2021-01-08 Meeting notes

Date

08 Jan 2021

Attendees

Julie McEnery, Alice Shapley, Cristina Oliveira, Dara Norman, David Spergel, Dimitri Mawet, Dominic Benford, Edward Wollack, George Helou, Harry Ferguson, Jason Rhodes, Jeff Kruk, Jessica Lu, Jessie Christiansen, John Mackenty, Jonathan Hargis, Josh Schlieder, Karoline Gilbert, Keith Bechtol, Ken Carpenter, Lee Armus, Megan Donahue, Neil Zimmerman, Neill Reid, Peter Melchior, Rachel Akeson, Rebekah Hounsell, Roeland van der Marel, Ryan Hickox, Saurabh Jha, Sangeeta Malhotra, Saul Perlmutter

Agenda

- High Latitude time domain survey (SNIA Cosmology) - Rebekah Hounsell
- Galactic Bulge time domain survey - Matthew Penny

Minutes

Matthew Penny - Galactic Bulge time domain survey

RGES - No longer called "microlensing survey" since it will do more science than that

Measure mass function of cold exoplanets, frequency of free floating planetary mass objects in the galaxy.

Estimate masses and distance to the host stars.

Only a sub-dominant fraction of systems have gas giants. Only 1/2 of systems have super-Earths mini-Neptunes. Are the remainder of systems populated by "failed" giant planet cores?

RGES will look for features in the planet mass function that discriminate formation paths. RGES will greatly exceed the statistical power of current microlensing surveys in this respect.

Achieving 10% precision in a decade size bins around 1 M_Earth requires detecting 100 Earths.

Based on detection efficiency 0.01, Need 10^5 events. Event rate per star is few x 10^-5. => Monitor 200 milllion star years.

Time resolution is important for extracting parameters. Need 15-minute cadence.

RGES DRM uses 7-9 fields to cover 2-2.6 deg^2 survey area. 1 year total survey duration, spread out over the 5-year mission.

Large time baseline of survey enables resolving the source and lens stars. Can then infer planet masses, not just the planet/star mass ratio.

Questions

Megan: What fraction of mass measurements come from the event itself versus lens-source separation?

Matthew: Expect lens-source separation for 50% of them. Another 25% of mass measurements will benefit from finite source effects and microlensing parallax (modulation in light curve due to acceleration of spacecraft).

Jessica: What ancillary data is needed before/after?

Matthew: Seasons are only 72 days, so many events will only be partially covered. Precision improves if you can cover the remainder of the event from LSST or Subaru. Also Satellite parallax between Earth and Roman, or between Euclid and Roman.

Jessica: Spectral typing stars?

Matthew: Helpful but not required. Spectroscopy of the lens star would be extremely valuable.

Jessie: Is 50% mass measurement fraction limited by time baseline of mission?

Matthew: Yes, for longer time interval you can increase that fraction, but never all the way to 100% due to other problems

Megan: Is the assumed mass function conservative at low planet mass?

Keith: Are there other science cases driving the RGES survey design. e.g., compact objects? (neutron stars, black holes)

Jessica: Keith, they can't drive it; but I like to constantly remind them (and the team has been keeping it in mind). Field selection and spreading out observations impact this case.

Julie: The survey presented here is the DRM, but ultimately we will have community input to help maximize overall science.

Jessica: What time scale does is that input needed?

Julie: We want substantial discussion about that at one of these meetings in the future.

Rebekah Hounsell - High Latitude time domain survey (SN Ia Cosmology)

Roman aims to improve the dark energy figure of merit by a factor of 10.

SN 1a are a key cosmological probe for this. Roman will get SN 1a out to z~3.

To achieve this, need to understand systematic uncertainties in SN 1a optical-NIR data

We have simulated dozens of SN surveys strategies using multiple tools, evaluating different combos of spectroscopy, imaging, areas, depth.

Shallow (z < 1) filters RZYJ. Deep (z < 1.5) filters YJHF. Imaging SNR=10 in each filter at peak. Prism exposures SNR=25 in rest frame V.

Investigating varying fraction of prism time (10% to 75%). Each design has pros and cons.

Less prism time means more light curves but rely more on photo-z and ground-based support.

More prism time means less light curves, less overlap with other surveys like Rubin, easier classification.

All analyses include major systematics. Current studies are evolutionary population drift (TWINNING), impact of host galaxies.

Questions

Jessica: Are these trades self-contained within Roman survey, or do they include Rubin, Euclid, etc?

Rebekah: That will be done later.

Saul: We have looked at supplementing the survey with spectroscopy from Subaru and JWST, and they are very time demanding. It will be hard to get follow-up for many events with JWST.

Saurabh: Could you discuss non-astrophysical systematics?

Rebekah: The Roman pilot survey would help address those.

Julie: I propose discussing pilot surveys and early deep fields at our next meeting (in 2 weeks).