LAMOST Spectroscopic Survey

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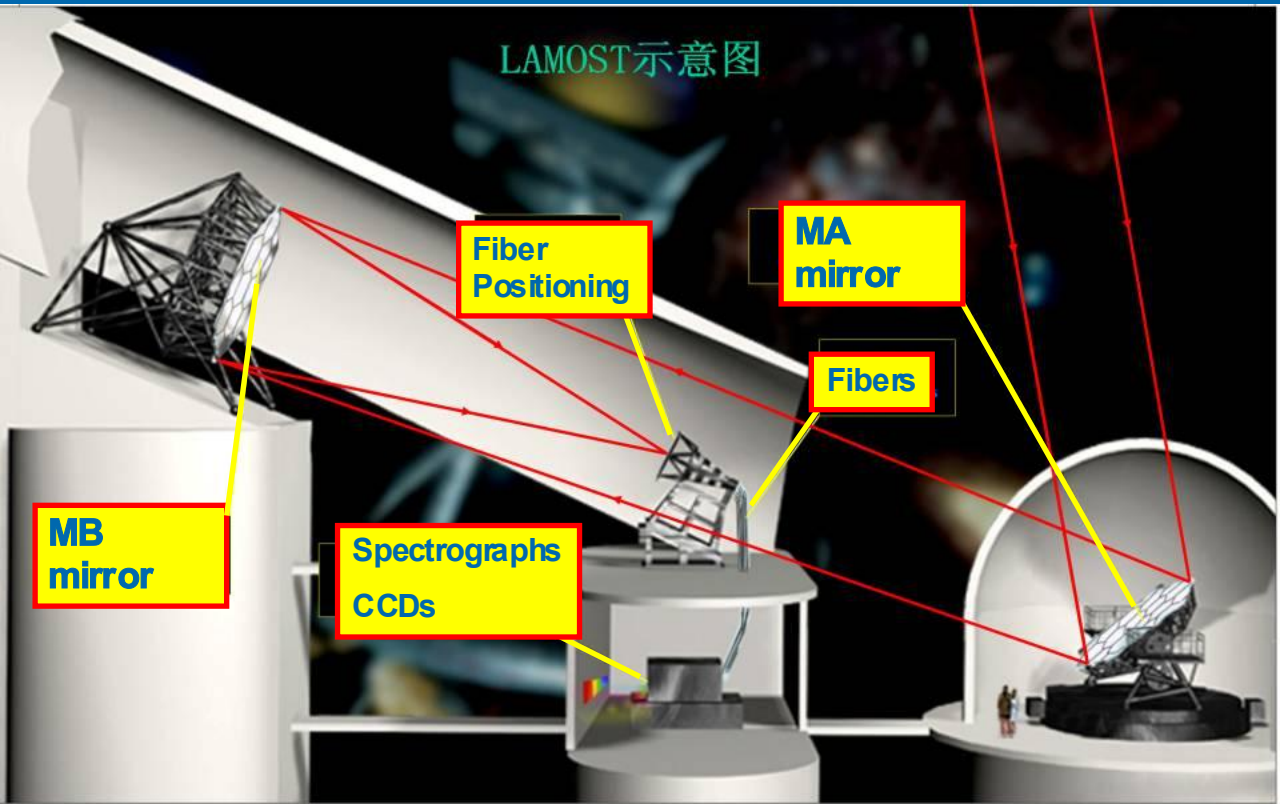
Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST)

- A meridian active reflecting Schmidt telescope
- Started in 1997
- First light in August 2008
- Inauguration in 16 October 2008
- now in commissioning stage

Characteristics of LAMOST

- Effective aperture 4 meter
- FOV 5°（1.75m linear）
- Number of optical fiber 4000
- Observing sky area $-10° \leq \delta \leq +90°$
- Spectral resolution 1-0.25nm
- Size of fiber 3.30 arcsec（320macro linear）
  - Site seeing: ~2 arcsec
- Survey capability taking spectral resolution 1nm, integration time 1.5 hours, magnitude limit: 20.5^m

