JOINT CDS/EIT/MDI/SUMER/TRACE PROGRAMME

The Temperature Range of the Sunspot 3-minute Oscillations

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Scientific Justification:

This programme builds on the knowledge obtained from JOP018 about the 3-minute oscillations above sunspots, see Brynildsen et al. 1999, ApJ 511, L121, Brynildsen et al. 1999, ApJ 517, L159, Brynildsen et al. 1999, Solar Phys., in press, Maltby et al. 1999, Solar Phys., in press. Briefly, simultaneous SUMER measurements of the intensity and the line-of-sight velocity show that the observations in the chromosphere and the transition region are compatible with the hypothesis that the oscillations are caused by upward-propagating acoustic waves.

Most recently we have studied the intensity oscillations observed with the TRACE 171 Å channel above the sunspot NOAA 8580, observed on 15 June 1999. The power spectrum of the observation shows a maximum at 6.2 mHz, corresponding to a period close to 160 s. These 171 Å intensity oscillations may be an extension of the sunspot transition region oscillations into the corona. However, this result is uncertain since the oscillations occur in an area where the emission in the 171 channel is weak, most likely because the coronal Fe IX/X emission is weak. Hence, without simultaneous spectroscopic observations we cannot exclude the possibility that transition region lines, such as O VI at $\lambda\lambda$172.93, 173.08 contribute to the oscillations in the 171 channel.

To evaluate the feasibility of deriving spectroscopic information from the CDS Grazing Incidence Spectrometer (GIS) we have studied GIS observations of the sunspot in NOAA 7981, observed on 2 August 1996. Comparing the results for different locations in the NOAA 7981 sunspot region the GIS observations show that the contribution from the O VI $\lambda\lambda$172.93, 173.08 lines to the total emission within the 171 channel ranges from 3% to 17%.

We plan to increase our knowledge by simultaneous observations with:

- At least three wavelength bands of the CDS Grazing Incidence Spectrometer (GIS). The intension is to measure the relative contributions of such transition region lines as O VI $\lambda\lambda$172.93, 173.08, Ne VII λ465.22, and O V λ760.40, to the intensity oscillations.
- SUMER observations of the transition region lines O V λ629, N V λ1238, λ1242 and the chromospheric Si II λ1260 line.
- TRACE observations in the 171 channel with high cadence.
- EIT when possible: observations in the 171 channel with high cadence.
- MDI when possible: Doppler velocities and magnetic field measurements, with high spatial resolution and high cadence.

Note that CDS, SUMER and TRACE should be run without compensation for solar rotation. The starting position is in front of the sunspot, letting the solar rotation move the sunspot over the slit. Phase 1 (CDS and SUMER) should be repeated until the image of the sunspot has moved across the slit, then Phase 2 should run once. TRACE should repeat Phase A + B during the whole study.

CDS

Phase 1:
GIS Study: O_SPOT10
Spectrometer: Grazing Incidence
Slit: 4×4 arcsec
Raster Area: 4×4 arcsec
Step (DX, DY): 0 arcsec, 0 arcsec
Raster Locations: 145
Exposure Time: 17 seconds
Duration of Raster: 2732 seconds
Number of Rasters: 1
Total Duration: 2732 seconds
Line Selection: Full GIS output
Pointing: Sunspot

Phase 2:
NIS Study: O_SPOT2

Spectrometer: Normal Incidence
Slit: 2×240 arcsec
Raster Area: 120×120 arcsec
Step (DX, DY): 2 arcsec, 0 arcsec
Raster Locations: 60 x 1 = 60
Exposure Time: 20 seconds
Duration of Raster: 1430 seconds
Number of Rasters: 1
Total Duration: 1430 seconds
Line Selection: Mg VIII 315.02, Fe XIV 334.17, Fe XVI 360.76,
Mg IX 368.06, He I 522.20, O IV 554.52,Ne VI 562.83,
He I 584.33, O III 599.59,O V 629.73
Bins Across Line: 21
Telemetry/Compression: truncate to 12 bits
Pointing: Sunspot

SUMER

Phase 1:
Study: o_spot3_osc
Duration: 47 minutes

Study: o_spot3_osc_f
Duration: 46 minutes (n times)

Phase 2:
Study: o_spot3_rast
Duration: 34 minutes

TRACE

Phase A:

Channel: WL
Exposure Time: 0.0032 seconds ?
Image Area: 768 pixels×768 pixels
Pixel size: 0.5 arcsec
Number of images: 1
Duration: 0.0032 seconds
Pointing: Sunspot

Phase B:

Channel: 171
Exposure Time: 17 seconds
Image Area: 768 pixels$\times$768 pixels
Pixel size: 0.5 arcsec
Number of images: 160
Duration: 2720 seconds
Pointing: Sunspot

EIT

For a limited data set: Channel 171 with high cadence

MDI

When possible: Doppler velocities and longitudinal magnetic field with high cadence