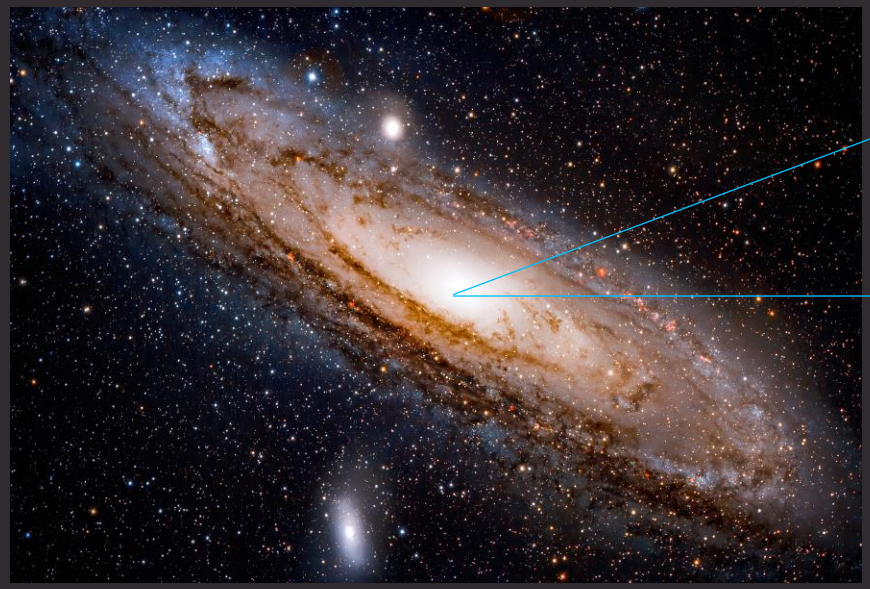
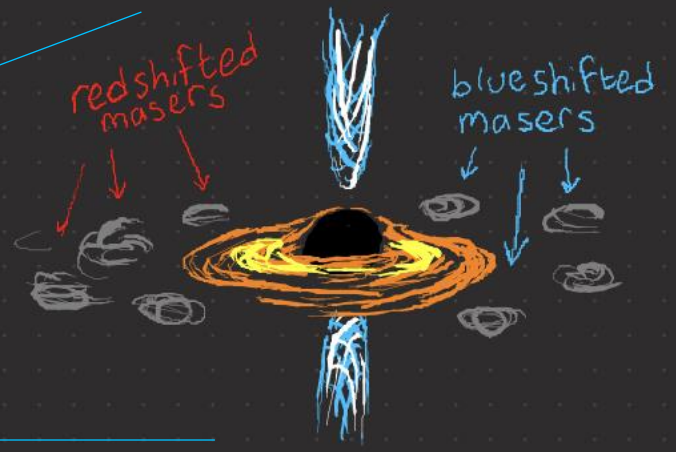
Probing the AGN Nature of Maser Galaxy Hosts



From Dayag 2019

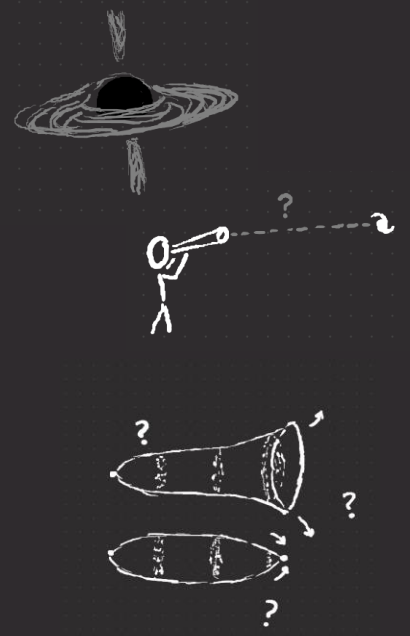


Gaudeor Rudmin
Dr. Anca Constantin
James Madison University
Summer 2023

Why do we care about Maser Emission?

- How massive are supermassive black holes?
- How far away are other galaxies?

- How do we refine cosmological models?
- What is the fate of the universe?

