Studying Galaxy Formation via Nearby Star-Forming Galaxies

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Introduction

- Why study star-forming galaxies?

- Understand evolution and formation of galaxies

- Look at ionized gas via emission lines

- Two components

  - Tables with properties of ionized gas

  - Data cube of NGC4449

- Data collected using GEMINI north telescope

By NASA, ESA, A. Aloisi (STScI/ESA), and The Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration - http://hubblesite.org/newscenter/archive/releases/2007/26/image/a/ (direct link), Public Domain, https://commons.wikimedia.org/w/index.php?curid=2348015

Gemini North Telescope

By NOIRLab, Joe Pollard (NOIRLab) - https://www.gemini.edu/gallery/media/maunakea-star-trails-over-gemini-norths-photo-voltaic-panels

- Two Gemini Telescopes
  - Gemini North
  - Gemini South
- The north telescope is in Hawaii
- Gemini Multi-Object Spectrograph (GMOS)
- Operates in two modes
  - Single slit with a sky FOV of 5" x 1.75" and an object FOV of 5" x 3.5"
  - Double slit with a sky FOV of 5" x 3.5" and an object FOV of 5" x 7"

Integral Field Spectroscopy Data Reduction

- What does IFS do
  - IFS provides spatially-resolved spectroscopy
- Three techniques
  - Lenslets
  - Lenslets and fibers
  - Slicer
- The device has 750 fibers
  - 250 are for sky FOV
  - 500 are for object FOV
- 3-dimensional data cube

By Mark Westmoquette - https://doi.org/10.48550/arXiv.0905.3054
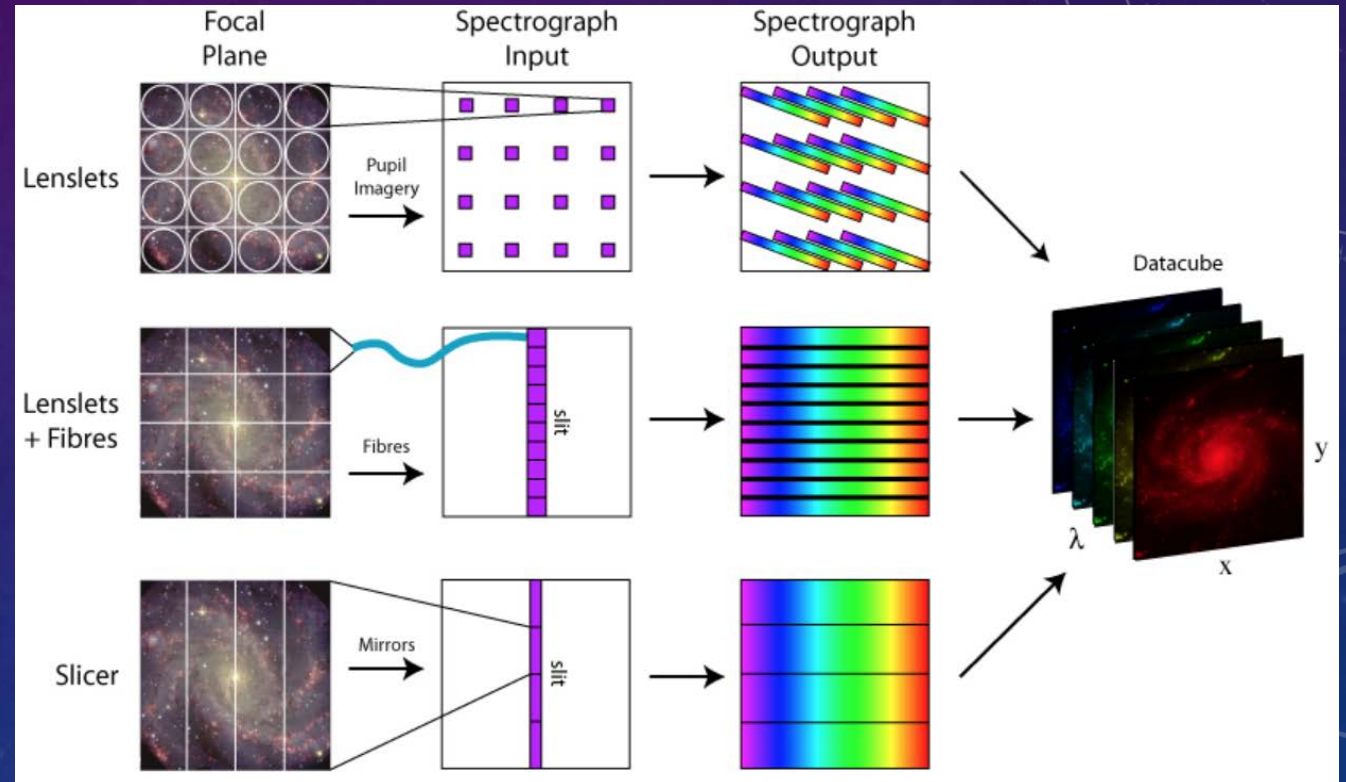
Data Reduction Process

