Long-Term Variability of Three-minute Compressible Waves in the Solar Corona

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Abstract

Long-term observation (30 June to 4 July 1998) was performed by TRACE over active region AR8253 at full spatial resolution (0.5 arcsec/pixel) over half FOV 512×512 pixels in two EUV bandpasses (171Å and 195Å). The cadence was about either 41 s or 30 s for both EUV bandpasses, 195Å images were normaly captured about 11 s later than the 171Å ones. The data contained several gaps, but the observations covered about 70% and 40% of the time interval in the 171Å and 195Å bands, respectively. In the magnetic fan that forms the leading (Western) part of the active region, propagating periodic variations of the EUV intensity are seen clearly in both bands for almost five days. Our analysis shows that the variations are harmonic with very high quality in both bands. The period is estimated as 179 ± 14 s in the 171Å and 183 ± 16 s in the 195Å bands. The periodicity is found to be persistent and not significantly varying during the whole observation.

The propagating speed was analysed by running difference techniques. The time-distance plot is obtained by extracting the average intensity of a running macro-pixel (3×3 pixels) along a slit situated in the fan-like structure. Running difference is generated by subtracting the intensity at phase π ahead (90 s earlier). Repeated ridges in the running difference plot, indicating propagating features, are visible and persistent over the whole dataset. The Cross-Fitting technique is developed by crossly fitting the difference intensities with harmonic function propagating at constant speed. The projected speed is measured at about 47 km/s with accuracy of less than 10%, and varies around 10% - 20% at period of $1 - 2$h over days time interval.

Hough Transform is also applied to measure the ridges by binarising the running difference plot at proper threshold. The dominant peak in the Hough space is fitted with a gaussian function, which gives the slope of the ridge. The uncertainty is $\sim 15\%$ and dependent on the thresholding. The measured values confirm the correctness of Cross-Fitting technique.