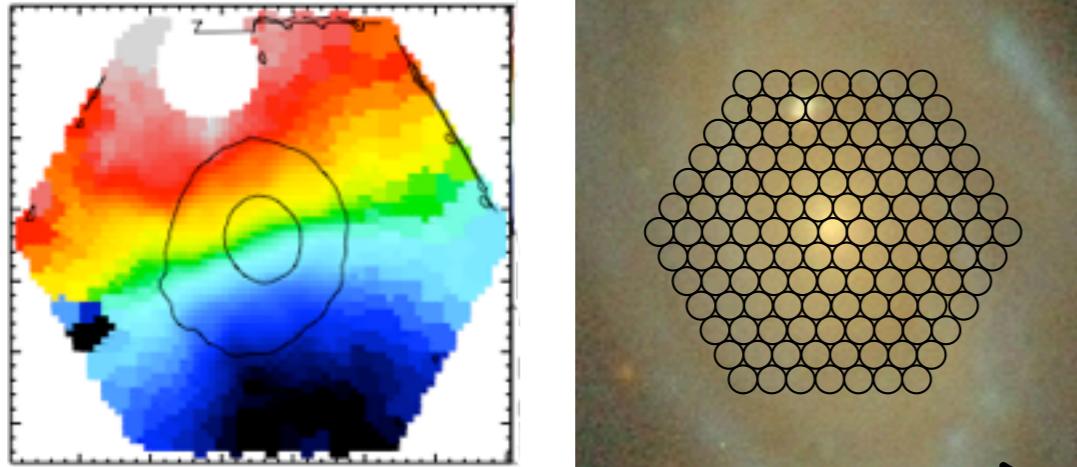


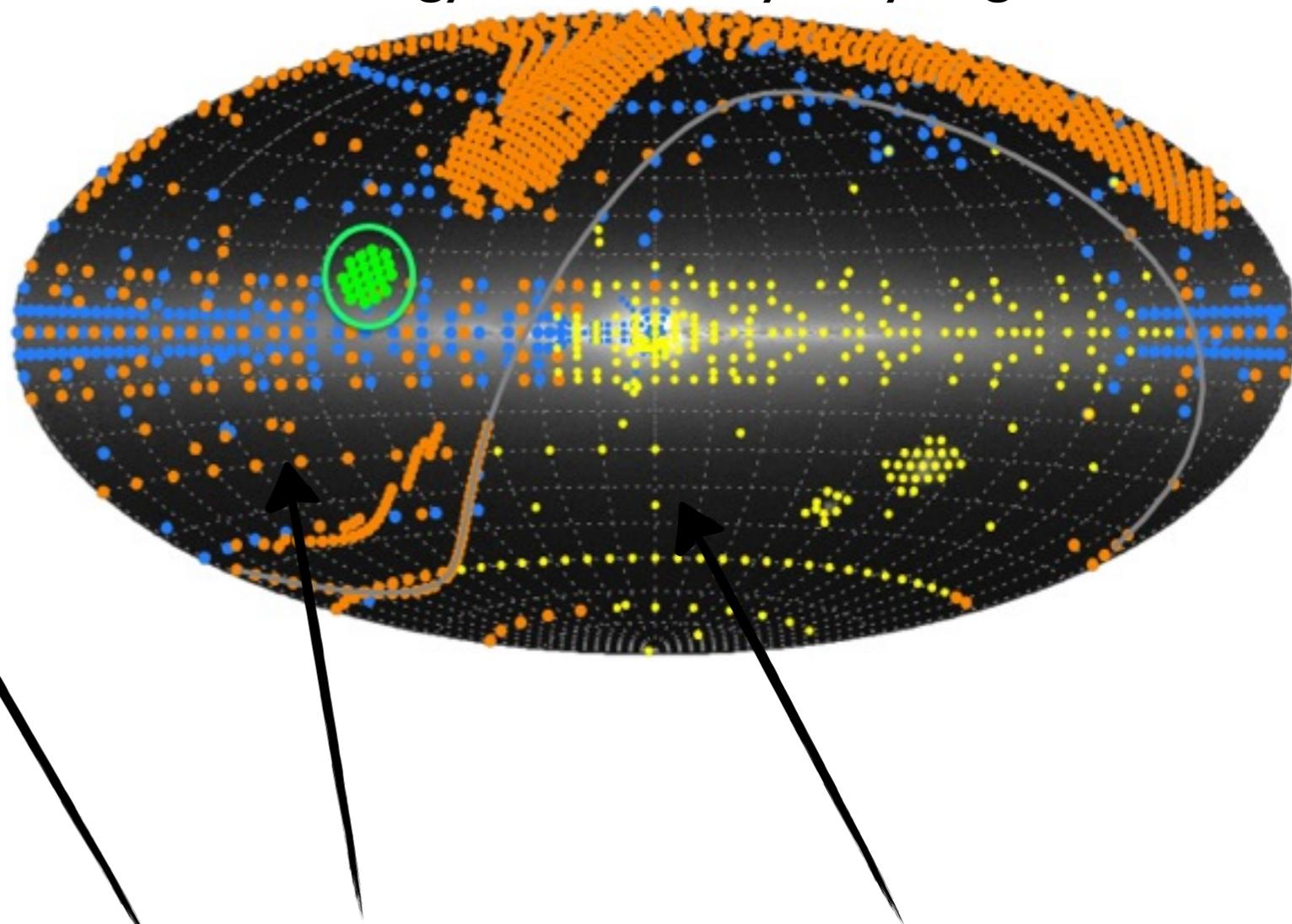
A view of astronomical survey science from the perspective of the Sloan Digital Sky Survey IV



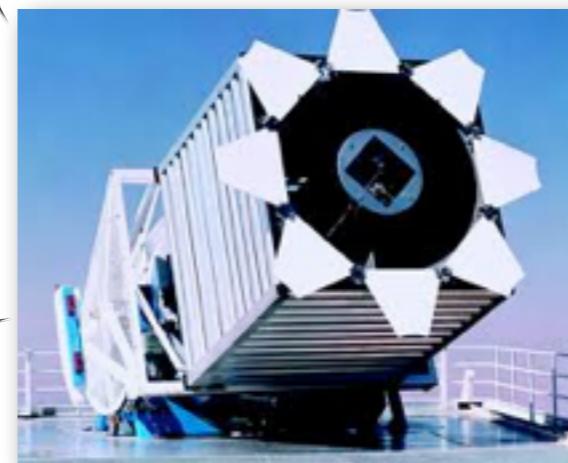
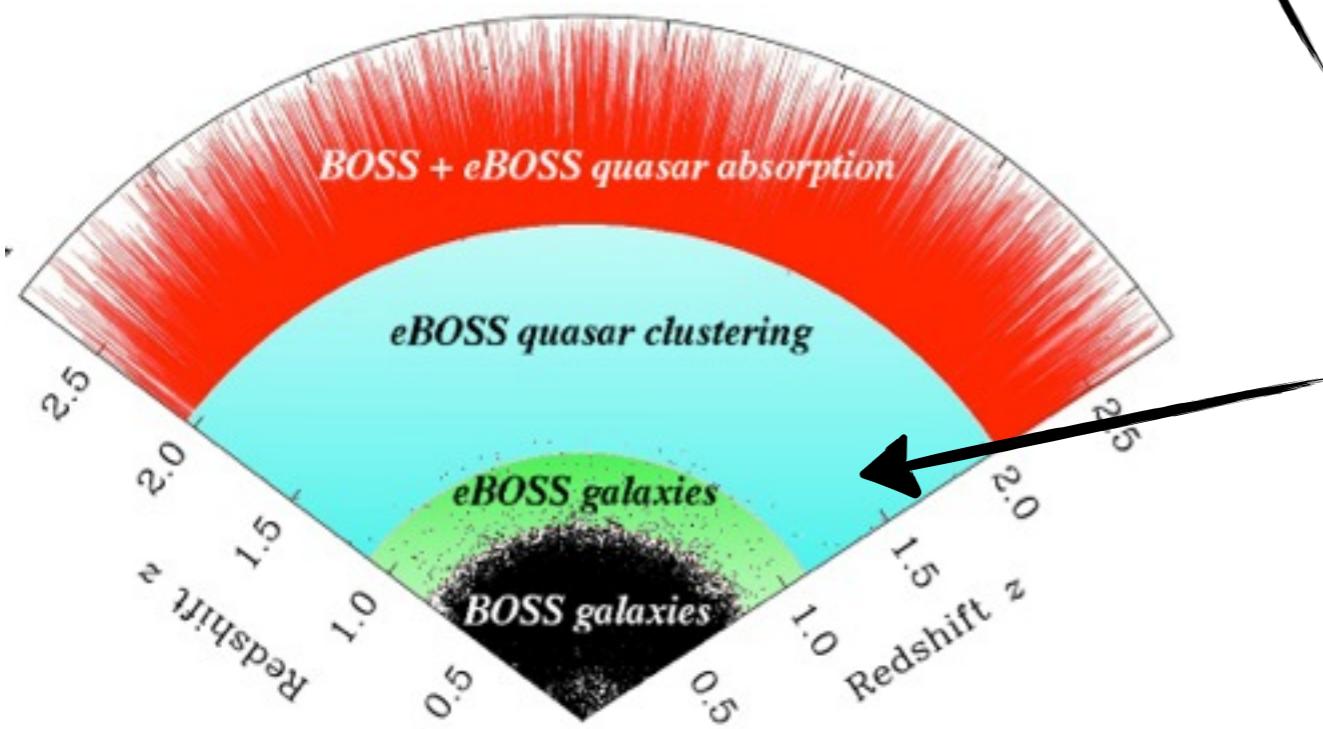
MaNGA: 10,000 galaxies
with spatially resolved
spectroscopy



