Atominių duomenų įvertinimas taikant astrofizikinius modelius ir astronominius stebėjimus

Atomic data accuracy evaluation using astrophysical models and astronomical observations

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Understanding the enrichment history of galaxies is crucial to understanding star formation and feedback processes central to galaxy evolution. Absorption lines of damped Lyman-alpha (DLA) and sub-DLA absorbers in the spectra of background quasars or gamma-ray burst (GRB) afterglows provide the most sensitive tools for measuring the heavy element content of distant galaxies. Estimation of element abundances from absorption lines is very sensitive to the accuracy of the atomic data used for the spectral lines. Atomic parameters are essential for astrophysical spectra modeling. For the theoretical results to be considered and utilized as the data one needs to know or at least to estimate their accuracy. As it was pointed-out in [1], spectroscopic parameters for many lines of astrophysically important species are determined with insufficient accuracy. Moreover, some prominent lines do not have their accuracy defined at all. These uncertainties lead to problems in determining the chemical element abundancies.

In order to overcome above mentioned issues, we calculate new sets of atomic spectroscopic data for low ions such as O I, Mg I, Si I, P I, Cl I, Mg II, Si II, P II, Cl II, Co II, Ti II. Our main goal is to calculate highly accurate oscillator strengths, transition probabilities and to determine their accuracy. Our calculations are based on a very broad configuration interaction basis within a numerical Hartree-Fock framework utilizing quasirelativistic one-electron radial orbitals (quasi-relativistic Hartree-Fock approach) and non-relativistic radial orbitals (semi-relativistic Hartree-Fock approach) with the relativistic effects included by applying Breit-Pauli method. The results of these new atomic calculations are then incorporated into the plasma simulation code Cloudy through its atomic and molecular database Stout [2].

As a sample of our investigation, we present the radial velocity plots of the P II lines λλ 961.041 Å, 963.801 Å, and 1152.818 Å, detected in the spectrum of the O7I star SK 80 in the Small Magellanic Cloud taken with the FUSE (Far Ultraviolet Spectroscopic Explorer) spectrograph in Fig.1. In the top three panels, the normalized data are shown in black and the dashed horizontal red line shows the continuum level. The blue curve at the bottom of the panels is the 1σ error values in the normalized flux. In all panels, the vertical dashed lines illustrate the centroid and width of the component of interest at zero velocity, which is absorption occurring in the interstellar medium associated with the Milky Way. The fourth panel shows an overplot of the P II lines showing a direct comparison of the absorption due to each transition, where the strongest absorption occurs for λ963 Å, indicated by the green curve.

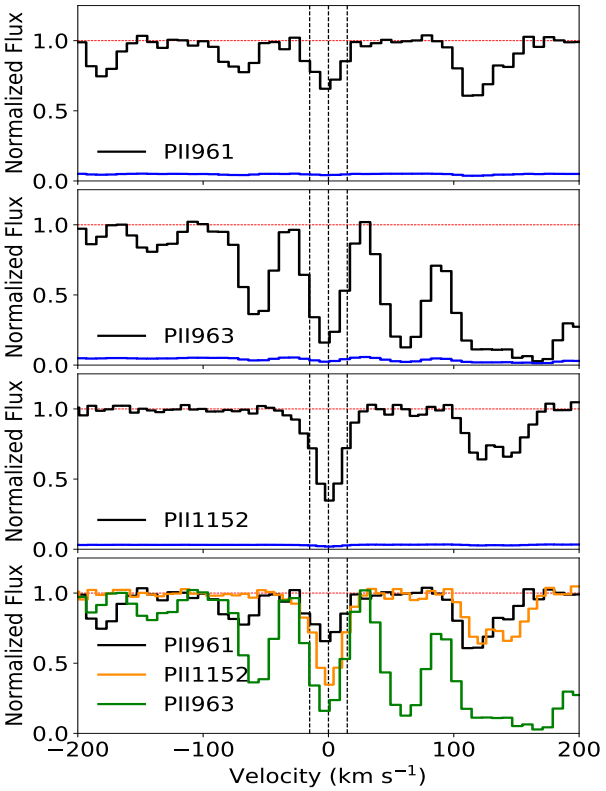

Fig 1. Radial velocity plots of three P II lines at λλ961.041Å, 963.801Å, and 1152.818Å

Reikšminiai žodžiai: atomic data, absorption lines, spectra modeling

Literatūra

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