

## **“May infinity be left without stars”. Dissemination of Astronomy from planetariums and science museums.**

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### **Abstract**

The title (borrowed from a famous *bolero*) is not so exaggerated when we remember that more than twenty five planetariums, scattered about the Spanish territory, do “ex officio” the magic of making the stars accessible to the public. They are unique spaces that simulate, in a very realistic way, the celestial vault as seen from different places and dates, giving back to their visitors the emotion of gazing at a night sky free of light pollution. They can also project fulldome programs of astronomical content. Therefore, planetariums turn into valuable tools for the teaching and dissemination of Astronomy.

At the same time, more than twenty Spanish science museums, with or without planetarium, bring Astronomy closer to the public of all ages and backgrounds through numerous and varied activities.

This paper aims to be a meeting between the Spanish professional astronomers and those essential allies in the dissemination of Astronomy. The last ones offer intelligent fun and unforgettable experiences, transmitting basic knowledge and showcasing the latest advances. They definitely contribute to promote vocations and to educate society in positive attitudes towards Astronomy and Science in general.

## **1 Introduction**

The history of modern planetariums starts in 1919, when Walther Bauersfeld, chief design engineer and later director of Carl Zeiss, had the idea of projecting the celestial vault in a dark room. The first shows of the optical star projector Model I took place in a dome set up on the roof of the Zeiss factory in Jena. In 1925, the Deutsches Museum in Munich was the venue for the world premiere of the so-called “Wonder of Jena”.

The physicist Frank Oppenheimer (brother of the Project Manhattan director) created in 1969 the *Exploratorium* of San Francisco, the first interactive science museum. It is a center for non-formal learning, considered as the prototype for participatory museums.

Following the example of these pioneering centers, the planetariums and science museums proliferated all over the world and turned into modals of the astronomical and scientific outreach, addressed to the great public. Let's meet these invaluable resources.

## 2 Essential allies in the dissemination of Astronomy

### 2.1 Planetariums: The stars within reach of the public

Spanish planetariums have a wide variety of sizes (domes from 5 to 20 m), setups (from 1 eyefish projector to several ones, in different settings), capacities (from about 25 to 245 seats), and ownerships (private or public). There are veteran planetariums (since the 70's of the last century) or very recent (the last one of 2014). Some of them are within science museums, observatories or schools, while some others are isolated. In addition to the fixed installations, there are portable planetariums, which can easily be moved to other centers, star partys, villages or cities, etc. From the technical point of view, the first planetariums had opto-mechanical projection systems. They have later been replaced or complemented by digital systems, and some planetariums currently benefit from the best of each option, with hybrid setups.

All planetariums possess the technical resources to simulate in a very realistic way the celestial vault as seen from different places and dates. On the starry night, free of light pollution, it is possible to superimpose circles, axes, coordinates, orbits, lines, drawings, images, texts, animations, videos... They finally allow to project spectacular fulldome shows of astronomical content, thus bringing the stars within reach of the public.

### 2.2 Science museums: Non-formal learning, educating in attitudes

According to the European Commission, non-formal learning is embedded in planned activities not always explicitly designated as learning (in terms of objectives, time or support), but which contains an important learning element. It is intentional from the learner's point of view, and can take place in museums, science camps/clubs, etc. Besides their vocation as centers de information, formation, and education in scientific contents, the interactive museums of science especially aim to educate the public in positive attitudes towards the science.

Activities of astronomical outreach organized by the science museums are very numerous and varied: popular talks and cycles of talks, courses, meetings, workshops, etc.; permanent or temporary exhibitions, some of them interactive; workshops, astronomical camps, contests, shows...; astronomical observations, often in collaboration with amateur astronomers' associations. Moreover, these centers participate in the IYA2009, World Space Week, anniversaries, astronomical ephemerides...

### 3 Census, geographical distribution, and overview

The census of planetariums and science museums engaged in activities of dissemination of Astronomy is:

- $\geq 6$  fixed and isolated (not in science museums or observatories) planetariums
- $\geq 3$  portable planetariums
- $\geq 4$  planetariums integrated in astronomical observatories
- 8 science museums without planetarium
- 14 science museums with planetarium

Some numbers are approximate, provided there are other less known planetariums whose public activity and information I have not confirmed. (See the list in the Appendix, and further information in this link).



