



# Discovery of new oxygen-rich supernova remnants

(Kravtsov+24 submitted)

*Timo Kravtsov, Hanindyo Kuncarayakti, Joe Anderson*

*Keiichi Maeda, Seppo Mattila*

*ESO/University of Turku*

*14-06-2024*



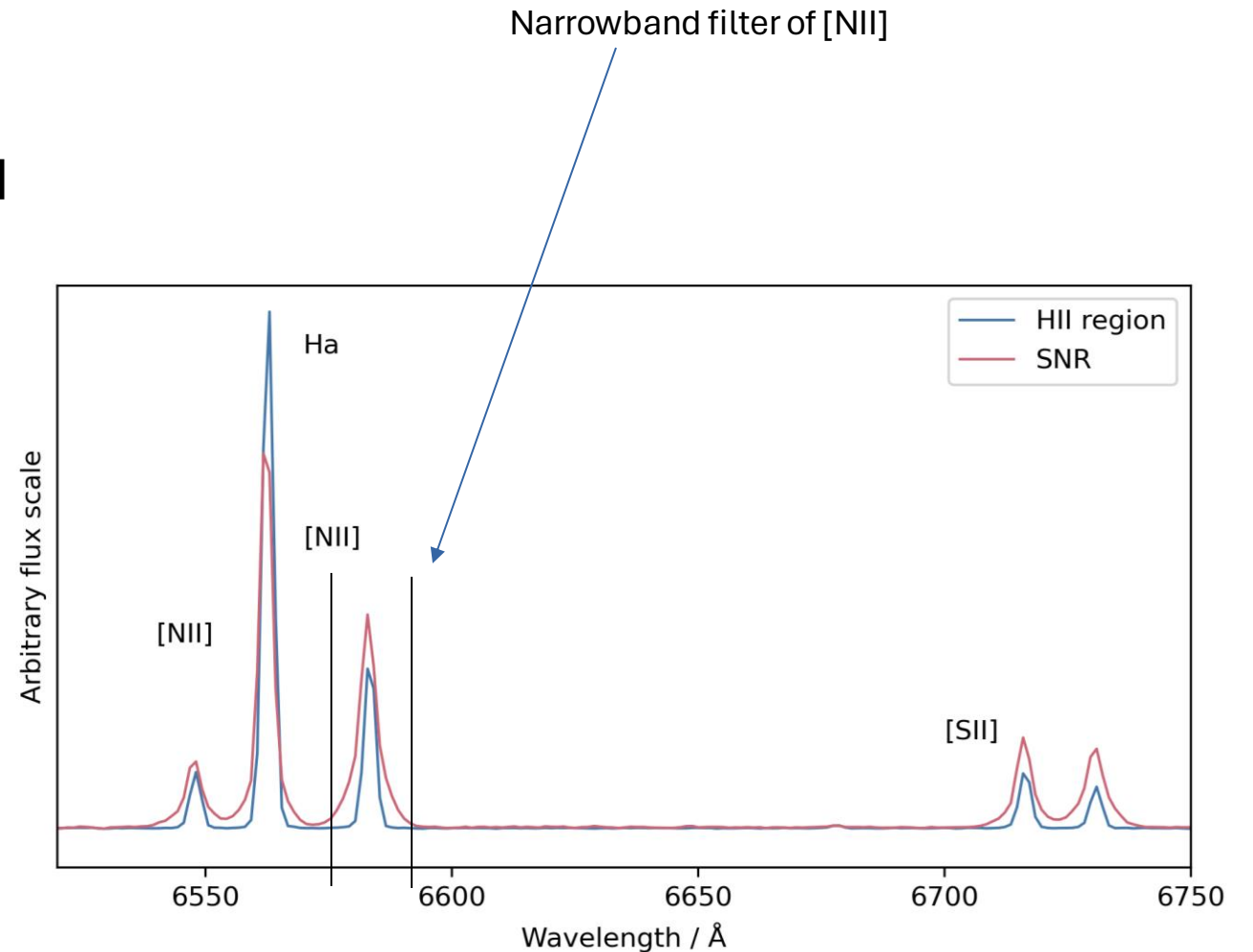
# SN environments

- Constrain progenitors from environment
- Study a host with multiple SNe
- M61/NGC4303 has six type II SNe
  - SNRs need to be found first



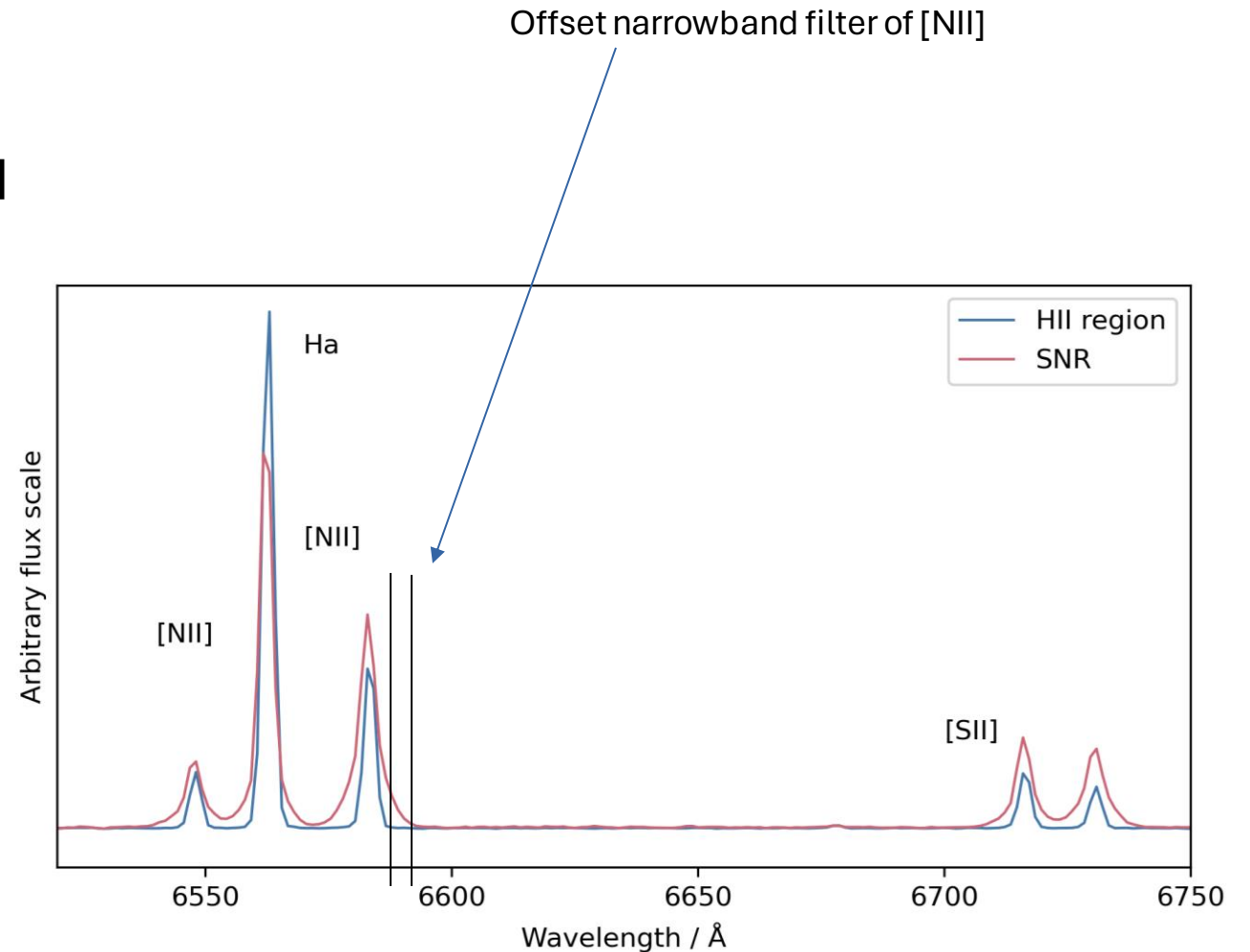
# "What's an [SII]:Ha ratio?"

- MUSE provides medium resolution spectra
  - Shocked regions are resolved
- Concentrate on broad emission sources...



