The Sloan Digital Sky Survey - IV

Brazilian Collaboration

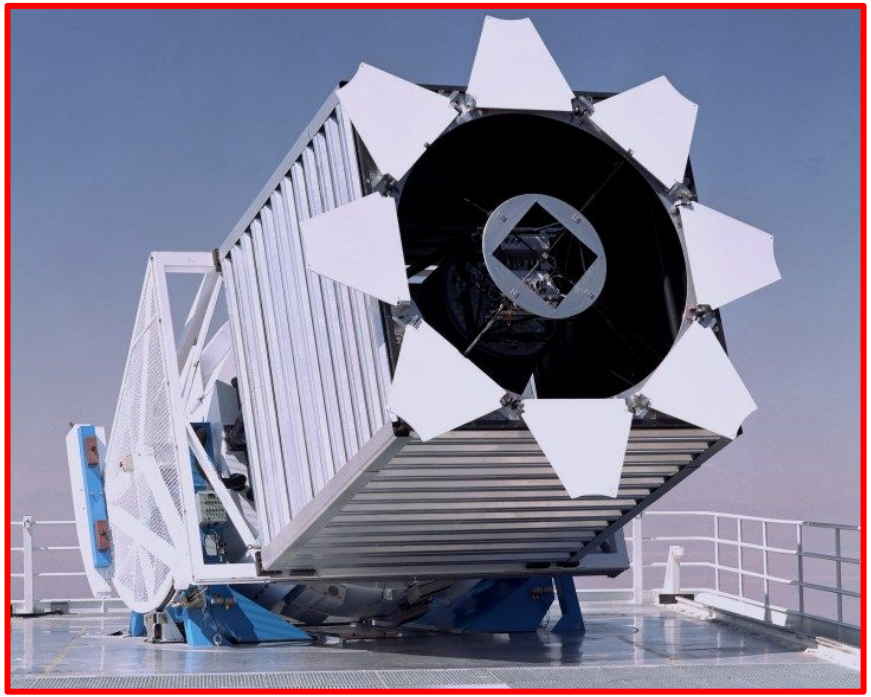
Jaderson Schimoia

This talk:

- What is the Sloan Digital Sky Survey - IV
  - eBOSS
  - APOGEE-2
  - **MaNGA**
- **Brazilian participation in the SDSS - IV**
- The scientific collaboration and current projects
- Current data release, DR 15

The Sloan Digital Sky Survey

- **Dedicated 2.5-m** telescope located at Apache Point Observatory
- Currently is running the **4th** generation of the survey … and **there will be a 5th one**
  - **SDSS-I/II – (2000 – 2008)**
  - **SDSS-III – (2008 – 2014)**
  - **SDSS-IV – (2014 – 2020)**
  - **eBoss, APOGEE-2, MaNGA**
  - **SDSS-V – (2020)**



Sloan Foundation 2.5-m Telescope at APO

Brazilian Team working with SDSS-IV data

Researchers:

- Basílio Santiago (UFRGS)
- Jaderson Schimoia (UFSM)
- Luiz Nicolaci da Costa (ON/LIneA)
- Márcio Maia (ON/LIneA)
- Rogemar Riffel (UFSM)
- Rogério Riffel (UFRGS)
- Sandro Rembold (UFSM)
- Thaisa Storchi-Bergmann (UFRGS)

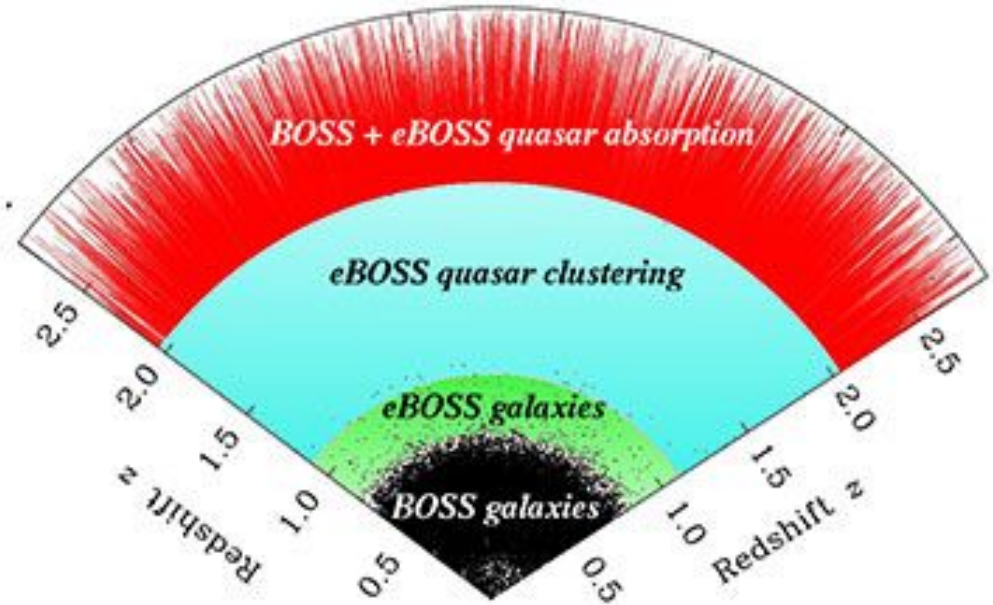
Students:

- Alice Machado (UFSM)
- Gabriele Ilha (UFSM)
- Janaína Nascimento (UFRGS)
- Nícolas Mallmann (UFRGS)
- Rafael Ciroline (UFSM)

The collaboration already produced **8 first author papers** and participated in many other papers in the SDSS collaboration.

