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# ROME IS STAR SHAPED: S.T.A.R. THE FIRST ITALIAN APP FOR THE SPREAD OF CULTURAL ASTRONOMY

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## ABSTRACT

STAR is the first Italian App for smartphone and tablet entirely dedicated to the cultural astronomy sites in Rome.

The user will be guided on a journey to discover mithraea, sundials and Astronomy related places of the Capital. In most cases, these sites are visited by millions of tourists for their historical and artistic value but their astronomical significance point of view is not valorised.

Despite many ancient monuments also enclose a strong astronomical significance, linked for example to the original constructive purposes, this aspect is largely ignored by the general public. The aim of STAR is therefore offer the opportunity to discover an unexpected, original and evocative side of the city of Rome to a widest possible audience through an innovative technological support, simple and attractive, which STAR wants to be.

This App aims to involve the foreign tourist as the Roman citizen rediscovering the city, the neophyte as the expert of this topic. With STAR it is possible to modulate the itinerary, to choose the number and type of sites to visit, depending on the time available, and the favorite way to reach the sites.

Moreover, the user will have the opportunity to select the type of presentation of the site based on the desired level of detail. To add emotional impact to the experience, making more effective the communication of contents, the App allow to reveal the original appearance of the sites or bring to light hidden details using the virtual augmented reality. This tool also allows you to discover places otherwise not be visited because they are not easily accessible, in particular for those who are suffering from disabilities, with particular reference to mitrei for their underground nature.

Moreover, STAR replace or compensates the lack of in situ traditional communication systems, mostly absent or very reduced.

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**KEYWORDS:** App, Cultural Astronomy, Rome, mithraea, sundials.

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## 1. INTRODUCTION

During the period between 2004-2015, the course of Museology (Master Degree in Technology for the Conservation and Restoration of Cultural Heritage, University of Rome "La Sapienza") included a short course of museography and museology applied to archeological sites, monuments and artworks connected to the History of Astronomy and the Cultural Astronomy in Rome.

During this period, the students produced papers and thesis on several sites connect with the Cultural Astronomy, such as historical sundials, ancient obelisks, mithrea, museal collections.

All these works had to be included in a project aimed to create a spread thematic museum, a particular museal tipology, on History of Astronomy in Rome.

The student's works was based not only on bibliographic and website researches, but mainly on direct investigations to obtain measures, data, original iconographic materials and others.

So, the students of the different academic years have conducted museographic exercises on several sites, among these historical sundials, obelisks, mithrea, monuments with astronomical meanings, museal collections. During this works, we studied with accuracy the ancient cartography of our city, especially the maps of Etienne Duperac (1535-1604) and the great map of G.B. Nolli (1692-1756) (as showed in Fig.1).

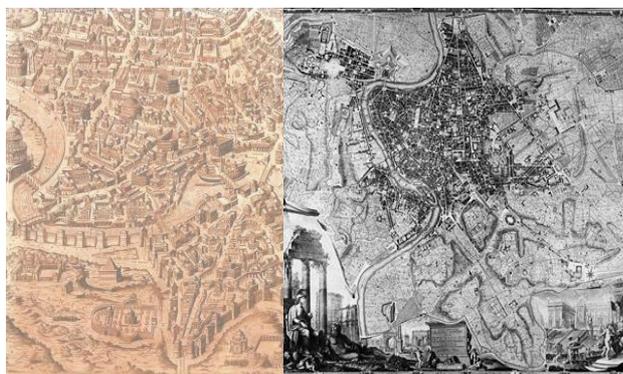


Figure 1. Maps of Etienne Duperac (1535-1604), area of Circus Maximum, and of G.B. Nolli (1692-1756)

In this way, we have recognised a particular shape of Rome, formerly identified by the studies and researches of the famous archeologist R. Lanciani (1845-1926) (Lanciani, 1902) and in the later time, by the architect and urbanist P.M. Lugli (1923-2008) (Lugli, 2006). Their works hypothesized that some civil architectonic complexes in the imperial age, would have built in specific sites, to enhance and to underline some morphological characteristics of our city, drawing an "altera forma urbis", a star shaped city (as showed in Fig.2).