- Calibration and twilight flats are reduced

- Wavelength calibration from the CuAr arc lamp

- The standard star is reduced for the flux calibration

- Reduced calibration data is applied to the science data to create the data cube

Twilight Flat · Standard Star · CuAr Arc · Calibration Flat
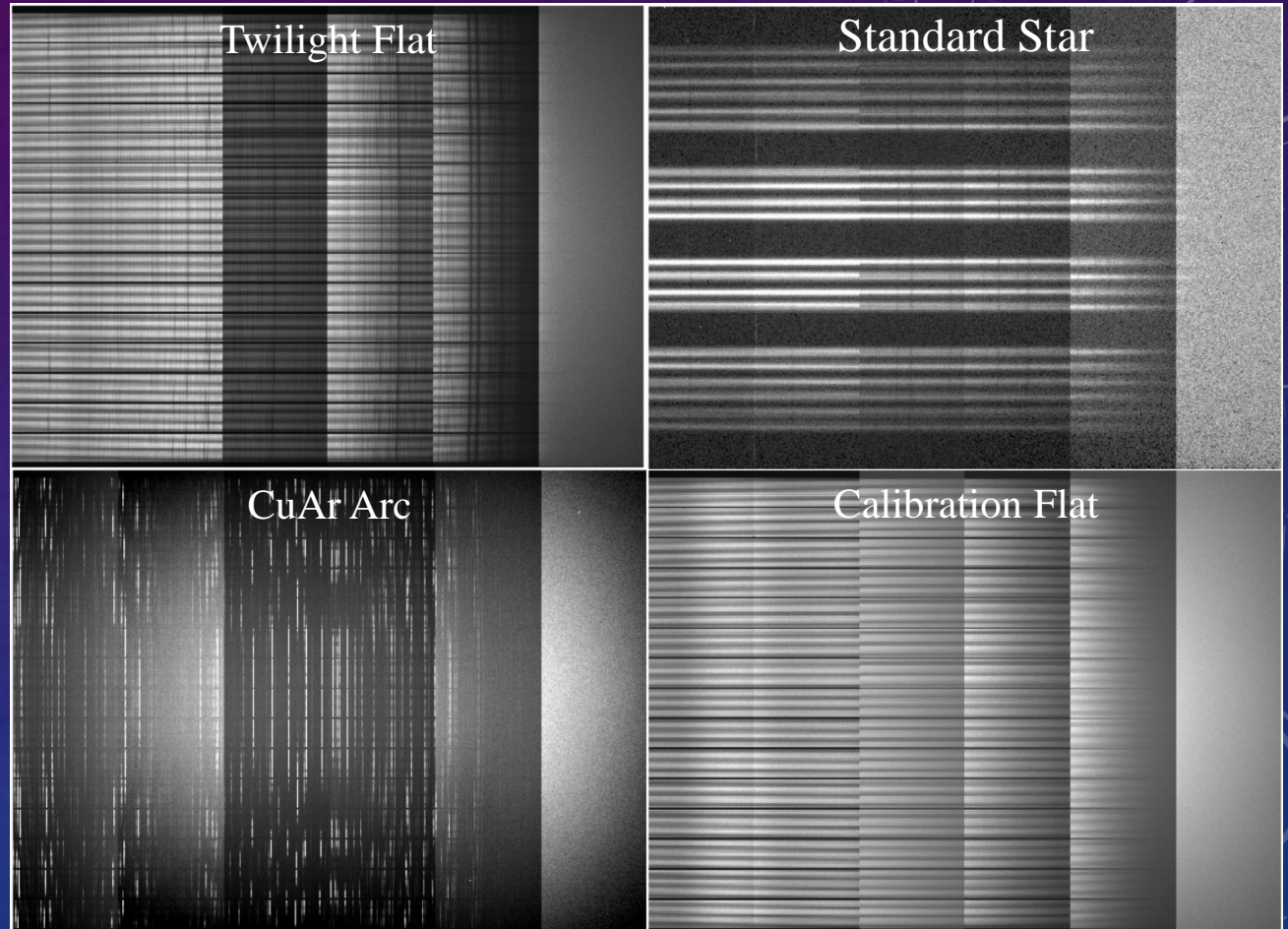
Data Cube