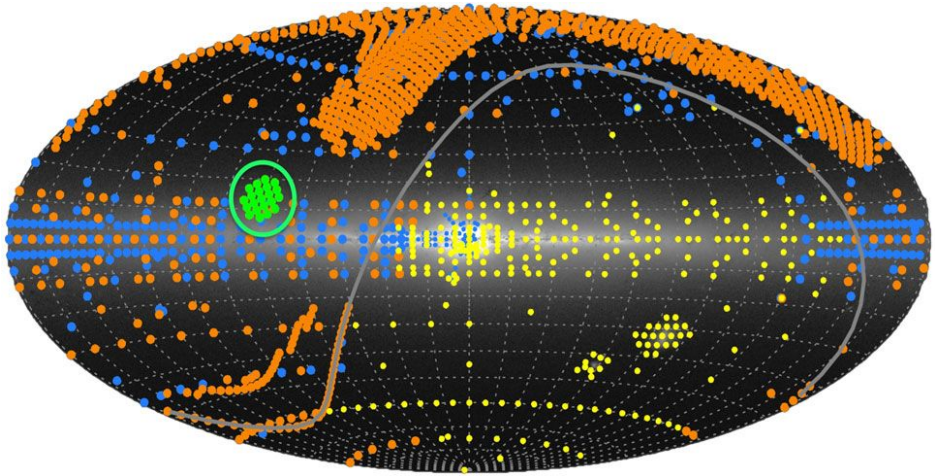
eBOSS : Extended Baryon Oscillation Spectroscopic Survey

- Focuses os spectroscopic observations of galaxies and Quasars up to redshift **z ~ 3 to study BAO**
- Wavelength: **360-1000 nm,** resolution R~2000
- 500,000 quasars over 6,000 square degrees, **0.8 < z < 3.5**
- Data can also be used to study **BL Quasar Variability → Catherine Grier** webinar → can be used to estimate the mass of the SMBH in Quasars



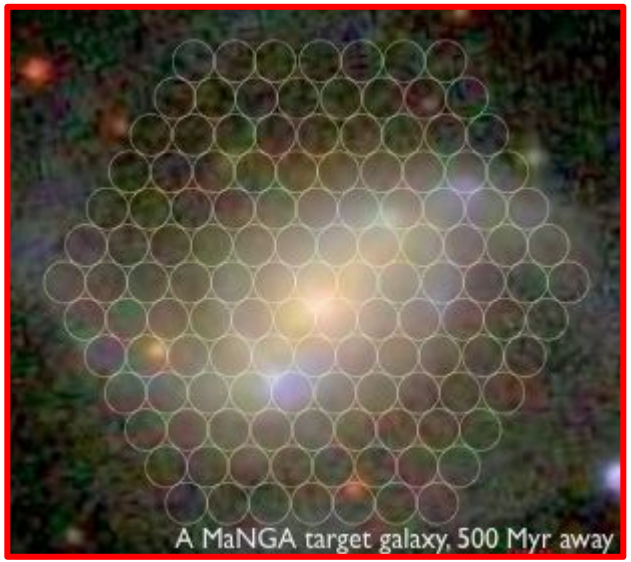
APOGEE-2 : APO Galaxy Evolution Experiment 2

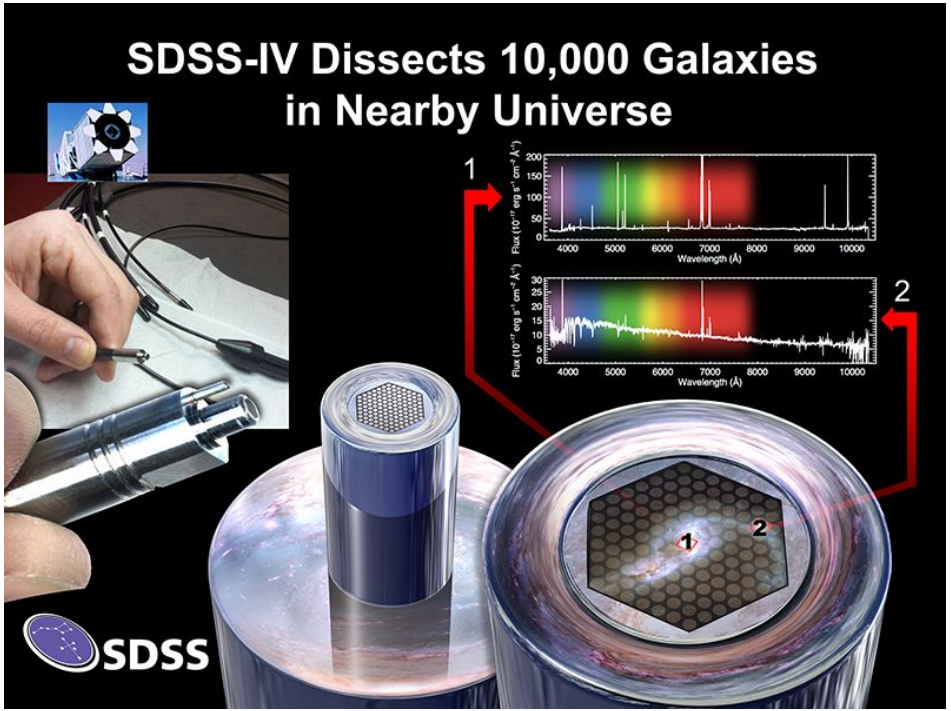
- Duration: Fall 2014 - Fall **2020**
- **Spectral Resolution: R~22,500**
- Wavelength Range: 1.51-1.70 μm
- **DR15 Sample Size: ~263,000 stars**
- **Basílio Santiago+2016, Barbara Queiroz+2018 → StarHorse code to estimate distance, ages, extinction of field stars in the Milky Way**



