

Supermodulation of the solar cycle

Raphaël Raynaud (CEA)

Steve Tobias (University of Leeds)

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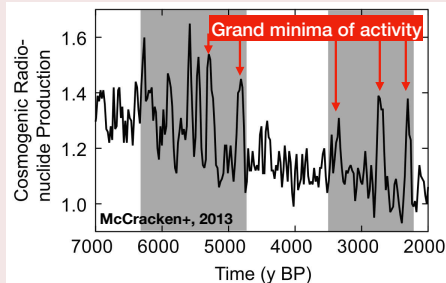
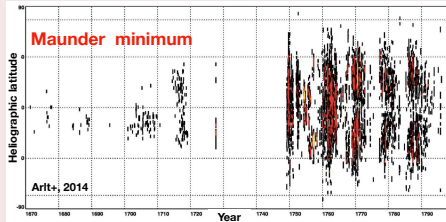


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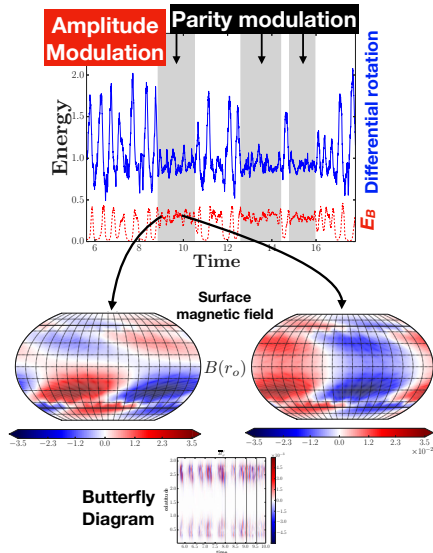
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Observations

- Solar cycle modulation



3D direct numerical simulation



Results

- 1st evidence of supermodulation in 3D direct numerical simulations (chaotic alternance between amplitude modulation phases and parity modulation phases devoid of grand minima)
- reminiscent of the variations of the solar activity
 $\tau_{\text{wave}}^{\text{solar cycle}} (\sim 10 \text{ yr}) \ll \tau_{\text{amp. mod.}}^{\text{de Vries cycle}} (\sim 10^2 \text{ yr}) \ll \tau_{\text{super mod.}}^{\text{Hale cycle}} (\sim 10^3 \text{ yr})$
- parity interactions may govern the long term modulation of solar magnetic activity

References

- McCracken *et al.*, 2013, Solar Phys., 286, 609 [\[ADS\]](#)
- Weiss & Tobias, 2016, MNRAS, 456, 2654–2661 [\[ADS\]](#)
- Raynaud & Tobias, 2016, JFM, 799, R6 [\[ADS\]](#)
- Beer, Tobias & Weiss, 2018, MNRAS, 473, 1596-1602 [\[ADS\]](#)