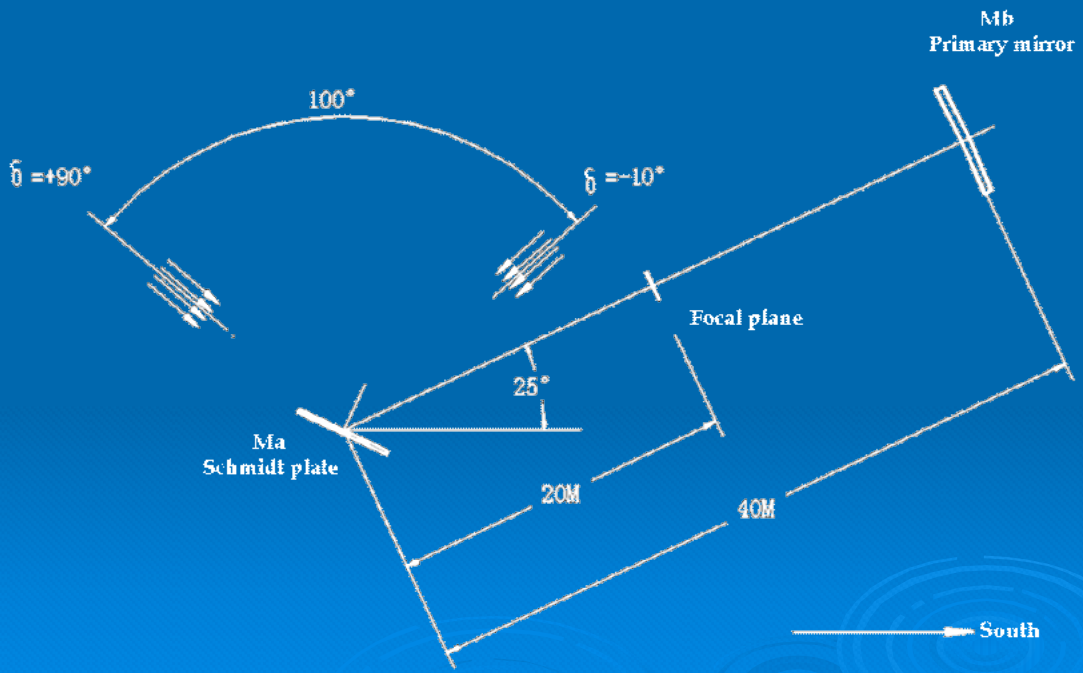
Structure of LAMOST



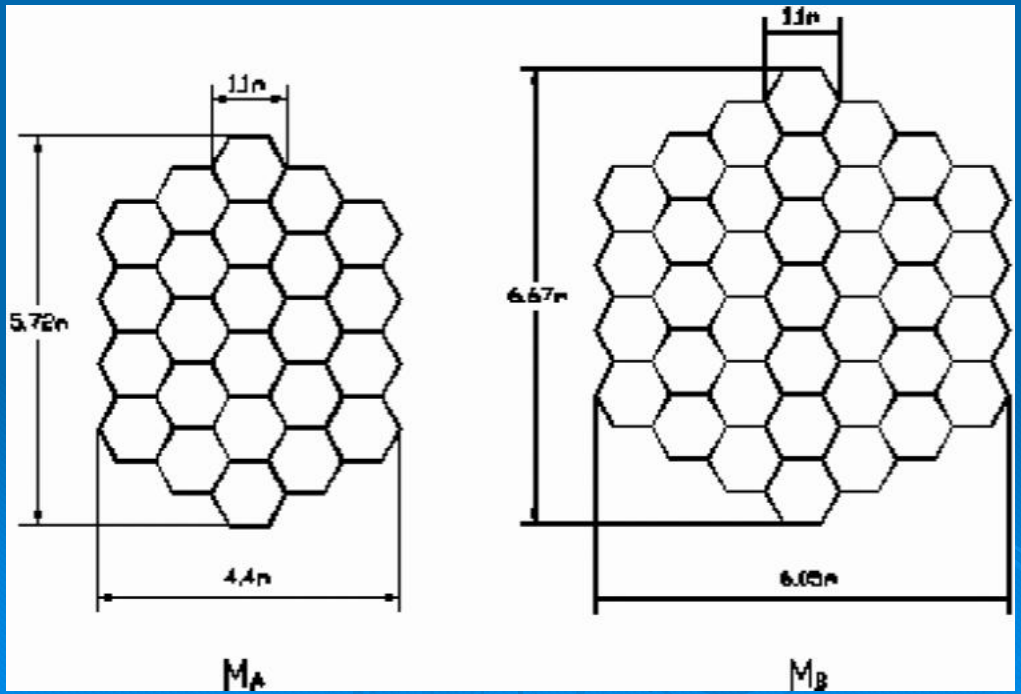
Enclosure

Oct 20, 2007

Optical System

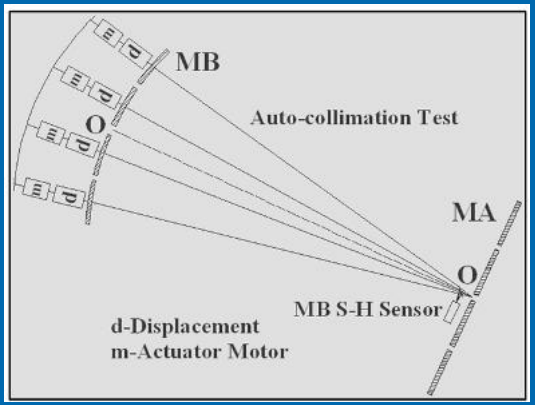


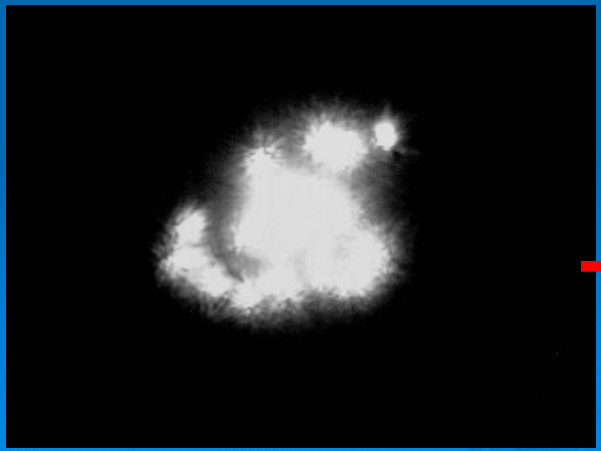
- MA: reflecting corrector (24 sub-mirrors) ~ 4.9m
- MB: spherical mirror (37 sub-mirrors) ~ 6.1m



MB

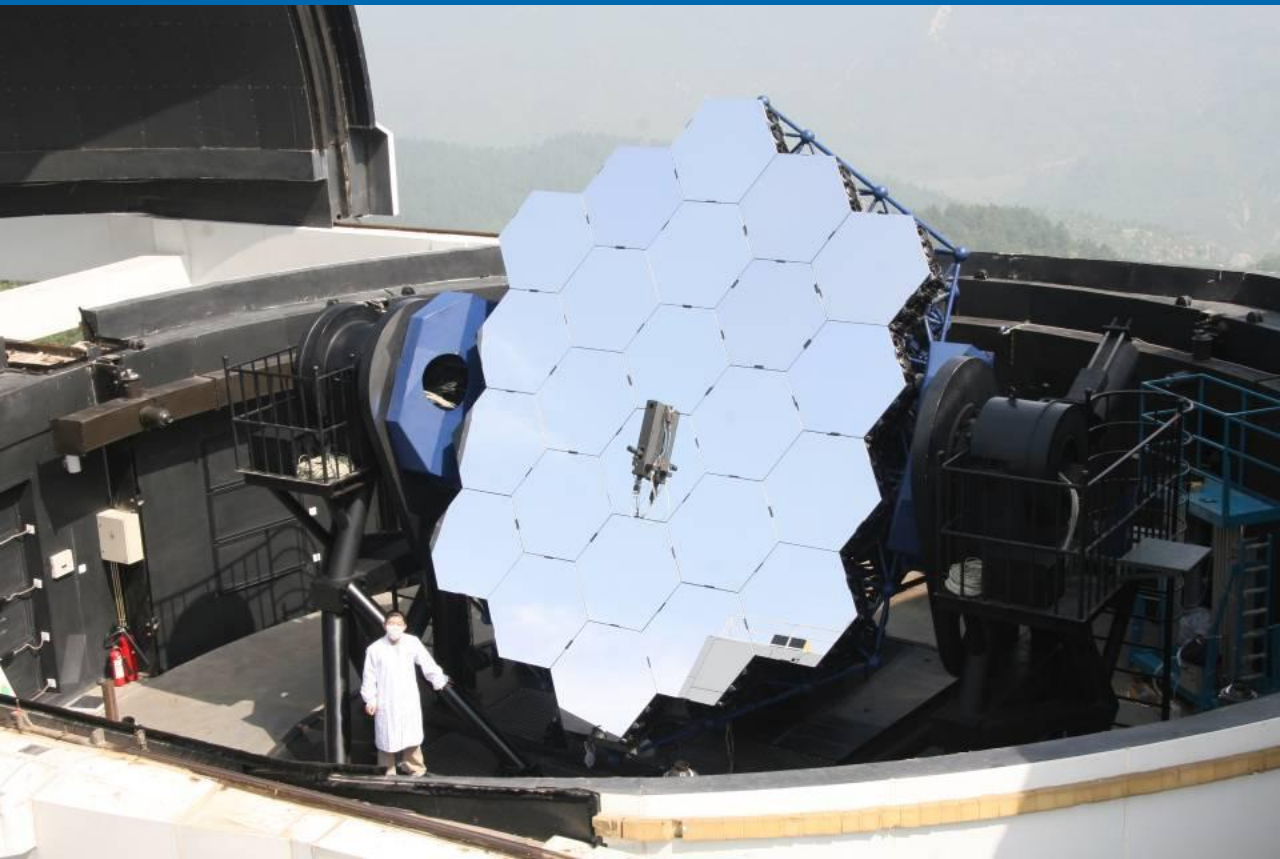
Segmented Active optics for 37 sub-mirrors of MB