APOGEE-2: Massively expanded Galactic
archeology for all Milky Way regions



eBOSS: Studying cosmic acceleration
in a new redshift regime with the
largest ever quasar sample



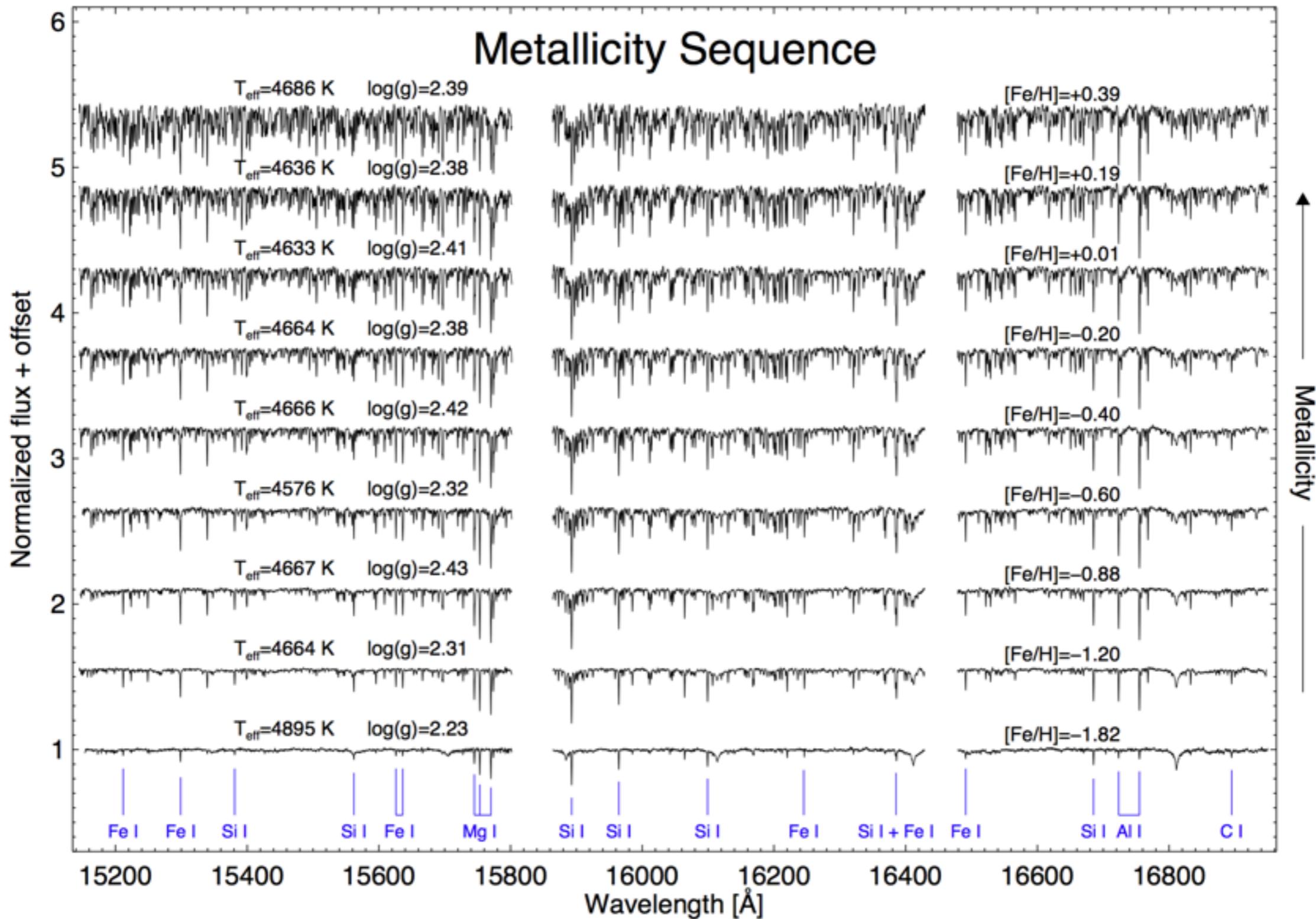
Sloan Foundation
Telescope



du Pont Telescope

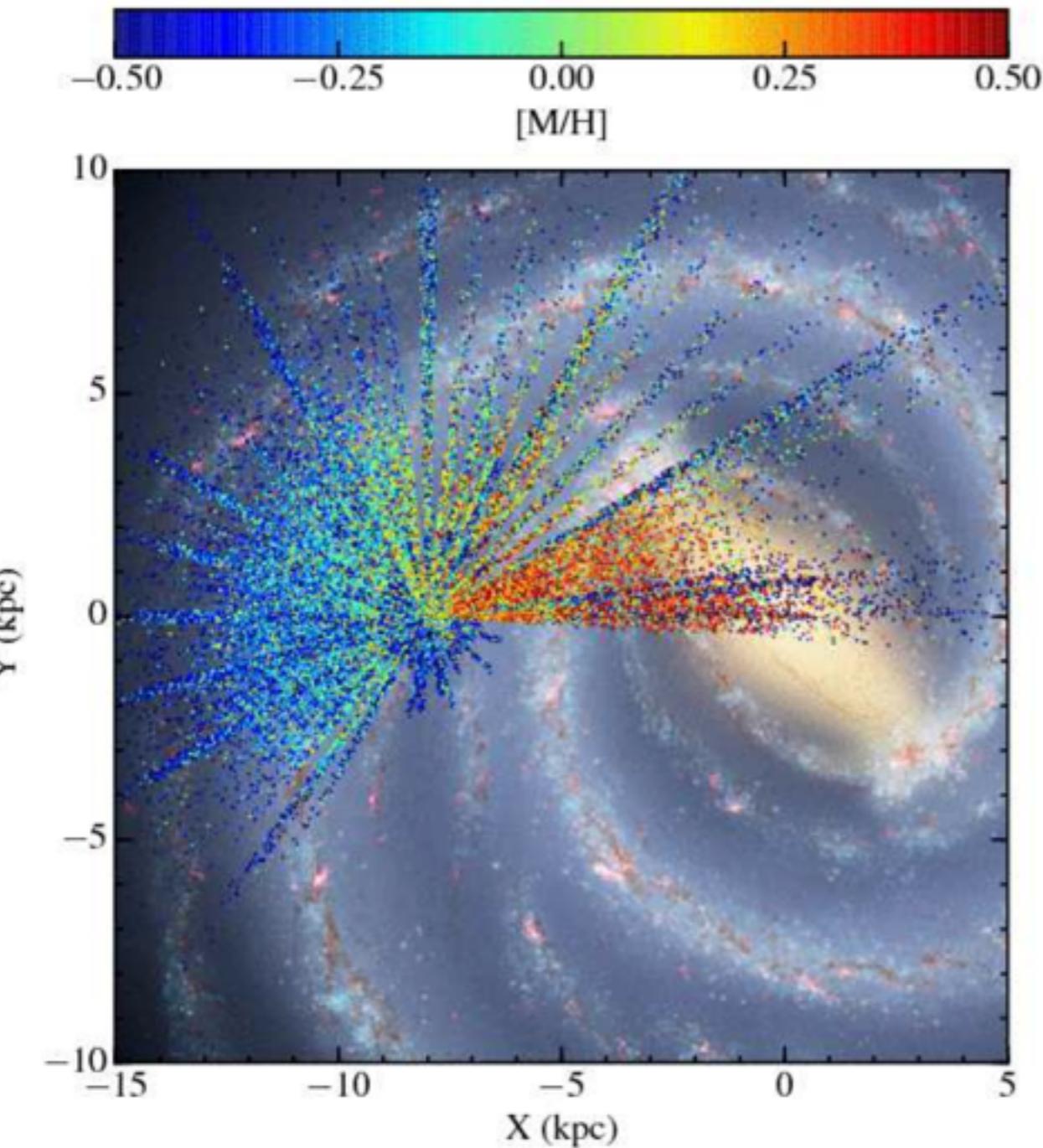
APOGEE-2: assembly of the Milky Way with near-IR, dual-hemisphere facility

(S. Majewski, PI)



(see Holtzman et al., Garcia-Perez et al., etc.)