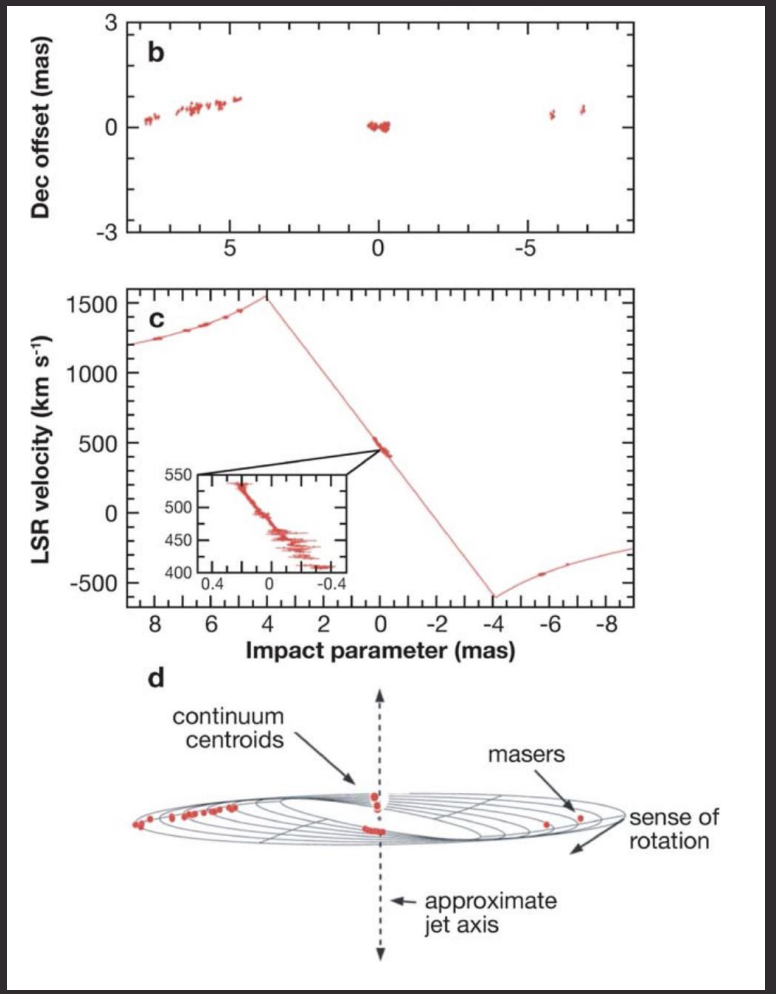


Geometric Measurement via
Newtonian Physics

Masers are extremely rare:

< 3.6% of surveyed galaxies are masers

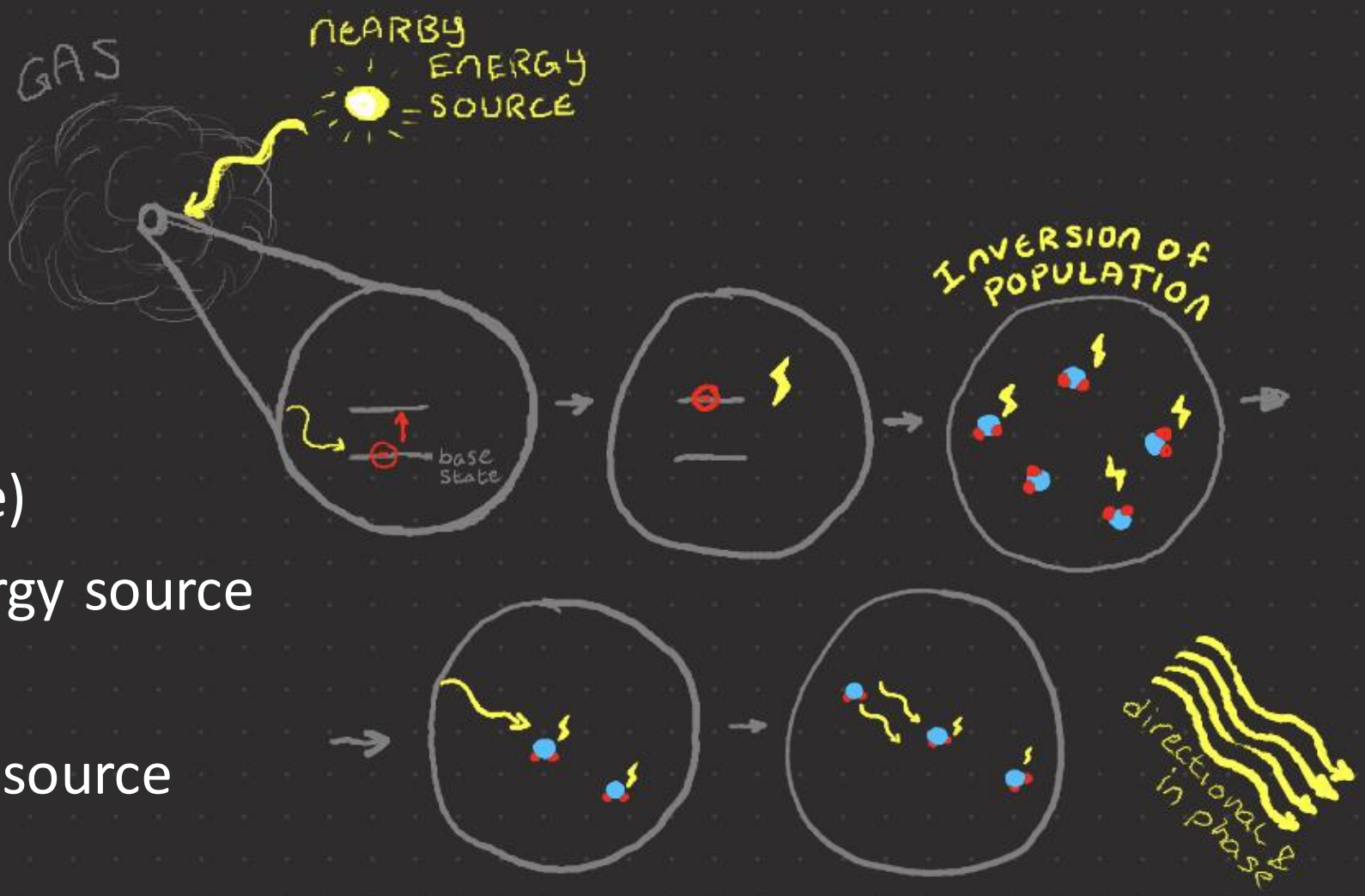
< 0.7% of surveyed galaxies are masers in a disk configuration (useful)



