



# APOGEE-2

## THE SECOND PHASE OF THE APACHE POINT OBSERVATORY GALACTIC EVOLUTION EXPERIMENT IN SDSS-IV

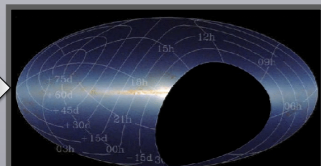
J. SOBECK ON BEHALF OF THE APOGEE-2 COLLABORATION



### OVERVIEW:

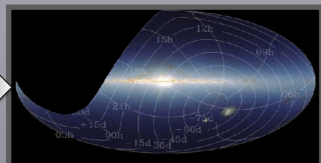
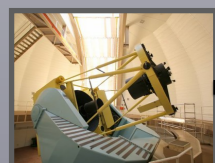
- SDSS-IV Project 2014-2020 (bright time allocation; co-targeting with MaNGA [halo])
- Large-Scale ( $N_{\text{stars}} \sim 3 \cdot 10^5$ )
- High-Resolution Spectral Data ( $R \sim 22,500$ )
- High Signal-to-Noise ( $S/N \geq 100$ )
- Near-infrared wavelength coverage ( $H$ -band;  $1.51\text{-}1.69 \mu\text{m}$ )
- Primary Data Products of radial velocities, atmospheric parameters ( $T_{\text{eff}}$ ,  $\log g$ ,  $[\text{Fe}/\text{H}]$ ), individual element relative abundance ratios (C, N, O, Na, Mg, Al, Si, S, K, Ca, Ti, V, Mn, Ni)
- Primary targets (M,K,G) giants (in all Galactic components)
- Core, Goal, and Ancillary Science Programs
- Two observational facilities (APOGEE-2N-APO; APOGEE-2S-LCO)

### DUAL HEMISPHERE VIEW OF THE SKY:



#### APOGEE-2N:

- Apache Point Observatory (New Mexico, USA)
- 2.5m Sloan Foundation Telescope (f#/7.5)
- 2014-2020 Survey Operational Period
- Approx. 196,000 Stars, 2444 Visits
- Time Allocation of 90% Core, 5% Goal, 5% Ancillary
- Co-targeting program with the MaNGA Survey

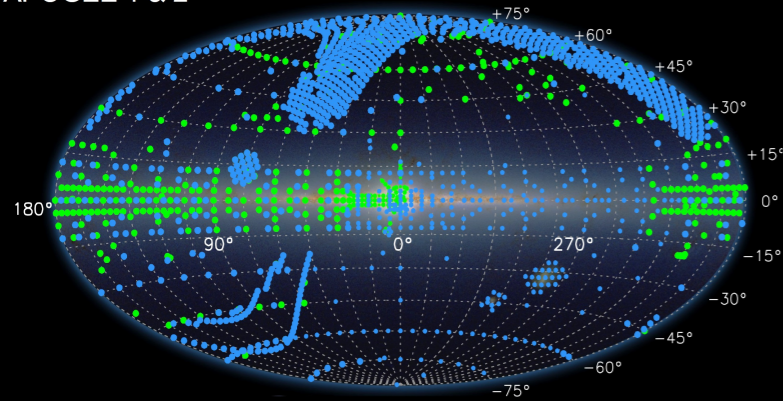


#### APOGEE-2S:

- Las Campanas Observatory (Chile)
- 2.5m Irene du Pont Telescope (f#/5)
- 2016-2020 Survey Operational Period
- Approx. 96,000 Stars, 1512 Visits
- Time Allocation of 95% Core, 2.5% Goal, 2.5% Ancillary

### FINAL RESULTS AND PERFORMANCE:

APOGEE 1 & 2



- Total Survey Period: 10 Years [2011-2020]
- Anticipated Number of Observed Stars:  $\sim 420,000$
- Galactic Components: Bulge (full extent), Disk (all quadrants), Halo
- Sweeping Goal Science Program
- Dedicated Ancillary Science Program

### CORE SCIENCE (SCIENTIFIC PROGRAMS/THRUSTS ESSENTIAL TO THE SUCCESS OF THE SURVEY)

#### BULGE

- Formation mechanism (mergers, accretion, secular)
- X-Shaped Structure
- Origin of metal-deficient population
- Young bulge stars
- Transition regions/interfaces

#### DISK

- Spiral Structure
- Axi-symmetric Perturbations (due to presence of bar)
- Disk-Bulge Interface (role in bulge formation via secular evolution)
- Radial Gas Flows and Radial Migration
- Accreted Substructure
- Outer Disk (Warp, Monoceros Stream)

#### HALO

- Formation Mechanism (in situ, early mergers, tidal stripping,...)
- Galactocentric Distance Variation (inner v. outer halo)
- Resident Stellar Population Comparison
- Streams

#### GLOBULAR AND OPEN CLUSTERS

- Calibration (internal, inter-survey, external survey)
- Star Formation History (halo build-up [GC]; age-metallicity relation [OC])
- Chemical Evolution
- Multiple Stellar Generation Phenomenon [GC]
- Stellar Evolutionary Processes (dredge-up, nucleosynthesis)
- Binarity
- Internal Cluster Dynamics
- Disk Resonances [OC]
- Radial Migration [OC]
- Smooth Axisymmetric Deviations

#### APOKASC

- Age determinations via asteroseismology [pulsation] and gyrochronology [spin-down]
- Rotation-mass-absolute age relationships for dwarfs
- Mass-composition-absolute age relationships for giants
- Age-metallicity relation in various stellar population
- Stellar photospheric model and associated theory examination
- Stellar interior model examination
- Stellar pulsation theory testing
- Asteroseismic diagnostics for stellar evolutionary state determination (RGB/RC)
- Extrasolar planet host characterization

#### SATELLITE GALAXIES

- Star formation history as a function parameters such as density, dark matter fraction, star formation rates
- Chemical evolution as a function parameters such as density, dark matter fraction, star formation rates
- Hierarchical formation and diverse galactic morphological types
- Binarity fraction
- Disk and bar comparisons of the MC
- Tidally-disrupting system of Sgr

### GOAL SCIENCE (DESIRED SCIENTIFIC PROGRAMS/THRUSTS)

Approved Goal Programs: K2 Follow-Up; Young Clusters; Kepler Objects of Interest; Eclipsing Binaries; M Dwarfs; Substellar Companions

\* First Ancillary Call Made; LOI Notices: February 1, 2015; Final Proposal Submission: April 3, 2015