Astronomers for one night: When a telescope enters a planetarium dome

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Abstract

While sharing the astronomical experience with our public at the Rome Planetarium, we tried to transform the dome into a real observatory. For this purpose, we used the Virtual Telescope – a remote, fully robotic observatory – with an astronomer on site. This way, it was possible to blend the atmosphere of the planetarium with the typical environment where astronomers work: the former was used in concert with the observing facility, with the remote astronomer guiding and explaining the observing session. Each observation was previously introduced under the dome, hunting for the right corner of sky, before switching to the telescope. We have had very positive feedback from our visitors, who enjoyed the excitement of a typical night at the telescope. Images were also properly enhanced live, to show and explain the benefits of image processing. Whenever possible, we have chosen last-minute targets (like newly discovered comets and near-Earth asteroids) or true astrophysical targets (like fast variable stars), to reinforce the return of such a live experience. In this work our approach, the format of the show, the techniques and the feedback from the public are presented and discussed.

Introduction

Doing and communicating astronomy in our technological era is a very exciting experience. Plenty of tools are available to explore this fascinating science fully, to leave our planet and discover the wonders of the Universe. While the many and marvellous accomplishments of this science itself are continuously attracting people of any age and any nationality, the ancestral view of the sky at night is still unsurpassed in both its charm and beauty. This is the ground that scientists are probing each night with their powerful instruments, to unveil the secrets of the cosmos, eventually answering its intriguing questions. Besides science, many meanings, such as cultural, historical and ethnological meet each other “up there”. It is not easy to merge all of them with science, but, it is a challenge we can try to face with modern technology. First of all, we need to recover all the elements involved.

It is well known that the real sky is slowly disappearing. Most people living in urban areas can see just a few tens of stars, completely missing the ancient actors up there, the constellations. While they can experience a dark site from time to time, the sky is no longer an obvious part of our lives.

A planetarium is often the only place where people can meet the stars again, as, even in a very light polluted city; it can promote the protection of the natural sky and the recovery of the feeling of enchantment and discovery. By properly blending the available contents and technology, a planetarium can offer an amazing, immersive experience that carries the contents and meanings of modern science.

The next, natural step would be to bring the feeling of real research under the dome: in short, to share the experience of astronomers with the public. While people can easily enjoy reading or hearing about the latest discovery, we are often left without the right perception of the efforts needed by modern science to reach a given result. We have tried to fix this, blending the benefits of two technological resources, the Planetarium of Rome and the Virtual Telescope Project, to go beyond the virtual sky.

Rome Planetarium

After being shut down for more than 20 years, the Rome Planetarium[1] re-opened to the public in May 2004 with a completely new set up. The modern planetarium is hosted at the Museo della Cività Romana, in the EUR district of Rome.

The dome is 14 metres in diameter and the projector is a RS Cosmos SN95, showing a very realistic sky with 4,500 stars. Two sets of fulldome diapo projectors and three digital projectors complete the equipment; a total of 98 ergonomic seats are available, see Figure 1. Since it opened the planetarium has been great success with the public. Each year, it hosts about 100,000 visitors of all ages, with special attention to students; it is very popular with children as well.

There are a wide variety of programmes on offer: to date, about 60 different shows, mainly live lectures, with a few automatic shows and special live, interactive ones for children. Special observing sessions are organised for important astronomical events (eclipses, comets, occultations, planetary oppositions, space missions and discoveries). The Planetarium also offers a series of monthly talks, hosting a leading scientist in a given research field. Since its new opening, the Rome Planetarium has participated in all the annual "Notte Bianca" events, hosting about 10,000 visitors on each occasion. We adopted a particular approach to exploring astronomy under the dome, fine-tuning the scientific content and properly interspersing it with artistic elements. For a complete account of our philosophy, please see Gandolfi et al. (2005).

Planetarium of Rome

Figure 1 – Inside the dome of the Planetarium of Rome before of a public event.

The Planetarium also contains an Astronomical Museum, which occupies seven rooms

[1] http://www.planetarioroma.it

and is inspired by three key themes: space, time and the origin of the elements. The visitor is taken on a journey from the Earth to the distant Universe and back, crossing the Solar System and the nearby stars, using 3D models. Dioramas of the Moon and of icy Europa emphasise the immersive feeling of the environment, while several multimedia positions help in the understanding of a key process of the place where the visitor is situated.

Planetarium of Rome

Figure 2 – The Orrery inside the Astronomical Museum, showing the motion of the Earth, Moon and eclipses.

