Mem. S.A.It. Suppl. Vol. 5, 432

Memorie della
Supplementi

Laboratories for EPO in Astronomy

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Abstract. I discuss here the role, the relevance and the state-of-the-art of the Italian laboratories for Education & Public Outreach (EPO) in Astronomy.

Key words. Education and Public Outreach – Astronomy

1. The challenges of astronomy

Astronomy is a science which always bet on big technological and theoretical challenges. Examples of such cultural attitude are the projects of new ground based observatories (e.g., the 100 m. telescope OWL) and next generation space experiments (e.g., XEUS, LISA) and the theoretical challenges of understanding the physics of the primordial universe and/or the nature of its dominant components (Dark Matter and Dark Energy). The boundary conditions of the field in which Astronomy fight its challenges are, however, equally pressing: i) the surviving and development of research institutes; ii) the impact of Astronomy on the global structure of our Society; iii) the links of Astronomy with the cultural, social and political tissues. I believe that these last aspects are so important that they require a specific attention from the scientific community.

2. Research and outreach

We are all in the gutter, but some of us are looking at the stars (O. Wilde).

There are questions which emerge from the previously outlined context. Why research in Astronomy should receive attention in the complex economic and social context of the European countries (and specifically of Italy)? Why Astronomy should be considered a Big Science with big projects? Why young researchers should invest their life in Astronomy and scientific research? There are certainly many and valid motivations which answer the previous questions, including D. MacSmith's consideration that *"... strong countries always had a strong body of scientific research with a substantial development ..."*. Italy certainly aims to invest its own human, technological and scientific resources along this direction. However, we cannot think to realize big projects (both technological and cultural) without involving large parts of the world of Media, Politics, Economy and Culture. Many questions remain, nonetheless, on this point, and in particular that concerning the role and involvement of the "Public" (tax payer) which has to fund - eventually - Science in modern societies. *"If the layman does not understand what he is paying for or, even worse, if he lives in the worry of the consequences deriving from Science funding, the future of Science remains fragile"*. (Dunbar, 1996). It's a problem re-

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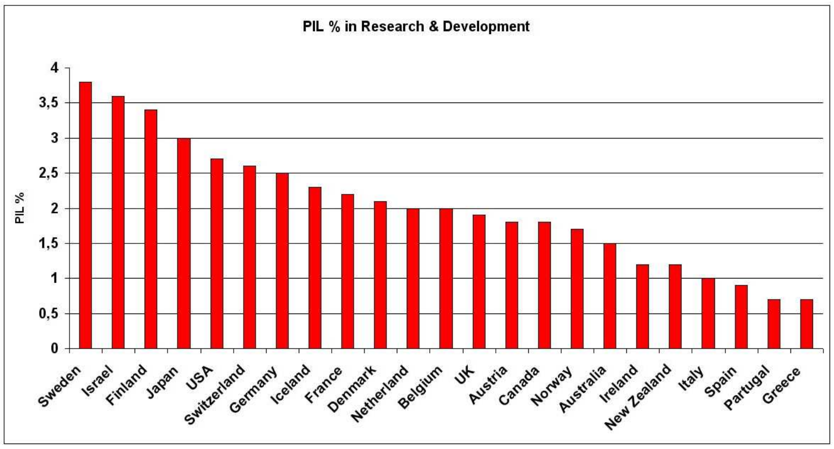

Fig. 1. The distribution of the 2003 PIL fraction which goes into research and technology for the 20 more developed countries. Data from United Nation Organization.

lated to communication. This, hence, calls for a strong EPO activity.

Astronomy has an immediate and strong impact as well as a natural communication channel with the public. There are, however, different points of view:

• an optimistic approach which sounds: no problem. The interest for Astronomy will never die. *"Among sciences, Astronomy is certainly easier to communicate w.r.t., e.g., particle physics, which requires to understand concepts which are often very complex. Stars are part of our everyday life and it is simpler to explain the principles of physics starting from examples of everyday's life. Astronomy is also very attractive for non-experts which are interested from the history, the origin and the destiny of our universe. People, in fact, are not only interested in practical aspects of research, but they want to know how the world works, because this means to know more about our own origin"* (Hack, 2003).

