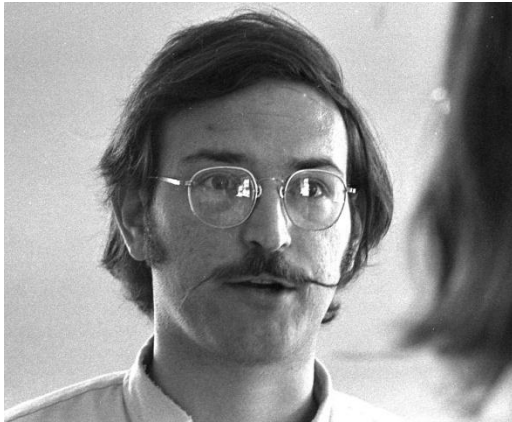


# 4He Abundances: Optical vs Radio

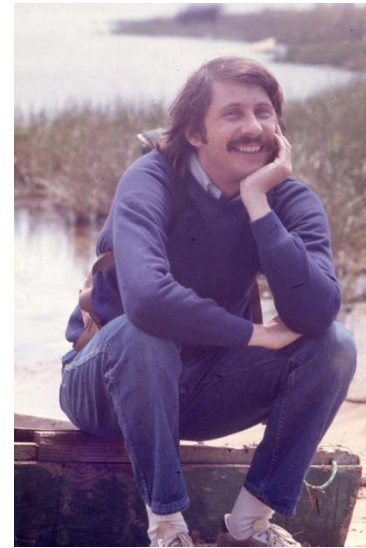
Dana S. Balser



# Collaborators



Tom Bania

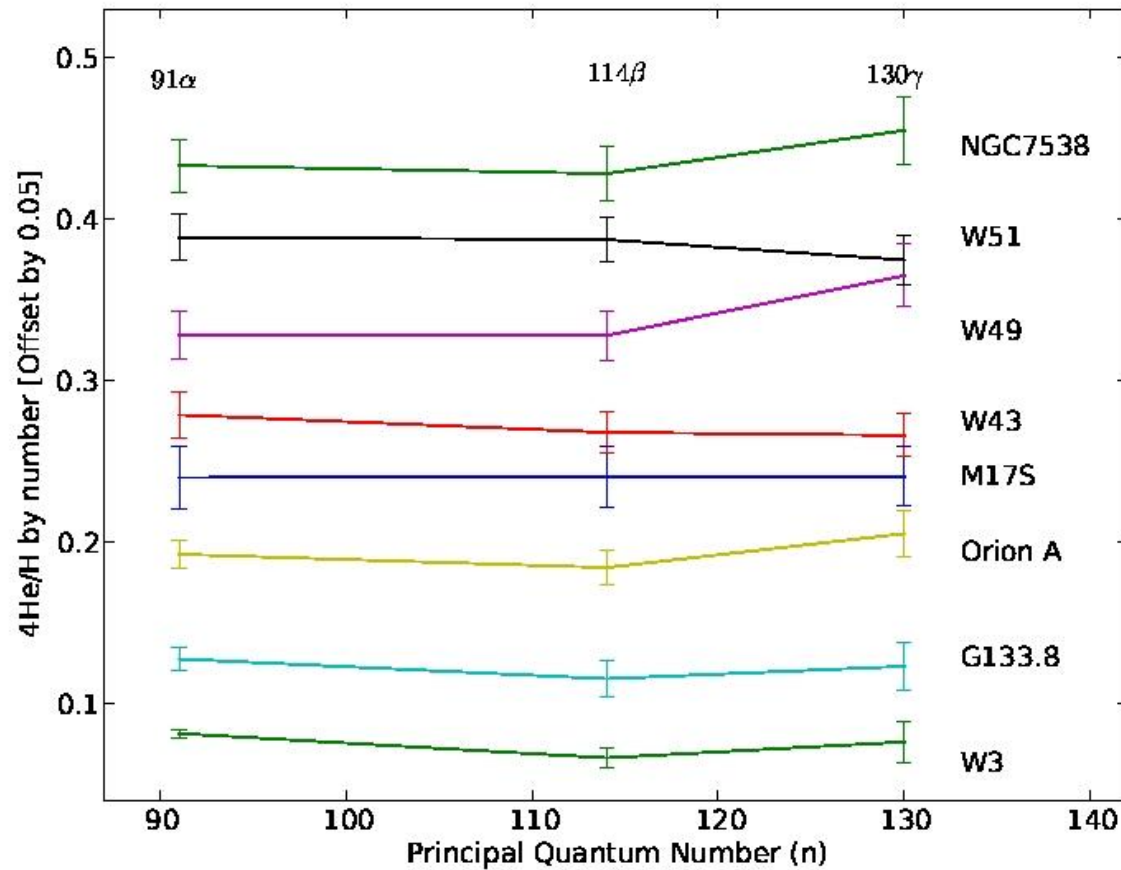


Bob Rood

## Radio Recombination Lines

- Sensitivity
- Spectral Baselines
- Departures from LTE
- Ionization Structure
- Density Structure

# 4He/H: RRLs with the 140 Foot Telescope



Peimbert et al. (1992)

# Green Bank Telescope Observations



GBT HPBW = 80" at 9 GHz

H and He  $87\alpha - 93\alpha$

Planetary Nebulae :

