**TRENDS IN PHYSICS**

Some personal views of the current lead points in physics presented by senior members of the EPS Divisions with special reference to the:

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**Atoms in Highly Ionized States**

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Highly ionized atoms play a fundamental role in both astrophysical and laboratory plasmas, especially in fusion-oriented plasmas, and in other branches of plasma applications. Atoms, neutral and ionized, have a direct influence on the thermodynamic state of a plasma and, thus, on its emission properties.

Under most laboratory and many astrophysical conditions, the plasma's state deviates from local thermodynamic equilibrium (L.T.E.), the deviation in general increasing with temperature and decreasing with particle density. As the latter is mostly fixed (within limits), the changes of temperature are the more significant. In order to describe the thermodynamic non-equilibrium state locally and temporally, and especially the spectral dependence of the local instantaneous emission coefficient, recourse is made to models whose input depends directly on atomic properties (such as Einstein coefficients, oscillator strengths, cross-sections, ...) together with more specific data for special purposes. Owing to the peculiar properties of high-temperature plasmas, it is only possible to interpret some measurements through the use of such models.

In the solar corona, for example, where the temperature is of the order of \( kT = 100 \) to 200 eV, one finds up to 14 times ionized iron atoms. Tokamaks, laser-produced and low-inductance spark plasmas on the other hand, now reach temperatures of the order of keV and, thus, permit the ionization of atoms to much higher charge states: in Tokamaks, spectral lines of Fe XLV and Mo XXXII have been observed. Information on many new atomic states is thus needed for plasma diagnostics and plasma modelling. At the same time, these new types of high-temperature plasma, open to physicists a new field, as the observed spectra can be used for testing theoretical structure and collision data, and for stimulating new research work in the fields of atomic