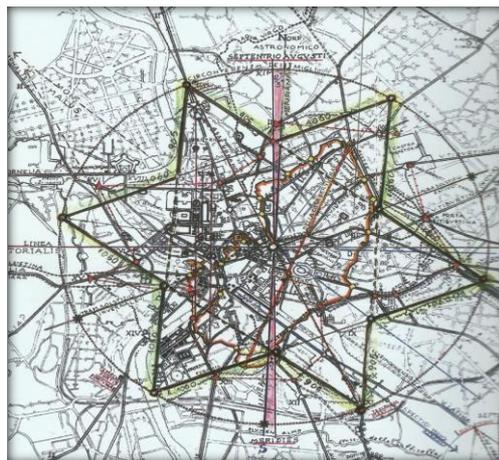


Figure 2. Star shape of Rome in P.M. Lugli (1923-2008) map.

Such hypothesis was perfect for our aims, giving to the thematic museum of Astronomy in Rome an enhanced cultural suggestion.

The authors underline that the present work is not aimed to present new archeological discoveries but to show an example of museography applied to the spreading and valorization of Cultural Heritage sites through innovative technologies.

The best occasion to realize this project had been the selection of the Regione Lazio, especially targeted for young creative people and aimed to the development of innovative applications for smartphone and tablets. Each winning young participant had the occasion to be connected and work with a company of this sector for the realization of the App. The project S.T.A.R. (Sites of astronomical tourism in Rome), presented by our former student Dr. Livia Lombardi, in collaboration with Dr. Ludovica Ruggiero and Dr. Lucilla Fabrizi, was chosen by Mobile Soft s.r.l., a leading company in software development for smartphone and tablet, and classified first on the list of this selection.

## 2. THE CULTURAL ASTRONOMY SITES INCLUDED IN S.T.A.R.

The actual development of S.T.A.R. includes ten sites, with astronomical meaning. Particularly, for the Horologium Augusti in Campo Marzio had been developed an original virtual reconstruction, based on research and studies, offering the occasion to obtain valuable museological, museographics and scientific results. It is important underline that the museographic works on some mithraic sites in Rome (among those opened) gave original results regarding some enigmatic astronomical characteristics in the frescoes of Barberini's Mithreum and possible extraordinary astronomical events, like planetary superconjunctions, that could had inspired the building of some mithraic cult sites.

## 2.1 *Horologium Augusti*

The Horogium Augusti was the major solar sundial in the classic ancient world, builded in 10 B.C. in Campo Marzio, with the Psammetico's obelisk , now in p.zza Montecitorio.

To realize the reconstruction we had to make a choice between two recostruction models, proposed by different researchers.

The firt one was E. Buchner, an archeologist of The Deutsch Archeologische Institute, who digged the area in Via Campo Marzio at the end of the seventies years of the twentieth century and found a piece of the ancient bronze meridian line of the sundial.

He proposed that the ancient device would have had a large travertine platform, with a certain number of hour lines (variable between 7 and 11), the monthly hyperboles and the meridian bronze line having metallic daily lists.

Another recostruction model was proposed later by various authors, including Heslin (Heslin et al. , 2007) and was based only on the obelisk, his pedestal and the meridian line with narrow travertine slabs.

An answer to solve which of these two reconstruction is the correct one could come from a new set of geological prospections, conducted by georadar non invasive method, aimed to find or not the remains of the ancient platform, probably presents at 6.5-8.5 m under the street ground.

The area of Campo Marzio had been largely and deeply altered by several works and the remains of ancient large travertine platform could be entirely removed (Lanciani, 1902).

