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EMISSION LINE SHAPE, TIME DELAY, AND THE SIZE OF BROAD LINE REGION IN 2.5D FRADO MODEL

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The broad emission-line profiles observed in active galactic nuclei (AGN) arise from the complex dynamics of clouds within the Broad Line Region (BLR). Using a physically motivated FRADO (Failed Radiatively Accelerated Dusty Outflow) model of cloud distributions launched by radiation pressure on dust, we investigate the generic spectral line shapes and their dependence on black hole properties and accretion dynamics. By convolving a large grid of simulations using the 2.5D FRADO code with photon-flux weighted emissivity, we analyze the width, asymmetry, and time-delay histograms of emission lines. Our results show that line widths increase with black hole mass and viewing angle, while higher accretion rates lead to narrower profiles and enhanced blue-wing emission, indicative of outflow structures. Furthermore, we find that peak time-delays provide a more robust measure of BLR size, offering new insights into the radius-luminosity relation. These findings contribute to a deeper understanding of AGN kinematics and spectral variability.