"2nd Workshop on Astronomy Beyond the Common Senses for Accessibility and Inclusion (2022)"
Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias (RMxAC), **54**, 24–27 (2022)

https://doi.org/10.22201/ia.14052059p.2022.54.05

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A PERMANENT AND INCLUSIVE EXHIBITION AT INAF ARCETRI ASTROPHYSICAL OBSERVATORY

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ABSTRACT

The INAF Arcetri Astrophysical Observatory recently inaugurated a permanent exhibition that has been designed in order to be inclusive also for blind and visually impaired people. The project built on previous activities at local, national and international levels and on newly designed exhibits, like the haptic planetarium dome. The exhibits, designed and tested with blind people, also proved to be attractive and useful for the general public visiting the Observatory.

RESUMEN

El Observatorio Astrofísico INAF Arcetri inauguró recientemente una exposición permanente que ha sido diseñada para ser inclusiva también para las personas ciegas y deficientes visuales. El proyecto se basó en actividades previas a nivel local, nacional e internacional y en exhibiciones de nuevo diseño, como la cúpula háptica del planetario. Las exhibiciones, diseñadas y probadas con personas ciegas, también resultaron atractivas y útiles para el público en general que visita el Observatorio.

Key Words: astronomy outreach — inclusive astronomy — models planetarium

1. INTRODUCTION AND GENERAL PRINCIPLES

Istituto Nazionale di Astrofisica (INAF) is the Italian public body in charge of performing research in all the domains of Astrophysics and Space Physics; the research interests of INAF naturally include Education and Outreach. Moreover, we are deeply convinced that an inclusive approach should be the standard in the design of educational and outreach environments and activities carried out at all INAF facilities. The communicative power of Astronomy strongly resides in its universality: whatever the culture, there are traditions linked to astronomy; whatever the social origin, everyone can look at the sky and feel its fascination; whatever the preferred learning style, everyone has his own way of being curious about the Universe. Even in the presence of individual difficulties, and sensory difficulties in particular, equal access to scientific culture should be guaranteed.

The main intention is therefore to design and test inclusive outreach and education activities and experiences that maximally take into account the wide diversity of people approaching astrophysics - being perfectly aware that absolute and perfect inclusion is impossible to achieve (this is in fact referred to as the barrier free utopia (Shakespeare 2010). Presenting different approaches enriches the overall experience and offers multiple points of view to all, regardless of their abilities and background experiences. When designed to be inclusive, outreach and education experiences can lead everyone to feel competent and empowered as science learners, and generate excitement and enthusiasm for science. On the other hand, when such aspects are not considered, the result can be experiences where people may feel disempowered, frustrated, uncomfortable, and alienated from sciencethat it is "not for them." (CAISE 2010).

Finally, we believe that this approach can also inspire in all the actors involved, both in the design and in the fruition of the activities, more conscious attitudes and thoughtful viewpoints. Indeed, as the noted psychologist Howard Gardner pointed out, among the five most important and rewarding cognitive abilities for the future, there are the respectful mind (awareness of and appreciation for differences among human beings) and the ethical mind (capacity of operating on needs and aspiration of society as a whole), (Gardner 2006).

The activities are designed in cooperation with experts and people with specific difficulties and discomforts, so to take into account different point of views, approaches to reality and knowledge, ways of fruition and cognition, needs and aspirations with regards to science.

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Fig. 1. HR diagram with text in Braille and drawings and graphics in relief.

2. THE PROJECT

The work we present is a permanent exhibition, designed also for blind and visually impaired people, at Arcetri Astrophysical Observatory in Florence.

2.1. *BACKGROUND*

The exhibition presents innovative elements, but also builds on previous research carried out at INAF and in the framework of international collaborations during several years that led to the production of educational resources, exhibits and multisensory experiences designed in order to increase the possibilities of access to information also for individuals with visual impairments. For example:

- INAF Osservatorio Astronomico di Brera and INAF Osservatorio Astronomico di Padova have worked since its inception within the international project "A touch of the Universe", a project conceived by the Observatory of Valencia (Spain) for the production of a tactile astronomy kit aimed at children with visual impairments.

- INAF Istituto di Radioastronomia actively contributed to the Inspiring Stars exhibition, a collaborative project of the International Astronomical Union; this was designed to include various sensory disabilities and was inaugurated in Vienna at the IAU General Assembly in August 2018. The contribution included the "Sense the Universe" exhibit, a tactile and audible representation designed to overcome the limits of visual representations and make the information and data contained therein accessible to an audience of blind or visually impaired people. This information, which is usually not visible and therefore originally has a fair nature in terms of accessibility, is traditionally rendered in visual form, effectively excluding individuals with visual impairments from its fruition

2.2. *THE EXHIBITION*

At present the exhibition is composed of:

- Prints and 3D models; the prints were produced in house, partly created from scratch or from existing projects. Some models from existing projects we printed are: the representations of the Moon and Mars developed in the aforementioned "A touch of the Universe" project, to reproduce the impression one gets from observing at a telescope; the scale model of the sizes of the planets of the solar system and that of their distances (international projects, NASA, etc). Examples of original prints include tactile reproductions to explain the shape of galaxies; 3D scale prints of the historic Arcetri Observatory dome (hosting the 150 years old Amici telescope) and the domes of the main international telescopes (e.g. LBT, VLT, ELT), allowing to compare the different sizes of the instruments at glance and/or by touch.