A wide collection of citations and data was recovered by the works of the so called "antiquarians" in Rome between the XV-XVI century: humanists, pre archaeologists, draughtsmen, and engravers. Among these, Flavio Biondo (1392-1463), Pomponio Leto (1428-1498) (Pomponio, 1953), Andrea Fulvio (1470-1527) (Andrea, 1588), Bartolomeo Malviani (1488-1566) (Malviani, 1632), Lucio Fauno (1501?-1560?), Pirro Ligorio (1513-1583), Michele Mercati (1541-1593), Alessandro Donati (1584-1640) (Donati, 1648), A.M. Bandini (1725-1803) (Bandini, 1751). Some of these authors had a direct knowledge of the digs, with specific witnesses of unknown details. Indeed, the only available classical sources were some lines in the *Historia Naturalis* of Pliny the Elder (L. XXXVI parr. 71-73 cit. op.).

Particularly, two authors Pomponio Leto, in the "Excerpta a Pomponio dum inter ambulandum cuidam domino ultramontano reliquias ac ruinas urbis ostenderet " and Andrea Fulvio, in the "Dele antichità di Roma" (L.V. cap. XVI), give us a direct

report of the digs occurred in 1480, in the occasion of works in some houses of this area.

These witnesses tells of a large travertine platform with a certain number of hour bronze lines, with inscriptions and musive works of the winds. These and other information had been used by A. Donati, in his "Roma vetus ac recens: utriusque aedificiis ad eruditam cognitionem espositis ", for a graphic reconstruction of the zone between Porta Flaminia and Campo Marzio.

The drawing of the Augustus's Sundial clearly presents many useful and original details, particularly the special orientation of the obelisk and his pedestal, on the meridian line (as showed in Fig.3).

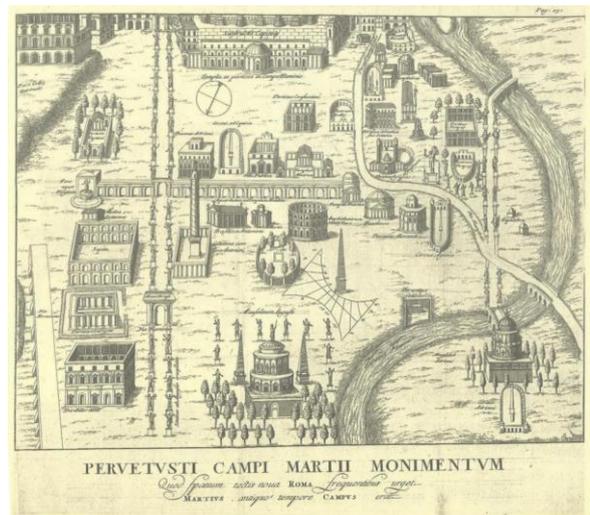


Figure 3. A. Donati graphic reconstruction of the area between Porta Flaminia and Campo Marzio.

So, for the reconstruction of the Horologium Augusti (as showed in Fig.4), we have chosen the Buchner's model, because more consistent with the prevailing historical and literary sources.

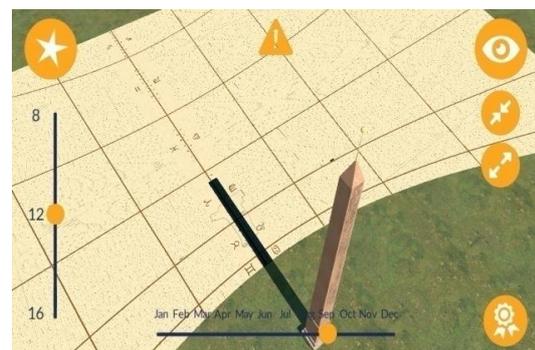


Figure 4. S.T.A.R. 3D reconstruction of the Horologium Augusti

Other original and useful notes of history of astronomy, astrology, metrology, calendars history, obtained in our work, will be presented in next articles of our group.

## 2.2 *Santa Maria degli Angeli Meridian*

In 1561, Pope Pius IV commissioned the building of the Santa Maria degli Angeli Basilica.

