

Annual quasiperiodicity in muon rate observed by PolarquEEEst detectors at 79° N

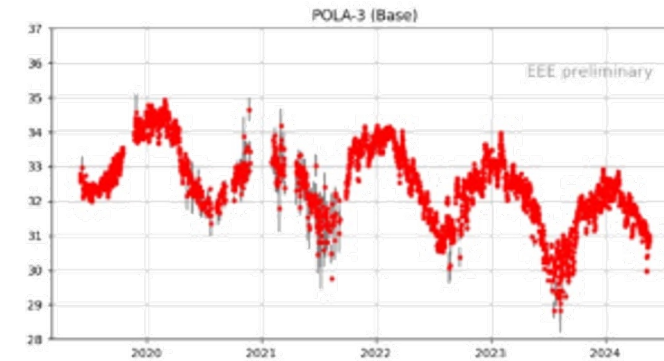
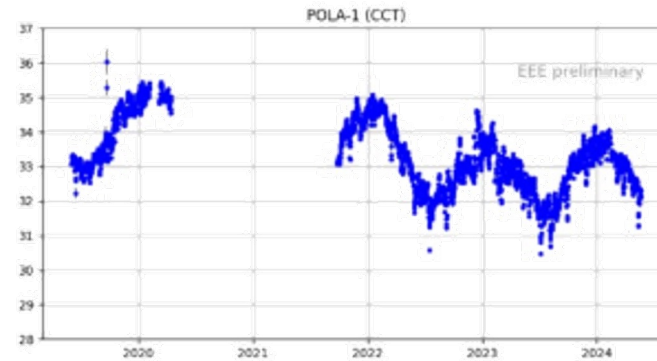
Since 2019

Muon rate recorded by the 3 POLA-R detectors binned over 12h

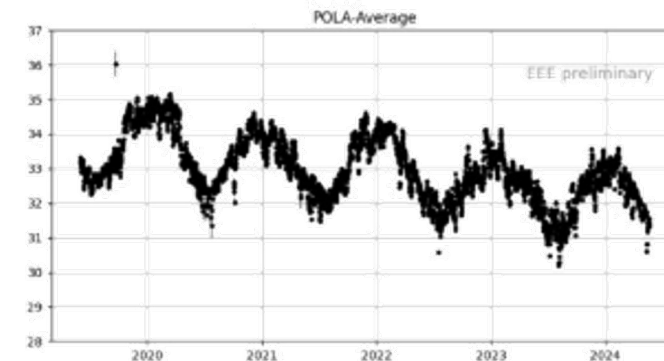
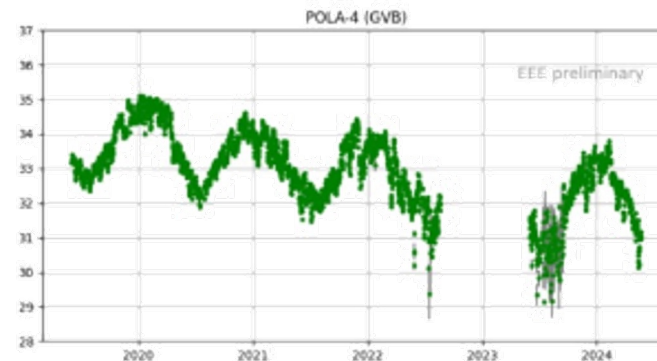


3 scintillator detectors permanently installed at Ny Alesund – Svalbard

(The detectors are part of the EEE Project)



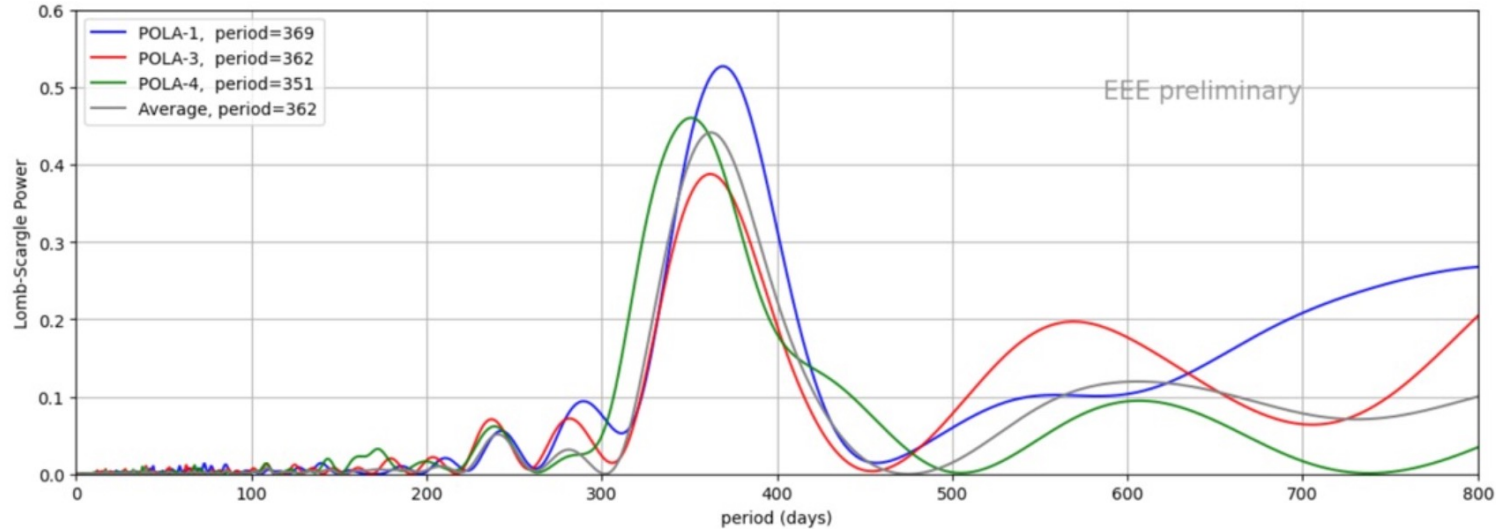
The gaps are due to malfunctioning periods, power failures and other data taking issues.