NGC 3242

NGC 6543

NGC 6826

NGC 7009

HII Regions :

M17

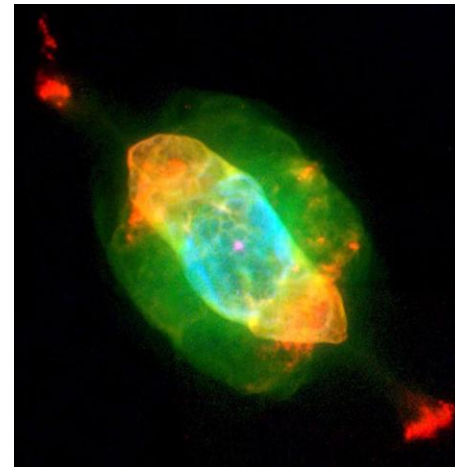
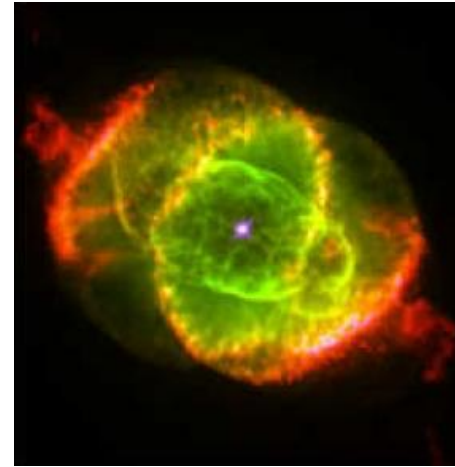
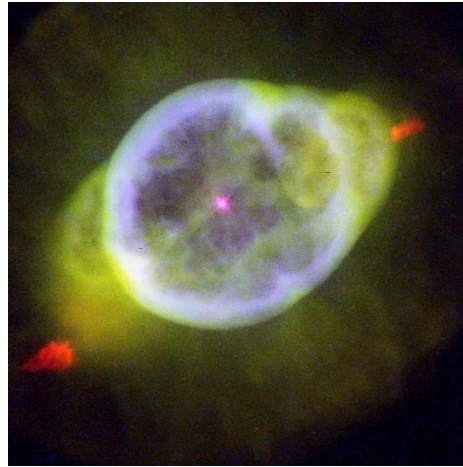
S206

# Planetary Nebulae

NGC 3242

NGC 6543

50''

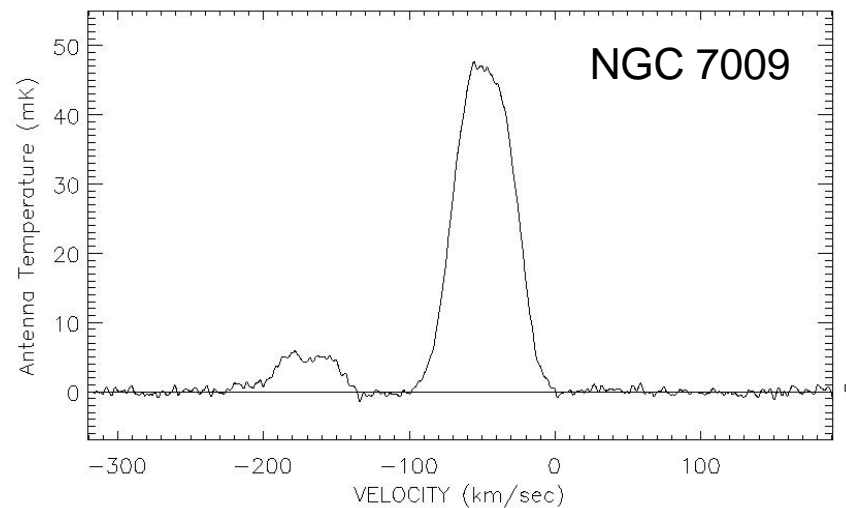
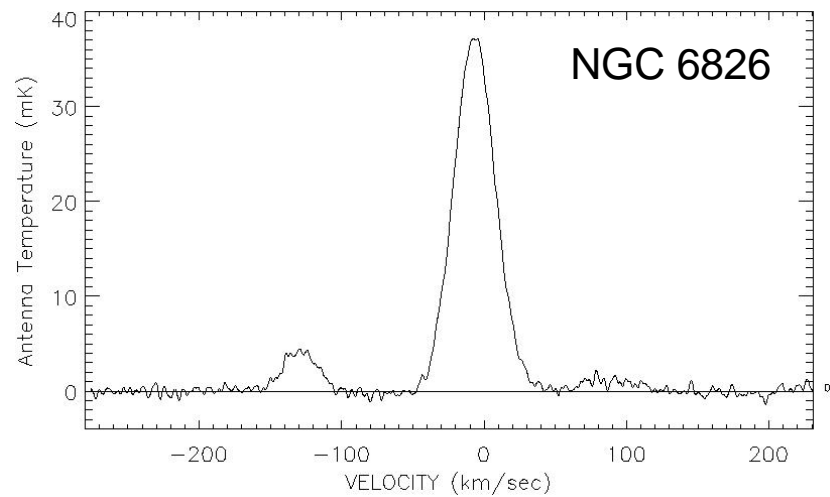
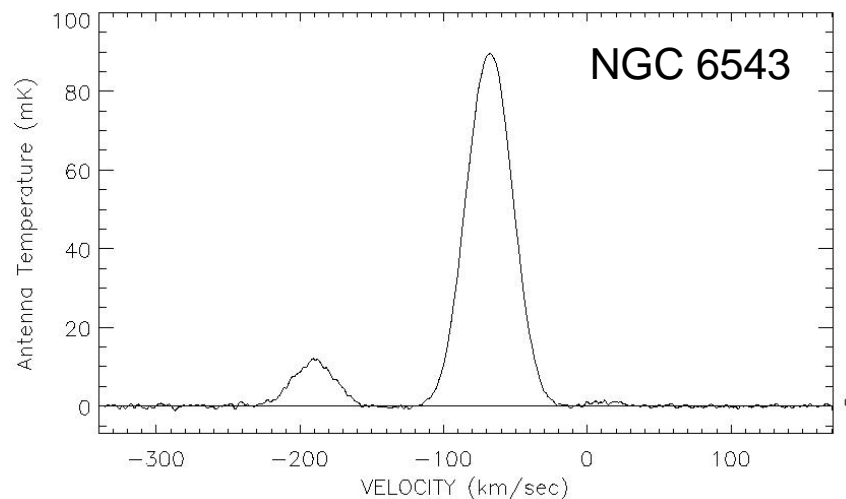
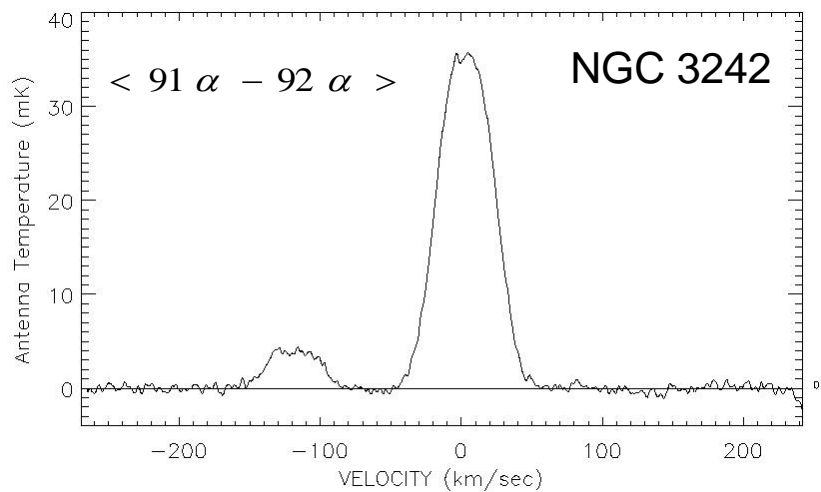