Michelangelo designed the church inside the ruins of the ancient Baths of Diocletian. This gigantic church contains a meridian that Pope Clement XI had constructed. Between 1700 and 1702, the architect and astronomer Francesco Bianchini built this gnomonic hole sundial to precisely calculate the day on which Easter will fall.

The light beam that enters through the gnomonic hole at solar noon will create a light ellipse on the pavement. Depending on the sun height above the horizon, this ellipse occurs every day at a different point along the meridian line.

Day after day, an ellipse – a circle of light – runs along the meridian line through the various constellations, just as the sun apparently travels.

This ellipse's movement between the two extremes of the meridian line during the year allow it to be used as a calendar.

The information about the artistic details of this site are based on an original petrographic research, realized in collaboration with the Science Department of University of Roma Tre. This research was focused on the stony materials used for the zodiacal drawings inspired by the "Uranometria" of J. Bayer (1572-1625), along the 44,2 mt of length of the meridian line. Other information are available for the APP users, particularly regarding the extraordinary accuracy of the astronomical measures, obtained by Francesco Bianchini, for specific calendar researches and for the studies of Earth's movements in the space.

### 2.3 St. Peter's Meridian

St. Peter's Square was designed by Gian Luigi Bernini and completed in 1667 after 11 years of work. The world's largest meridian stands in the centre of the piazza encircled by a long colonnade (320 metres). The sundial was built in 1817. The gnomon is the obelisk itself, which is one of few Roman-era obelisks that was never knocked down. A replica of the original bronze globe that was said to have held Julius Caesar's ashes tops the obelisk. The obelisk is 25.5 m high and reach a 37.5 m height with the base and the bronze globe.

### 2.4 Pantheon

The Pantheon is one of the most extraordinary and best-preserved ancient Roman monuments.

According to the scholar Robert Hannah, the Pantheon oculus and dome are a colossal version of the small hemispherical sundials often seen in backyard gardens with a hole at the top.

For example the sundial of Tenos, an island of the Cyclades, made by the Greek astronomer and math-

ematician Andronikos, that on the south side had a semi-spherical sundial, open to the north, with gnomonic hole summit, presents considerable similarities with the Pantheon and seems actually a realization in scale of the great dome. Inside the dome, in fact, there are lines very similar to those of the dome of the Pantheon.

### 2.5 Barberini mithraeum

In 1936, the Barberini Mithraeum was discovered during the construction of the Savorgnan di Brazzà villa in the garden behind Palazzo Barberini.

The mithraeum is in a rectangular underground room measuring about 12 by 6 metres with a barrel-vaulted ceiling. It likely dates back to the third century AD and is located inside a second-century building.

The axis of the mithraeum is directed towards the east horizon at the sunrise on the day of the summer solstice (N60 ° E).

The presence of a fresco sets apart this mithraeum. In fact, the Barberini, Santa Prisca and S. Stefano Rondo mithraea are the only in Rome with frescoes.

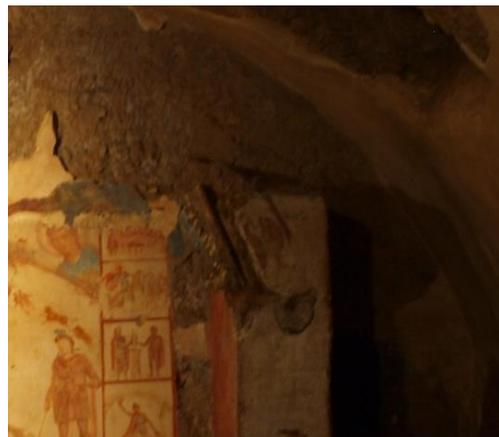


Figure 4. Barberini Mithraeum fresco - detail of the fishes

The central representation shows the design of numerous stars, about 18. The god is represented with the cloak with the seven-star enigmatic pattern. A special attention have to be focused on the altar wall, on the far right, where it is possible to see a drawing of two fishes (as showed in Figure 4). The fishes are a typical Christian symbolism and the presence in a mithraeum may be explained by an astronomical interpretation. The drawing in fact presents two fishes oriented inversely, indicating precisely the symbolism of the Zodiac. They could be related to the new precessional era that at the beginning of the Christian era had moved the spring equinox to this Constellation.