• a pragmatic approach which suggests: some problem is there, but it'll be enough to change some wheels and things will start to work better. *"Apart from all the problems which Italian research has, there is an increasing interest in it. This is proved by the success of dedicated magazines and by the EPO initiatives... We (*the astronomers*) are lucky. Our activity is spectacular. It is a pity that only the politicians have not yet realized the passion that science rises and its importance for the future of the country"* (Pacini 2003).

• a fideistic approach, which indicates: we believe in Science but we don't know it. *"Science and its mother (and not daughter) which is technology is our world, as it was mythology for the Greeks, theology in the Mid Ages, humanism in the Renaissance, rationality for the illuminists. But with a difference: Greeks knew myths, Medievals covered arts and literature with sacrality, while we "believe" in Science, we use its discoveries and results, but we don't know it. We live in the age of techno-science not with our knowledge, but with our faith"* (Galimberti 2003).

• a skeptical approach, which warns: scientists are fascinating neighborhoods... but we don't know what they are doing. *"Science and technology are an indispensable cultural reference, a food for our curiosity and for the imaginary. Scientists are like unknown neighborhoods, which do strange things, but they fascinate and thrill us"* (DelGiudice 2003).

3. The trouble of EPO

The various changes in the scientific attitude and the enormous increase of scientific knowledge have made more difficult to illustrate to non-experts why astrophysicists are inter-

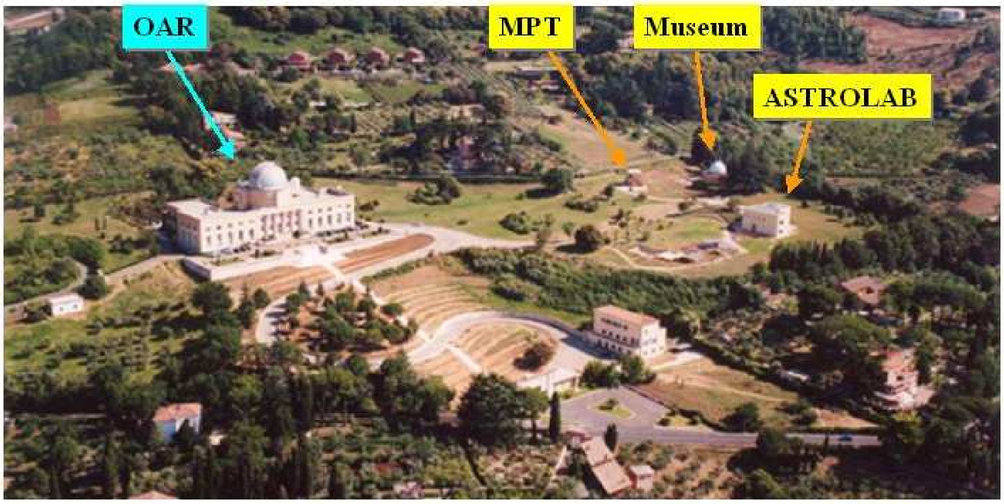

Fig. 2. The Astronomical Park at the Rome Observatory (OAR) in Monteporzio. The various labs. for EPO (MPT, ASTROLAB, Historical Museum) are indicated together with the main building of the OAR.

ested in, e.g., Supernovae or in Dark Matter. Moreover, since mathematics became an essential component of scientific description, Science became difficult to understand for everyone who is not an expert. The trouble of science communication is that in front of the fundamental questions posed by our attempt to understand the universe, the layman often remains confused and the professional scientist sometimes remains silently abashed. The risks deriving from this situation are that, on one side, the scientist looses interest (or gets bored) in EPO and, on the other side, that generic, popular magazines (inevitably profit oriented) proliferate. A consequence is that Science often appears in the media as a distorted, sensational register (information market). It should be also noticed, nonetheless, that there is still a scarce attitude to appraise correctly the role of EPO in the scientific community: this happens both at the individual and at the institutional levels. In conclusion, the bigger risk related to the lack or superficiality of the EPO activities is that of throwing a bad light on the professional scientific activity.

It is clear today that *"the strategic factor of capital production is knowledge. The true richness of modern enterprises consists of intangible goods: competence, data, historical memory, strategy, Knowledge! Knowledge must be first acknowledged and then boosted and shared. Not a easy task when traditional methods of organization, planning and management are still used, methods which are now obsolete since the advent of the global market"* (Stewart 2002). In such a context, *"scientific information is essential, not only for the scientists. Politicians, business men and the gen-*

eral public need it. Those who work in business discover that neither media nor press provide the necessary data. Generic information are no longer sufficient and specific information are manageable only from the experts. Who will fill the gap?" (Groen et al. 1990).
I believe that an effective strategy to tackle this challenge is the one in which the scientist enters as the principal subject of the outreach and communication to the public of his own professional activity. Such an attitude can provide the scientist, ultimately, with practical tools to ensure his future.

