RESPONSE TO WHITE PAPER QUESTIONS

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WHITE PAPER QUESTIONS

7. Given the increasing complexity of astronomical instrumentation, where should new major instruments be built (e.g. universities, national labs, collaborations)? How much instrument duplication is desirable or sustainable across different facilities of similar aperture?

The University of Texas at Austin (UT-Austin) and its McDonald Observatory firmly believe that new, advanced instrumentation is fundamental to achieving new frontiers in astronomical understanding. World-class instrumentation development is a key strategy for achieving the scientific goals of the Decadal Survey.

UT-Austin and its McDonald Observatory have a long history of developing state-of-the-art instrumentation and deploying it to achieve breakthrough scientific results. Some recent examples of instrumentation developed for and deployed at McDonald Observatory include: The George and Cynthia Mitchell Spectrograph and VIRUS-W, both highly capable integral-field optical spectrographs for the Harlan J. Smith 2.7-m Telescope; IGRINS, an R=40,000 infrared spectrograph for the Harlan J. Smith Telescope that provides complete coverage of the H and K bands in a single exposure. New and upgraded instrumentation being developed at McDonald Observatory for the upgraded Hobby-Eberly 10-m Telescope (HET) includes: the VIRUS Integral Field Spectrograph array with 78 VIRUS units and 35,000 fibers over HET's 22 arcminute wide field of view; a new, highly efficient low-resolution spectrograph (LRS-2); and an upgrade to HET's high-resolution optical spectrograph (HRS) with improved efficiency, capabilities, and radial velocity stability.

UT-Austin is a founding partner in the Giant Magellan Telescope (GMT). We plan to serve as a major developer of innovative instrumentation for GMT. Currently, we are carrying out a GMT-funded design study for GMTNIRS, a very capable high-resolution infrared spectrograph that builds on the heritage of IGRINS. This is one of only five instruments currently under development for GMT.

In order to carry out this ambitious instrumentation agenda, we maintain a cadre of instrument PIs, engineers, software professional and technicians, plus laboratories and machine shops. We also engage graduate students, postdocs and undergraduate students in our instrumentation activity (see white paper submission from Tuttle et al.). Notably, UT-Austin has developed world-class technical capability in several specialist areas: 1) the development of silicon immersion gratings; 2) the mass production of replicated optical spectrographs; 3) the

construction and testing of fiber-based integral-field units; 4) design and testing of volume phase holographic gratings; 5) high dynamic range, high stability, low noise CCD controllers.

The ability of UT-Austin to develop instrumentation, integrate it with a telescope, test it, refine it, and use it for extensive scientific programs is enhanced by our access to the McDonald Observatory telescopes. Our strategy is to test new technologies and ideas first at McDonald Observatory before moving on to larger telescopes. Thus, IGRINS for the Harlan J. Smith 2.7-m Telescope is an essential precursor to GMTNIRS for the much larger and more complex GMT. Similarly, the VIRUS multi-spectrograph integral field spectroscopy concept was first developed and tested for the Harlan J. Smith Telescope, then developed at greater scale, complexity and telescope aperture for the HET. This strategy reduces risk and results in world-leading instruments on the relatively small McDonald telescopes. We are currently exploring the idea of applying VIRUS technology to the GMT, possibly fed by the MANIFEST instrument planned for GMT. Given the risk-reduction approach that the extremely large telescope (ELT) projects are adopting, a successful precursor instrument is becoming a necessity for innovative ELT instruments.

The NSF-funded ATI, MRI and MSIP programs are the primary paths to funding instrumentation for U.S. ground-based facilities. The amount of funding in the NSF programs is modest given the escalating cost of state-of-the-art instrumentation. We recommend that NSF encourage the funding of transformational instrumentation and technologies for the U.S. OIR System by increasing the funding limits and total allocations to the ATI, MSIP and MRI programs. We urge the NSF, NASA and DOE to conduct open competitions with opportunities for the full community to propose when considering funding any and all OIR instrumentation development activities.

McDonald Observatory is a highly successful public-private partnership. We maintain an extensive program to engage philanthropists in astronomy at McDonald Observatory. Three components of instrumentation funding, from the State of Texas, private philanthropy, and federal agencies, work together in a mutually supportive manner at UT-Austin.

Without sufficient and steady funding, it is not possible to maintain a world-class instrumentation program. We believe that the number of institutions in the U.S. that are capable of developing state-of-the-art astronomical instrumentation is diminishing. We urge the Committee and the funding agencies to carefully consider the need to maintain a sufficient instrumentation development and training capacity in the U.S. as they optimize the allocation of funds to their various programs.