On the evolution of carriers of AIB emission in planet-forming disks

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Aromatic infrared band (AIB) emission is a ubiquitous component in the interstellar medium of metal-rich galaxies. Although the exact chemical nature of their carriers is still under debate (e.g., Tokunaga et al. 2026), the carriers of AIBs are likely a class of very small carbonaceous molecules and particles (e.g., Tielens 2005). Such small carbonaceous particles are also expected to be present in planet-forming disks. Although AIBs are commonly detected in disks around Herbig Ae/Be stars, they are much less common in disks around T-Tauri stars (Geers et al. 2006; Seok & Li 2017). This may imply the evolution of AIB carriers in some planet-forming disks. Several factors have been proposed to influence AIB emission in disks around low-mass stars, such as the radiation field (Geers et al. 2006; Visser et al. 2007), photon hardness (Siebenmorgen & Krügel 2009; Lange et al. 2025), particle properties (e.g., PAH size and clustering) (Lange et al. 2021), and vertical mixing (Dullemond et al. 2007). However, these effects have often been investigated under different conditions, and a comprehensive understanding of the AIB carrier's evolution in disks remains elusive.

In this study, we have been developing a disk model that accounts for the interactions between high-energy photons and very small particles, disk radiative transfer, and the subsequent computation of observational quantities, such as SEDs and disk images. Here, as an initial result, we mainly report on the outcomes of interactions between high-energy photons and polycyclic aromatic hydrocarbon (PAH), a potential AIB carrier. Although X-ray photons have previously been suggested to rapidly disrupt large PAH molecules, we show, using the Rice–Ramsperger–Kassel–Marcus (RRKM) theory and stellar X-ray emission models, that X-ray photon absorption by PAH molecules most likely results in the ejection of a photoelectron followed by an Auger electron, and that X-ray photodissociation of PAH containing more than ~ 100 carbon atoms is inefficient. We will discuss implication for the lack of AIB emission in disks around T-Tauri stars.