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## Archaeoacoustic analysis of Cybele's temple, Imperial Roman Palace of Felix Romuliana, Serbia

### An interpretation using a method complementary to archaeology

prof.agg. Paolo Debertolis<sup>1</sup> & dr.sc. Maja Zivić<sup>2</sup>

#### Abstract

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Archaeoacoustic and physical phenomena research at ancient sites has developed beyond the initial stage. Our research group uses a practical standard (SBSA) complementing the field of archaeology. Studying archaeoacoustics and natural phenomena over the last four years, has enabled us to offer an explanation as to some of the enigmas of ancient archaeological sites that were not possible to explain with other methods. Following our experience, we applied the same method to look at an interesting question about the orientation of Cybele's Temple situated within the Imperial Roman Palace Felix Romuliana, South-East Serbia. This temple and its fixtures are the only place within the palace that is not oriented along the east-west axis of the complex as was the Roman tradition (Decumanus). Historians also made reference to mysterious rituals, so we used archaeoacoustical methods to better understand why this ought be. We found that the temple's orientation followed the direction of some infrasound and low frequency vibrations most likely originating from an underground flow of water. These frequencies would have increased the effect of rituals by enhancing the psyche of the participants due to the influence of these low vibrations on human brain waves. This suggests the builders of this temple had some sort of knowledge of this effect.

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**Keywords:** archaeoacoustics, infrasounds, low frequencies, brain activity, SBRG

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<sup>1</sup> Department of Medical Sciences - University of Trieste, Chair of Dental Archaeology, Project SB Research Group, Trieste, Italy. [paolo.debertolis@sbresearchgroup.eu](mailto:paolo.debertolis@sbresearchgroup.eu)

<sup>2</sup> National Museum Zaječar, Curator of Roman Palace Felix Romuliana, Gamzigrad, Serbia. [majazivicnika@yahoo.com](mailto:majazivicnika@yahoo.com)

## Introduction

Archaeo-acoustics is a complementary discipline of archeology which may help expand our understanding of why certain sites were considered sacred in ancient times. It may also help to explain why ancient structures were built or carved into the rock. Starting from the premise that past ages were not devoid of noise or spent in silence, we know the human voice used in songs along with the vibrations produced by the musical instruments remained the highest expression of culture for a long period. Natural sound phenomena were used in several civilizations to create impressive rites, with some ancient structures modeled in a certain way to directly influence the mind through the vibrations produced in them towards a particular state of consciousness (Jahn, Devereux & Ibison, 1996; Watson, 2006; Devereux, Krippner, Tartz & Fish, 2007; Cook, Pajot & Leuchter, 2008; Debertolis & Bisconti, 2014; Debertolis & Gullà, 2015).

Recently SBRG demonstrated a relationship between mechanical vibrations in some Neolithic temples from resonance phenomenon and brain activity (Debertolis, Tirelli & Monti, 2014; Debertolis & Bisconti, 2014; Debertolis, Coimbra & Eneix, 2015). Any severe and artificial extreme sound imposed on the sonic environment has a profoundly destabilizing effect on the individual, indeed infrasound has been used in the context of wars in the area of acoustic weapons (Debertolis & Bisconti, 2013). However, natural low vibrations with an absence of high pressure can have a positive influence on human health and some people can perceive very low-frequency sounds as a sensation rather than a sound (Debertolis & Bisconti, 2013). Infrasound may also cause feelings of awe or fear in humans and given it is not consciously perceived, it may make people feel like odd or supernatural events are taking place (Tandy & Lawrence, 1998). So it is possible to hypothesize that where a lot of natural low vibrations are present, ancient populations considered these sites to be "sacred" (Debertolis & Bisconti, 2013). Through archaeoacoustical analysis, it is possible to demonstrate there was some knowledge of acoustic phenomena in the past and later periods, which could for example have been used in ancient rituals (Debertolis & Savolainen, 2012; Debertolis & Bisconti, 2013a; Debertolis & Bisconti, 2013b; Debertolis, Mizdrak, Savolainen, 2013; Debertolis, Tirelli & Monti, 2014; Debertolis & Bisconti, 2014; Debertolis, Tentov, Nikolić, Marianović, Savolainen & Earl, 2014; Debertolis, Coimbra & Eneix, 2015). This same analysis was applied to the historical mysteries at Felix Romuliana.

