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THE ORIENTATION OF THE MITHRAEA IN OSTIA ANTICA

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ABSTRACT

We conducted an investigation on the orientations and geometrical content of the Mithraea of Ostia Antica. A geometrical CAD study based on the most reliable plans from the Archives of the *Sovrintendenza Speciale per il Colosseo, il MNR e l'Area Archeologica di Roma - Ostia Antica*, aside with the identification of geometrical and numerical schemes and associated length units, allowed us to identify the axes of the Mithraea. Then the orientations of the axes were measured on field by means of a professional compass with $\pm 0.5^\circ$ uncertainty. The distribution of these measured azimuths follows the topography of the city. On the contrary, the *Decumanus*, the main street of the town, presents an indubitable orientation toward the Winter Solstice Sunset. This was ascertained by measuring the coordinates of four significant points along the street with the help of a palmar Trimble GPS which averages 100 measures per point.

The exceptional density of Mithraea in Ostia led us to suppose that a symbolic cosmic-solar value is to be searched in the orientation as a whole of the town itself, founded half a millennium before the first presence of Mithraism in Rome. The *Decumanus* could be considered the very holder of this symbolic value with its orientation toward the Winter Solstice Sunset, possibly making of Ostia a very special place for Mithraicism.

KEYWORDS: Ostia Antica, Mithraicism, Winter Solstice, Decumanus, Orientation of Ancient Shrines, Ancient Geometry, Triads of Integers, Roman Length units.

1. INTRODUCTION

Mithra is the god of a religion of salvation and of a mystery cult widely spread throughout the Roman Empire from the end of the 1st Century AD until the destruction of Mithraea after the establishment of Christianity as the state religion of the Roman Empire in the second half of the 4th century AD.

A cosmological cult of a god Mithra is also attested from the 2nd millennium BC in India, Iran and the Near East. Many historians of religion perceives a continuous line from the God of the Vedas and the Indo-European area of the 2nd millennium BC to the Roman Mithra (see, e.g. Turcan, 2000; Ries 2004; Sauer, 2012 and references therein). However, Beck (1998; 2006), introducing a new, hermeneutical method to study the mysteries of Mithra, warns against exaggerating the importance of the Iranian inheritance on the Roman Mithraism.

Whatever was its origin, the mystery cult of Mithra, in the form in which it has developed in the Roman Empire, is a cosmic religion. It aim to join the Earth and the Sky with an astrological doctrine that explains the universe with the devotees ascending to the divine world and win immortality with a series of ritual practices (Merkelbach 1984). It is therefore not surprising that this cult is full of astronomical symbolism. Many are the astrological references in the decorations of Mithraea. In the Mithraeum of the *Sette Sfere* (Seven Spheres) in Ostia a representation of a cosmic geography has been recognized, where the seven planets (as in the Mithraeum of *Felicissimo*) and the twelve signs of the zodiac are represented (Gordon, 1976). It has been suggested that each of the seven spheres drawn on the mosaic floor corresponds to a step of the hierarchy that characterized the initiatory path but also to a step of the ladder that through the seven celestial spheres leads to Heaven (Gordon, 1976).

This strong influence of astrology is certainly related to the influence of the neo-Pythagorean and Platonic doctrines, very popular in the Roman Empire in the first centuries of our era (Turcan, 1975; Ries, 2004). Following Beck (2006), the Mithraeum is a model of the Graeco-Roman universe as it was

conceived in Platonic philosophy: the Mithraeum allowed the initiate to experience once again the descent of his soul from the heavens and to experience its exit back to the heavens.

The same Tauroctony, focal point of all Mithraea in the Roman Empire, has a cosmological content: the sacrifice of the bull is the saving act that generates the cosmos and all forms of life (Ries, 2004 and references therein). The Sun and the Moon appear at the edges of the representation of the Tauroctony. Sometimes, the signs of the zodiac are above the scene.

In a rich epigraphic documentation, we find also the dedicatory formula "*Dei Soli invicto Mithrae*" and surely Mithraism was advantaged by the popularity of solar cults in imperial times (Ries, 2004).

Ostia Antica has the highest known concentration of Mithraea. Because of this reason, as part of a broader research on the architectural planning of the Mithraea in Ostia Antica (Gaudenzi et al., 2012), we have performed on field measurement of their orientation, searching for a possible astronomical symbolism.

2. EXPERIMENTAL METHOD AND DATA ANALYSIS

At first we performed a geometrical CAD study on the most reliable plans from the Archives of the *Sovrintendenza Speciale per il Colosseo, il MNR e l'Area Archeologica di Roma - Ostia Antica* for the 16 presently known Mithraea of Ostia (Figure 1). For each of these Mithraea we identified the geometrical and numerical scheme, the associated length units and the axis.

