Preliminary Results Of A Legacy Survey In The Crowded Galactic Plane

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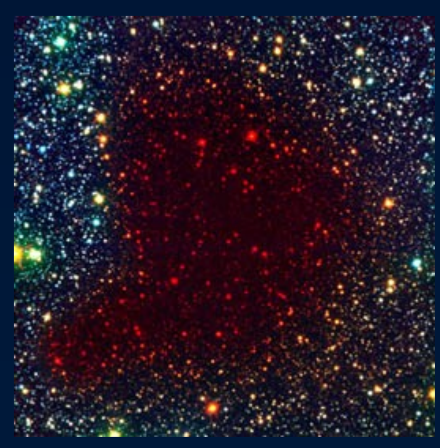
The multiband study of the Galactic Plane

The Galactic Plane is concentrated with large amount of stars amounting to almost half of the baryonic mass within our galaxy. This provides a rich playground for finding unique stellar sources and hence studying them, which has the potential to provide novel understanding of various stellar properties as well as helping with the fundamental quest of estimating distances. However, the observation of the Galactic Plane has been mostly avoided in the past due to interstellar extinction. Furthermore, observing the same unique candidate over time is a problem owing to the rich crowd of other stars it is present in.



Current capabilities

ZTF

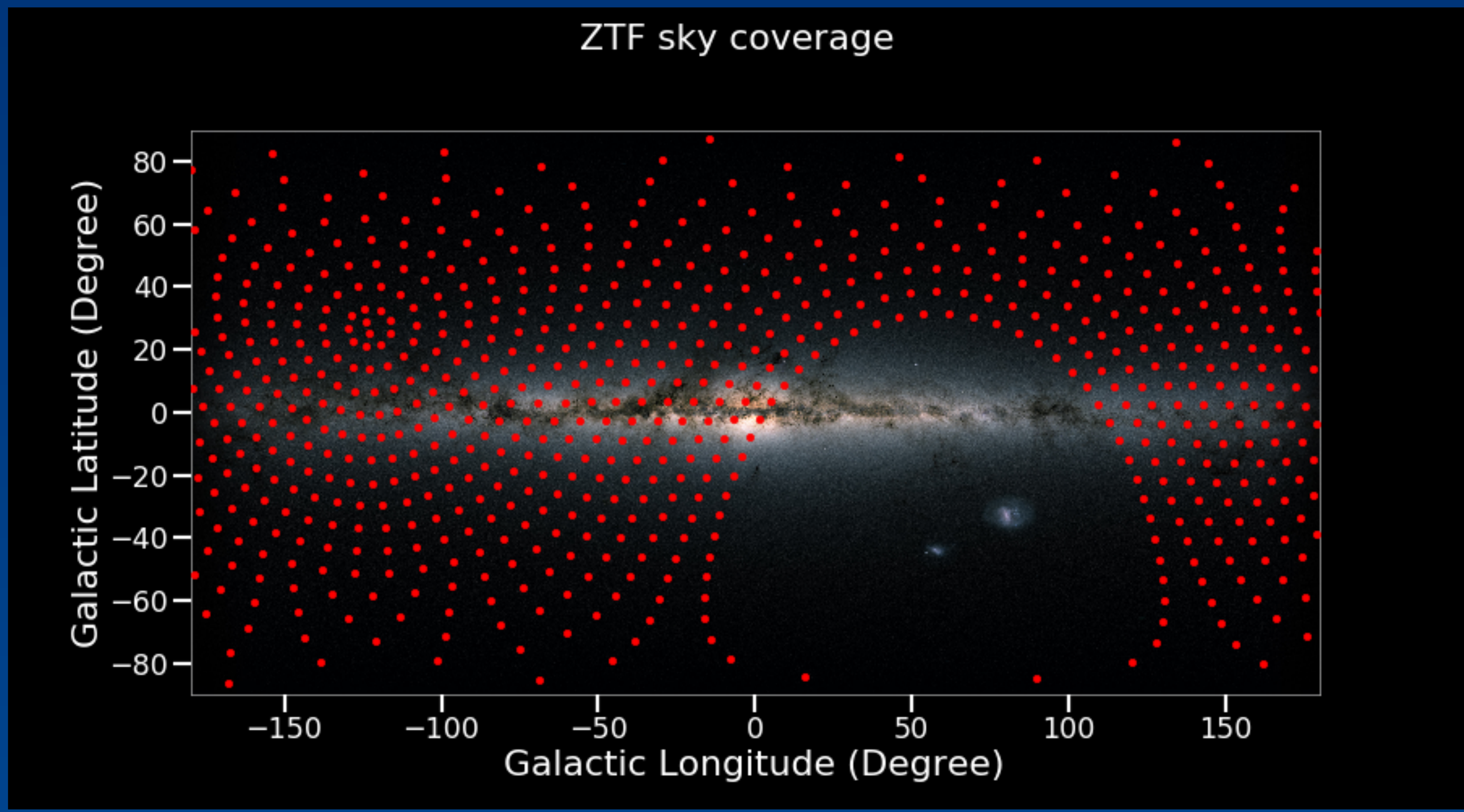
CFHT

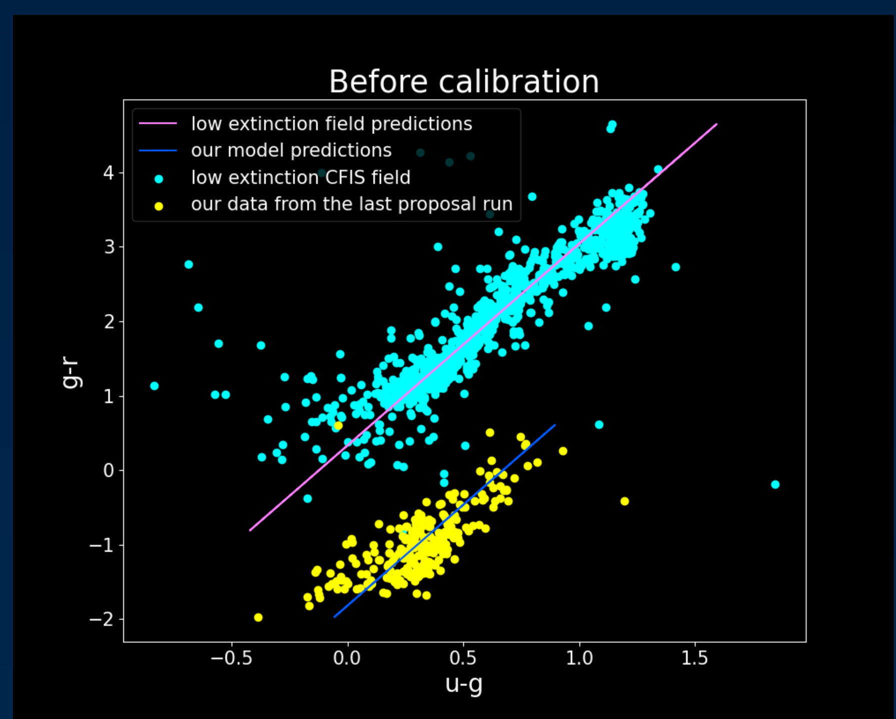
ZTF

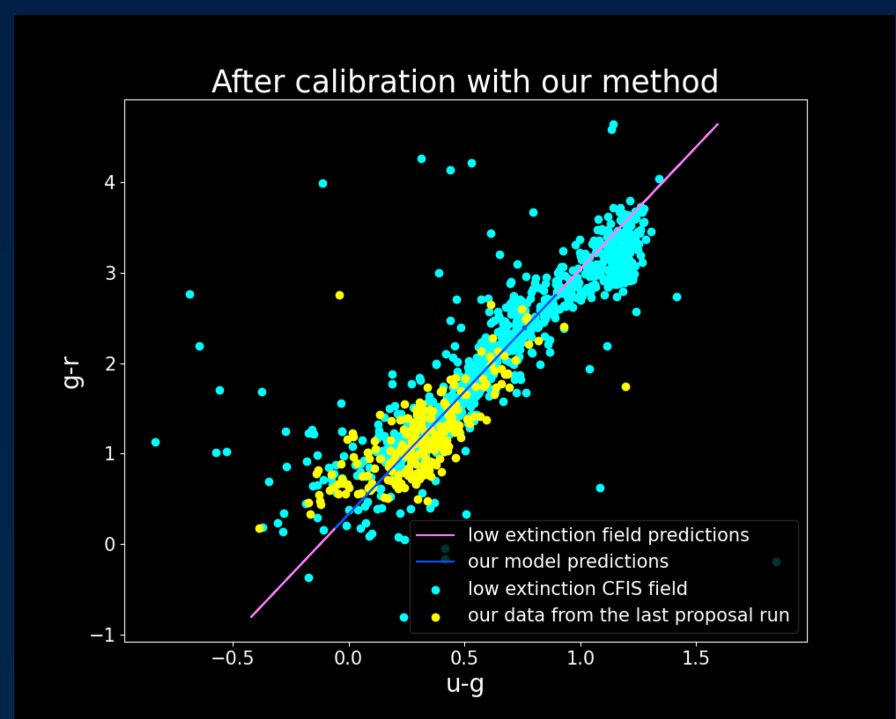
Zwicky Transient Facility (ZTF) is one of the leading time-domain wide-field survey. ZTF employs a very wide field mosaic camera, mounted on the 48-inch Schmidt telescope on top of the Palomar Observatory and periodically scans the northern sky. It's data is available in the g, r and i bands.