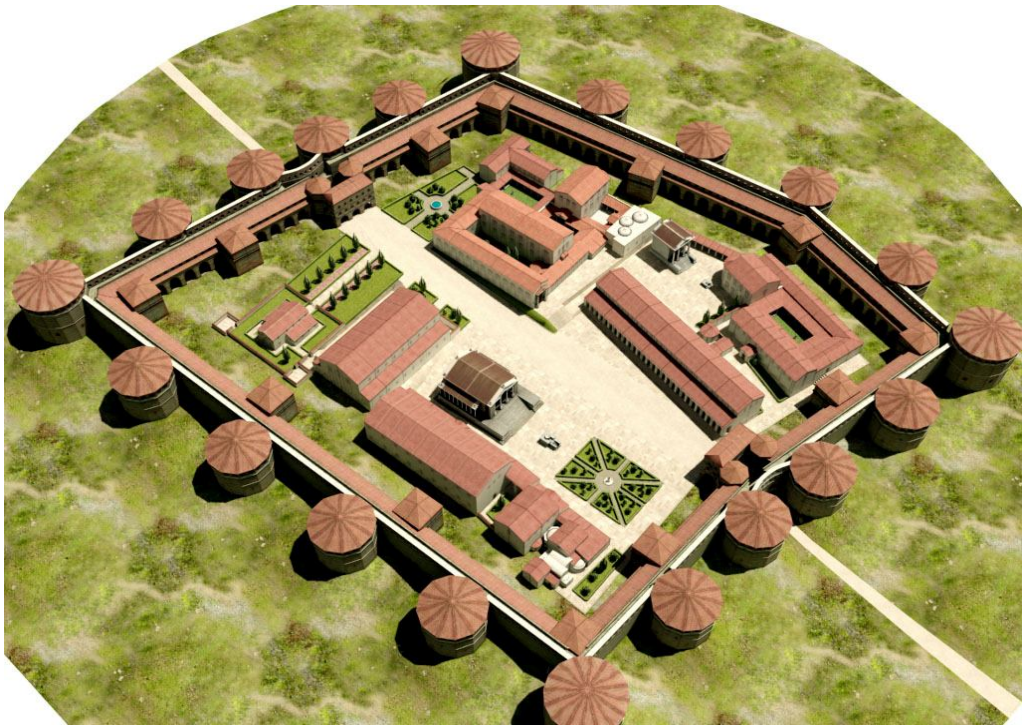
## The Imperial Roman Palace Felix Romuliana

*Romuliana* is an imperial court and memorial complex, the endowment of Emperor Gaius Valerius Galerius Maximianus (293 – 311 AD) who was born here. It is located near the present village of Gamzigrad, 11 kilometres northwest of Zaječar, in the valley of Crna Reka, which is situated within eastern Serbia. This part of modern Serbia has been known since ancient times for its wealth of natural resources, primarily minerals and ores, which has attracted diverse settlers.

Among the travel writers and interpreters of ancient history, baron Sigismund August Wolfgang von Herder, German geologist and head of the Saxon miners, was one of the first to record his first encounter with Gamzigrad. In his book *Bergmännische Reise in Serbie im Jahre 1835* (von Herder, 1846) he gave the first description and professional reviews of this fascinating monument. Janko Šafárik, who undertook the first proper archaeological field survey in Serbia in 1846, proposed that the excavations of the archaeological site near the village of Gamzigrad be carried out (Šafárik, 1860). After him, German mineralogist and professor at Freiberg Mining Academy in Freiberg (Saxony) August Breithaupt also wrote an article about Gamzigrad with equal enthusiasm (von Gümbel, 1876).

Finally, Felix Kanitz, Austrian archaeologist, historian and travel writer, visited the remains of the palace of Galerius during his travels through Serbia on two occasions, in 1860 and 1864. Attracted by the magic of this place, he left us drawings and descriptions of fragments of the walls and towers visible at the time (Kanitz, 1909). This exceptionally important information can be found in his writings about Serbia, where he emphasized that Gamzigrad is “one of the most splendid monuments of the times past” and “one of the largest and best preserved monuments of Roman architecture in Europe”.

Former romantic enthusiasm towards Gamzigrad dampened in the late 19<sup>th</sup> century. The interest in this unique monument was revived during the 1950s. The architect Đurđe Bošković drew a new outline of the Gamzigrad fortress in 1950, marking positions of the most significant buildings in its interior and, at the same time, pointing to the need that this important late antiquity monument be researched and conserved (Bošković, 1953).