Mapping **N**earby **Ga**laxies at Apache Point observatory (MaNGA)

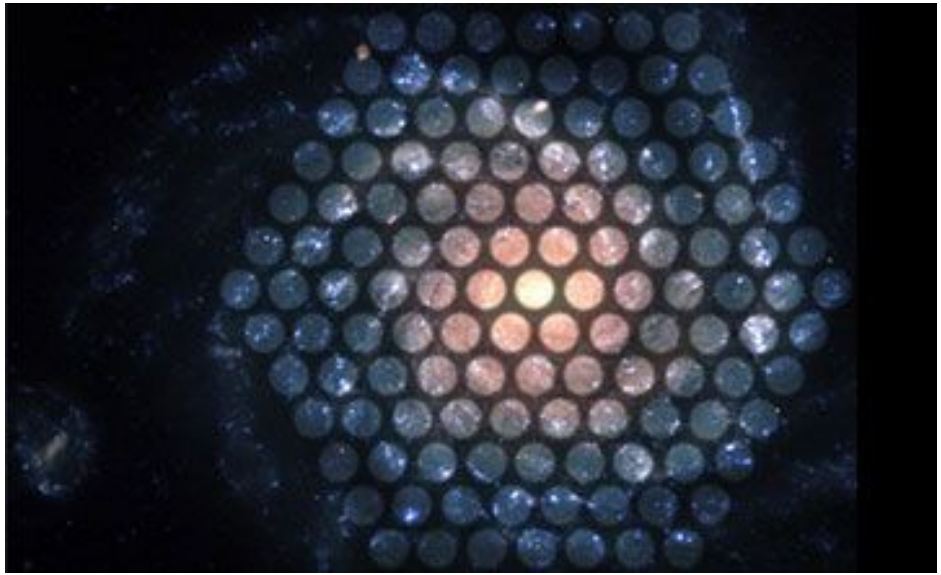
Integral Field Spectroscopy (IFS) is a very powerful way to study spatially resolved properties of galaxies!