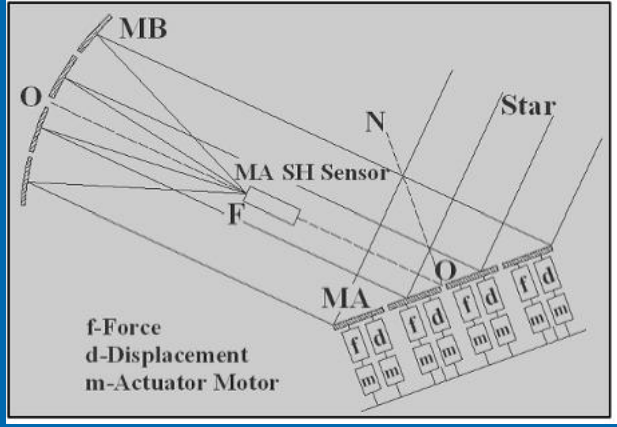


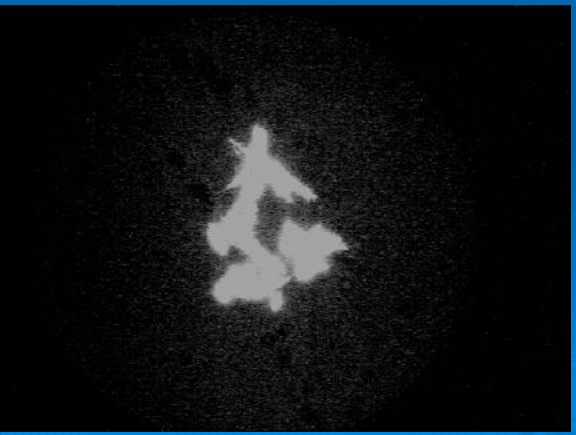
（July 13,2008）

24 sub-mirrors of MA



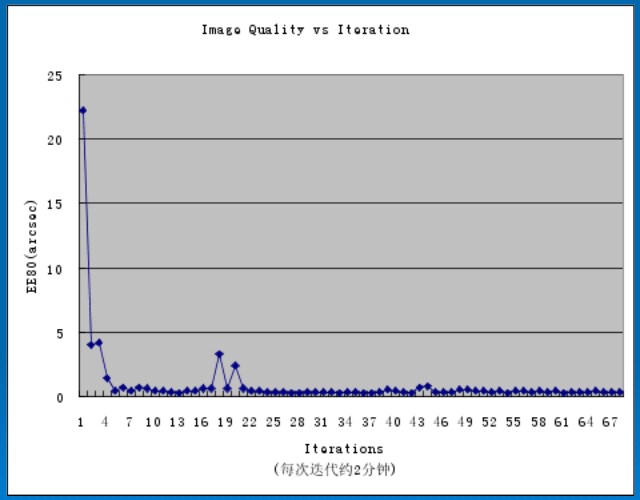
- Segmented and thin mirror active optics for 24 sub-mirrors of MA

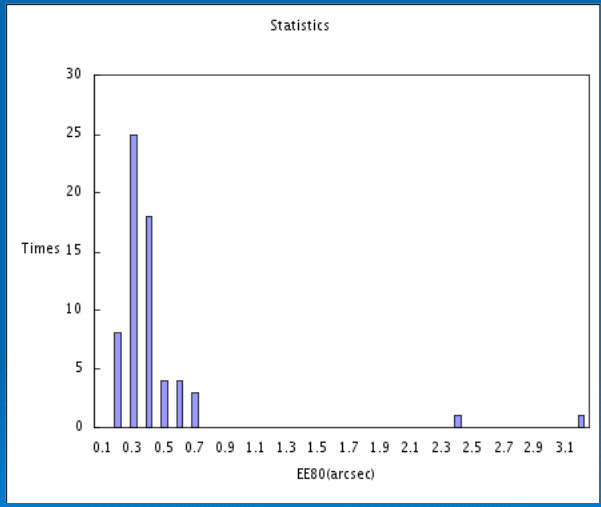




（Sept. 10, 2008）

Image quality of LAMOST





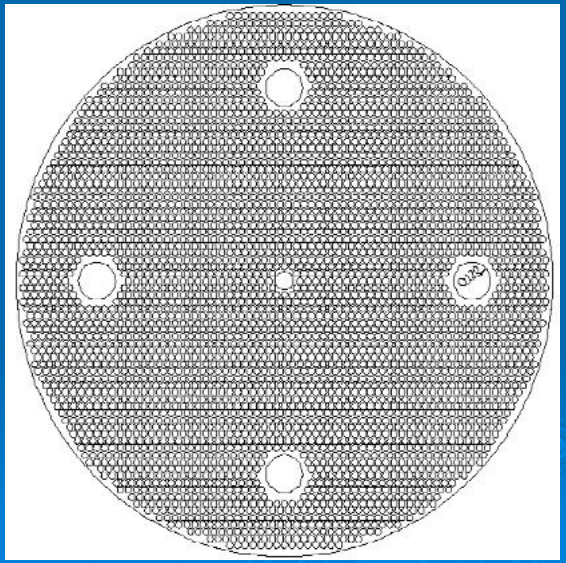
（Nov. 21, 2008)

Instruments

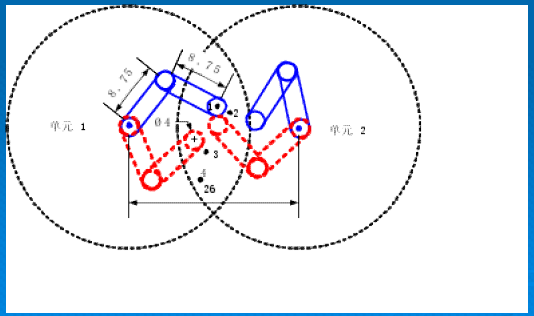
- 4000 Fibers (130km)
- 4000 Fiber positioning units
  - 8000 step motors
- 16 Spectrographs
  - 250 fibers per spectrograph
- 32 4k x 4k CCD Cameras
  - E2V CCD chips