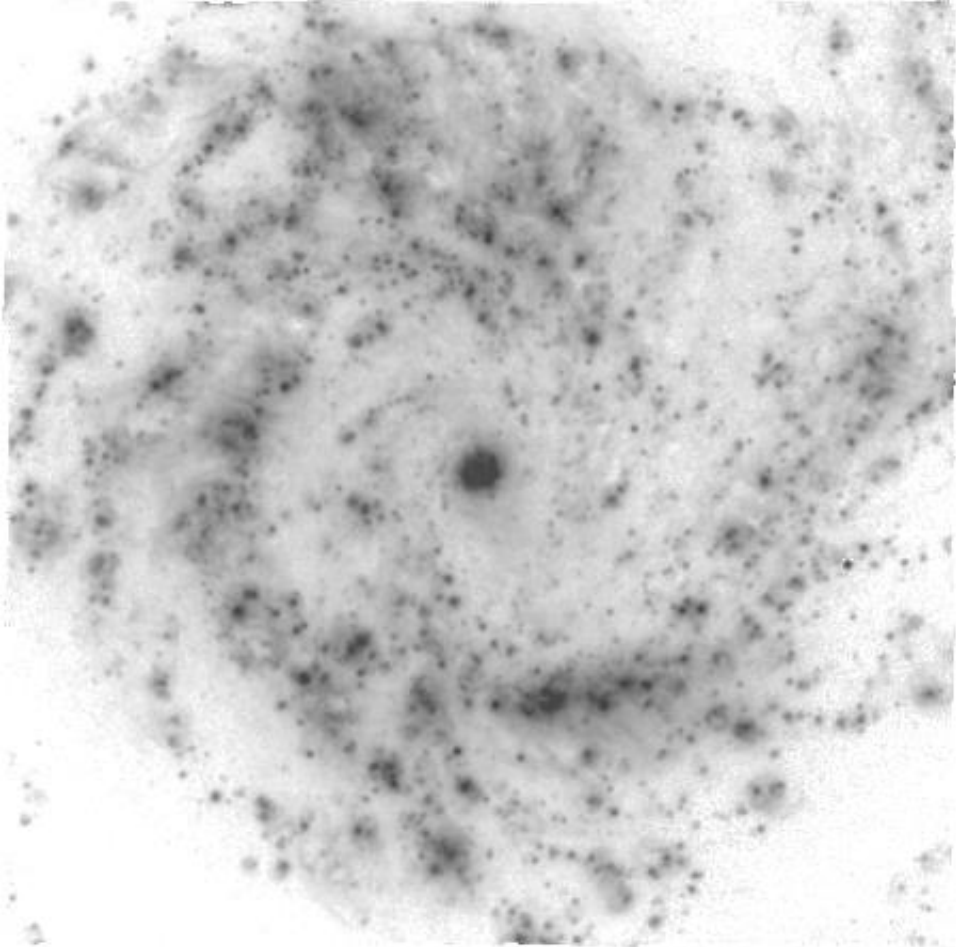
# "What's an [SII]:Ha ratio?"

- MUSE provides medium resolution spectra
  - Shocked regions are resolved
- Concentrate on broad emission sources...
- Inherent biases
  - Probably good enough

