Streamlining MaNGA data with Marvin

SDSS

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Outline

MaNGA overview

Astronomy Bottlenecks

Introducing Marvin

Marvin Live Demo

MaNGA overview

Overview on MaNGA

Science motivation

Metallicity

Stellar / gas kinematics

AGN

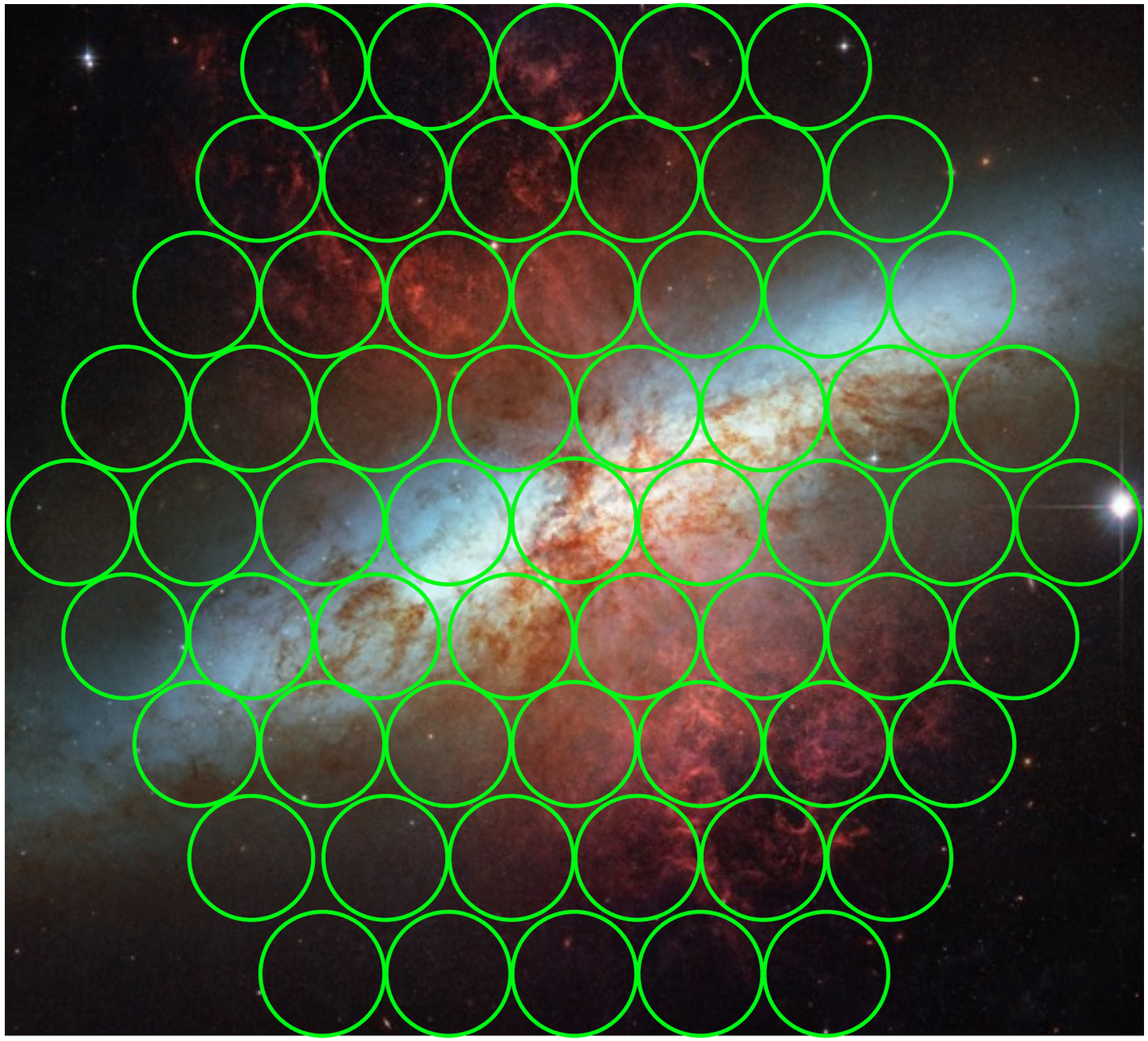
SFR

Star Formation History

Chemical abundances

Science motivation

Disk growth



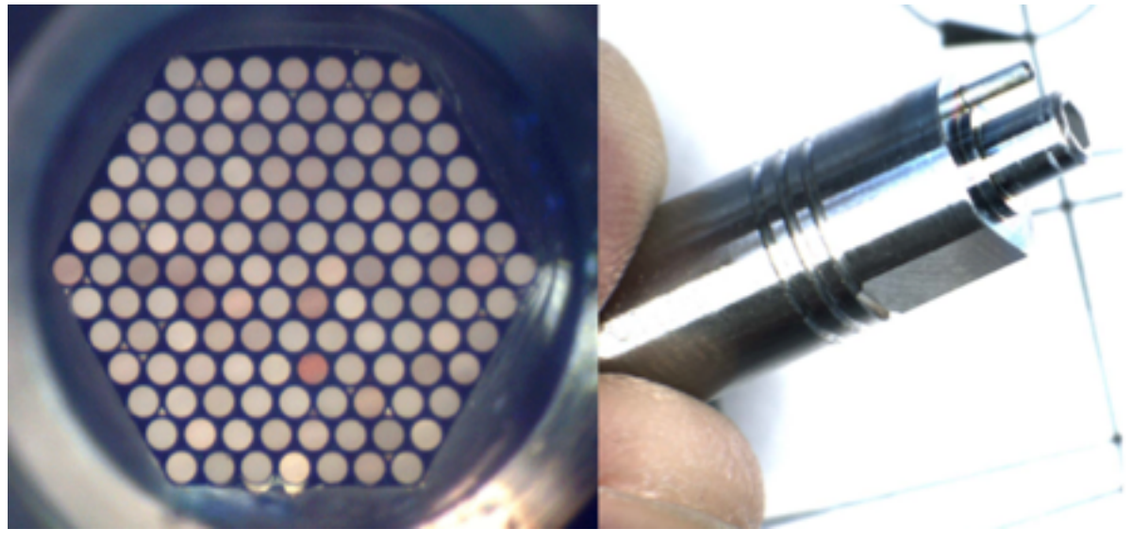
Spheroid growth

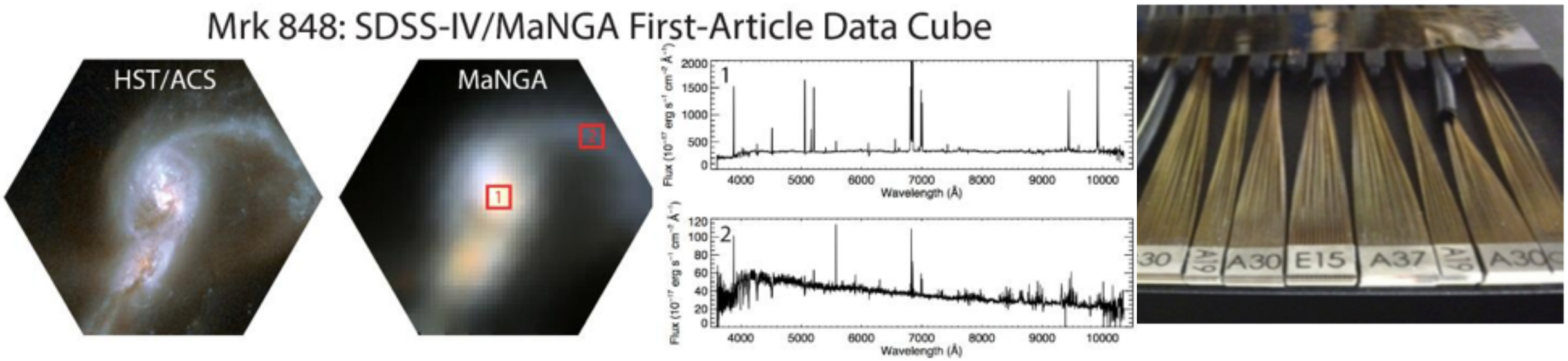
SF regulation

Mass and ang. mom. distribution

MaNGA overview

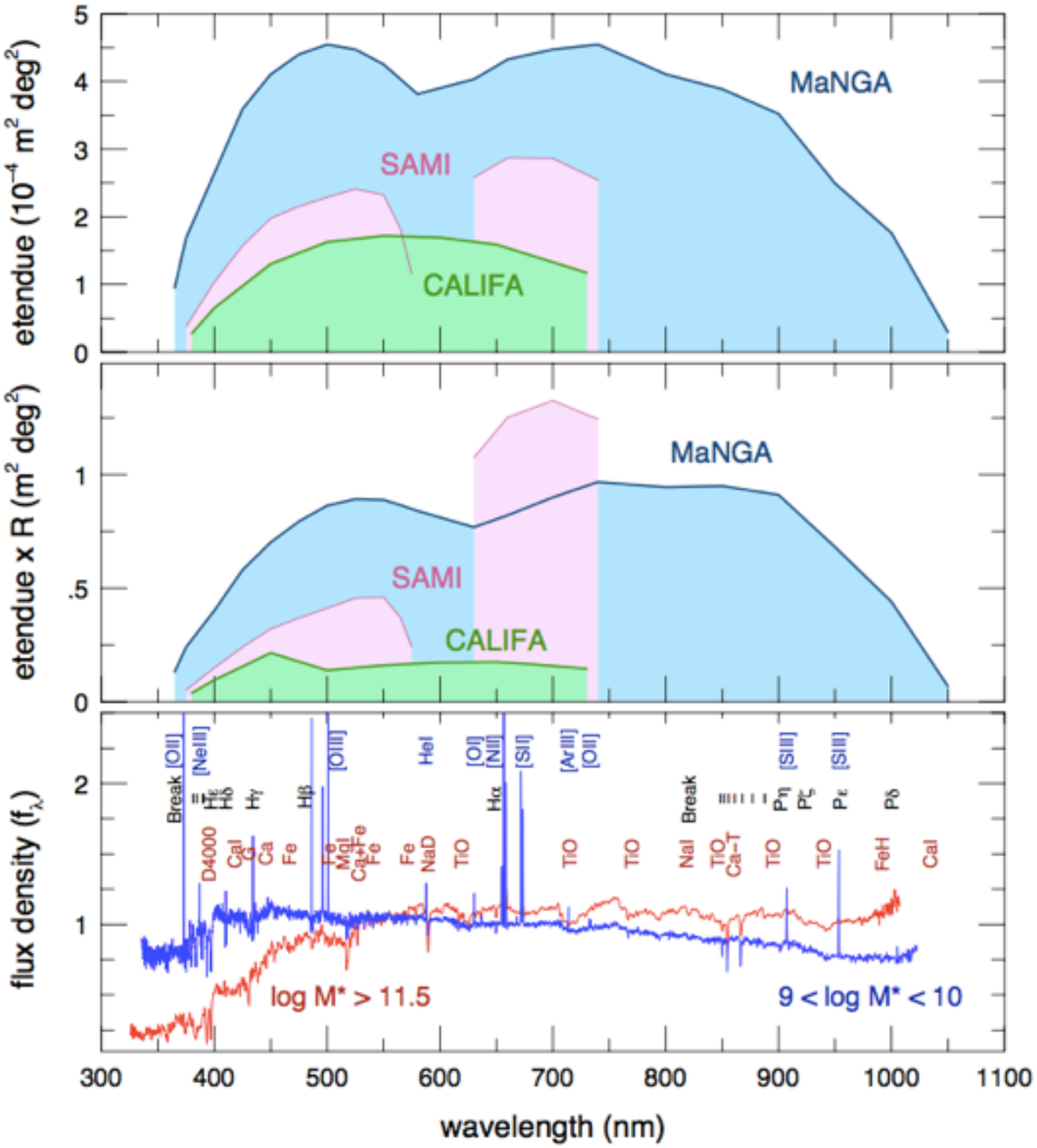
- MaNGA: Mapping Nearby Galaxies at APO
- PI: Kevin Bundy. Over 160 members in 50+ institutions.
