WIRE Ancillary Science - Are Galactic Halos Dusty?

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WIRE will contain many nearby resolved galaxies extending on scales of several arminutes with $f_{25\mu m}\gtrsim$10mJy. The idea is to use mid-IR and optical follow-up (B-band) photometry of distant galaxies observed through the halos of these nearby galaxies to search for dust in galactic halos out to 100kpc scales. The strategy is to compare the mid-IR–to–optical colours of background galaxies in 2-3 concentric regions at different projected separations from a nearby resolved galaxy. Due to stellar winds and past supernovae, relatively more dust should be present close to the visible galaxy. Thus, we expect that background galaxies at smaller projected separations will have colours that are statistically redder than those in outer regions.

There have been numerous studies using QSO absorption line observations to probe the dust properties of galaxies beyond their visible extent and into their halos. Significant differences were found between the optical continua of QSOs seen through damped Ly-α systems and those without Ly-α absorption (Fall & Pei, 1989). Furthermore, there have been numerous claims of metal enriched gas at projected radii $>$ 50kpc from galaxies in the fields of background QSOs showing metal-line absorption in their spectra (eg. Ellingson et al. 1994). Although such studies may indirectly suggest dust in extended halos, they do face one difficulty: the selection of the dustiest absorption systems are severely biased against since they will obscure their background sources in the optical (eg. QSOs).

WIRE will overcome this difficulty since selection in the mid-IR is unbiased by foreground dust obscuration (at least in the optically thin limit expected from galactic halo-type dust). WIRE's sensitivity and large areal coverage will also provide a large statistical sample of background galaxies with which to probe a galactic halo on different scales. This is important since the halo may be flattened or disklike, and not have a spherical geometry, A large statistical sample of background galaxies will also enable us to isolate their intrinsic colour dispersion. An average of the colours of hundreds of these galaxies in different projected fields will allow us to detect the small reddening differences ($\lesssim$0.3mag) expected between these fields from halo dust.

This project has important implications for galaxy evolution and chemical enrichment of the IGM. In particular, the presence of an early generation of population-III type stars associated with the formation of galactic halos is still hotly debated. Can dust provide the relevant tracer? Also, do early (E/S0) and late-type galaxies have similar halo dust properties? Our results can be compared with other observations of the baryonic component of galaxy halos, providing a handle on their dark matter content and distribution.