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The survival of PAHs and (hydro)carbon nanoparticles in H II regions

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Abstract. Observations show that emission from the Unidentified Infrared (UIR) bands is strongly suppressed in H II regions. UIR bands are generally attributed to vibrational relaxation of FUV - excited Polycyclic Aromatic Hydrocarbon (PAH) molecules or hydrocarbon nanoparticles containing aromatic domains. If the strongly reduced UIR emission in H II regions is due to the suppression of the carriers, an efficient destruction mechanism is required to explain observations. The aim of this work is to clarify whether UV processing of PAHs and nanoparticles is indeed responsible for the observed lack of infrared emission. We present here our first results on the physical response to photo-processing of the proposed UIR-bands carriers.

Keywords. molecular processes, H II regions, ISM: lines and bands, dust, extinction

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We study the photo-processing of three proposed carriers for the UIR bands: "classical" PAHs (planar) with Vis-UV absorption cross section per carbon atom, $\sigma_{\rm abs}$, given by Verstraete & Léger (1992); "astronomical" PAHs, whose effective radius is defined as the radius of a graphite sphere having the same number of carbon atoms, with photon absorption coefficient $Q_{\rm abs}$ from Li & Draine (2001); spherical amorphous carbon (a-C) nanoparticles with $Q_{\rm abs}$ from Jones (2012c).

We compare the $\sigma_{\rm abs}$ of PAHs and a-C grains having the same radius (of the disk and of the spheres respectively) and find that they are very similar. We treat carbon nanoparticles as PAHs, using the approach that we have developed for these latter (Micelotta *et al.* 2010b, 2015). Therefore, the dissociation probability depends only on the number of carbon atoms in the particle, $N_{\rm C}$, and for a given $N_{\rm C}$ it is the same for both PAHs and a-C grains. The dissociation rates as a function of $N_{\rm C}$ have been calculated in the hard and intense radiation field of the dwarf galaxy IIZw40. We find that the dissociation rates are also very similar, especially for $N_{\rm C} > 50$. Finally, we calculate the mid-infrared Spectral Energy Distribution of IIZw40 resulting from 100 Myr of photo-processing. Our results show that the intensity is globally reduced but the UIR features are preserved, with the exception of the 3.3-3.4 μm complex which is strongly suppressed for a-C nanoparticles.

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