High-resolution spectroscopy with TMT.

1. **Wavelength coverage**: optical versus (near-/mid-)infrared?

a. Blue: preference to go as blue as possible, but need for special fibres
    a. Star formation: from UV cut-off to reddest possible range
    b. High-z ISM studies: as blue as possible to at least JH (K?)
b. Red: suggestion to go as red as the L band to link up with MICHI wavelength coverage; redder than ~1.5–2 μm needs cooling so cost implications
c. Simultaneous coverage: some preference for separate optical/infrared instruments (field of view tradeoffs); simultaneous optical + NIR coverage needed for some science cases (e.g., to remove stellar jitter in RV studies)
d. NIR (only?): embedded photospheric lines, exoplanets (NIR dominated; bio signatures), etc.

2. Stability versus throughput

a. 1 m s^{-1} repeatability over 10 years – cosmological constraint
b. Instantaneous stability? Driven by RV studies, need to worry about drift (offset in velocity)

3. Multiplexing/IFU

a. Field of view specification? Multi-object capability a must.
b. Dense spatial sampling in central FOV (possibly the GLAO-corrected area? 4 arcmin diameter); sparser coverage in outer field
c. Nearby galaxies, Galactic star formation, cosmic web studies would benefit from good spatial coverage; could be a smaller number of IFUs in a central configuration instead of a filled focal plane
d. AO versus seeing limited benefits/options
e. Tradeoffs: fibre diameter, spectral resolution? Fibre-fed rather than image slicers (instrument volume)? Cost/benefits
f. High-res instrument could be fed by WFOS fibres/configuration?

4. Resolution

a. R = 50,000 or 100,000; tradeoffs? 30m needed for sufficient throughput

b. r-process elements, stellar kinematics, R > ~20,000
c. At least R = 100,000 for isotope ratios, abundances, line profile analysis; stellar physics, also in distant galaxies
d. high-z science: R > 100,000 for rotational lines of CO and other molecular lines; measuring the CMB temperature directly; deuterium
e. Costs increase significantly for R > 70,000–80,000 – possible to cut in resolution? Many isotopes cannot be resolved.

5. **Time domain**

a. Optimal time resolution? Fast transients, etc.
b. Quick-look facility, mode switching, fibre repositionings

6. **Polarimetry?**

a. Need to design science cases beyond a single niche
b. NIR? Or MIR? Better than optical (e.g., Zeeman splitting scales with wavelength^2)
c. Case for 30m rather than 8–10m?
d. Cost/benefits analysis needed

White paper:

- Core team? Executive committee drawn from all members?
- Contact wider TMT community for input
- Build on previous high-res instrument design, involve relevant people
- Start from the DSC and develop the key (highest-priority) science cases in a similar way as the WFOS team is doing (spreadsheet like that for the science flowdown).
- Potential to split into smaller interest groups – good or bad? Preference to start from an integrated approach.
- Consider synergies with confirmed missions and instruments; proposed instruments lower priority.