**Fig. 1 – Reconstructed image of the Palace**

Archaeological excavations and conservation and restoration works at Gamzigrad began in 1953, on the initiative of Vekoslav Popović, who at the time was the director of the Museum in Zaječar and who struck the first pickaxe on the 15<sup>th</sup> of May. His former professor at the Royal Art School, Đorđe Mano-Zisi, who at that time was the curator of the Byzantine department of the Central National Museum in Belgrade, accepted the position of the head of research and held it until 1960 (Mano-Zisi, 1956). Perhaps the almighty Jove intervened on this occasion yet again, as the immersion into the secrets of this place, which celebrates the members of his divine family, begun precisely at the time when another great celebration was at its height, more than 1,700 years ago. Namely Diocletian, Jupiter's earthly incarnation, hosted *ludi persici*, games in honour of the magnificent victory over the Persian ruler Narseh, from the 13<sup>th</sup> to 17<sup>th</sup> of May 298 AD. The main "culprit" of this triumph was no other than his adopted son and co-ruler, the one who built Romuliana, the invincible Hercules-Galerius, *Iovii fillius*.

Two temples were discovered within the Palace of Galerius, which are conceptually and ideologically closely related with the monuments on nearby Magura hill. The smaller of the two sanctuaries is located nearly in the centre of the northern part of the Gamzigrad complex. The temple is a tetrastyle prostyle, small in dimensions – 16.5 x 10.5 meters and not oriented perfectly to East-West axis. It was dedicated to worshipping the cult of the goddess Cybele – the Great Mother (*Magna Mater*), as evidenced by *fossa sanguinis*, a kind of underground baptistery – crypt, where an initiation into the mysteries of the goddess was performed. A direct association between the cult of the oriental goddess and the emperor was established in a way that after the death and apotheosis of Galerius' mother, she was supposed to be celebrated in this temple as *Diva Romula*.



**Fig. 2 – Reconstructed image of Cybele's Temple**

On Magura hill, located about 1 km from the main gate of Romuliana, a sacral complex is located: two mausoleums, Galerius' and Romula's, with two consecration monuments in the form of giant tumuli. These gigantic cupolas with a stone retaining wall mark the place where the rites of apotheosis were performed, by which, after their deaths, both the Emperor and his mother would ascend among the gods.

Galerius' choice of the place of his eternal rest was not random. The discovery of a Bronze Age necropolis below the sacral complex is evidence that Magura has always represented a kind of a sacred hill, *Mons sacer*. Here, about 3,500 years ago, members of an ancient culture were being buried. Even today, this collective memory of the "sacred place" is kept alive in the local population. Residents of the Serbian village Zvezdan, to whose territory Magura hill belongs, but also their neighbours, Vlachs from the village of Gamzigrad, lit candles here for ages. Temples in the northern and southern part of Gamzigrad palace are closely conceptually and ideologically related to the Magura monuments. Galerius, god on earth, who was officially declared God on Magura after his death, was to be honoured in the temple in the southern part of Romuliana as a god – *Divus*, along with his divine stepfather Diocletian. Accordingly, Galerius' mother would be worshiped as *Diva Romula* after her death, in the temple in the northern part of Romuliana.



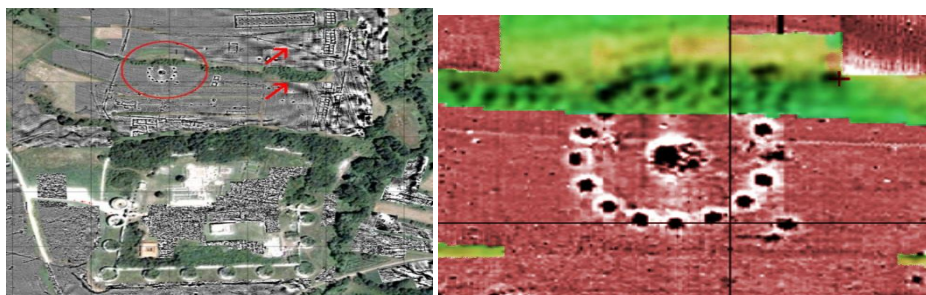
*Fig. 3: Above: the East entrance of the imperial palace Felix Romuliana (III century a.C.) in Gamzigrad, Serbia. Below: some ruins of the strong walls*

The hypothesis

Archeoacoustic analysis was carried out inside the palace at the temple of Cybele where it is believed Romula performed many sacrifices. Romula lived in the palace continuously, while her son the emperor Gaius Galerius was rarely present.