NGC 6826

NGC 7009

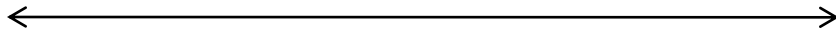
Balick et al.

# GBT: PNe Radio Recombination Lines



# HII Regions: M17

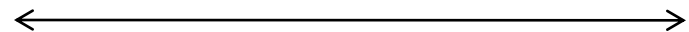
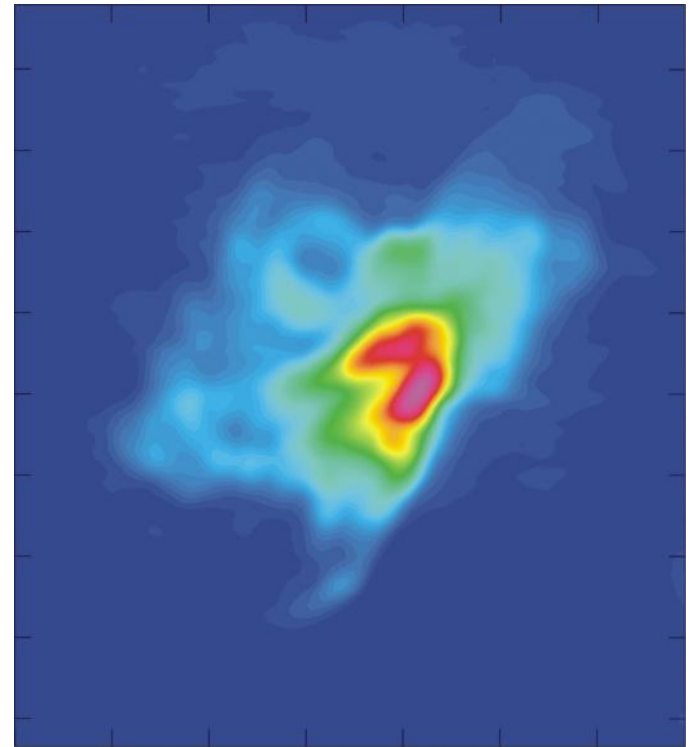
Optical (H $\alpha$ )



30'

MacQuarrie

Radio Continuum (9GHz)



