

## *Dr. Stefano Livi*

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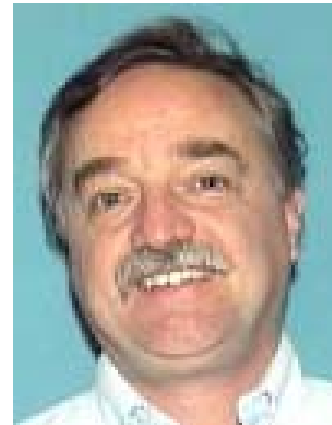
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### **Heavy Ions in the Solar Wind**

Hydrogen and Helium constitute more than 99.9% of the solar wind and the plasma processes governing and ruling the solar wind plasma are by far dominated by those two species. Consequently ions other than protons and alphas, the so-called “heavy ions”, are also often referred to as “minor ions”: they do not affect the dynamics of the system, but act as co-participants in the flow. Exactly here lies their importance: like leaves in the river, they do not affect the flow, but are powerful indicator and tracers of the physical phenomena that acted or still act on the plasma. First and foremost, the charge state of the heavy ions is established very low in the corona, and does not change during propagation: heavy ions carry the imprint of the electron temperature in the region the plasma detached from the Sun. Also, the easiness of ionization (known as First Ionization Potential) affects how long the particles were subject to the gravitational potential of the Sun, before been accelerated by electromagnetic forces, which sets powerful constraints on the dynamic of the early solar wind accelerations. The characteristics of the distribution functions of the ions reveal also the plasma processes that are at work during the expansion: heavy ions travel faster than protons, up to the Alfvén speed; the temperature is proportional to the mass of the ion; and present a large anisotropy, clear marker of the conservation of magnetic moment. All plasma characteristics of the heavy ions are moderated by Coulomb collisions and enhanced by wave-particle interaction, making these ions an excellent laboratory for studying the processes that regulates solar wind acceleration and expansion.



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