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TITLE: The Computer-aided Line Identification Code PyEMILI and Its Application in Astronomical Spectroscopy

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ABSTRACT:

Deep spectroscopy of planetary nebulae (PNe) and H II regions reveals numerous nebular emission lines. As a key step of spectral analysis, identification of emission lines hitherto has mostly been done manually, which is a tedious task, given that each line needs to be carefully checked against huge volumes of atomic transition database to reach a reliable assignment of identity (ID). We have developed a line-identification Python code PyEMILI, with significant improvements over the old, Fortran-based package EMILI introduced 20 years ago. Our PyEMILI package has amended the major shortcomings in EMILI's line-identification paradigm and utilizes a much expanded atomic transition database. Moreover, effective recombination coefficients of the nebular lines emitted by the most abundant heavy element ions are collected from the literature and incorporated into the atomic database, to aid the identification of faint optical recombination lines. PyEMILI was tested using the high-dispersion spectra of two Galactic PNe, Hf 2-2 and IC 418, and overall >90% reliability in line identification obtained. We also ran PyEMILI to identify the complex emission and absorption features in a late-type [WC11] star UVQS J060819.93-715737.4, with over 90% agreement with the manual identification. The new identifier PyEMILI can be applied to not only emission-line nebulae but also emission-line stars, such as Wolf-Rayet stars.