MEASUREMENTS OF CHROMOSPHERIC MAGNETIC FIELDS WITH OBSERVATIONS OF POLARIZED RADIOEMISSION

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Bremsstrahlung radiation of solar (fully ionised) plasmas at microwaves becomes circularly polarized in presence of magnetic field, with polarization rate proportional to the total magnetic flux (relative to the line of sight) in resolution area. This mechanism is important because of its universality (at a high frequency band above domain of 2 - 4-th harmonic of an electron gyrofrequency ν_b).

Observations of such polarization effects opens a way to direct measurements of longitude magnetic fields B at chromosphere and corona - chromosphere transition region (TR) levels. The known practical implementations for such approach were limited before by absence of proper radiation transfer theory and lack of polarization measurements at microwaves with accuracy about 1% at centimetric waveband. Here we report for the first times some progress, based on (a) a new theoretical approach to polarization transfer and (b) on the Nobeyama radioheliograph imaging techniques (in intensity and polarization at 17 GHz). We discuss here two most major problems: how to discriminate between contributions from corona and chromosphere to observed intensity and polarized emission brightness and (b) how to localise estimated magnetic fields to proper (chromospheric, TR or coronal) heights in atmosphere.

We attempted to solve these problems by matching theory, tomography models, and observations with mm-cm band imaging (Metsahovi and Nobeyama at 87 - 17 GHz) in intensity, and from published and current microwave polarization measurements (WSRTR, RATAN, NOBEYAMA) for the plage area(s), sunspot(s) and the coronal holes in frequencies range 17 - 2 GHz.

First preliminary results on relation between values of chromospheric and photospheric magnetic fields show much more of expected a penetration rate of magnetic fields from photosphere to upper chromosphere and corona above plage area(s), and rather complicated patterns of magnetic structures for a strong sunspot magnetic fields.

These results show the importance of microwave methods for magnetic field studies in the solar chromosphere and may lead (with expected growth of resolution in future) to 3D-reconstruction of magnetic field structures between photosphere and corona from combined microwaves-optical observations.