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Invited Lecture

A NEW METHOD FOR CALCULATING COLUMN DENSITIES USING GR MODEL. AN APPLICATION IN THE CASE OF C IV, N IV AND N V SPECTRAL LINES IN THE UV SPECTRUM OF THE O STAR HD 149757 (ζ Oph)

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In this work, we present a new method for calculating column densities of ionic transitions exhibited in the spectra of various astronomical objects. The method is based on the GR model and the A.S.T.A. software we have developed for analyzing broad and complex absorption and emission profiles of astronomical objects like hot stars and BAL quasars. As the model is able to decompose broad absorption and emission profiles to the uniquely determined number of components they consist of, we can measure not only the column density of the entire profile but the column density (N_{ion}) of each absorption component. Apart from column densities the model provides the radial (V_{rad}) and rotational (V_{rot}) velocities, optical depths at line centers (τ_0), FWHMs and EWs of individual absorption components. In this pilot study, we analyze the DAC complex profiles of C IV, N IV and N V of the O-star HD 149757 (ζ Oph). We utilize multi-epoch spectra, obtained 13 years apart, in order to probe the variability of each absorption component's column density, i.e., variations of the column density of each absorbing system in the line of sight. We find that the absorption profiles of C IV and N V resonance lines consist of two absorption components, while the N IV spectral line of one. Our findings show that C IV, N IV and N V DACs arise from the same clumpy gas clouds, which have similar locations, kinematics as well as structure and physical conditions. The column density variations exhibited by individual absorption components are due to changes in the ionizing state of the outflowing gas.