

The CaFe Project: Search for the correlation between Fe⁺ and Ca⁺ in active galaxies

Resolving the complexity in Fe II species in quasar spectra has been an ongoing work for over 40 years. First identified and reported for the prototypical Narrow-line Seyfert 1 galaxy I Zw 1 (Phillips 1978a), the study has made a niche of its own in the field of AGN research. Seminal works led by Boroson & Green (1992), Verner et al. (1999), Sigut & Pradhan (2003) and others encapsulate the ‘yet to be complete’ understanding of the physics of the line formation for this first-ionized state of iron (Fe II). A major part of the puzzle is lent by the sheer number of spectral lines in Fe II than spans across a wide energy range (from UV to NIR). This extended emission seen in the spectra mimics a continuum of sorts, thus the telltale term *pseudocontinuum*.

Gaining knowledge from the past studies and of our own, in this study we search for a reliable proxy to Fe II. This proxy, Ca II, is a much simpler ionic species which is characterized by its triplet in the near-infrared part of an AGN spectrum. The analogous line excitation mechanisms (dominated by the Ly α fluorescence and collisional excitation) for the production of these two species is confirmed by the tight correlation between the respective line strengths that we observe from our *up-to-date collection of coincident measurements in the optical and NIR*, and re-affirmed by our photoionization models. Additionally, our models constrain the physical parameters, such as the required level of ionization and the density of the medium (i.e. the broad-line region) that contain these ionic species, hinting also to the cloud’s composition and structure (Panda et al. 2020b; Panda 2020). This study reveals the utility of the Ca II as a proxy for Fe II in ways more than one, primarily, **establishing a new radius-luminosity relation** and in **quasar main sequence studies**.

Primary author: Mr PANDA, Swayamtrupta (Nicolaus Copernicus Astronomical Center, Warsaw, Poland)

Co-authors: Dr MARTINEZ-ALDAMA, Mary Loli (Center for Theoretical Physics, Warsaw, Poland); Prof. CZERNY, Bożena (Center for Theoretical Physics, Warsaw, Poland); Dr MARINELLO, Murilo (National Astrophysical Laboratory, Itajuba, Brazil); Prof. MARZIANI, Paola (Padova Observatory, INAF, Italy); Prof. DULTZIN, Deborah (National Autonomous University of Mexico, Mexico)

Session Classification: Student presentations