The Virtual Telescope Project

The Virtual Telescope Project[2] consists of a remote observing facility hosting several robotic telescopes, fully accessible on the internet. It is installed in Ceccano, Central Italy, about 100 km south of Rome. It was founded by G. Masi in 2006 and since then it has enjoyed a rewarding success. The Virtual Telescope Project provides a complete setup for real-time astronomical observations, including instruments for both research and "aesthetic" imaging. True colour, as well as narrow-band imaging, is possible. During the observing session, the user can control every parameter, which makes the Virtual Telescope a unique facility.

The primary telescope is a C14 optical tube assembly (diameter 355.6 mm and 3910 mm of focal length, typically used at f/6) installed on a Paramount ME robotic mount, from Software Bisque.

At the primary focus there is a SBIG ST8-XME, high efficiency CCD camera, as well as a motorised filter wheel. Filters for standard photometry and colour imaging are available. The secondary telescope is a C11 optical tube (diameter 279.4 mm and 2800 mm focal length, typically used at f/5) and it is installed on a robotic New Atlux mount, from Vixen. The imaging instrumentation consists of a SBIG ST8-XME, high efficiency CCD camera equipped with a motorised filter wheel, equipped with filters for colour and narrow-band imaging. In the near future this telescope will be upgraded and will become an exact twin of the C14.

A high quality Fluorite refractor and a solar, H-alpha telescope complete the available instrumentation are also available. The Virtual Telescope has served 35,000 images to more than 400 users since its launch, while its website has been surfed by more than 160,000 individual visitors. It has contributed to many scientific projects, including the co-discovery of two exoplanets. To learn more about the Virtual Telescope Project and how to use it, please refer to Masi (2007).

[2] http://www.virtualtelescope.eu

Beyond the virtual sky: Astronomers for one night

As mentioned earlier in this paper, at the Rome Planetarium we were keen to enrich the experience under the dome, carrying the meaning and the efforts of modern research as well as its discoveries and results. We had previous experience with our live show "Southern Skies", where we introduced real-time observations of the celestial bodies, imaged remotely using a telescope located in Chile. The public found this fascinating, actively asking for other similar experiences. We were motivated to take another step: to share with the public the work of an astronomer in his/her observatory, inviting visitors to "be astronomers for one night" (*Astronomi per una notte* is the title of the show)!

We decided to leave the astronomer at the remote site, connecting with him by video conference, so that the public could see him in his own environment. The astronomer would discuss his work with the host in the planetarium and explain what he is doing, how and why, using the proper scientific language in the process. The goal is to bring the feeling of performing actual research to our guests, including unpredictable side effects such as weather changes, wind, schedule variations, noise, etc.

We mixed the Virtual Telescope features with the peculiarities of the virtual sky. After discussing the work the astronomer at the observing site is doing and the best targets available, the public is guided to the right corner of sky using the planetarium. After this, we go back to the remote observatory, slew the telescope to the target, following its movement through a webcam, and finally try to capture real-time images. It is important to note that the telescope can be controlled both by the planetarium staff (in principle, by anyone in the audience) and the remote astronomer.

Gianluca Masi

Figure 3 – The primary telescope unit of the Virtual Telescope. A C14 OTA in installed on a robotic Paramount ME mount, while a CCD camera is at the telescope focus.

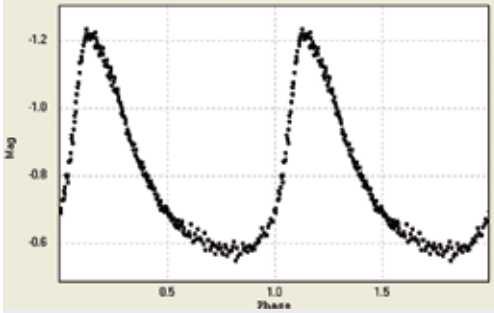
Images are shared in real-time, as soon as they are downloaded from the CCD camera, with all their artifacts and noise, without any processing. The astronomer comments on each image; what it tells us about the nature of the observed object; continuously interacting with the staff at the planetarium to make each step clear to the public. Then the astronomer calibrates the image and the object can be seen at its best. He also does some quick image processing, to show how a single image actually contains lots of information: something that is not obvious to the public.

We try to focus especially on objects like bright near-Earth asteroids, comets and so on that are visible at the observing time, what we

call *The Astronomical Chronicle*. Of course we also include galaxies and clusters but we prefer to share targets with an easily visualised astrophysical meaning, clearly showing the sense of time and evolution. After all, we want everybody to be an astronomer for one night, not a mere viewer! Our goal is to spy evolving and/or moving objects (like those above, plus fast variable stars), to exploit the meaning of time and reject the feeling of an immutable Universe or a sky that changes beyond our ability to witness it. We find it interesting to share how the 3D structure of a body (i.e. an asteroid) can be modelled even if it is just a dimensionless, point-like source, showing no details, and the benefits of true-colour imaging, by combining RGB frames. But we never forget that we are in a planetarium and so, each object is properly placed in its celestial frame on the dome. To strengthen the experience, we also invite the public to propose a target to observe or to question the remote astronomer.

