining the time reversal operator in a new way, involving also complex conjugation, just to obtain reversibility. This new formal insight was obtained for the first time only in 1932, in the paper *Über die Operation Zeitumkehr der in der Quantenmechanik* by Eugene Wigner.

Alchemy, in our time

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This contribution offers an unprecedented retrospective on the editorial story of "Alchimia del tempo nostro", a book co-written by Ginestra Amaldi and Laura Fermi. It is a story holding a special historical-scientific interest and human value, which unfolds against the backdrop of the 1930s and the Second World War. The events are reconstructed through the documents emerged from the archive of the Hoepli publishing house, preserved at the University of Milan. Published in 1st edition in 1936, "Alchimia del tempo nostro" was the first Italian book dedicated to explaining the newly born nuclear physics to the general public. The volume was expanded by Ginestra and republished in 1943, while the war had interrupted the contacts between the two authors, separating them into two mutually hostile countries. With her husband Edoardo and their children, Ginestra was still living in Italy, in the "open city" of Rome, while Laura was in the USA, about to move with her husband Enrico and their children to the secret laboratories of Los Alamos. Read today, Laura and Ginestra's book has not lost its formidable informative effectiveness, to which, however, a remarkable historical value is added, as an unaware testimony of a crucial era for science and humanity.
The present historical research was stimulated on the occasion of the next re-edition of "Alchimia del tempo nostro", edited by Luisa Bonolis and Adele La Rana for the publisher Castelvecchi (November 2024).

La corrispondenza italiana di Bruno Pontecorvo dal 1945 al 1950

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Una ricognizione sistematica del Fondo Pontecorvo al Churchill Archives Centre, del Fondo Wick alla Scuola Normale Superiore di Pisa e del Fondo Amaldi a Roma "La Sapienza" ha consentito un'ampia ricostruzione della corrispondenza tra Bruno Pontecorvo e alcuni altri membri del gruppo romano di fisica nucleare (Amaldi, Bernardini, Wick, Segré) negli anni 1945-1950.
Ne emergono significativi elementi di comprensione delle relazioni intercorse tra gli ex collaboratori dopo la diaspora causata dalle leggi razziali e dalla guerra. Sono presenti anche importanti riferimenti alle ricerche in corso e indizi dell'evoluzione di alcune idee scientifiche di Pontecorvo, in particolare sulla fisica dei neutrini.

Exchanges in the nucleus in the 1930s: Werner Heisenberg and Ettore Majorana

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The discovery of the neutron in 1932, provided the key picklock that allowed quantum mechanics to be applied to the problem of nuclear structure. The first, moderately satisfactory attempt was undertaken by W. Heisenberg, who had already pioneered the introduction of exchange interactions in the quantum mechanics of identical atoms and had first applied them to the helium atom. While Heisenberg took inspiration from a different incarnation of exchange interactions, introduced in molecular physics to explain covalent bonds, E.Majorana went back to the original idea and proposed (at first independently of Heisenberg) his own version, which overtook several drawbacks of Heisenberg's theory and gave results closer to experiments. In this contribution, we reconstruct this story, including a detailed discussion of Majorana's unpublished notes on this subject, which in fact contain much more material than what was published.

Revisiting Bruno Rossi's experiment on cosmic rays showers: comparison with the original results

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In this study, we revisit Bruno Rossi's pioneering experiment on cosmic ray showers, a milestone in understanding high-energy astrophysical phenomena. Rossi's original technique, developed around 1930, utilized Geiger-Müller (GM) tubes arranged in a coincidence setup, provided with an original coincidence circuit. Among other configurations, Rossi wanted to detect showers produced by primary cosmic rays interacting with various absorbing materials of different thickness placed above the counters. Our experiment consists of a replica of the original Rossi's coincidence setup, including the circuit based on vacuum triodes coupled to three G-M tubes,

complemented with a modern acquisition system digitizing the same signals processed by the Rossi's circuit. Our re-experimentation aims to rerun and extend Rossi's findings, by using contemporary technology, specifically employing some cheap, though very accurate, technology today available in the world of home computers. Our methodology tries to reproduce the geometric configuration of Rossi's counters while incorporating modern computational tools for data analysis, providing a multifaceted interpretation of the phenomenon. Special attention is dedicated to study the combined effect of coincidence resolving time, detector shielding and rate of chance coincidences provided by the original Rossi's approach. The relevant performances are compared with the ones obtained with the now available digital acquisition techniques and associated data analysis. The comparison underscores the enduring relevance of Rossi's contributions to cosmic ray physics. This re-experimentation not only honors historical scientific milestones but also demonstrates the potential for new evaluations with upgraded methodologies, thereby enriching our understanding from a historical and educational point of view.