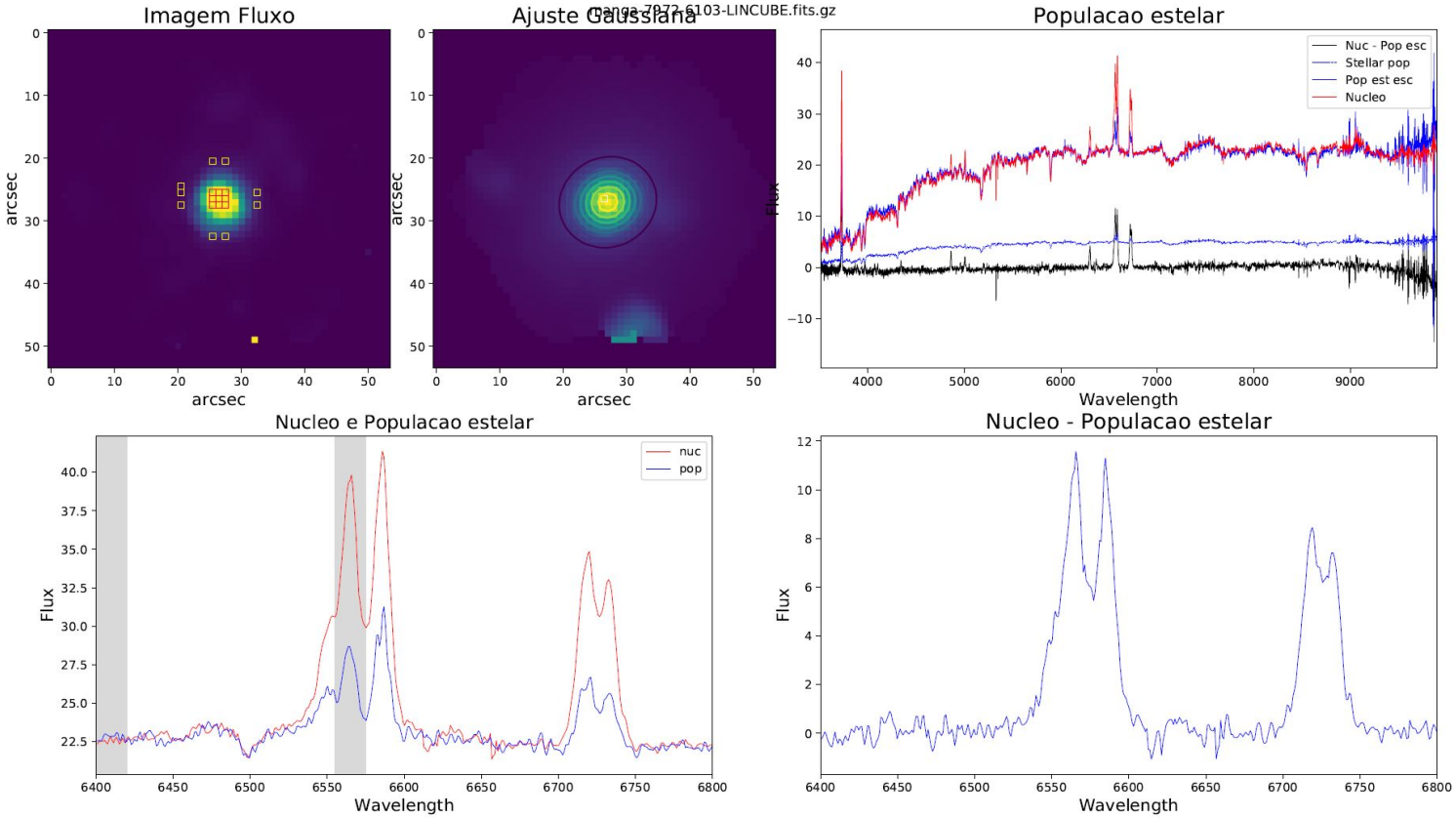


MaNGA - Technical Details

- Fall 2014 - **Spring 2020**
- 17 IFUs per 7 deg^2 plate
- Wavelength: **360-1000 nm**, resolution R~2000
- **10,000** galaxies across, redshift **z~0.03**
- Spatial sampling of **1-2 kpc**
- Per-fiber S/N=4-8 (per angstrom) at **1.5 Re**



This is how MaNGA data looks like!



DR 15 in a few numbers:

TABLE 1
REDUCED SDSS-IV SPECTROSCOPIC DATA IN DR15

Target Category	# DR13	# DR13+14	# DR13+14+15
eBOSS			
LRG samples	32968	138777	138777
ELG Pilot Survey	14459	35094	35094
Main QSO Sample	33928	188277	188277
Variability Selected QSOs	22756	87270	87270
Other QSO samples	24840	43502	43502
TDSS Targets	17927	57675	57675
SPIDERS Targets	3133	16394	16394
Standard Stars/White Dwarfs	53584	63880	63880
APOGEE-2			
All Stars	164562	263444	263444
NMSU 1-meter stars	894	1018	1018
Telluric stars	17293	27127	27127
APOGEE-N Commissioning stars	11917	12194	12194
MaNGA Cubes	1390	2812	4824
MaNGA main galaxy sample:			
PRIMARY_v1_2	600	1278	2126
SECONDARY_v1_2	473	947	1665
COLOR-ENHANCED_v1_2	216	447	710
MaStar (MaNGA Stellar Library)	0	0	3326
Other MaNGA ancillary targets[1]	31	121	324

[1] Many MaNGA ancillary targets were also observed as part of the main galaxy sample, and are counted twice in this table; some ancillary targets are not galaxies.

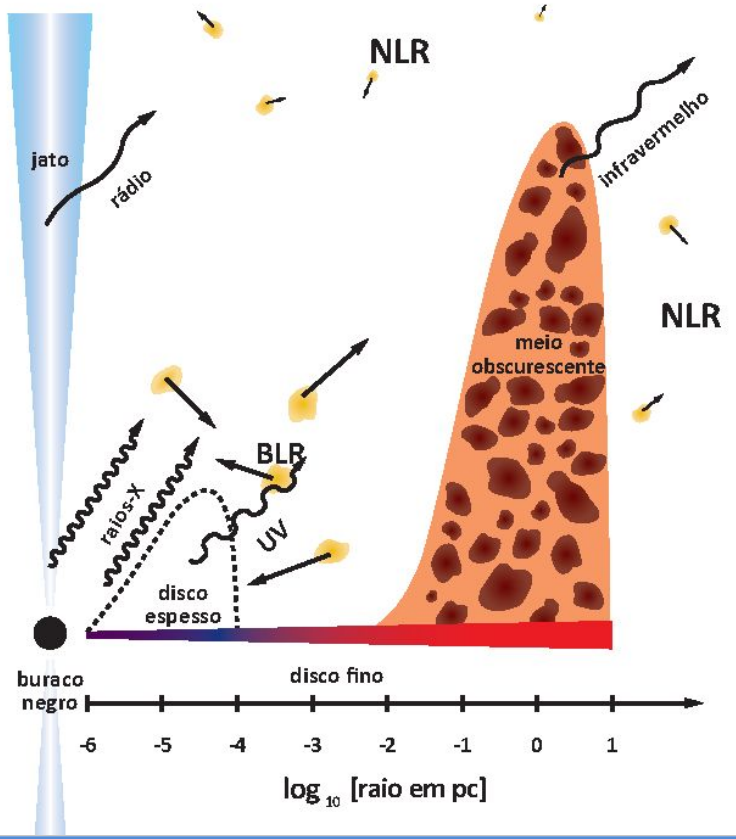
The SDSS data release papers are very informative and detailed!