Evident **oscillating component** with a period of about **one year** observed

Preliminary analysis of the muon rate time series after collecting **5 years of data**

Applying the *Lomb-Scargle periodogram technique**,
it is possible quantify the annual component and verify its independence
from environmental and experimental factors.



Frequency power plotted as a function of the period expressed in days

**Lomb-Scargle periodogram technique*,
based on sinusoidal fit optimization,
developed in astronomy for frequency
analysis of irregularly spaced data,
consisting of least-squares fitting of
sinusoidal waves.

The highest peak corresponds to the dominant periodicity:

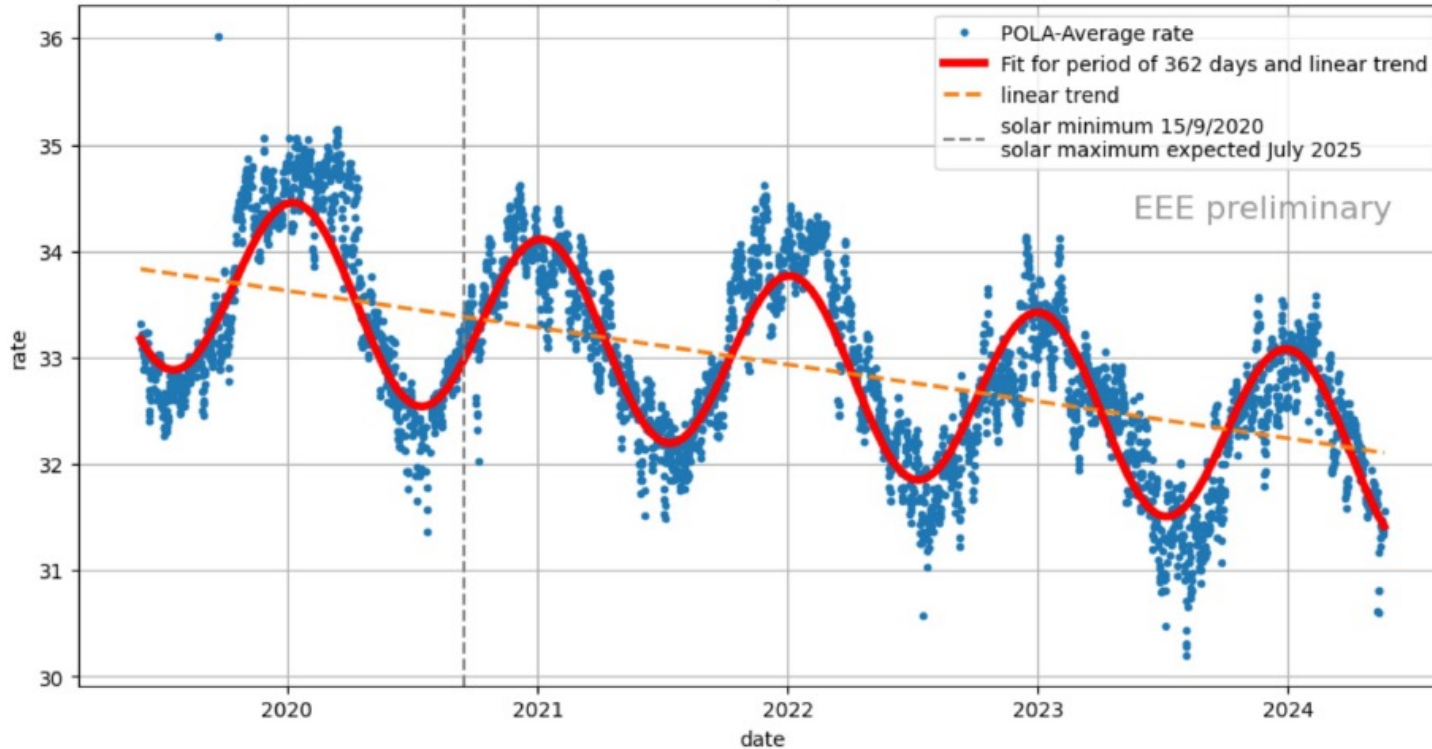
POLA-R muon rates have an evident periodic oscillation, whose duration is between 350 and 370 days, with a maximum occurring between the 1st and the 15th of January, compatible with an annual periodicity.

The implemented method consents to build a periodic model.

Quasiperiodic rates for POLA-R



POLA-A rate and periodic model



Average rate with the first **periodicity model**

The annual model fits very well with the main oscillations in the muon rate.

The decreasing trend is likely related to the undecennial solar cycle and is the subject of a further analysis.

Conclusions

The present preliminary study qualifies as a starting point for future analysis:

- the residual decreasing trend suggests the existence of a possible periodicity with a long period, that will need a longer time series to be exploited
- with a different binning and a careful selection of events studies of possible higher frequencies are also being carried out
- comparison with other muon detectors and neutron counters may also give indications about the nature and origin of these oscillations.