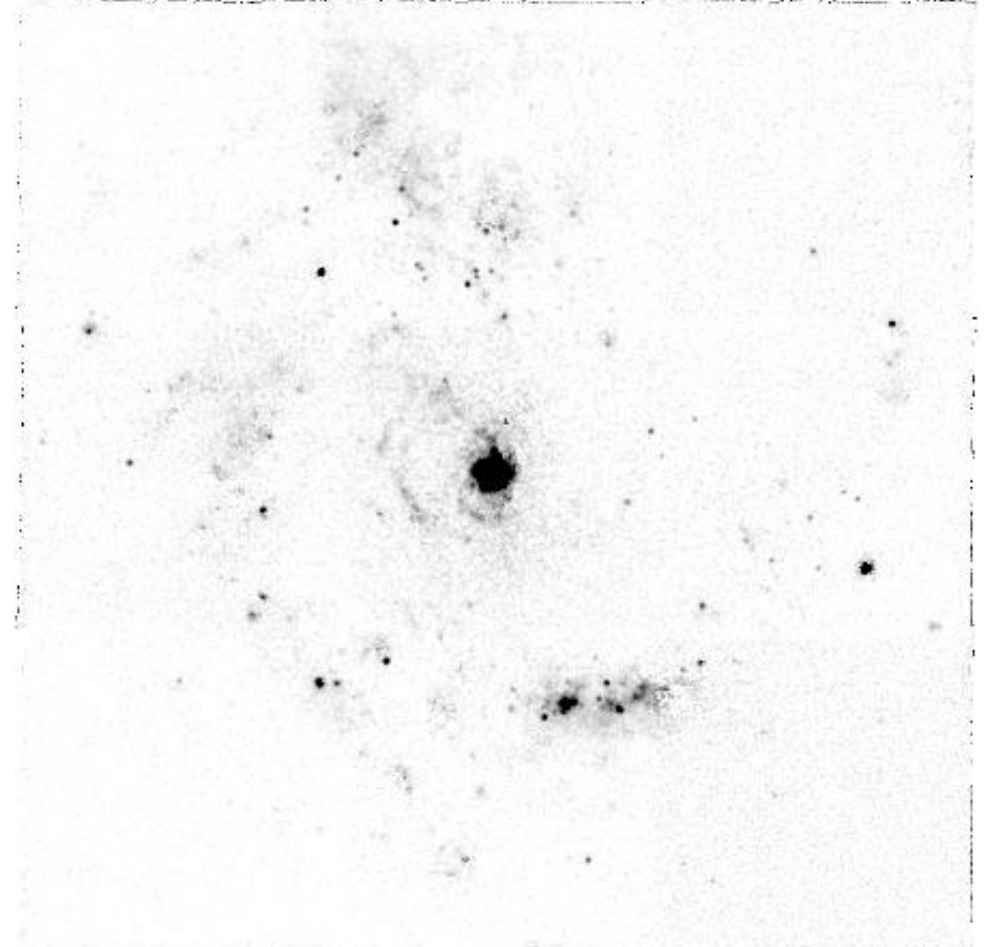


# It works!

Narrowband [NII] map of M61

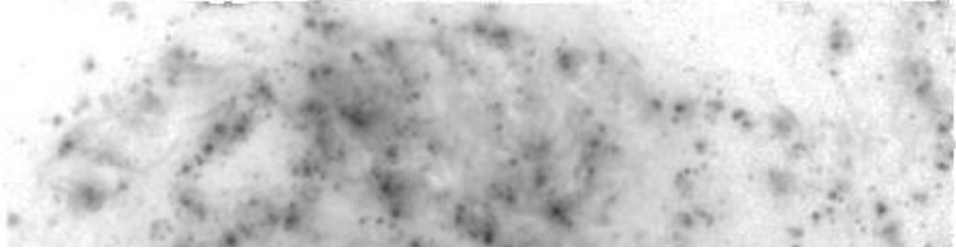


[NII] red wings with continuum subtraction

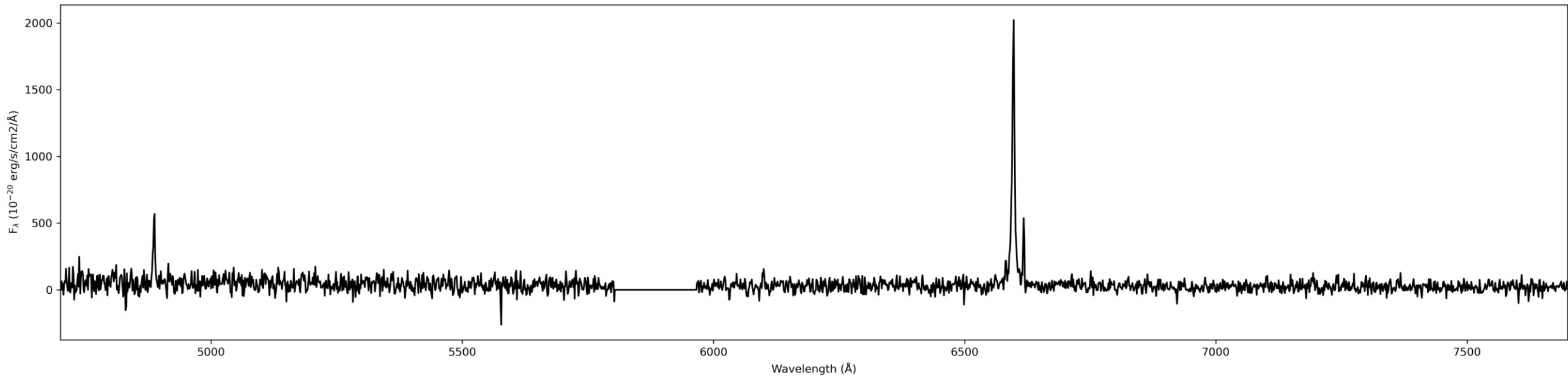
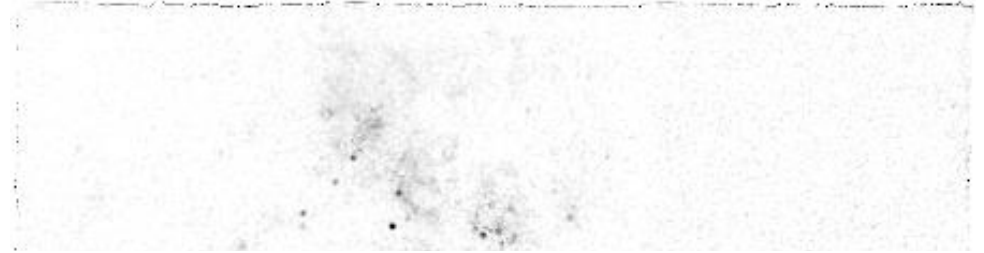


# It works?

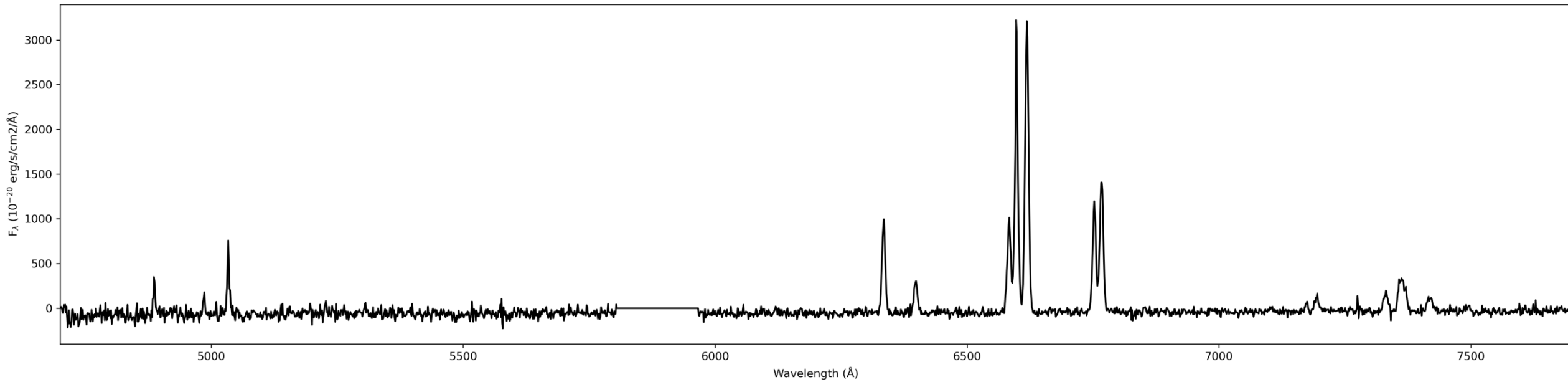
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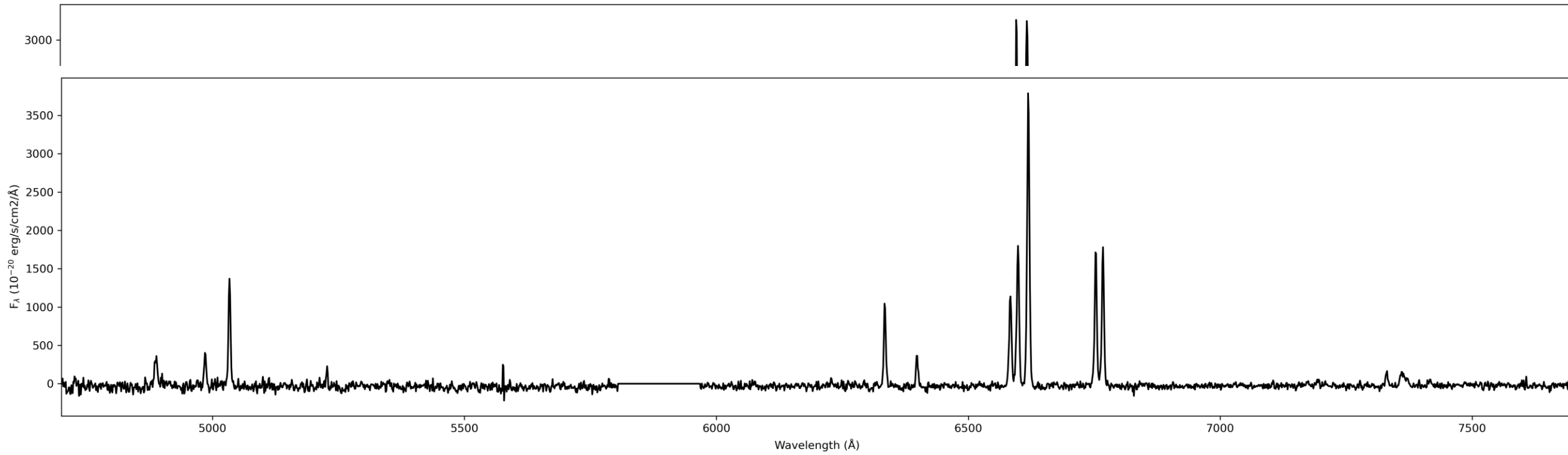
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# It works!