Then, with the collaboration of the *Sovrintendenza Speciale per il Colosseo, il MNR e l'Area Archeologica di Roma - Ostia Antica*, we measured in Ostia Antica the orientation of 15 Mithraea (being not accessible the 16th, the *Aldobrandini* one) and of the *Decumanus*, that is the leading directional element of the Roman street system (Figure 4).

We successively performed a DBSCAN Cluster Analysis on the measured azimuth data of the Mithraea.

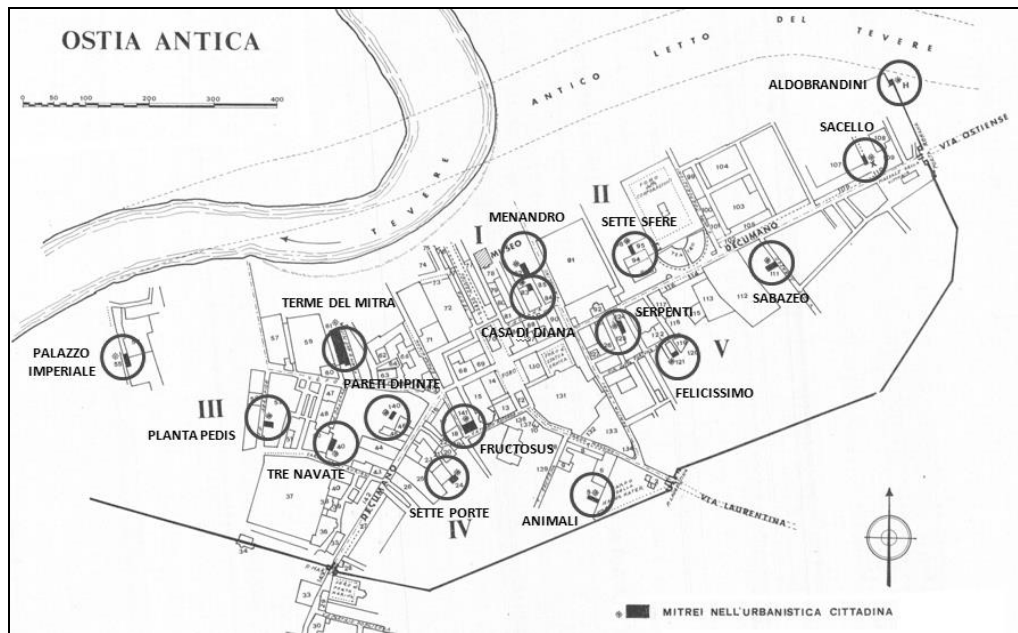


Figure 1. The positions of the 16 Mithraea in Ostia Antica

3. GEOMETRICAL ANALYSES

This type of analysis has already demonstrated a valid and suited tool to arrive at the geometrical features of ancient architectural structures: the intended geometric forms, the length-units used at the ancient building yard and the associated integer numbers describing the lengths. In particular, the squaring of rectangular parts is attributed to those combinations of small integer numbers that are suited to determine a right angle (that is, the Pythagorean Triads of integers) or an “almost right” angle, that is, sufficient for building purposes (Quasi-Pythagorean Triads). A complete explanation of the method and its background can be found in Ranieri (1997). A list of these combinations is reported in table I.

Table I. Pythagorean and Quasi-Pythagorean Triads of integers

Symbol	TRIAD (A-B-C)	r (B/A)	α (° ')	Symbol	TRIAD (A-B-C)	r (B/A)	α (° ')
Q	5 5 7	1.0	1 9	4/W	18 30 35	1.6666	0 3
Q	7 7 10	1.0	1 10	2/SB	11 19 22	1.7273	0 16
Q	12 12 17	1.0	0 12	1/3	15 26 30	1.7333	0 4
Q	17 17 24	1.0	0 12	MA	4 7 8	1.75	1 1
V	20 21 29	1.05	0 0	MB	12 22 25	1.8333	0 20
VA	15 16 22	1.0667	0 21	M	8 15 17	1.875	0 0
VB	13 14 19	1.0769	0 38	MC	12 23 26	1.9167	0 19
VC1	10 11 15	1.1	1 2	2Q	4 8 9	2.0	0 54
VC2	18 20 27	1.1111	0 24	2Q	9 18 20	2.0	0 53
S	8 9 12	1.125	0 24	2Q	13 26 29	2.0	0 20
SA	13 15 20	1.1538	0 53	2QA	13 27 30	2.0769	0 10
SB	19 22 29	1.1579	0 16	2QB	9 19 21	2.1111	0 10
SC	11 13 17	1.1818	0 12	2VC1	5 11 12	2.2	1 2
W/2	20 24 31	1.2	0 54	1/5	9 20 22	2.2222	0 29
SD1	14 17 22	1.2143	0 7	WA	10 23 25	2.3	0 30
SD2	17 21 27	1.2353	0 5	W	5 12 13	2.4	0 0
3/W	20 25 32	1.25	0 3	WB	10 25 27	2.5	0 28
D	3 4 5	1.3333	0 0	WC	11 28 30	2.5455	0 28
LDR	19 27 33	1.4205	0 3	φ ²	5 13 14	2.6	0 53
LD	16 23 28	1.4375	0 5	1/7	11 29 31	2.6364	0 5
G/2	13 19 23	1.4615	0 7	2D	6 16 17	2.6667	0 54
L	10 15 18	1.5	0 11	1/8	6 17 18	2.8333	0 17
LA	17 26 31	1.5294	0 16	G	12 35 37	2.9166	0 0
π/2	7 11 13	1.5714	0 22	3Q	6 18 19	3.0	0 16
φA	10 16 19	1.6	0 54	π	7 22 23	3.1429	0 45
φP	28 25 53	1.6071	0 0	-1/10	6 19 20	3.1667	0 45
φB	11 18 21	1.6364	0 35	2LVC	7 23 24	3.2857	0 21
LVC	14 23 27	1.6429	0 21	GA	7 24 25	3.4286	0 0
GA/2	7 12 14	1.7143	1 1				