What are Masers?

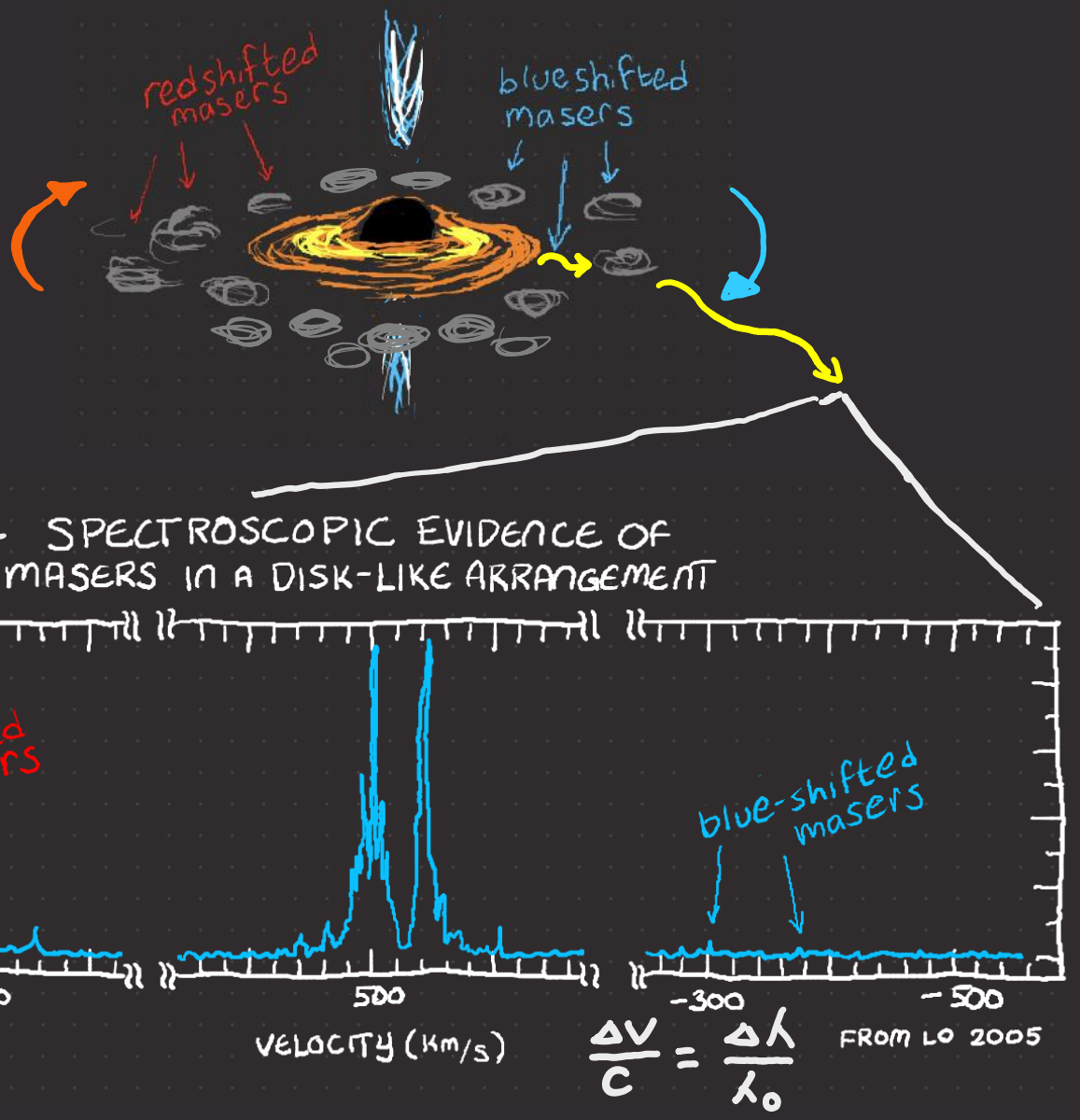
- Laser in
  Microwave at
  22 Ghz
- Emitted by hot,
  high density (for space)
  gas with a nearby energy source