4. Laboratories for EPO in Astronomy: the case of Italy

There are various approaches/tools to Astronomy EPO in Italy: Planetariums, Museums, Didactics, WEB, Laboratories, and outreach activities linked to specific events (e.g., the Venus Transit 2004, *www.passaggiodivenere.it*). In the following, I will discuss specifically the issue of outreach in laboratories for astronomy.
Didactical telescopes. The representative laboratory in Astronomy is the telescope. However, this instrument does not provide a specific characterization of the lab. In fact, each INAF (*www.inaf.it*) institution has a didactical telescope, as well as many cultural and amateur associations. What an astronomer working in a scientific institution can further offer? The scientist can provide the contact with a professional research environment, an exposure to the subjects and techniques of modern research, a travel through multi-wavelength astronomy. In such a context, the visitor is able to step up towards the Sky taking advantage of both the telescope and the assistance of a competent guide. A typical example of the success of this activity is offered by the case of the MPT at the Rome Astronomical Observatory (OAR) (*http://diva.mporzio.astro.it/webdiva/*).
Laboratories for didactics. Several experiences exist in this field within the INAF institutions. Some of them also provide links to international projects (e.g., EAAE and Physics on Stage at the Padua observatory). There are also didactical collaboration between INAF institutions and amateur associations (see, e.g., the case of the Turin observatory). Dedicated publications are also edited by single institutions (see, e.g., the review "Leggere il Cielo" by the Bologna obaservatory) and by the Italian Astronomical Society (SAIt).
Virtual laboratories. There are not yet systematic experiences in Italy of virtual laboratories dedicated to Astronomy, at least of the level of those existing in the international context (see, e.g., the Exploratorium in S.Francisco, the Kelly McLarnon and Quia Corporation virtual labs.). However, similar activities are being explored in various INAF institutions.
Hands-on laboratories. In the recent past the concept of "hands-on" labs has been developed in the context of the Italian EPO activity. Such labs originate in Science Centers and are strictly related to the presence of exhibits. They provide an interactive approach and require large space and investments. Nonetheless, these interactive labs are the fundamental showcase for the outreach process. In many cases, they are also sites where new educational projects are experimented.
A recent survey shows the presence of similar labs (even with small dimensions) in various INAF institutions (Trieste, Milan, Padua, Florence, Rome, Naples). There are also educational labs with partial interest for outreach in Astronomy also in private institutions (Trieste, Trento, the Alessandria Planetarium, the Museo del Cielo e della Terra in S.Giovanni in Persiceto, the Cittá della Scienza in Naples). There are, finally, recent projects of new hands-on labs, some of which have been already funded, like the Museo dello Spazio in Turin.

4.1. The DIVA experience

A recent EPO project in Astronomy which makes extensive use of multi-media/interactive labs and is managed by a research staff is the DIVA project (*http://diva.mporzio.astro.it/webdiva/*) at the OAR (Fig.2. See Colafrancesco 2004 for a detailed presentation of DIVA). The operational structure of DIVA provides a scientific super-

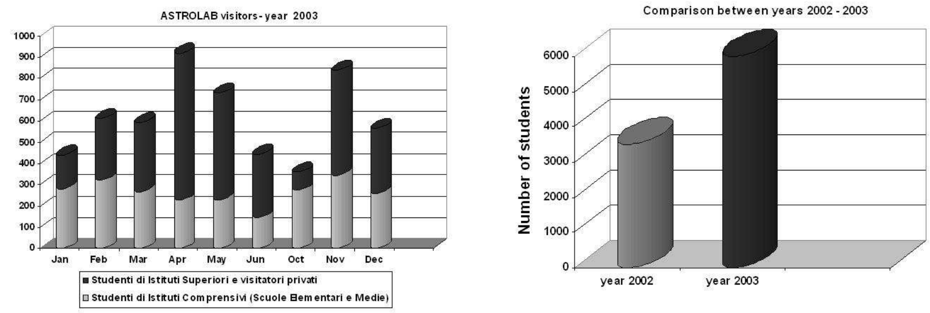

Fig. 3. Left panel: total number of visitors to the ASTROLAB for the 2002. Right panel: comparison between the ASTROLAB visitor number in the years 2002 and 2003.