4000 fiber positioning units

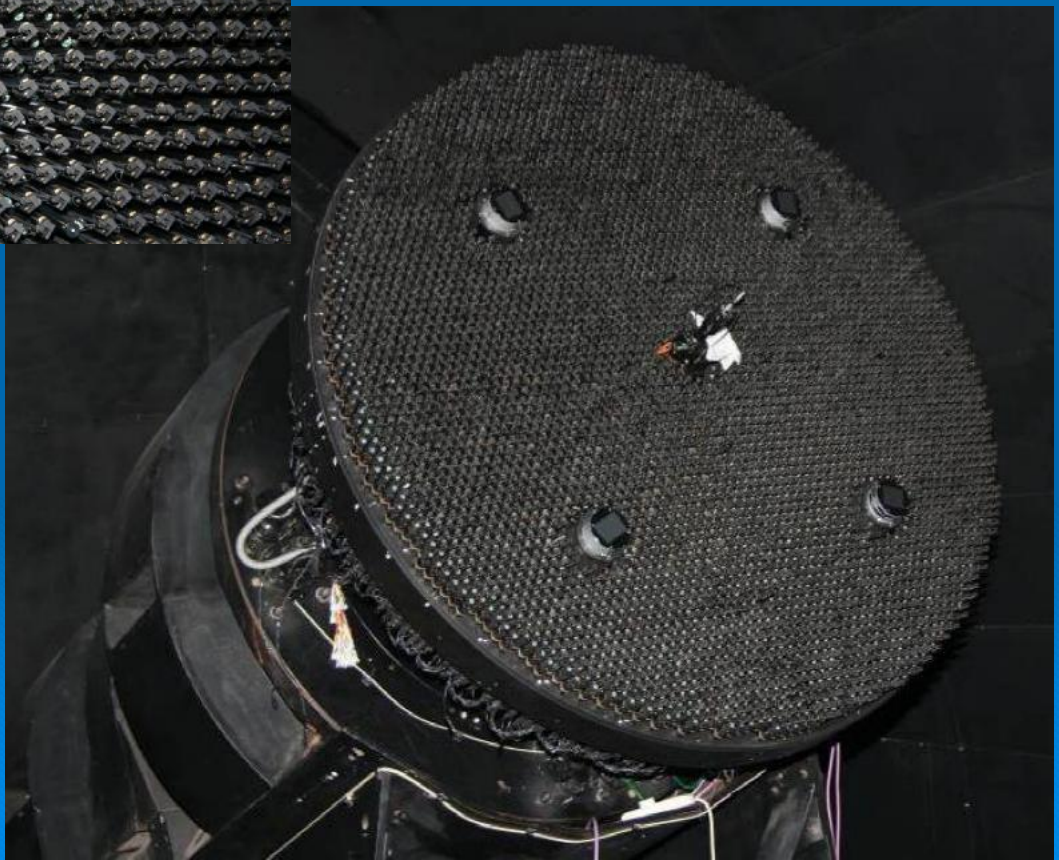
Positioning unit with 2 step motors



Focal Plate for holding 4000 fibers



Double arm scheme

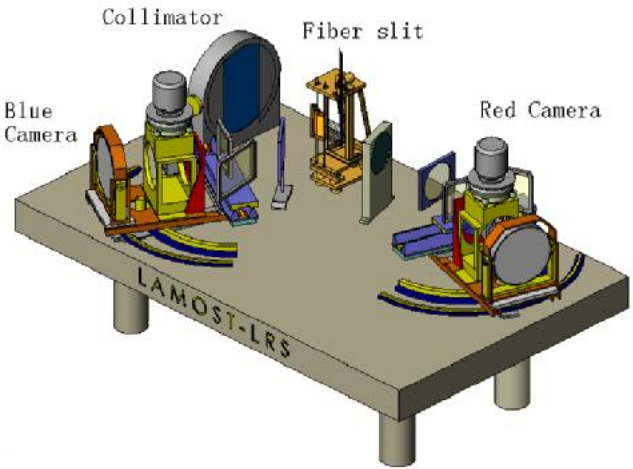


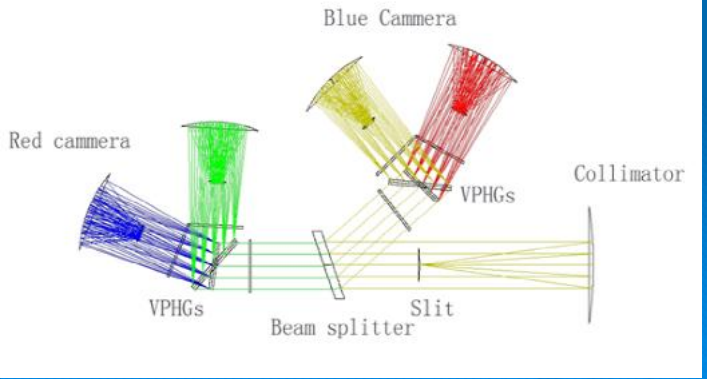
16 spectrographs

250 fibers per spectrograph

R_L = 1000/2000

R_M = 5000/10000





Spectral range:

Low blue: 370—590nm

red: 570—900nm

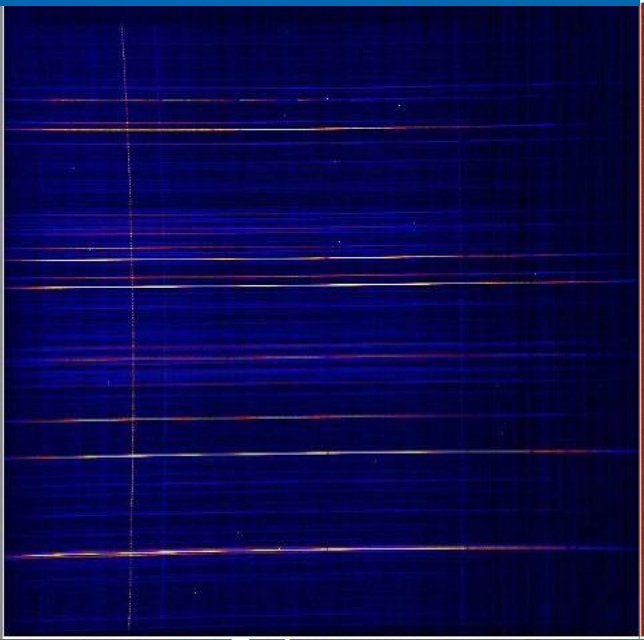
Medium blue: 510nm—540nm

red: 830nm—890nm

Test Observations

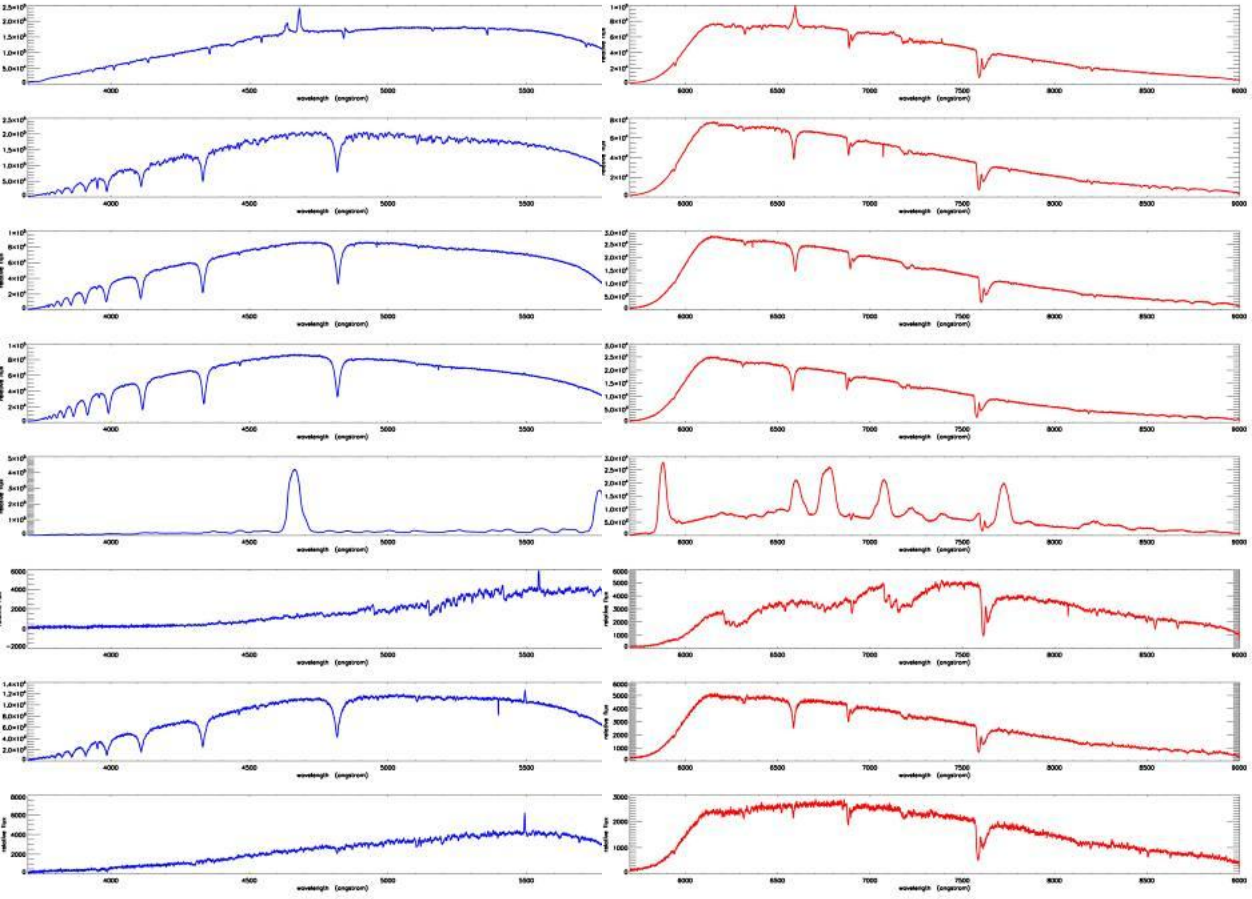
- Sept. 28, 2008
  - More than 2000 spectra of bright stars got in one test observation
- Dec. 27, 2008
  - M31