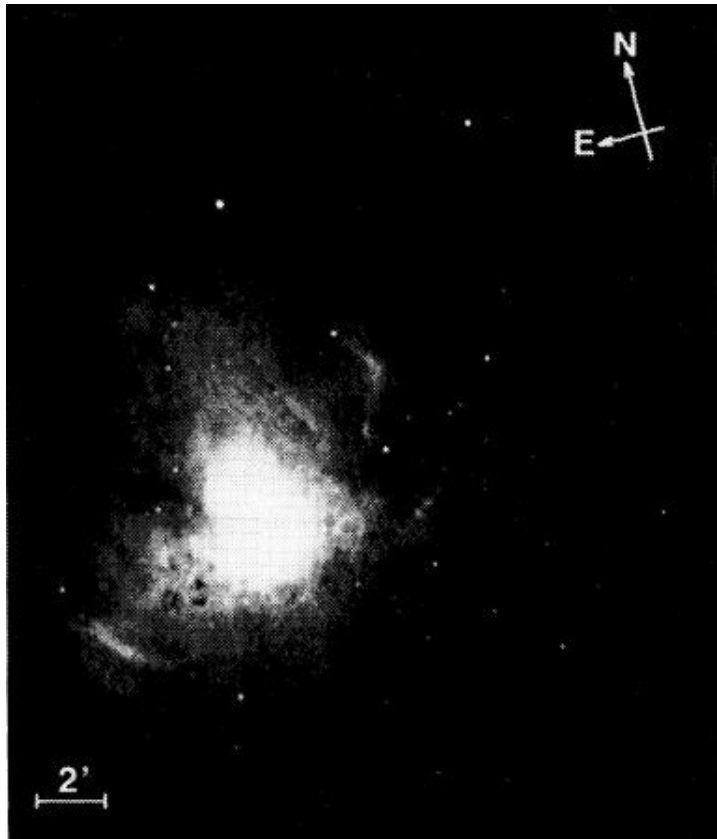
60'

Maddalena et al.



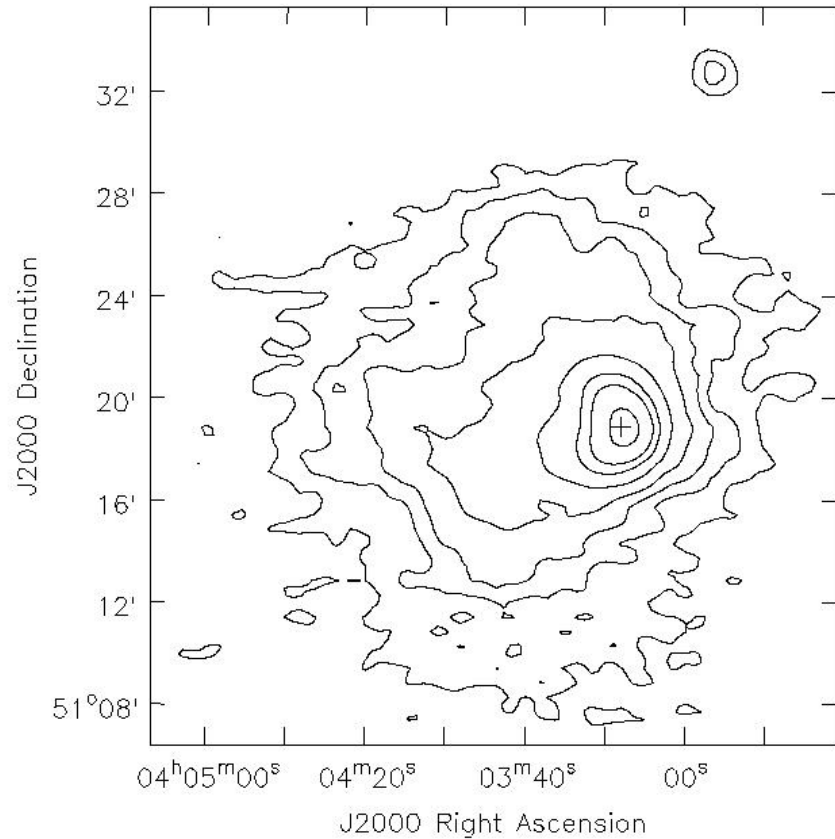
# HII Regions: S206

Optical (H $\alpha$ )