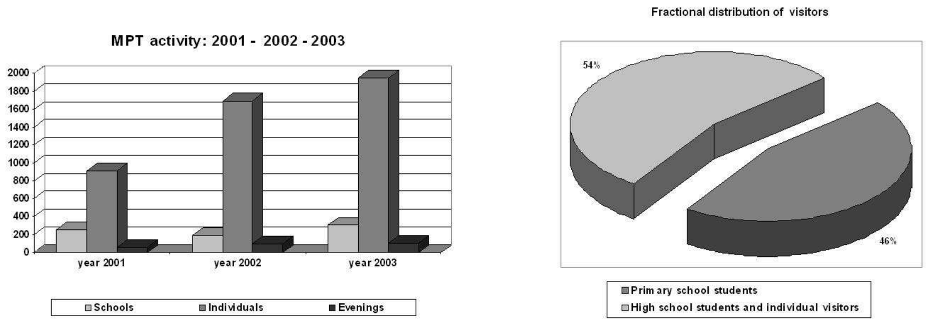

Fig. 4. Left panel: comparison of the visits to the MPT for the years 2001-2003. Right panel: the distribution of the overall visitors to the DIVA activities for the year 2003.

vision and control of all the EPO projects. This is ahead of two structures for the technical supervision and operational control of all the DIVA activities.
The tools of DIVA are:
ASTROLAB: this lab has been widely recognized as a frontier educational tool whose aim is to introduce Astrophysics to the general public. It uses interactivity and multimediality as the keys to immediately capture the attention of the visitor. ASTROLAB is divided in four rooms equipped with tens of exhibits, interactive stands and discussion points.
MPT: the MPT represents a unique opportunity to the general public to become acquainted with a real astronomical observation run, due to its technical equipment (a MEADE LX200, 12" aperture telescope, equipped with a movie camera and a CCD camera). **WEB site**: the importance of Internet as a tool reaching a large number of people interested in Astronomy carries out the needs to provide a website capable of describing the various activities, to show the permanent structures, to announce the special events, to provide an efficient tool to contact the DIVA staff and to manage the booking activity.
Historical Museum: the pre-existing Museum is being renewed to be presented as a dynamic open space which can provide a large cross-section between the historical perspective and the modern techniques of multimediality ad interactivity.

The guidelines for the DIVA activity are: outreach strictly linked to scientific production; international competition; professional scientific communication; socially-oriented scientific communication; acquisition of semiologycal perspective in science communication; global management of the EPO activity. Such guidelines produced our own "behaviour manual" for the construction of an effective dialogue between scientists and the Public. This can be summarized by some general keywords: i) it's wise to know what one is talking about; ii) not everything which is obscure is necessary deep; iii) Science is not a textbook iv) do not imitate the scientist dialogue; v) be careful with the authority principle; vi) do not confuse specific scepticism with radical scepticism; vii) avoid ambiguity as an axpedient to the lack of clarity. A tomography of the DIVA's public is shown in Figs.3-4. These data indicate an increasing interest in our activities. About 80% of the visitors belongs to school groups with a substantial fraction (61.7 %) of high-school classes which find here unique opportunities to get closer to professional scientists. The remaining 20% of the visitors consists of individuals with a general scientific education whose aim is to increase their specific knowledge in Astronomy. A similar results holds for the MPT activity (Fig.4). DIVA activities have a strong impact onto the general social environment as well as on the Media world, and a strong link with School and University, with the national scientific environment (e.g., INAF, INFN), with international research institutions (e.g., CERN, CNRS). The link with University has always been nourished through two main channels: i) the presence of degree students as guides for the DIVA activities, and ii) the characterization of DIVA as a Lab course at the University of Rome "Tor Vergata".

4.2. Which future for DIVA?

In conclusion, we can safely say that the social impact of DIVA is quite strong. A similar result is found considering the impact of DIVA activity on the Media. The impact on the scientific comunity is still to be completely decoded, even though some encouraging examples already exist. However, it still remains the need to develop synergies among the institutions which have a strong tradition in EPO activities (e.g., ESO, NASA, CERN) for the exchange of educational experience and strategies. We harbor, for the future, the ambition to develop and configure scientific outreach as a relevant aspect of scientific research in Astronomy.

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