APOGEE-2: assembly of the Milky Way with near-IR, dual-hemisphere facility

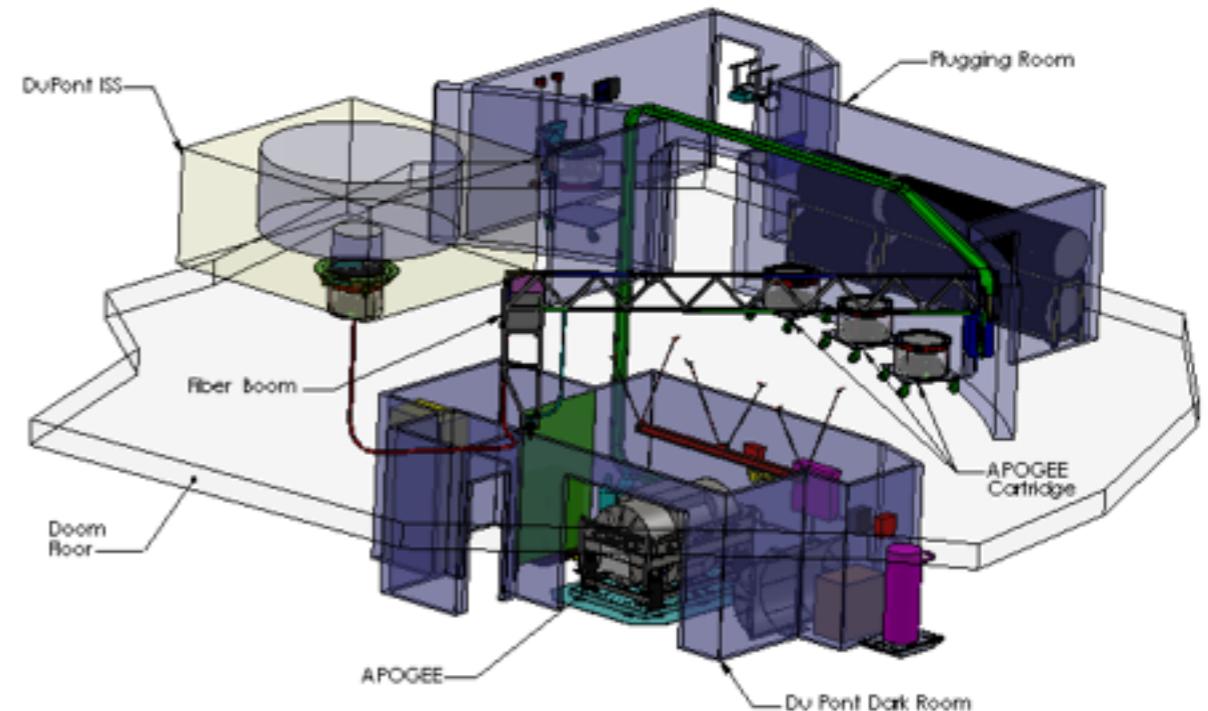


(see Hayden et al, Nidever et al.,
Zasowski et al., Bovy et al., ...)

*Southern survey starting late 2016,
operated by Chilean Participation Group
institutions.*



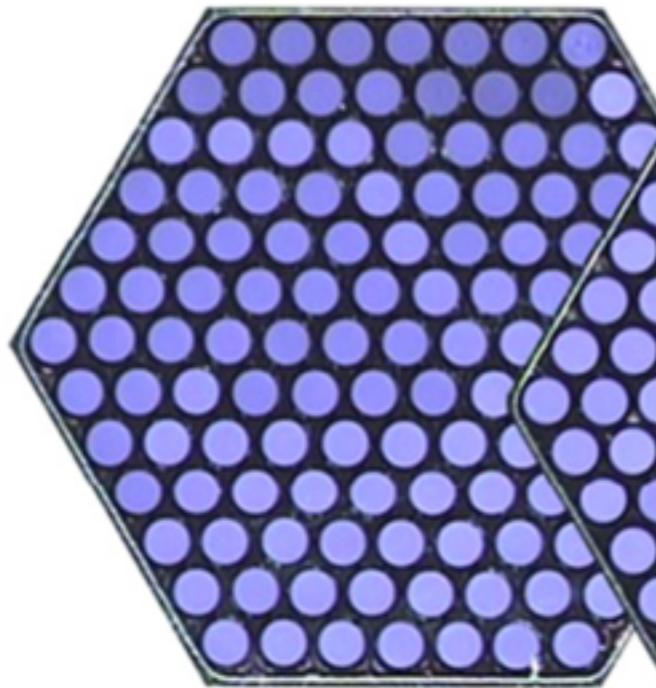
APOGEE Integration Overview



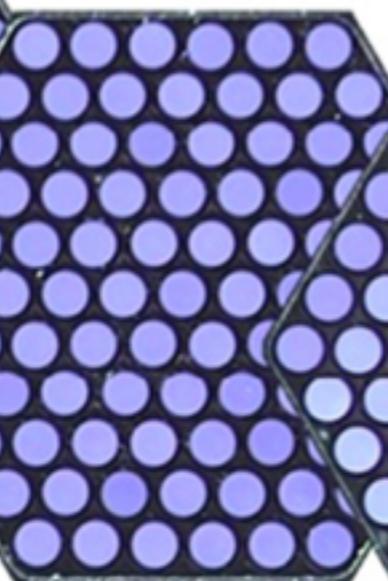
MaNGA: Mapping Nearby Galaxies at APO

(K. Bundy, PI)