### 2.6 Circus Maximus mithraeum

The Circus Maximus Mithraeum was discovered in 1931. In the latter half of the third century AD, this place of worship was constructed inside a large second-century AD complex that probably served the public. The mithraeum contains a series of rooms that are connected and not the typical, one-room layout. In ancient times, the entrance was most probably located opposite the present entrance that was likely used as a secondary entryway.

Between the first and second rooms, it is possible to see two aediculae (small shrines) with small columns resting on consoles, a type of bracket. The marble bases inside these niches probably supported small statues of the torch-bearers Cautes and Cautopates, who respectively held torches upwards and downwards.

The second and third rooms contain prominent marble seats where followers sat during functions.

The last room was symbolically dedicated to the ritual of tauroctony, the ritualistic sacrifice of a bull, and houses a wonderful example of Mithraic art: a bas-relief of the god Mithras.

### 2.7 Caracalla Mithraeum

The Baths of Caracalla are one of the most impressive examples of ancient Roman thermal baths.

Emperor Caracalla had the baths constructed on the east flank of Aventine Hill between 212 and 217 AD.

Hidden underneath the northwest exedra, the third-century AD Caracalla Mithraeum is the largest discovered in Rome. This place of worship could accommodate up to 100 followers. In the original sanctuary, it's still possible to admire a fresco portraying the god Mithras.

The mithraeum was discovered during excavations in 1912.

### 2.8 San Clemente Mithraeum

The San Clemente in Laterano Basilica is renowned for its elaborate layers of architecture. The mithraeum is located at the lowest of the three levels. The sanctuary's main room is rectangular with a star-covered ceiling. The orientation of the temple is approximately east-west, with the altar facing east (N 75 ° E).

During excavations, a statue portraying the god Mithras was discovered. A masterfully created bas-relief of the tauroctony was also found.

### 2.9 Santa Prisca Mithraeum

From 1934 to 1939, the priests of Santa Prisca Church uncovered beneath the church the ruins of a mithraeum dating from 202 AD (the archeological researches were conducted by J. Vermaseren et al. , during the period between 1953-1966). The cult main

sanctuary was rectangular (11.25 by 4.20 metres) and lavishly decorated with frescoes, which are now almost completely indecipherable, and statues that are partially conserved. The cycle of frescoes illustrate the grades of initiation that followers underwent.

The entire complex is oriented to the east-northeast. At the left of the niche is still present a graffito showing a date: November 21 202. This date can be interpreted as the initiation of one of the new members or more probably, as the day of creation of mithraeum. In both cases, it confirms that the mithraeum was then existing and active.

Searching the explanation of this graffito, we notice that an unusual astronomical event occurred in coincidence of November 21, 202 D.C.

### 2.10 Santo Stefano Rotondo Mithraeum

Santo Stefano Rotondo Church is the oldest existing example of a Christian church with a circular layout in Rome. Founded in the fifth century, Pope Simplicius commissioned the church that was modelled after the first Oriental Christian sanctuaries. From 1973 until 1975, excavations beneath the church's floor revealed one of the largest mithraea uncovered in Rome.

Along the southwest slope of the Caelian Hill in ancient Rome district called Caelimontium, there are many underground spaces, some better known than others. During the excavations, some structures were discovered that were part of the enormous *Castra Peregrinorum*, the barracks for provincial armies posted in Rome.

A part of the first building contained sleeping quarters connected by a corridor. In the second block of barracks, a mithraeum was discovered that had been built when the barracks were operational. The soldiers worshipped in the sanctuary. This is not surprising since Mithraism was the most popular religion among those serving in the army. This characteristic also explains its wide reach into every corner of the empire.

The mithraeum covered a rather small, rectangular space of about 4 by 10 m when it was first built around 180 AD.

