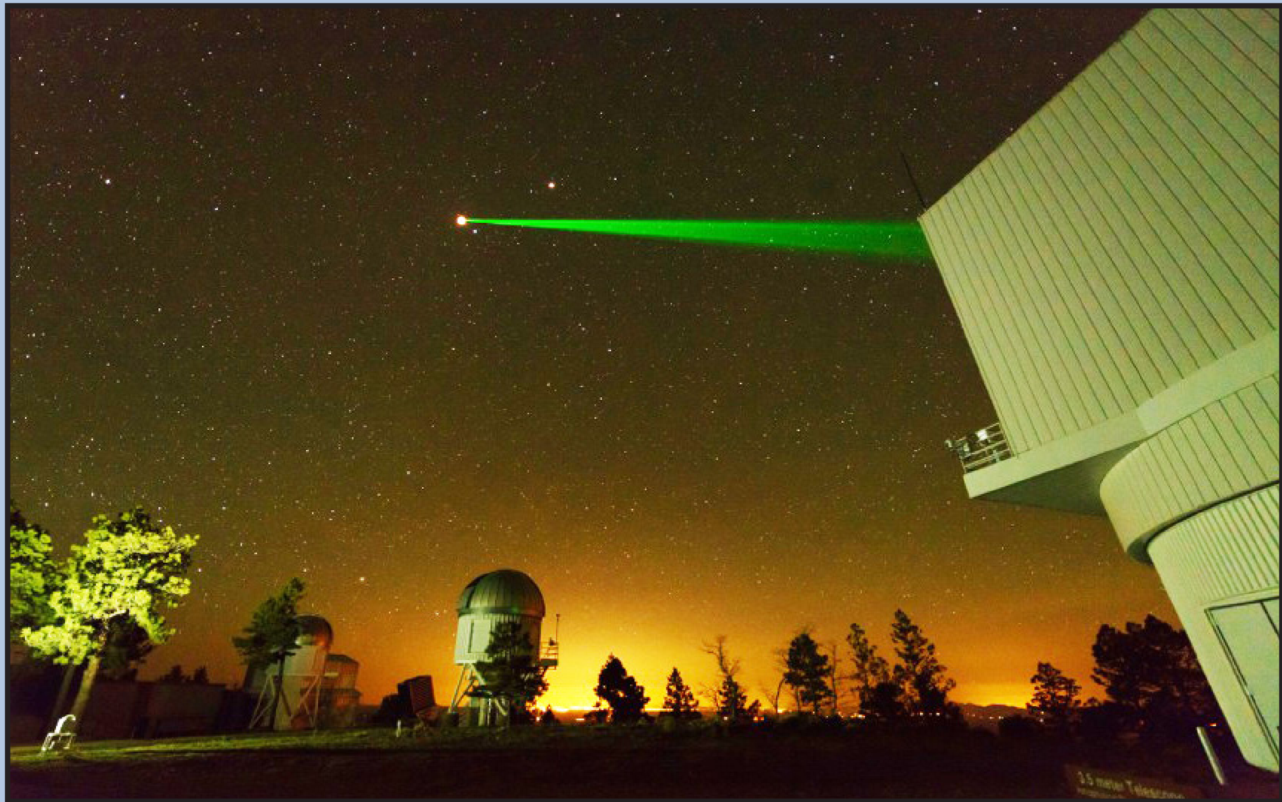


ARC 3.5-meter Telescope

The night sky observatory's largest telescope is the versatile ARC 3.5-m, which studies a variety of astronomical objects using synoptic programs requiring many short observations over long periods, as well as responding quickly to targets of opportunity. It was a pioneer telescope in remotely operating the telescope and instruments.

In conjunction with the Sloan Digital Sky Survey's 2.5-m telescope, the ARC telescope's observations aided in discovering some of the furthest objects from Earth and helped to create one of the largest catalogs of cosmic objects.

For additional information:
APO - www.apo.nmsu.edu
ARC - www.arc.apo.nmsu.edu
Sloan Digital Sky Surveys and Data Releases: http://sdss.org