- Part of SDSS-IV (2014-2020)
- IFU observations of 10,000 galaxies (4000 already observed!)
- Stellar library during bright time
- $0.01 < z < 0.15$
- $\lambda \sim 3600–10300$ Å
- R~1400-2600 (115-215 km/s)
- Spatial resolution 1.3-5.1 kpc





MaNGA overview

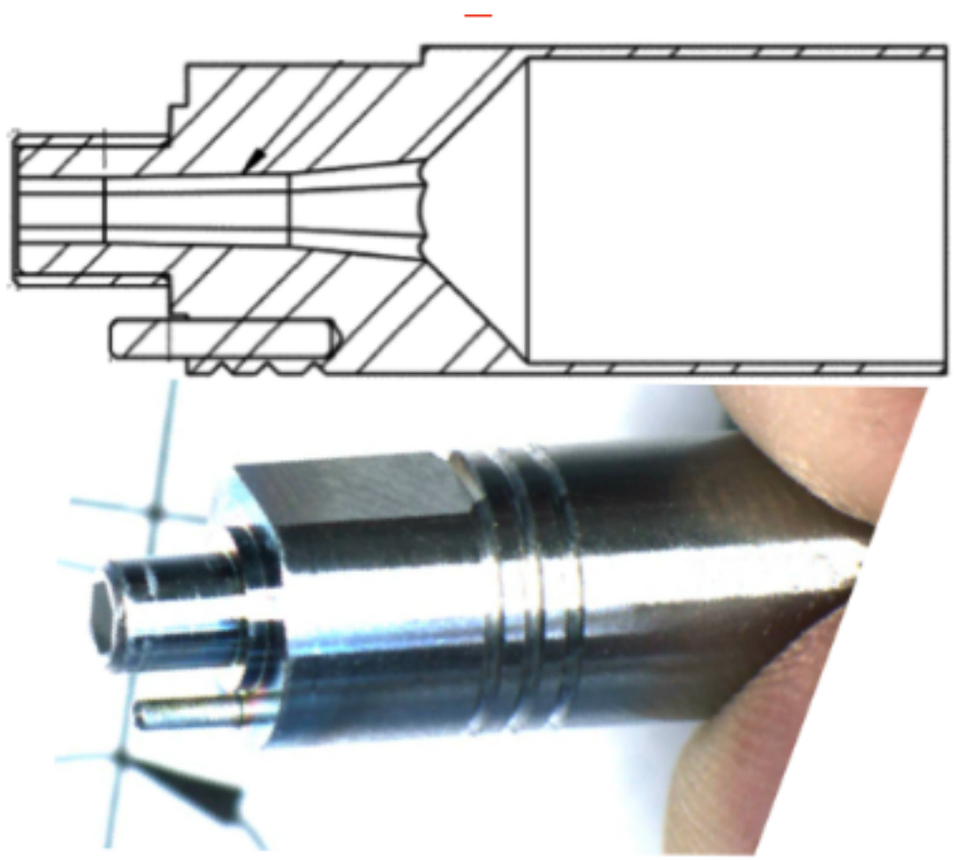
MaNGA vs the World



Bundy et al. (2015)

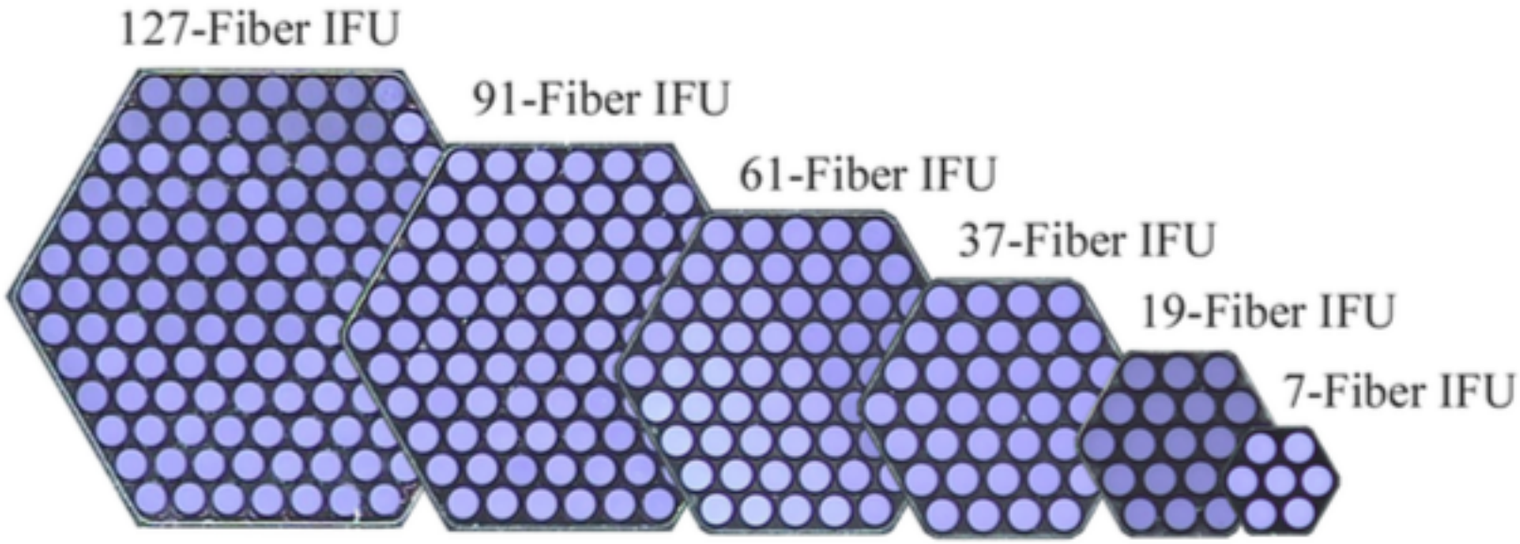
MaNGA overview

Hardware



- 17 IFU bundles
- 5 bundle sizes ranging from 19 to 127 fibres in hexagonal pattern
- 12 x 7-fibre mini-bundles for spectrophotometric calibration
- 92 single fibres for sky subtraction

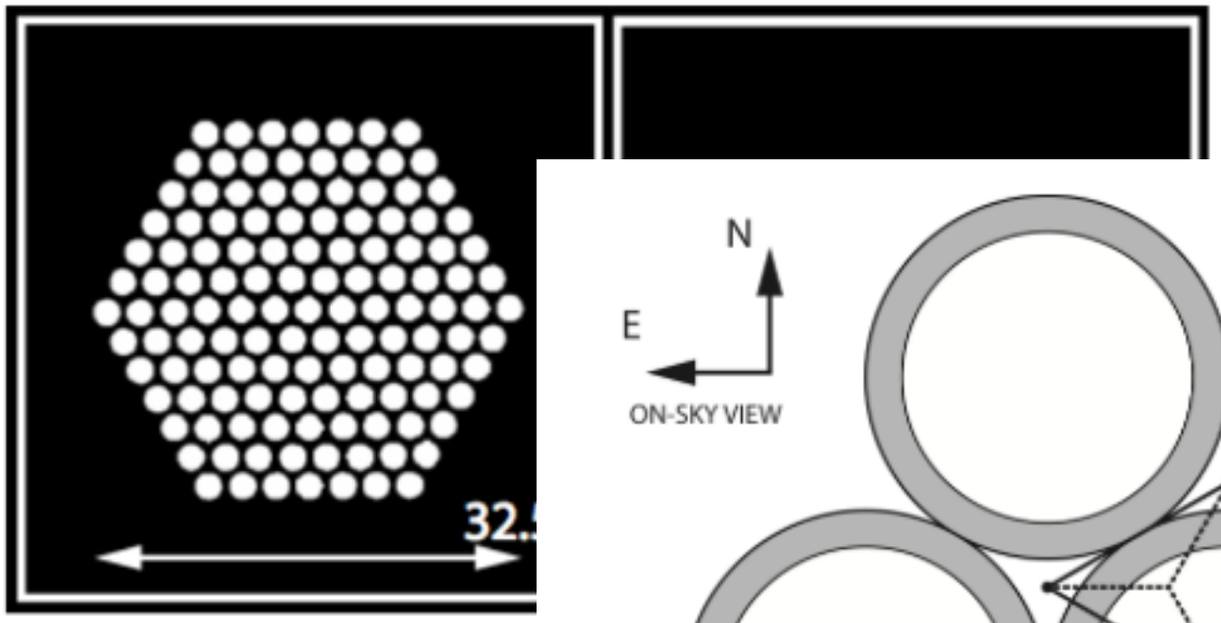
Drory et al. (2015)