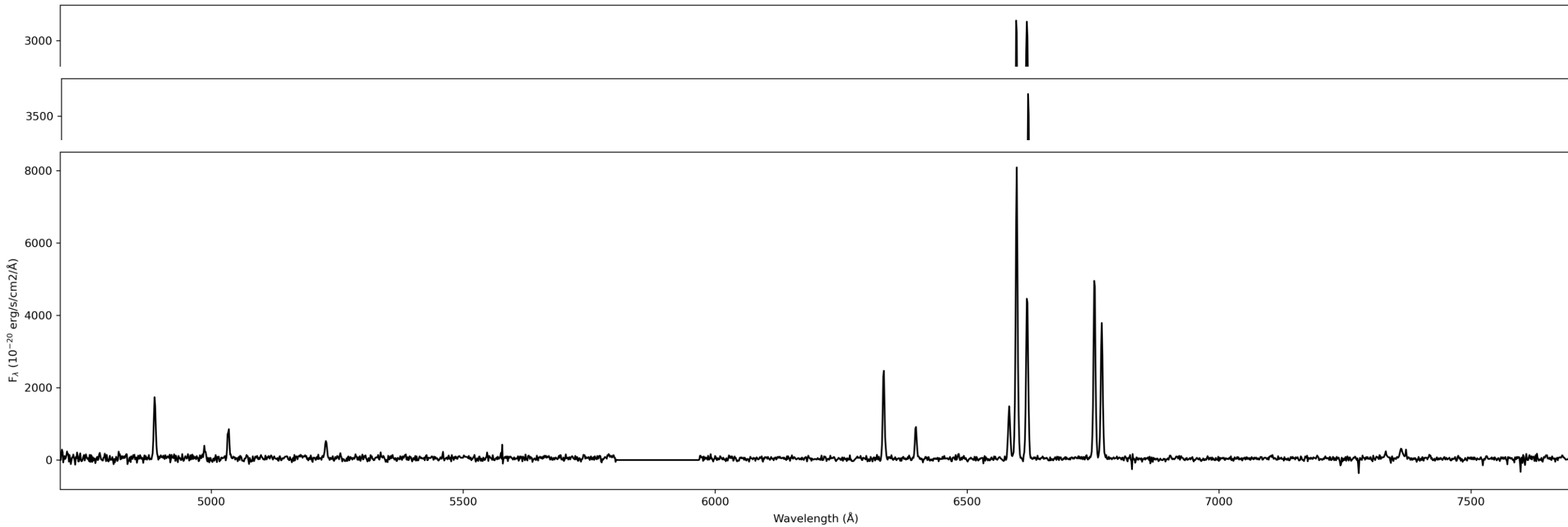


# It works!

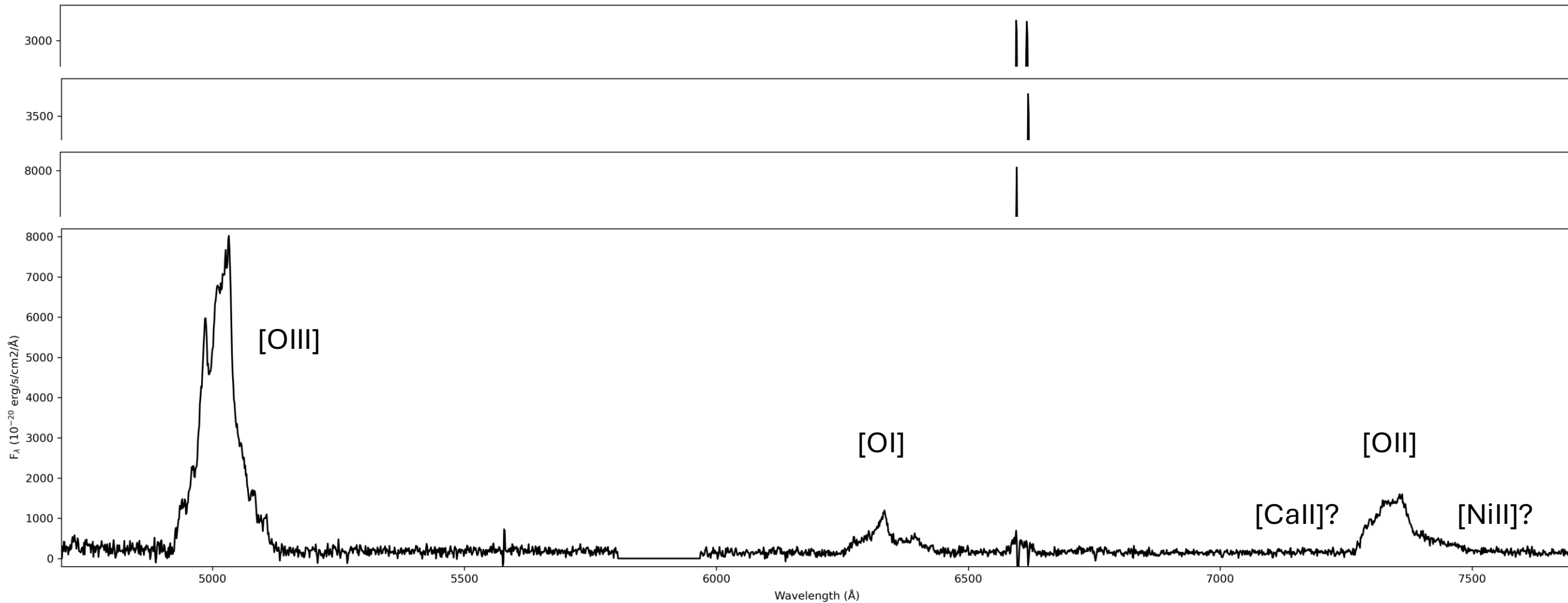




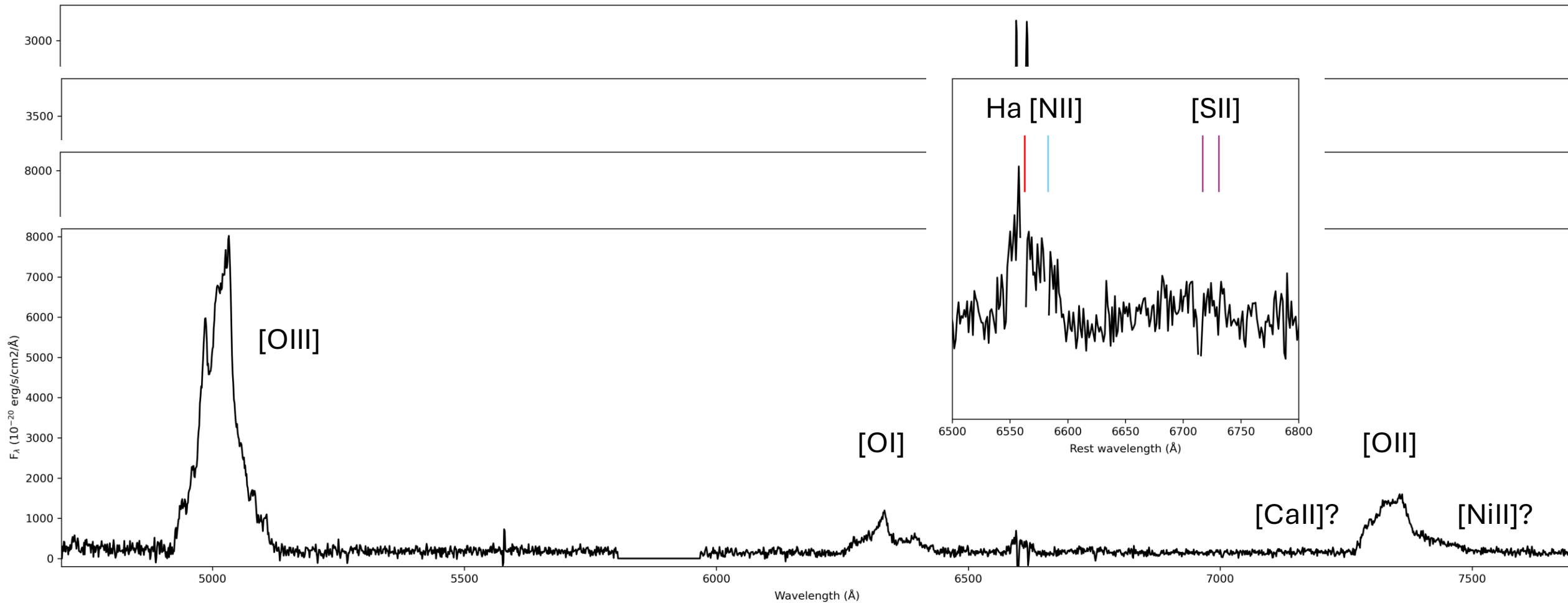
# It works!