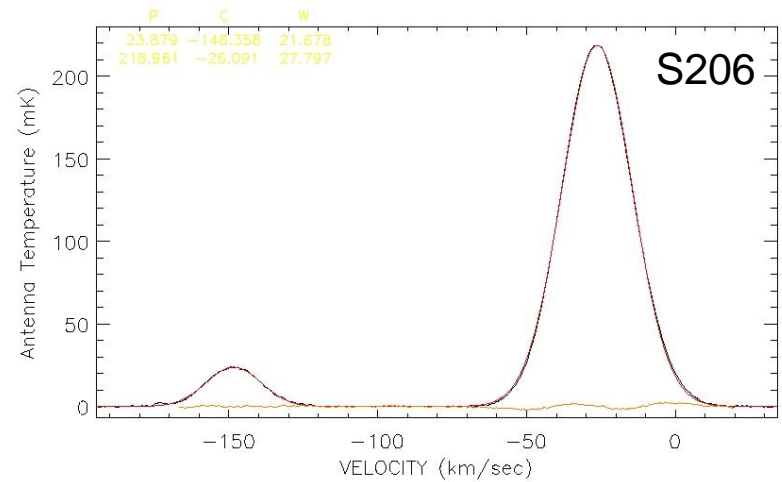
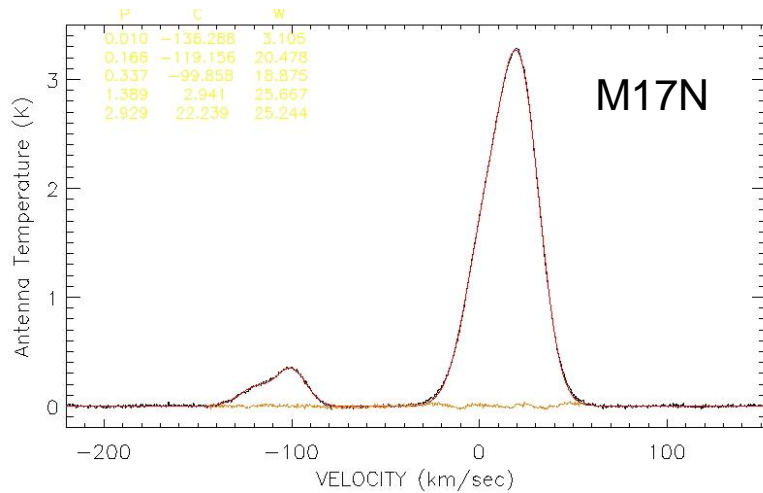
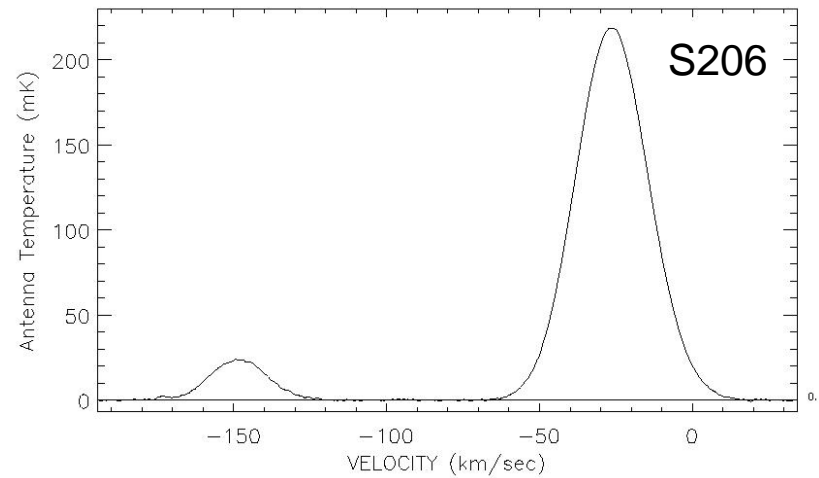
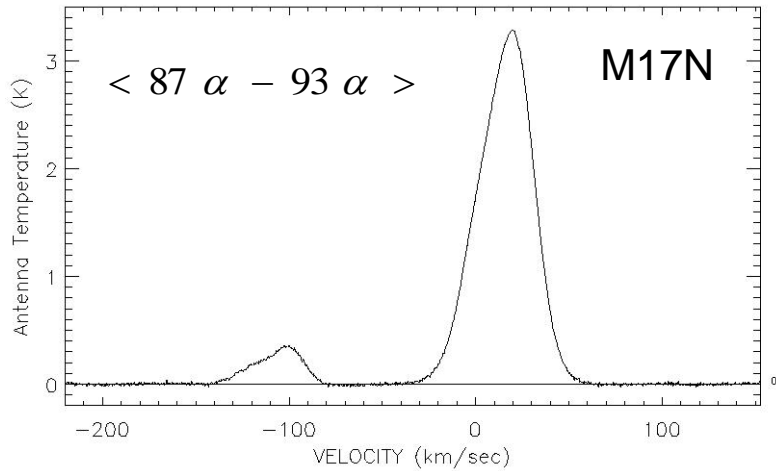
Pismis & Mampaso (1991)

Radio Continuum (9 GHz)