SISFA General Assembly

Venue: Department of Physics and Astronomy, Garbasso Building, room A

19 September

Section: *History of Physics and Astronomy (until 19th century)*

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Angelo Catone and the comet of 1472

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Angelo Catone was a natural philosopher, physician and astrologer from Benevento who lived at the end of the Middle Ages. In Naples, he was a reader at the University, having excellent relations with the Aragonese court, becoming superintendent of the library of King Ferrante I and personal physician of Frederick of Aragon. At the court of France, Catone was a counsellor and royal physician of Louis XI and Charles VIII, and also the protagonist of Parisian cultural life and appointed as archbishop of Vienne in the Dauphiné.
In 1472, Angelo Catone published a text on the great comet C/1471 Y1, which he called *Pogonias*, or bearded. *De cometa 1472*, a rare incunabulum, was probably printed by Sixtus Riessinger, who introduced movable type printing in Naples. With exceptional brightness: a tail estimated at 36° and a coma as big as the Moon, this comet was illustrated in some chronicles like the *Liber chronicarum* of 1493 by the German physicist Hartmann Schedel, and observed by many like Regiomontanus in Nuremberg and Dal Pozzo Toscanelli in Florence. The volume by Catone was among the first astronomical texts published in Italy, along with the much more authoritative *Tractatum de Spera* by Sacroboscos.
The communication presents the figure of Angelo Catone, the astronomy of the comet according to the Aristotelian tradition, and the social and political predictions described by the physician from Benevento.

Astronomical observations and scientific practices between Cayenne and Paris

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After spending twenty years in Bologna developing first-rate research in collaboration with the Jesuit astronomers of the College of Santa Lucia, Gian Domenico Cassini arrived in Paris in 1669 at the invitation of Colbert, Louis XIV's minister, to develop research to determine the longitudes of places and to define the first topographic map of France. Of the scientific missions organized by Cassini at the Paris Observatory, one of the most famous is undoubtedly

that of Cayenne in 1672-73, when Jean Richer's observations of the parallax of Mars, then at perigee, together with those by Cassini in Paris, led to the first reliable measurement of the Earth-Sun distance. The presentation deals with the figure of Cassini, the influences exerted by the Bolognese scientific environment in orienting him towards certain areas of study, and finally the methods used in Cayenne and Paris to estimate the parallax of Mars and the Earth-Sun distance. What emerges is a complex picture in which evaluations of celestial distances, astronomical observations carried out in different places and time-measuring techniques are intimately connected with each other and linked to the knowledge in the field of geography and geodesy available at the time.

A Hebrew witness of the Theorica Planetarum from 1492 Naples

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In my talk, I will discuss the hitherto unstudied Hebrew transmission of the Theorica Planetarum, which was translated in the middle of the fifteenth century by the Italian Jewish physician and polymath Judah Astruc ben Samuel Shalom Ha-Rofe. I shall focus on a beautiful copy from 1492 Naples, part of a rich collection of astronomical and mathematical treatises (Biblioteca nazionale Vittorio Emanuele III, Ms F 12), created by Abba Mari Halfan, who had come to Naples to study astronomy, as one learns from the colophon. Halfan's copy is characterised by extremely high textual as well as diagrammatical precision and it raises interesting questions regarding its role and connection to the other surviving manuscripts, while serving as a palpable witness to the dissemination of the Theorica Planetarum outside the Latin sphere .

E noi uscimmo a riveder le stelle: the Medici family and the scientific patronage in Florence

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When we think of Florence and its rich history, we think about the Medici family. This Mugellan-born family had shaped significantly the world they lived in, using patronage as a weapon for both political and economical purposes, leaving a considerable mark within Florence. Despite knowing a lot about their arts patronage and how they had shaped significantly the Renaissance, we know few of their scientific patronage. Even though some science historians have tried to study the relationship between Galilean scientists and their patrons, there was never an attempt to understand the reason why the Medici wanted to invest their time, money and effort within this patronage.

This paper aims to aims to discover the reasons from both the cultural and political world whilst relating with Galileo and other scientists such as Viviani, Torricelli and Rinaldini and relating their patronage throughout an historical perspective. Another fundamental point that will be explored are some key figures within the Medici family that are going to see the evolution of this kind of patronage, from the beginning up until the end of the dynasty leaving a mark also within the Florentine science.

