The Cherenkov Telescope Array (CTA)

Description: The Cherenkov Telescope Array (CTA**)** is a ground-based observatory for very high-energy (VHE, 30 GeV–300 TeV) γ rays with construction starting in 2016. It will use atmospheric Cherenkov telescopes (ACTs) of 4–23 m diameter deployed over >10 km^2 to detect flashes of Cherenkov light from air showers initiated by γ rays, a technique pioneered at Whipple Observatory in the US. Current ACTs have cameras consisting of ~ thousand fast photomultiplier tubes, and their effective collecting areas typically reach ~ 0.1 km^2. The current generation, namely H.E.S.S., MAGIC, and VERITAS, have up to 5 ACTs with separations of ~100 m to record multiple views of each shower. CTA will be an array of ~ one hundred ACTs to increase the collection area and the number of recorded images of each γ-ray shower. CTA will have improved angular resolution, a wider energy range, larger fields of view, and an order of magnitude better sensitivity that will deepen and broaden the discovery space in fundamental physics and VHE astrophysics. CTA will provide a natural continuation of the successful program executed by Fermi-LAT and VERITAS, in particular addressing dark matter models at WIMP masses above 100 GeV. CTA will provide complementarity to dark matter searches at the LHC and direct detection searches as well as the theory effort.

Science: CTA is a critical component of any comprehensive program to identify and study **dark matter**. The HEPAP Particle Astrophysics Scientific Assessment Group (PASAG) and the Panel on Particle Astrophysics and Gravitation (PAG) of the Astro2010 NRC Decadal Review of Astronomy & Astrophysics recognized VHE γ-ray observations as the most promising approach to study the nature and properties of dark matter particles in a cosmic context. Their annihilation or decay shows distinctive, "smoking gun" spectral signatures common to all sources. These particles should be concentrated in the center of our Milky Way galaxy, with important substructure in the Galactic halo and satellite galaxies. CTA will deepen and extend the searches beyond what is possible with the Fermi-LAT and VERITAS.

Collaboration: A consortium with members from more than 27 countries on five continents has assembled to realize CTA. Scientists in the U.S. established the field of VHE γ-ray astrophysics and bring extensive experience and expertise to CTA. The CTA-US consortium, which includes ~ 100 scientists, is proposing to contribute 36 medium-sized telescopes (9-12 m) to CTA to optimize the performance for the science drivers described above. The U.S. groups are building a prototype telescope (NSF-MRI funded), to demonstrate the feasibility of an innovative design that will allow less expensive cameras with ~ 10,000 pixels using modern solid-state photodetectors, to provide better angular resolution over larger fields of view than conventional designs. This work is collaborative between national labs, universities, and industry.

Costs: The estimated U.S. cost for CTA construction and operation through the end of the decade is ~$100M (shared by NSF-AST, NSF-PHYS and DOE), as estimated by the Astro2010 review, making for a 25% fraction of the total cost of CTA (~ $400M).

Science Classification and Readiness: Major community assessment groups have recognized the importance of CTA for identifying and studying dark matter. The ACT technique is well established and construction could start immediately if funding were available. R&D work and the construction of a prototype of the novel US telescope should demonstrate significantly lower costs for a given level of performance in comparison to conventional ACTs.