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Memorie della

Francesco's legacy in education and outreach

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Abstract. Francesco has always been keen on sharing scientific knowledge with the public, in schools and in public events. We recall some aspects of Francesco's outreach activity in the later years and highlight his legacy in this field.

1. Introduction

Besides being a renowned researcher and university professor, Francesco was really passionate about sharing scientific knowledge with the public, coherently with his view of science as part of the broader human culture. Everyone who witnessed a public conference delivered by Francesco knows how talented he was, and speaking of all of his important contributions in this area would require too many pages. Hence we shall concentrate on the later years only, considering first his activity related to schools, and later the outreach activity for the general public.

2. Education

Francesco has carried out several activities in schools with the collaboration of his colleagues at the Arcetri Observatory:

- specific courses for students;
- diffusion of the most recent results of scientific research;
- exchange of experiences between university and school teachers;
- experimentation and development of new teaching methods;
- support in finding of both national and European funding, in order to improve and enhance the scientific equipment available in schools, and to develop specific projects in the field of astronomy.

In recent years, a number of secondary schools in the Florence area have been involved in these activities, mainly, but not only, Licei specialising in scientific studies. Structured courses in astronomy, as well as specialised seminars on specific astronomical topics, have been held by university professors and researchers. Besides, some important projects were devoted to the training and the updating of secondary school teachers. Some examples are described here.

2.1. *"Astronomy from four perspectives" (2013–2016)*

This project was developed in the framework of a bi–national collaboration between Italy and Germany. It was organized by two Italian universities (Florence and Padua) and two German ones (Heidelberg and Jena), with the financial support of the "Wilhelm and Else Heraeus Foundation", a German non–profit foundation committed to promote research and training in the natural sciences, particularly physics. The project was addressed to high–school teachers and teacher students in astronomy and physics, and it was a sort of frontier crossing in several respects. It included conventional elements, but, in addition, it led to a horizontal exchange between participants from different countries and cultural areas, and to a vertical exchange between participants in different phases of their teacher education or professional life. All members were exposed to precious experiences and a broadened view on their tasks in practical school teaching and academic education.

The program consisted in a 4–year cyclical series of training seminars, each year focused on a different subject area in astronomy and astrophysics. Participants attended a number of seminars locally at their seat, followed by a 7-day final meeting in summer, held in rotation at one of the four organizing nodes, according to the specific expertise of each University:

2013 – Cosmology: University of Heidelberg;
2014 – Active Galactic Nuclei (AGN): University of Padua;
2015 – Gravitational Wave Astronomy: University of Jena;
2016 – Birth of Stars and Planetary Systems: University of Florence.

A number of 15 members for each node attended the four final meetings.

Due to his long–term experience in research and teaching, Francesco was one of the leading promoters of this international project. He both followed all the organizational phases and took part as a lecturer in several seminars as well as in the annual meetings.

As a consequence of the great success of this first 4 year project, a second edition is in progress.

2.2. "Light from stars" (2014–2016)

In 2014 the ISIS "Gobetti – Volta" (Bagno a Ripoli – Florence), the Liceo Scientifico "L. Da Vinci" (Florence) and the Department of Physics and Astronomy of the University of Florence, with the essential cooperation of the Arcetri Astrophysical Observatory (INAF), developed a two–year joint project aimed at introducing secondary school students of the last two years to the fundamentals of photometric and spectroscopic analysis applied to astronomy. The project exploited innovative teaching methodologies, involving both school and university expertise, and, for this reason, was co–founded by the Italian Ministry of Education (MIUR) as *"initiative for the diffusion of the scientific culture"* (project PANN14T2–00906).

The main phases of this project consisted in:

- a basic theoretical course on photometry and spectroscopy, with applications to astrophysical investigation and research;
- observational stages at some Italian observatories (Arcetri, Loiano, Asiago);
- experiences of Virtual Observatory (VO) at school, exploiting public astronomical databases available online; this phase required also a specific training of school teachers by university researchers;
- purchase and development of scientific equipment suitable for school laboratories (portable telescopes, spectrometers, digital cameras,...).

Furthermore, during this project, a group of students from the ISIS "Gobetti–Volta" had the opportunity of visiting the astronomical site of La Palma (Canary Islands, Spain) and the Italian "Telescopio Nazionale Galileo (TNG)" facilities, interacting with the research staff working there (Fig. 1). The visit was organized with the crucial support of Francesco, who unexpectedly departed just a few weeks before it took place.

Fig. 1. "Gobetti–Volta" students visiting the TNG site (April 2016).

2.3. "Astronomy" as a school subject

Trying to carry on Francesco's example and heritage, the ISIS "Gobetti–Volta" has set up a school project which introduces "astronomy" as an optional curricular subject in its Liceo Scientifico, from School Year 2017/2018 on. Students attending such classes are going to follow a 60–hour per year course, for the whole 5–year secondary school duration, which will deal with the study of astronomy from a multi-disciplinary point of view, considering its several cultural aspects.

