The WISE Mission: an atlas for luminous galaxy evolution

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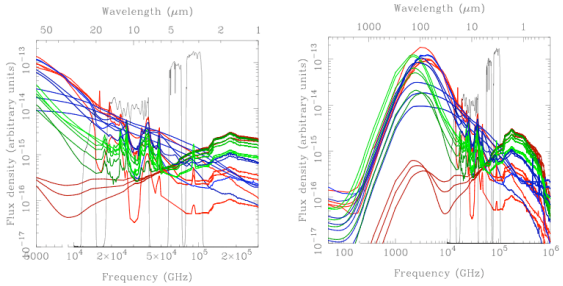

Fig 1: The range of template SEDs that describe galaxies detected in SWIRE. Bright red lines present various ultraluminous galaxies, dark red lines represent elliptical galaxies, blue sources have a variety of AGN characteristics, and green sources are a variety of spirals. The WISE passbands are shown by the black lines.The WISE bands are located where the SEDs have features and differences.

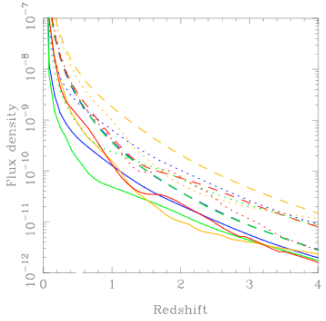

Fig 2: Redshift dependence of the flux densities expected in the four WISE bands for a range of ultraluminous galaxies (shown in red, orange, yellow and blue in order of increasing band frequency), for Arp 200 (solid lines), Mrk 231 (dashed lines) and I19254 (dotted lines). All templates show features due to the presence of spectral features in the passbands, shown in more detail in Fig 3.

http://wise.ssl.berkeley.edu

WISE is a NASA all-sky survey mission due for launch in 2009. WISE will produce a 4-band image of the mid-infrared sky at 3.3, 4.65, 12 and 23 μm with sensitivities of at least 0.1, 0.2, 0.6 and 2.6 mJy respectively. The passband profiles of the filters are shown in Fig 1, along with a range of template spectra that describe the spectral energy distributions of the wide range of galaxies that WISE will detect, based on the results of the SWIRE Spitzer Legacy survey (Polletta, priv. comm.).

We have convolved libraries of these mid-IR SEDs with the WISE passbands (see left) to predict the colors and flux densities of different galaxies that will be detected by WISE as a function of redshift. The WISE catalog alone can highlight of order $10^{6\text{-}7}$ unusual and extreme galaxies out to moderate and high redshifts (see right). WISE can thus identify the most interesting galaxies – perhaps in the richest environments – for follow-up spectroscopy and imaging observations with GBT, VLA, ALMA, JWST and optical/near-IR spectrographs. Its power is enhanced by combining optical data from SDSS, and in the future from synoptic survey telescopes like PanSTARRS and LSST. The 3.3 and 4.65 μm color can screen out brown dwarves, while stars are revealed in existing optical imaging.

The WISE bands detect dust and small-grain PAH emission at the longer wavelengths and evolved stellar populations at the shorter wavelengths. The WISE catalog alone will provide reasonable estimates of both the far-IR luminosity for dust-enshrouded galaxies, along with at least an an upper limit to the stellar masses developed up until the point of observation. The range of SEDs of galaxies that WISE is likely to find are plotted in Fig 1. In Fig 2 we show the sensitivity of the passbands to different redshifts/astrophysical properties for ultraluminous galaxies, and in Fig 3 we highlight the discriminatory power of WISE colors using the full range of templates shown in Fig 1, showing WISE color--color diagrams for these classes of galaxies at different redshifts are shown. In Figure 3 the color-color diagrams available from the WISE survey are shown to be suitable for identifying the most luminous high-redshift galaxies and AGN on the grounds of their powerful 23-micron emission, with neither spiral nor elliptical galaxies having colors that can be confused. The range of positions occupied by the ultraluminous on these diagrams shows that the colors hold great promise as indicators of photometric redshifts and astrophysical conditions.

WISE will highlight millions of ideal ALMA targets at redshifts where star formation and black hole fuelling was most powerful.

WISE will also identify new asteroids and provide a baseline IR image of the sky for all classes of transient searches.

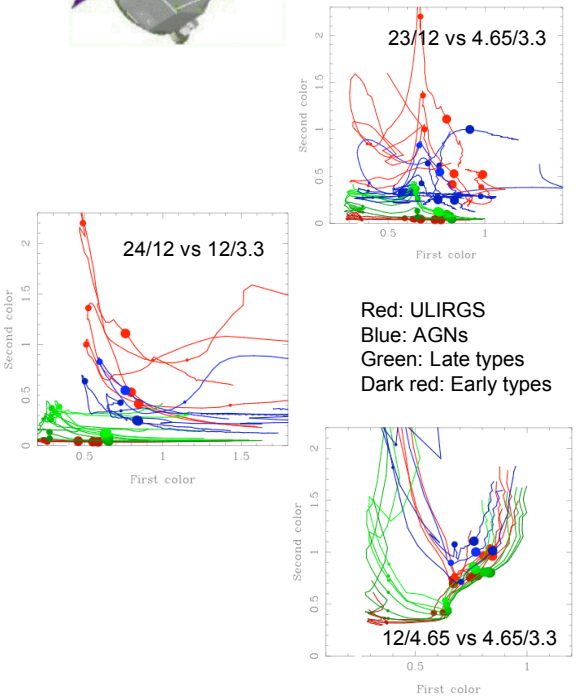

Fig 3 Color-color diagrams for the template galaxies shown in Fig 1 as a track as a function of redshift from 0 to 4.5. The line colors represent the same galaxy types shown in Fig 1, while the points track z=1, 2 and 3 in order of increasing size. Bright red ultraluminous galaxies, and blue AGN can be separated from spirals and ellipticals using the WISE colors, especially the 23-micron band where the detection of ultraluminous galaxies is expected to be most significant. From top to bottom the colors are 23/12 vs 4.65/3.3, 23/12 vs 12/3.3 and 12-4.65 vs 4.65/3.3 respectively. This clearly shows the importance of the excellent 23-micron data expected from WISE for discriminating different galaxy types and highlighting targets for ALMA

http://www.astro.ucla.edu/~Ewright/WISE/