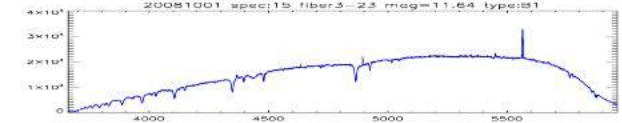
Spectra of stars（28/9/2008）

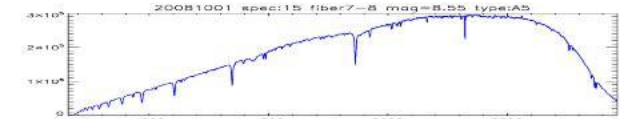


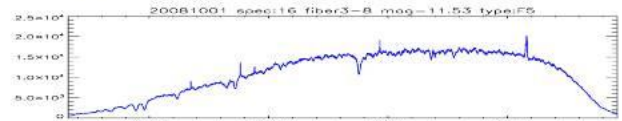
Red

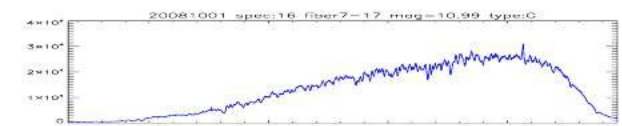
Blue

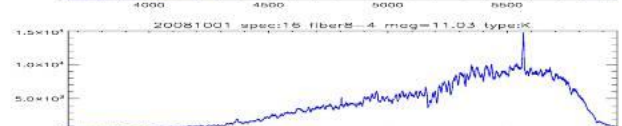

wavelength (angstrom)
relative flux

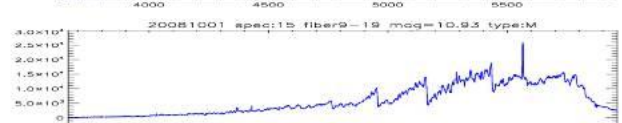

20081001 spec:15 fiber3-23 mag=11.64 type:B1

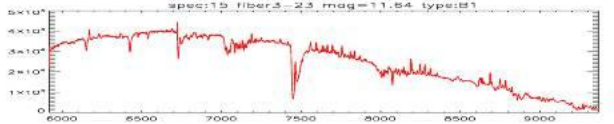

20081001 spec:15 fiber7-8 mag=8.55 type:A5


20081001 spec:16 fiber3-8 mag=11.53 type:F5

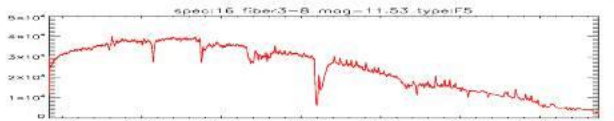

20081001 spec:16 fiber7-17 mag=10.99 type:G


20081001 spec:16 fiber8-4 mag=11.03 type:K

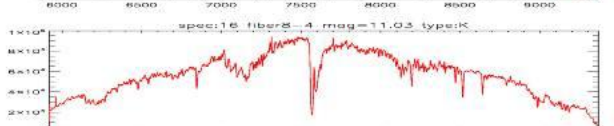

20081001 spec:15 fiber9-19 mag=10.93 type:M


spec:15 fiber3-23 mag=11.64 type:B1


spec:15 fiber7-8 mag=8.55 type:A5


spec:16 fiber3-8 mag=11.53 type:F5

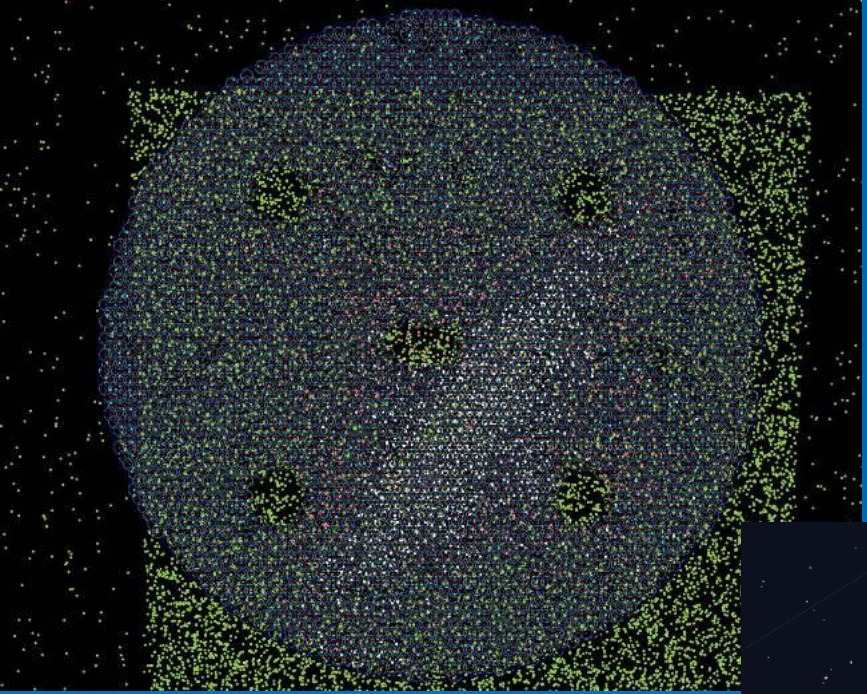