Every corner of this country palace seems to have been built for a magical or ritual function as its construction has not been built for military defense. A lot of bulls were sacrificed in front of the temple on a big stone in public view, however in a hidden part of the temple it is believed sacrificial rituals were made privately, something not in line with the Roman tradition.

Romula was devoted to the '*Gods of the Mountain*' who were not the traditional Roman Gods (Lattantius, 313dC). There is a sort of channel in the most hidden part of the temple here it is quite possible the blood of the victims could flow. But who were these ancient Gods? Lucius Cæcilius Firmianus Lactantius, Roman historian of the time, only speaks about mysterious and harmful rituals by Romula and her acolytes (Lattantius, 313dC). The place is really impressive and thanks to our collaboration with the National Museum Zaječar we conducted research from a broader perspective. Georadar images taken by a German research team in 2012, show the palace was built on a more ancient settlement extending beyond the palace walls. Images show a buried settlement to the north of the palace which includes a stone circle, revealing the presence of a very ancient sacred site before the palace was built.

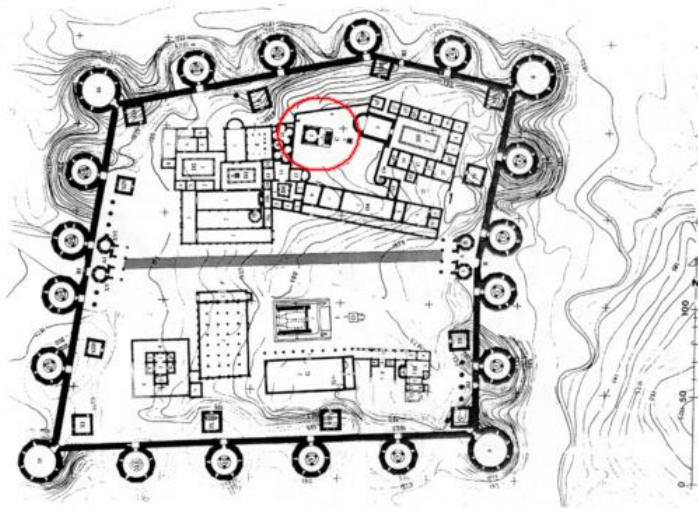


*Fig. 4 – The stone circle on the north of the palace and the ancient settlements not yet excavated*

An interesting question is why Cybele temple is the only place within the palace not oriented along the East-west axis of the building as in the Roman tradition. The palace is developed along the so-called "decumanus" the only road clearly visible.

It appears to be influenced by the contours of the ground, however this does not explain the different orientation of Cybele's temple which is not of a size that would require a different position in the general layout of the building. In contrast, the larger temple dedicated to Jupiter, is oriented along the east-west axis, as in the Roman tradition.

What kind of Gods were those to whom Romula was inspired? What sort of rituals were imposed on Cybele's temple? To answer this question we used an archaeoacoustic method to study this ancient temple to search for a natural anomaly which could potentially influence the different orientation of the temple. Our archaeoacoustic experience has shown that natural phenomena (ultrasound, infrasounds, low frequencies sounds) can create a direct effect on the human mind without people necessarily understanding the reasons why they experience a particular emotional state in that place.



*Fig. 5 – The map of the building that shows the significant distortion of the square shape of the palace with modifications to this angle near Cybele's temple (circled in red)*

## **Materials and methods**

The SB Research Group Standard for archaeoacoustics (SBSA) (Debertolis, Mizdrak, Savolainen, 2013) that has been tested at several archaeological sites throughout Europe (Debertolis & Savolainen, 2012; Debertolis & Bisconti, 2013a;



Debertolis & Bisconti, 2013b; Debertolis, Mizdrak, Savolainen, 2013; Debertolis & Bisconti, 2014; Debertolis, Tentov, Nikolić, Marianović, Savolainen & Earl, 2014; Debertolis, Coimbra & Eneix, 2015)) was used in this study.

