D.R.E.A.M.: a new atomic database on rare-earth elements

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In the periodic table of the elements, the lanthanides (or rare-earths) are a group of 15 metallic elements of atomic number 57 to 71. Spectroscopic data for these elements are needed to address astrophysical problems such as those related to the chemical composition of peculiar stars. Interest in this area is increasing because of new spectrometers which make it possible to record many high signal-to-noise ratio and high spectral resolution stellar spectra. In addition to astrophysics, industrial research is considering the possibility to replace by rare-earths the heavy metals used to make coloring pigments. Indeed, although cadmium, mercury and lead produce superb colors in paintings and plastics, these heavy metals are unfortunately toxic. So, some industrial groups have developed a new generation of coloring pigments based on a "cocktail" of rare-earth elements, the resulting color being determined by use of electronic modelling of each component of the cocktail. However, these elements, which are characterized by complex configurations with unfilled 4f shells, have been rather little investigated up to now. The experimental or theoretical analyses are still very fragmentary or missing, for many ions. Nevertheless, some progress has been reported in the laboratory, particularly regarding the radiative lifetime determination with selective laser excitation techniques.

The main purpose of D.R.E.A.M. (Database on Rare-Earths At Mons University) is to provide the astrophysicists, but also the physicists, with an updated information concerning the lanthanide atoms or ions. These new data are obtained through a sophisticated relativistic Hartree-Fock (HFR) approach [1] taking configuration interaction and core-polarization effects into account. They are tested, whenever possible, by comparison with recent radiative lifetimes measured by laser spectroscopy. This new database is accessible on the Website http://www.umh.ac.be/~astro/dream.shtml. Up to now, it contains about 50000 lines belonging to La III, Ce II, Pr III, Tm II, Yb II, Lu II and Lu III and will be updated and extended in the near future.

[1] R. D. Cowan, *The Theory of Atomic Structure and Spectra* (University of California Press, Berkeley, 1981).