SWG1+2 Breakout Notes

- **Are we missing obvious/compelling science questions in our field?**
  None noted. But let us know if we do!

- **Are some of the things we think are compelling actually not very interesting?**
  - RV stellar multiplicity: also done by SDSS-V/APOGEE, using Fabry-Perot etalon: ~30 m/s
  - MSE should be able to do ~15 m/s with R~40K. Fabry-Perot a “thought” at the moment for MSE.
  - Circular/octogonl fibers: ~70 m/s effect; cal fibers?
  - Emphasize complementarity: MSE going fainter, unique for cool (substellar) primaries
- Multiplexing versus multithreading: e.g. TESS planets are sparse; can’t be done with Keck, but ride on larger MSE survey. Same with exoplanet atmospheres.
- Cadence might be issue for multithreading. E.g. need >15 RVs for an orbit
- SGWs to merge multithreading science cases?

● Plans for a major survey?
  - SWG1 hasn’t prioritized yet. RVs & WDs too sparse. Cluster survey - well matched to FOV? PLATO
  - SWG2: metal-poor stars; r-process stars; high priority since can only be done with MSE in the blue
  - APOGEE lesson: don’t plan ahead > 5yrs, be flexible
SWG1+2 Breakout Notes

- **Science Capabilities** (e.g. 30K/35K/40K vs S/N?)
  - High resolution major science driver for both SWGs
  - Need to perform simulations, e.g. what S/N with what R do we need to measure [X/Fe] to sufficient precision? Done for APOGEE. What are our key lines?
  - Blue HR channel critical for SWG2

- **Astro 2020 plans**
  - ~6-7 people in the room planning to write white papers involving MSE
  - SWG1 plans to put white paper on astro-ph before Astro2020 deadline (i.e., will be cite-able)
● Discussion topics & “conclusions”
  ○ White papers:
    ■ at least a handful of papers in preparation; everyone encouraged to submit something without waiting for “instruction”
    ■ Some way of coordinating effort would be very valuable (eg Google docs)
  ○ Science cases:
    ■ Some concern that SDSSV could scoop some of the ISM science cases in the disk prior to MSE - NIR HR capabilities of APOGEE (vs optical of MSE) make up for difference in apertures?
    ■ but interesting idea to investigate the temporal variations in the ISM via mapping experiments (will follow up with Lallement et al)
    ■ the main MW science for MSE is focused on (i) the distant galaxy (outer disk, halo via in-situ studies) for which the increased sensitivity is crucial (ii) HR studies for stars across the entire magnitude range of Gaia, again sensitivity being crucial. Unclear if there is anything that competes with MSE in this arena.
Discussion topics & “conclusions”

- Major surveys:
  - Could easily develop a very major survey using multiple resolution settings
  - Obvious complementarity with Stars/Exoplanets & Chemical nucleosynthesis

- Capabilities:
  - Medium resolution mode is critical for studies of DM halos in dwarf galaxies, M31, Local Group galaxies in general (R~3000 isn’t high enough, even with good SNR)
  - Pushing the “low-res” people to “moderate-res” is more desirable than getting rid of moderate res :-)
    For low read-noise detectors, this would be possible since binning could be used without introducing significant noise
  - The precise wavelength windows used in HR need to be reexamined to make sure they are optimally tuned for whatever spectral resolution is finally adopted (where optimal gives the highest number of elements + distinct nucleosynthetic pathways as possible)
  - Note that HR observations at *low* SNR are still very useful for dynamical (velocity) studies
SWG 4 breakout session report
Are there other science cases that should be in the DSC?

- Power spectrum of Lya and constraints on the primordial power spectrum (with implications for warm, fuzzy and self-interacting dark matter models). Will this be systematics dominated in 10 years, if not already? Will this science be done as well as it can be before MSE? Not a compelling case for MSE yet.

- Increase packing in the core to get resolved stellar velocities in ETGs and UDGs? Will this science be done before MSE?
Are there possible issues with the science cases already in the DSC?

- Studying dwarfs in the local universe (z<0.1) to get a complete census.
  - Are they too diffuse? Do we need larger fiber sizes? Sizes < ~ kpc, which at 200 Mpc is about 1”. So not a huge worry, but something to think about.