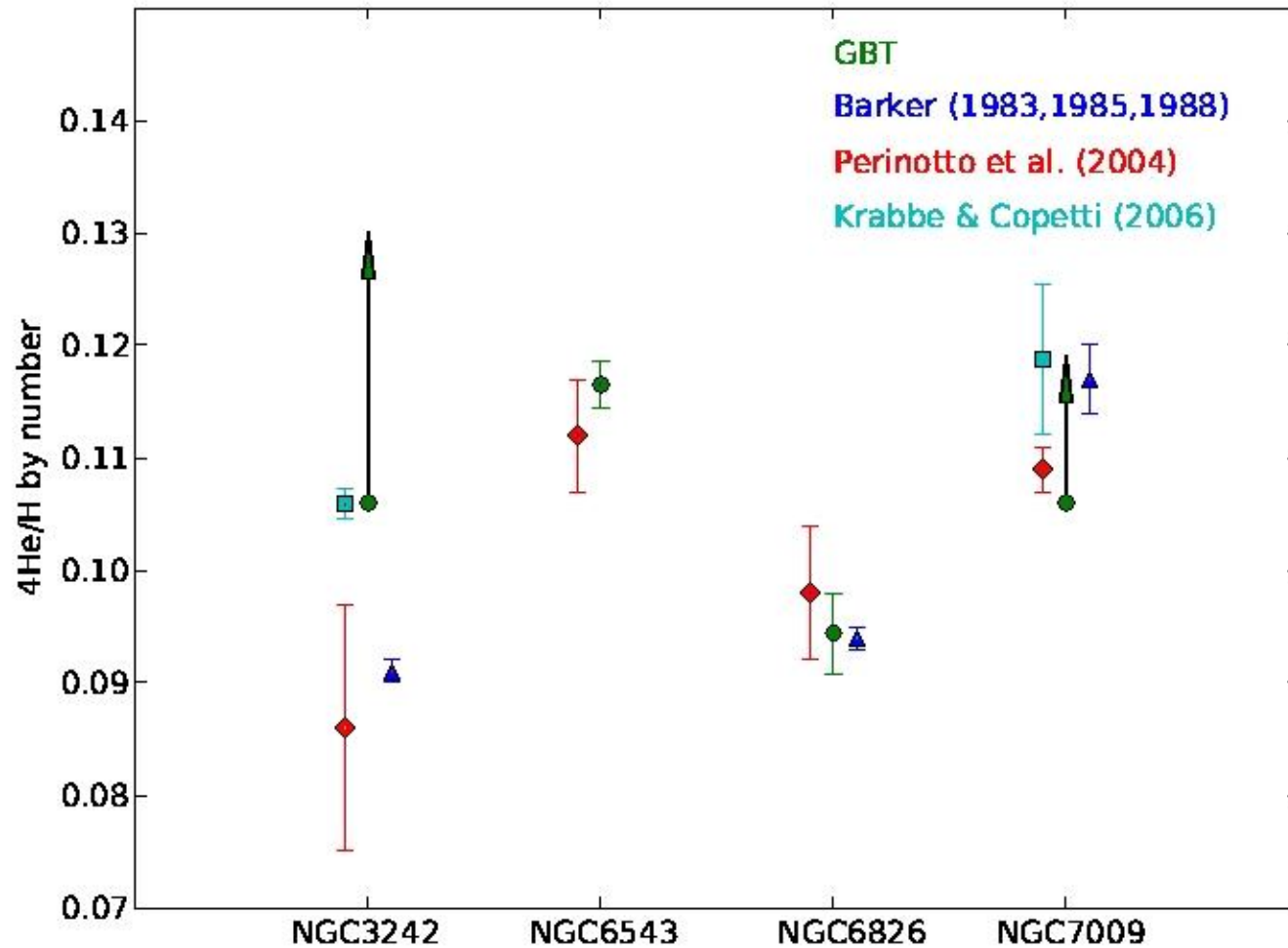


Balser (2006)

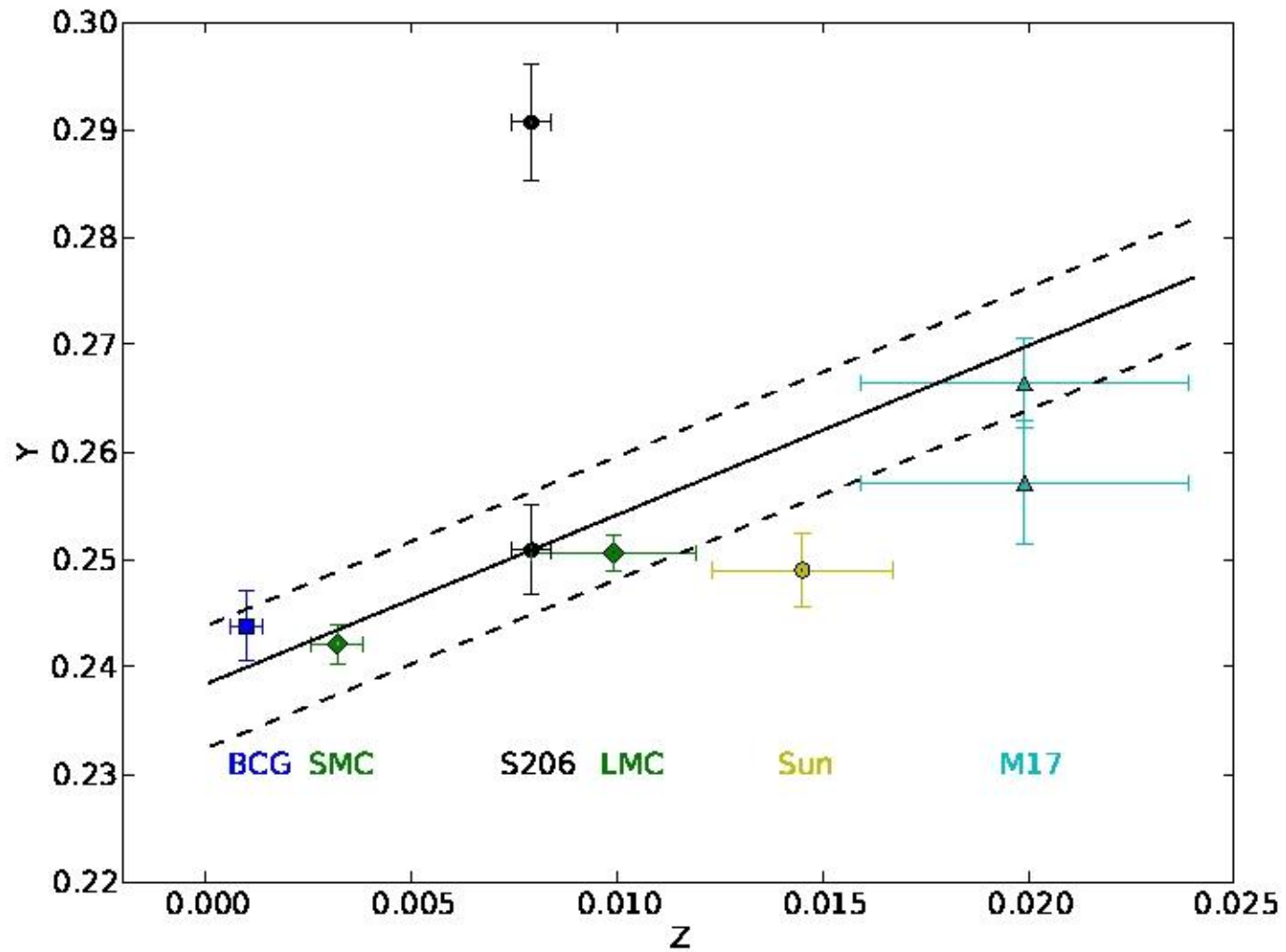
# GBT: HII Region Radio Recombination Lines