- 3-dimensional data cube of NGC4449
- Each slice represents a different wavelength
- Left image is at [OIII] 5007 Å
- Right is at Hβ 4860.1 Å
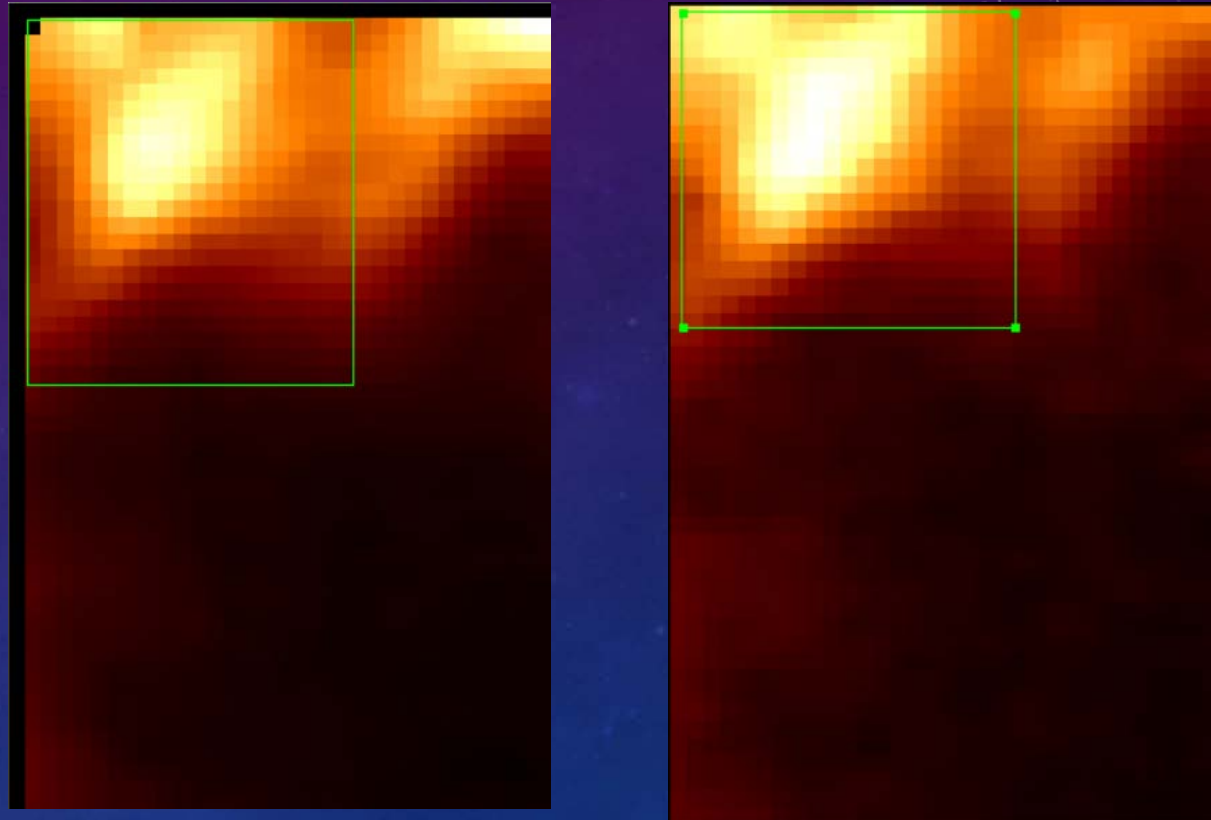
The brightness of each slice helps determine if a chemical element is present