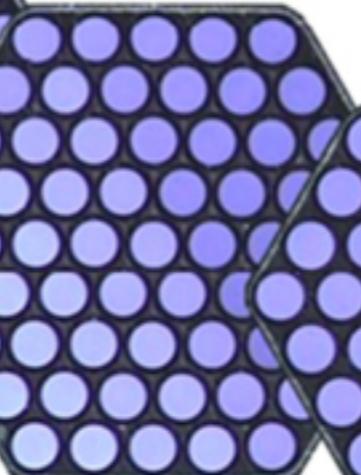
127-Fiber IFU



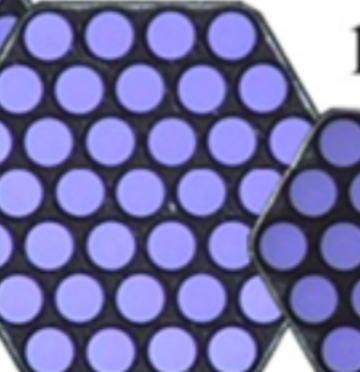
91-Fiber IFU



61-Fiber IFU



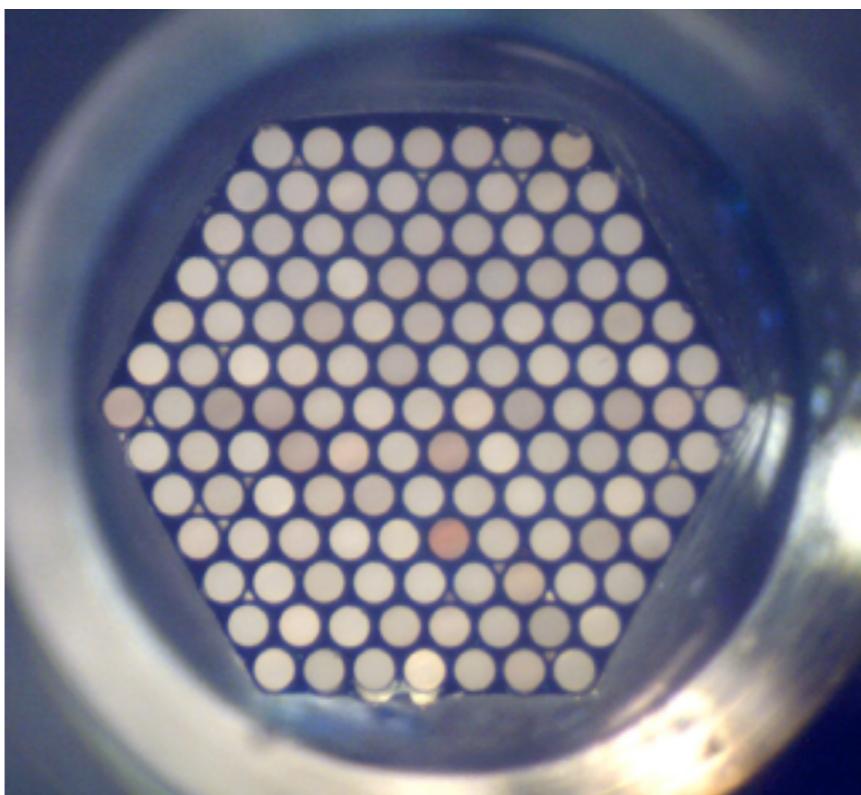
37-Fiber IFU



19-Fiber IFU



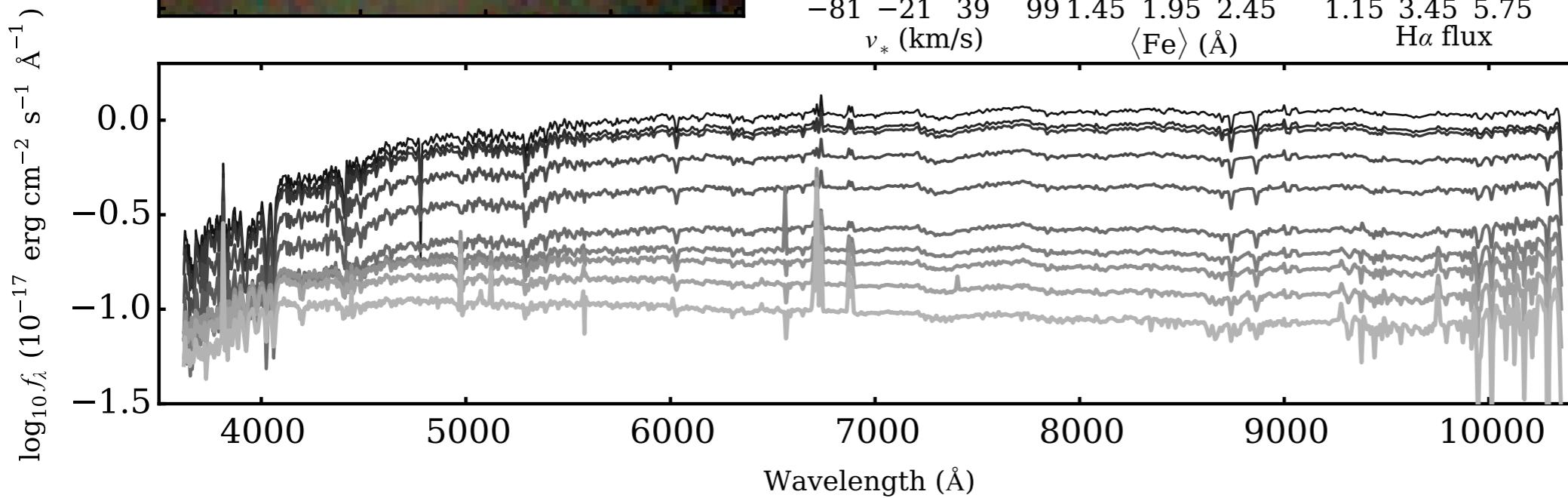
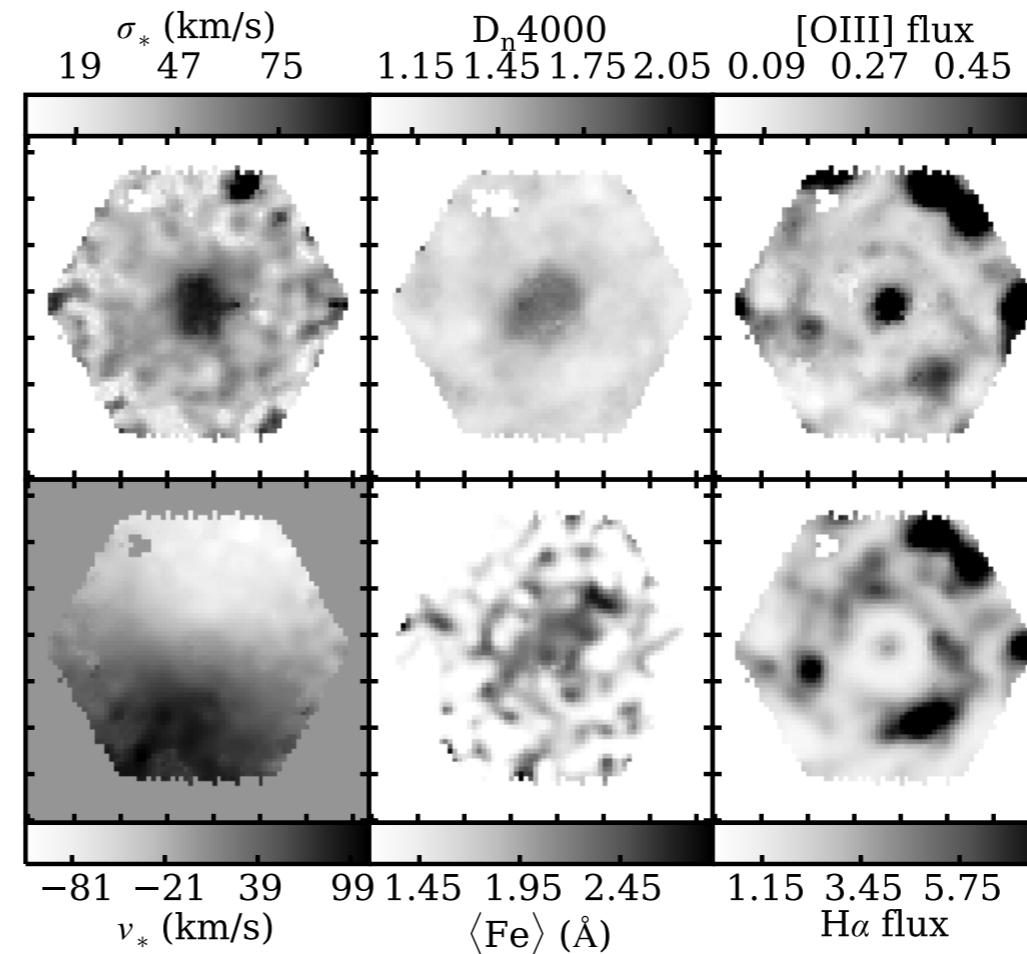
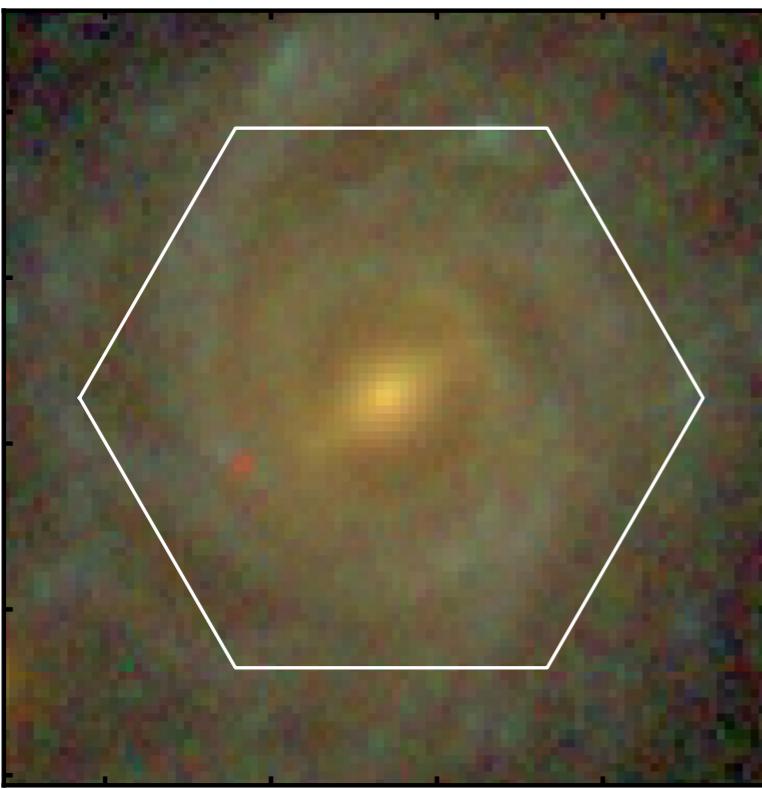
7-Fiber IFU



