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The anisotropic Debye Shielding as visible in sunspot photosphere

Recent measurements, that now allow 3D mapping of the solar magnetic field vector, as well as past astrophysics literature, coincide about the surprising feature that the vertical gradient of the magnetic field |dBz/dz|, which is found about 3 G/km, is not compensated for by the horizontal gradient |dBx/dx + dBy/dy|, which is found about 0.3 G/km only, in sunspot photosphere. The departure from zero of their combination to form divB is much larger than the estimated measurement uncertainties. A test of the observational result will be presented. I assign this feature to a plasma effect, the Debye shielding, but anisotropic as in plasma located at the surface of a star. The horizontal Froude number is found to be on the order of a few 1e-

2. The solar photosphere plasma is however dominated by neutral hydrogen atoms, whose density is on the order of 1e16 atoms per cubic centimetre, whereas the electron density is about 1e12 electrons per cubic centimetre only. Thus the magnetization remains small. I will present how the Debye shielding when anisotropic is able to explain how the gravity, which makes the velocities anisotropic by strong stratification, thus makes the shielding anisotropic, which results in an apparent magnetic flux non-conservation for the magnetic field created by the moving charges. Interesting experimental results in an also anisotropic plasma, also displaying measured non-zero divB, are available in the literature (Gekelman et al., 2012, ApJ, 753, 131 and Gekelman et al., 2016, Phys. Scr. 91, 054002).

Biography

Véronique Bommier, born in 1954, is "ancienne eleve" of the "Ecole Normale Superieure de Jeunes Filles". She was formed about quantum mechanics by Pr Cohen-Tannoudji at the "Ecole Normale Superieure". After her thesis about the magnetic field measurement by interpretation of the hanle effect observed in the He I D3 line of solar prominences, she participated to the preparation and development of the observations with the French-Italian THEMIS telescope. She was formed in radiactive transfer by Pr Egidio Landi Degl'Innocenti (Florence University), who developed also a Zeeman effect inversion code UNNOFIT, that V. Bommier generalized to the scan of active and quiet regions and unresolved magnetic structures. Thus, she is now an expert on all magnetic field measurements in all the various solar regions. She then applied to space data from the HINODE/SOT/SP and recently SDO/HMI satellites, the methods developed on THEMIS about active and quiet region magnetic field mapping.

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