spec:16 fiber7-17 mag=10.99 type:G

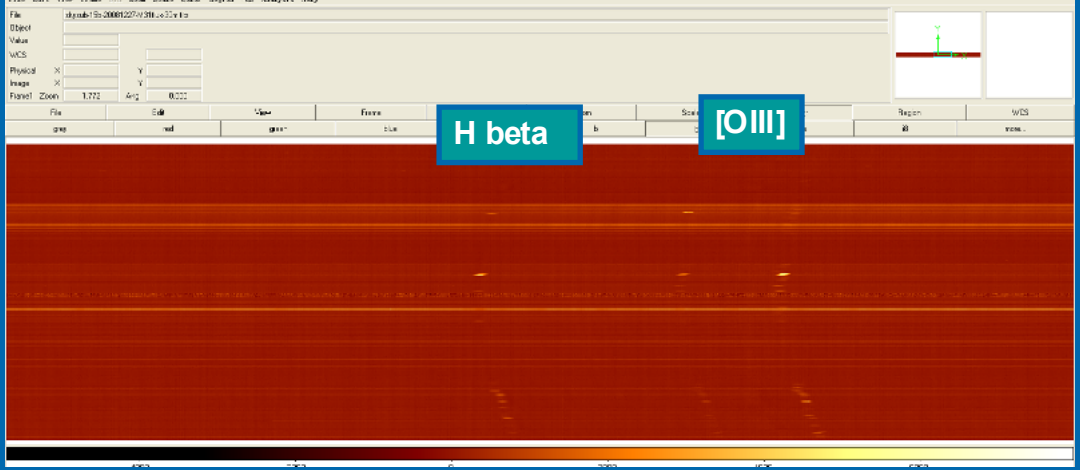

spec:16 fiber8-4 mag=11.03 type:K

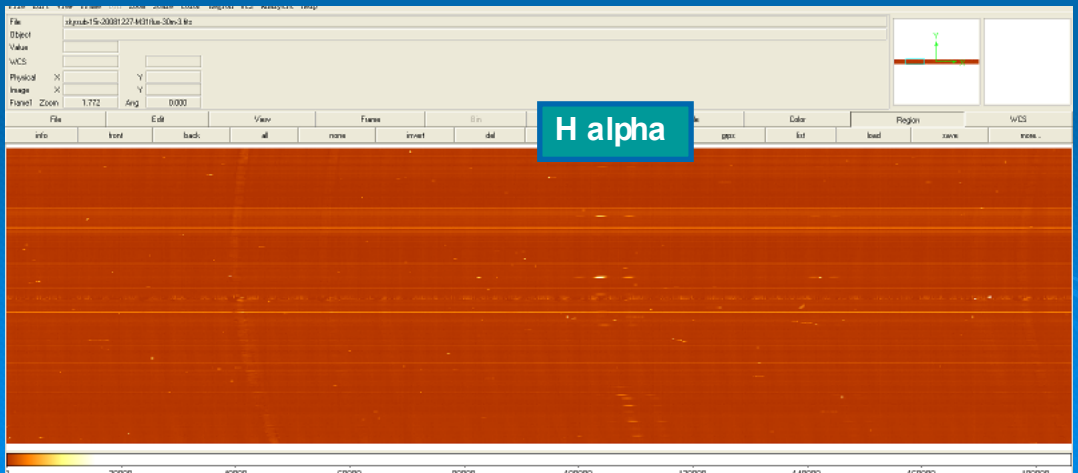

spec:15 fiber3-19 mag=10.93 type:M

Test Observations

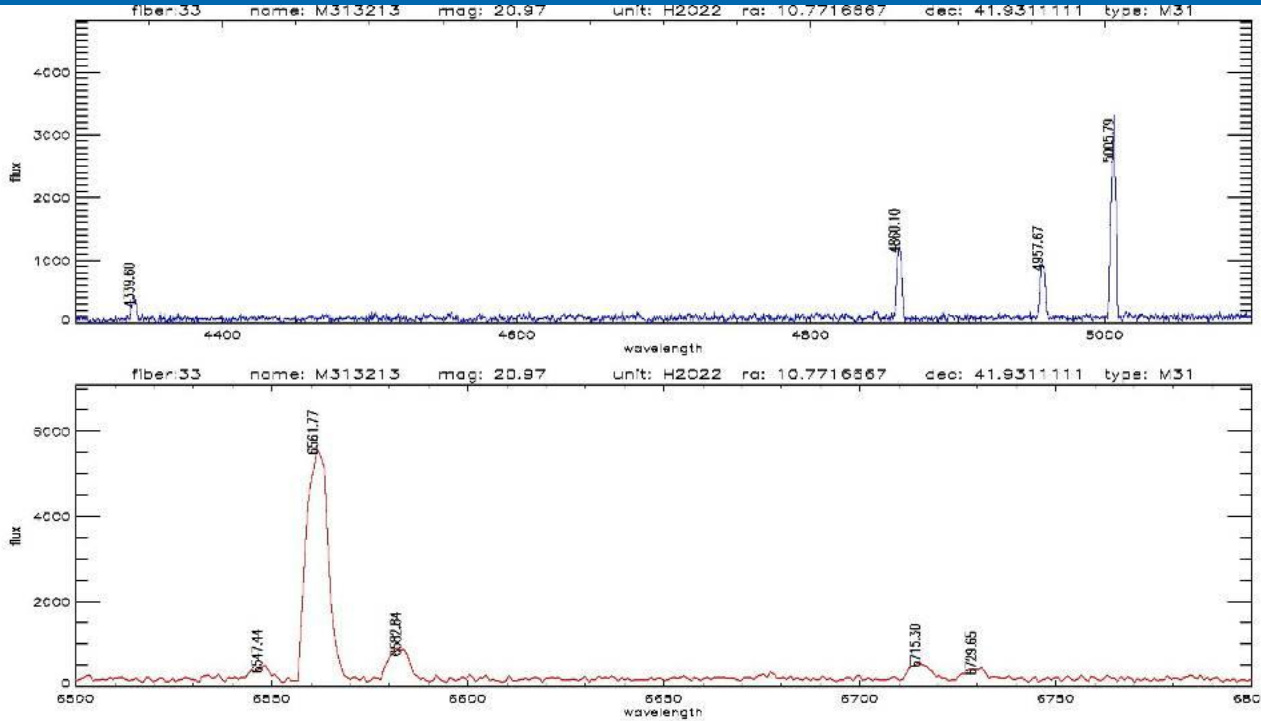
- Dec. 27, 2008
  - M31
    - Planetary nebula
    - Global clusters
  - Others
    - Galaxies
    - Stars
  - 1800s Exp.




H beta
[OIII]


H alpha

PN in M31


fiber:33 name: M313213 mag: 20.97 unit: H2022 ra: 10.7716667 dec: 41.9311111 type: M31
flux
wavelength
4139.60
4860.10
4957.67
5005.79
fiber:33 name: M313213 mag: 20.97 unit: H2022 ra: 10.7716667 dec: 41.9311111 type: M31
flux
wavelength
6547.44
6561.77
6682.84
6715.30
6729.65

Plan

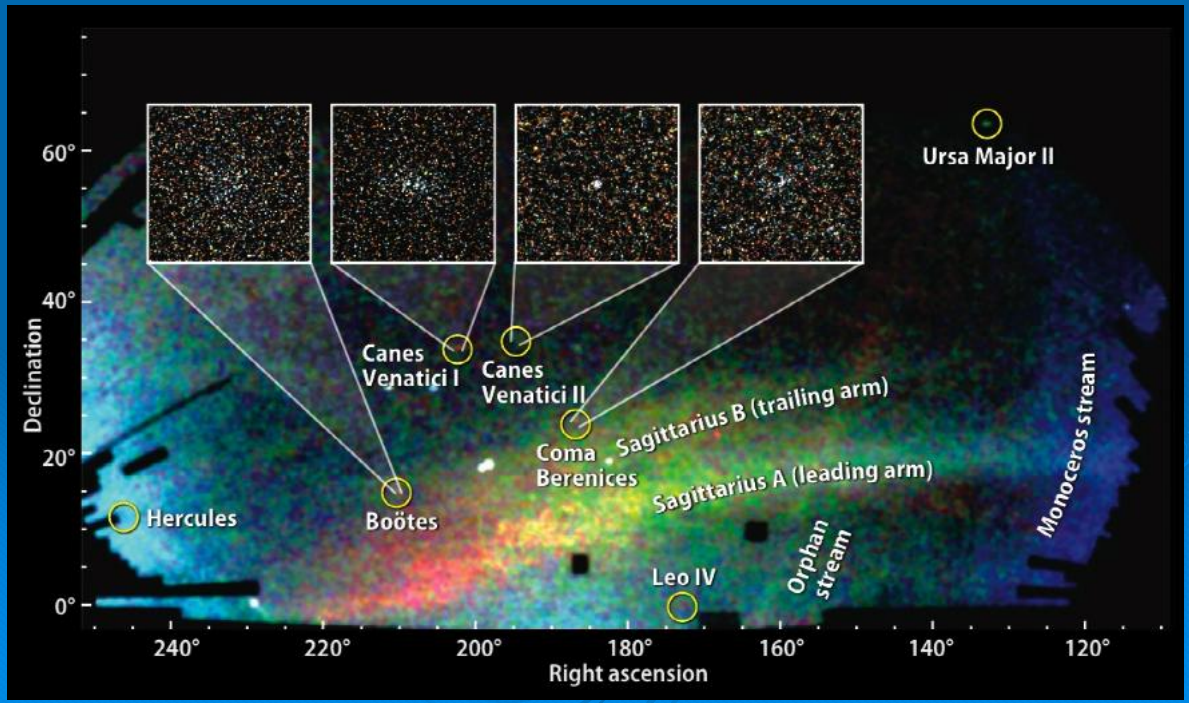
- 2009: commission period
  - Early Science
- 2010 / 2011: regular spectroscopic survey
  - 5 year survey