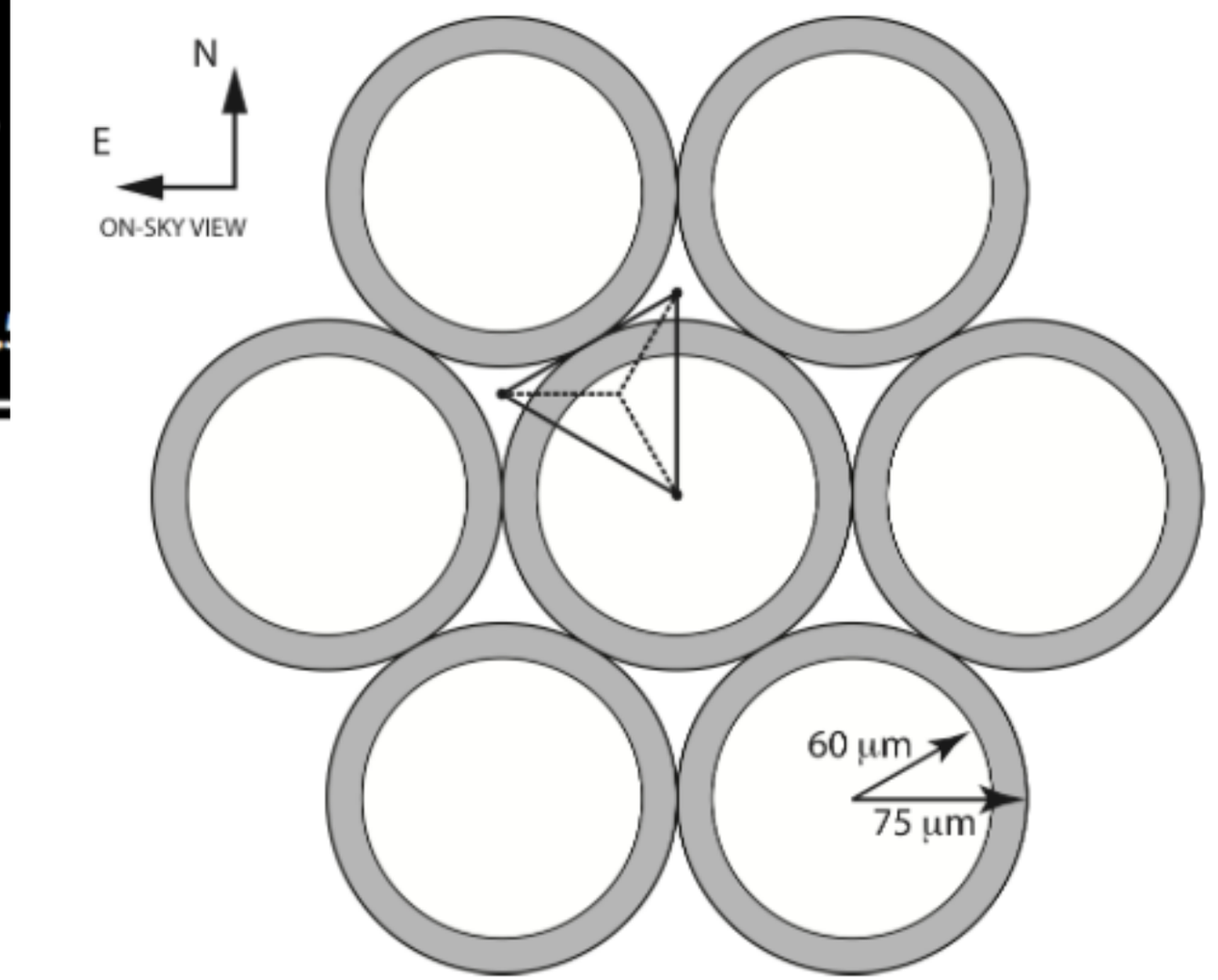


MaNGA overview

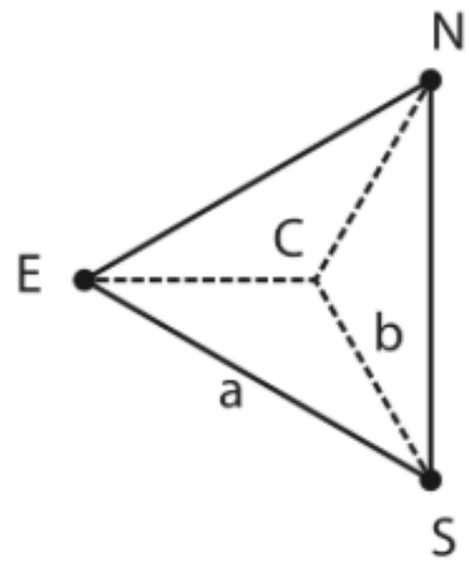
Dithering

MaNGA SAMI





Set: combination of N+S+E exposures

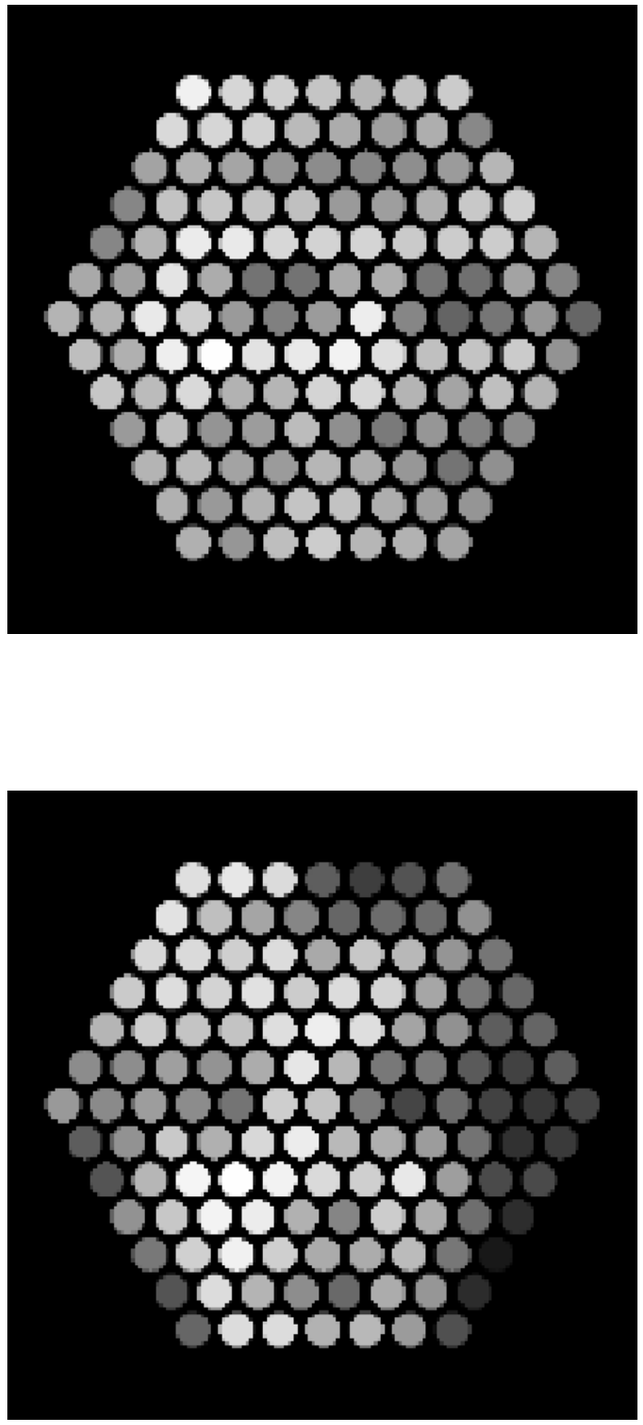


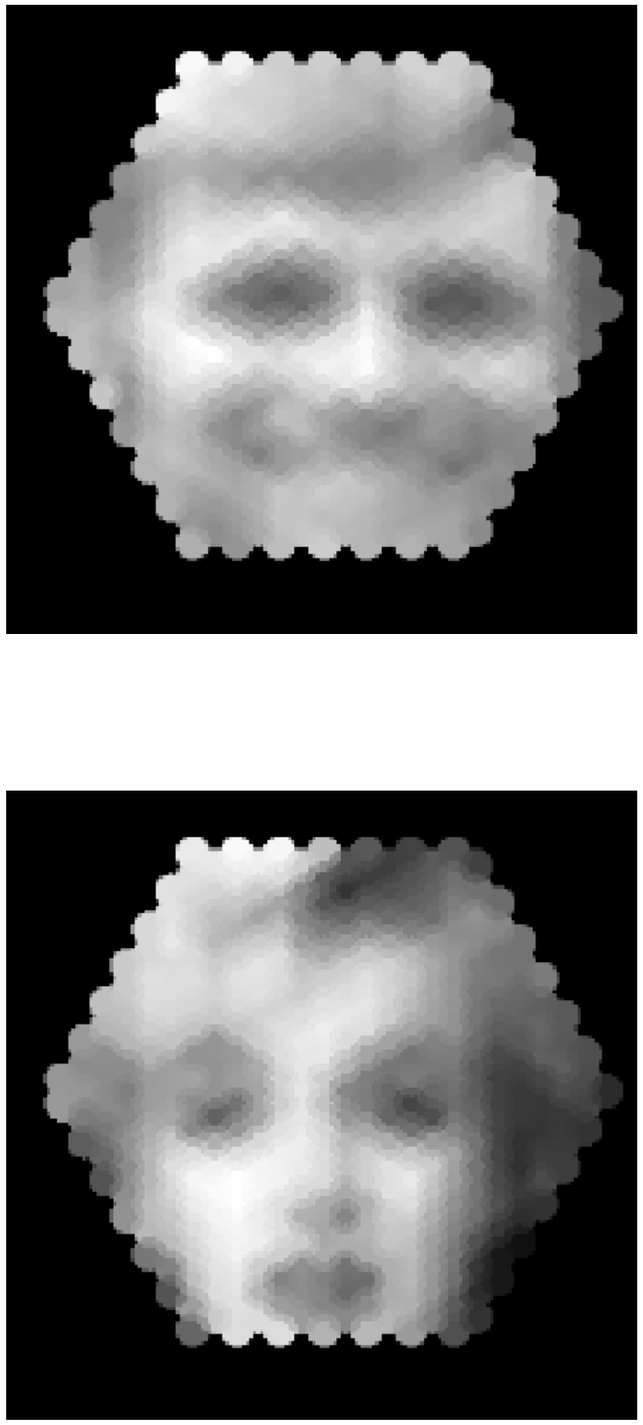
a = 86.6 μm = 1.44″
b = 50.0 μm = 0.83″

Law et al. (2015)