Because archaeological sites can sometimes be influenced by electro-magnetic pollution, it is important to use sophisticated devices to avoid anomalous results. The equipment used consisted of dynamic high-end recorders extending from the ultrasound to the infrasound range with a maximum sampling rate of 192KHz (Tascam DR-680) or sampling rate of 96KHz (Tascam DR-100 and Zoom H4N equipment). Use of gain control in recording devices is very delicate. In quiet places, maximum gain for recording is used. In more noisy environments gain is determined with 0,775V/0dB AES/EBU standard.

The microphones used have a wide dynamic range and a flat response at different frequencies (Sennheiser MKH 3020, frequency response of 10Hz - 50.000Hz) with shielded cables (Mogami Gold Edition XLR) and gold-plated connectors.



*Fig. 6 - The manoeuvrings for placing the microphones in the “fossa sanguinis” of Cybele’s temple in the roman palace Felix Romuliana*

Ultrasensitive omnidirectional microphones (Aquarian H2a-XLR Hydrophone, frequency response from 10Hz to 100,000Hz) were used to accurately obtain any possible sound information from water sources (eg pond within the palace grounds). These act like a dish antenna, which captures all noises or sounds from a wide area underground. This type of microphone has a wide bandwidth and is used by sea biologists to hear whale song several kilometers away. Sound is transmitted very quickly in water, with the body of water acting as a reflector capable of capturing vibrations (Debertolis & Savolainen, 2012; Debertolis & Bisconti, 2013a; Debertolis & Bisconti, 2013b; Debertolis, Mizdrak, Savolainen, 2013). For Ultrasounds we used a Pettersson D1000x ultrasound detector with a 500Hz-305kHz audio recording range. This is a light and easy to use device but the most expensive piece of equipment which directly transforms ultrasounds into audible sounds.

The recording devices also used two electromagnetic sensors (Demiurg, Croatia) with different electromagnetic wave sensitivity. These can detect if there are any magnetic fields nearby, whilst simultaneously recording sound vibrations, thereby giving more reliable results. In fact the graph on the computer shows different waves recorded from each source. A trained researcher can distinctively hear an anomalous vibration when the headphones are connected to the equipment, the generated graphic confirms the sound anomaly within a few minutes. If a particular archaeological site has any acoustic or electromagnetic phenomenon, either induced or natural, that can affect the psyche of a person, it is now possible to identify it by using the electromagnetic sensors which form part of the SBRG standard.

The electromagnetic sensors built by Demiurg are very easy for anyone with practical knowledge of electronic devices to build. Without entering into a technical description, they consist of two little condensers and one copper coil. The different diameter of the coil modifies the sensitivity of the device. The frequency response is linear from 5Hz to 99.5KHz which covers any frequency (VLF, Very Low Frequencies and LF, Low Frequencies radio waves) that could influence the microphones. The sensors can also detect natural emissions present at an archaeological site.

However, using this method it is not possible to eliminate the source of the interference, the process of clearing the recordings has to be done in the audio studio taking this into consideration.



*Fig. 7 – The sensors with different sensitivity (300Ω) normally used by SBRG during archaeoacoustical research. Built in Demiurg laboratories (Zagreb) they transform electromagnetic impulses from the environment, into electrical impulses used by the digital recorder*

Pro Tools ver. 9.06 software for Mac is used to analyze the various recorded tracks, Praat version 4.2.1 from the University of Toronto and Audacity open-source program version 2.0.2, both for Windows PC are also used. Before recording, a spectrum analyzer (Spectran NF-3010 from the German factory Aaronia AG) was used to search for other electromagnetic phenomena that could be present in the surrounding environment which could have a negative influence on the results.

## Results

Cybele's Temple includes a pit surrounded by bricks reliably identified as a "fossa sanguinis" (bloody pit): the space within which the worshipers of Cybele carried out the rite of "Taurobolium". During this ceremony, the faithful stood below while above there was a priest standing on a sturdy grille where a bull was sacrificed. The worshiper would then be bathed in the blood of the bull. It was believed that this was a rite of extraordinary power conducted in connection with the imperial cult. But here in Cybele's Temple maybe there is a distortion, because the "fossa sanguinis" is too small to accommodate a bull, which would have been sacrificed outside. Probably in these rites something else was sacrificed, not in the Roman tradition.



Fig. 8 - *What remains of the temple of Cybele today: only the base.*

In this study, recordings were taken at a number of locations following the orientation of the temple (which is not perfectly oriented to the east, but is offset by approximately 10 degrees to the south). Powerful vibrations understood to be coming from the movement of underground water, were discovered, which varied depending upon where the microphones were placed. The same procedure was repeated on two separate visits to the site in July and November 2013 to compare and confirm the results.