Examples of this type of analyses can be found, among others, in Ranieri (2000) for prehistoric Turkmenistan, in Malgora (2001) for ancient Egypt, in Ranieri (2002) for ancient Sardinia, in Ranieri (2005; 2011) for Etruscans, in Ranieri (2007) for the Myceneans, in Ranieri (2008b) for Mesosoamerica, in Ranieri & Polcaro (2009) for the Levant, in Ranieri (2014) for Greek temples, in Labianca et al. (2008), Ranieri & Monaco (2014), Monaco et al. (2010) for Roman architectures.

We would like to stress that the technique to use Pythagorean (or Quasi-Pythagorean) Triads of integers to obtain right angles in buildings applies to all ancient civilizations (and it is known to have been in use since recent times) and therefore cannot be considered as typical of Mithraea.

Figure 2 shows, for eight only of the 16 Mithraea, the obtained geometrical schemes, numerical combination and related length units. The large majority of the Mithraea are constructed inside re-adapted spaces. Nonetheless, as it can be seen in Figure 2 and in Table II, the very space of the Mithreum was carefully designed, for all the 16 Mithraea, with the use of precise squaring combinations of numbers (Pythagorean and Quasi-Pythagorean triads of integers) by utilizing the same length units, that is Roman feet (pr), cubits (cr) and palms (pa = 1/2cr). Of course, the finding of Roman length units is to be considered as normal.

The results of the geometrical CAD analysis are reported in Table II.

