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Database of atomic parameters for plasma radiation modeling

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Synopsis The database ADAMANT of atomic parameters for the simulation of the electromagnetic radiation from plasma is established (www.adamant.tfai.vu.lt). The energy levels, radiative and autoionization transition probabilities, electron-impact excitation and ionization as well as dielectronic recombination rates for atoms and ions are constantly added to the database.

For the plasma simulation purposes, a newly-established database ADAMANT (**A**pplicable **DA**ta of **M**any-electron **A**tom e**N**ergies and **T**ransitions) containing various spectroscopic parameters of many-electron atoms and ions is being developed at Institute of Theoretical Physics and Astronomy, Vilnius University. This database contains parameters, involving free-electrons, such as autoionization probabilities, electron-impact excitation and ionization collision strengths, cross-sections and rates, dielectronic recombination rates as well as energy levels, radiative transition parameters (line strengths, oscillator strengths, transition probabilities) that are needed in modeling both high temperature (astrophysical, nuclear fusion) and low temperature plasma, such as planetary nebulae, working material of spectroscopic and medical devices.

Large amount of spectroscopic data for variuos atoms and ions has been produced so far (see, e.g., databases NIST [1], ADAS [2], or NIFS [3]). Unfortunately, it is rather complex task to apply these data for modeling purposes, because they are calculated in different approximations, with different computer code suites and atomic data accuracy. Therefore, it becomes difficult to match one set of data, e.g., energy levels, radiative transition probabilities, with another set of data involving free electrons, e.g. electron-impact excitation or ionization rates.

In ADAMANT, the atomic data sets for specific atom are produced by using the same computer code suites, applying the same approximation for inclusion of relativistic and correlation effects. They are generated using identical multireference wavefunction basis. Such an approach to produce data significantly reduces workload for data application, making possible an automatic data parsing in plasma modeling codes. The configuration interaction (CI) approximation by using numerical solutions of Hartree-Fock [4], relativistic Dirac-Fock-Slater [5] or quasirelativistic Hartree-Fock [6] equations is used for calculations of the same set of spectroscopic parameters.

ADAMANT database is constantly updated and extended with new results. At present it contains more than 2000 sets of parameters for some atoms and isoelectronic sequences of ions. Website for the database (www.adamant.tfai.vu.lt) provides general information about calculation methods, data formats, data accuracy assessment, it welcomes any comments on data or requests for new data production or accuracy improvement of existing data. We have an ambition to make this freely available ADAMANT database to serve not only as a source of highly-accurate data but also as a vehicle for other atomic data producers to disseminate their results.

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