The sound coming from the basement has a continuous frequency of 18-20 Hz, such frequencies could easily have had a direct effect on the psyche of anyone participating in any rituals, like standing in the belly of Mother Earth (Debertolis, Tirelli & Monti, 2014). Creating an atmosphere of excitement, while immersed in the darkness of the womb of the Great Mother, or rather inside the "*fossa sanguinis*".

We found that the temple was oriented to follow the direction of the infrasound and low frequency vibrations coming from an underground flow of water. This movement of water was captured on the recordings. Nothing similar to these sounds or frequencies found within Cybele's temple were found at other locations in the palace (25 samples), or for example around the palace's perimeter or in a pond just outside the perimeter.

Only in the area of the former public baths, were any vibrations found, these were likely be as a direct result from the source of thermal water which evidently once flowed into this structure.

The graph in figure 9 shows the frequencies found at the "*fossa sanguinis*". These low frequencies and infrasounds would certainly have contributed to a general atmosphere of excitement and/or fear in those participating in any rituals inside this temple. For this last theory we can refer to the psychological studies of Lindstrom and Zubrof on fear and amazement in ancient sites (Lindstrom & Zubrov, 2014) For an overview of the different vibrations that can be perceived in the temple of Cybele, or outside of this, it is useful to take a look at the graphic chart of the recordings taken there.

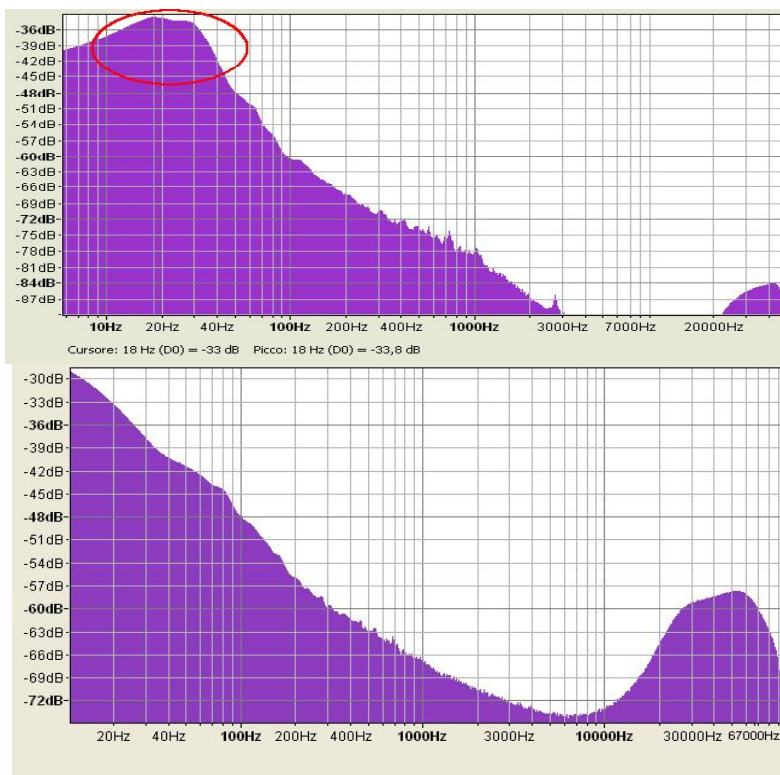


Fig. 9 – Graphs of the recordings made in and around the Temple of Cybele. **Above:** there is a strong peak of low frequencies and infrasounds inside the "*fossa sanguinis*". **Below:** the recording taken outside the temple on the stone where bulls were sacrificed, showing no specific sounds (the peak of ultrasounds at the end of the curve is only an artificial aspect of the ultrasensitive microphones)

As you can see from the plots above, there are no peaks outside of the temple of Cybele, the graph looks flat even though the sacrifice stone positioned directly in front of the temple is at a distance of almost fifteen meters away. The peak at the end of the curve is only an artifact imposed by the microphones which become unreliable above 60.00Hz.