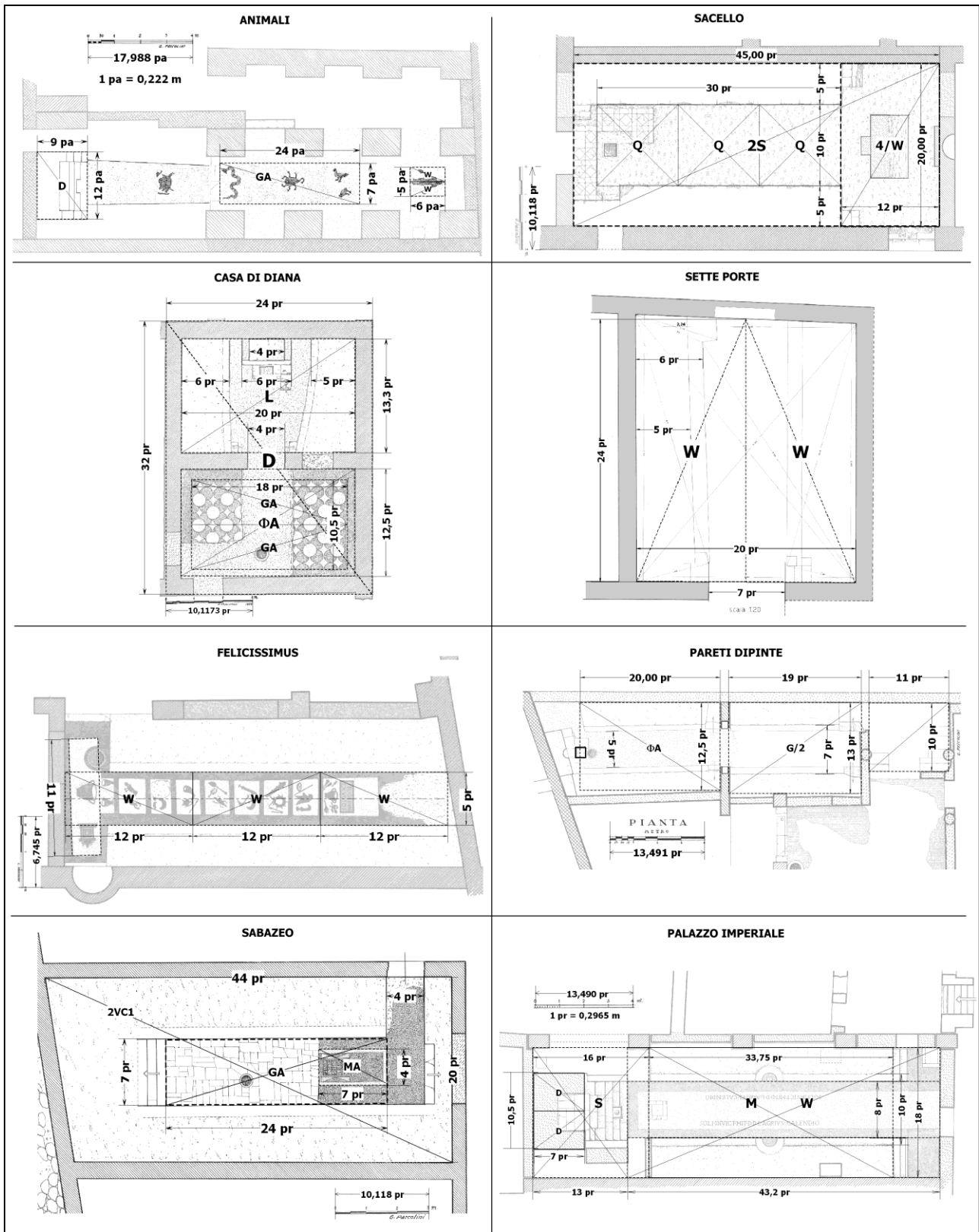


Figure 2. Geometrical schemes, numerical combinations and related length units resulting for some Mithraea (in Table II the complete results)

Table II. Pythagorean and Quasi-Pythagorean Triads of integers identified in the Mithraea and the corresponding length units

ID	MITHRAEUM	LENGTH UNIT (±0.0005)	TRIADS
1	Animali	pa=0.2220m	D=3-4-5 (x3), GA=7-24-25, W=5-12-13 (x1/2)
2	Casa di Diana	pr=0.2965m	D=3-4-5 (x9), L=10-15-18(x4/3), ΦA=10-16-19(x5/4), GA=7-24-25(x3/4)
3	Felicissimo	pr=0.2965m	W=5-12-13
4	Fructosus	pr=0.2965m	D=3-4-5 (x5)
5	Menandro	pr=0.2965m	D=3-4-5 (x3), MA1=15-27-31
6	Palazzo Imperiale	pr=0.2965m	S=8-9-12(x2), W=5-12-13 (x18/5), M=8-15-17(x9/4), D=3-4-5 (x7/4)
7	Pareti Dipinte	pr=0.2965m	ΦA=10-16-19(x5/4), G/2=13-19-23
8	Planta Pedis	pr=0.2965m	2D=6-16-17, 18-39-43(x1/3), 2M=8-30-31(x1/2)
9	Sabazeo	pr=0.2965m	2VC1=5-11-12(x4), GA=7-24-25, MA=4-7-8,
10	Sacello	pr=0.2965m	2S=24-54-59(5/6), Q=10-10-14, 4/W=36-60-70 (x1/3)
11	Serpenti	pr=0.2965m	WB=10-25-27 (x8/5), Q=12-12-17(x4/3), Q=7-7-10, L=10-15-18(x2/5)
12	Sette Porte	pr=0.2965m	W=5-12-13 (x2)
13	Sette Sfere	pr=0.2965m	D=3-4-5 (x2)
14	Terme del Mitra	pr=0.2965m	W=5-12-13, M=8-15-17(x3/2), G=12-35-37, D=3-4-5 (x3)
15	Tre Navate	pa=0.2220m	L=10-15-18(x2), MC=12-23-26(x5/2)
16	Aldobrandini	cr=0.4440(2/5)	D=3-4-5 (x4), D=3-4-5 (x3), GA/2=7-12-14, Q=7-7-10

4. ORIENTATION OF THE MITHRAEA

Being Ostia Antica at sea level and bordering on the sea, azimuth data are sufficient to characterize the orientation of the Mithraea. On place, after the identification of the axes, the measurements were done with a professional compass (±0.5° uncertainty). The distribution of the azimuths is reported in Figure 3. Azimuths are intended from North to East and are meant from the interior (altar) outward: the obtained values are reported in Table III.

ic layout of the street system of the town departing from the *Decumanus*.

Table III. Azimuth values for 15 Mithraea of Ostia Antica.

