RESPONSE TO WHITE PAPER QUESTIONS

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3. Comment on the need for the U.S. community's access to non-federal O/IR facilities up to 30 meters in size.

McDonald Observatory operates telescopes at its very dark site in the Davis Mountains of Texas. The telescopes include: the Hobby-Eberly 10-m Telescope (HET); the Harlan J. Smith 2.7-m Telescope; the Otto Struve 2.1-m Telescope; a 1-m telescope that is a node of the Las Cumbres Observatory Global Telescope; and several smaller telescopes. These telescopes feature a versatile suite of advanced instrumentation for both optical and near-infrared wavelengths, including high- and moderate-resolution spectrographs, integral-field spectrographs and imagers. McDonald Observatory celebrated its 75th anniversary in 2014 and has served as one of the key centers for ground-based OIR astronomy.

The HET, one of the largest optical telescopes available, is being completely revitalized with a wide-field upgrade and powerful new instrumentation. HET's usable field is being extended to 22 arcmin diameter. New and upgraded instrumentation for HET includes: the VIRUS Integral Field Spectrograph array with 78 VIRUS units and 35,000 fibers over HET's wide field; a new, highly efficient low-resolution spectrograph (LRS-2); an upgrade to HET's high-resolution optical spectrograph (HRS) with increased efficiency and radial velocity stability; and a new high-resolution infrared spectrograph, the Habitable Planet Finder (HPF). The Harlan J. Smith 2.7-m Telescope also features new, unique instrumentation: IGRINS an R=40,000 infrared spectrograph that provides complete coverage of the H and K bands in a single exposure.

The scientific goals prioritized by the Decadal Survey are highly aligned with McDonald Observatory's capabilities. McDonald is well positioned to be a vital contributor to meeting many of the Decadal science themes as listed below. Exoplanet characterization: Precision radial velocity monitoring from the HET and 2.7-m telescopes will identify and characterize exoplanets and their host stars, including candidates located by space-based transit surveys. The HPF and IGRINS instruments facilitate the Doppler study of low-mass exoplanets orbiting M dwarfs and brown dwarfs. Dark Energy: HETDEX will measure the evolution of dark energy out to z of 4 with high precision. The Transient Universe: The HET, with its effective queue observing system, always available instrument suite, and considerable spectroscopic capability, will allow prompt follow-up of transients discovered by LSST and precursor surveys. LSST follow-up: The bounty of astrophysically interesting objects identified by LSST, from rare classes of white dwarfs to distant supernovae, will require spectroscopy to reap the full scientific rewards. McDonald Observatory, especially HET, is well suited to LSST spectroscopic follow-up.

McDonald Observatory is the key observing facility for University of Texas astronomers. In addition, Penn State is a partner in the HET. Several U.S. institutions participate in the HETDEX project, including Penn State, Texas A&M, Rutgers and others. McDonald Observatory allows outside users to apply for observing on its 2.7-m and 2.1-m telescopes. For the past five years, the average outside use was 24% on the 2.7-m and 43% on the 2.1-m.

10. What types of scientific and observing coordination among the various NSF telescopes (including Gemini and LSST) and non-federal facilities are the most important for making scientific progress in the next 10-15 years? How can such coordination best be facilitated?

McDonald Observatory's operating funds are predominantly provided by the State of Texas. Funding for new instrumentation has resulted from federal grants and from donations by individuals and private foundations. The federal funding received is highly leveraged by private and state funding. McDonald Observatory maintains a long-standing program to engage philanthropists in astronomy.

The most significant challenge to sustaining a world-class observatory is attracting the funding to keep the instrumentation current and aligned with the scientific frontiers. There is a shortage of funds to develop new instrumentation for observatories. The NSF ATI, MRI and MSIP programs are the primary federal funding vehicles for instrumentation for U.S. ground-based facilities; they are highly over-subscribed. Expending NSF funds at university-based observatories not only helps to maintain these facilities at the state of the art but also provides an opportunity to train the next generation of astronomers with a background in both observations and instrumentation.

This need for instrumentation development funds provides an opportunity to coordinate the observing system. The TSIP Program offered funding for new instrumentation in return for offering observing access through peer-reviewed proposals to the NOAO TAC. This allowed TSIP to influence which new capabilities were being introduced into the System and to allow peer-reviewed universal access to these frontier instruments. MSIP offers similar possibilities. McDonald Observatory is enthusiastic to participate in programs in which an observatory can propose for new instrumentation funding and include community access. We are prepared for such proposals to be judged in part by how they enhance the U.S. OIR System.

The exchange of observing time between observatories is another way that the System can be enhanced. McDonald Observatory has several unique capabilities as described above. Yet we lack other capabilities, such as wide-field optical imaging at large aperture, multi-object near-infrared spectroscopy at large aperture, and adaptive-optics near-IR imaging and spectroscopy. Other observatories have developed such capabilities. It is not practical for every observatory to possess every capability, both due to economic factors and their telescope and site properties. McDonald would be willing to participate in a national clearinghouse whereby we could offer some time with our telescopes to the broad community and secure in return access to observing time elsewhere with capabilities that we lack.

In summary, McDonald Observatory would welcome the opportunity to participate in a vital U.S. OIR System. We would value an exchange of ideas with the funding agencies and other System participants on how we can all coordinate more effectively.