# It works!



# It works!



# SNR 4449-1

RADIO EMISSION FROM A POSSIBLE SUPERNOVA REMNANT IN THE GALAXY NGC 4449

E. R. SEAQUIST

Department of Astronomy, University of Toronto, Toronto, Ontario, Canada

AND

R. C. BIGNELL

National Radio Astronomy Observatory,\* Socorro, New Mexico 87801

*Received 1978 June 29; accepted 1978 August 16*

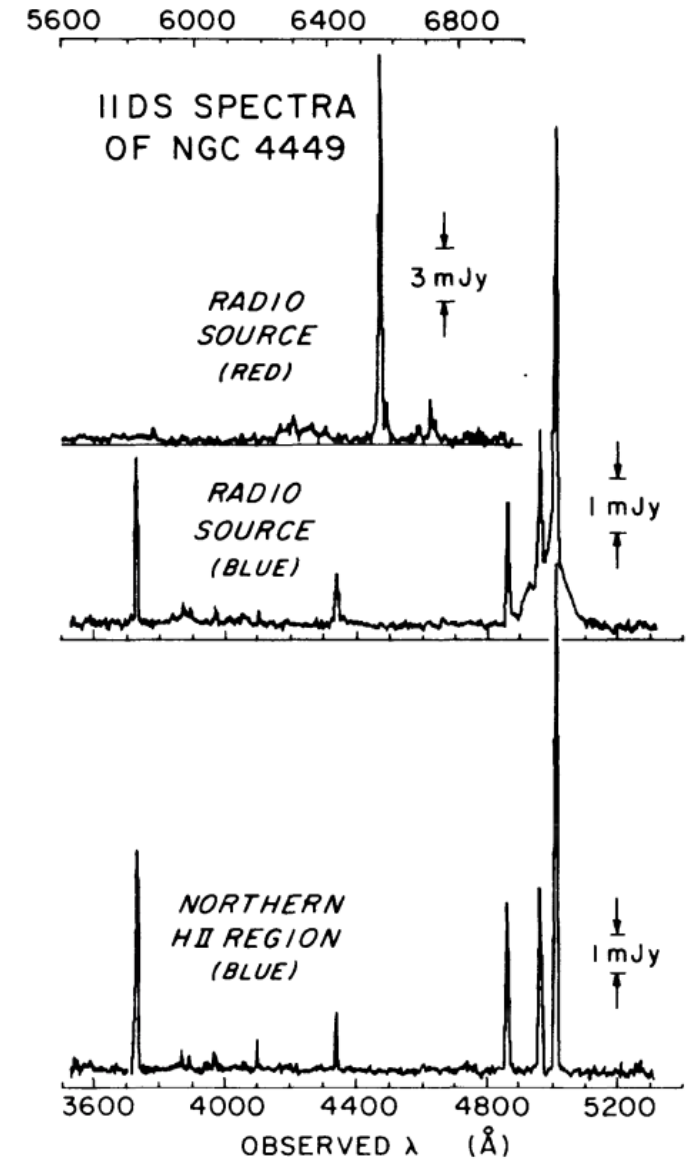
AN UNUSUAL SUPERNOVA REMNANT WITH BROAD EMISSION LINES NEAR NGC 4449

BRUCE BALICK AND TIMOTHY HECKMAN

Astronomy Department, FM-20, University of Washington, Seattle, Washington 98195

*Received 1978 June 26; accepted 1978 August 16*

Blair+84, Blair+98,  
Patnaude+03, Milisavljevic+08,  
Bietenholz+10...

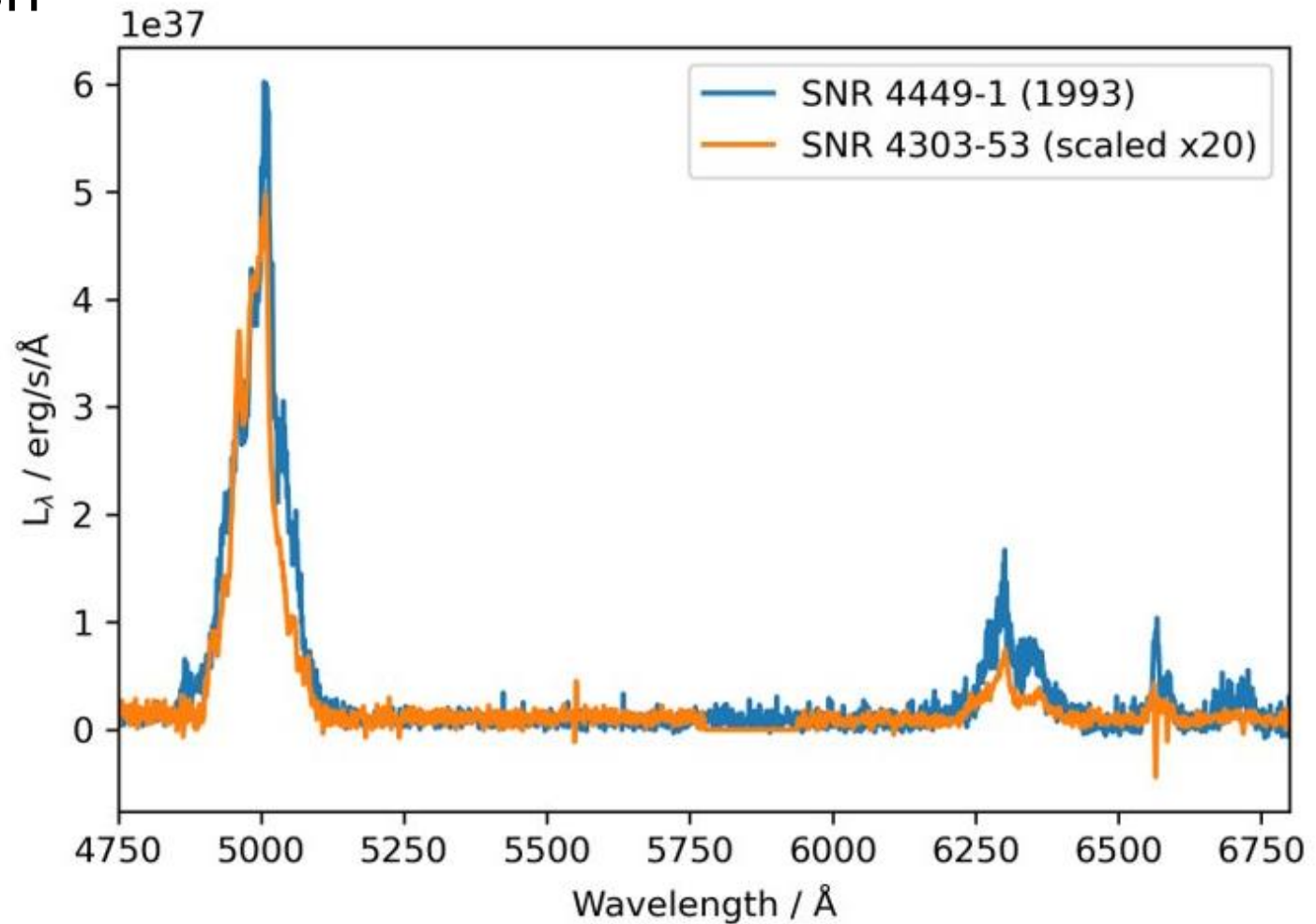


Balick+78

# SNR twins

- Strong resemblance between the two SNRs

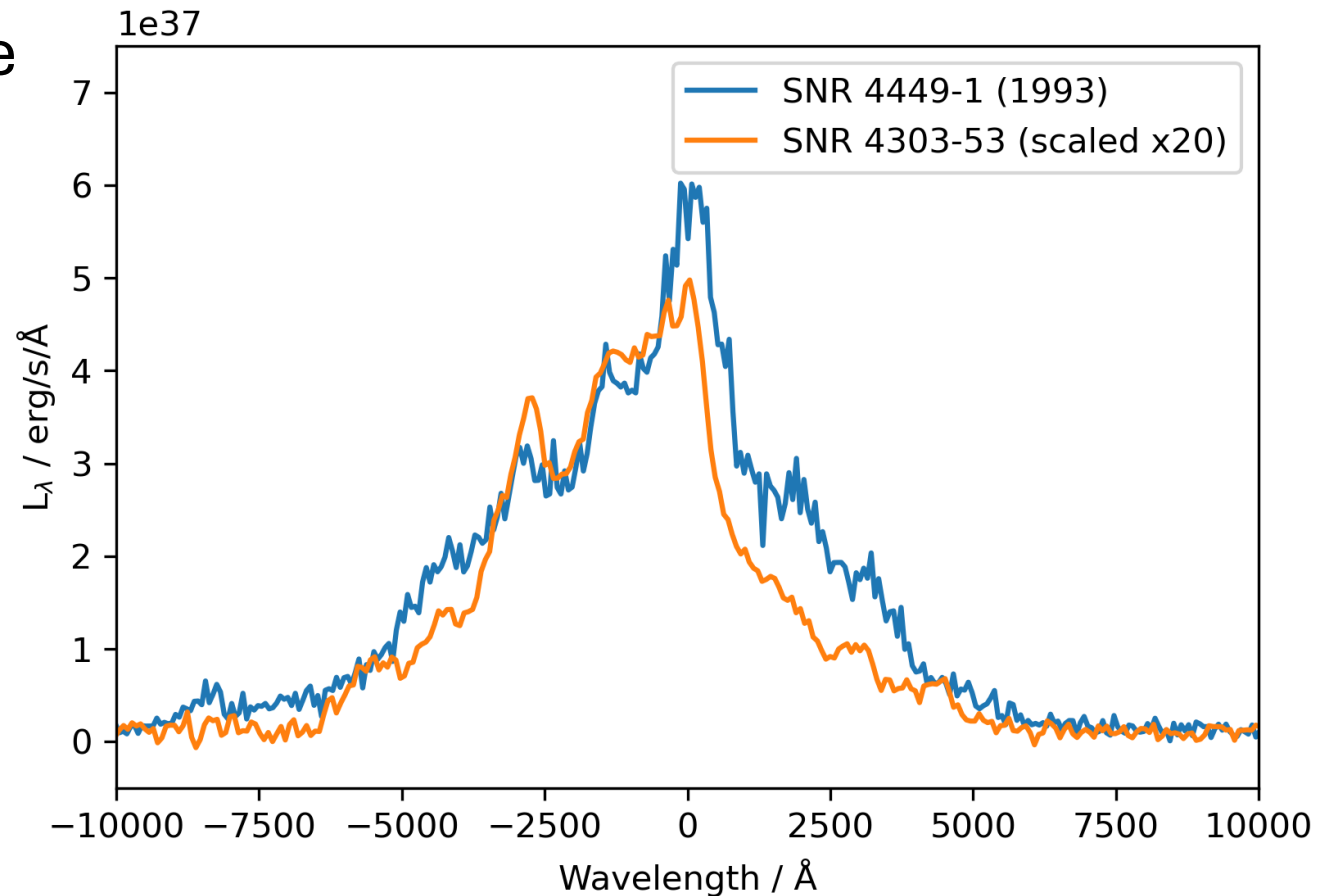
Let's find more!

