How does Keck lead in the era of the thirty meter telescopes?

The W. M. Keck Observatory remains one of the most scientifically productive facilities on the planet. Leveraging the combination of telescope size, geographic location, powerful instrumentation, and an innovative community, Keck has enabled transformative science, including two Nobel Prizes, over the last three decades. As telescopes with larger apertures come on line, Keck must differentiate and strengthen itself to maintain its leadership in the mid-2020s and beyond. The Keck Discovery Engine provides the signature vision for a bold future for enabling science with Keck by combining the most advanced instrumentation on the planet with next generation artificial intelligence and machine learning to produce an unrivaled capability for astronomy.
A transformative leap in capability: Both the Wide Field Imager and FOBOS make huge gains over current Keck capabilities. Shown at left in red is the field of view of the LRIS imager and spectrograph in current operation at Keck. LRIS is limited to a small footprint on the sky (The Andromeda Galaxy and the Moon are shown to scale), and can obtain at most up to a hundred spectra at once. By contrast, the field of view of the Wide Field Imager (in yellow) is over 50 times larger, and FOBOS (in white) offers up to 2000 spectra per pointing. Both FOBOS and the Wide Field Imager are optimized to provide wavelength coverage down to the atmospheric cutoff, with a throughput no instrument on any telescope current or planned will have, including next generation thirty meter telescopes.

Unrivaled efficiency: The combination of the Wide Field Imager and FOBOS through an artificial intelligence/machine learning layer enables observing efficiency no other telescope can provide. The Wide Field Imager, stationed at the prime focus, makes ultra-deep, wide-field observations, and feeds them to the artificial intelligence layer which selects targets for spectroscopic follow-up based on the observing team (or teams) science requirements. A secondary mirror is deployed, and the FOBOS star bug fibers shown at right move in the field to line up with the selected targets within minutes. This process enables science at a rate never before possible. As shown below, a suite of observations in a single night with the Discovery Engine can provide the science that used to require years of observations.

With their powers combined, the components of the discovery engine offer unmatched capability, leading the world in astronomical discovery for decades, and advancing our knowledge of the universe and our place in it for decades to come.