Joseph Sauveur and the fixed sound

Authors: Danilo Capecchi; Giulia Capecchi

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At the turn of the 18th century, as a result of the development of musical instruments, the increase in the size of orchestras and the diffusion of music on European scale, the need to standardize the frequencies associated with notes began to be felt. This was a not easy task because there were no instruments to measure the frequency of a sound and standardization was essentially left to the ear.
Giuseppe Sauveur, the leading acoustician of the time, proposed two methods to achieve this goal in the early 1700s. The first was based on the theory of beats, which he was just beginning to understand. This method aimed to produce a sound of 100 Hz, the fixed sound, using an organ pipe. A second method was to find the equation for the frequency of a vibrating string as a function of the characteristic parameters. This law was known since the end of the 16-th, century but only in a relative way, i.e. it was known that the frequency was proportional to some parameters, but the constant of proportionality was not known and it was not easy to determine this quantity experimentally. Sauveur proposed an analytical method that led to an equation that was within 1% of the value now considered correct.
The following paper analyzes Sauveur's two approaches, using unpublished writings that exist in manuscript form in the procès-verbaux of the Paris Académie des sciences.

The history of the many versions of the "Curie's Principles". A comparative study of their versions and their ranges of validity

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In 1894 Pierre Curie introduced into theoretical physics the first symmetry laws; they concern symmetry breaking. But the content of his paper remained longtime obscure.
Previous my papers showed that 1) the same word "symmetry" is a double negation without a corresponding affirmative word; that means the failure of the double negation law; hence, this word belongs to intuitionist logic; 2) the metaphysical part of Curie's paper represents an inconclusive effort of generalizing experimental data; 3) the theoretical organization of Curie's paper is not a deductive-axiomatic theory; rather, it is substantially a problem-based one.
Owing to the many difficulties met in accurately recognizing the theoretical content of Curie's paper, in past decades some scholars extracted from it the central proposition. Many versions of "Curie's principle" resulted. They are listed and their logical, mathematical and physical differences are examined. In particular, the question of its range of validity is discussed in both cases of its belonging to each kind of the two theoretical organizations.

Section:
1924–2024: Edwin Hubble and the Evolution of Modern Cosmology

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Beyond the Milky Way: an historical perspective

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The discovery that what were once called spiral nebulae are other galaxies similar to our own, has modified our concept of Universe and marked the beginning of extragalactic astronomy, of space exploration beyond the Milky Way and of its time evolution. In this talk I will summarize facts that have stimulated and driven Hubble's discovery 100 years ago, and which have been the immediate revolutionary consequences of this. Our knowledge of galaxies and of the Universe has made an enormous progress during the past century, but we are still missing a solution for a few relevant cosmic puzzles, which are shaping the next generation of telescopes and future astrophysical researches.

A semi-Malthusian analysis of the possible social and cultural causes behind Hubble's discovery of the law of recession of galaxies

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The thesis I will present concern the new idea of Large Scale in cosmology due to Hubble's discovery. I propose that the hypothesis of a larger universe was probably a cultural need born not only in astrophysics environment, but already present in the air and stimulated by the social events of that period. I will make an "investigation" of some of them, focusing mainly on the general political situation, on the hint of an imminent even more devastating world conflict and on the crisis of values in art, reflection of the uncertain socio-political conditions at the origin of the Second World War. In this phase, the concept of "big" quickly became "bigger": the economy ceased to be an internal aspect of a given country, becoming a factor binding increasingly distant nations; the previous colonial policy of expanding borders led to the expansion of clashes of interests from a European to a global scale. The "Great War" was truly great and was greater than all previous conflicts: almost 70 million people lived the experience of the trenches and the return home of the survivors brought about unprecedented problems of social reorganization. American industrial production inflated the stock markets and its collapse a few years later caused a vortex dragging with it all the countries economically linked to United States. I will try to show how, in this climate of new social crisis, it was possible, if not even necessary, to question also the vision of a universe hitherto considered much narrower.

Hubble did not discover the expansion of the universe: observation versus discovery

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The standard belief is that the expanding universe was discovered by Edwin Hubble in 1929. Important historians of cosmology (H. Kragh, R. Smith, S. Bergia, C. O'Raifeartaigh) have recently underlined that the question is more complicated, and Hubble cannot reasonably be credited with this *discovery*: his measurements only provided the first experimental *evidence* in support of the hypothesis of an expanding universe, as a linear relation between the redshifts and distances of galaxies does not in itself imply an expansion. On the other hand, Hubble never claimed to have discovered it: his general agnostic attitude was that of a cautious empiricist; thus, he did not deny that the universe expands, but neither was he convinced that it does expand. The same happened in early 1965 when Arno Penzias and Robert Wilson measured an isotropic radiation but did *not* discover a fossil radiation from the Big Bang: that observation became an actual discovery only when Robert Dicke provided a valid theoretical context within which a primordial universal radiation acquired meaning. In short, *observation/measurement* and *discovery* should not be confused: the former might imply the latter only when a theoretical background provides valid reasons to explain that observation. My contribution aims to reflect on this subtle difference, in light also of a distinction by Bergia, according to which observations of a cosmological *nature* might assume a cosmological *value* (thus a relevance for the entire universe) only after accepting specific physical clauses, laws, or hypotheses.