- Type based on energy source



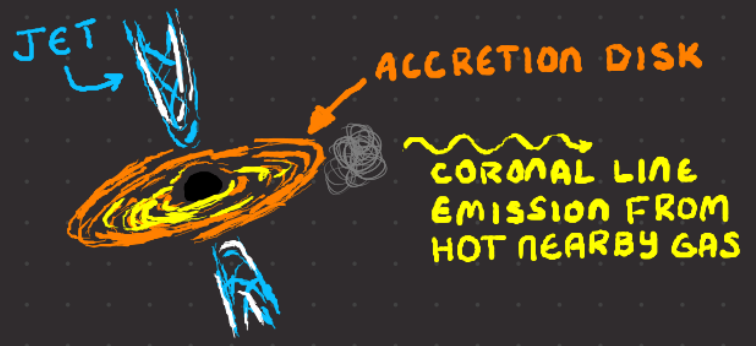
Types of Masers

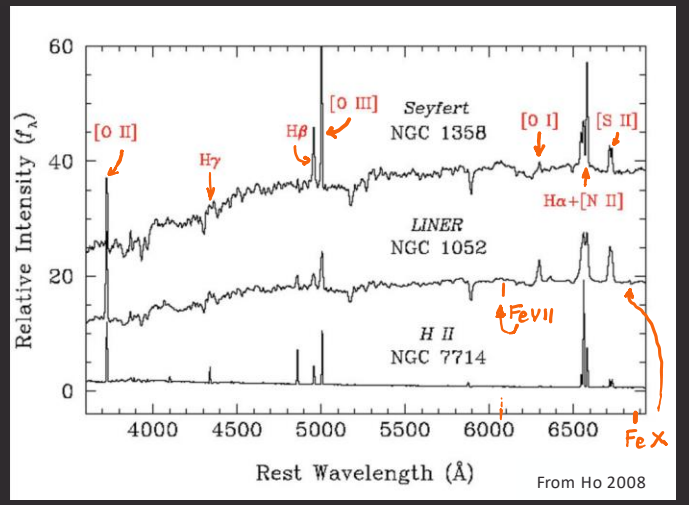
- Masers near Star-forming areas
- MegaMasers (1 M x more luminous)
  - From Galaxy Centers
  - Maser Disks (Rare)



Active Galactic Nucleus (AGN)

- A black hole feasting at the center of a Galaxy on an accretion disk of gas and dust.
- We know more about AGN than about masers, so finding a connection could help us understand megamasers' properties.
- AGN Identification
  - Xray
  - Radio (Jet)
  - Mid-Infrared
  - Variability (all wavelengths)
  - Optical Spectroscopic Lines
  - Coronal Spectroscopic Lines