As a consequence, the scientific and technical approach to the subject, traditionally followed in both Natural Science and Physics study plan, will be placed side by side to modules of Italian and international literature, as well as Latin, History, Philosophy, History of Art, concerning astronomical subjects. The role of English as the communication language in modern science will be highlighted, too. Additionally, extensive experimental activities will be carried out outside school at several astronomical and observation sites, with the help of professors and researchers of the University of Florence and the Arcetri Observatory, who will also support school teachers in their educational work.

This project has a twofold aim. First of all to arouse the students' interest increasing their preparation in scientific subjects, in particular in astronomy and astrophysics, in order to support those who wish to continue their university studies in these fields. Last, but not least, to enhance the overall cultural preparation of students, and, consequently, to develop their critical abilities and skills in any branch of knowledge. The last one, in particular, represented a key point in Francesco's commitment in schools, and not only, considering his perspective of astronomy as one of the fundamental components of human culture.

3. Public outreach

Speaking of Francesco's contributions to public outreach in the later years, a remarkable event we can start with is the end of the world. More precisely, the would-be-end-of-the-world as predicted by the Maya prophecy to occur on 12-21-2012. On that (cold and wet) night Francesco invited the public to the terrace of the Arcetri observatory to discuss together with the astronomers about the possible ways the world could really end, astronomically speaking. The observatory was so crowded that people had to be rejected at the doors, and incidentally the world did not end. A successful outreach event requires both ideas and organization: one of the main teachings by Francesco was that outreach, just like scientific research, is a collective endeavour and talent alone is not sufficient, you need good organization too. To this end, Francesco was one of the promoters of the Associazione Astronomica Amici di Arcetri (AAAA, or the four A's), where Arcetri researchers and staff, University professors and other people interested in science communication gathered and that managed the outreach activity of the Arcetri observatory in the last decade. Francesco soon became not only the president, but the heart and soul of AAAA. The four A's are one of the many things that Francesco left us to take care of and grow.

3.1. The Sky Theatre

The natural arena of AAAA activities has been the Teatro del Cielo (the Sky Theatre), a Greek-style theatre carved into the the south face of the Arcetri hill, close to the historical Amici telescope dome, between the solar tower and the main building of the observatory. Built in

2009 under the direction of Franco Pacini, the theatre has since then witnessed hundreds of public events, and thanks to Francesco's impulse it has become a pace where science literally goes on stage and is shared with the public, especially during the Notti d'Estate ad Arcetri, a science festival running every summer where a scientific show or conference or science-related performance is offered to the public twice a week, followed by observations of the night sky hosted by Arcetri researchers.

Francesco has contributed with many conferences to the Notti d'Estate. One of them is worth recalling: it was about exoplanets and especially Earth-like ones, being entitled "Earths 2.0". The point we want to remember is not the conference itself, that was brilliant and entertaining as usual, but rather its incipit. Francesco had left on each theatre seat a printed map of the sky visible on that night to the naked eye. On the map, some of the stars were circled, and Francesco began his talk by asking the public to look at the sky and identify the circled stars: "Those stars you are looking at, they have planets circling around them". A simple handwritten circle on a printed map hooked the public more than any special visual effect could ever do. Human aspects are essential in science communication, and this special talent of Francesco to catch the people's attention came from his curiosity for culture as a whole, and for the human aspects of the scientific enterprise, starting with the awe and wonder for the beauty of Nature that led him and all of us to study it and to share this knowledge with our fellow citizens, being them school pupils or adults or retired elders.

3.2. Einstein's piano

Something that exemplifies Francesco's love for science as part of broader culture is the story of "Einstein's piano". The Blüthner piano we are speaking of was built in Leipzig at the beginning of the XXth century and acquired by Albert Einstein as a gift for his sister Maja who lived near Florence. Maja loved to play the piano together with his friend the painter Hans-Joachim Staude, so that the piano was left in the Staude house when Maja went to Princeton soon before World War II, to reach his brother and escape from the racial persecution of the Italian Fascist regime. Maja hoped to to Florence to get her piano back after the war, but she never returned from Princeton and the piano remained with the Staude family after having witnessed the tragedy of the Italian branch of the Einstein family, that was brutally exterminated by the Nazi troops while retreating to the North, as depicted in Lorenza Mazzetti's memoir "Il cielo cade" (Mazzetti 1961). The piano was later discovered by Francesco in the Staude house near Florence, that had been since inherited by his friend and fellow astronomer Jakob Staude, son of Hans-Joachim. After listening to the story of this instrument, Francesco started to research and fill out the details and then to tell this story in Italy and around the world, mixing this moving human story with Einstein's science and dragging the public into a voyage through history, science, and culture as a whole (Palla 1998). Thanks to the will of the Staude family and the effort of the Arcetri observatory and especially of its current director Filippo Mannucci, the Einstein piano has been restored and now sits in the Arcetri library being regularly played in public concerts. It is one of the last gifts Francesco has left to all of us.

The very last of Francesco's gifts to the public, and especially to the youngsters, is a marvelous small book, entitled "L'Universo del Piccolo Principe" (The Little Prince's Universe), where the wonders of the sky are told starting from one of the funniest chacarters of Antonine de Saint-Exupéry's book, the Turk astronomer. The book is enriched by the original illustrations by Francesco's wife, Sylvie Duvernoy. The book is not for sale online or at booksellers but can be requested to the Arcetri observatory.

References

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