Section/1:
History of Physics and Astronomy (until 19th century)

Venue: Astrophysics Observatory of Arcetri, Library

Insegnamento scientifico nel Seminario Vescovile di Bergamo tra XVIII e XIX Secolo

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The Seminary of Bergamo, founded in 1567, preserves a collection of around 200 instruments generally in a good state of conservation, most of which date back to the nineteenth century. The instruments were used for teaching Physics in the Seminary school, whose system in the 18th and 19th centuries was divided into Gymnasium, Philosophical and Theological studies. Physics, in particular, was a curricular subject in the philosophical course and, throughout the nineteenth century, it made use of the experimental method, as demonstrated by the many documents preserved in the historical archive of the Seminary and by the collection of instruments still present today. In addition to Physics, mathematics and natural sciences were teaching subjects for future priests, a sign of particular attention to the scientific education of seculars. But does this attention to scientific studies in the Bergamo seminary have more ancient origins? To hypothesize an answer to the question, let's consider that among the bishops who succeeded one another at the helm of the diocese of Bergamo, mention should

be made of San Gregorio Barbarigo (1625 – 1697), Bishop of Bergamo from 1657 to 1664. The numerous studies that see him as a protagonist especially in relation to his subsequent episcopate in Padua they also highlighted his scientific training and his relationships with eminent personalities in the scientific field of the time. An education which, according to researchers, influenced the determination of the Cursus studiorum of the Paduan Seminary; can we also say this for the Bergamo Seminary?

The two transits of Venus of 1874 and 1882: or *the greatest astronomical events of the 19th century*

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In 2004 and 2012, with the last pair of Venus transits across the Sun, there was a renewed interest in the history of this rare astronomical phenomenon. However, not enough attention was paid to the transits of 1874 and 1882, even though, in 1869, they had been described as *the greatest astronomical event of the century.* Indeed, the two transits of the 19th century represent one of the milestones in the history of astronomy. In fact, they not only made possible to obtain a value for the Earth-Sun distance with an uncertainty of less than 1% (as already requested by Halley in 1716), but also provided an extraordinary opportunity for testing new technologies (such as photographic plates), stimulated the development of new astronomical devices (including Houzeau's heliometer with unequal focal lengths), and facilitated collaboration among European powers and emerging nations such as Brazil, Argentina, and New Zealand. With old challenges such as the black-drop effect, renewed searches for an alleged satellite, and journeys to distant lands from Cape Horn to Hawaii (trough meticulously organized expeditions where nothing was left to chance), the transits of 1874 and 1882 constituted not only a fundamental scientific venture but also a popular event, managing to capture the interest of the general public, and thus contributing in heightening widespread awareness of astronomy. 150 years after the 1874 event, here is their story.

The Lorenzoni-Abetti correspondence: insights into Italian astronomy and social context post-unification

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The friendship between Giuseppe Lorenzoni (1843-1914) and Antonio Abetti (1846-1928) represents one of the most important and enduring relationships in Italian astronomy of the late 19th century. Although they were almost the same age, Abetti always regarded Lorenzoni as his Master, a respect that did not prevent the development of a fruitful scientific collaboration between them. The emotional bond they formed, which extended to their wives and Abetti's children, makes their correspondence one of the most valuable sources for understanding not only Italian astronomy in the period after the unification of Italy but also the social context of its development. This talk will explore the relationship between the two astronomers, with a focus on the previously unseen aspects that emerge from the reading of their correspondence.

Friendly Stilbon, fraudful Hermes. Giovanni Virginio Schiaparelli and the rotation of Mercury

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Starting in 1881, Giovanni Virginio Schiaparelli dedicated himself to the observation of the planet Mercury. Contradicting the results of previous astronomers, who had assigned Mercury a rotation period similar to that of the Earth, Schiaparelli came to the conclusion that the planet's rotation period coincided with the period of its revolution around the Sun; in other words, Schiaparelli became convinced that the planet Mercury was in synchronous rotation, as the Moon is with respect to the Earth. Today we know that this conclusion is incorrect, but Schiaparelli's error persisted for decades, being definitively disproven only in the mid-twentieth century thanks to new observational techniques. In this contribution, we will consider the explanations offered by scholarly literature regarding what might have misled Schiaparelli. While some authors tend to emphasize the difficulties inherent in the observation itself, others stress different, extrinsic factors (for example the fact that Schiaparelli entertained the idea that Mercury could have an atmsophere, and perhaps even living beings dwelling on its surface). Furthermore, an attempt will be made to compare the drawings from Schiaparelli's diaries, preserved in the Historical Archives of the Brera Astronomical Observatory, with the maps obtained in recent years by probes.