ID	Mithraeum	Azimuth (°)
1	Animali	110.0
2	Casa di Diana	148.0
3	Felicissimo	231.0
4	Fructosus	241.0
5	Menandro	327.5
6	Palazzo Imperiale	156.0
7	Pareti Dipinte	22.0
8	Planta Pedis	81.0
9	Sabazeo	241.0
10	Sacello	333.0
11	Serpenti	328.0
12	Sette Porte	225.0
13	Sette Sfere	150.0
14	Terme Del Mitra	339.0
15	Tre Navate	16.5

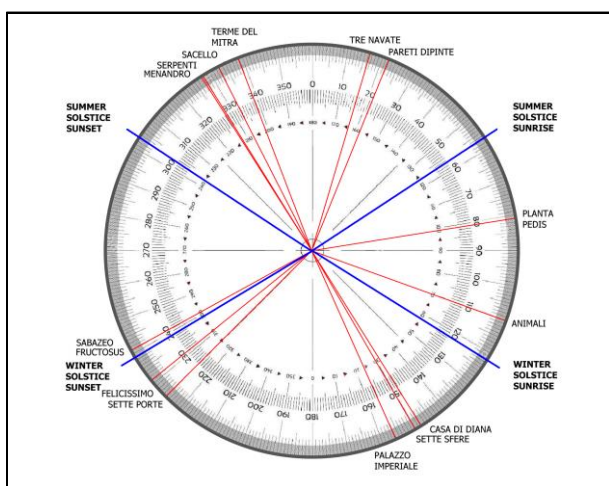


Figure 3. Distribution of the Mithraea azimuths.

At first sight, the distribution does not present any preferential orientation. In fact, the orientations of the Mithraea are bound to the orientations of the pre-existing structures, which follow the topograph-

In order to reveal the presence of possible grouping in the azimuth data, a Cluster Analysis was performed with a reasonable discriminating criterion: 10° is the maximum distance between two elements belonging to the same cluster. We used the open-source MATLAB script made by Yarpiz (2015)¹ as an implementation of the DBSCAN data clustering algorithm proposed by Ester et al. (1996). From our

¹ www.yarpiz.com/255/ypml110-dbscan-clustering

analysis four different groups emerge: the first between 225° and 241° corresponding to Mithraea 3, 4, 9, 12; the second between 327° and 339° corresponding to Mithraea 5, 10, 11, 14; the third between 16° and 22° corresponding to Mithraea 7, 15; the fourth between 148° and 156° corresponding to Mithraea 12, 13, 6.

Further studies will investigate if these groupings can be related to possible hierophanies inside the mithraea, such as, for example, the one discovered in the so-called “Neo-Pythagorean Basilica” of Porta Maggiore in Rome (Lbianca et al., 2008), produced by alterations to the building design (such as opening of light shafts or similar). Level of preservation does not allow this study in most cases. However, this possibility is worth to be further analyzed.

5. ORIENTATION OF THE DECUMANUS

The main part of the *Decumanus* extends from the entrance to the older *Porta Marina* of the *Castrum* where it bifurcates in two branches. The upper branch is supposed that brought to the ancient fluvial harbour (Goiran et al., 2014) while the other to the coastal *Via Severiana* (Fogagnolo and Valenti, 2005; Bruschi, 2015). We performed a series of measurements with a palmar Trimble GPS (which averages 100 measures per point) along the main part of the *Decumanus*. As the *Decumanus* is not a unique straight line, the coordinates of four points were measured to take account of this (Table IV).

Table IV. Coordinates of the four points along the *Decumanus* as taken with the averaging GPS

Point	Latitude N			Longitude E		
	Degr.	Min.	Sec.	Degr.	Min.	Sec.
P1	41	45	24.96	12	17	40.98
P2	41	45	20.22	12	17	29.76
P3	41	45	16.32	12	17	21.30
P4	41	45	13.26	12	17	14.70

The first point (P1) corresponds to the *Porta Romana* entrance; the second (P2) is in correspondence of the theatre, the third and the fourth (P3 and P4) are at the known entrances of the ancient *Castrum* (Figure 4), the first settlement of the colony of Ostia. The bearings of the three segments are reported in Table .

By means of Stellarium² we determined the Solsticial azimuth for year 400 BC:

Winter Solstice Sunset (WSSS) 237.941°

Summer Solstice Sunrise (SSSR) 56.746°

As it can be seen in Table , the bearings of the three segments between the four points diverge from the bearing of WSSS from a maximum value of 2° 32' 5"

² www.stellarium.org/it/

to a minimum of a mere 0° 11' 53" for P3-P4 just corresponding to the *Castrum*.

