Resource Wish List: Faint Universe

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Wide Field Spectroscopy:

Science Example 1: Improve LSST photo-z's from 5% to 2%. Important for cosmology, weak lensing, cluster identification, many other science cases. Need a template set of ~30,000 sources down to **i = 25.3** with **R~5000** spectroscopy. Various facilities could be used (4-m, 8-m, 30-m), but so much time is required that a dedicated wide-field highly multiplexed spectrograph seems the best approach

Science Example 2: Study kinematics of resolved stars in galaxy halos out to 10 Mpc (GCs to 20 Mpc). Can tell us about shape of DM potential wells (-> constraints on DM interaction cross-section), and relationship between baryons and DM. Need to reach **25-26 mag** at **R~5000** (can measure velocities to 2 km/s in dwarfs). This is a GSMT project, or could be done on a 10-m with a wider FOV instrument.

GSMTs - US community access

Capabilities complementary to JWST will be desirable for a range of faint universe science:

- higher angular resolution (AO) for NIR imaging and IFU spectroscopy
- higher spectral resolution (R > 2700)
- multiplexed IFUs (JWST/NIRSpec has one IFU)
- optical wavelengths (e.g., IGM/CGM tomography)

Science example 1: map kinematics and metallicities of stars in nearby galaxies (e.g., M31 and M33). Crowded fields require AO, metallicities require R~20,000. This will take a lot of time!

Science example 2: physics of galaxy assembly via resolved structure, kinematics, chemical abundances and ISM conditions at high redshifts. Higher angular/spectral resolution than JWST for larger samples with multiplexed AO IFUs

Resource need: time for dedicated surveys either through US open access time or coordinated with GMT/TMT communities

Wide-field imager (4m to 8m class) in the North

With the Mayall conversion to DESI and open-access WIYN time dedicated to NASA exoplanets, there is no longer US community access to wide-field imaging (of any type) on >=4m-class telescopes in the northern hemisphere, but there will still be science cases for this, e.g., gravitational wave counterpart identification.

Resource needs: Access to Subaru/HSC? CFHT? (non-NASA) time on WIYN/ODI?

*Solar system: need support for purchase and installation of narrow-band filters. For fast-rotating objects, also need (near) simultaneous visible and IR observations or fast instrument switching

Joint processing/analysis of LSST + Euclid/WFIRST data

Combining information from LSST and Euclid/WFIRST will greatly enhance most faint LSST science (high-z: get rid of MW foreground stars; low-z: get rid of background galaxies, proper motions).

Resource needs: Open public access to such joint data sets should be eagerly sought and widely disseminated. Work on developing tools for analyzing data of very different spatial resolutions

Continued "GO" capabilities

Resource need: continued availability of some amount of open-access time for smaller PI-led "GO" programs on telescopes with a range of apertures

- Workhorse optical+IR spectrographs and imagers on 8m-class and smaller telescopes will continue to be important during and after JWST, and in the GSMT era, and can offer complementary capabilities
- Explore future telescope observing exchanges (i.e., similar to the current Subaru/Gemini/Keck observing time exchange program)
- Include "community fibers" in big spectroscopic programs
- Support different observing cadence requirements. For some solar system science, many short observations are needed over a long period of time. Important to reduce telescope overheads (slewing, filter changes, guider set-up time)