CFHT

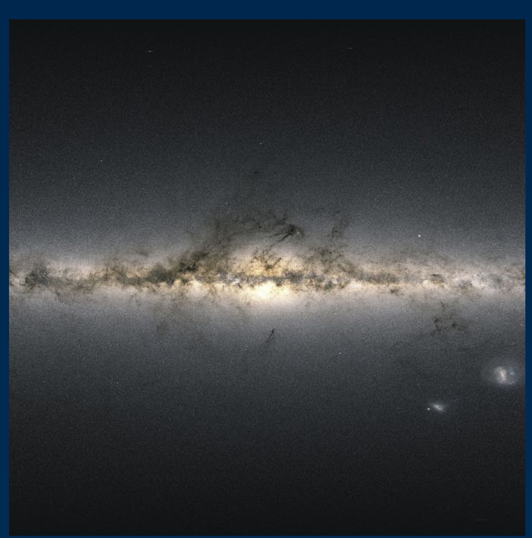
Canada-France-Hawaii Telescope (CFHT) is a world class, 3.6 m optical telescope situated in Hawaii with a 0.7 median arc-second seeing. Currently, CFHT's MegaCam is the best and most efficient facility to carry out the u band surveys.





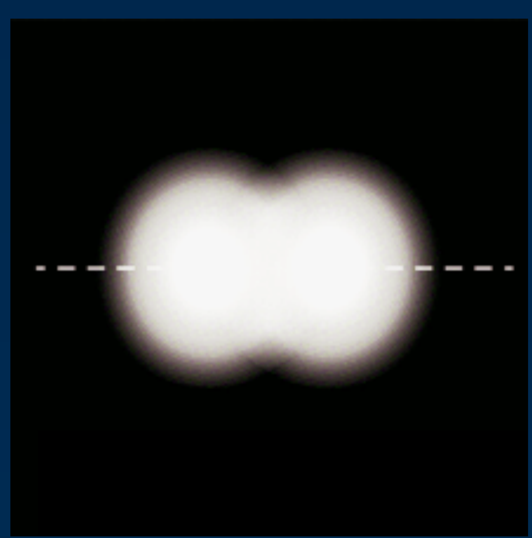


Why haven't we done this before?



Galactic Plane

Crowded field



Overlapping PSF

Having obtained data along the Galactic Plane, the most important step will then be cross matching the catalog of known stars against this list of the newly observed stars. This will help in identifying the known as well as new counterpart observations in our data. Conventionally, the packages used for such cross-matching uses the smallest distance between a star in the standard catalogue and stars in the dataset obtained, which is generically referred to as proximity matching. However, the Galactic Plane being so densely crowded, this task becomes prone to errors as a given star might have multiple counterparts in the standard catalogue depending on the cutoff distance given for the proximity matching. This issue of crowding has been looked into by Wilson et al. by using proabilistic matching using an astrometric uncertainty function instead of the hard cut offs put on by proximity matching.

Earlier metallicity results + CFHT observations

- Since, metallicity is correlated with U-B and B-V color and Johnson UBV ~ SDSS ugr, F & G Blue main sequence stars were selected as samples
- Cuts were applied to select bright Main sequence stars
- Proof of concept: u-band calibration without external data
- Strong color-color correlation permits derivation of stellar metallicities from photometry alone
- Various dust models, extinction calculation methods exist: eg: PNICER for validity check.

Future: Machine Learning + LSST Integration

Machine Learning shall be primarily used for two purposes later on:

- Identifying the correct counterpart in the crowded galactic field by applying ML to the probabilistic matching
- To characterize metallicity of observed stellar sources

These techniques along with archival Galactic Plane data and future LSST observations will then be used to cover the whole galactic sky and hence obtain a legacy survey.

References

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