The Cluster Analysis performed on the Azimuth data of the Mithraea confirms that their orientations follow the topographic layout of the street system. In fact, the first group (the one between 225° and 241°) point out that *Fructosus* and *Sabazeum* orientation differs very little from the *Decumanus* bearing, while the third and fourth groups are orthogonal to it. The alignments of the second group appear to conform to the direction of the deviated portion of the *Decumanus* toward *Porta Marina*.

Table V. Bearings of the three segment between the four points: *Castrum* corresponds to P3-P4

SEGMENT	BEARING	DIFF. (WSSS)	DIFF. (SSSR)
P1-P2	240.4756	2° 32' 5"	3° 43' 47"
P2-P3	238.2835	0° 20' 33"	1° 32' 15"
P3-P4	238.1389	0° 11' 53"	1° 23' 35"

The obtained results are not surprising because solar orientations are not uncommon in Roman *Castra* (see, e.g., Magli, 2008; Gonzales Garcia & Magli, 2014; Bertarione, 2014), although in many cases it appears that the practical mentality of the Roman overruled the symbolic principles. The winter solstice night was of particular importance in the Republican era, being the central point of the festivities dedicated to *Sol Indiges*, the archaic solar god (Torelli, 1990).

It is manifest that this orientation, in itself, has nothing to do with Mithraism, since Ostia was founded at the beginning of the 4th Century BC, while the Mithraism spread in Rome half a millennium later. However, we will suggest in the conclusion why this circumstance should have some interest in the present context.

6. DISCUSSION AND CONCLUSIONS

Our study on the Mithraea of Ostia Antica shows that:

- Pythagorean and Quasi-Pythagorean triads of integers were used in the arrangement of the available space for the Mithraea;
- all the Mithraea are based on the same length units;
- the distribution of the axes does not present any preferential orientation but follow the topographic layout of the street system built departing from the *Decumanus*.
- Finally, the *Decumanus* of Ostia Antica is oriented toward the Winter Solstice Sunset.

As conclusion, we would suggest a few considerations justifying an apparent higher density of Mithraea in Ostia Antica with respect to Rome.

Between the Second and the Third Century AD, the epoch of its maximum expansion, Ostia reached a population of 50000 people, while it is evaluated that in the same epoch Rome had from 450000 to one million inhabitants (Storey, 1997; Dyson, 2010).

We know that at least 16 Mithraea were present in Ostia, but, following Vermaseren (1956), two further mithraea were excavated in Ostia during the 19th Century and are presently lost. Bakker (1994) suggests a total of 24 mithraea in Ostia. Considering that a community of about 20 believers used each Mithraeum (Ries, 2004), these figures suggest a diffusion of the Mithraism on about 0.65% - 1% of the population, a percentage that is not far from the estimate given by Ries (2004) from historical and archaeological evidences. By assuming that the same percentage of Mithraic believers was present in

Rome at the same epoch, they should have been between about 4500 and 10000 and use more than 200 Mithraea. At present, the estimate of the number of Rome's Mithraea by various scholar varies between 700 and 2000 (Dyson, 2010), depending from the assumed diffusion of this religion.

However, we presently know only nine Mithraea in Rome, while hints from various sparse archaeological findings suggest the presence of a few tens of others (40, following Dyson, 2010). We have to increase fivefold this number in order to reach the minimum estimate of Mithraea in Rome. Considering that the area of the city of Rome is the subject of intensive excavations, for various reasons, all supervised by law by an archaeologist, it is very unlikely that still at least 150 undiscovered mithraea are present in Rome.



Figure 4. The solstitial orientation of Ostia Antica. P1: porta romana; P2: the theatre; P3 and P4: the entrances of the Castrum.

The relatively smaller number of mithraea in Rome with respect to Ostia should be explainable by a number of hypothesis:

- The diffusion of Mithraicism in Ostia was wider because of sociological reasons. Actually, Ostia population included some seventeen thousand slaves (Dyson, 2010), mostly coming from Near East, the possible area of origin of

Mithraicism. However, the percentage of slaves on the Rome population was more or less the same, as well as their origins.

- Mithra mysteries were particularly diffused in Roman Army and Ostia have a strong presence of the Roman military fleet. On the other hand, Rome too had, at the same epoch, an extremely high military presence.

- The destruction of Mithraea when the Christianity became the state religion of Roman Empire was more intense and effective in Rome than in Ostia. Actually, Rome was the major center of the Christianity and it is quite possible that the fighting of the pagan cults was stronger than elsewhere. However, Ostia is just a 20 km from Rome and there is no reason to assume that there was there a higher tolerance for the Mithra cult.

All these factors could have contributed to left such a higher presence of mithraea in Ostia with respect to Rome, but cannot totally explain it.

We thus suggest a further factor.

