Effect of wavelength-dependent radiation pressure on interstellar hydrogen distribution in the heliosphere

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We calculate density distributions of interstellar hydrogen in the inner Solar System using the Warsaw test-particle model of heliospheric gas distribution, extended with a newly-developed wavelength-dependent model of solar Lyman-alpha radiation pressure. The radiation pressure model is based on observations of the solar Lyman-alpha profile from minimum to maximum of solar activity (Lemaire et al. 2002). The non-flat shape of the profile results in the dependence of radiation pressure on radial velocity of hydrogen atoms with respect to the Sun, which strongly modifies their dynamics in the inner heliosphere. We show differences between our results and those obtained with earlier non-Doppler models. With the spectral shape of the solar Lyman-alpha line taken into account, interstellar hydrogen density is less than density resulting from the earlier calculations inward from a distance about 5 AU from the Sun (coinciding with Ulysses aphelion). This deficit results in a significantly steeper gradient of interstellar hydrogen density inside ~ 5 AU from the Sun, which should be seen, e.g., in Ulysses H PUI observations, but on the other hand only weakly affects the Lyman-alpha helioglow intensities from observations carried out from ~ 1 AU. The magnitude of the deficit is a strong function of heliocentric distance, offset angle from the upwind direction, and of the phase of solar cycle.