# 4He/H: Planetary Nebulae



# 4He/H: HII Regions



## Summary

- $4\text{He}/\text{H}$  differences as large as 20% between Optical and Radio
- Galactic  $dY/dZ \sim 1$  (M17, S206)

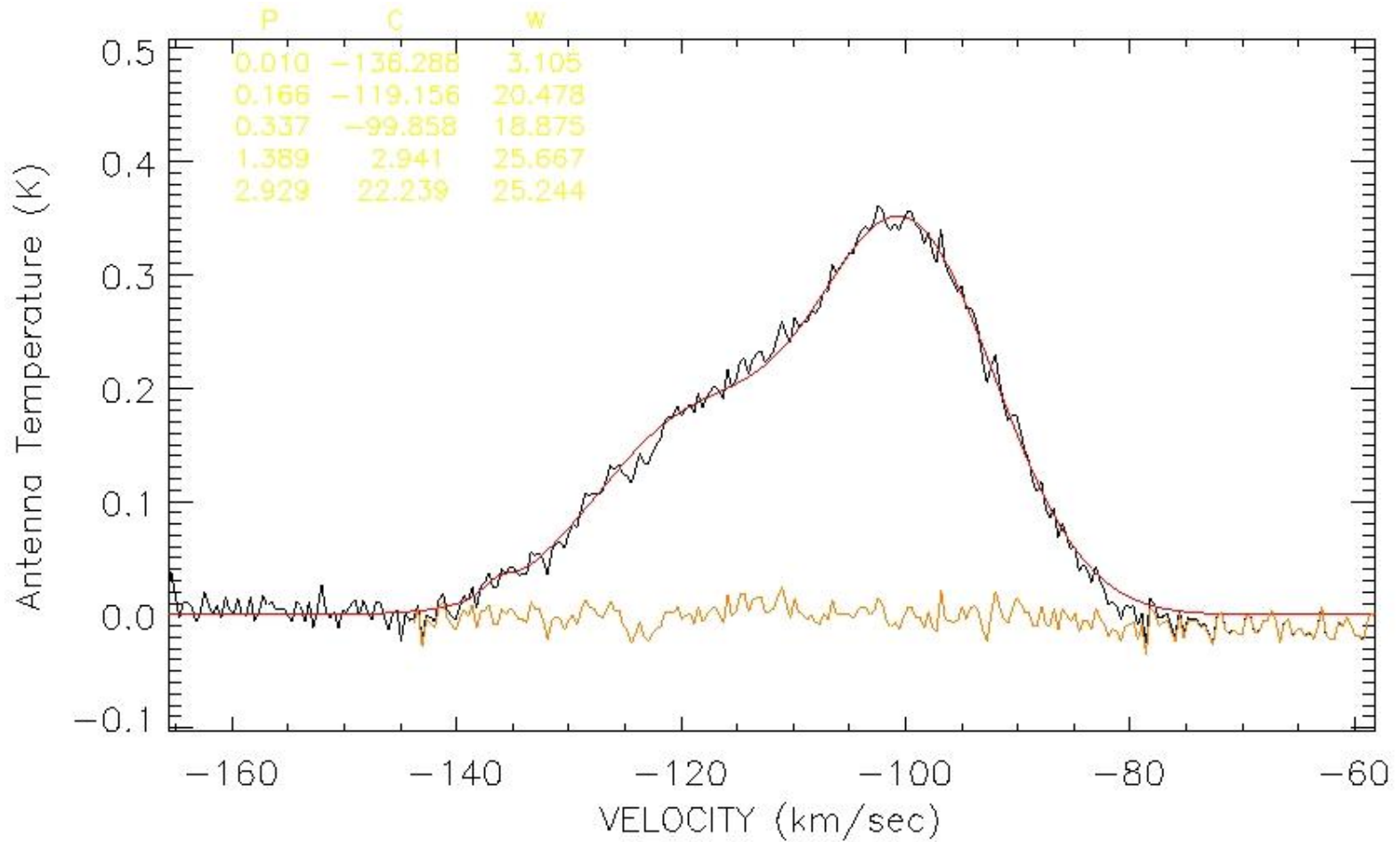
## Future Work

- Explore  $4\text{He}/\text{H}$  with  $n$
- Models of PNe and HII Regions
- EVLA



