MaxWISE: Astrophysics with the Reactivated NEOWISE

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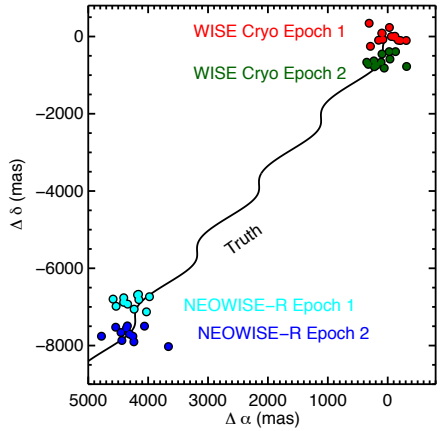
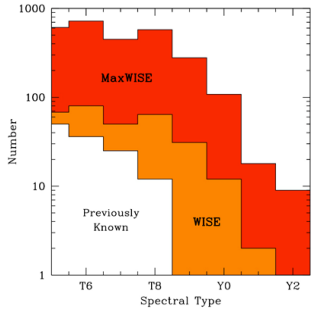
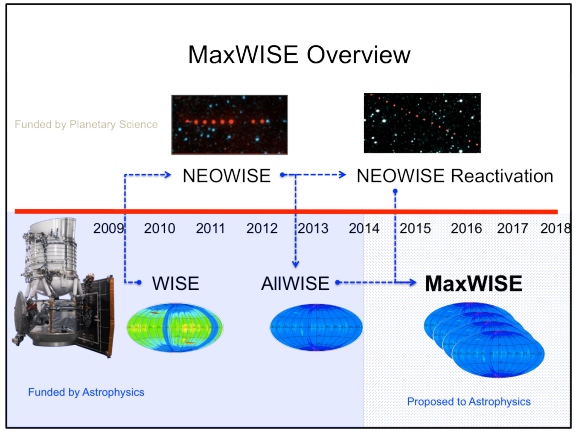
The repeated coverages of the sky by the ongoing NEOWISE survey offer the potential for astrophysics well beyond those possible using the existing WISE and AllWISE data products. Combining the anticipated total of 4 years of survey will detect L* galaxies at 4.6 microns to redshift 2, vs. redshift 0.5 in the one year of surveying comprising AllWISE. With a time baseline a dozen times longer than AllWISE, over 10,000 cool nearby stars can be detected from their proper motions. With 8 epochs of observation taken using a 2 AU baseline, parallaxes can be measured for all T6 dwarfs within 10 pc, objects too cool for Gaia. I summarize the proposed MaxWISE effort to realize these potential gains for the astrophysics community.



WISE and observations in 2010 and NEOWISE observations in 2014 of the cool (T7) brown dwarf Gliese 570D reveal its proper motion (1.0" in RA, 1.7" in dec) and 0.17" parallax. Each epoch of WISE or NEOWISE observations is 6 months apart, providing the maximum possible 2 AU baseline for parallax. AllWISE measured the combination of parallax and proper motion in 2 epochs over 6 months. With 8 epochs over 6 years, MaxWISE would detect motions over the whole sky 18 times smaller than AllWISE, measuring both proper motions ***and parallaxes***.



MaxWISE would increase the search volume for cool brown dwarfs by nearly an order of magnitude. Kirkpatrick et al. (2014) required 2MASS confirmation for the 3,525 new moving stars they discovered with AllWISE. With 8 MaxWISE epochs (vs. 2 AllWISE epochs) 2MASS confirmation is not needed. MaxWISE motion accuracy at W2=16 is comparable to AllWISE for W2<12. This means that MaxWISE would find ***tens*** of thousands of new cool neighbors. These would include old low mass stars and brown dwarfs invisible to Gaia: survivors of our Galaxy's initial starburst.

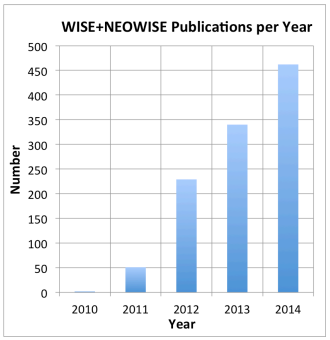


MaxWISE leverages major investments by NASA.