MaNGA overview

Dithering



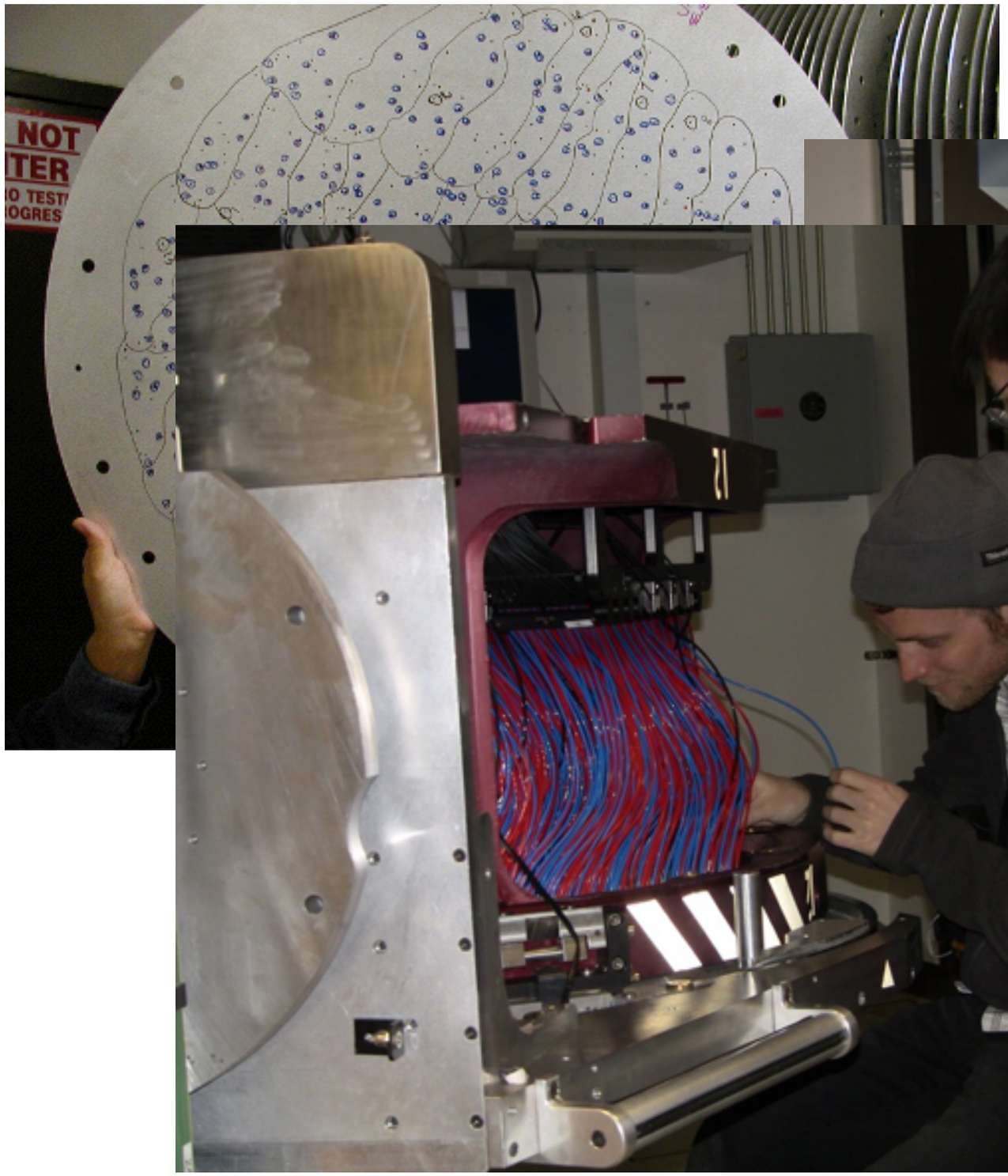


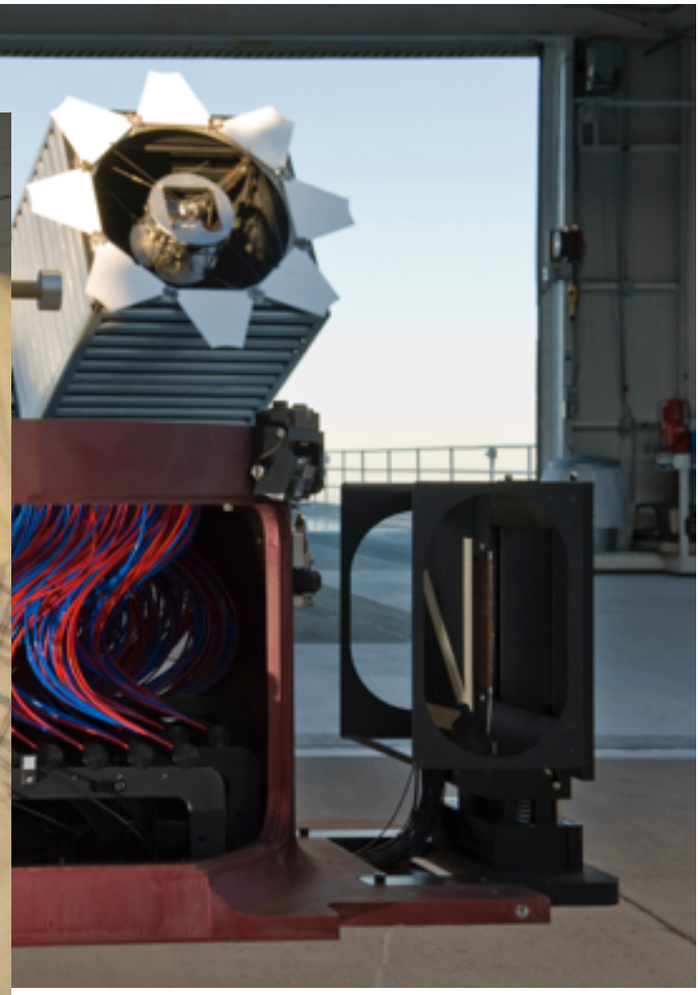
Kevin ≠ Marilyn

David R. Law
CDR May 2013

MaNGA overview

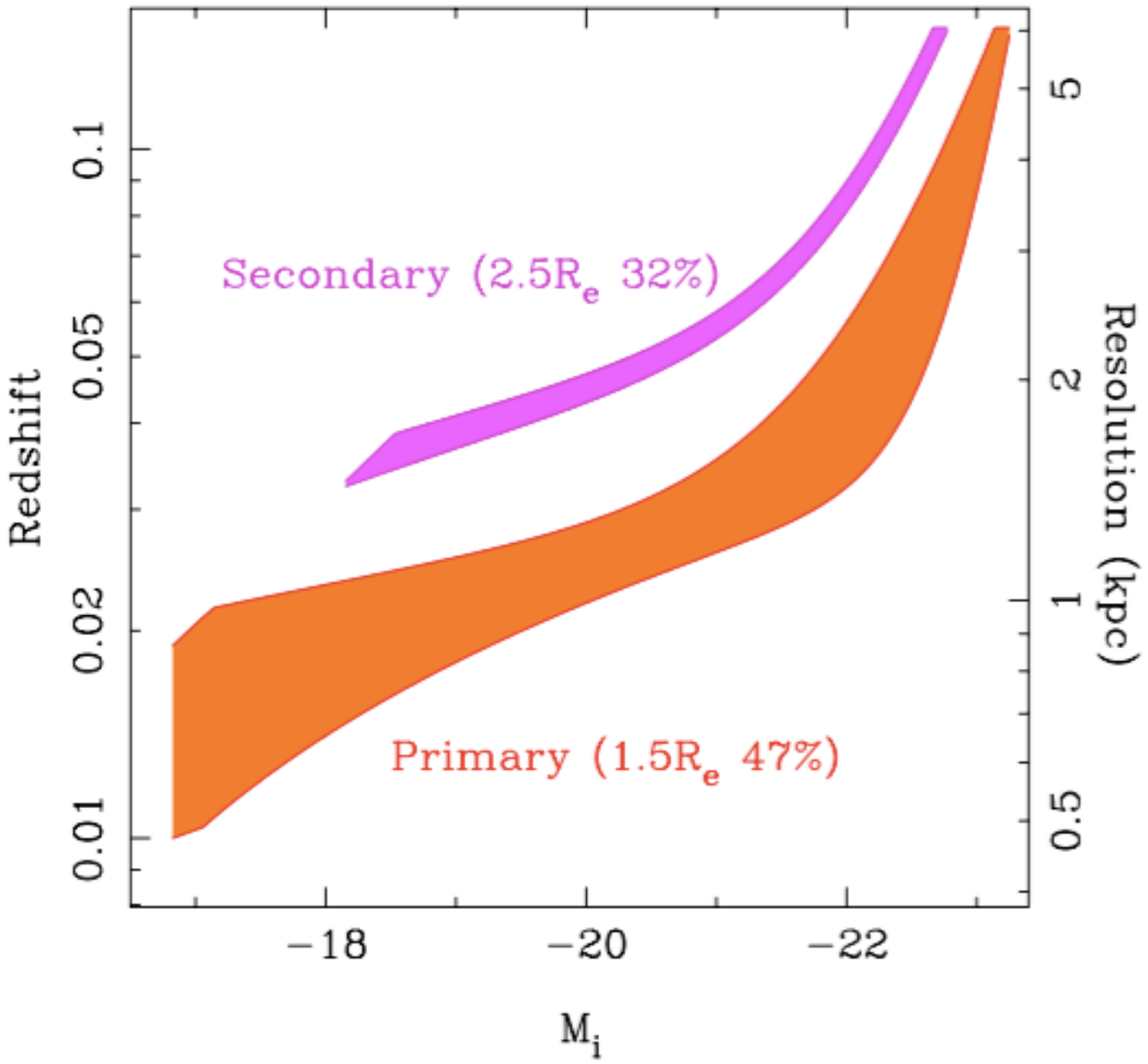
Hardware





MaNGA overview

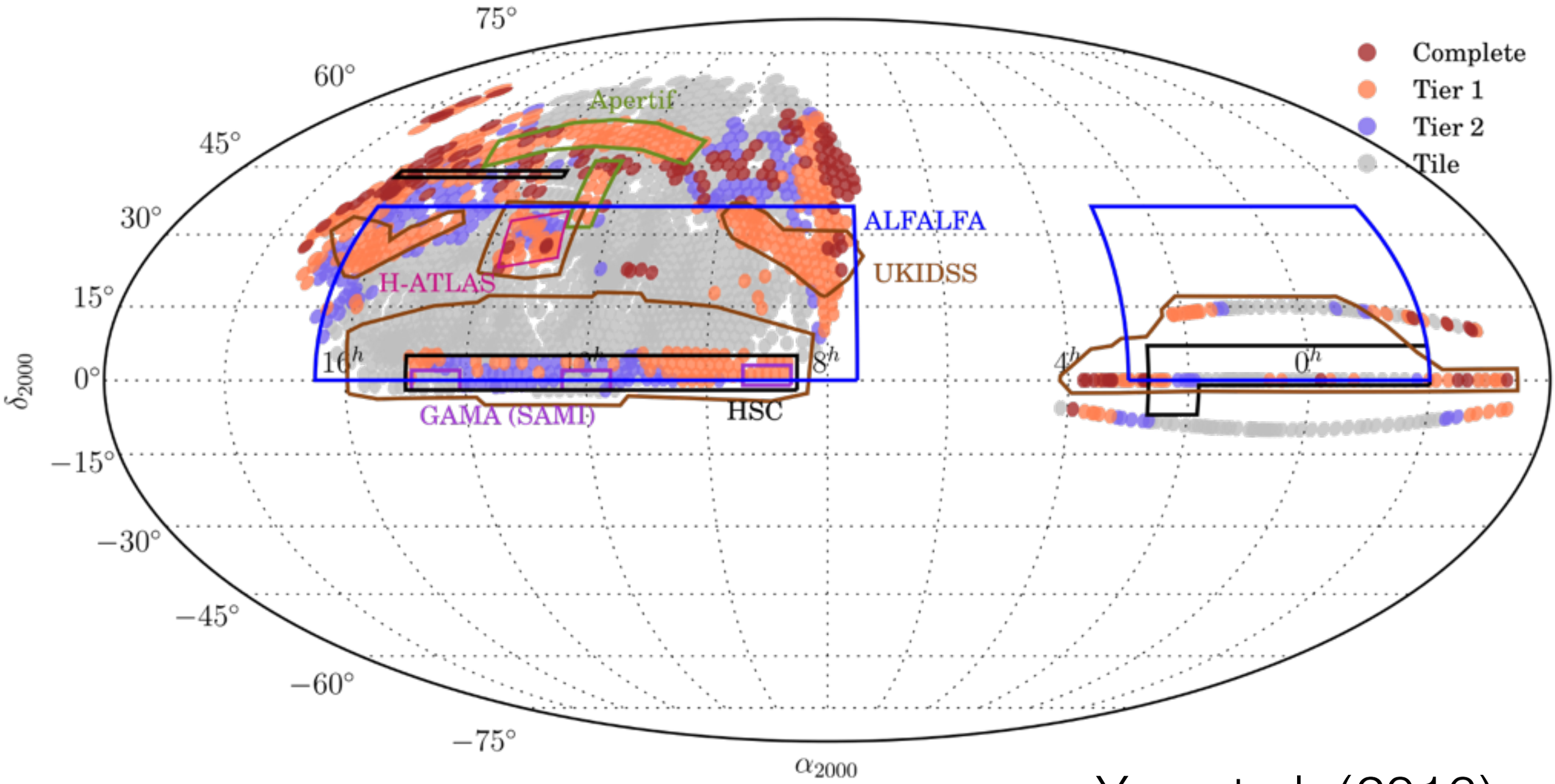
Sample design



- $M_* > 10^9 M_\odot$
- Two main subsamples at 1.5 and 2.5 Reff
- Flat distribution in M_*
- Based on NASA Sloan Atlas v1
- 5-10% bundles allocated to ancillary programs

MaNGA overview

Field selection

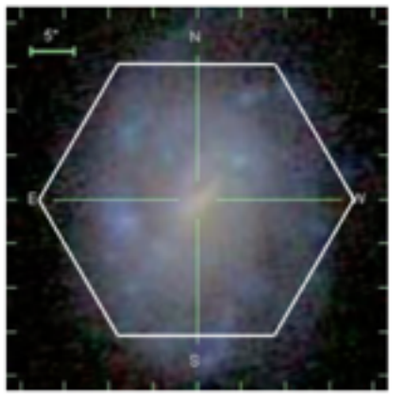


Yan et al. (2016)

Science

Early science results