Solar storms that enchant and frighten: a historical-artistic journey among the aurorae boreales appeared in the sky of Naples over the last two centuries

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The *aurora borealis*, a name Galileo used for the first time to describe the spectacular luminous phenomenon caused by the collision of electrically charged particles from the Sun and gaseous particles in the Earth's atmosphere, has always fascinated scientists for their multiple shapes and colors. Generally, the auroras are visible in the circumpolar areas at high latitudes, but when solar activity is very intense, the aurora can become visible as far away as Italy.

In this communication, we report observations made from Naples and its surroundings of the aurora borealis of the last two centuries, starting from the one observed in 1737 by Francesco Serao, in his unpublished report, passing through the aurora of 1848 observed and portrayed by Capodimonte Observatory by Salvatore Fergola and described by Patrelli, the director of the Royal Navy Observatory. There will also be no shortage of images of the last Northern Lights of 10 May 2024, visible from the Neapolitan skies.

Section/2:
Dialogue Between History, Teaching and Dissemination in Physics and Astronomy

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Photon or light quantum?

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In Physics teaching practice, terms and concepts are sometimes used without highlighting the historical and epistemological process that generated them and choosing them to identify and explain a particular phenomenon. This also happens with electromagnetic radiation. To support students in understanding it, we tried to adopt a cultural-historical approach that shapes the epistemological process experienced by physicists at the beginning of the 20th century. Linguistic and etymological aspects emerge from the history of Physics and can support culturally and historically integrated teaching. Furthermore, they keep constructing a cultural context to understand the challenges and innovations of quantum electrodynamics.

The Lorentz force and transformations: an example of how the history of physics can simplify teaching

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The Lorentz force, which is the force acting on a moving charge within an electromagnetic field, is generally introduced in secondary school textbooks as an experimental result: its origin is not deeply described since demonstrating it would require a good grasp of differential calculus. However, the dependence of the Lorentz force on the charge's velocity - and therefore on a specific reference frame - leads to conceptual consequences, especially after studying the theory of relativity, which are usually overlooked. Indeed, in a frame of reference moving with the charge itself, where the velocity vector is zero, its origin remains unexplained.
In the same paper where Lorentz derived the expression for the force that bears his name, he also deduced the coordinate transformations that are also named after him. Through these transformations, it is possible to explain in a simple manner the emergence of the force detected by an observer moving with the charge, without resorting to differential calculus.
This paper thus highlights how the historical connection between the Lorentz force and transformations simplifies the explanation of a complex phenomenon, showing how the application of these transformations allows to calculate the electric field that determines the force acting on a moving charge within a magnetic field, even in a frame of reference moving with the charge itself.

From Faraday's candle to today's STEM: some suggestions for teachers

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According to Faraday, there was nothing more instructive than a burning candle for the juvenile audience of his time. This topic can still be educational for our pupils if we actualize some of its phenomena. First, let us expose the flame of a candle to the rays of the sun, or put it in front of the light of a video projector: we will show that on a screen made of a white sheet of paper not only the trace of the convective motions of the air heated by the flame will appear, but also something curiously opaque at the tip of the flame itself: the black smoke that radiates the light. Moreover, let us cut the flame horizontally at different heights by means of a thin wire gauze: we shall see that the flame is hollow and that during combustion a white vapor of melted wax comes out from its interior, while higher up we would get black smoke. Of equal interest in the meantime will be noting the automatic cooling of the outer edges of the candle, the separation of the melted wax from the flame, the necessity of a plaited wick for it to feed by capillarity by drawing from the cup below, the water vapor and carbon dioxide as products of combustion, and the similarity of this to human respiration. Topics, these, that interconnect physics, chemistry, technology and biology as Faraday wanted and are suitable for those among teachers who prefer STEM teaching.