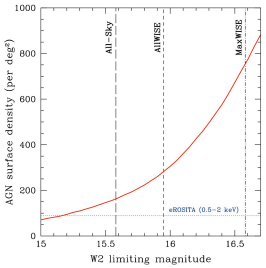
- WISE, funded by Astrophysics (Ned Wright PI), carried out a cryogenic all-sky survey at 3.4, 4.6, 12 and 22 um in 2010.
- NEOWISE. funded by Planetary (Amy Mainzer PI), searched for asteroids by looking for objects that moved from frame to frame.
- Planetary supported continued asteroid surveying in 2010 at 3.4 and 4.6 microns, after the cryogen was exhausted, long enough to sweep completely around the asteroid belt, and complete a 2nd scan of the inertial sky.
- WISE was put into hibernation in Feb. 2011.
- In 2013 Astrophysics funded the AllWISE progam to combine both sky surveys and search for objects that had moved in the 6 months between them. AllWISE was released in November 2013.
- In October 2013, Planetary reactivated the NEOWISE survey for 3 more years, or 6 more sky coverages. This is a grand total of 8 sky coverages, or 4 times AllWISE, spanning 6 years, a dozen times the 6 month interval between the two sky coverages in AllWISE.
- MaxWISE proposed to the Astrophysics Senior Review in 2014 to apply and extend the techniques used to combine sky surveys with AllWISE, to the four times bigger data volume now being created with the reactivated NEOWISE survey.

The Senior Review recommended funding MaxWISE.

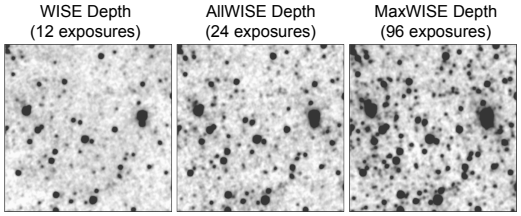
Although MaxWISE was not funded in 2015, with support in 2016 it is still possible to provide the main data products to the community in time for JWST launch in 2018, reaping the benefits of NASA's investment.



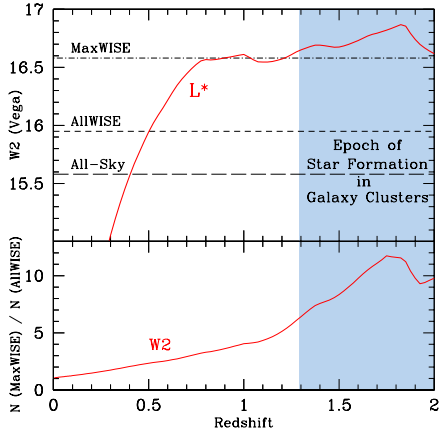
At least 1175 refereed papers using WISE and NEOWISE data have been published or accepted, 462 of them in 2014.
http://tinyurl.com/WISEpapers



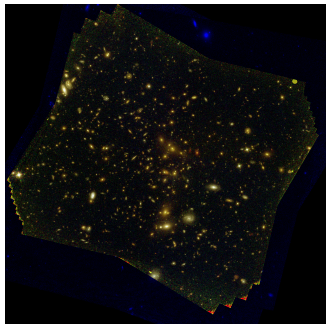
The number of AGN detected by WISE per square degree, where AGN are defined to be galaxies with at least 50% of the UV-mid-IR luminosity powered by an AGN (Assef et al. 2013). Compared to WISE, MaxWISE will vastly increase the number of detected AGN.



The effect of adding together sky coverages – each of which has 12 or more exposures over the whole sky – is shown in these images of the North Ecliptic Pole. These W2 band images extend over 8 × 8 arcmin.



With four times as many exposures as AllWISE. MaxWISE sensitivity reaches a plateau for typical (L*) cluster galaxies that extends vastly further into the distant Universe. At redshift > 0.7, W2 samples increasingly brighter parts of the rest frame SED, compensating for the increasing luminosity distance. L* galaxies fall beyond the reach of AllWISE at z > 0.5 (8 Gyr after the Big Bang), but are detectable with MaxWISE to z ~2 (3 Gyr after the Big Bang). This increases the number of galaxies seen by MaxWISE when clusters are forming by an order of magnitude compared to AllWISE.



An object from the Massive Distant Clusters of WISE Survey (MaDCoWS – see presentation by Anthony Gonzalez on Wed. afternoon). This z~1 cluster was imaged with HST's WFC3 camera in F814W, F105W, and F140W by Saul Perlmutter's cycle 22 supernova program. The extra depth of MaxWISE would allow massive clusters to z ~ 2 to be found over the full sky.