p11-127A



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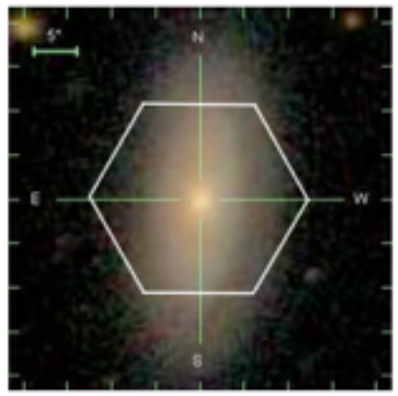

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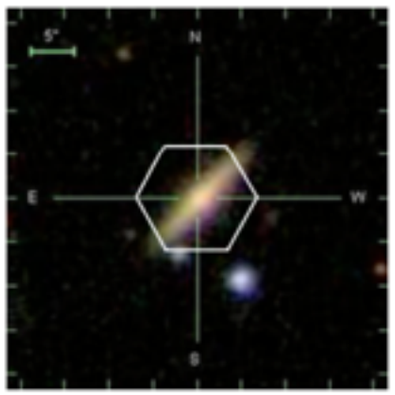

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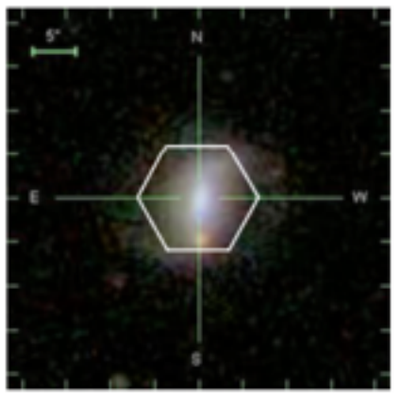

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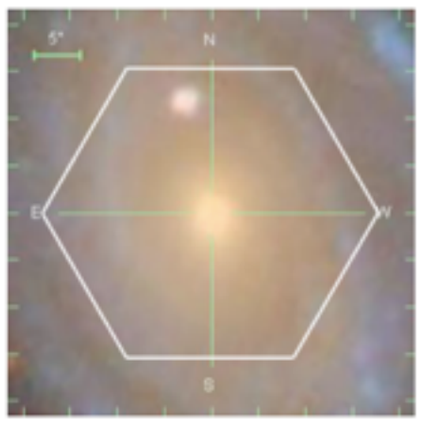

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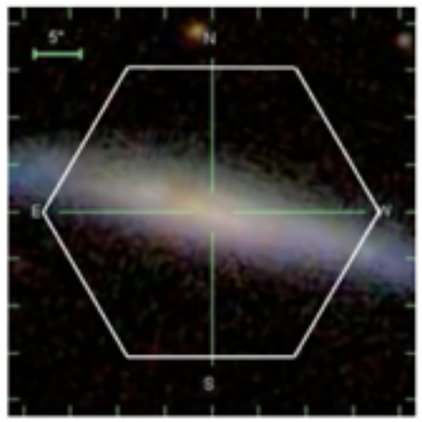

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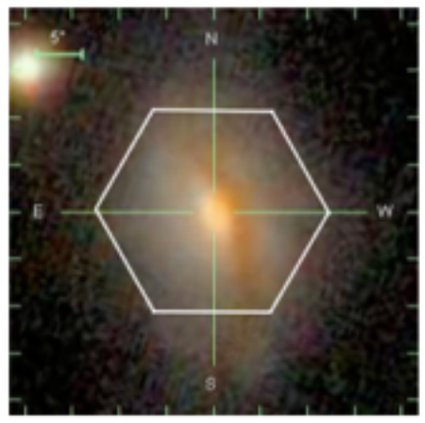