Emission Spectrum

- Emission Spectrum of NGC4449

- Blue lines are principal emission line

- Information of star formation, temperature, density, and chemical composition

NGC4449 Blue Emission Region
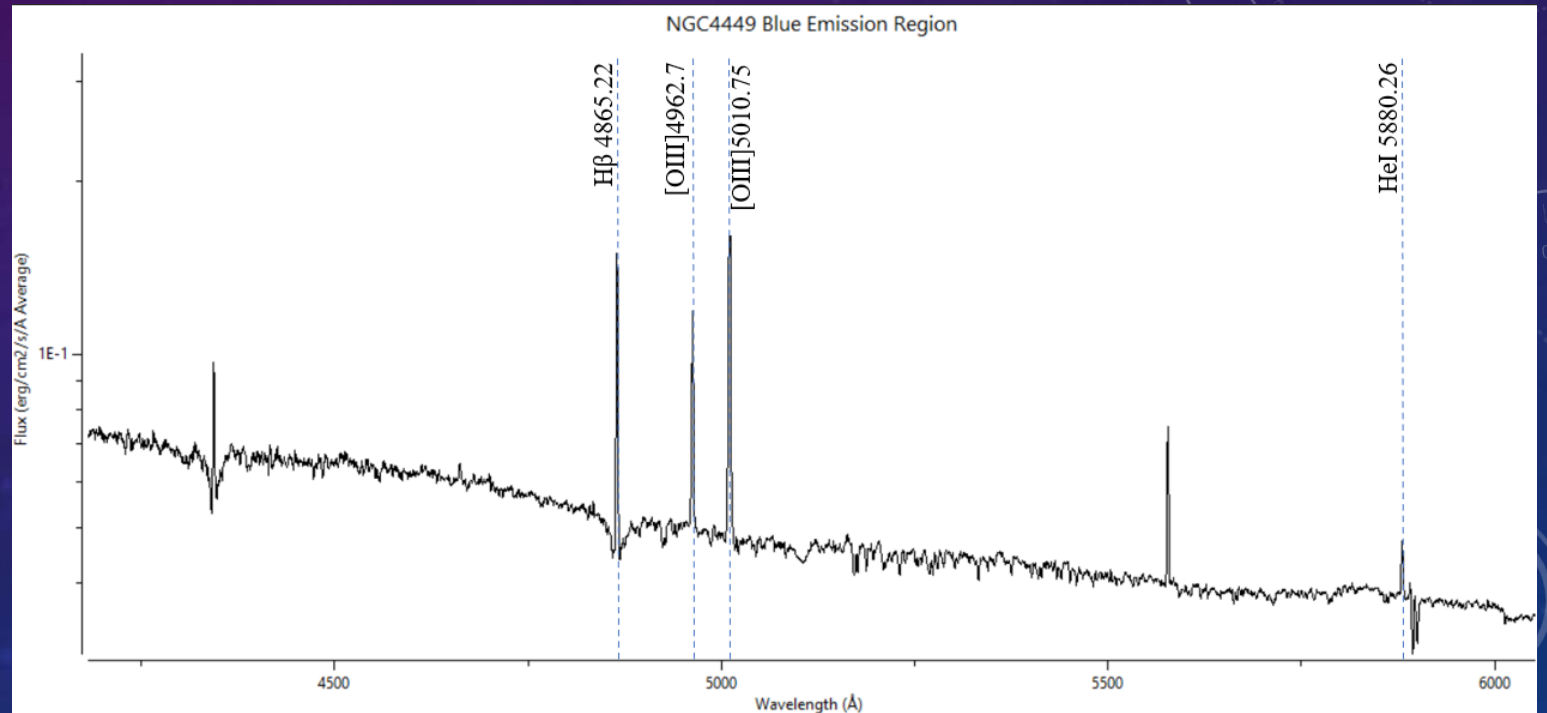
Properties of Ionized Gas

- **Collected information from 25+ papers**

- Equivalent width of various lines (Such as CIII], CIV, and [OIII])

- Gas Phase Metallicity 12+log(O/H)