It has been reported that Mithraea in the northernmost regions of the Empire are generally East-West oriented (Campbell, 1968; Merkelbach, 1984). Madlenović (2009) have interpreted the identical orientation of two Roman mausoleums at Gamzigrad and Šarkamen in Dacia as related to Orion, to the Winter Solstice and in turn to Mithras. Beck (1976) stress the role of the East-West orientation of the mithraeum in Ponza to understand the symbolism of

the zodiac represented on the ceiling of the cult niche.

In Rome and Ostia, portions of free land for constructing Mithraea *ex novo* were not easily (and/or cheaply) available. Mithraea occupy thus readapted spaces in pre-existing buildings, thus following the orientation of the streets bound to the topographic pattern. Rome had at that epoch (and still has) a street system that is randomly oriented and centred on the *Capitolium*. On the contrary, the Mithra believers found in Ostia a solar orientation, being the town developed, since its foundation, along the *Decumanus* oriented along the Summer Solstice Sunrise - Winter Solstice Sunset direction. Actually, three of the 15 measured mithraea have their axis approximately oriented along this direction, while 7 other have their axis approximately at 90 degrees from the solstitial line: these orientations could have made easier to build an opening in the right position to generate hierophanies inside the mithraea at the solstices.

However, it should also be possible that placing a Mithreum in Ostia, no matter which his specific orientation, could have had a symbolic value just for the symbolic orientation of the whole town.

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REFERENCES

- Bertarione S. (2014), *Ecco come nasce la Roma delle Alpi*, Archeologia Viva, XXXIII, pp. 70-72.
- Bakker, J.T. (1994), *Living and working with the gods: studies of evidence for private religion and its material environment in the city of Ostia (100-500 AD)*, Warszawa, JC Gieben.
- Beck, R. (1976), Interpreting the Ponza Zodiac: I. *Journal of Mithraic Studies* 1, pp. 1-19.
- Beck, R. (1998), The Mysteries of Mithra: a New Account of their Genesis, *Journal of Roman Studies*, 88, pp. 115-128.
- Beck, R. (2006), *The Religion of the Mithras Cult in the Roman Empire: Mysteries of the Unconquered Sun*, Oxford, Oxford University Press.
- Bruschi A. (Ed.) (2015), *Portus, Ostia Antica, via Severiana. Il Sistema archeologico paesaggistico della linea di costa di Roma imperiale*, Roma, DiAP Print.
- Campbell L.A. (1968), *Mithraic Iconography and Ideology*. Leiden, Brill.
- Dyson S. L. (2010), *Rome a living portrait of an Ancient City*, Baltimore, The John Hopkins University Press.
- Ester M., Kriegel H.P., Sander J., Xu X. (1996), *A density-based algorithm for discovering clusters in large spatial databases with noise*. In Simoudis E., Han J., Fayyad U. (eds.). Proceedings of the Second International Conference on Knowledge Discovery and Data Mining (KDD-96). Portland, AAAI Press, pp. 226-231.
- Fogagnolo S., Valenti M. (2005), *Via Severiana*, Roma, Istituto Poligrafico e Zecca dello Stato.
- Gaudenzi, S., Preite Martinez, M., Bernardini, M.L., et al., (2012), *Studio interdisciplinare sui mitrei di Ostia Antica*, In V.F. Polcaro (ed.) Atti del XII Convegno SIA, Albano Laziale, Italy, 5-6 October 2012, Napoli, La Città del Sole, pp. 201-217.

