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An iterative method for determining the solar coronal temperature from Metis coronagraph observations

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Various models exist to determine the electron temperature profile Te(r) in the solar corona, which is a key parameter for understanding coronal heating and solar-wind acceleration. Among these, the recent hydrodynamic equilibrium (DYN) method, introduced by Lemaire and Stegen (2016) and Lemaire and Katsiyannis (2021), links the coronal temperature to the radial evolution of electron density and solar-wind speed. In this study, the DYN method is applied to observations from the Metis coronagraph, using electron densities derived from polarized brightness measurements and solar-wind velocities inferred through Doppler dimming diagnostics (Giordano et al., 2025). Furthermore, the combined use of the DYN model and Doppler dimming technique enables iterative studies in which an initial temperature profile is used to infer the solar-wind speed; the resulting velocity profile is then employed to compute an updated temperature, and so on.

The availability of in-situ measurements of both electron density and temperature from Solar Orbiter, Parker Solar Probe, and BepiColombo, obtained at heliocentric distances well within 1 AU, provides new constraints to the models and enables direct comparisons between model-derived temperature and velocity profiles and plasma properties measured near the Sun, offering also validation of different methods.

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