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3D velocity distribution functions of heavy ions and kinetic properties of fast solar wind O^{6+} at 1 AU

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We used the actual-prolonged solar minimum to study the kinetic properties of the solar wind under quite-time conditions. So far, observations of Velocity Distribution Functions (VDFs) of solar wind heavy ions have been solely 1D. They are known to exhibit non-thermal features, but because they are 1D projections of the 3D velocity phase space it is difficult to interpret them properly. We have modeled heavy-ion VDFs based on 3D observations of protons and alpha particles from Helios. In the model, the magnetic field vector plays a crucial role by defining the symmetry axis of the VDFs. A thermal anisotropy $\mathrm{T}_{\parallel}/\mathrm{T}_{\perp} \neq 1$ and a beam drifting along the magnetic field vector at a relative speed of approximately the Alfvén speed are included. The modeled VDFs are analysed using a virtual detector and then compared with data from the Solar Wind Ion Composition Spectrometer (SWICS) on the Advanced Composition Explorer (ACE). Our observations give evidence for the existence of heavy-ion beams. The projection of these beams can explain observed differential streaming. Especially the rare periods of negative differential streaming correspond to periods in which the magnetic field lines are strongly bend no longer pointing towards Earth but towards the Sun. We present in-situ measurements and derived kinetic properties of fast solar wind O^{6+} at 1 AU under quite-time conditions.