Figure 1: Location of the above mentioned centers, according to the following code: **P**: Fixed and isolated (not in science museums or observatories) planetarium; **pP**: Portable Planetarium; **OP**: Planetarium in Astronomical Observatory; **M**: Science Museum without planetarium; **MP**: Planetarium in Science Museum

All the centers appearing in Table 1 organize activities of dissemination of Astronomy for general public. The information has been provided by their own staffs.

In this link a table with information of all Spanish planetariums and science museums engaged in astronomical activities can be found.

Every center in this list carries out in its environment an irreplaceable activity, and thus deserves institutional and economic support, and the appreciation of the public. Though not intended to be exhaustive, let me remark some of them:

The first planetariums in Spain were those associated with naval schools and naval museums, but the first one for astronomical outreach was the Planetari Municipal of Barcelona (1973), which still continues offering educational activities for public from 2 years on. In 1981, there was the opening of the planetarium of the Science Museum of Barcelona, transformed into CosmoCaixa in 2004. It is the only one in Europe offering the “accessibility pack”: audio-description, subtitles, video in sign language, and system of inductive loop. The planetarium of the Casa de las Ciencias (Coruña), the first Spanish interactive science museum of public ownership, was opened in 1985. It offers daily live shows, produces numerous planetarium programs, has created the exhibition “Astronomy as they’re telling you”, and much more.

The Planetarium of Pamplona (1993) is the biggest one in Spain, and has gained a well-deserved prestige due to its live sessions for students, and own production shows. They also organize exhibitions, courses, popular talks, workshops, educational activities, meetings, astronomical observations, etc. The second one in size is the Planetarium of Madrid, widely renowned and popular. Opened in 1986, and re-opened in 2017 after a deep technical upgrading, it has produced numerous shows for all kinds of public, in which careful attention has been paid to the scripts and music.

In the 90’s, the planetariums of Castellón, La Laguna, Santander, Barcelona (Museu Marítim), Granada, Murcia, Valencia, Las Palmas de Gran Canaria, Cuenca and Málaga were created. Among them, it stands out the Science and Cosmos Museum by its close link to the Instituto de Astrofísica de Canarias. Besides live and own production shows, it organizes popular talks, Astronomy courses for general public, university students and teachers, astronomical camps, astronomical contemporary dance, Cosmos-cinema, etc. The Parque de las Ciencias de Granada is an enormous complex with nothing less than 5 planetariums, observatory and other facilities dedicated to the Astronomy.

The first 15 years of the 21st century have seen the birth of new planetariums and science museums. The one of Valladolid (2003) was of the first ones in Europe with digital system, and of the first ones in the world in using LED’s projectors after its technical updating in 2015.

Among the centers without planetarium, San Pedro Cultural, a restored Romanesque church, mainly aimed to the dissemination of Astronomy, stands out by its originality. The planetariums within astronomical observatories offer singular facilities as opening ceilings or projections of images observed through the telescopes.

#### 4 Milestones, *the name of which we will have desire to call to mind*

In 2016, the fourth centenary of Miguel de Cervantes’ death was celebrated. The beginning of *El Quijote*, “*In a village of La Mancha, the name of which I have no desire to call to mind*” . . . , serves us to introduce some milestones of the dissemination of Astronomy driven by Spanish planetariums and science museums.

*Estrella Cervantes*, the project of the Planetarium of Pamplona, SEA and the Cervantes Institute, won the IAU contest “NameExoWorlds” with a 69% of all the registered votes. As a consequence, the system mu Arae received the names of Cervantes for the star and Quijote, Sancho, Dulcinea and Rocinante for its four planets. In addition, the Science Museum of Castilla-La Mancha, the Planetarium of Pamplona and the Impulsa CLM Foundation have produced a fulldome planetarium show offered to all the interested centers under CC license of free culture.

Several years before, the planetariums of Pamplona, Coruña and Cuenca created the fulldome show *Evolution* to commemorate the Darwin Year and the International Year of Astronomy 2009. It was the first great production in digital format, projected in practically all the Spanish planetariums. The Science Museum of Valladolid made a subtitled and audio-described version, accessible to visually and hearing impaired persons. Examples of other spectacular fulldome shows, produced with the collaboration of different planetariums, are *Starry night at the museum*, *Energy for life* or the recent *Night is necessary*.