MaNGA: Mapping Nearby Galaxies at APO

(K. Bundy, PI)

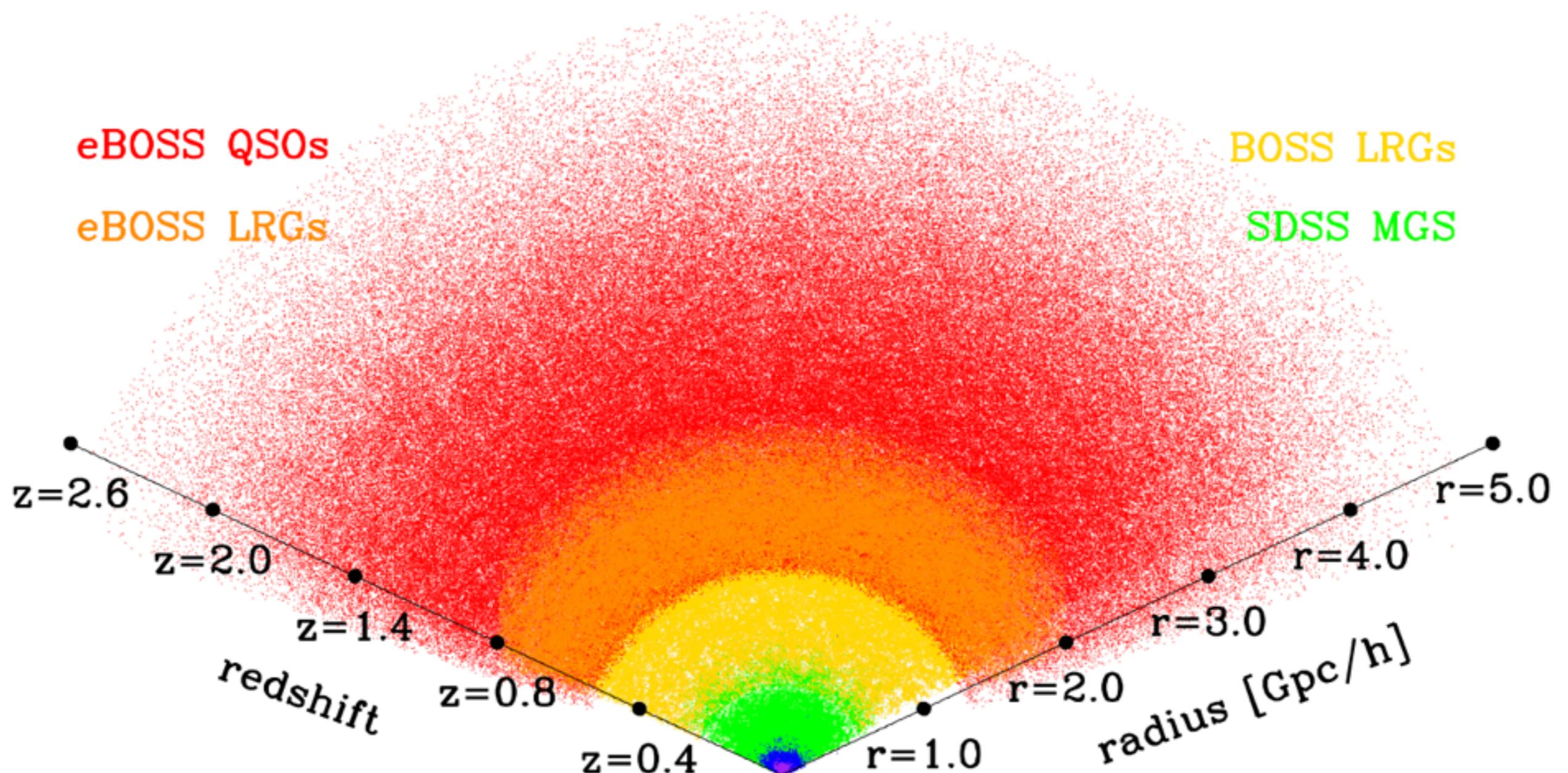
8083-12704 NSAID=645723



see Drory et al., Bundy et al., Law et al., Yan et al., Belfiore et al.,
Wilkinson et al., Li et al., etc.