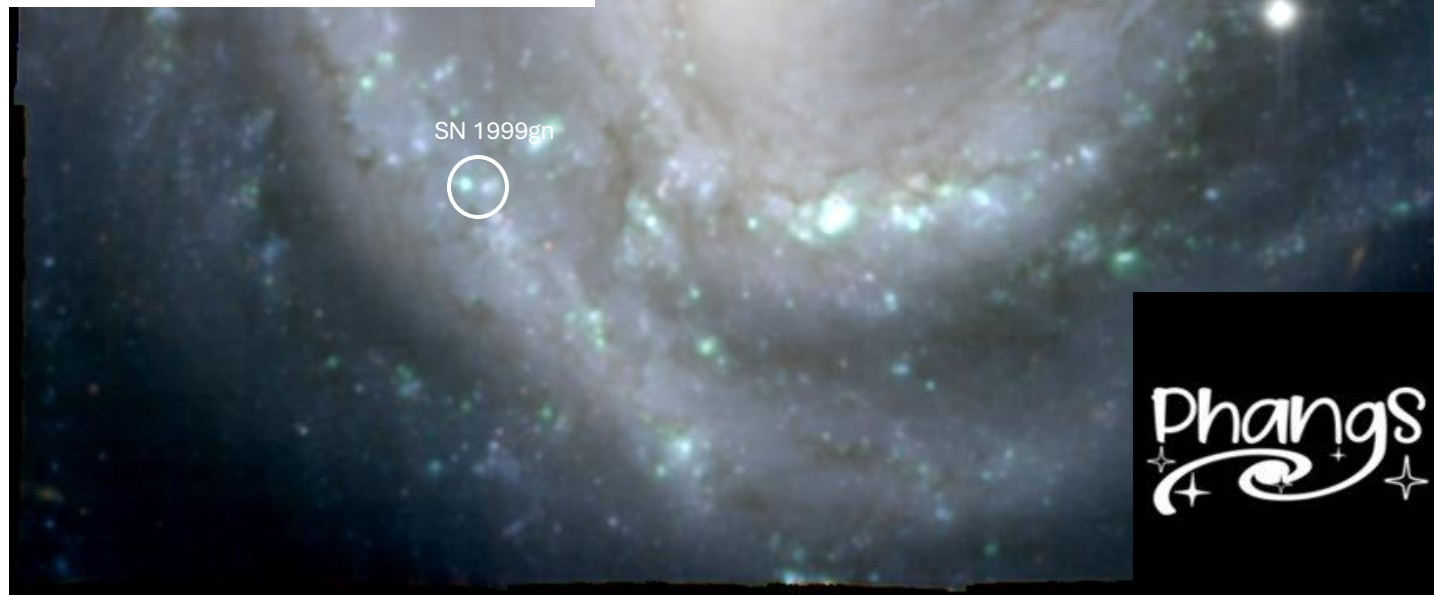
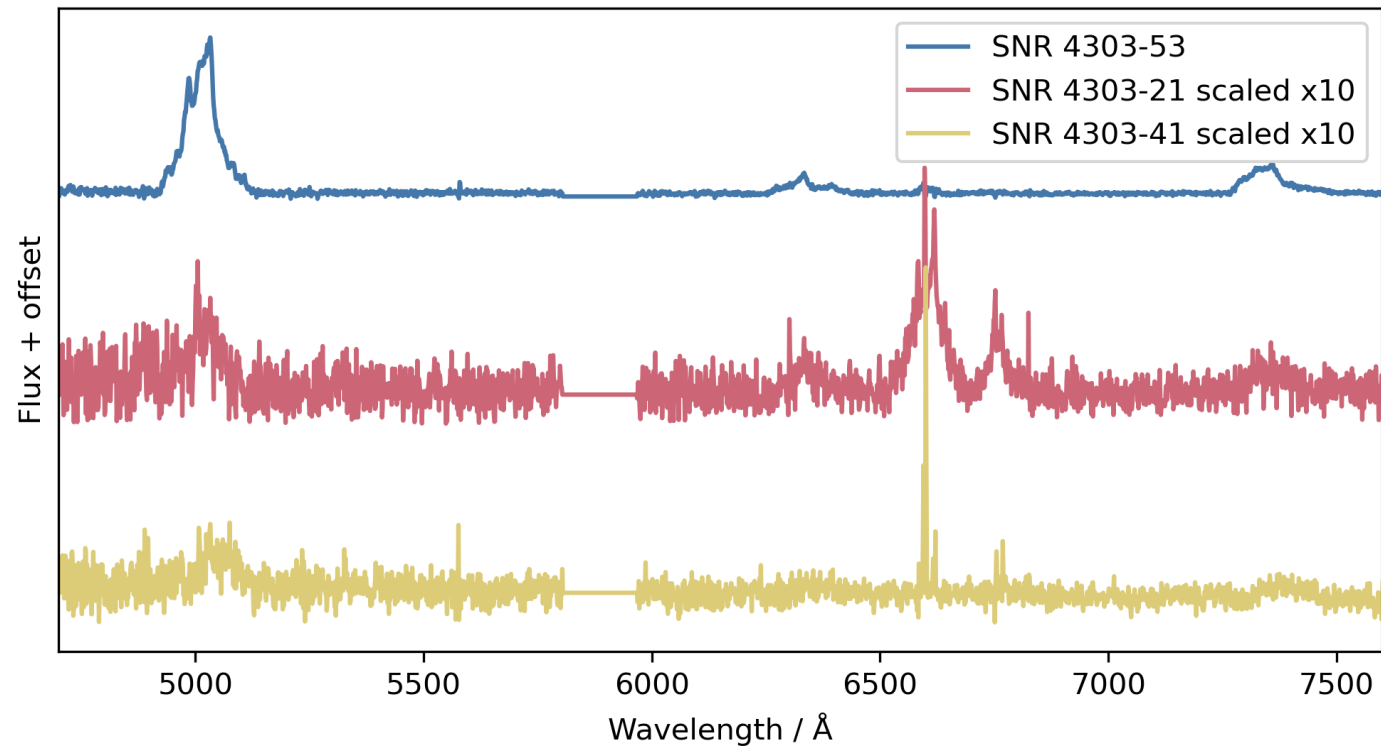


# SNR twins

- Strong resemblance between the two SNRs
- Asymmetry in the emission line complex