Cultural understanding of physics: quantum mechanics a century later

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In a world where the second quantum revolution drives the study of physics orienting much research toward technological developments, physics courses often focus more on the applied aspects of Quantum Mechanics than on the epistemological ones. This technological shift of goals is quite widespread, and certainly not limited to Quantum Mechanics alone. Indeed, academic proposals to transform courses of Mathematical Analysis into Calculus, to reduce the credits for Analytical Mechanics, or to diminish or abolish courses on Relativity due to their limited practical applications are not uncommon. In many countries, one can even pursue a doctorate without a Master's degree… This trend results in a widespread lack of cultural and historical awareness among students and young graduates in physics. This lack not only hinders a deeper and more meaningful understanding of Quantum Mechanics itself but also provides an inconsistent epistemological framework for physics in general, risking of giving an incorrect image of the nature of science. This presentation will provide elements for discussion on the importance of contextualizing Quantum Mechanics within its cultural and historical environment as an emblematic example of a process aimed at cultivating physicists who are not only experts in a narrow field of research but also aware of the importance of a broader cultural context (at least to manage changes and innovations). In particular, we will discuss some examples of the initiatives by the physics education research group of the University of Milan aimed at fostering a cultural and historical understanding of QM.

Round table on instrumentation

Chair: Oronzo Mauro

Venue: Department of Physics and Astronomy, Garbasso Building, room A

I beni culturali scientifici: diritto e misure (Gloria Mancini Palamoni, UNICAM -Scuola di Diritto, Diritto dei Beni Culturali).
Collezioni private e collezioni pubbliche: limiti e opportunità.
Il restauro dei beni culturali scientifici privati: dal fai da te al professionista.
Il mercato della strumentaria: tra scuole trafugate e aste internazionali.
Azioni, raccomandazioni, comunicazione, proposte.

Visit to the Research Institutes located on the Arcetri hill

20 September

Section: *Museums, Archives, and Scientific Collections of Physics and Astronomy in Italy and Abroad*

Venue: Department of Physics and Astronomy, Garbasso Building, room A

The Mathematisch-Physikalischer Salon in Dresden. A princely collection of scientific instruments

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Since 1728, one of the world's leading collection of historical scientific and philosophical instruments, clocks and watches, and globes is housed in the famous Zwinger Building in Dresden, capital of Saxony. The "Mathematisch-Physikalischer Salon" was founded under August the Strong, Elector of Saxony and King in Poland, and is running back to the 16th century "Kunstkammer" in the residential palace. The exhibits are outstanding examples of finely crafted scientific instruments and devices.

Il Museo Enrico Fermi di Roma apre le porte ai più giovani: metodi e strumenti per raccontare la scienza alle nuove generazioni

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In un'epoca in cui la scienza rappresenta la cultura egemone, ma non la più diffusa e condivisa, è indispensabile ripensare al tema dell'educazione scientifica, declinata nei contesti di apprendimento formali, non formali ed informali. All'interno di questa cornice di riferimento, i musei si configurano come istituzioni particolarmente impegnate nel coinvolgimento del pubblico, offrendo attività educative sempre più diversificate ed individualizzate. In questo contesto si inserisce la mission portata avanti dal Museo Enrico Fermi di Roma che si impegna ad educare i più giovani alla scienza ed al patrimonio scientifico, cercando di incuriosirli, coinvolgerli e stupirli. Con tale intento, sono stati portati avanti due progetti didattici rivolti rispettivamente alla scuola secondaria di primo grado ed alla scuola primaria. Pertanto, si presentano nel dettaglio i vari strumenti, le tecniche ed i materiali messi in campo per trattare argomenti legati all'affascinante mondo della fisica con un pubblico poco avvezzo a questa disciplina. Partendo dalla storia di Enrico Fermi e dei celebri ragazzi di via Panisperna, sono stati pensati due percorsi ad hoc per i differenti target fissati.

Il Mondo in Tasca MUMEC Museum celebrations 2024

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Specifically for the year 2024, the MUMEC Museo dei Mezzi di Comunicazione in Arezzo proposes a calendar of events entirely dedicated to the history of telecommunications to celebrate a series of fundamental anniversaries: - 150 years since the birth of Guglielmo Marconi - 100 years of broadcasting in Italy - 70 years of Rai Italian radio-television
The exhibition *Il Mondo in Tasca* will be the protagonist of the year. It testifies how technology has brought a constant and widespread ease of information. *L'ha detto la Radio* was the key phrase of the years of large-scale diffusion of the radio, which first established itself as the absolute protagonist in the dissemination of information. It has always been considered the voice of truth, and with time, will be joined by TV and online information.
The exhibition - open until February 2025, will feature original equipment recalling the early successes of Marconi, the inventor of Radio, from 1895 onward. They will be followed by vintage apparatus from the early 1920s (the beginning of Italian radio) and later eras up to pocket transistors as evidence of the constant miniaturization of technology. The novel bust of Marconi, made around 1930 by the Turin sculptor Giuseppe Bottinelli, will be exposed.
The volume of over 350 pages *Il Mondo in Tasca*, written by Prof. Fausto Casi, Founder and Scientific Curator of the MUMEC, and a bronze medal, celebrating all the above-mentioned events, created specifically by the Arezzo sculptor Enzo Scatragli, are the spearheads of the celebrations in Arezzo.