- Exhibit on the scale of distances in the solar system, simply made with a string with attached beads (all the same size: since the focus is on the scale of distances). This immediately - at a glance, but also by touch - gives an idea of the distances and spacing of the inner and outer planets and the impression of how empty the Solar System is.

- Typhlodidactic (educational support for the blinds and visually impaired) material and thermoformed panels; in particular, the HR diagram (Fig. 1), with text in Braille and drawings and graphics in relief, was specially designed at the Observatory and produced by the National Federation of Institutions for the Blinds. More panels can easily be printed with the matrix created for the occasion, to be used in schools, museums, planetariums, astronomy associations, etc., on-demand. In particular, this display was created in order to provide a tool for communicating more complex concepts of astrophysics that generally are not addressed in these inclusive exhibitions.

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Fig. 2. People testing the tactile dome during an opening event.

- A tactile, original and unique planetarium dome. The "tactile planetarium" is an innovative exhibit developed in Arcetri, with the collaboration of the INAF Institute of Radio Astronomy (IRA); it is a 120 cm transparent dome, inside which it is possible to "touch the stars", exploring the constellations, as we see them in Italy on a clear spring night: a truly immersive experience, to grasp the feeling of the most famous constellations. The dome will be described more in detail in Sec. 2.3.

These exhibits were either derived, as mentioned, from research international projects (with the involvement of associations of the visually impaired or experts at the local level), or were tested with blind people, both in the design phase and during an opening event in collaboration with the Unione Italiana Ciechi e Ipovedenti, (Fig. 2). Moreover, as the exhibition is part of the standard tour for the visits at Arcetri Observatory, we have found that it is eye-catching and effective even for visitors without specific sensory difficulties.

2.3. *THE MAKING OF THE TACTILE DOME*

For building the dome we used a transparent Plexiglas half sphere, ready-made. With a string, we reproduced meridians and parallels on the dome, in order to provide a reference for locating the stars positions relative one to the other and relative to the zenith (Fig. 3). We used Stellarium prints of a spring Italian early night sky: this is because we wanted to show as many "famous" constellations as possible (e.g. Orion, Cygnus, Lyra, Andromeda ... we had to sacrifice Scorpio!). We made different prints for magnitude range: mag 1 and 2 (about 30 stars); up to mag 3 (about 80 stars); up to mag 4 (about 200 stars) and mag 5 (hundreds of stars, but we only chose to display the ones necessary to get the idea of the shape of the constellation).

Fig. 3. Meridians and parallels reproduced on the dome.

We decided to reproduce the stars using differently protruding spheres depending on their appar-

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ent brightness (pearls, half pearls and "diamond beads" all of the same diameter, Fig. 4): we avoided the use of smaller and bigger balls to represent fainter and brighter stars, so as not to promote misconceptions about the relationship between the (apparent) magnitude of stars and their physical size. Using the size of tactile features to represent other characteristics (e.g. intensity of emission) creates misunderstandings because of its strong connection with reality (Horton et al. 2017). Indeed, the incorrect belief that the fainter the stars, the smaller their radius is a common 'naive' idea among the sighted people since the observation of very bright stars might give the impression that they are also very big: so here is a practical example of universal design that is useful to all and that produces benefits and avoids confusion!

The chosen spring sky also allowed us to show diffused objects such us Andromeda Galaxy and the Orion Nebula: those were represented by different sandpaper textures.

Finally, the haptic planetarium can also display planets; to take into account their changing position we used magnets to attach them to the dome in the right constellation depending on their visibility.

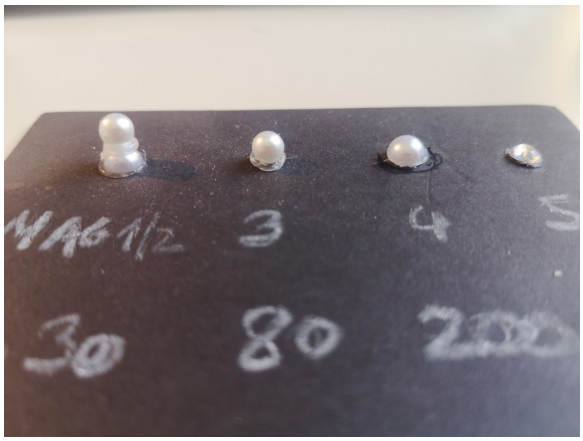

Fig. 4. Stars with different apparent brightness represented by protruding spheres.

2.4. *IMPACT AND FUTURE DEVELOPMENTS*

The exhibition was tested in a presentation event with 40 blind people and their accompanying persons. The event was a great success, particularly the tactile planetarium, which proved to be an exciting, accessible and effective tool: blind participants were able to recognise the most famous constellations by themselves, after being guided in a single demonstration.

The tactile dome and the exhibition have been used on other occasions with groups including visually impaired visitors, but these types of installations have shown a universal value, being inclusive for the blind, but also attractive and really effective for kinaesthetic or visuospatial intelligences (Gardner 2006).

In the next future, we are planning more evaluation and testing of the existing exhibits and design of new ones. In particular, a new immersive multisensorial (sight, touch, hearing) dome is under study, the prototype being developed at INAF IRA Bologna representing non-optical astronomical sources with lights, textures, vibrations, sounds and other sensorial stimuli represented through interactive devices and electronic components. With respect to monosensory representations (e.g. standalone images or sounds), multi-sensory abstract ones offer a wider range of parameters that can be used to show several features of the represented object, therefore providing a more complete presentation of the non-visible reality. What is under specific study is how to avoid sensorial confusion and overexposure to different stimuli at the same time.

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