We present a catalog of compact sources detected in the Spitzer/MIPS24 24 microns survey data (P.I. Sean Carey). These small (<1 arcminute) rings, bubbles, disks, or shells are pervasive throughout the entire Galactic plane in the mid-infrared. Over 400 such sources are detected from visual inspection of the MIPS24 mosaic images. Their average density is found to be around 1.5 bubbles per square degree.

We identify 10% of these objects by extensive cross matching with available catalogs. We find that the majority are planetary nebulae (PNe), three are supernova remnants (SNR) and one is a post-AGB star. The remaining 90% of the bubbles are yet unknown objects. Most of them are detected at 24 microns but neither at 8 nor 70 microns. We also present Spitzer/IRS spectroscopic observations of a limited sub-sample of 15 objects. Their spectra show significant variations in the low to high excitation gas lines ratio, as well as in the dust continuum intensity, suggesting some are dust free objects. We compare these spectroscopic data to templates of evolved stars, including PNe, SNRs and extremely rare mass losing stars to constrain their nature.

**MIPS24 Catalog**

**Some numbers:**
- More than 400 compact-extended objects (Disk, Shell, Donut, Twobubbles, Ring) identified through careful observations of the MIPS24 24 microns Galactic plane survey.
- Sizes about a few 10" (85% smaller than 1)
- Fluxes about a few 0.1 Jy (85% smaller than 1 Jy)
- Average density around 1.5 bubble per square degree:
  - 1.0 arcmin, in the 1st quadrant, 1.0 arcmin, in the 3rd quadrant
  - 2/arcmin, in the Galactic Center region
- 59 objects (~14%) show a central source at 24 microns

**MIPS24 and IRAC 80 microns counterparts**
- 112 bubbles (~25%) show a counterpart at 70 microns (MIPSGAL survey, Carey et al. 2009)
- ~10% show a counterpart at 8 microns (GLIMPSE survey, Benjamin et al. 2003)

**Most bubbles are “MIPS24-only” objects**
- Dust continuum ?
- Gas lines ?
- Extinction ?
- Intrinsic property of the objects (no PAHs, no hotter dust or purely ionized gas emission) ?

**Identification**
- 10% of these objects have been identified by carrying out an extensive cross reference of catalogs available from the VizieR database.
- Majority found in the NASA Catalogue of Planetary Nebulae (Parker et al. 2006)
- and in the Catalogue of Galactic Planetary Nebulae (Kohoutek 2001)
- 3 SNRs and 1 post-AGB star also identified from published catalogues
- 90% of the bubbles are yet unidentified objects
- Suspects evolved stars (SNRs, PNe, AGB, post-AGB, LBVs, WR...)

**Intrinsic Property of the objects**
- Emission from hot small dust grains in winds and ejecta
- Main source of dust and heavy elements in the Galaxy and beyond

**Dust-free PN Candidates**
- PNe are the most frequent identified objects in our catalog
- If MIPS24 central source, could it be a white dwarf?
- One would not expect to see it in IRS, unless there is a surrounding disk of dust (e.g. the Helix Nebula, Su et al. 2007)

**Very high excitation lines (NeIII) 14.3 and 24.3 >> (NeII) 15.5 >> (NeII) 12.8**
- Very weak or no dust continuum
- No IR features
- Similar to some Magellanic Cloud PNe (Bernard-Salas et al. 2008)
- [NeIII]15.5/[NeII]12.8 vs [BrII]16.7 in agreement with PNe (Greene et al. 2004)
- [FeII] 22.92 line

**No Candidates**
- BR between the different morphologies of the bubbles within the catalog

**LBV Candidate 1**
- MIPS24 morphology and spectra similar (continuum, Fe and He lines) to that of LBV DQh 20+0.46
- LBVs are extremely rare objects: 12 confirmed members and 23 candidates in the Galaxy (Clark et al. 2005)
- Dust continuum:
  - Longer wavelength continuum = shell
  - Shorter wavelength continuum = central source
  - Hotter dust inner shell
  - MIPS24 central source, Fe-rich inner shell?
- MSX 15 microns flux (13 years ago) about a factor 2 lower than that measured on the IRS spectrum: variability of the central source?
- [FeII]17.26 ratio of the inner shell traces high temperature, high density medium (Hewitt et al. 2009)
- Possible blue-shift of the lines (3000km/s) that may trace the expansion of the outer shell
- Similar morphologically and spectroscopically to HR Car (Parker et al. 2006)
- Even though the line ratios are different and the 2 continuum are slightly hotter
- 2 possible additional LBVs within our 15 objects subsample!

**LBV Candidate 2**
- Dust continuum:
  - Longer wavelength continuum = shell
  - Shorter wavelength continuum = central source
  - Hotter dust inner shell
- MIPS24 central source, Fe-rich inner shell?
- MSX 15 microns flux (15 years ago) about a factor 2 lower than that measured on the IRS spectrum: variability of the central source?
- No PAHs, no hotter dust or purely ionized gas emission:
- Intrinsic property of the objects (no PAHs, no hotter dust or purely ionized gas emission) ?

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