- Goiran J.P., Salomon F., Mazzini I., Bravard J.P., Pleuger E., Vittori C., Boetto G., Jonatan Christiansen J., Arnaud P., Pellegrino A., Pepe C., Sadori L. (2014), *Geoarchaeology confirms location of the ancient harbour basin of Ostia (Italy)*, 41, pp. 389-398.
- Gonzales Garcia C. & Magli G. (2014), *Roman City Planning and Spatial Organization*, in Clive Ruggles (ed.) *Handbook of Archaeoastronomy and Ethnoastronomy*, pp. 1643-1650.
- Gordon R.L. (1976), *The sacred Geography of a Mithreum: the example of Sette Sfere*, *Journal of Mithraic Studies*, 1, pp. 119-175.
- Labianca L., Sciortino I., Gaudenzi S., Patané A., Polcaro V.F., Ranieri M. (2008), *An archaeoastronomical study of the neo-Pythagorean basilica at Porta Maggiore in Rome*, *Proceedings of the SEAC 2007 and Oxford VIII Conference Astronomy and cosmology in folk tradition and cultural heritage*, *Archaeologia Baltica*, Klaipeda University Press, 10, 195-199.
- Madlenović D. (2009), *Astral Path to Soul Salvation in Late Antiquity? The Orientation of Two Late Roman Imperial Mausolea from Eastern Serbia*, *American Journal of Archaeology*, 113, pp. 81-97.
- Magli G. (2008), *On the orientation of Roman towns in Italy*, *Oxford J Archaeol*, 27, pp. 63-71.
- Malgora S. (2001), *L'uso dei numeri e la ritualizzazione delle strutture cerimoniali nella topografia monumentale di Saqqara*, Thesis, Bologna University.
- Merkelbach R. (1984), *Mithras*, Königstein Verla Anton Hain Miesenheim GmbH.
- Monaco M., Gaudenzi S., Ranieri M., (2010), *Among the circles: a geometrical analysis of the Teatro Marittimo in Villa Adriana*, *Proceedings of the 18th SEAC 2010 Conference Astronomy and Power*, Gilching, Germany, in press.
- Ries J. (2004), *Il culto di Mitra dall'India vedica ai confine dell'Impero Romano*, Milano, Jaka Book.
- Ranieri M. (1997), *Triads of Integers: how space was squared in ancient times*, *Rivista di Topografia Antica Journal of Ancient Topography*, VII, pp. 209-244.
- Ranieri M. (2000), *The Development of Architectural Forms of Prehistoric Turkmenistan*, *South Asian Archaeology*, *Proceedings of the 14th International Conference of the European Association of South Asian Archaeologists*, Roma, Is.I.A.O., II, pp. 593-615.
- Ranieri M. (2002), *The stone circles of Li Muri: geometry alignments and numbers*, *Proceedings of the 14th SEAC Conference Lights and Shadows in Cultural Astronomy*, Isili, Sardinia, pp. 58-67.
- Ranieri M. (2005), *La geometria della pianta del tempio urbano di Marzabotto (Regio I – Ins. 5)*, in *Culti, Forma Urbana e Artigianato a Marzabotto*. Nuove prospettive di ricerca, Ante Quem, Dipartimento di Archeologia Università di Bologna, Bologna University Press, 11, pp. 73-87.
- Ranieri M. (2008), *A geometrical analysis of Mesoamerican pre-hispanic architecture: squaring triads, numbers, length units and the calendar*, *Proceedings of the SEAC 2007 and Oxford VIII Conference Astronomy and cosmology in folk tradition and cultural heritage*, *Archaeologia Baltica*, Klaipeda University Press, 10, pp. 183-194.
- Ranieri M. (2008b), *The Pythagorean geometry of the Atreus tholos tomb at Mycenae*, *Proceedings of the SEAC 2007 and Oxford VIII Conference Astronomy and cosmology in folk tradition and cultural heritage*, *Archaeologia Baltica*, Klaipeda University Press, 10, 2pp. 11-213.
- Ranieri M., Polcaro A. (2009), *Early Bronze Age geometry in the Dead Sea region at Tel Arad and Bab edh-Dhra' numerical squaring, harmonic compositions and length-units*, *Proceedings of the 17th SEAC 2010 Conference From Alexandria to al-Iskandariya: Astronomy and culture in the ancient Mediterranean and Beyond*, Alexandria, Egypt, in press.
- Ranieri M. (2011), *Himera and Pyrgi: the diagonals and the alignment of the temples*, *Proceedings of the 19th SEAC 2011 Conference Stars and Stones: Voyages in Archaeoastronomy and Cultural astronomy*, *BAR International Series 2015*, Oxford, 2720, pp. 94-98.
- Ranieri M. (2014), *Digging the archives: the orientation of Greek temples and their diagonals*, *Proceedings of the 21st SEAC 2013 Conference Astronomy: Mother of Civilization and Guide to the Future*, Athens, *Mediterranean Archaeology & Archaeometry*, 14, 3, pp. 165-174.
- Ranieri M., (2014), *Geometrie Pitagoriche e circolari nella pianta del Pantheon adrianeo*, *Proceedings of the 11th S.I.A. 2011 Conference Il Dentro e il Fuori del Cosmo*, Bologna, pp. 15-27.
- Sauer, E. (2012), *Mithras and Mithraism* in *The Encyclopedia of Ancient History*, Oxford, Jhon Wiley and sons pp. 4551-4553.
- Storey G. R. (1997), *The population of ancient Rome*, *Antiquity*, 71, pp. 966-978.
- Torelli, M. (1990), *Riti di passaggio maschili di Roma arcaica. Mélanges de l'Ecole française de Rome. Antiquité*, 102 (1), pp. 93-106.

-
- Turcan R. (1975), *Mithras Platonicus*, Leiden, Brill, coll. Études Préliminaires aux Religions Orientale dans l'Empire Romaine. 47.
- Turcan, R. (2000), *Mithra et le mithriacisme*, 2nd edn., rev., Paris. Les Belles Lettres.
- Vermaseren, M.J. (1956), *Corpus Inscriptionum et Monumentorum Religionis Mithriacae*, The Hague, Martinus Nijhoff.