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Extended UV Disk (XUV-disk) Galaxies

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Abstract. Motivated by the GALEX discovery of recent star formation in outermost regions of M83 and NGC4625, we have investigated the nature of the XUV disks with follow-up high resolution imaging and spectroscopy, and attempted to detect them at other wavelengths (IR, Hα). We searched for additional XUV-disk galaxies in the local universe, in order to quantify the incidence of the XUV-disk phenomenon, infer the causes of such extended star formation (SF), and place these systems in the context of disk galaxy evolution.

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An early result from the GALEX Nearby Galaxies Survey (NGS) was the discovery of UV emission extending up to a few times the optical radius (R_{25}) in M83 (Thilker et al. 2005, ApJ, 619, L79) and NGC4625 (Gil de Paz et al. 2005, APJ, 627, L29). The UV emission appears mostly as spiral-arms structures, suggesting a disk geometry, and indicates that star formation is occurring in these outer regions, which were previously believed to be stable against star formation because of their gas surface density significantly lower than the traditionally accepted threshold (Σ_{gas} < 5-10 M$\odot$ pc^{-2}, Kennicutt 1998, ApJ, 344,685). We have now discovered a few dozen "XUV-disk" galaxies, in a sample of 600+ nearby (D<40 Mpc) S0–Sm galaxies (Thilker et al., in prep.). In most cases, as in our XUV-disk prototypes M83 and NGC4625, the Hα radial profile has a sharp decline ("edge") at a radius consistent with the star-formation threshold, as estimated from classical criteria. By contrast, UV-light profiles show no "edge", in spite of the much smaller area coverage of the "XUV-disk" structures in comparison to the inner spiral arms. The general lack of conspicuous HII regions accompanying the UV emission, and the fact that only a fraction of the spirals in the GALEX NGS are "XUV-disk" galaxies, pose new questions. Is the IMF truncated in such low density environments? Or is SF occurring only in form of low-mass clusters so that stocastic effects dominate? Or is the low gas density favouring substantial photon leakage? In these objects we are witnessing the progressing of disk formation. Are the XUV-disk morphologies observed in our sample snapshots of different disk formation phases? or are XUV-disks episodical? Interaction events are seen in some of the objects, but not all.

The varied morphologies and extents of the XUV-disks in our current sample fall in two main types: one class displays filamentary, spiral-arm-like structures, usually very extended, and another class shows flocculent and diffuse UV emission surrounding the inner (optical) galaxy (Thilker et al., in prep.). Spectroscopy for a few UV-emitting regions in our two protoytpe XUV-disk galaxies, indicates metallicity of $\approx$0.1Z$_\odot$ (Gil de Paz et al. 2007, ApJ, in press). Bianchi et al. (in prep.) estimated the SF complexes in two XUV-disks to have extremely small masses (from SED modeling). HST-ACS imaging for some of the GALEX XUV-disk sources in M83 shows the UV emission to originate from sparse clusters or individual stars.