Thermal observations of the solar corona in the metric radio band

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Introduction: In this poster we present examples of thermal observations of the solar corona performed with the Nançay Radioheliograph (NRH). Coronal holes, filament cavities, and an eruptive event involving a sigmoïdal filament are compared with SOHO/EIT and SOHO/LASCO images.

Quiet sun structures can be mapped with a sufficient dynamic using an aperture synthesis mode over ~ 3 hours. The correlations between the East-West and the North-South arrays, used since 1996, increase significantly the quality of the maps. Figure 1 displays an observation at 4 frequencies of a meridian coronal hole in october 2000. Brightness temperatures are extremely low within the hole: $2.3, 2.7, 5.4, \leq 9 \times 10^5$K at 410.5, 327, 236.6 and 164 MHz. The contrast of the hole diminishes as the frequency decreases, probably a propagation effect, similar to what was observed in the decameter range.

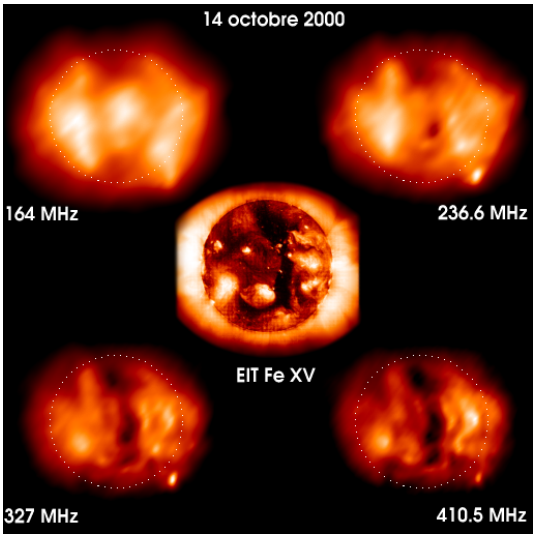

Fig.1 EIT and NRH observation of a coronal hole

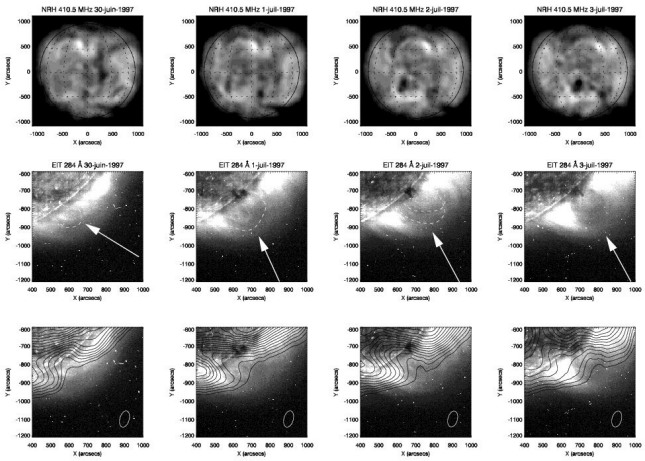

Fig.2 Synoptic observations of filament cavities.

Quiescent filaments have been recently observed as brightness depressions in the metric range with the NRH. A statistical study was performed to investigate the origin of such a depression, and led to the conclusion that the depression was due to the filament cavity and its magnetic environment. Taking into account the convolution effect by the instrumental beam, it was demonstrated that the depression was more extended than the filament itself, and that the coronal contribution to the brightness temperature should be decreased in order to get a depression. Some EUV observations of cavities, shown in Fig.2, reveals that the radio depression closely follows the shape of the cavity.

The eruptive event is related to a dark sigmoid filament that erupted near the central meridian in February 28th 2001 (upper left panel of Fig. 3). A few hours before the eruption, a parasitic polarity seen as bright point, appeared on one edge of the filament (white head arrow). A faint type III like burst, occurring at 11:20 UT near this polarity marked the beginning of the slow ascending motion of the structure on EIT. After 12:40, the radio depression (upper right panel of Fig. 3) was seen to form and to expand to the south as expected by EIT observations of the erupting phase (13:00 UT). The westward moving depression ($\Delta T_B \sim 6 \times 10^5 K$) had no EUV counterparts in Fe XII line. Dimmings were seen both in EIT and in the radio domain around the site of the eruption, as already related for sigmoid-CME associated events (not shown here). In this case a Halo CME of moderate velocity (lower than 300 km/s) was observed. Here again, the radio depression and CME peculiar substructures have the same dynamical behavior. This suggests they belong to the same magnetic structure.

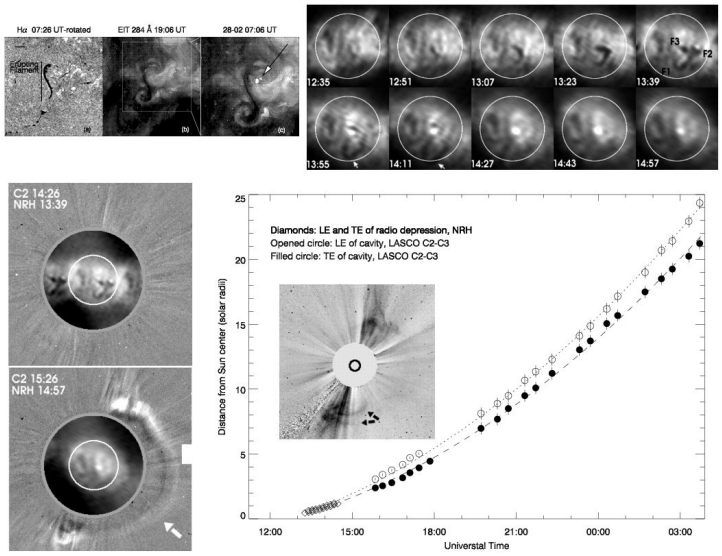

Fig.3 Synoptic view of a 'sigmoid' filament eruption on 28-Feb-01. (from Marqué et al. A&A 387,317, 2002)

Conclusion: Quiet sun structures of the corona are usually probed via thermal emission in the metric range. Among them, cavities of filaments have been observed for the first time. Low energetic release events reveal both the reconnective processes (faint non-thermal emissions), as well as the behavior of the filament and CME cavity at low altitude, and the restructuring of the surrounding corona.