There will be 10,000 in 2020!!

DR 16 is coming soon, December 2019

Active Galactic Nucleus (AGN)

NGC 1097



Motivation

- The AGN feedback is thought as the main physical mechanism responsible for regulating the stellar mass growth in the high redshift galaxies. The feedback heats or expels the gas from the galaxies quenching the star formation

- There are many evidences of AGN feedback in nearby galaxies, although the impact of the nuclear activity in the properties of the host galaxies is still not completely understood

- **Comparing the spatially resolved properties of active and inactive galaxies we aim at the long-term goal of understanding the impact of AGNs on their host galaxies**

The first 62 AGN observed with MaNGA

(Rembold, S., Schimoia, J, et al, 2015)

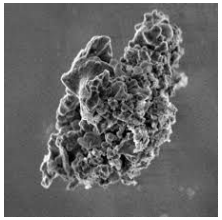
- AGN selected via nuclear emission and diagnostic diagrams (BPT, WHAN)
- For each AGN we paired 2 non active control galaxies: **estelar mass**, **morphology**, **distance**, **inclination** and **mag r**

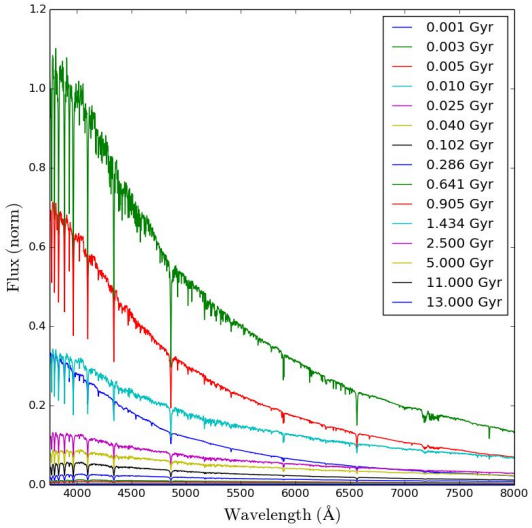
AGN

Control 1

Control 1

Stellar Population Synthesis: *Starlight_v05* (Cid Fernandes+2005)