A unique feature of this mithraeum, consists of a long inscription on a small marble altar, a prayer to the god, whose dedication was performed by a faithful, *Cascelia Elegans*. The "Cascelia prayer" is a unique and problematic discovery, since the women were not allowed to Mithraic mysteries. Moreover, this fact is very unusual taking into account that the mithraeum was in a barracks.

The orientation of mithraeum-entrance is towards Southeast-(about N125 ° S).

## 3. HOW DOES S.T.A.R. WORK?

From the Home menu you can visualize all STAR sites on the map of Rome.

By clicking on each site, a pop-over window will appear showing its name. A set of intuitive icons below will guide you to any information you might be looking for regarding the chosen site.

A traffic-light colour coding system is used to describe the availability of the site:

- Open to the public
- Booking in advance required
- Not yet accessible, but you will be able to visit remotely thanks to the STAR multimedia content

The presence of the 3D ICON indicates the availability of contents implemented using virtual or augmented reality.

You can access the real-time 3D reconstruction with first-person view only once reached the site and from the observation areas defined.

This areas were established to ensure the correct view of the 3D reconstruction as well as to guarantee the safety of the app users.

If you leave the area (or if you want to access the 3D content off-site), you will access only the flyby view (from above).

The page dedicates to each site contains:

1. GENERAL INFO regarding the site such as booking details, ticket cost, opening/closing time.
2. WRITTEN GUIDE that contains a brief description of the site. By clicking on the More icon it is possible to access the extended version of the guide, with more in-depth info, for those who are looking for more detailed information, on the basis of previous experience and personal curiosity.
3. AUDIOGUIDE A simple and engaging guide accessible with a single click.
4. VIRTUAL OR AUGMENTED REALITY

Simply clicking on the icon and aiming the device in the direction shown, it is possible to visualize on the screen of the smarphone or tablet the reconstruction of the original appearance of the site.

These contents are also available in off line mode or when it is not possible for you to physically visit the site.

5. GALLERY

This section includes all images of the site, including those indicated in the audio and written guide.

With S.T.A.R. it is possible to modulate the itinerary, to choose the number and type of sites to visit, depending on the time available.

In fact, S.T.A.R. include the possibility to carry out the CUSTOM JOURNEY, which allows to choose the sites to visit among all those available in S.T.A.R., and THEMED JOURNEY, which narrows down the choice of the sites belonging to either of the two categories, Mithreum or Sundial.

Furthermore, S.T.A.R. allows to choose the favorite way to reach the sites.

In fact, the App contain within it specific features able to follow the user all the time during his trip and allowing him to choose how to reach the sites of interest between WALKING, where the integrated S.T.A.R. Navigator suggest the quickest way to walk to the site, or using PUBLIC TRANSPORTS, where S.T.A.R. provide all necessary information (such as bus stop/tube ID, line name, average time and more) to guide to the destination.

Then, S.T.A.R. elaborate the quickest journey that best suits the user using as a starting and finishing point his current location.

In the section FOR MORE INFORMATION, S.T.A.R. includes:

1. FOR THE BOOKWORMS

List of the in depth resources organised by topic, site and more.

2. ROME IS STAR SHAPED

A city shaped like a Sun, symbol of power at the centre of the Mediterranean and the Ecumene in general, that would radiate civilisation.

A fascination more than two millennia old, buried in small references in the classic texts, inspired by monuments and building rich in symbolisms, that like a STAR shed light on the discoveries and vision of scholars and researchers.

3. HOW DOES A SUNDIAL WORK?

The science behind this fascinating ancient technological device.

4. WHAT SOLAR TIME IS IT?

Toolkit that allows to automatically calculate the solar time based on the time on your watch.

All materials contained in S.T.A.R. are available in both Italian and English, with the intention of extension to other languages in the future. The attention to internationalization is essential because this tool also wants to involve the foreign tourists who, in many cases, have a marked sensitivity towards the astronomical culture.

## ACKNOWLEDGEMENTS

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