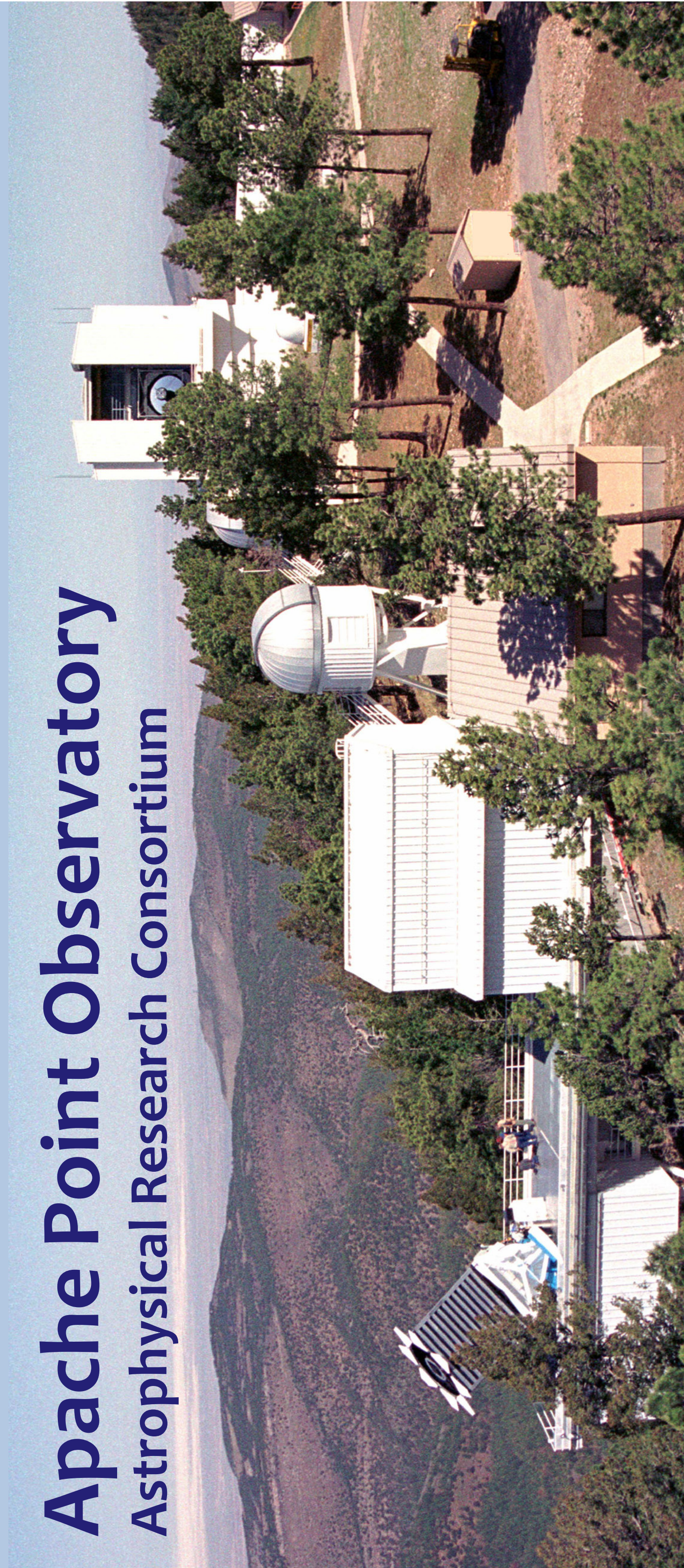
APOLLO Project

The Apache Point Observatory Lunar-ranging Laser Operations (APOLLO) instrument project is attempting to map the orbit of the Moon by distance measurements at an accuracy of ~1mm, and measures the distance from the Earth to the Moon (within ~2-millimeters) in support of the study of Einstein's Theory of Relativity and Gravitation.

The laser projects a beam to retroreflectors left on the Moon's surface by the APOLLO and Russian moon missions which reflect the beam back to ARC's 3.5-m mirror (see photo above). Using this information, we will be able to gauge the relative acceleration of the earth and moon toward the sun (like a modern-day Leaning Tower of Pisa experiment) in order to ascertain the free-fall properties of earth's gravitational self-energy.

(Photo by Dan Long/APO)

ARC Astrophysical Research Consortium



Apache Point Observatory

Astrophysical Research Consortium

Apache Point Observatory is located in the Sacramento Mountains of south-central New Mexico. Four telescopes are currently operated: The Astrophysical Research Consortium (ARC) 3.5-m Telescope, the Sloan Foundation (Sloan Digital Sky Survey, or SDSS) 2.5-m Telescope, the New Mexico State University 1.0-m Telescope, and the ARC Small Aperture 0.5-m Telescope. State-of-the-art optical and mechanical designs optimize each telescope for their specific purpose. This includes wide-field imaging and spectroscopy, high-precision tracking and pointing, and wide wavelength coverage.

A large suite of instruments are available to support the varied science requirements of the ARC and SDSS scientists and their collaborators. In conjunction with the Sloan Digital Sky Survey's 2.5-m telescope, the ARC telescope's observations aided in discovering some of the furthest objects from Earth and helped to create one of the largest publicly accessible catalogs of cosmic objects.

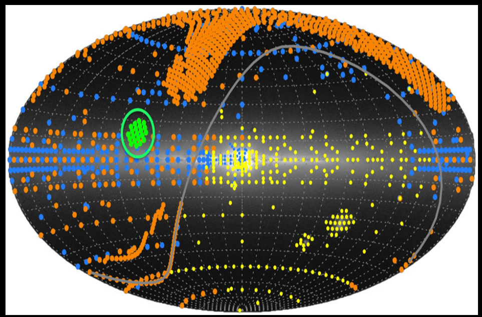
Current members of the Astrophysical Research Consortium are: University of Washington, Johns Hopkins University, New Mexico State University, University of Colorado - Boulder, University of Virginia, and Georgia State University.