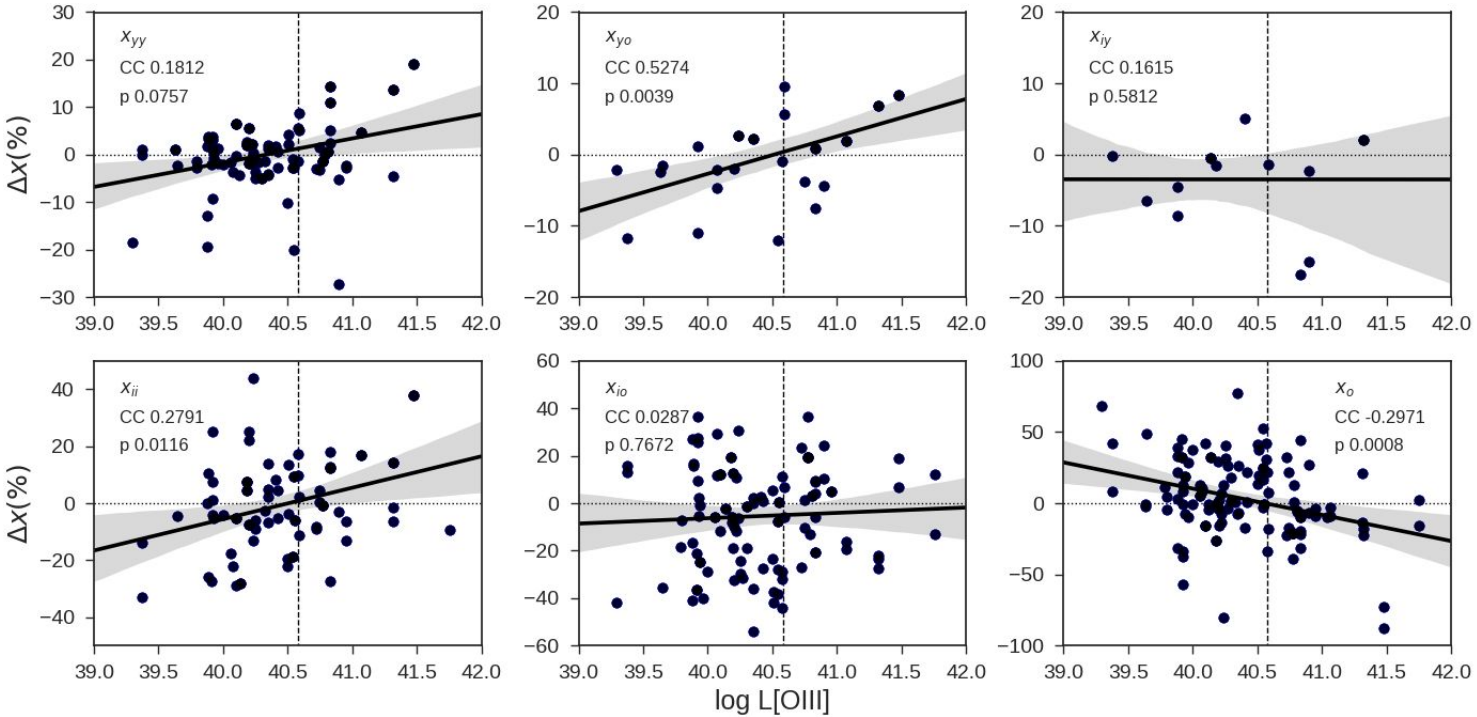
(Xyy  + Xo ) * Av  = 



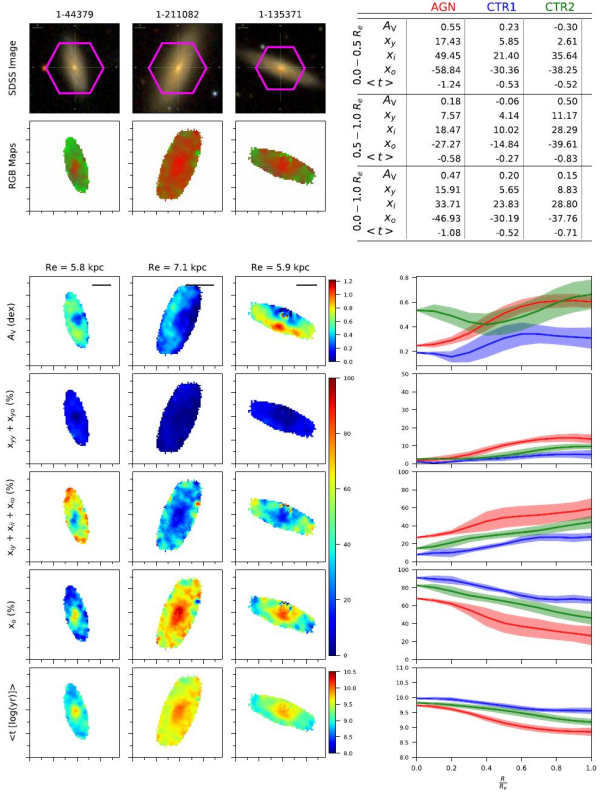
Nuclear stellar population of the the first 62 AGN observed with MaNGA

(Rembold, S., Schimoia, J, et al, 2015)

The nuclear stellar population properties vary with the AGN luminosity!!



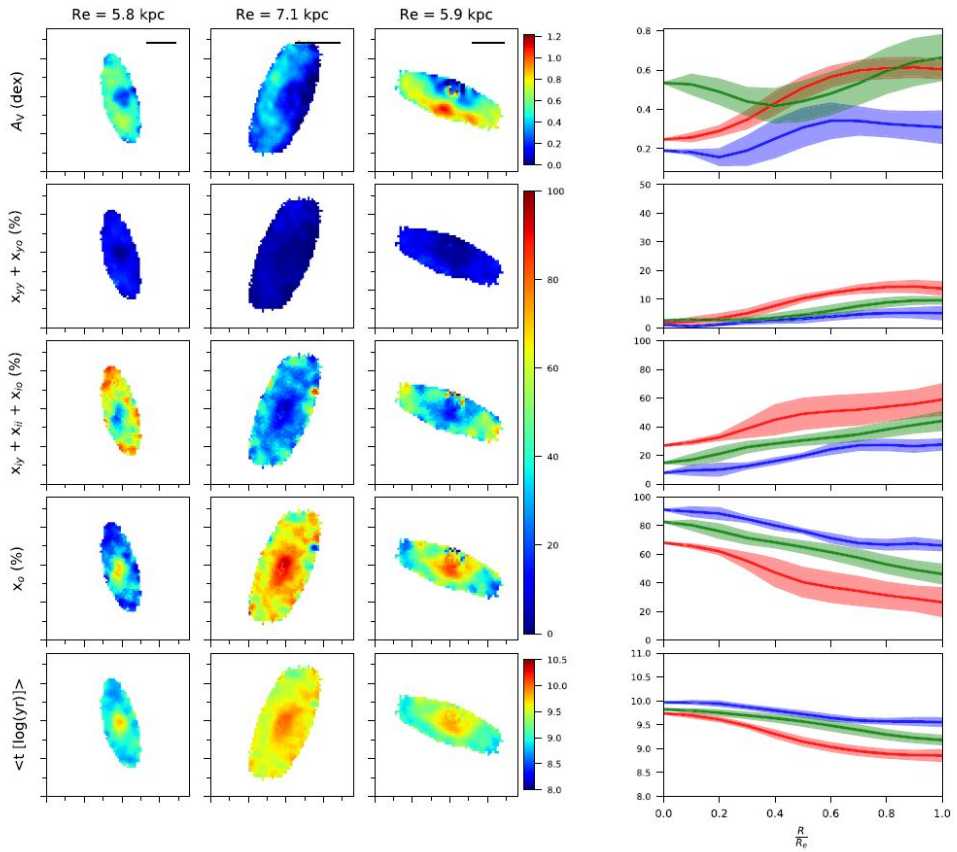
Spatially resolved stellar populations (Mallmann, Rogério Riffel + 2018)