The Data

MCP
MEGAMASER COSMOLOGY PROJECT
4959

MASERS 180

NONMASERS 4779

MEGAMASERS 131

DISK MASERS 33

+

+

+

=

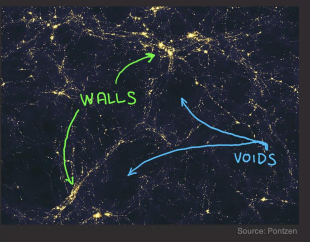
CLASS
CORONAL LINE ACTIVITY SPECTROSCOPIC SURVEY
CORONAL LINES

MPA
MAX PLANK INSTITUTE FOR ASTROPHYSICS DR7 RELEASE OF SPECTRUM MEASUREMENTS
OPTICAL LINES

VOID & WALL DATA
COSMIC ENVIRONMENT

SDSS

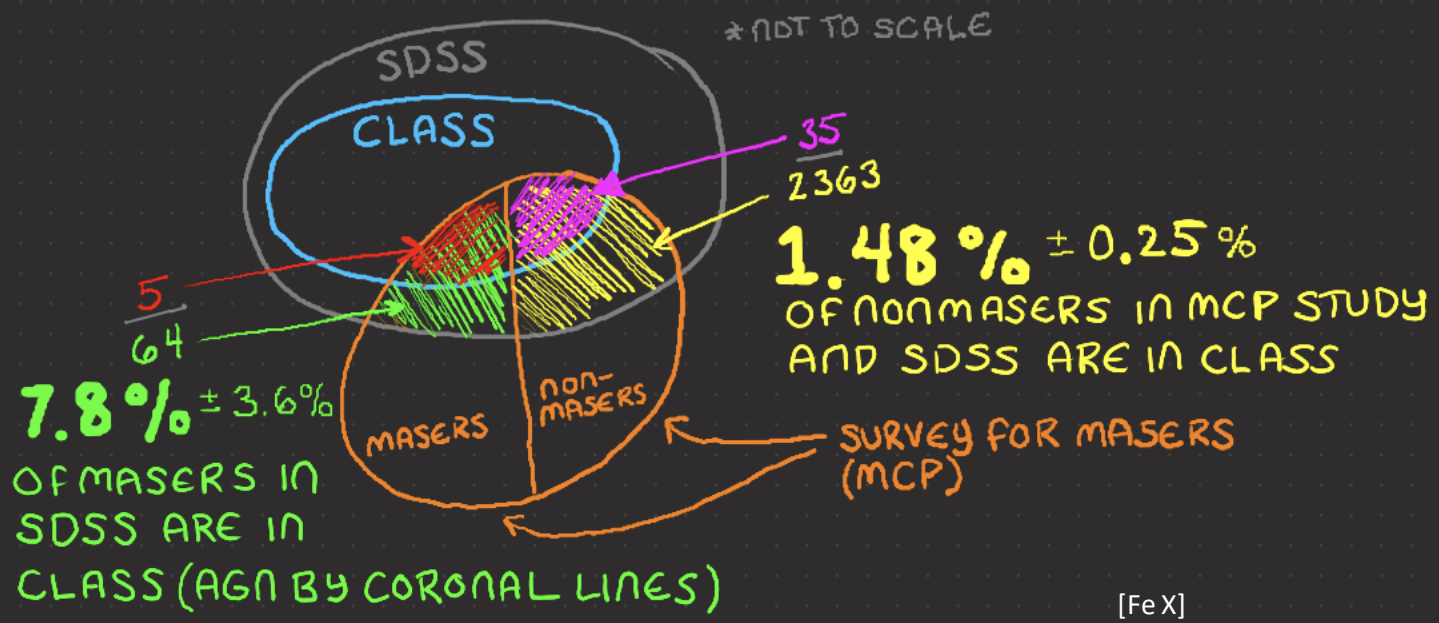
