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.

MaxWISE would increase the search volume for cool brown dwarfs by nearly an order of magnitude. Kirkpatrick et al. (2014) required 2MASS observations in over 10,000 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.
- AllWISE, funded by Planetary (Amy Mainzer PI), searched for asteroids by looking for objects that moved from frame to frame.
- Planetary supported continued all-sky surveying at 2010 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 infrared sky.
- WISE was put into hibernation in Feb. 2011.
- In 2013 Astrophysics funded the NEOWISE program 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.
- 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.

An object from the Massive Distinct 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 F140W, F105W, and F814W 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.

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 at 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.

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.