Most of planetariums and science museums has celebrated relevant anniversaries such as 20 and 25 years of HST, 10 years of GTC, 50 years of ESO, 50 years of the Moon landing, IYA2009, World Space Week. . . and astronomical events such as solar or lunar eclipses (10000! persons attended the Planetarium of Madrid to observe the 2005 solar eclipse), Mercury or Venus transits, meteor showers, etc., with a rich variety of activities. Astronomical observations are carried out in observatories, planetariums and museums, often with the collaboration of amateur astronomers’ associations.

Let us emphasize the training courses addressed to general public, students, and teachers, who thus turn into new transmitters of astronomical information and knowledge. Some examples are the 20 editions of the Introduction to Astronomy course organized by the Planetarium of Castellón, the “astro-tourism” course of the Centro Astronómico Aragonés or the starting of the ESERO Spain office of ESA, aimed to the training and elaboration of didactic material for teachers, by the Parque de las Ciencias.

Last, but not least, here is a brief list of other original initiatives:

- *Meteorite, a rock of the space*, the first planetarium show with puppets (Science and Cosmos Museum)
- Evenings of remote observation with the IAC80 telescope (several museums)
- *All-night planetarium*, 24 hours of projections (Science Museum of Valladolid)
- Dinners or concerts under the stars (Madrid, Montsec, Tiedra, San Sebastián. . .)

- Popular talks given by astronauts Pedro Duque and Scott Kelly (Madrid), cosmonauts Valentina Tereshkova or Aleksandr Lazutkin (Valladolid), the Discovery's crew or astronaut André Cuiper in the ISS (Granada), etc.
- Exhibition *Mars, the conquest of a dream* (Valencia, with Fundación Telefónica, INTA, ESA, INAF)
- *The Galaxy Garden*, by the artist Jon Lomberg, consists of an outdoor scale model of the Milky Way, mapped in living plants and flowers and based on current astrophysical data. In Spain, it is located in the Yamaguchi park around the Planetarium of Pamplona. Hopefully, it will soon be replicated in other places.

## 5 Conclusions

Let us remark the main strengths of planetariums and science museums as powerful actors for the dissemination of Astronomy:

- They are spaces valued and estimated by the citizenship
- satisfy a social demand
- offer information and non-formal education in Astronomy for publics of all ages and trainings
- are excellent showcases of the astronomical advances
- return to the public the enjoyment of the starry night
- educate in the respect and defense of the dark sky, in the appreciation and support to the astronomical research
- have staffs full of professionalism and enthusiasm that master the technical, explanatory, didactic and communicative resources
- bring together a variety of collaborations: with universities, research centers, observatories, associations of amateur astronomers, researchers, etc.
- are real crowd-pullers, offering their platforms of dissemination and advertising, especially through social networks

I hope that this rendezvous of professional astronomers with the Spanish planetariums and science museums will lead to an increasing and more fruitful collaboration.

## Appendix

Links of interest:

- Sociedad Española de Astronomía (SEA): Outreach
- Liga Iberoamericana de Astronomía (LIADA)
- World Planetariums Database

As mentioned in Sect. 3, other planetariums are itemized below:

- Parque Aldea Nova (San Estevo de Sedes, Narón, Coruña)
- Planetario - Centro Cultural Jose María Gutiérrez Romero (El Limonar, Málaga)
- Escuela Superior de la Marina Civil (Portugalete, Vizcaya)
- Planetario de Úbeda (Úbeda, Jaén)
- Museu de Ciències Naturals de Granollers (Granollers, Barcelona)
- Facultad de Náutica de Barcelona (Barcelona)
- Instituto Politécnico Marítimo Pesquero del Mediterráneo (Alicante)
- Planetario de la Base Aérea de Matacán (Salamanca)
- IES Náutico Pesquero de Pasaia (Pasaia, San Sebastián)
- Kosmos Lanzarote (Arrecife, Lanzarote)
- Universidad de Oviedo (Gijón, Oviedo)
- Instituto Marítimo Pesqueiro do Atlántico (Vigo, Pontevedra)
- Universidad de Cádiz (Puerto Real, Cádiz)
- Castillo de Hornos de Segura (Hornos de Segura, Jaén)
- Universidad de la Laguna (La Laguna, Tenerife)
- El Parque de la Vida (La Mata, Valdés, Asturias)

Finally, there are in Spain around 30 astronomical observatories not listed before. Some of them are professional, while other are of public or private ownership, or managed by amateur astronomers' associations. Many of them organize astronomical activities open to the public, and frequently collaborate with science museums and planetariums. References can be found in the links of interest.

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