SDSS

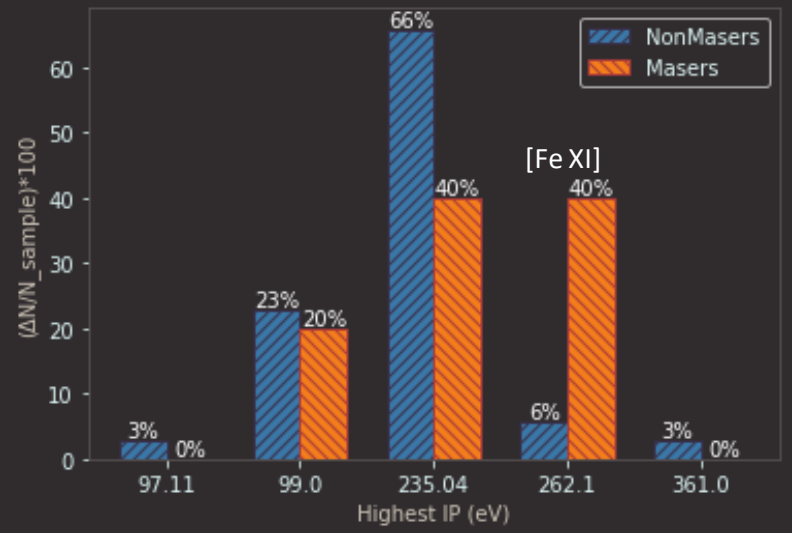


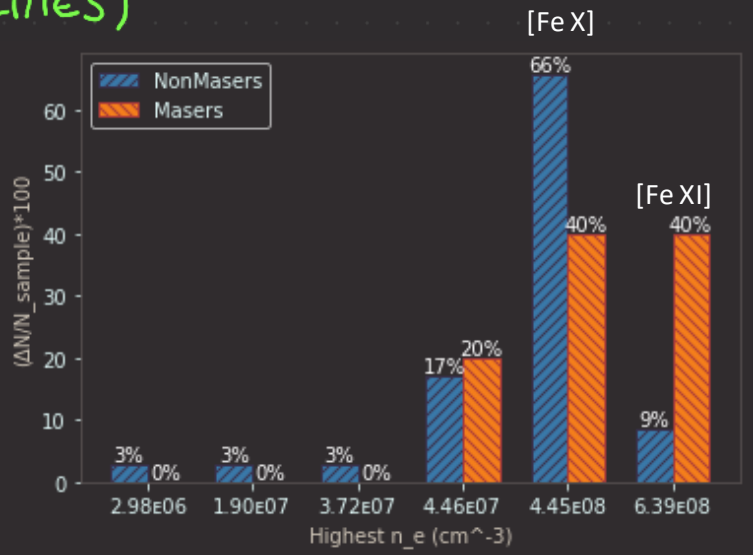
NEW UNDERSTANDINGS ABOUT THE PROPERTIES OF MASERS AND HOW TO FIND THEM

Masers VS Coronal Line AGN

- A higher percentage of Masers have coronal Lines (so are AGN) than non-masers.
- Physical Properties associated with coronal Lines: Ionization Potential (IP) And Critical Density (n_e)

