

# The importance of the azimuth of sunrise and sunset in Archaeoastronomy: in memory of Francesco Giannini, collaborator of the ICRANet School Department

## Content

### Abstract:

A fundamental tool in Cultural Astronomy and Archaeoastronomy is the measure of the azimuth of sunset/sunrises and of typical landmarks as seen from a given position, or from the axis of a temple or church.

This experience was made on the Adriatic sea in front of Pescara by using a fixed webcam, in the period 1 March-5 July 2022, as an exercitation for the student of the local Lyceum Galilei.

The algorithm to obtain the rising azimuth in case of low clouds on the line of sight with the horizon is described, also with two practical examples (3 and 4 July) as well as a discussion on the parabolic fit of solstice data, using the ones obtained at the red lens in the Dome of St. Maria degli Angeli Basilica in Rome.

This lecture is in memory of Francesco Giannini (1945-2022) collaborator of ICRANet and expert of Abruzzo traditions and Cultural Astronomy, who passed away on July 4th.

**Keywords:** azimuth, linear extrapolation, celestial mechanics, parabola, fit, didactic, paint, excel, stellarium, Francesco Giannini, archaeoastronomy, cultural astronomy

**Cultural Astronomy**, also known as Archaeoastronomy, is a discipline which helps to understand the astronomical observations and calculation techniques and knowledges in the past, when no books were written, and where the information were left in the orientation of religious buildings, whole cities or sighting sites. Ancient notions of celestial mechanics are also hidden in particular alignments between sites and mountain skylines.

**Francesco Giannini (1945-2022)** was the scholar who knew better that places in Abruzzo region, and became a faithful collaborator of ICRANet in divulging these knowledges to the public, especially the Lyceum students in contact with our School Department since 2015. Constantly eager to know new developments of this rather new discipline, Giannini was known, met in person and corresponded with nearly all experts of it in Italy. His love for Abruzzo's traditions was much wider than Archaeoastronomy and he founded associations of Quarrymen and of Bagpipers of Abruzzo. He studied deeply the Shepherd's Transhumance.

**The measurement of the sunrise's azimuth** is made using a fixed webcam looking at the sea horizon of Pescara since before the spring equinox till after the fall equinox.

We are using a fixed reference point in the foreground (SE corner of "La Prora" building), and the coordinates  $y$  to the horizon level and  $x$  towards left (+) or right (-).

The data of each sunrise are the dimensionless azimuth  $a_i = x/y$ , and the time  $t_i$  of sunrise.

The comparison with the ephemerides of Stellarium allows to obtain the parallax angles to extrapolate the solar path down to the horizon in the case of clouds' covering (that are 5 times more probable at the horizon with respect to the zenith). The video explaining the method has been recorded in Pescara ICRANet Carlo Pace conference hall on July 4th.

<https://youtu.be/UXdrzU9Y7pw>

while a practical example on 3rd and 4th July azimuth is shown here

<https://youtu.be/RWHPciEfBmE>

This experience has been developed with the students of Galileo Galilei Lyceum of Pescara, in the present year 2022, starting from an idea of January 2020 presented to the students of Galileo Ferraris Technical Institute of Rome.

A parabola is obtained in this way, from the data ( $t_i$ , azimuth $_i$ ) and it is possible to analyze it with modern tools, now available in many spreadsheets softwares (quadratic fit).

The discussion on the parameters' definition of such parabola, and on its errorbars is made by changing the experimental points azimuth $_i$  with a small perturbation, compatible with the measurement's uncertainties.

The example is not made on the azimuth series, because it will be the students' final product, but on the solstice appulse of the red solar image to the center of the Cupola of St. Maria degli Angeli in Rome.

A playlist in youtube is available here [https://www.youtube.com/playlist?list=PLJaer2KV492\\_45qXrFXUP-fBlv-xhB9aE](https://www.youtube.com/playlist?list=PLJaer2KV492_45qXrFXUP-fBlv-xhB9aE)

with data from 29 May to 6 July.

It is possible to recover the instant of the summer solstice by fitting a parabola on them, and noticing the “solstice’s asymmetry” due to the aphelion position 2 weeks after the solstice: the minimum of the fitting parabola does not correspond to the solstice’s instant, but it drifts forward as more days including the aphelion enter in the dataset.

The discussion is recorder here <https://youtu.be/GfTkTAKsDIc>

on these data from Santa Maria degli Angeli summer solstice red lens (made by the Mexican astronomer Salvador Cuevas Cardona in 2000).

### **Francesco Giannini Obituary**

This argument is presented in memory of Francesco Giannini (1945-2022) who passed away this July 4th 2022. He was probably the first to scholarly study the ancient astronomical traditions of Abruzzo, starting from the point of view of the shepherds, and of the natural alignments of the mountains as seen from particular point of view. He found many of these alignments all over the region, using the compass and the ruler and always going in place to verify the hypothesis. Nowadays these procedures are greatly simplified by using google maps and Stellarium (ephemerides softwares), but the on-site observations remain necessary.

Francesco visited many locations of astronomical interest, and cooperated to valorize and save them, as in the case of the Church of the Madonna delle Piane

([https://drive.google.com/drive/u/2/folders/1uWdVhv3FmedLkL95ruL\\_aBzEXAqmnTTn](https://drive.google.com/drive/u/2/folders/1uWdVhv3FmedLkL95ruL_aBzEXAqmnTTn))

of the beginning of XIV century, restaured in 1610 and very recently, with the building of the new Church next to it. This Church’s axis is toward the azimuth=223°, the smaller for sunset of the whole year (21 december), due to the Gran Sasso slopes in that direction. The new building maintained the same orientation, thanks to his contribution to the local authorities. In that church on July 5th 2022 his funeral was celebrated. The proves of that archaeoastronomical hypothesis are either geometrical and observational, because the mountains skyline is irregular and a verification in the correct days is always required.

His heritage left in the culture of Abruzzo region is invaluable, and we will miss his humble mastership.

**Conclusions:** The solstice’s parabola of the sunrise azimuth requires a great accuracy to show the solstice’s asymmetry. We proposed a method to limitate the parallaxes’ errors and to obtain more data in case of low clouds. Francesco Giannini encourage us and the students to become active parts in the observations.

Once he said to me “I don’t get tired when I do something I love.” And he said that talking about checking particular sunrises in special locations of Abruzzo, where he conducted me with the power of the imagination...

Good bye Francesco, we will not forget your teaching and we will miss you deeply!

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