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Long period oscillations in sunspots: period persistence and phase response to eruptive activity

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Long period oscillations in the microwave radiation intensity generated over the sunspot of NOAA AR 10330 are studied with the Nobeyama Radioheliograph as the sunspot passes over the solar disk, over the course of 9 days (06-15 April 2003). Fourier, periodogram and global wavelet analysis reveal the presence of a significant oscillatory component in the range P $\approx$ 50-120 min over the course of the observations. The ground-based nature of the instrument naturally introduces long data gaps in such long duration observations. To investigate phase changes in the dominant oscillatory component, we make use of the cross-correlation between signals and the time delay theorem of the Fourier transform, reducing the limitation imposed by the data gaps. Possible phase changes in the dominant component (P $\approx$ 107 min) are seen to coincide with configuration changes in the region; large decreases in phase occur after a filament disappearance and a flare. As a model to explain the persistence of the dominant long periods, a simple oscillator with a nonlinear driving term is proposed.