LAMOST-II Medium resolution spectroscopic survey

Chao Liu
(National Astronomical Observatories, CAS, Beijing)
2019-03-13@Bamberg
LAMOST Telescope

- 4-meter reflective Schmidt telescope with segmental mirrors and active optics
- Quasi-meridian
- 4000 fibers on the 5 degree-FoV focal plane
- 16 spectrographs
- Low resolution spectra: $R \sim 1800$, wavelength: 370-900nm
LAMOST Telescope

- 4-meter reflective Schmidt telescope with segmental mirrors and active optics
- Quasi-meridian
- 4000 fibers on the 5 degree-FoV focal plane
- 16 spectrographs
- Low resolution spectra: $R \approx 1800$, wavelength: 370-900nm
LAMOST Telescope

- 4-meter reflective Schmidt telescope with segmental mirrors and active optics
- Quasi-meridian
- 4000 fibers on the 5 degree-FoV focal plane
- 16 spectrographs
- Low resolution spectra: $R \sim 1800$, wavelength: 370-900nm
• 10+ million stellar spectra with limiting magnitude $r<17.8$

• Scientific goals:
  
  • The Galactic disk and halo, Stellar physics
Type II+III radial density profile

Thin+Thick disks

Radial stellar density at Z=0

- $L_1 = 2.12 \pm 0.26$ kpc
- $L_2 = 1.18 \pm 0.08$ kpc
- $L_3 = 2.72$ kpc

Thin disk

Halo

Pollen et al. 2006

Wang, LC et al. 2018
only with Gaia DR2 data

Katz et al. 2018
Cheng, LC et al. 2019, using 12000 OB stars

only with Gaia DR2 data

Katz et al. 2018
Cheng, LC et al. 2019, using 12000 OB stars

Katz et al. 2018, only with Gaia DR2 data

D’Onghia et al. 2016, simulation
Better view of Sgr stream

LAMOST M-giants + Gaia proper motions

More than 100 kpc

Li, LC et al. 2019

Belokurov+2014
Stellar physics

Karoff et al. 2016

The Sun

- All stars
- Stars with flares
- $E_{\text{flare}} > 2 \times 10^{34}$ erg

Relative fraction

S index

Chromospheric activity
Upgrade the spectrographs

- Gratings are upgraded to $R \sim 7500$
  - Blue arm: 496-533 nm (Mg Triplet, metal lines)
  - Red arm: 630-680 nm (Halpha, Li)
Information extracted from med-res spectra

- Teff, logg, [Fe/H], [alpha/Fe]
- around 20 elemental abundances: C, Na, Mg, Ca, Si, Ti, Sc, Cr, Fe, V, Mn, Co, Ni, Cu, Ba, Y, Sm, Nd, Li etc.
- accurate radial velocity ~1 km/s
- stellar rotation: vsini~10 km/s
Survey plan of LAMOST II

• 5-year survey: Oct 2018-Jun 2023

• Dark/gray nights (13-14 nights/month): low-res survey same as LAMOST I

• Bright/gray nights (13 nights/month): med-res survey (MRS)

• Expected numbers of spectra
  
  • low-res: ~3 million more spectra with 1.5h exposure (stars + galaxies + QSOs), r<~18
  
  • med-res: ~2 million stellar spectra (20’’*3 exposure), G<15
  
  • med-res: ~200 K stars with time-domain spectra (20’’*n_epoch, <n_epoch>~60), G<14
Time-domain spectroscopic survey

- Observation mode & products
  - short exposure (~20min) multiple epochs per night (~8 exposures per night)
  - each exposure reaches G<14 at S/N>10
  - average 60 epochs for each field in 5 years
  - In total 100 time-domain fields with 20 sq. deg.
Footprints of time-domain regions
Scientific goals

- Galactic archeology
- Star forming region: Young populations
- Kepler/K2 & TESS: Variables, binaries, exoplanet hosts
- Fields: binaries
- Open clusters
- Galactic nebula: HII region, SNR, PNe
Chemical tagging

Hogg et al. 2016

APOGEE/The Cannon data

Tolstoy et al. 2009

Sculptor Carina Fornax Sagittarius MW

Hogg et al. 2016
Young stellar populations

Protostars

PMS stars

Stutz et al. 2016
Exoplanet host stars

- Knowing the properties of the host stars of exoplanets is critical in the studies of planet formation and evolution

Xie et al. 2016
Variable stars

Jeffery et al. 2016
Binary stars

• Searching stellar mass black hole

• Gravitational wave progenitor (NS+NS, BH+BH)

• Supernova type Ia progenitor (WD+*, WD+WD)

• Evolution of massive stars

• Binary formation/evolution
Binary stars

• Searching stellar mass black hole

• Gravitational wave progenitor (NS+NS, BH+BH)

• Supernova type Ia progenitor (WD+*, WD+WD)

• Evolution of massive stars

• Binary formation/evolution

Thompson et al. 2018
Binary stars

- Searching stellar mass black hole
- Gravitational wave progenitor (NS+NS, BH+BH)
- Supernova type Ia progenitor (WD+*, WD+WD)
- Evolution of massive stars
- Binary formation/evolution
Binary stars

- Searching stellar mass black hole
- Gravitational wave progenitor (NS+NS, BH+BH)
- Supernova type Ia progenitor (WD+*, WD+WD)
- Evolution of massive stars
- Binary formation/evolution

Thompson et al. 2018
Sana et al. 2012
Moe et al. 2018
Summary

- LAMOST II = Low-res + Med-res
- LAMOST II ==> Med-res Time-domain survey
- Future products:
  - 200K stars with time-domain med-res spectra (G<14)
  - 2 million single-epoch med-res spectra (G<15)
  - ~13 million low-res spectra (inc. LAMOST I) (r<~18)