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Nonstationary dynamics of the heliospheric termination shock in presence of pick up ions: PIC simulations

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The nonstationary dynamic of the heliospheric termination shock in presence of pick up ions (PUI) is analyzed with the help of a one-dimensional PIC (particle-in-cell) simulation code. This work is initially stimulated by Voyager 2 data which evidenced the nonstationary behavior of the termination shock (TS) [Burlaga et al., 2008]. Recent hybrid and PIC simulation [Wu et al., 2010; Scholer and Matsukyio, 2011] have clarified the strong contribution of PUI in the global energy partition at the TS. Present work focusses on the nonstationary behavior of the shock front in presence of PUI (with different percentages) and its impact on the global energy partition (between protons and PUI) in the downstream region. Solar wind (SW) protons and PUI are described respectively as Maxwellian and a shell distributions. Present results (i) evidence that the TS front is still nonstationary (selfreformation of the shock front driven by the accumulation of SW ions) even in presence of 25% of PUI and even for a moderate supercritical Ma regime, (ii) confirm in average that 15% and 85% of the upstream SW energy is respectively transferred to protons and to PUI in the downstream region for a shock profile at a given time, (iii) analyzes the energy partition between reflected (R) and directly transmitted (DT) ions separately for SWI and PUI, and (iv) quantifies the impact of the nonstationarity of the shock front on local ion distribution. Moreover, present results show also quantitatively how the energy partition may vary between the SW protons and PUI in the heliosheath because of the front selfreformation. These results provide quantitative inputs on the strongly turbulent state (both in space and in time) of the heliosheath before it interacts with the heliopause.