Sloan Digital Sky Surveys SDSS-IV: 2014-2020

After nearly a decade of design and construction, the Sloan Digital Sky Survey (SDSS) saw first light on its giant mosaic camera in 1998 and entered routine operations in 2000. While the collaboration and scope of the SDSS have changed over the years, many of its key principles have remained: the use of highly efficient instruments and software to enable surveys of unprecedented scientific reach, a commitment to creating high quality public data sets, and investigations that draw on the full range of expertise in a large international collaboration. The generous support of the Alfred P. Sloan Foundation has been crucial in all phases of the SDSS, alongside support from the Participating Institutions and national funding agencies in the U.S. and other countries.

The latest generation of the SDSS, SDSS-IV, is extending precision cosmological measurements to a critical early phase of cosmic history (eBOSS), expanding its revolutionary infrared spectroscopic survey of the Galaxy in the northern and southern hemispheres (APOGEE-2), and for the first time using the Sloan spectrographs to make spatially resolved maps of individual galaxies (MaNGA). Two smaller surveys will be executed as subprograms of eBOSS: the Time Domain Spectroscopic Survey (TDSS) will be the first large-scale, systematic spectroscopic survey of variable sources; while the SPectroscopic IDentification of EROSITA Sources (SPIDERS) will provide a unique census of supermassive black-hole and large scale structure growth, targeting X-ray sources from ROSAT, XMM and eROSITA.

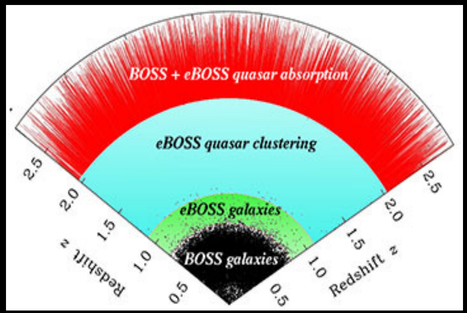
APOGEE-2: APO Galaxy Evolution Experiment North and South



APOGEE-2 will explore the formation history of the Milky Way using the "archeological" record provided by hundreds of thousands of its individual stars. The details concerning how smaller galaxies assembled so that the Galaxy grew from its progenitors are preserved in the patterns seen today in the motions of stars and the abundances of chemical elements that they contain.

We will map these patterns using observations from the Apache Point site in New Mexico, and from the 2.5-meter du Pont Telescope at Las Campanas Observatory in Chile, obtaining a complete view of our Galaxy's history. We are also collaborating with NASA's planet-finding mission, Kepler, to measure the abundances of carbon, oxygen, nitrogen and iron in planet-hosting stars, to study the role that these elements play in the formation of terrestrial planets.

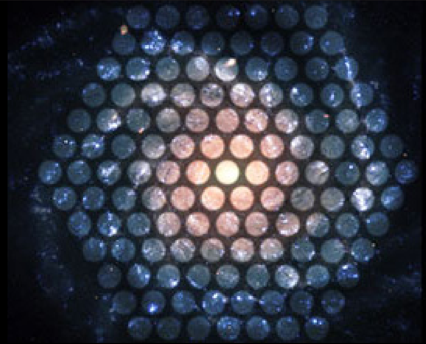
eBOSS: Extended Baryon Oscillation Spectroscopic Survey



eBOSS will precisely measure the expansion history of the Universe throughout eighty percent of cosmic history, back to when the Universe was less than three billion years old, and improve constraints on the nature of dark energy. "Dark energy" refers the observed phenomenon that the expansion of the Universe is currently accelerating, which is most mysterious experimental result in modern physics.

eBOSS concentrates its efforts on the observation of galaxies and in particular quasars, in a range of distances (redshifts) currently left completely unexplored by other three-dimensional maps of large-scale structure in the Universe. In filling this gap, eBOSS will create the largest volume survey of the Universe to date. The figure above shows the region that will be newly mapped by the eBOSS project. This region corresponds to the epoch when the Universe was transitioning from deceleration due to the effects of gravity, to the current epoch of acceleration.

MaNGA: Mapping Nearby Galaxies at Apache Point Observatory



Unlike previous SDSS surveys which measured spectra only at the centers of target galaxies, MaNGA bundles sets of optical fibers into tightly-packed arrays, enabling spectral measurements across the face of each of ~10,000 nearby galaxies. MaNGA's goal is to understand the "life cycle" of present day galaxies from imprinted clues of their birth and assembly, through their ongoing growth via star formation and merging, to the end of their existence.

MaNGA will provide two-dimensional maps of stellar velocity and velocity dispersion, mean stellar age and star formation history, stellar metallicity, element abundance ratio, stellar mass surface density, ionized gas velocity, ionized gas metallicity, star formation rate and dust extinction for a statistically powerful sample. Just as tree-ring dating yields information about climate on Earth hundreds of years into the past, MaNGA's observations of the dynamical structures and composition of galaxies will help unravel their evolutionary histories over several billions of years.