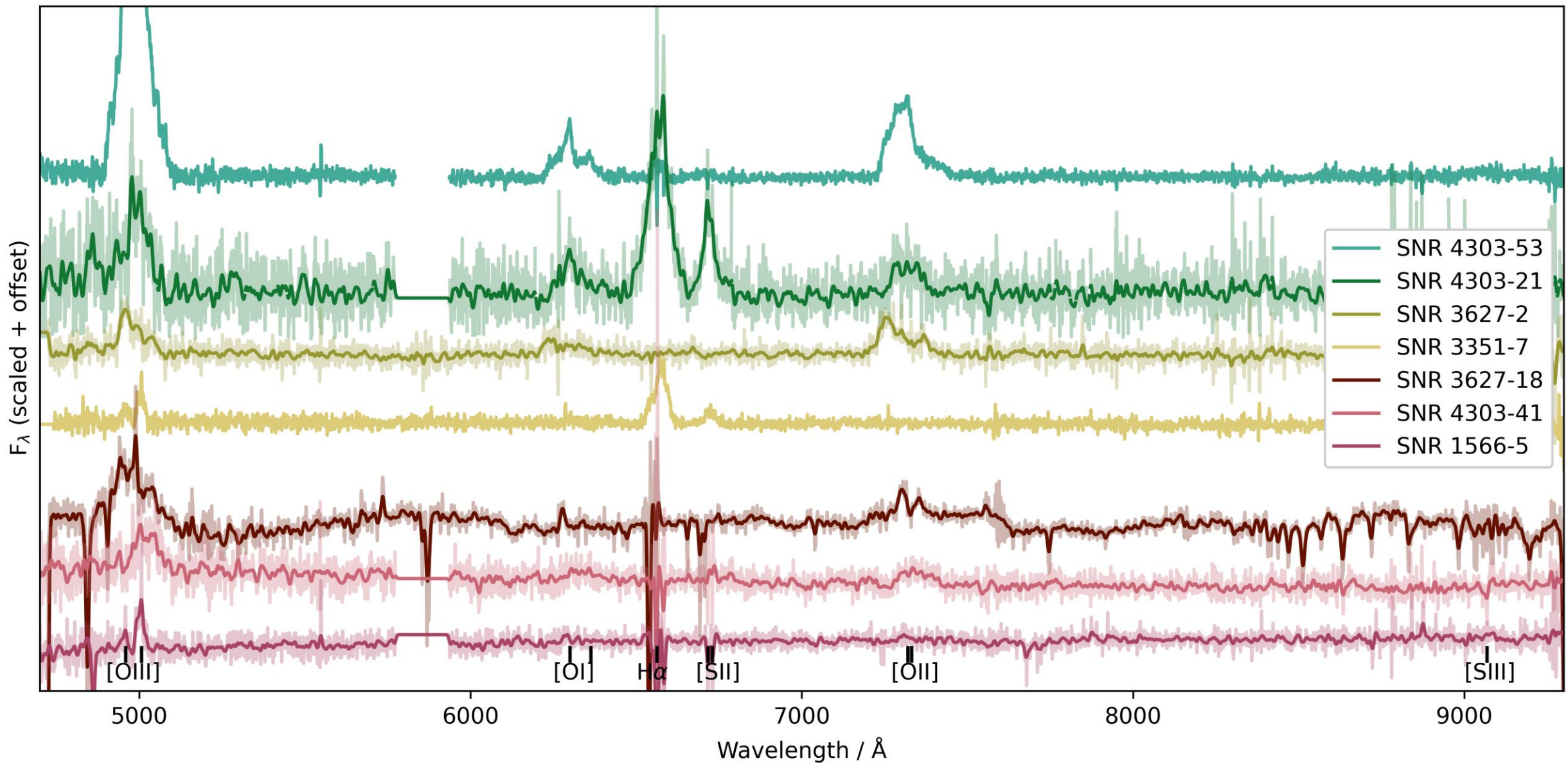
Let's find more!





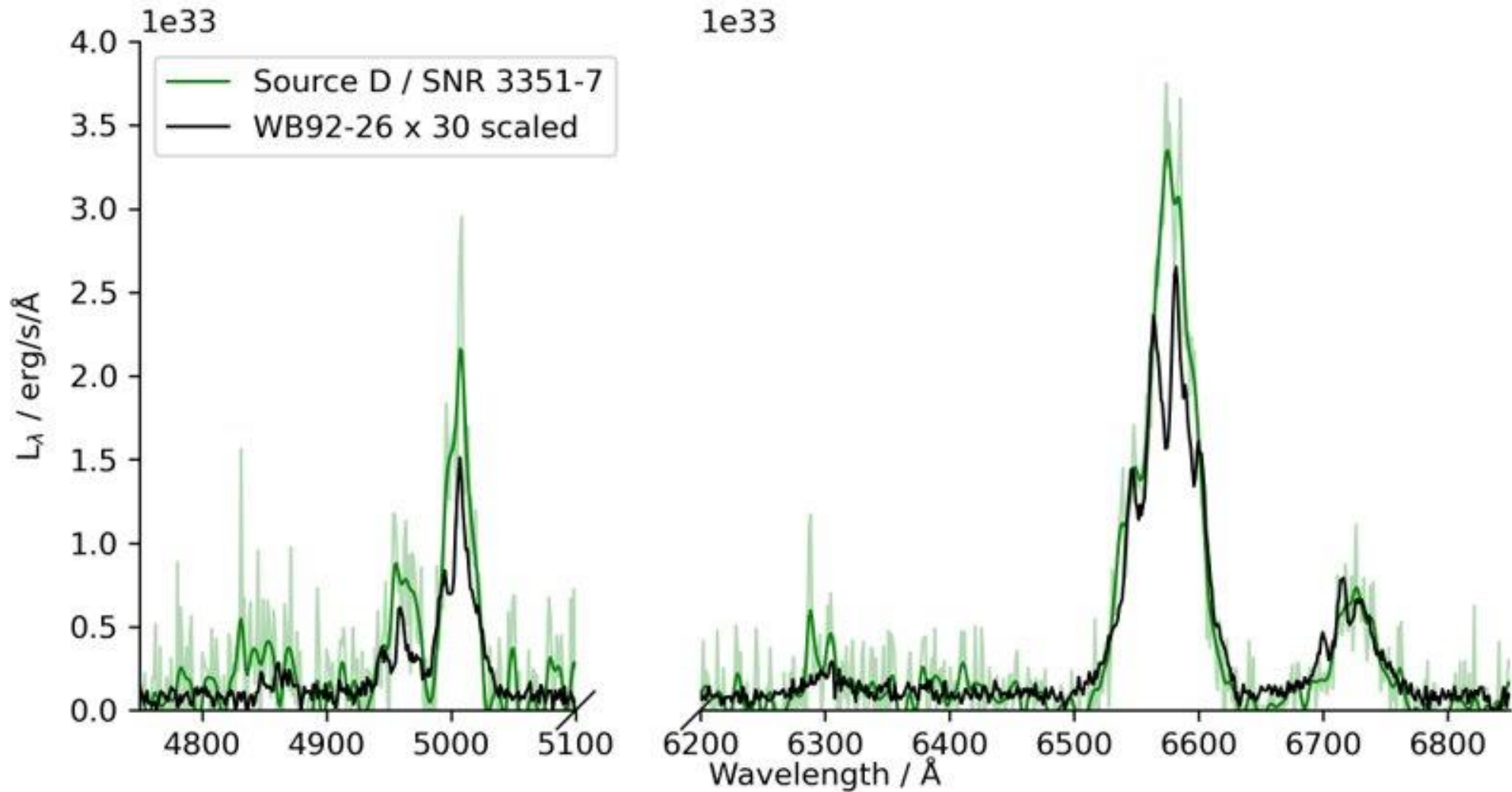
MORE!