		AGN	CTR1	CTR2
$0.0-0.5\ R_e$	A_V	0.55	0.23	-0.30
	x_y	17.43	5.85	2.61
	x_i	49.45	21.40	35.64
	x_o	-58.84	-30.36	-38.25
	$<t>$	-1.24	-0.53	-0.52
$0.5-1.0\ R_e$	A_V	0.18	-0.06	0.50
	x_y	7.57	4.14	11.17
	x_i	18.47	10.02	28.29
	x_o	-27.27	-14.84	-39.61
	$<t>$	-0.58	-0.27	-0.83
$0.0-1.0\ R_e$	A_V	0.47	0.20	0.15
	x_y	15.91	5.65	8.83
	x_i	33.71	23.83	28.80
	x_o	-46.93	-30.19	-37.76
	$<t>$	-1.08	-0.52	-0.71

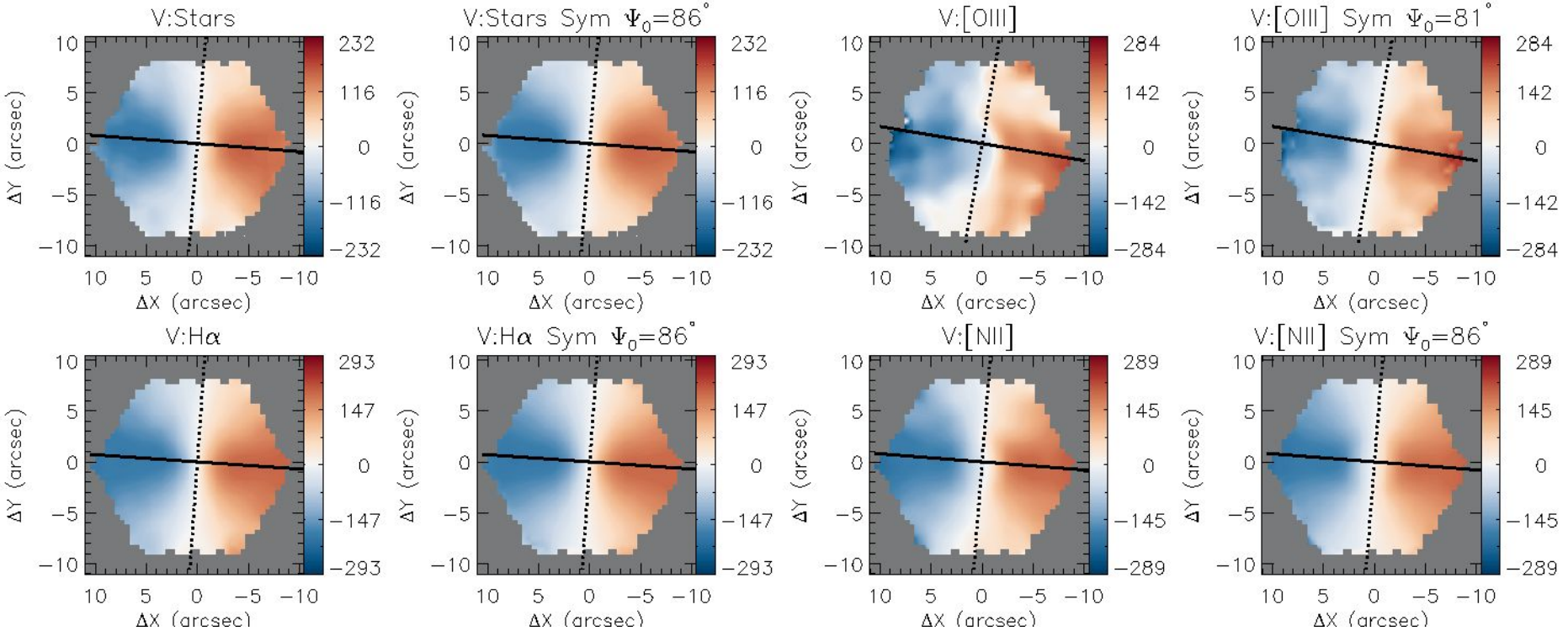
- Código MEGACUBE: Nícolas, Rogério, Jaderson
  - Extract individual spectra from MaNGA datacube
  - Runs stellar population in all spaxels (S/N>10)
  - Stores the stellar population vectors back into the original data cube as new fits extension
  - Calculates gradients of spatially resolved properties

Spatially resolved stellar populations (Mallmann, Rogério Riffel + 2018)



- The **most luminous AGN** seems to have been triggered by a recent supply of gas that has also triggered recent star formation (t ≤40 Myr) in their central regions.
- For low luminosity AGN the radial distribution of stellar population is very similar.

