HELIOSEISMOLOGY

Shaken to the core

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After 40 years of searching, astronomers have detected the gravity waves that propagate through the core and radiative zone of our nearest star: the *g* modes of the Sun. These waves have so far eluded firm detection because they do not extend to the surface layers of the Sun — they are evanescent — and their signatures have been occluded by noise and the pressure waves (*p* modes) that dominate those surface regions. However, by studying data collected over 16.5 years from the Global Oscillations at Low Frequencies (GOLF) instrument on board the Solar and Heliospheric Observatory (SOHO), Eric Fossat and collaborators have managed to statistically identify the contributions of the *g* and *p* modes to the very low frequency oscillations of the Sun's surface. The measured *g* modes indicate that the core of the Sun is rotating roughly once per week (7.04 ± 0.10 d) — about four times faster than the Sun's radiative envelope, which has a rotation period of ~25 d at the equator and ~35 d at the poles.

To achieve this *g* mode measurement, the authors plotted an echelle diagram: the frequency separation between even and odd pairs of *p* modes (the so-called semi-large separation, which is proportional to the mean density of the Sun) as a function of frequency. By taking the most linear parts of this diagram, which are sensitive to the deepest material, they were able to identify a frequency regime (2.32–3.74 mHz) reasonably free from surface effects. Stacking ~35,000 power spectra in this frequency range, they computed the round-trip travel time of a pressure wave through the solar centre (4 h 7 m), and inferred that modulations of this *p* mode value are the signature of the *g* modes shaking the Sun at its core.

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