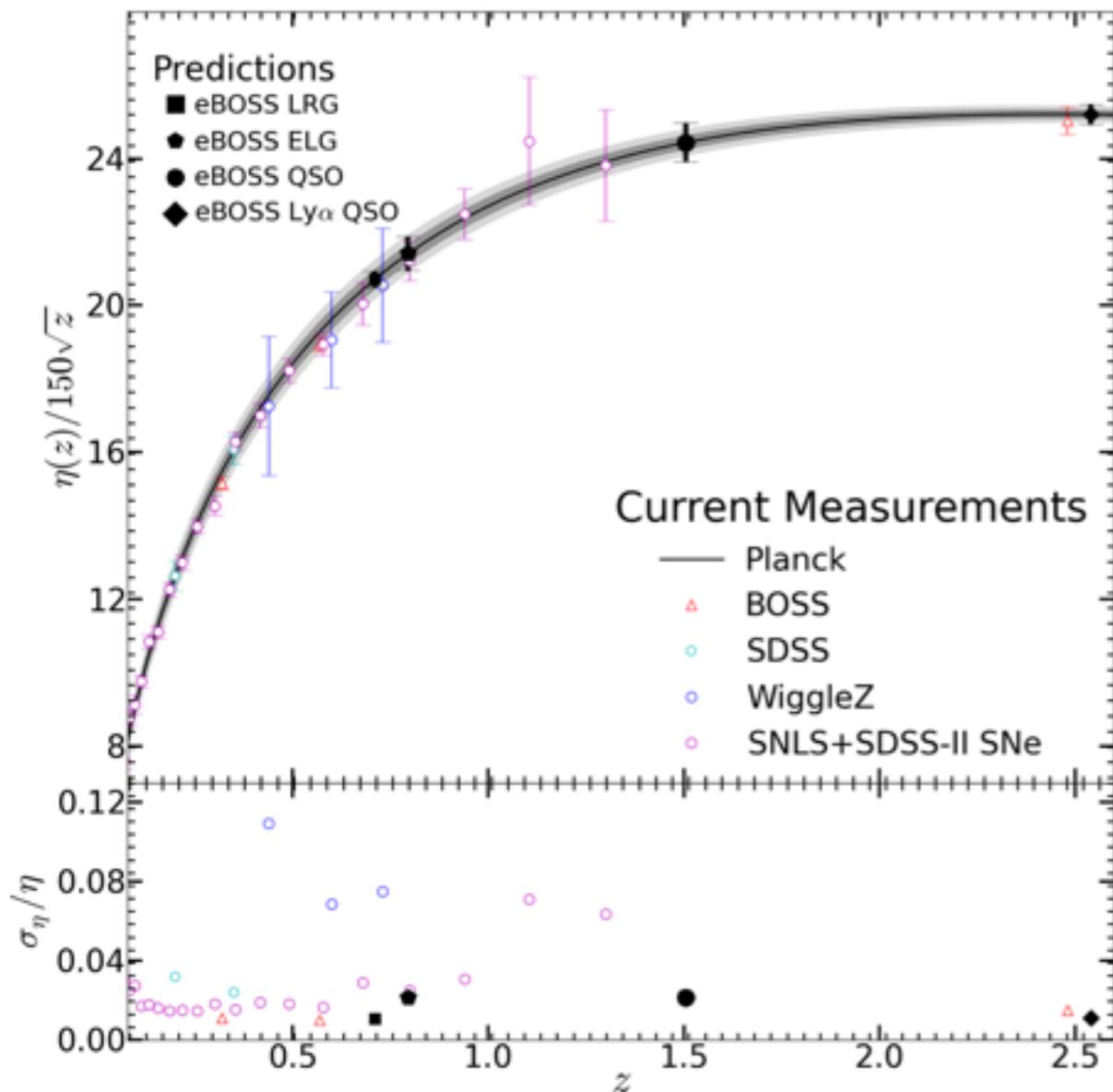
eBOSS: huge quasar + galaxy survey to measure dark energy

(J-P Kneib, PI)

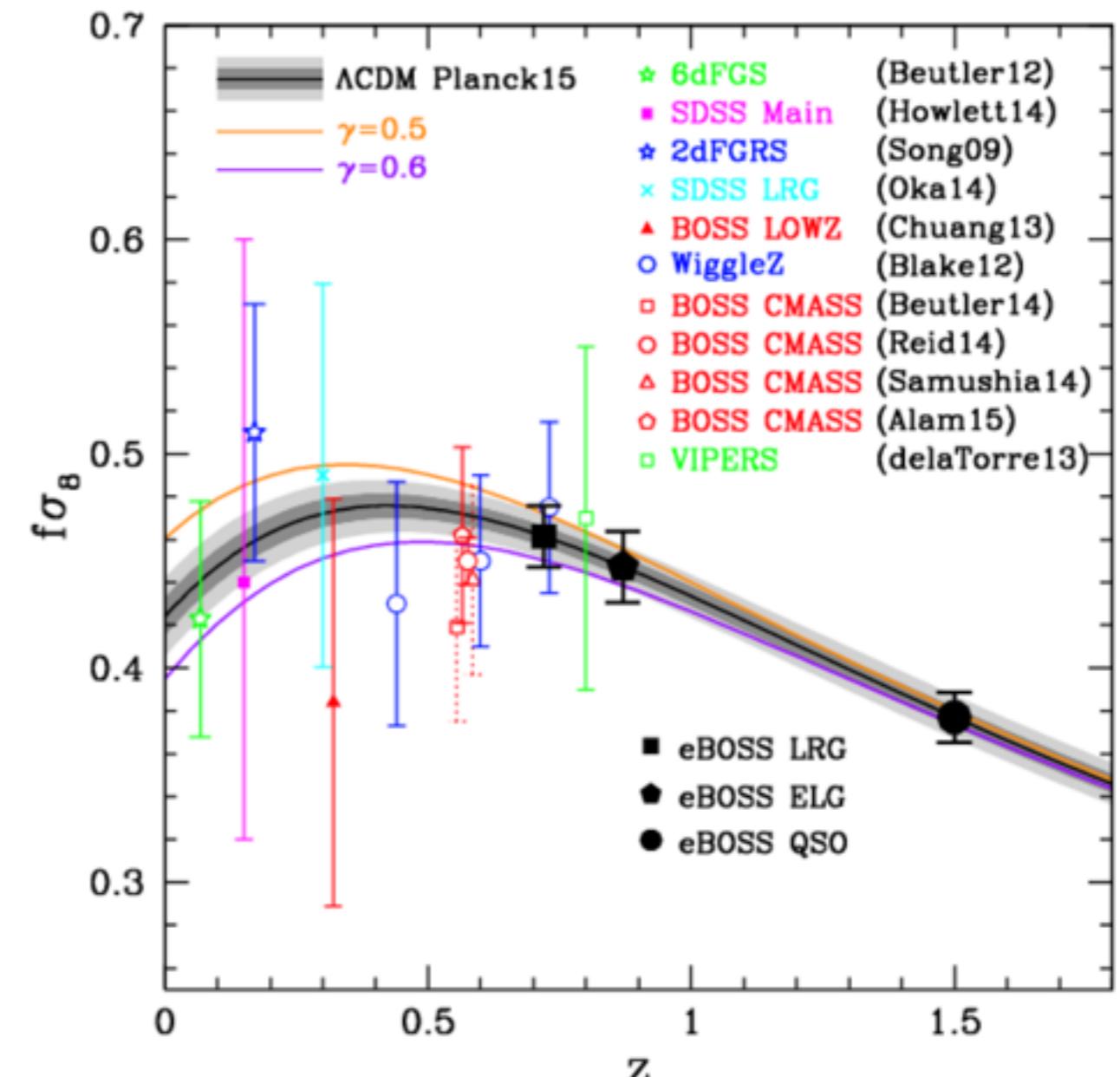


eBOSS: huge quasar + galaxy survey to measure dark energy

(J-P Kneib, PI)