Examples

We would like to show a few examples taken from recent performances of the show *Astronomi per una Notte*. Figure 4 shows the light-curve of the variable star CY Aqr. The star produces a regular cycle and strong variation in just 90 minutes, which is the length of a football match! Figure 5 shows the passage of the potentially hazardous asteroid 2006 RZ, moving very fast against the starry background. Figure 6 finally shows how colour images are assembled. The entire sequence of telescope pointing, imaging and image processing is performed live in the show.



Gianluca Masi

Figure 4 – The light-curve of the CY Aqr variable star, showing a complete cycle after only about 90 minutes.Oct. 2006. The asteroid appears as a trail, as it was moving fast against the stars.

Gianluca Masi

Figure 5 – The potentially hazardous asteroid 2006 RZ, grabbed on 5 Oct. 2006. The asteroid appears as a trail, as it was moving fast against the stars.

During the last *Notte Bianca* (September 2007), we installed a telescope in the square outside the planetarium showing the variable star V455 and, at that time, a primary astrophysical target. It was visited by more than 13,000 people.

Discussion and Conclusions

After about 18 months of experience with this format we can try to draw some conclusions. The (virtual) presence of a telescope is an obviously fascinating factor: every time we offer the *Astronomers for One Night* show (about ten occasions so far), we have been strongly overbooked, even during less popular periods (like in summer, with many people on holiday). Quite surprisingly, we see that visitors are generally satisfied even when the sky is cloudy. In these cases, while continuing to monitor the weather with the public, we reproduce the whole observing experience working with backup material. The use of previously re-

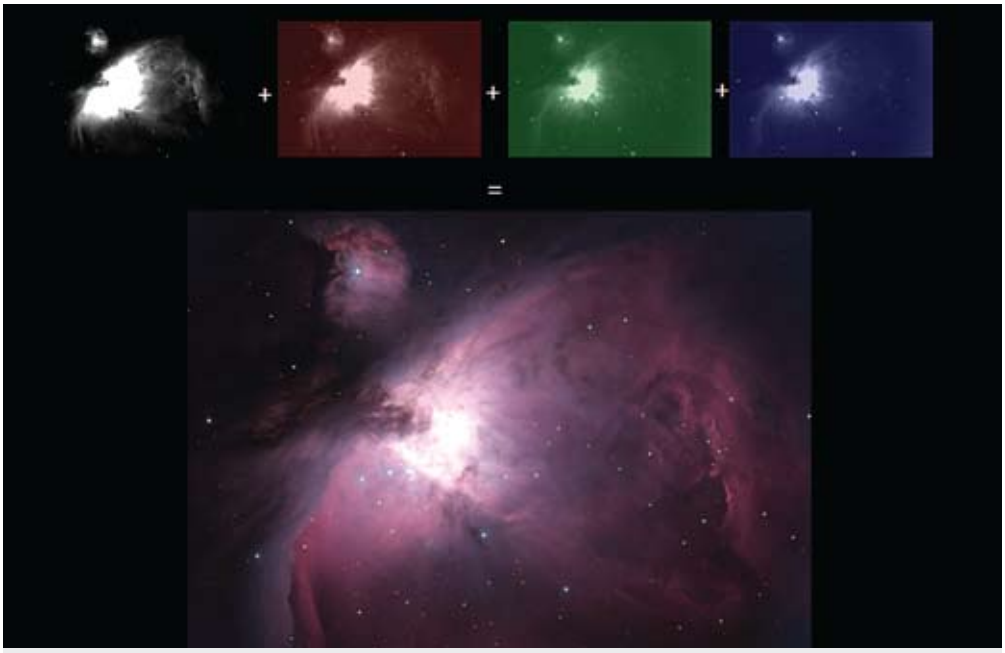


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Figure 6 – A true-colour picture of the Orion Great Nebula (M42) is finally obtained by assembling RGB images

corded images is declared: after all, clouds are part of the game. People are somewhat surprised to learn that a given setup on the telescope is not able to get good views both of deep-sky objects and planets. After surfing nebulae and clusters, they usually ask to see fine details of the Moon, Saturn and so on, discovering that substantial changes to the set up would be necessary: another way to "see" the differences among astronomical objects and instruments.

We have often received spontaneous feedback from the public, and they said they liked the experience, as they touched the world of real astronomical research, which adds to the value of the planetarium experience. Accordingly following some other suggestions, we will try to increase the realism, even asking the public (and not only the planetarium staff) to slew the telescope directly to its destination. In conclusion, we regard the results and the emotional, scientific and cultural return of the Virtual Telescope-Planetarium combination as very encouraging for an innovative approach to planetarium shows.

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