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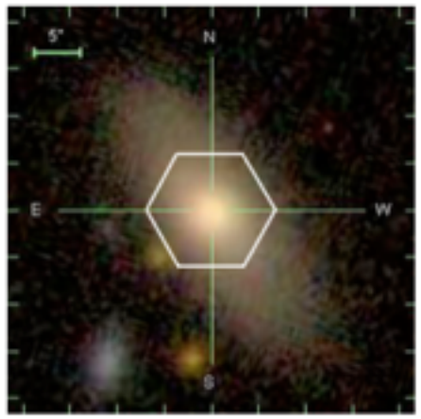

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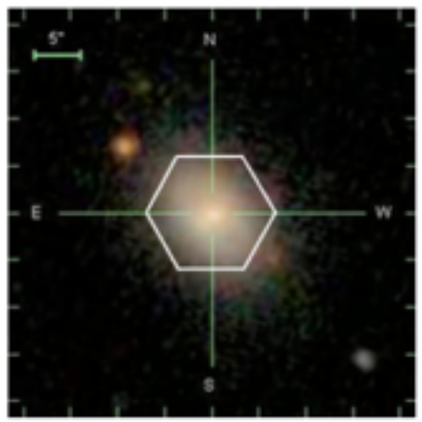

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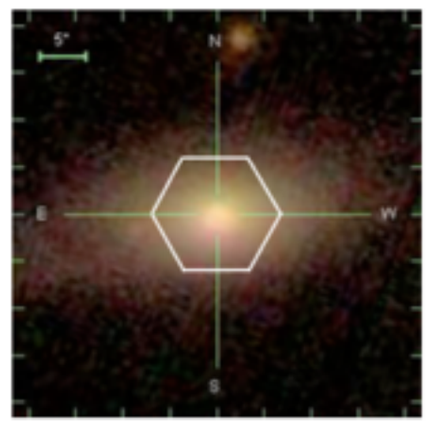

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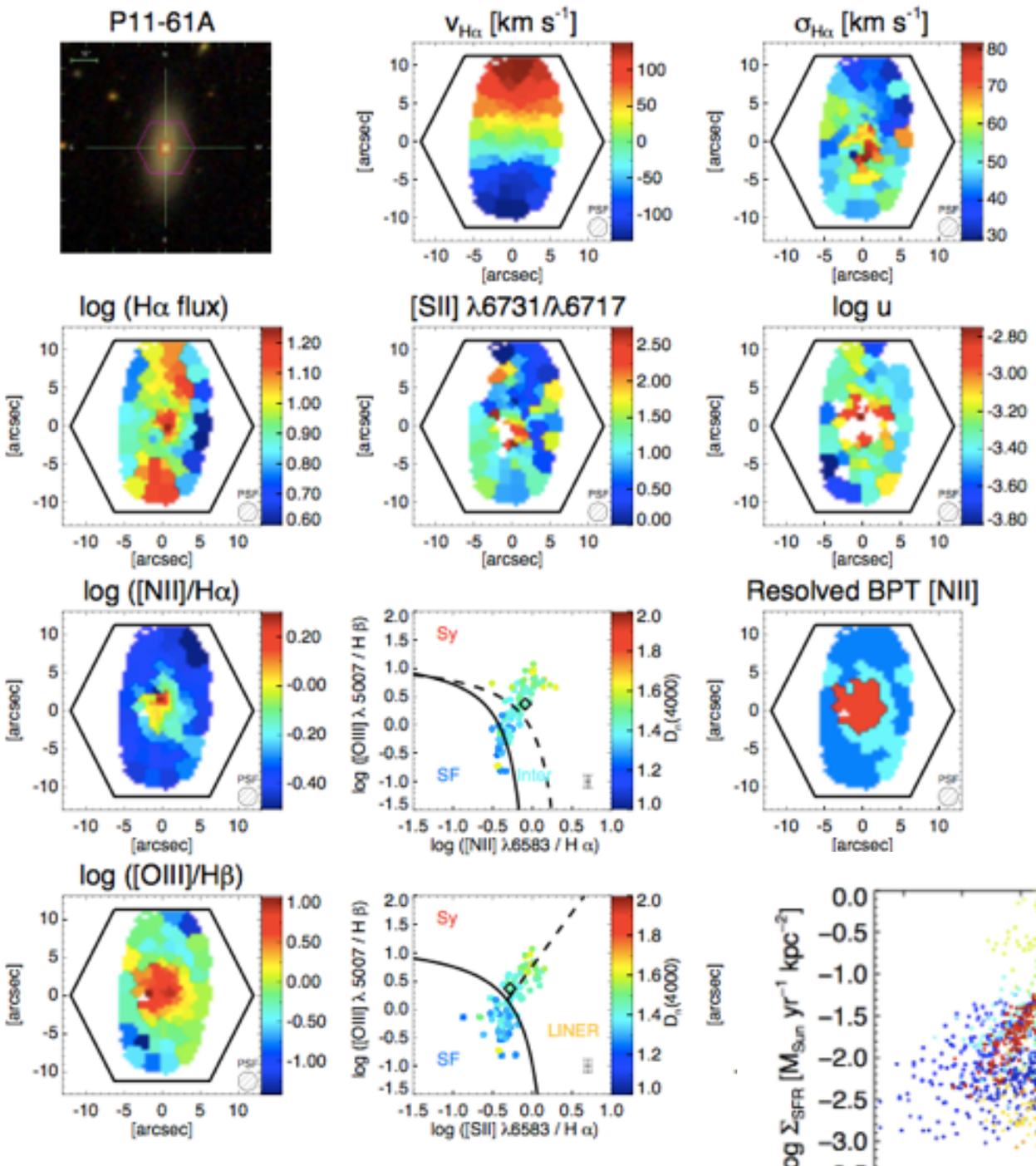
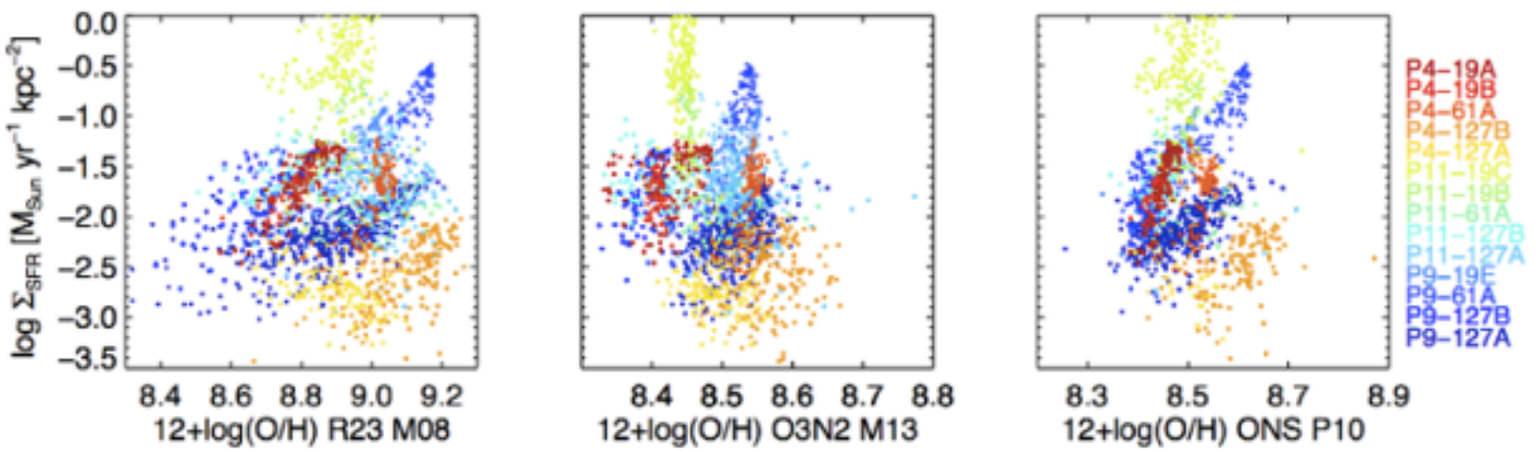
Science

Early science results: emission line diagnostics



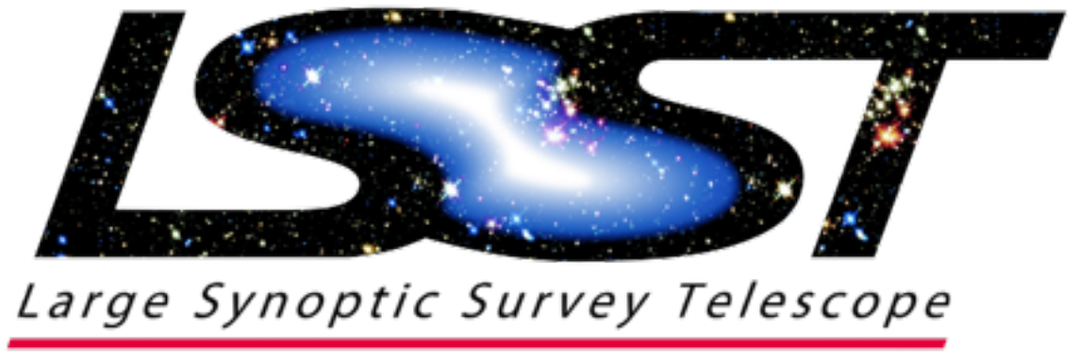
- Star formation in galaxies with central AGN-like emission
- SFR-metallicity correlation for low/intermediate-mass galaxies
- Inside-out growth picture



Belfiore et al. (2015)

Marvin Motivation

The Future: Survey Science Astronomy



- Homogeneous processing
- Statistically meaningful cross comparisons and population studies

Marvin Motivation

Limitations of Small Data Techniques

- Small data techniques: assume bandwidth and memory are not bottlenecks.
- At best inconvenient, at worst impossible.

