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Swayamtrupta Panda - Understanding the general scheme of Fell emission in active galaxies

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Quasar main sequence, analogous to the stellar main sequence, explains the connection between the wide variety of active galactic sources and their evolution. Based on Principal Component Analysis (PCA), the sequence can be explained by correlations between the observed spectral properties (Boroson & Green, 1992). Among those quantities, it was observed that the bulk of the correlation is driven by anti-correlation between two dominant terms - the measure of the Keplerian velocity of the H β profile (the full-width at half maximum) and the parameter \mathbf{R}_{FeII} (which is the FeII emission in the optical band between 4434-4684 Å, normalised to the broad H β emission). Due to its complexity resulting in numerous emission lines that span from the infrared to the ultraviolet regime, this resemblance to a continuum makes FeII difficult to extract useful information lest the spectra have a sufficiently high signal-to-noise. We utilize the current state of the art photoionisation modelling code, CLOUDY (Ferland et al. 2017), to estimate the net optical FeII emission (incorporating a 371 level FeII model with 68,535 transitions) emanating from the dense, ionized broad-line region (BLR) clouds. (a) With the two main physical observables - the black hole mass and accretion rate, and incorporating the distribution of viewing angle, we explain the dependence of the R_{FeII} sequence on Eddington ratio (L_{bol}/L_{Edd}) and on the related observational trends. This dependence is shown as a function of the SED shape, cloud density and composition, verified from prior observations; and (b) We explain the high accretors from the theoretical relation between ionization parameter (U), the mean cloud density (n_H) and R_{FeII} . We incorporate the departure coefficient in standard radius-luminosity relation (Martínez-Aldama et al. 2019) and the fundamental plane relation (which is a bivariate relation between the Eddington ratio, R_{FeII} and $D_{H\beta}$ i.e., the shape of the broad emission profile for H β) for the BLR (Du et al. 2016) in this relation to constrain the physical parameter space for these high-Eddington sources.

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