- C/O abundance

- Range of redshift values, z, from 0.003 to less than 9

Log(C/O) vs. 12+Log(O/H)
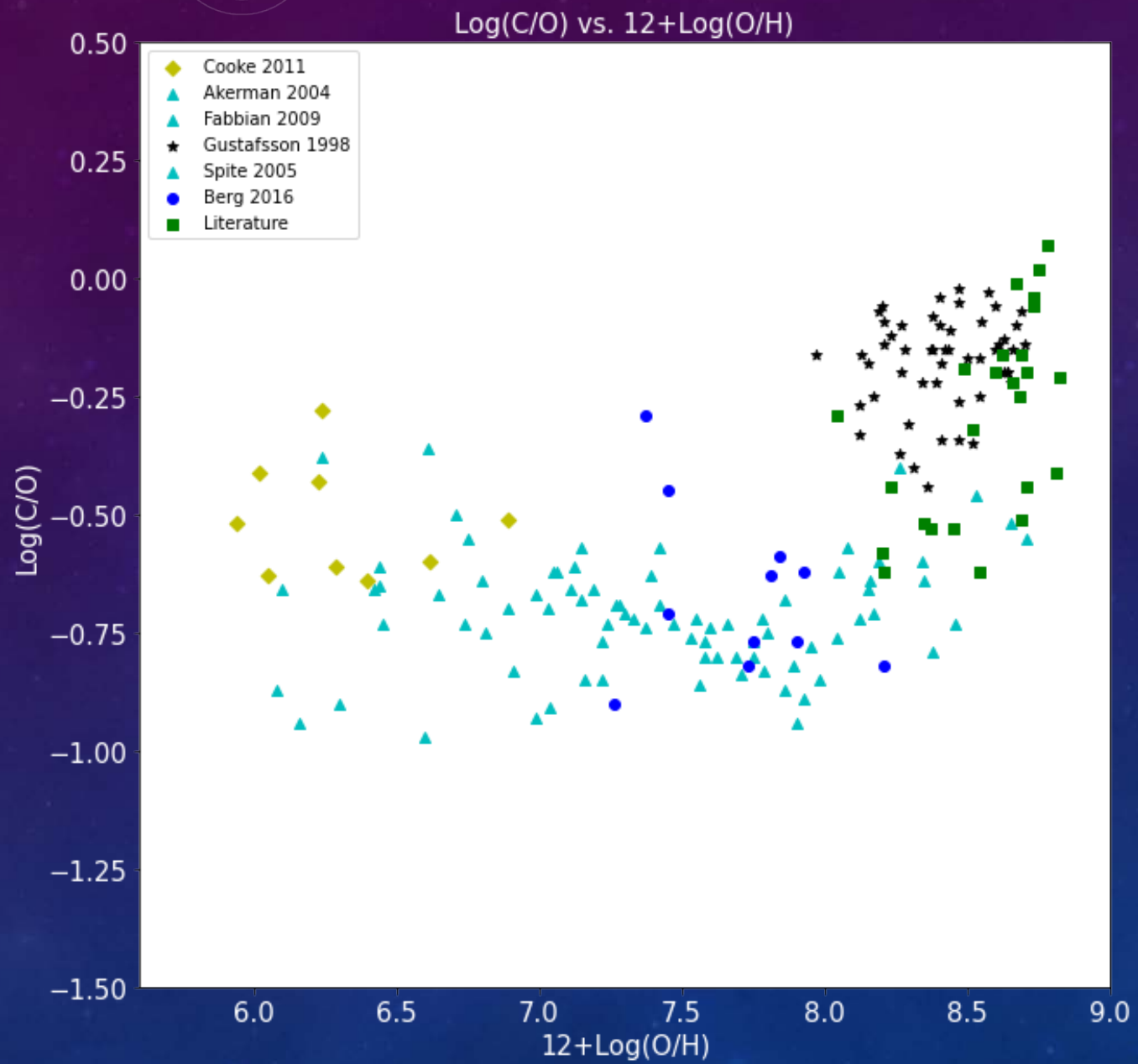
Summary

- Data reduction and compiling emission line properties from literature

- Can be used for comparison in other works

- Helps determine the gas phase metallicity of an object

- How new galaxies can form in certain conditions

- How galaxies can evolve over time