The Archimedes Institute for the manufacture of scientific-educational materials: the role of school museums in tracing the history of disciplines

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The Museo della Scuola e dell'Educazione "Mauro Laeng" of the Università degli Studi Roma Tre (MuSEd), established in 1874, is Italy's oldest museum dedicated to the history of pedagogy and education. Preserved at the museum are a few instruments for the teaching of physics originally manufactured by the Archimedes Institute in Rome. The scientific instruments were produced in the early 20th century and were used in the Physics Laboratory of the normal school at the Conservatorio della Divina Provvidenza in Via di Ripetta, Rome. Archival investigation, currently still in progress, has uncovered an intense debate, beginning in 1916, around the national manufacture of teaching aids in the scientific field, a debate characterized by deep discontent related to dependence on foreign manufacturing, mainly German, and the celebration of Italian potential in manufacturing which led to the foundation of an Institute for the manufacture of teaching aids in Rome. Characteristic of these exchanges is a letter by Prof. Quirino Majorana, dated Turin, October 1919, praising the initiative: "And I, on my own part, place my modest contribute at the disposition of its [Archimedes Institute NDR] management, committing myself to give all the suggestions that will be requested of me". This research aims to illustrate how even a small number of scientific instruments can be a significant asset for a museum dedicated to the history of education such as MuSEd.

Gli incunaboli e le cinquecentine dell'INAF: un catalogo a stampa per scoprire il patrimonio bibliografico antico degli Osservatori italiani

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Ad aprile 2024 è stato pubblicato dalla casa editrice Leo S. Olschki, nella collana Biblioteca di Bibliografia, un catalogo che raccoglie le edizioni a stampa del XV e XVI secolo conservate nelle biblioteche degli Osservatori astronomici e astrofisici italiani. Si tratta del primo catalogo collettivo scientifico prodotto dall'Istituto Nazionale di Astrofisica, frutto di un lungo e intenso lavoro realizzato grazie al supporto del Servizio Biblioteche, Musei e Terza Missione e della comunità bibliotecaria afferente. A una iniziale attività di censimento, compiuta nel biennio 2015-2016, che ha portato alla luce un numero pressoché elevato e sconosciuto di edizioni cinquecentesche, è seguito il lavoro di catalogazione, digitalizzazione e fruizione del materiale attraverso il portale dell'INAF "Polvere di stelle. I beni culturali dell'astronomia italiana". Il catalogo rappresenta l'ultimo tassello di un'operazione di analisi e studio di 227 edizioni scientifiche pubblicate tra il 1478 e il 1560 che consente di approfondire tematiche disciplinari differenti riguardanti la storia dell'astronomia ma anche la storia della tipografia e della circolazione del libro. Un patrimonio poco conosciuto ma di grande interesse che merita attenzione particolare sia da parte degli specialisti del libro antico che degli studiosi di astronomia.

The astronomy books of the former Istituto Tecnico of Florence

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The history of the *Istituto Tecnico* begins in 1850, when the Grand Duke Leopold II of Tuscany decided to separate the Terza classe from the existing *Accademia delle Belle Arti*. The new school was endowed with valuable collections and a rich library which was to be enriched with new acquisitions and donations throughout the life of the *Istituto*. It contained publications representative of the Italian and European technical and scientific knowledge of the nineteenth century, especially in the disciplines corresponding to the subjects taught. Because of its quality, the Library soon became a reference point for the training and updating of teachers. Alongside the book holdings, a copious collection of Italian and foreign periodicals was created, a fact that testifies to the cosmopolitan culture of the *Istituto* and to commitment to being part of a network that was soon to become supranational in nature. In the original core of the Library, there was no lack of publications from the 16th, 17th and 18th centuries that served to document the evolution of scientific thought. The collection of ancient books, strongly supported by Filippo Corridi (1806-1877), the first director of the Istituto, is now kept in the *Museo della Fondazione Scienza e Tecnica*, together with the Physics and Natural Sciences collections. The *corpus* of works on astronomy is particularly significant, including those by Aristarchus of Samos in the 1572 edition by Federico Commandino (1509-1575), Christen Sørensen Longomontanus (1562-1647), Carlo Antonio Manzini (1600-1677), Isaac Newton (1642-1726), John Keill (1671-1721), Ruđer Josip Bošković (1711-1787).