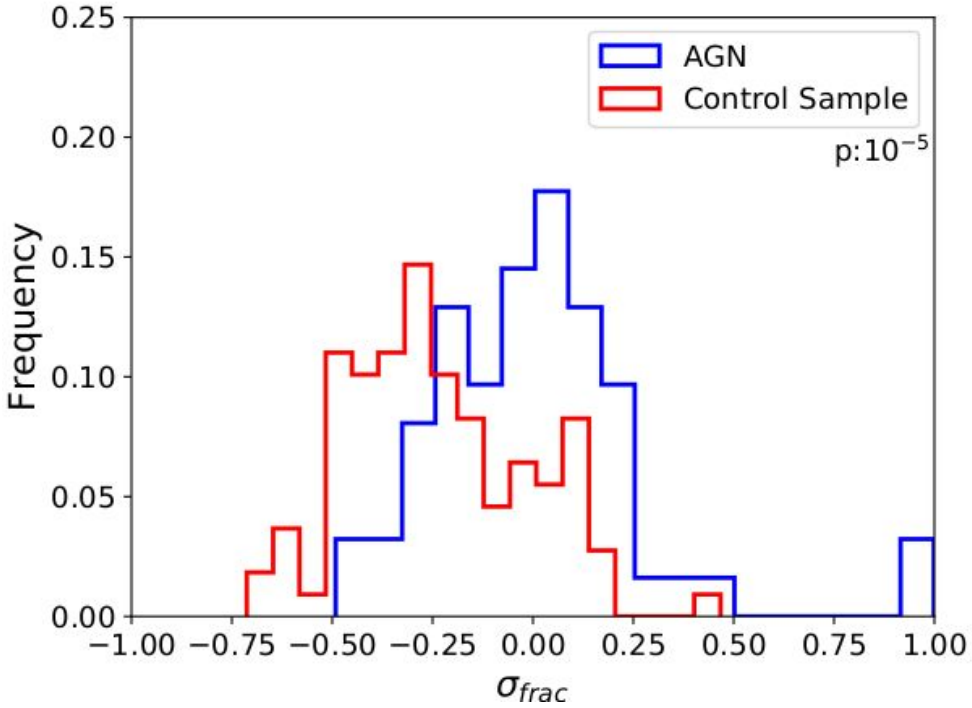
Gas and stellar kinematics: Gabriele Ilha, Rogemar Riffel+2019



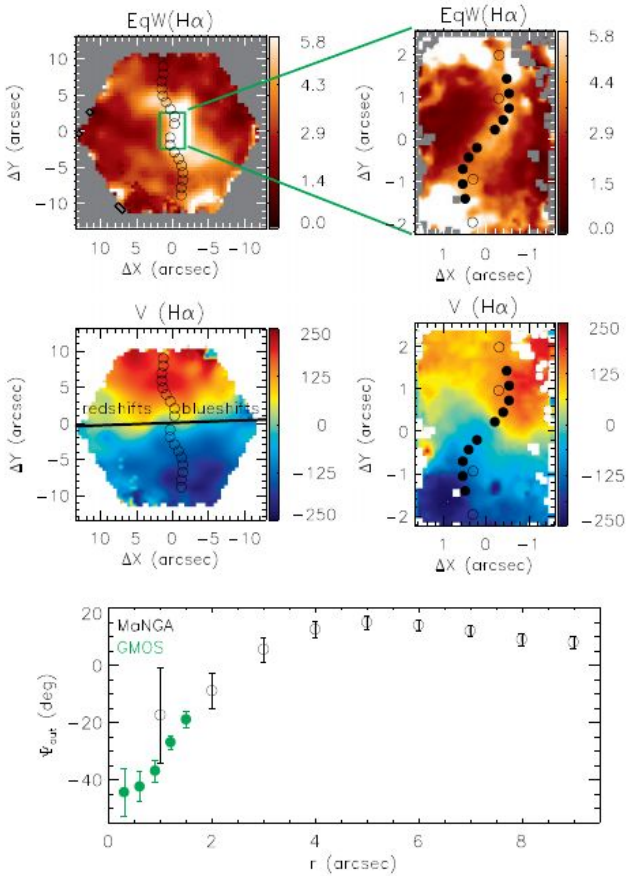
Gabriele Ilha, Rogemar Riffel+2019

- There is no difference in the large scale kinematics of the stars and gas between AGN and Control galaxies.

- The inner 2 arcsec present a higher **sigma_frac** parameter for AGN host galaxies → The presence of the AGN can disturb the gas kinematics in the central region → broader narrow emission lines



Red Geysers and spectroscopic follow ups (Rogemar Riffel+2019)



- Galaxies without recent star formation
- Present biconical pattern for EWHalpha
- Large scale outflows!!.

A scenario to explain the observations: A powerful AGN wiped out the gas from the galaxy an quenched star formation.

Follow up with Gemini telescope to study the innermost region < 1kpc. The orientation angle of the outflow from small to large scale is consistent with the scenario of precessing accretion disk and an AGN feedback affecting the entire galaxy

Currently we are working with MPL-8

AGN : 62 → **173**
CS: 124 → **340**
Unique CS 109 → **296**

We kept the same methodology: control galaxies are paired by, distance, stellar mass, inclination and mag r.

Updating MEGACUBE to include emission line measurements (testing IFSCUBE, free code from Daniel Ruschel - UFSC)

… other ongoing projects.

- Alice (UFSM) in prep
- Rafael (UFSM) → systematic search for BL AGN in MaNGA/SDSS data
- Gabriele Ilha (UFSM)→ spectroscopic follow up of the innermost region of Red Geysers
- ...+ new analysis with larger AGN and control samples

MaNGA collaboration meetings happen on Mondays at 10am via Zoom.

Some final highlights!

Please, access/explore DR15 data and get involved!

If you want some help with MaNGA data, please, send me an e-mail: **jaderson@linea.gov.br**

Many works are developed by students!

I hope this presentation was useful for you!