Hubble diagram

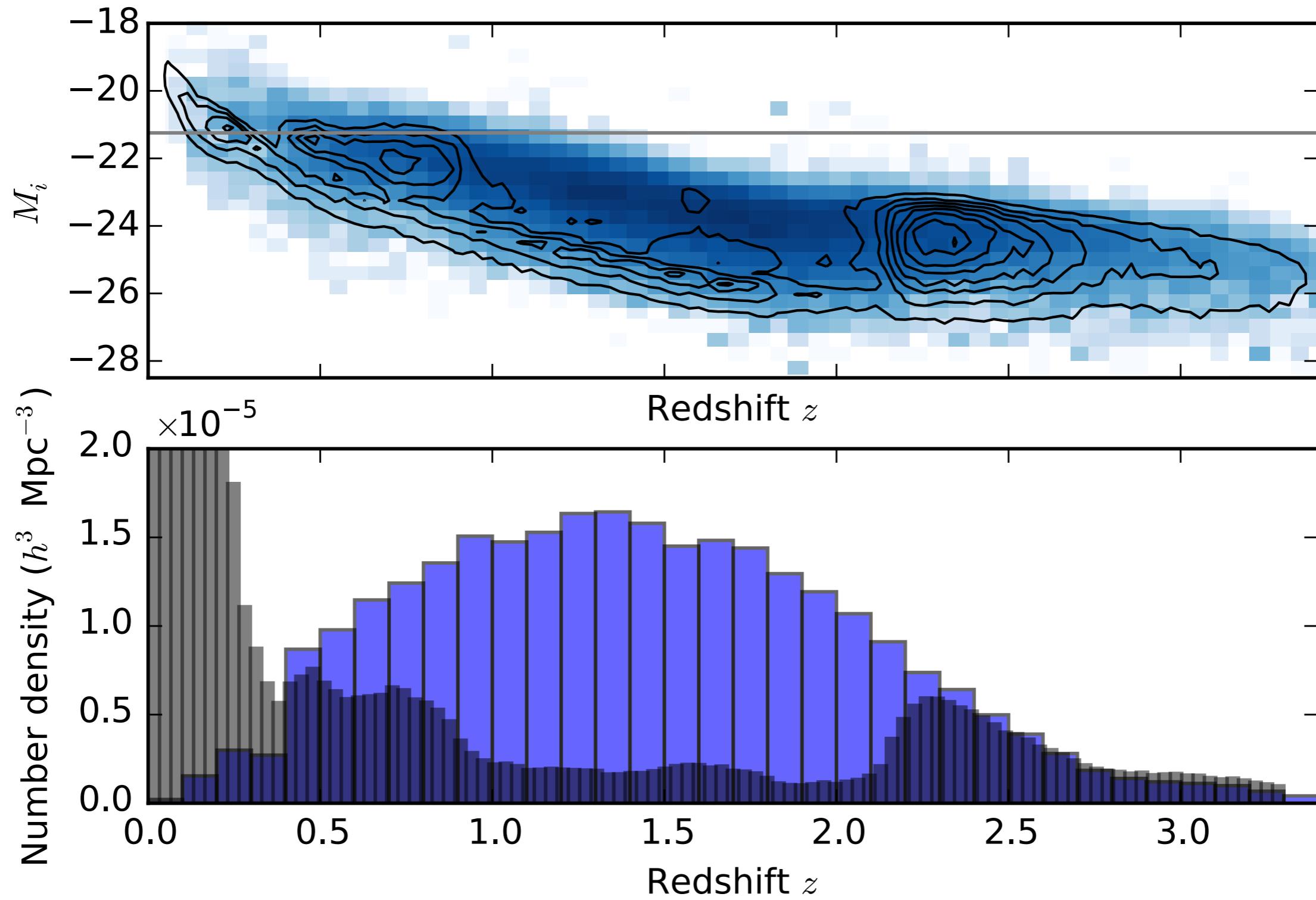


Growth of structure

see Dawson et al, Zhu et al, Zhao et al, Prakash et al, etc.

eBOSS: huge quasar + galaxy survey to measure dark energy

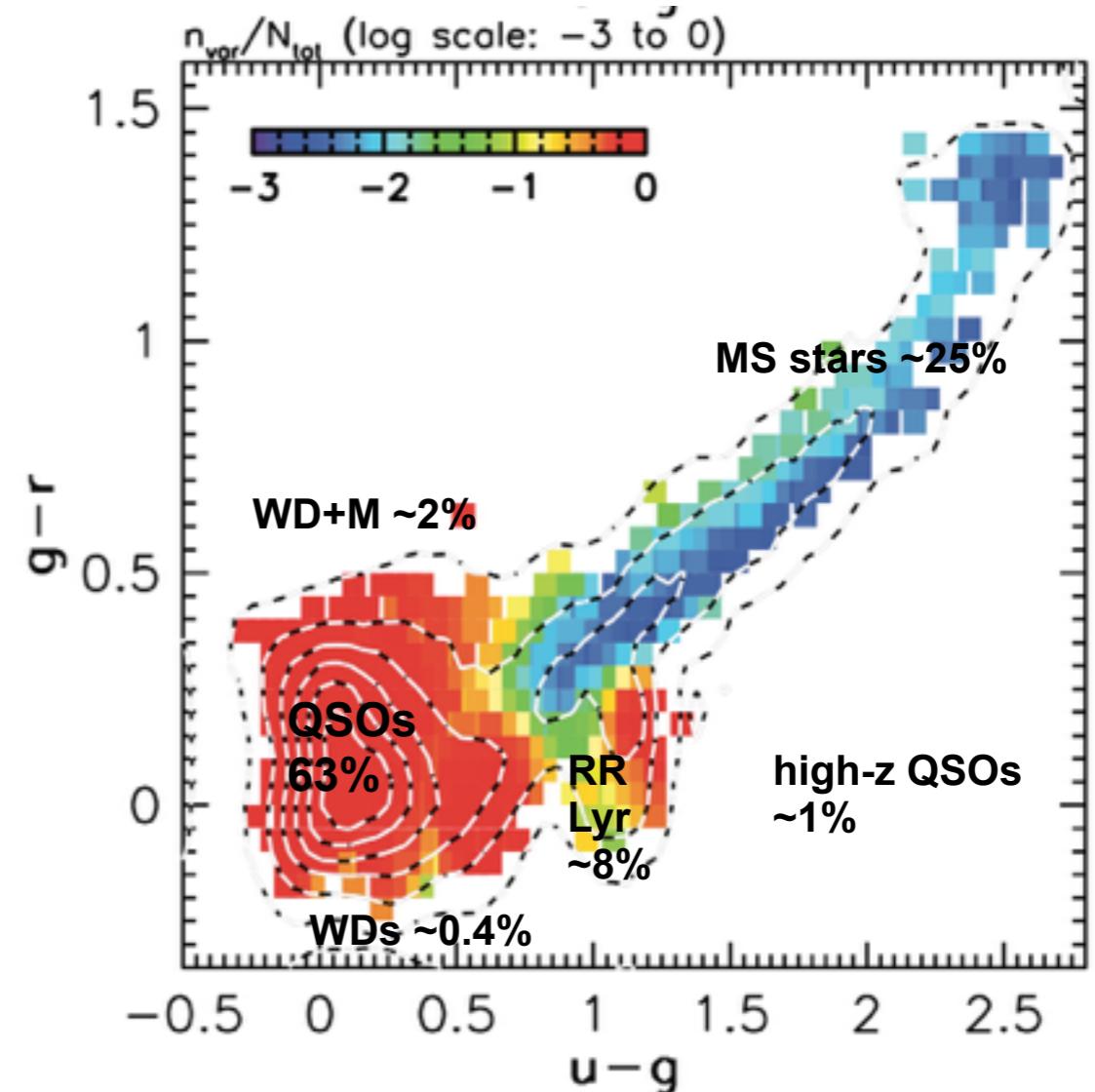
(J-P Kneib, PI)