Spectroscopic Surveys

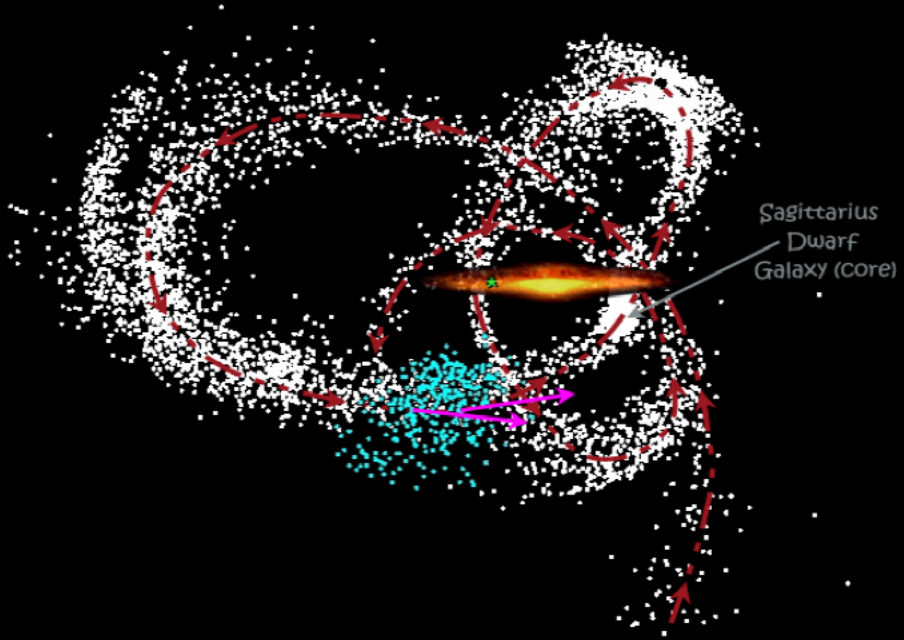
- Key projects include
  - extra-Galactic
  - Milky Way
  - cross-identification
- WG for the Milky Way study
- WG for extragalactic survey
  - Survey plan will be fixed in 2009

LAMOST SKY SURVEY FOR THE STRUCTURE OF THE MILKY WAY

Dwarf galaxies and stellar moving groups



How is the Galactic Halo formed?

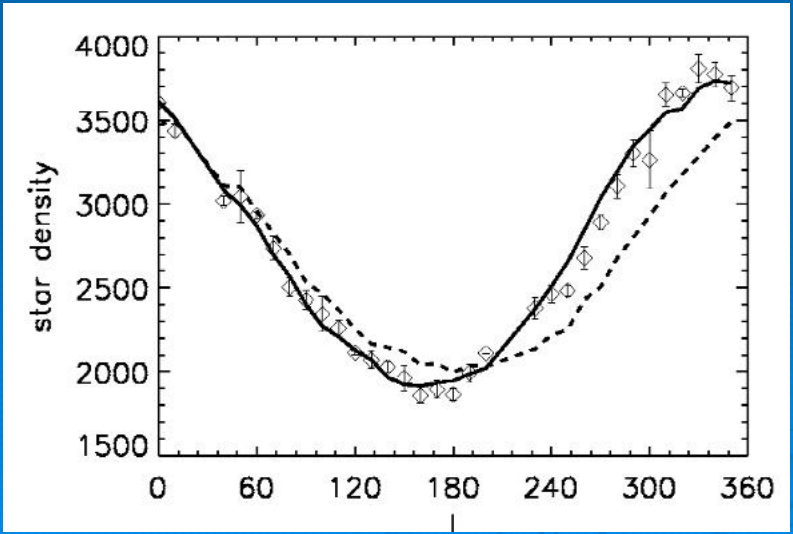


Constraining the gravitational potential

- The kinematical information carried by stars can be used to constrain the mass distribution in the Galaxy.
  Radial + tangential velocities + (α , δ ,d)
- Large area survey and homogeneous high precision data set is needed. Radial velocity measurement by LAMOST beyond GAIA limit (< 17m) will be important in this issue.

Probing the Spheroid, is it triaxial?

There is a apparent deviation from rotational symmetry as shown by star counts.



Stellar projected number density distribution in a ring at b=+60

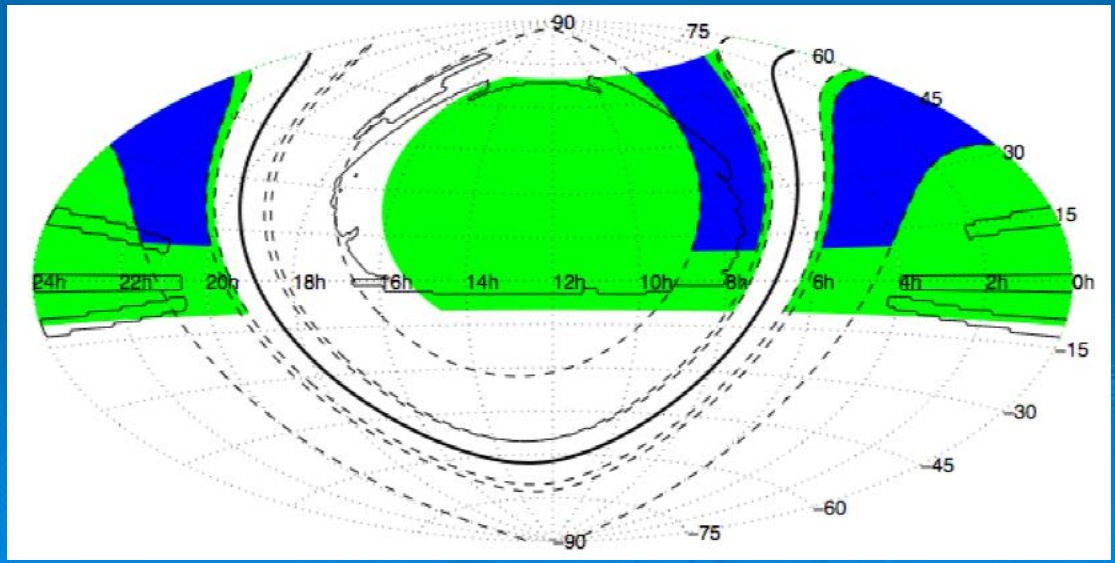
What are those substructures?

- Possibly
  - Dwarf galaxies
  - Globular clusters
  - Tidal debris of accreted dwarfs
- Tidal radius estimation: bound or unbound?
  - Need LAMOST survey data to confirm

Other scientific goals

- Search for extremely metal poor stars
- The structure of the thin/thick disks of the Galaxy, including the chemical abundance;
- Globular cluster: environment and their origin;
- A survey of the properties of Galactic open clusters, including the structure, dynamics and evolution of the disk as probed by open clusters;

Making a survey for planed scientific goals



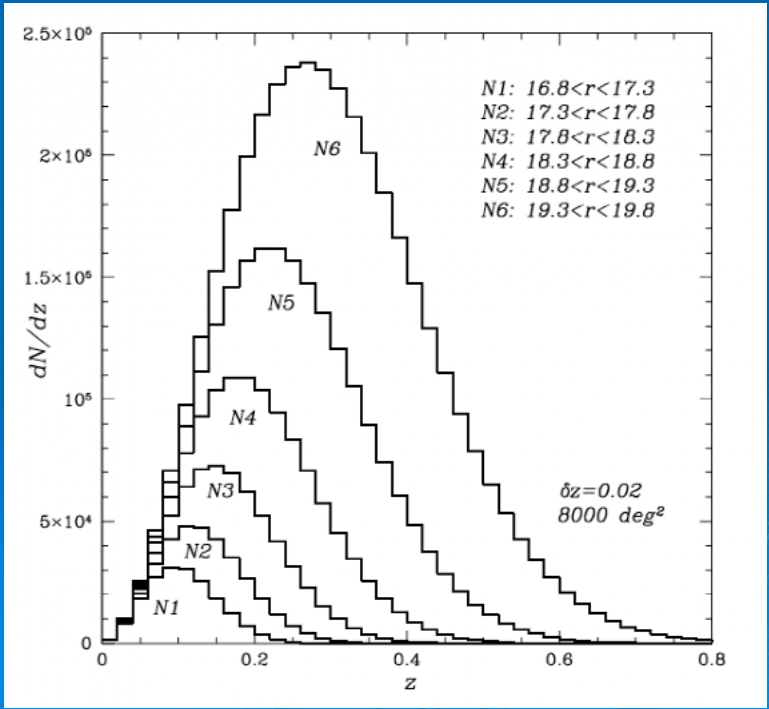
Galactic survey plan:

- Consider a 5 year survey plan
- spectra of 2.5m stars are expected
  - Using about ½ of the total dark observing time for halo (down to 20m)
  - Using about ½ of the grey and all bright nights for bright stars (18m) in the ‘green’ fields

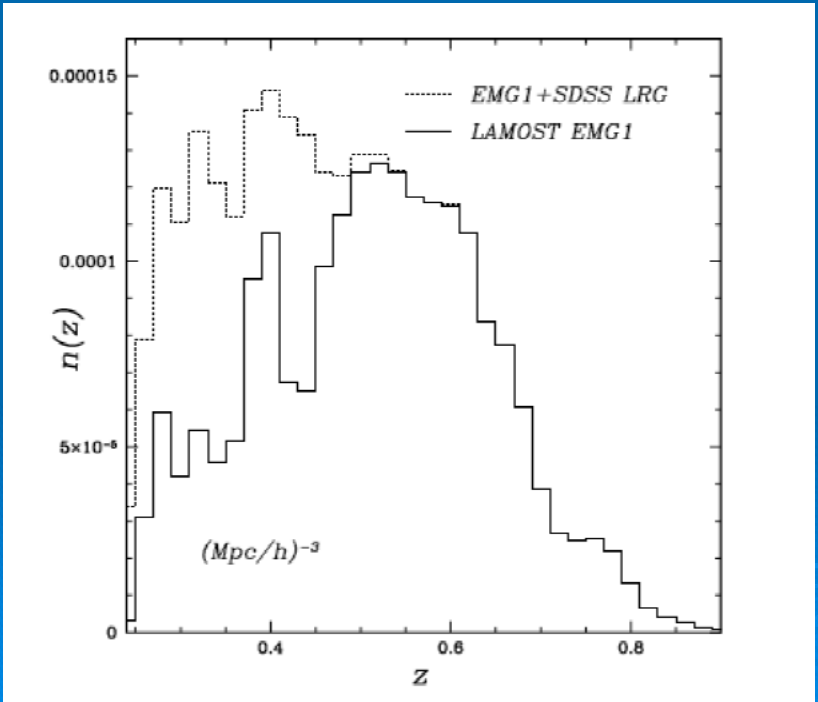
Extragalactic Survey

- **Shallow Survey:**
  large area with low S/N observation, only get redshift.
  30 minutes exposure, 10000 deg^2 (most in SDSS region), r<18.8
- **Deep Survey:**
  90 minutes exposure, 3000 deg^2 (most in South galactic cap), r<19.5
- **Early Massive Galaxy Survey (EMG):**
  similar to LRG, 0.5-2 million targets
- **QSO survey**
  0.5-1 million targets

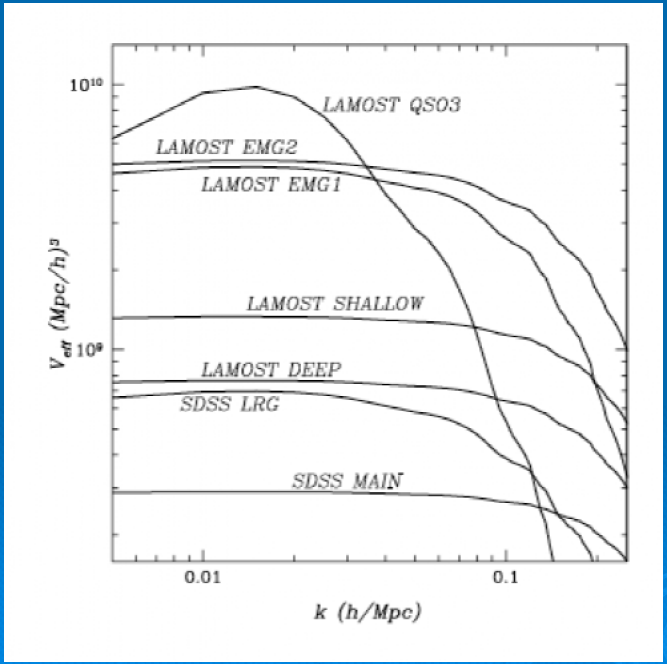
Number distribution of galaxies with different apparent magnitude



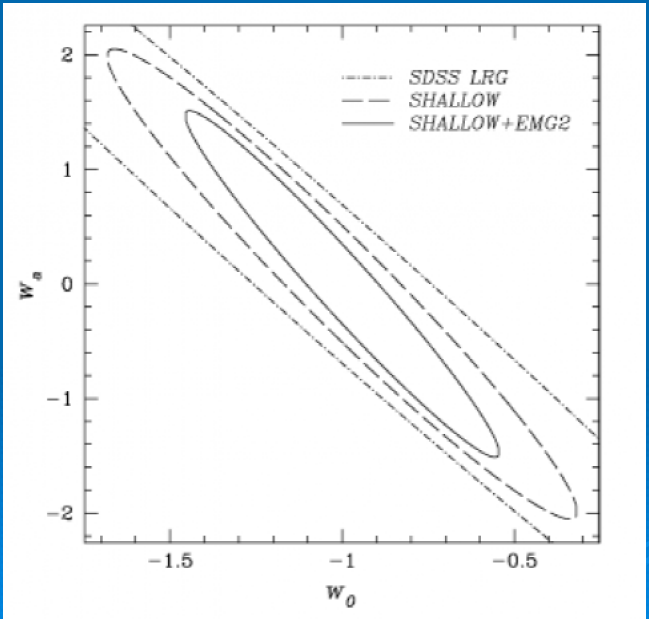
Comoving Density of Early Massive Galaxies



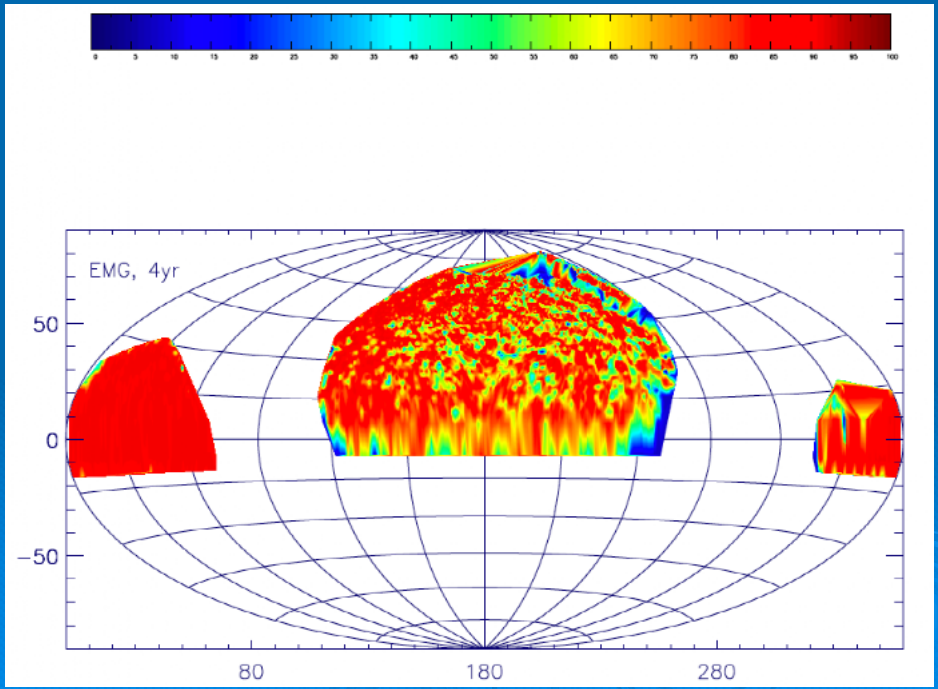
Effective Volume of the Surveys



Constraint on Dark Energy Equation of State



Completeness of EMG survey by 4th year



Thank You !