Radiative transfer equilibrium models of nearby interstellar matter (ISM) are required to determine the boundary conditions of the heliosphere from astronomical observations of nearby stars. These models are also constrained by data on the ISM inside of the solar system, including pickup ion, anomalous cosmic rays, and \textit{in situ} He\textsuperscript{+} data. The two best ISM models give semi-empirical filtration factors for H (0.41–0.52), He (0.86–1.16), N (0.74–1.11), O (0.55–0.77), Ne (1.41–2.80), and Ar (0.61–1.76) when observational uncertainties are included. Uncertainties in the Ne filtration factor may result from poorly known interstellar abundances.

These models predict the characteristics of the ISM outside of the solar system: $n$(H\textsuperscript{+})=0.20–0.21 cm\textsuperscript{-3}, $n$(e\textsuperscript{-})=0.10 cm\textsuperscript{-3}, H\textsuperscript{+}/H=0.29–0.30, and He\textsuperscript{+}/He=0.47–0.51. However, if the isotropic 2 kHz emission observed by Voyager (Kurth & Gurnett 2003) is formed in the surrounding ISM, an alternate model (Model 25) is indicated. The weakly polarized starlight of nearby stars suggests that the local galactic magnetic field is parallel to the galactic plane, and the strongest polarization is towards the upstream direction of the ISM flow, and also (coincidently) near the ecliptic plane. Observations of nearby ISM, the radiative transfer models, and historical $^{10}$Be records provide information on past variations in the galactic environment of the Sun.