

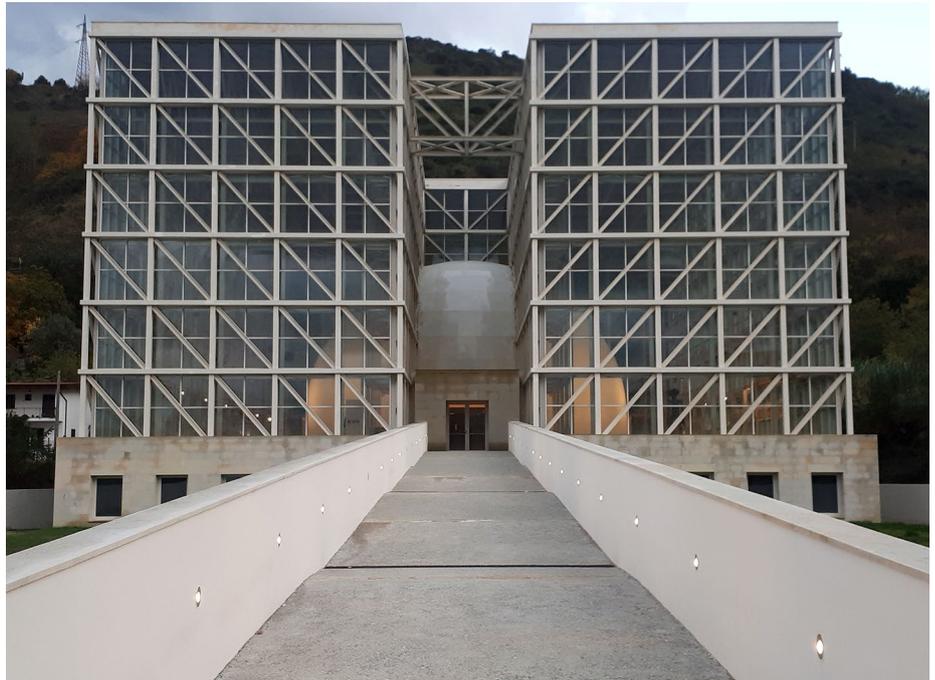
A bridge between research, education and communication

To the Editor — Efforts in education and public outreach are broadly recognized as being necessary to promote both scientific literacy in society and inclusivity and equal opportunities in science^{1,2}. Recent research³ has shown that astronomers are highly active in outreach and this participation is mostly at the level of the individual astronomer, with one-way forms of communication, and can be enhanced by a favourable institutional context. Our institutional efforts go in the direction of creating such a favourable environment that requires and at the same time facilitates a large involvement of researchers. We adopt a participatory approach, which includes forms of two-way communication, that allows outreach to evolve towards forms of public engagement that provide both researchers and the public with opportunities for mutual learning.

The opening of a planetarium in the town of Cosenza offered us the opportunity to implement a very simple idea of management that meets the above requirements: the local government and the nearby University of Calabria developed an institutional collaboration, so that the interactions of the planetarium with schools are entirely conducted by PhD students of the university's Department of Physics, under the supervision of senior scientists.

Young researchers practice outreach less than senior scientists³, but there is evidence that these programmes are much more successful when young graduate students and postdocs are actively involved⁴⁻⁷. Therefore, following our previous experiences^{5,6}, we involved graduate students in the management of the planetarium. Their role is to provide school pupils of all ages with an engaging interaction through the story-telling of research topics actually studied by our research groups. The lectures on offer range from Sun–Earth interaction and space weather, space physics, exoplanet exploration and discovery, black holes and so on.

Thus, the activities carried out at the planetarium are a direct result of the research that is produced in the Department of Physics. At the same time, school teachers and general users are encouraged to provide feedback to develop, improve and customize the activities to suit specific needs and demands. Consultation with school



The planetarium 'G.B. Amico'.

teachers of all levels can link the activities to curricular school programmes. In turn, this can result in opportunities for teachers' continuous professional development, which is often one of the main difficulties in introducing actual research topics in schools⁸. Moreover, school students and teachers can become active participants also through work-based learning experiences that will ensure a deeper and sustained interaction with researchers (work-based learning in Italy is named 'Alternanza scuola lavoro' — school–work alternation — and is mandatory for all students in the last three years, from 16 to 19 years of age, of the secondary education cycle⁹). These activities are run separately from lectures in the planetarium and are based on the development of the lectures themselves, the creation of digital content and work on actual astrophysical data to give a flavour of what research is. Work-based experiences are mostly run at the university and graduate students' activity is funded by the outreach programme of the Department of Physics^{5,6}, while regular lectures at the planetarium are funded by the local administration.

The planetarium, with 113 seats, is the second biggest in Italy. It is equipped with optical and digital technologies and our lectures are based on both. However, we take advantage of the digital full-dome technology, which allows the expansion of the potential of the planetarium far beyond the traditional night-sky observation. Four students have been trained to use the projectors and have started the activities, while others have become involved recently and more will be added in the next few months. This staggered training ensures the sustainability of the programme (two shows in the morning for five days a week) through a regular turnover, so that this additional activity does not negatively interfere with the scientific duties of PhD students. Instead, it represents an enjoyable and complementary activity that will help the young researchers in improving their communication skills. It will enrich their curriculum too, as education and public outreach can provide interesting career paths, suited for astronomers with a strong research background¹⁰. Moreover, the full-dome technology is so versatile that it

allows the involvement of students from other disciplines beyond astronomy, thus broadening the range of topics covered and establishing the planetarium as an infrastructure that connects the whole academic community with the host city.

In conclusion, by assigning the educational programme for schools to PhD students, we have developed a participatory model for the management of the planetarium of Cosenza that generates a virtuous circle of scientific research and science education and communication, resulting in a learning environment that can promote both cognitive and emotional engagement; creates stronger connections

among school programmes, everyday life and current research topics; and helps involve scientists in better defining their role in the local community. The model is feasible and easily replicable and we hope that it will inspire similar initiatives that can reinforce the role of planetaria and similar infrastructures as important assets at the interface between the scientific and civic communities. □

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