# New O-rich SNRs





# WB92-26



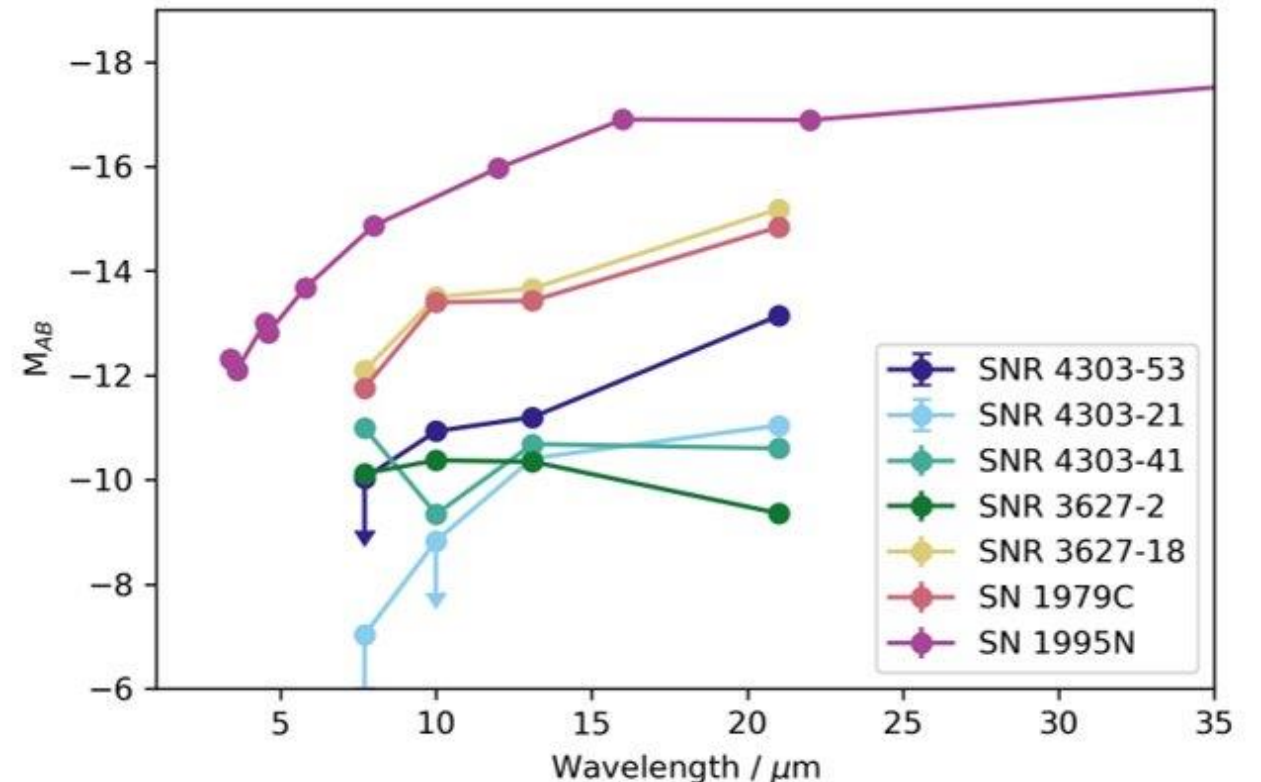
# X-ray observations

- All O-rich SNR host galaxies observed
- Five SNRs detected
- High X-ray luminosities,  $10^{37}$ - $10^{38}$  erg/s
- SNR 4303-53 observed with ROSAT in 1996
- Stable X-ray luminosities over 15 years

Target	Flux 0.5-7.0 keV	Luminosity $10^{37}$ erg/s
4303-53	1.74e-14	54
4303-21	1.21e-15	3.8
3627-2	7.14e-15	7.9
3351-7	4.02e-15	4.81
3627-18	1.22e-14	13.5

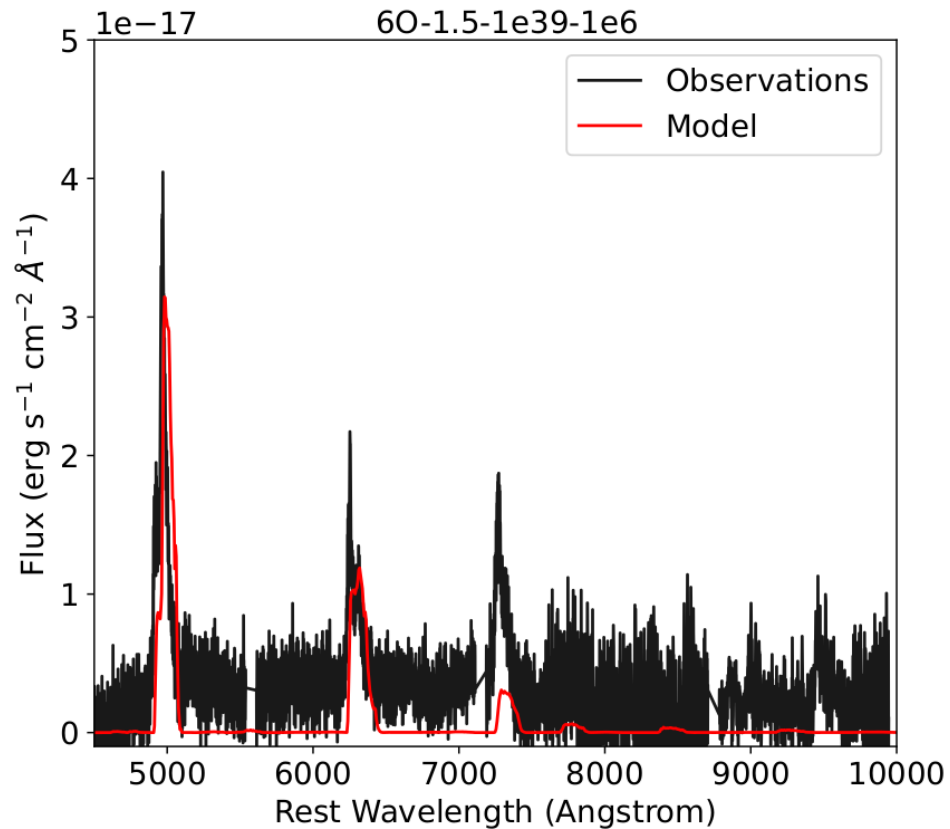
# JWST observations

- Host galaxies observed with JWST as part of PHANGS
- Observations still under way, hosts partially observed
- Mid-IR observations show possible presence of dust

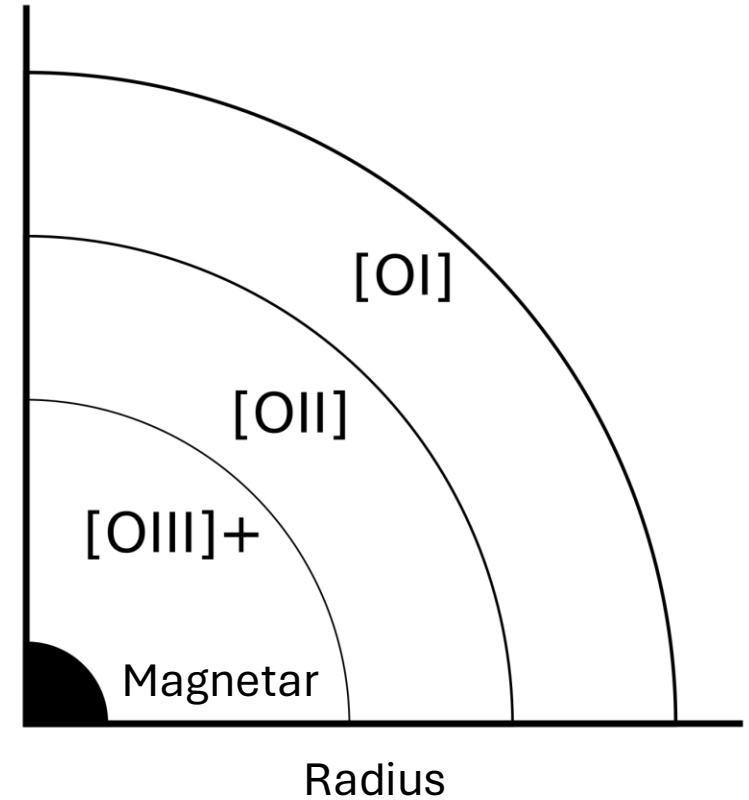


# Powering mechanism

See Conor's poster S3.25!



Omand+23



- Magnetar embedded in O-rich ejecta
- Other metal lines in NUV/IR(?)
  - Mid-IR bright
- X-ray and radio bright

# Summary

- Offset linemaps effectively find broadline SNRs
  - SNR 4449-1 is not alone anymore!
  - WB92-26 another type of SNR
- O-rich remnants bridge the gap between SNe and SNRs
- Follow up with more wavelengths
  - Radio observations, NUV/IR spectra
  - Test powering models
- Find more of them!
  - 8th found in another dataset

# SN1926A connection?