## Discussion

It was found that this line of low frequencies perfectly followed the direction of the temple base along the orientation of the "*fossa sanguinis*" (10 samples), this could offer an explanation as to why the temple was built there as its anomalous orientation offers the maximum effect from the low vibrations below the ground. The most likely source of which coming from the movement of underground water: at one time Felix Romuliana had a working thermal baths in its south-east corner where some frequencies of water were recorded among the ruins. So its quite possible other sources of water can be found at the palace, creating the infrasound along the axis of Cibele's Temple.

We can also say that the link between underground water and special sites exists on a world-wide scale. Venda-speaking people of northern South Africa, for example, link powerful spirits to the rumbling noises generated by flowing water deep down within specific cavernous mountains. Certain Mississippian period mound sites in limestone karst country of the eastern USA were built immediately above hidden caverns with flowing water and the mounds were topped with council houses/temples. The First and Second Jewish Temples and the current Muslim Dome of the Rock are directly above water-filled caverns of the limestone Temple Mound.

The question is: how were the Roman builders able to detect this vibration without modern instruments? The ancient Romans had a great regard for a particular category of priests the *auguri* who were considered the sensitive people of that time. Titus Livius wrote in his book *Roman History* that no decision in war or in peace was taken in ancient Rome before consulting the *collegium* (board) of *auguri* (Titus Livius, book VI). This collegium was formed of 15 members who were chosen by the 'dictator' Silla, but their decisions (which were not about predicting the future), always needed the approval of the Gods (Titus Livius, book I).

The àuguri were a special group of priests within the larger group of *aruspici*. Their job since the time of the Etruscan culture was to interpret and understand the will of the Gods. This tradition has its origin from the first days of Rome and some historians set this tradition from Romulus' time (Squadrilli, 1961; Beard, North & Price, 1998). Many modern people remember that the *àuguri* interpreted the flight of the birds and for this reason they had a wooden bent rod called a "*lituum*", whose function was to limit the number of birds visible in the sky so their behaviour could be observed. Few people however, remember that this *lituum* was also used as a divining rod, indeed the art of dowsing was known to the Roman's since the time of the Etruscans.

As the mother of an emperor it is highly plausible that Romula would have been able to obtain the services of the Roman *àuguri*, to find the optimum location and orientation for her temple. Today dowsing is considered a pseudo-science, but one of our collaborators re-enacted this ancient àuguri tradition of detecting natural phenomena by using a pair of copper dowsing rods. They discovered underground water present at a number of locations in two forms; a 'blind spring' along with a number of water veins emanating from it. According to dowsers, a blind spring is created when primary water travels towards the surface of the earth in a vertical direction, but without breaching it. A number of veins usually emanate from the spring, dispersing the water. Of interest is that at the same location this water was found, the sensitive sound recording equipment recorded infrasounds.



*Fig. 10 – Sound recordings at Felix Romuliana palace*

## Conclusions

Archaeoacoustic analysis of this Roman site offers another way to interpret some of this palace's mysteries that standard archaeological procedures are unable to establish. Felix Romuliana Palace represents a good example of how to resolve an anthropologic question about possible uses and customs of people in a certain historical timeframe. In this archaeoacoustic theory Cybele's temple had a different orientation in respect to the rest of the buildings situated within the perimeter of the Palace's walls, all of which are aligned along the *decumanus* the Roman standard to orientate buildings which can be found at other sites (as for example Jove's temple).

There is evidence anomalous vibrations have a strong effect on human brain activity like those found along the axis of Cybele's temple and in particular in the *fossa sanguinis*, it therefore seems unlikely this feature was utilized merely by chance. There has to be a logical explanation as to why the temples orientation exactly follows the propagation of these strong vibrations, given they are in contrast with the traditional orientation found on the rest of the site. It is reasonable to suppose that the Roman culture had knowledge of the effect of these vibrations on human brain activity and it is a pity that only nowadays medical research begins again to recognize the relationship between sound and emotionality (Debertolis, Tirelli & Monti, 2014; Debertolis, Coimbra & Eneix, 2015). With the Fall of the Roman Empire and almost a thousand of years of darkness, Humanity lost not only a stable form of state that also now inspires our laws, but all their technology and knowledge too. But archaeoacoustics allows this knowledge to be re-discovered using new technologies and methods to support archaeology.

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## Notes

(1) Note. SB Research Group (SBRG) is an international and interdisciplinary project team of researchers (Italian, Croatian, Serbian, English and Finish members) researching in anthropology and archaeoacoustics of ancient sites and temples in Europe ([www.sbresearchgoup.eu](http://www.sbresearchgoup.eu)).

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