Marvin Motivation

Limitations of Small Data Techniques

- Data access is bandwidth limited.
- Hampers exploration and reduces number of iterations.
- Results in simpler analyses that marginalize over interesting axes for logistical purposes.

- May not fit into RAM.
- Updated analyses multiply volume several fold.

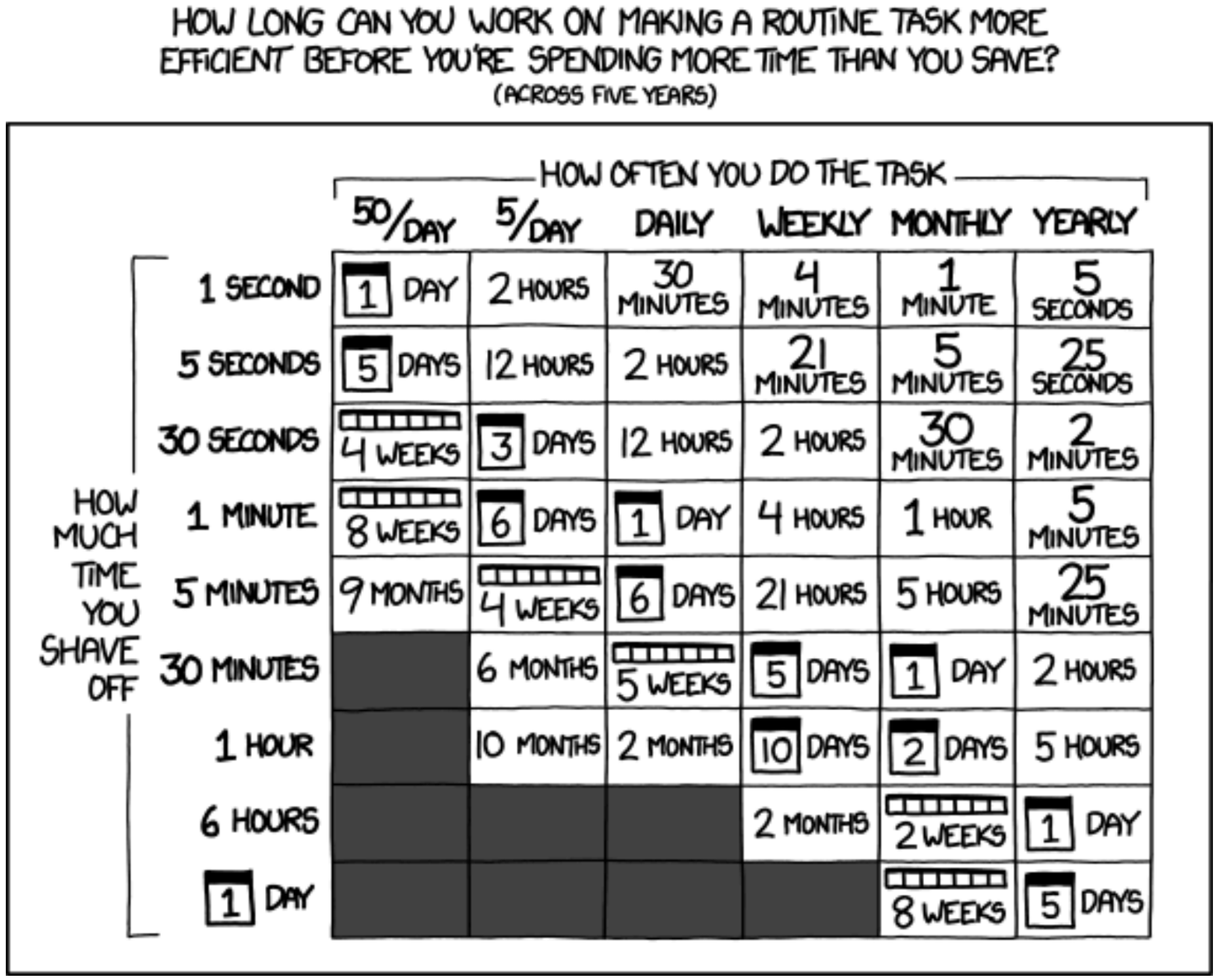
Marvin Motivation

Logistics

- Significantly more managing of datasets and formats.
- Large barrier to entry for new users
- Logistics not taught in grad school and technologies evolve rapidly.
- Not aware of or don't have time to learn big data techniques.

Marvin Motivation

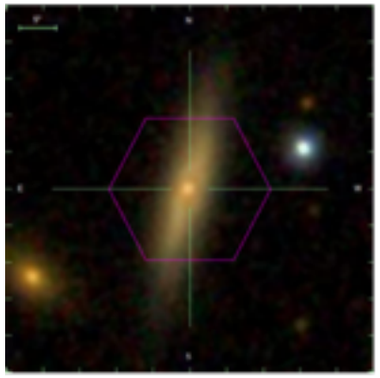
Logistics

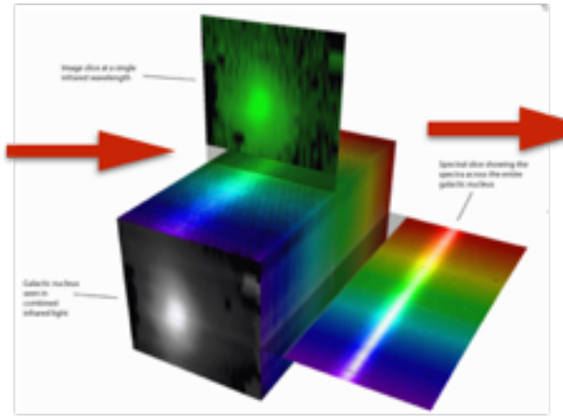


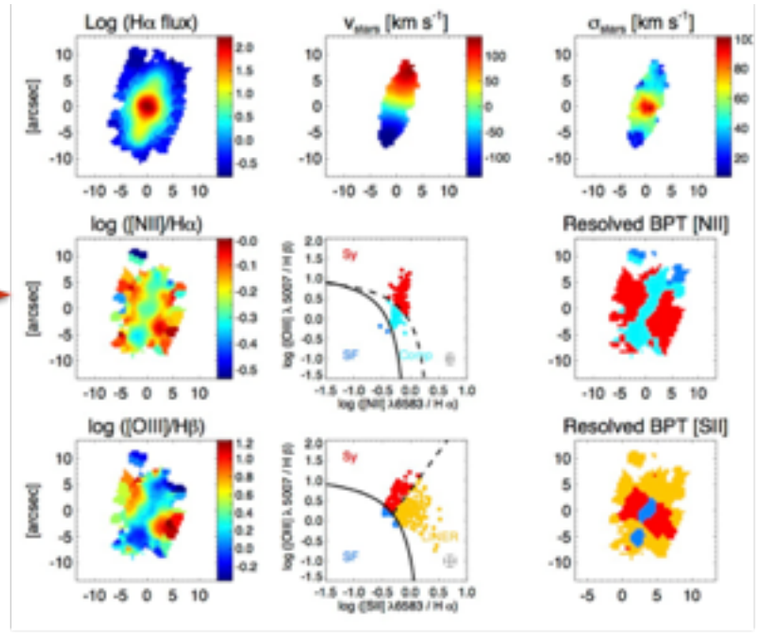
- Everyone has the same problems.
- Solve it once. Solve it right.