Le città del tempo delle Marche

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Nel 2014 a Montefiore dell'Aso (AP) venne fondato il Museo dell'Orologio con l'intento di tutelare e valorizzare il tempo. Nel corso degli anni, il museo ha sempre più offerto al territorio marchigiano supporto in materia di tutela e valorizzazione del tempo fino a creare una vera e propria rete territoriale estesa su tutte le province del territorio marchigiano. Nel contributo si parla di questa esperienza di *museo del tempo* distribuita su un territorio di oltre 1 milione di abitanti.

Section: *History of Physics and Astronomy (until 19th century)*

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Astronomical sciences and scientific diplomacy: Giuseppe Lorenzoni (1843-1914) and the International Geodesic Association during the second half of the 19th Century

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The director of Padua's Specola from 1878 to 1913, Giuseppe Lorenzoni (1843-1914) became a "full member" of the Italian geodetic commission in June 1873. His meticulous archives allow us to reconstruct the participation of the Regno d'Italia in the operations of "measuring of the European degrees".
What did "geodesic practice" consist of in the second half of the 19th Century?
In this lecture, after recalling some of the major debates that led, in Europe, to the creation of the Mitteleuropäischen Gradmessung in 1864, I will present Lorenzoni papers from which we can understand how he fitted into the major European geodesic operations. A story that illustrates what geodesy was in the second half of the 19th Century and the inextricable links between astronomical sciences and scientific diplomacy.

Trade and trust in watch precision: count Hans-Moritz de Brühl and the lever chronometer

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Between 1782 and 1794, the London workshop of Swiss-born watchmaker Josiah Emery manufactured some forty pocket chronometers equipped with the lever escapement designed by Thomas Mudge. According to contemporaries, these watches were the most accurate on the

market. Although they were the result of technical research that accompanied the emergence of marine chronometry in the second half of the 18th century, they were primarily intended for geodesy surveying. Their very high price severely limited their distribution within the scientific community: these timepieces were mainly owned by wealthy amateurs and a handful of astronomers. A few scientists took on the task of promoting, selling and testing Emery watches in Europe, including Italy. Our paper will focus on the most important of them, Count Hans-Moritz de Brühl, ambassador to the Saxon court in London. A leading figure in the London horological and astronomical world, the nobleman acted as Emery main go-between. To analyse his fundamental role, we will refer to the nobleman's scientific correspondence, which is held in the National Records of Scotland. Emery timepieces benefited from de Brühl's money, network and intuition, as he realized the advantage of miniaturizing the lever escapement, that its designer had destined to disappear. By keeping Mudge's invention alive, Emery chronometers constitued the very first stage in the triumph of an innovation that would deeply mark the history of watchmaking forever more. From the second half of the 19th century, the lever escapement became the industry standard, and its monopoly is still indisputable today.

The Italian Society of Sciences known as the Society of XL in Modena in the late 18th and 19th centuries

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Through the analysis of an unpublished manuscript, "History of the Italian Society of Sciences residing in Modena" conserved in Modena, Biblioteca Estense Universitaria, written by the librarian Antonio Lombardi (1768-1847), we propose to remember the Society history for the period in which it was based in the capital of the Estense Duchy, having Modena professors as presidents. The Society, also known as the Society of the XL, was created in 1782 by Antonio Maria Lorgna (1735-1796) in Verona: when in 1796, he was succeeded by Antonio Cagnoli (1743-1816), an astronomer and professor of mathematical analysis at the Military School, in accordance with statutory regulations, the seat was transferred to Modena. Lombardi's history ended in 1847, when he died, although the last president, the physicist Stefano Marianini (1790-1866), professor at the Modena University, remained in office after the fall of the Austro-Estense Duchy in 1859 until 1875 when the Society was definitively transferred to Rome. After the Restoration, Paolo Ruffini (1765-1822), a mathematician and physician from Modena University, new president elected in July 1816, succeeded in obtaining from Duke Francis IV (1779-1846) financial means for Society functioning. When he died in 1822, Luigi Rangoni (1775-1844), Minister of the Interior and financier of the Society, took over as president and remained in charge until his death in 1844. He located the headquarters in his palace in via Farini in Modena where he also placed the Social Library formed by exchanging volumes of the Memoirs published by the Society. Marianini was his successor.

Conclusions

Venue: Department of Physics and Astronomy, Garbasso Building, room A

Congress closing, acknowledgments and goodbye to the XLV SISFA National Congress.