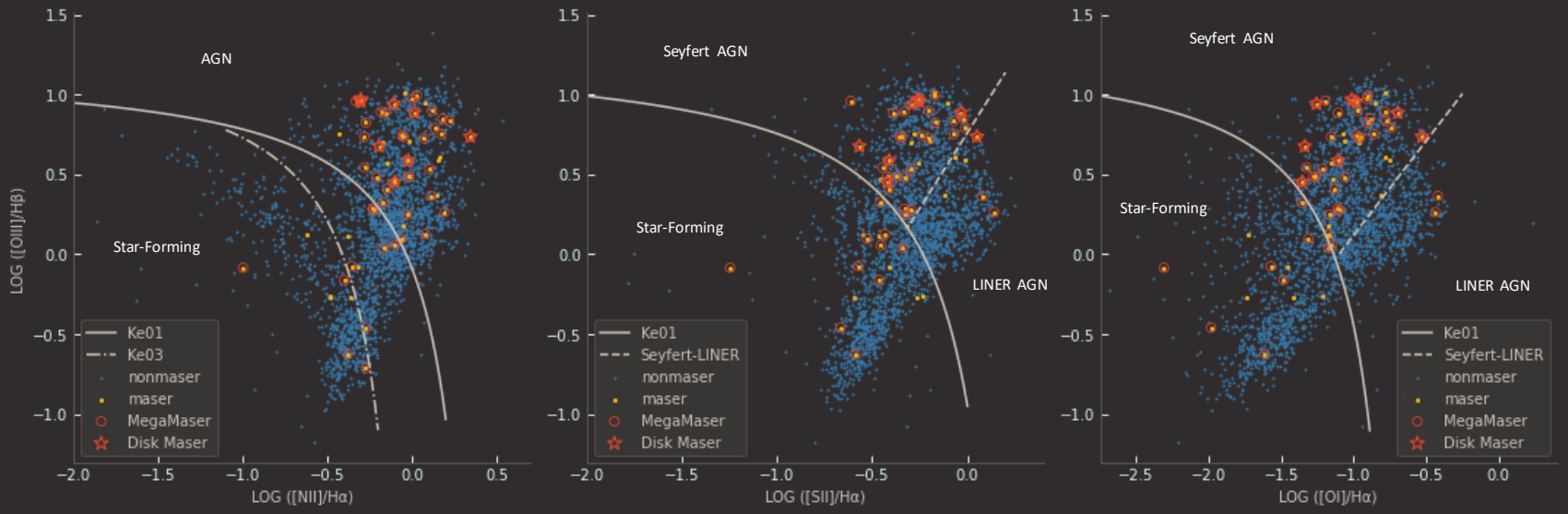


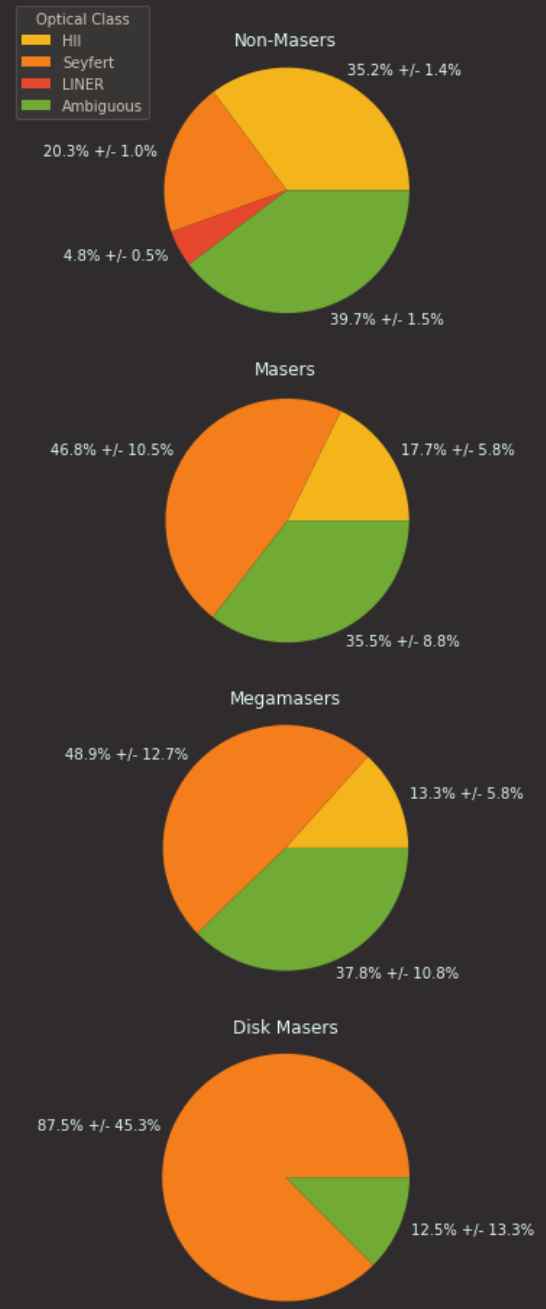




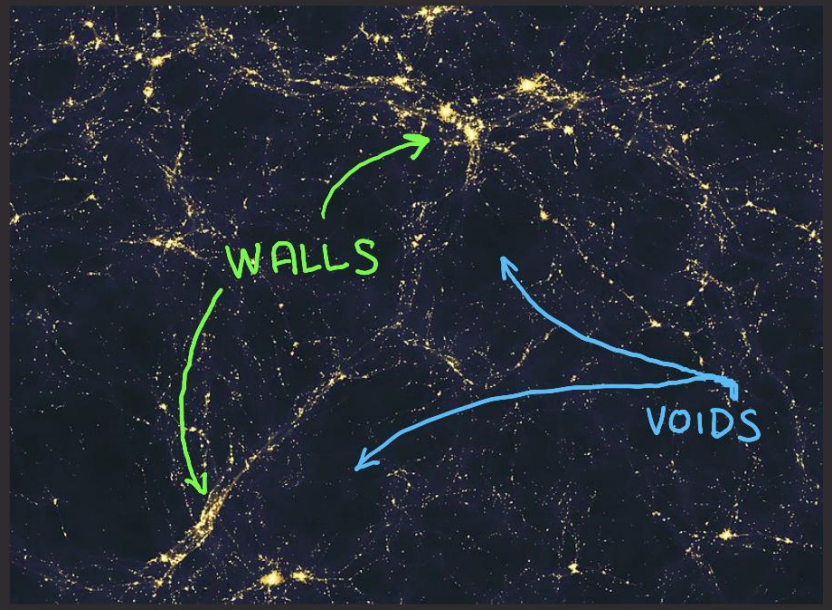
Masers VS Optical Line AGN

- Masers are concentrated in the Seyfert AGN area.
- Disk Masers are almost exclusively Seyfert AGNs