- Extragalactic DM science case of strong lensing to detect dark subhalos.
  - Will this science get done before MSE? This is a topic that the SWG hasn’t had time to do detailed calculations, so the landscape is unclear.
  - Make connections to strong lensing science in other parts of DSC.
Design and survey strategy

- No need for H-band.
- $R=40k$ vs $35k$. We need 100 m/s for detecting subhalos with stellar streams. How does that influence $R$?
- Cadence? For Milky Way dwarfs, we need repeats with a cadence of few months to year. Galaxy evolution science will repeat ~monthly. There is good synergy here.
- Bigger field of view with same density of fibers for Local Group probes? Not yet a clear cut case.
- Density of fibers is enough for the science cases already in the chapter.
Astro 2020 white papers

- TL and MK will write overview whitepaper. Nothing else planned.
• How critical is H-band for ExGal science?  
  **ESSENTIAL**

• High vs. Medium vs. Low Resolution
  Medium (R~6000) is the workhorse for Exgal
  High (R~20,000) in small fraction of objects (e.g. subset of AGN)

• Wide vs. deep survey? Where in the sky?
  Two primary ExGal pointings for scheduling & follow-up
  Higher fiber density preferred (lots of galaxies << M*)
The Science Case

Questions:
1. Are we missing obvious/compelling science questions in our field?
2. Are some of the things we think are compelling actually not very interesting?

Answers:
Increase the size of the survey, why only 10,000 deg²?
→ Driven by LSST (dec<2?) and UNIONS footprints

Add the H-band to increase the redshift range for ELGs
→ 2.9<z<3.7 but very faint targets, we need to estimate the redshift efficiency. Possibility to use LR and MR in parallel?

Synergies with other groups:
➢ Common targets with AGN and galaxy group
➢ Study of the systematics (crucial for the small scales RSD and neutrino masses)

Use the HR spectrograph for bright QSOs (Lyα forests)
Planning for the Design Reference Survey

Questions:
1. Within our field, what is the major science question that we would want to design an entire survey around?

Answers:
- Primordial non-gaussianity and neutrino masses
- Wide survey: 10,000 deg$^2$
- Three tracers covering $1.6 < z < 4.0$
- 100 nights per year for a 5-year MSE program
Science Capabilities

Questions:
1. Is H-band (1450-1780nm) essential?
2. Does the high resolution mode need to work at R=40k? Is a lower resolution (eg R=30k, 35k?) acceptable?
3. Do we want more fibers? A denser FoV?
4. Do we want a wider FoV?

Answers:
1. H-band not essential but....
2. Not needed, but possibility to switch to additional LR optical spectrograph
3. Denser: it can help for \( \Sigma m_v \) but not mandatory.
4. Wider FoV with same fiber density: a faster survey

It is still possible to change the design?
Questions:
1. What white papers are being submitted on our science?
2. What other WPs do we want to submit and who is leading them?

Answers:
1. Not WP submitted yet.
2. Michael Wilson is proposing to merge the MSE case into his WP: “Inflation and Dark Energy from spectroscopy at z > 2”
SWG8 (TD) Discussion Summary

Science Case:

- Anything missing? None noted (but BH orbits questionable)
- What's special about MSE for TD? Statistics and intrinsically faint objects (BDs/WDs)
- 1 fiber per pointing would result in 20,000 transients - significant sample for basically no impact (1/3000th of capacity)
- In next 10 years we will have a better idea of what transients are worth targetting
- MSE shouldn't chase LSST - better suited to individual facilities - better to build up long/large datasets
Planning:

● Which fields should be observed first? Could this be dictated by where transient science most probable (but be careful when fields are chosen by one object)
● Having a driving program/survey is important
● Non-transients may be harder than transients - matching cadences is key
● "Blind" TD survey may be ideal - parallel with reverberation mapping/calibration fields, ideal targets from imaging surveys
● Could build effective TD survey by building up S/N through visits spread over time
● Learn lessons from SDSS V, LCOGT, others; APOGEE currently running 2-11 parallel programs
Engineering concerns:
- Not much discussion on resolution or H-band
- Some discussion on "free fibers" - placement could be "dynamic" by swapping fibers instead of moving
- Low sidereal rate will probably be limited to short times - very small throw (but something to experiment with)
- High sidereal rate could be achieved with line of fibers

WP plan:
- Only one TD WP noted - more needed
- WP on best practices of scheduling TD programs would be worthwhile