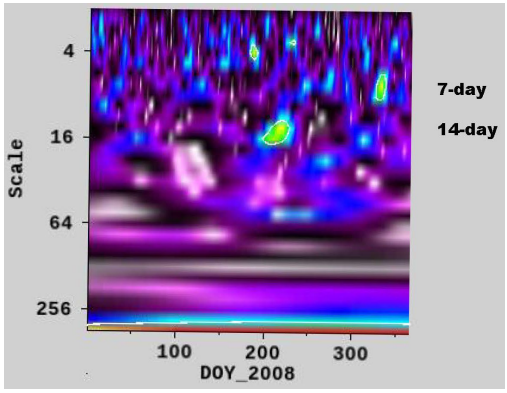
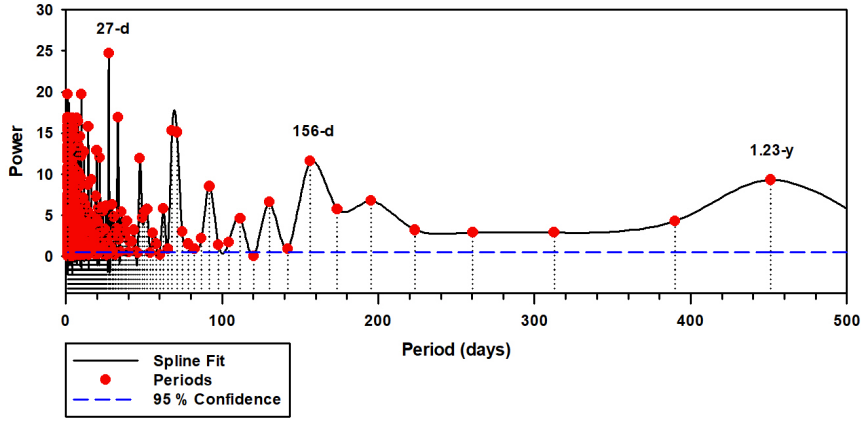
Behaviour of different periodicities in galactic cosmic particles as observed by ACE during solar cycles 23 and 24

Pieter Kotzé
Centre for Space Research, North-West University, Potchefstroom, South Africa
Department of Physics, Stellenbosch University, Stellenbosch, South Africa

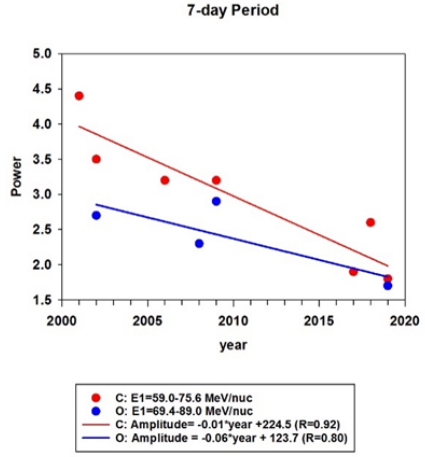
Abstract: **Periodicities in galactic cosmic particles like C, N, O and Fe as observed by the ACE satellite between 1997 and 2019 have been analyzed using various spectral analysis techniques. Daily mean energetic particle measurements are used to identify how several harmonics of the ~ 27-day synodic rotation period change during each individual year. Lomb-Scargle and Morlet wavelet spectral analysis of galactic cosmic particle data at different energies revealed in particular that the fourth harmonic (~7-day) of the solar rotation period occurs exceptionally strong during the minimum of solar cycle 23 (2008, 2009) when A< 0 (solar dipole pointing South) in comparison to the minimum of cycle 24 (2018,2019) when A> 0 (solar dipole pointing North). The results obtained in this investigation showed that galactic cosmic particles as observed by the ACE satellite exhibit peculiar short-term periodicity behaviour as a result of solar polarity dependent magnetic drifts during a negative minimum which is in line with previous results using neutron monitor data from Hermanus and Jungfraujoch (P Kotzé, Solar Physics, 2020).**



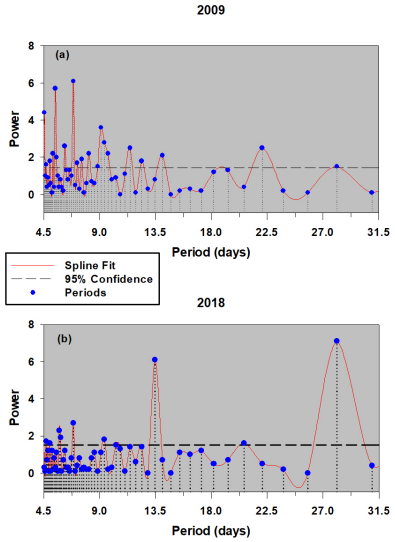
Morlet wavelet analysis of Fe during 2008 (150.4 MeV/n) above and 2018 (150.4 MeV/n) below.



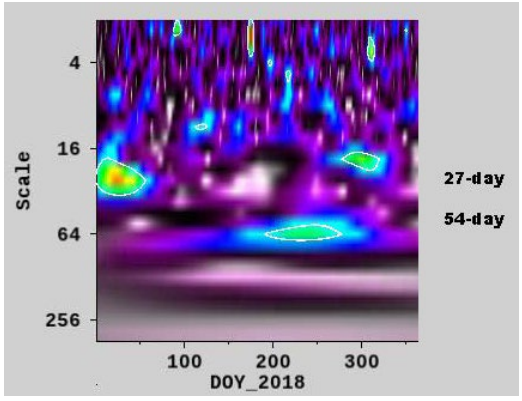
Lomb-Scargle periodogram of Fe (150.4 MeV/n)for the interval 1997 – 2019.

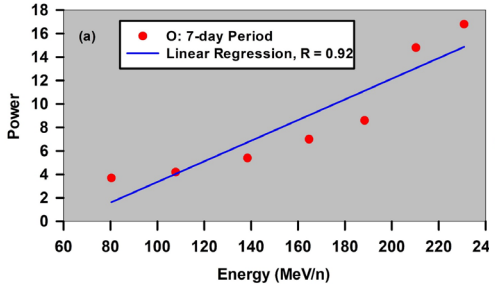


Temporal behaviour of C and O 7-day periodicity during 2000 – 2019.

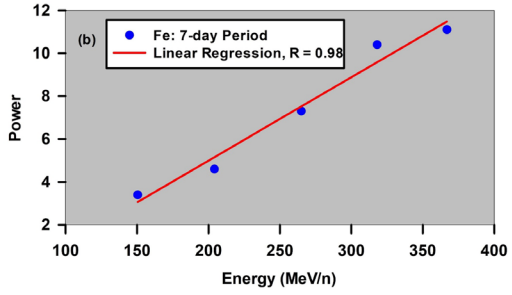


Lomb-Scargle spectral analysis of O (80.4 MeV/n) during 2009 (a) and 2019 (b)





Behaviour of O 7-day periodicity as a function of energy.



7-day periodicity behaviour in Fe as a function of energy.

Conclusions and Summary:

1. Spectral analysis revealed solar polarity dependant behaviour of the fourth harmonic (~ 7-day) of the solar rotation period.
2. 7-Day periodicity much stronger during A<0 solar mInimum (2008,2009) in comparison to A>0 minimum (2018,2019).
3. Energy-dependence of 7-day periodicity exhibits a linear increasing function of energy. Rieger period (~155 day) as well as the 1.3-yr periodicity, linked to the solar dynamo, detected in GCR particles.