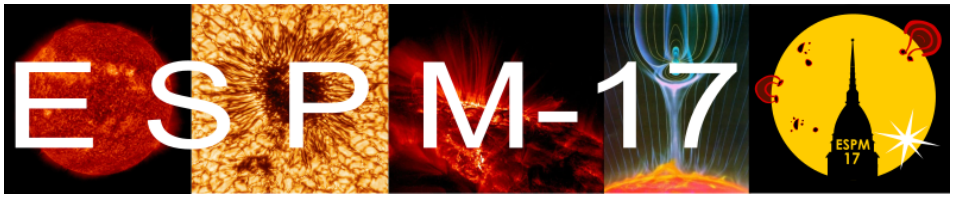

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Exploring the variable spectra and magnetic fields of the Active Regions in the chromosphere through high-frequency radio imaging: gyro-resonance emission and flare forecasting

High-frequency radio observations with large single-dish radio telescopes of the INAF network, in the context of the SunDish project, provided ~450 solar images since 2018, useful to monitor the vertical structure and physical conditions of the solar chromosphere both for quiet and active regions, during their evolution at different phases of the solar cycle.
Solar radio mapping in K-band (18-26 GHz) can probe the chromospheric magnetic field of the Active Regions through the detection of gyro-resonance spectral components related to flare events. Enhanced magnetic fields (up 1500-2000 Gauss) determine a spectral flattening (α<1.5) in the Active Regions compared to pure free-free emission (α~1.9) due to the addition of a steeper gyro-resonance component also associated to circular polarization up to ~40%.
When this sporadic anomalous Active Region spectrum is detected, the probability of a strong flare occurrence within 1-2 days is >80%, further rising at >90% also requiring that AR brightness temperature exceeds ~50% the quiet Sun level. We present several examples of 18-26 GHz radio images showing peculiar Active Region spectral and polarization configurations anticipating or following flare events, and through correlation statistics analysis, we discuss the sensitivity and robustness of this flare forecast method and the perspective of coupling it with other multi-messenger Space Weather proxies.

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Track Classification: Multi-scale energy release, flares and coronal mass ejections