quite a lot of quasars

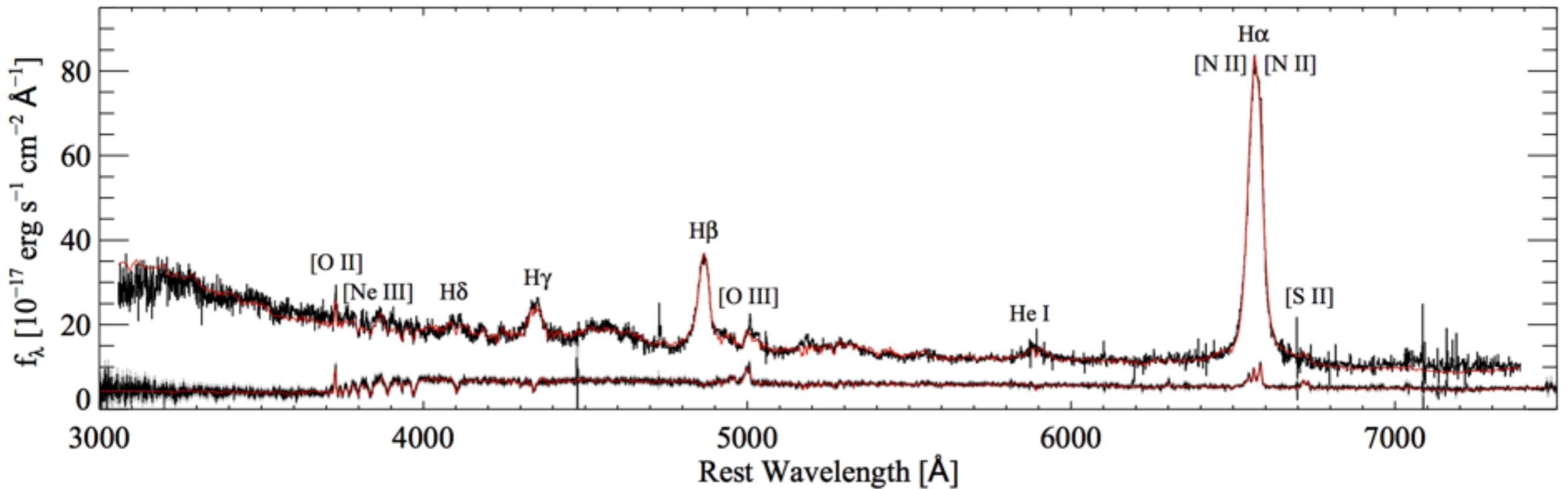
eBOSS: TDSS and SPIDERS subprograms

- Time Domain Spectroscopic Survey
 - Pan-STARRS variable sources
 - few-epoch spectra of quasars, dC stars, etc.
 - physical classifications to inform photometric classification
- SPIDERS:
 - 100,000 spectra of X-ray AGN and cluster galaxies
 - ROSAT-based now, eROSITA when it becomes available



eBOSS: *changing look* quasars found in TDSS

Runnoe et al, Ruan et al.



searching for spectral variation of quasars to better understand accretion physics and determine black hole masses is compelling

Faculty And Student Teams

- Sloan Foundation funded program for underrepresented minority student support for SDSS research
- Kelly Holley-Bockelmann (Vanderbilt)

Pioneering FAST cohort



Jesus Pando
& 2 Undergraduates
& 1 Masters student

Team DePaul — working on eBOSS



Anthony Pullen



Shirley Ho



rats....



Kevin Kadowaki



Taurean Ford



Noel Garcia

Pioneering FAST cohort

Team CUNY-Staten Island —
working on MaNGA + GalaxyZoo



Charles Liu
& 4 undergraduates



Karen Masters

Pioneering FAST cohort



Paul Mason
& 3 undergraduates

Team NMSU, El Paso —
working on TDSS



Jason Jackiewicz



Alaina Bonilla



Ashley Betances



Andrea Gonzalez



Christina Migliore



James Vesper



Joni Clark Jonathan Delgado

The Data Releases

- First SDSS-IV data release (DR13) is in Summer 2016
- Data release interfaces being upgraded for MaNGA.
- Continuing yearly, if we can continue to be funded.
- Last two data releases from this project are at risk due to funding:
 - *half the data total*
 - *all APOGEE-2 South data*
 - *mature versions of analysis*

The Collaboration

- Managed by the Astrophysical Research Consortium, a small group of universities
- Over 50 member institutions
- Almost 1000 active scientists: communication through phone, mailing lists and wiki.
- 4 continents, including most of the time zones
- A publication policy which requires notification and opportunity to review, but not a binding review.
- No carved out key projects.

What is the legacy of SDSS for survey science?

- Pooling resources:
 - *division of labor leads to efficiency improvements.*
 - *incremental improvements have tremendous leverage.*
 - *survey experiments are applicable for unforeseen questions.*
- Power of data releases:
 - *archival value of raw data*
 - *curation of well-vetted catalogs*
 - *common collaborative infrastructure*
 - *documentation*
 - *resource for education and outreach*
- Collaboration Culture
 - *a publication policy with few restrictions*
 - *openness to outsiders*
 - *openness to new ideas for improvements*
 - *minimal (but existing!) hierarchy*
 - *in our best moments, attentive to and polite in our disagreements*

Challenges for Data Releases: the SDSS approach

- Getting the basics: data integrity, defining file formats, tracking software versions and metadata. *These are paramount in importance.*
- Defining the product: how to determine when it is ready to go? *Think about the science papers.*
- What interface tools? *Start simple and build basic tools to address multiple use cases.*
- How to schedule? *Balancing science verification with lead time for collaboration to benefit. Sacrifice functionality for making schedule, always.*
- Documentation takes by far the most time and coordination:
 - developer documentation
 - reference guides (e.g. the SDSS glossary or data model)
 - “user manual”
 - tutorials & examples

Challenges for the SDSS Collaboration

- At times, vociferous disagreements: *time heals all wounds* ...
- International collaboration:
 - *conference calls & time zones*
 - *meeting minutes are important*
 - *regular physical meetings*
 - *religious use of open mailing lists*
- Software/data culture differences between surveys: *software, data and observing strategy focused meetings that cross survey teams*
- Lack of women in SDSS management: see *next slide*, *there is no one-liner for this one*.
- **We have no illusions: it is all a work in progress.**

Committee on the Participation of Women

- Sparked in 2012 because of the alarm raised by the Sloan Foundation regarding the lack of women in SDSS management. This changed it from a known problem to an existential issue.
- Representative of the astronomical population in the SDSS collaboration and in SDSS publication output. But not management. Why?
- CPWS formed to investigate, track progress, and recommend changes. See Lundgren et al. (2015)
- What we know:
 - *perception (more among women than men) that management is a closed circle of collaborators*
 - *we did tend to grow organically and opportunistically: this is a recipe for unconscious bias*
 - *women are overrepresented in education and outreach aspects of management*
- What we are changing:
 - *open recruitment policies for ALL roles, even volunteer ones.*
 - *central vetting of candidate lists, and explicitly seeking female candidates*
 - *Limited duration for roles*
 - *If we can afford it and recruit people, an increase in deputy or assistant positions*

A take home message?

- Getting the science done isn't just about getting the project built.
- A better collaboration can overcome adversity better and get better science out.
- Public data distribution and documentation, and open communication policies, can enable new and better science.
- This all takes WORK. It will not just happen. We should do this as well as our elders did.