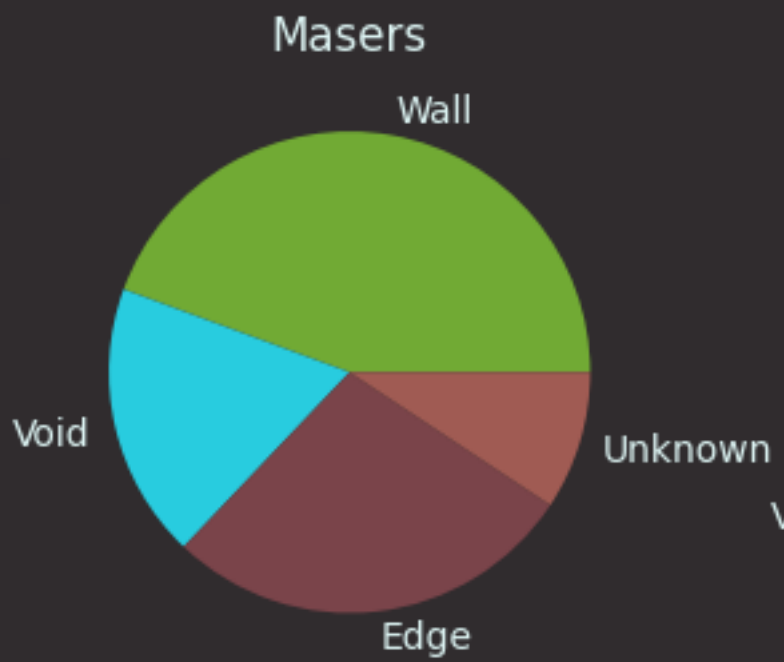


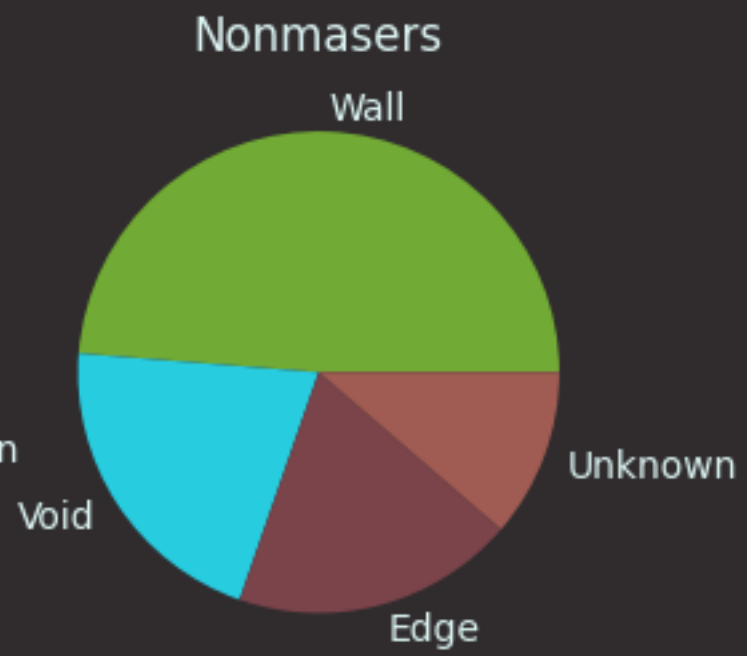
Masers VS Cosmic Environment



Modified from Pontzen 2014

Location	Masers	Non-masers
Wall	44.4% +/- 10.9%	48.7% +/- 1.8%
Void	18.5% +/- 6.4%	20.9% +/- 1.1%
Edge	27.8% +/- 8.1%	19.0% +/- 1.0%
Unknown	9.3% +/- 4.3%	11.3% +/- 0.8%





Conclusions

- There were statistically significant differences between Masers and Nonmasers using:
  - Coronal Line AGN Detection
  - Optical Line AGN Detection
- They may be useful tools in narrowing the search for usable Maser Disks
- Galaxy's location in the cosmic environment does not seem to be a useful tool.

Future Exploration

- Use other AGN detection methods
- More data

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