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Two days in the life of AR10486

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Abstract. Magnetic and acoustic properties of the complex active region AR 486 are analyzed for two consecutive days: October 28 and October 29, 2003 when two large flares of magnitude X17.2 and X10 were produced, respectively. Using the technique of helioseismic holography we detected seismic waves emitted from these flares at 6 mHz. SOHO-MDI white light images, magnetograms, and Dopplergrams are used to study the physics of the acoustic sources.

1. Detection of seismic sources

AR10486 is a complex region that flared many times during the period 2003 October 28 – November 4. The flare of October 28 had a maximum soft X-ray GOES flux at 11:10 UT (the flare started at 09:51 UT and ended at 11:24 UT) while the flare of October 29 culminated at 20:49 UT, starting at 20:41 UT and ending at 21:01 UT.

We used the technique of helioseismic holography (Lindsey & Braun (1997), Donea, Lindsey & Braun (1999)) to image seismic sources of acoustic waves at 6 mHz that travelled away from the flaring regions. Fig 1g and Fig 1h show 5–7 mHz egression power maps at 11:11 UT, October 28 and 20:49 UT, October 29, when the acoustic signatures fully developed. The acoustic deficit from magnetic regions as well as a surrounding 6 mHz acoustic emission halo are also prominent features in these maps. For the flare of October 28, we identify two conspicuous spatially extended seismic sources of the following dimensions: 18.2 Mm×15.4 Mm (FP1) and 11.2 Mm×8.4 Mm (FP2). Donea, Lindsey (2004) find that these sources are strongly correlated with the footpoints of a large coronal loop apparent in TRACE images. Smaller regions of enhanced 6 mHz egression power are also apparent. They are related to the footprints of other small coronal loops. The seismic sources FP1 and FP2 also co-align with the features that appear in the magnetic field difference frames of Fig 1i. However, these features are likely to be more the signature of a momentary variation in photospheric line formation than an actual shift actual magnetic configuration of the active region.

The October 29 flare produced acoustic emission with only a single acoustic source. The source region was spatially elongated (25 Mm×17.2 Mm, see Fig 1h) and aligned along the south-west to north-east direction. This is the direction of motion of the hard X-ray signature the orientation of the white flare signature seen from RHESSI, marking the eastern footpoint of a major coronal loop.

We attribute the seismic sources are the result of accelerated particles accelerated at the top following magnetic field lines to the foot points where they cause explosive heating and evaporation of the upper chromosphere. This drives a radiative shock downward through the chromosphere (Fisher, Canfield & McClymont(1985a)) that evolves into a

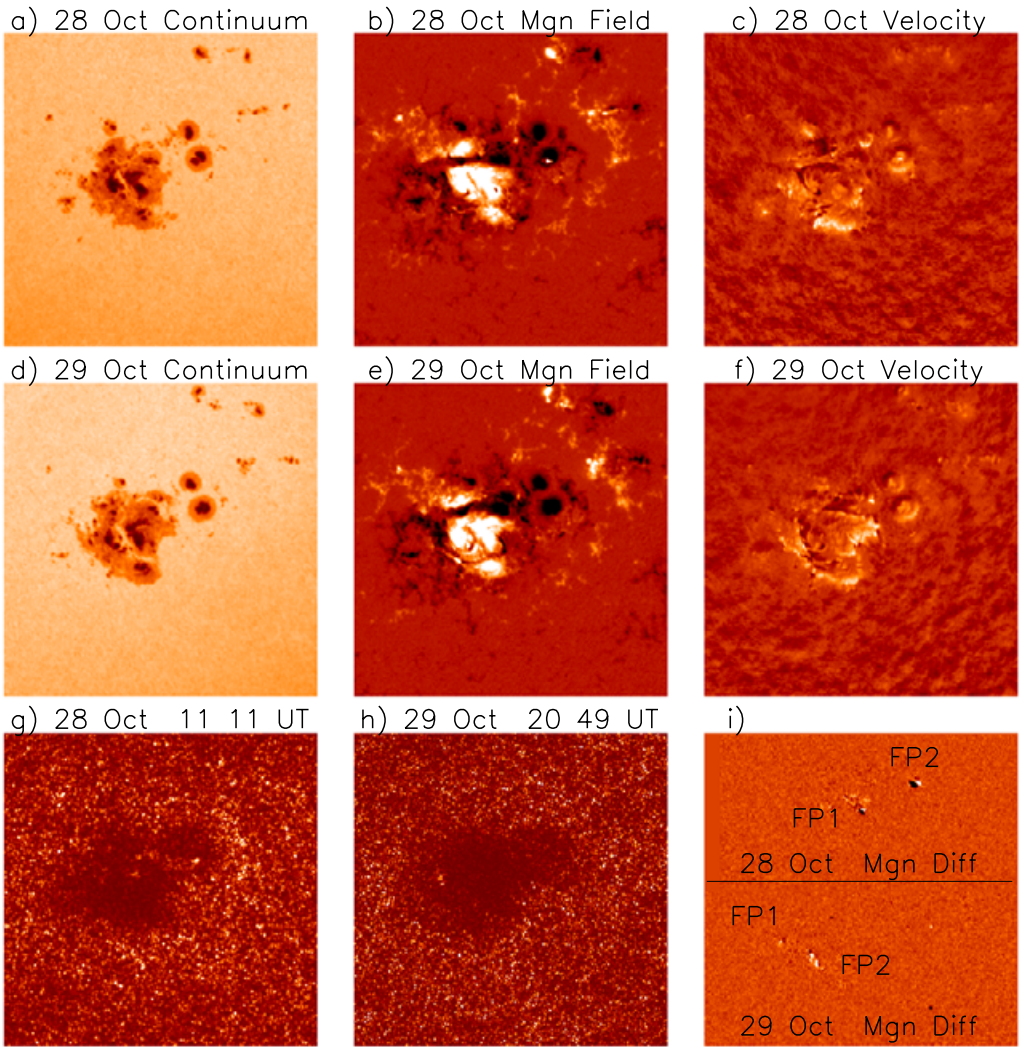

Figure 1. Montage of SOHO-MDI observations and 5–7 mHz egression power maps for the flares of 2003 October 28 (11:11 UT) and October 29 (20:48 UT)

seismic wave radiated into the solar interior. We have now detected acoustic sources of three sun quakes: 1996 July 9, 2003 October 28 and 29.

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