The propagation of Lyman-alpha in evolving protoplanetary disks

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We study the role resonant scattering plays in the transport of Lyman-alpha photons in accreting protoplanetary disk systems subject to varying degrees of dust settling. While the intrinsic stellar FUV spectrum of accreting T Tauri systems may already be dominated by a strong, broad Lyman-alpha line (~80% of the FUV luminosity), we find that resonant scattering further enhances the Lyman-alpha density in the deep molecular layers of the disk. Lyman-alpha is scattered downwards efficiently by the photodissociated atomic hydrogen layer that exists above the molecular disk. In contrast, FUV-continuum photons pass unimpeded through the photodissociation layer, and (forward-)scatter inefficiently off dust grains. Using detailed, adaptive grid Monte Carlo radiative transfer simulations we show that the resulting Lyman-alpha/FUV-continuum photon density ratio is strongly stratified; FUV-continuum dominated in the photodissociation layer, and Lyman-alpha dominated field in the molecular disk. The enhancement is greatest in the interior of the disk (r~1AU) but is also observed in the outer disk (r~100AU). The majority of the total disk mass is shown to be increasingly Lyman-alpha dominated as dust settles towards the midplane.

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