Maunakea Spectroscopic Explorer

The Maunakea Spectroscopic Explorer (MSE) is a next generation, Stage-5 spectroscopic facility that will enable transformative science. MSE will utilize a 12-m primary aperture and employ up to ~20,000 fibers over a 1.5 square degree field of view (FOV). It will perform data acquisition over the optical through near-infrared wavelength regimes at low, medium, and high spectral resolutions. MSE will be installed on Maunakea if approved by the newly established Mauna Kea Stewardship and Oversight Authority (MKSOA). The expected timeline, based on the approval process and anticipated funding opportunities, places the start of MSE construction in the early 2030s, leading to science operations beginning in the early 2040s.

Maunakea Spectroscopic Explorer Science Case

With the ability to collect millions of spectra over a broad wavelength range and large field of view, MSE will reveal the composition and dynamics of the faint Universe and impact nearly every field of astrophysics across spatial scales from individual stars to the largest scale structures in the Universe. Science enabled by MSE will include: the comprehensive follow-up of the Gaia and Rubin Observatory LSST stellar samples down to limiting magnitudes of g ~ 20-24 mag to understand the chemistry and dynamics of the Milky Way and its neighboring satellites with unprecedented detail; the revolutionary study of galaxy formation and evolution with a stellar mass complete sample over billions of years back to 'cosmic noon' (z ~ 2.5) when the Universe was at its peak of star formation; and, the examination of a large volume of the Universe with a galaxy density sufficient to measure the extremely large-scale density fluctuations required to explore primordial non-Gaussianity, at $\sigma(f_{NL})$ ~ 1.8, and consequently, inflation.

The golden age of transient discoveries has been ushered in by large area and highly cadenced imaging surveys such as ZTF, ASAS-SN, and ATLAS. ZTF is currently sending out hundreds of thousands of alerts per night of transient and variable events with a sensitivity of r = 20.9 mag. The upcoming Rubin Observatory LSST will exceed ZTF by orders of magnitude and deliver 10 million alerts per night down to r ~ 24.5 mag. A large fraction of transient and time domain events require spectroscopic follow-up for full characterization. Accordingly, Astro2020 recommended investment in future spectroscopic facilities to identify and characterize transients as they evolve.

With its large aperture and FOV as well as high level of multiplexing, MSE is well-suited to perform time domain follow-up. MSE will enable a myriad of time-domain science, especially in the faint magnitude regime with transients such as kilonovae, tidal disruption events, and fast radio bursts.

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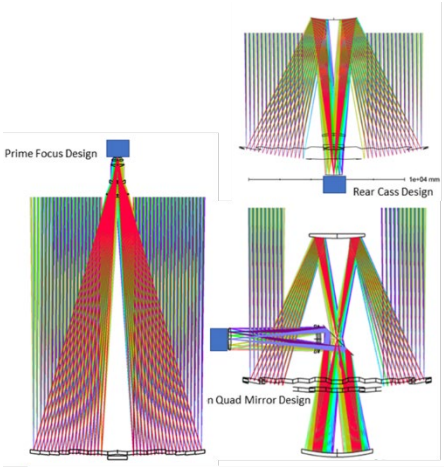
Maunakea Spectroscopic Explorer

Alternate MSE Design Variants

We are seeking science collaborators for the continued MSE Design Study. Specifically, we are exploring alternate telescope design variants that may modify the conceptual design prime focus telescope configuration. The major advantages of these new design variants over the current baseline are:

- Greater survey speed due to a factor of four increase in multiplexing over the same FOV
- Potential spectral range extension from short-blue to K-band with low, moderate, and high spectral resolutions

Survey Speed Metric for Select MOS Projects			
Instrument/Telescope	**No. Fibers**	**Collecting Area [m2]**	**Speed Relative SDSS****
SDSS Spectrograph/SFT	640	3.7	1
LAMOST	4000	18.9	158
HERMES/AAT	392	12.0	10
BOSS+APOGEE/SFT+du Pont	500	3.7	4
DESI/Mayall	5000	9.5	99
WEAVE/WHT	1000	13.8	29
MOONS/VLT	1001	50.0	105
PFS/Subaru	2400	50.0	251
4MOST/Vista	2436	12.0	61
MegaMapper/Magellan-like	20000	28.0	1170
FOBOS/Keck	1800	76.0	286
MSE-Baseline	**4332**	**80.8**	**731**
MSE-QM Preferred	**18000**	**~90**	**3385**
SpecTel-WST/TBD	15000	87.9	2755
MOSAIC/ELT	200	978.0	409
**Assumes dedicated survey			



Design Variant	Fiber Count in Calculation
Prime Focus Telescope	4,332
Rear Cass D-M Telescope	12,000*
Quad Mirror Q-M Telescope	18,000

*For information only

Becoming a MSE Science Team Member

The international MSE Science Team is open to all research astronomers in the international community and supports all aspects of MSE science development under eight working groups. The science working groups include exoplanets and stellar astrophysics; chemical nucleosynthesis; Milky Way and resolved stellar populations; galaxy formation and evolution; AGN and supermassive black holes, astrophysical tests of dark matter; cosmology; time domain astronomy and transients.

To join the MSE Science Team, email mseinfo@mse.cfht.hawaii.edu

Learn more about the science cases for MSE in our detailed science case: