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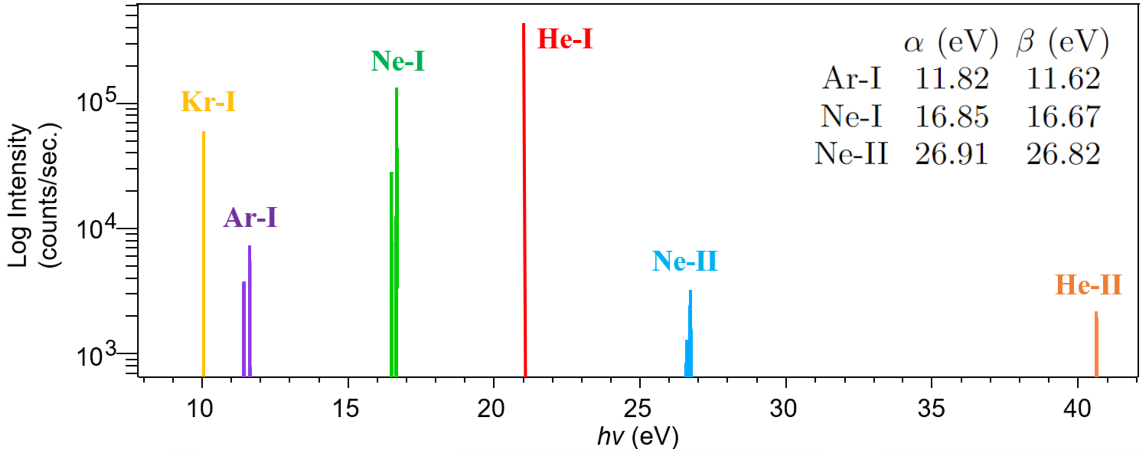
Expanding the Capabilities of Lab-Based ARPES on Quantum Materials

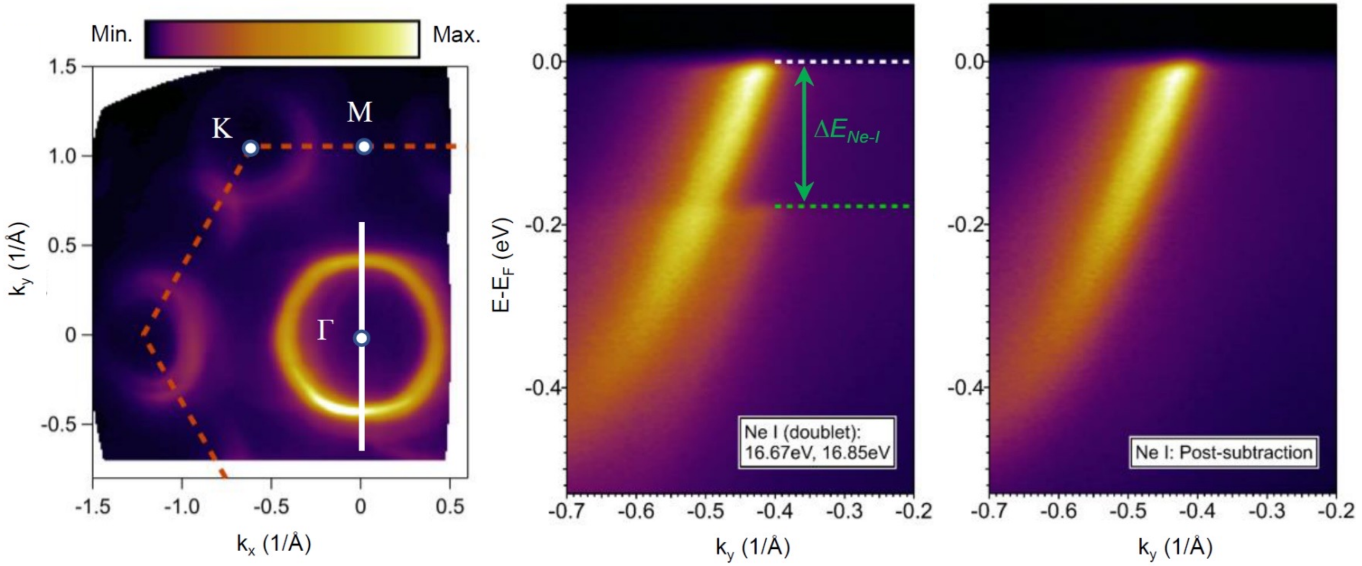
B.D. Faeth, K.M. Shen, and D.G. Schlom (Cornell University)
T.M. McQueen (Johns Hopkins University)

Angle-resolved photoemission spectroscopy (ARPES) is a powerful tool for characterizing the electronic structure of quantum materials. A key component in any ARPES setup is the ultraviolet photon source, with its characteristics largely defining the system's capabilities. Lab-based ARPES systems valued for their ease of access mostly rely on noble gas discharge lamps, which produce a series of intense narrow emission lines at discrete photon energies depending on the gas plasma used.

A critical shortcoming of these sources is the limited number of useful emission lines available – historically only He-Iα (21.2 eV) and He-IIα (40.8 eV) lines have found practical use in ARPES experiments. Although other bright VUV emission lines can be generated by using different discharge gases (such as Ne, Ar, Kr, or Xe), many of these intrinsically include closely spaced "doublet" emission lines, which result in superimposed replica features when used as an ARPES source, severely limiting their experimental usefulness.

Here, PARADIM's In-House Team developed a simple algorithmic method to separate the two components from ARPES spectra collected with doublet emission sources. Benchmark measurements on well-characterized 2D materials demonstrate that doublet spectra processed with this approach reliably produce accurate dispersion relations and quasiparticle lifetimes matching data from pure, monochromated sources. This method therefore successfully unlocks a wide range of critically useful additional photon energies to any lab with multi-gas discharge lamps at virtually no additional cost.





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