Manga Data

- Assuming 6 years of survey time

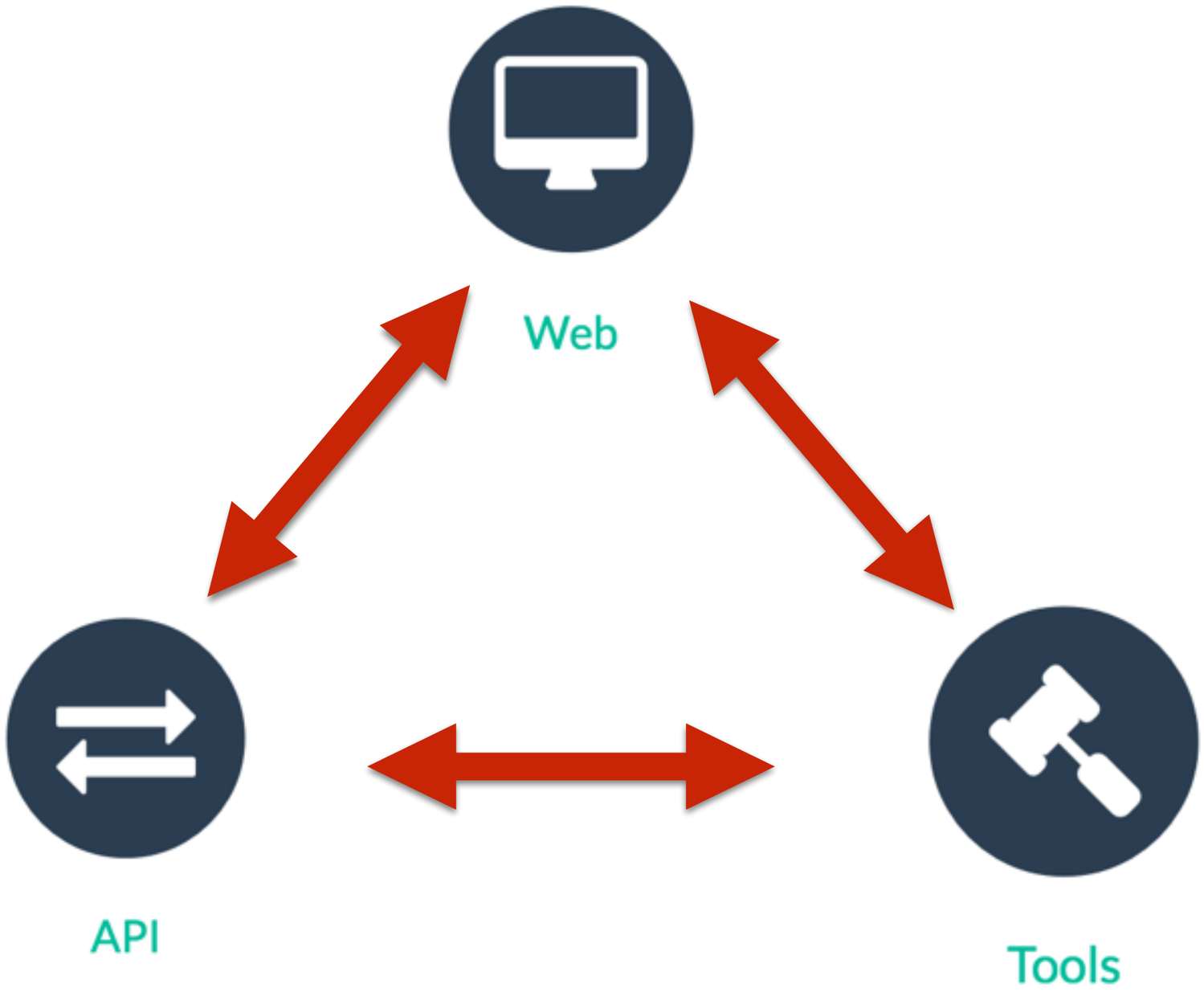






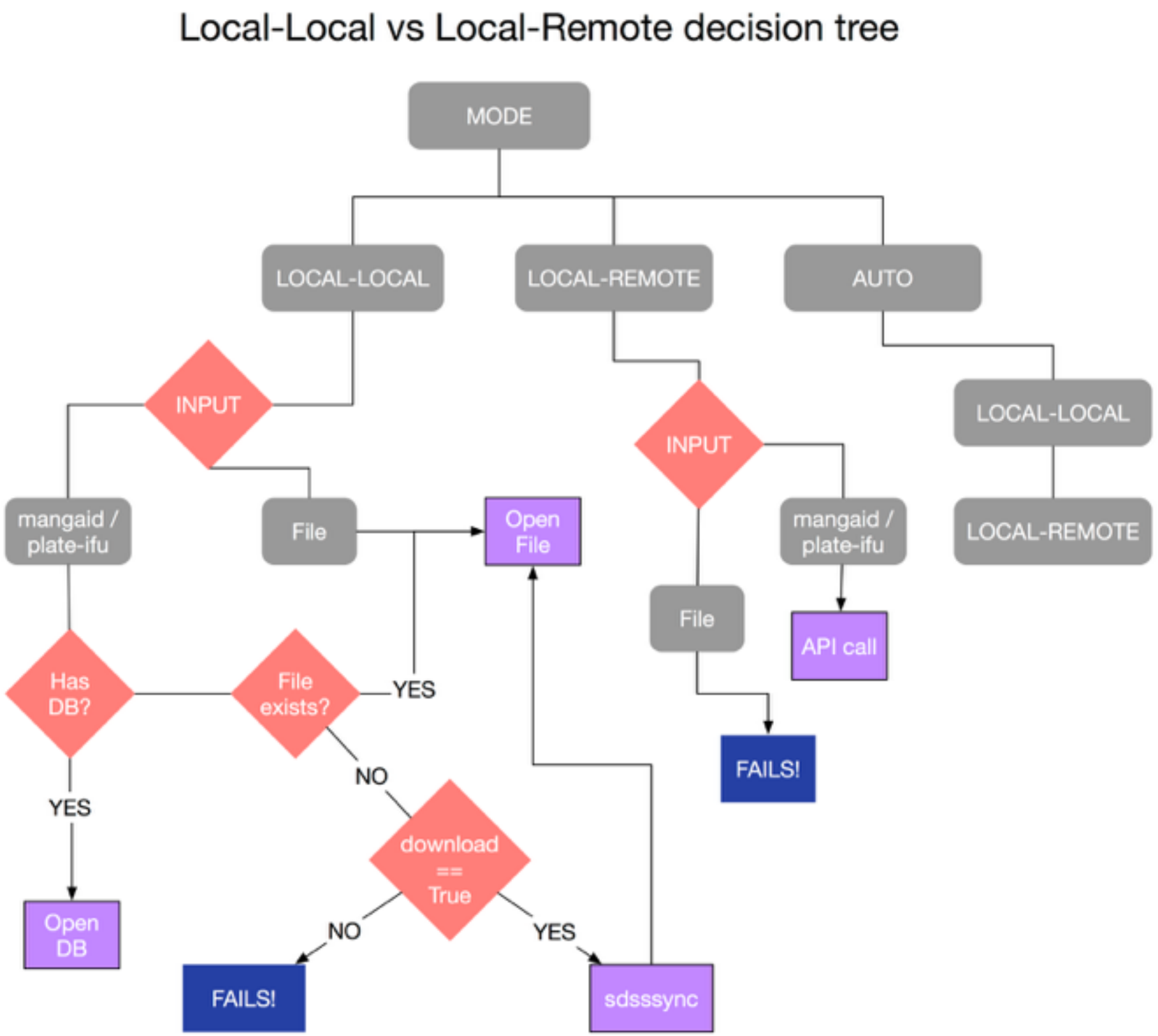
- ~10,000 galaxy cubes
- ~3,000 spaxels per cube
- ~100 measured properties + 10,000 spectral elements per spaxel
- ~300 billion total data elements

Marvin Ecosystem

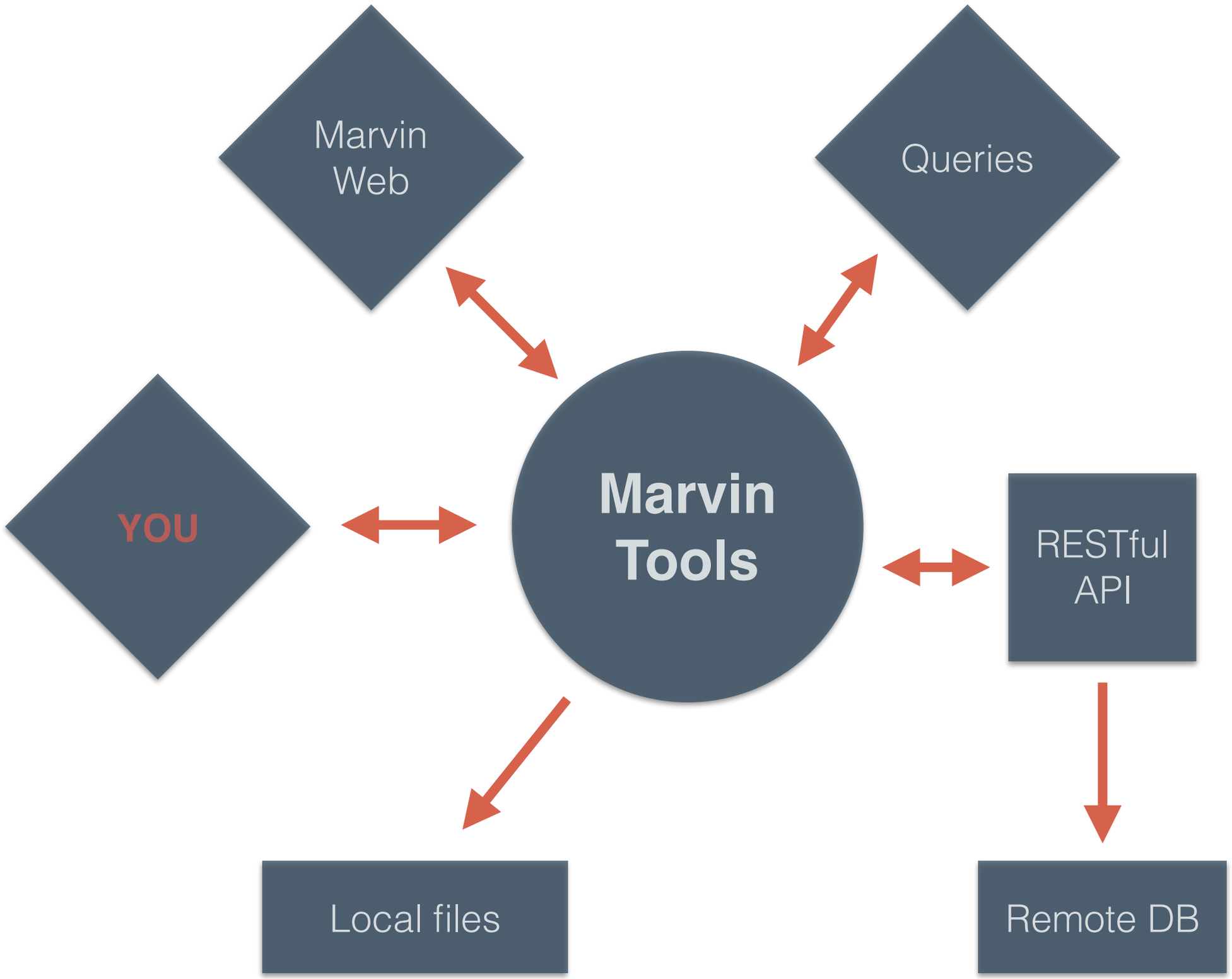


Core Idea : Smart Multi-Modal Data Access System

Decision Tree



Tools


Marvin
Web
Queries
YOU
Marvin
Tools
RESTful
API
Local files
Remote DB

Queries

- Backend database 

- Allows inter- / intra- galaxy searching
- Intuitive yet powerful query syntax
- Abstracts away the need to know SQL and database design

Web

- The Front-End for new users into MaNGA
- Warm, Streamlined, Intuitive, Accessible (like these bullets)
- Interactive Visual Exploration
- Uses the same Marvin Tools for robustness (or consistent failures)

Demo

- “Let’s do it live…”