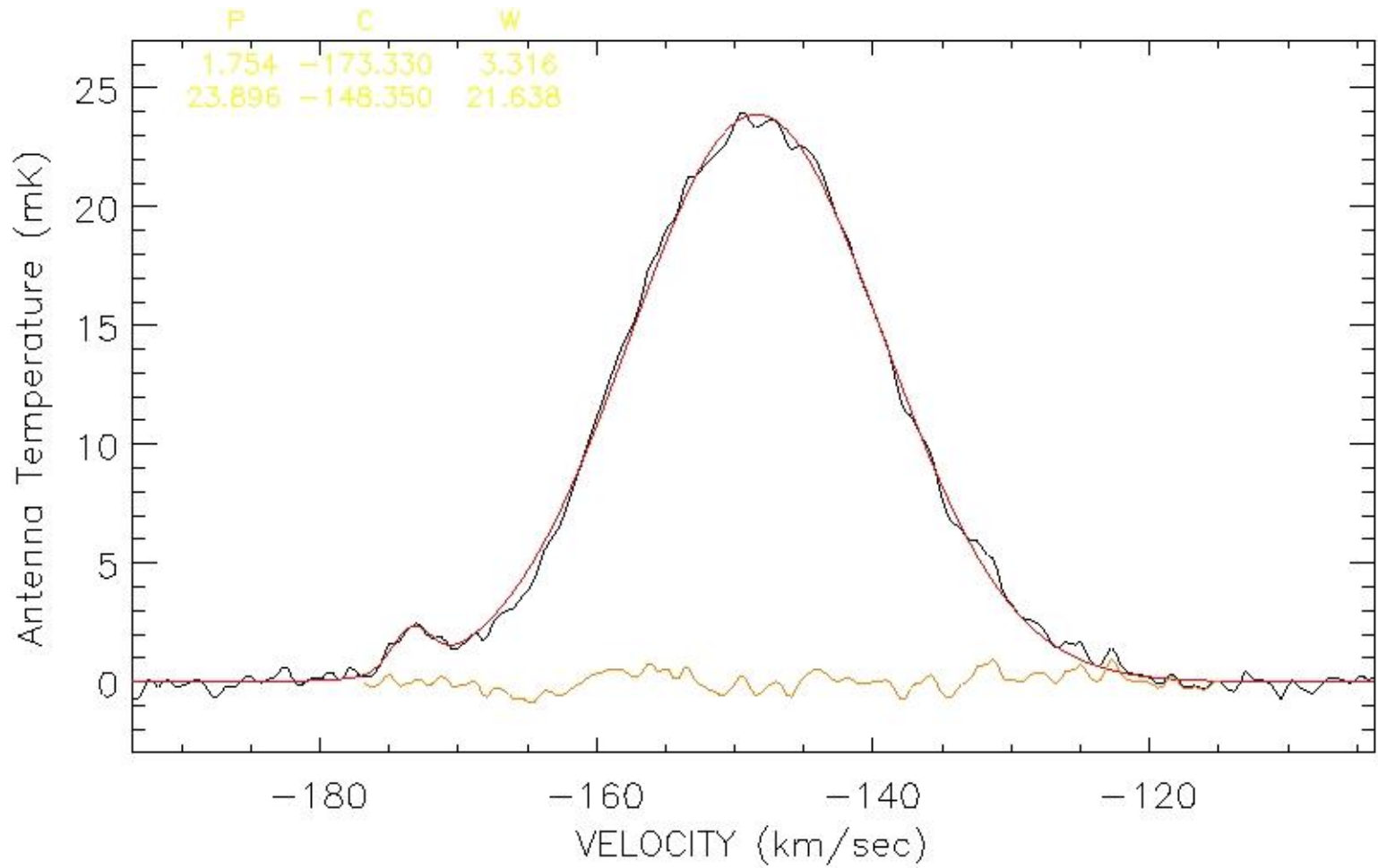
# Extra Slides

# Expanded View: M17N

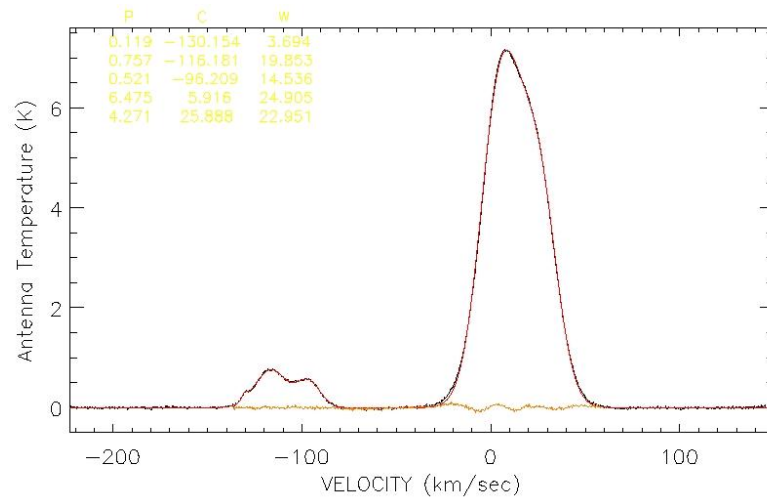
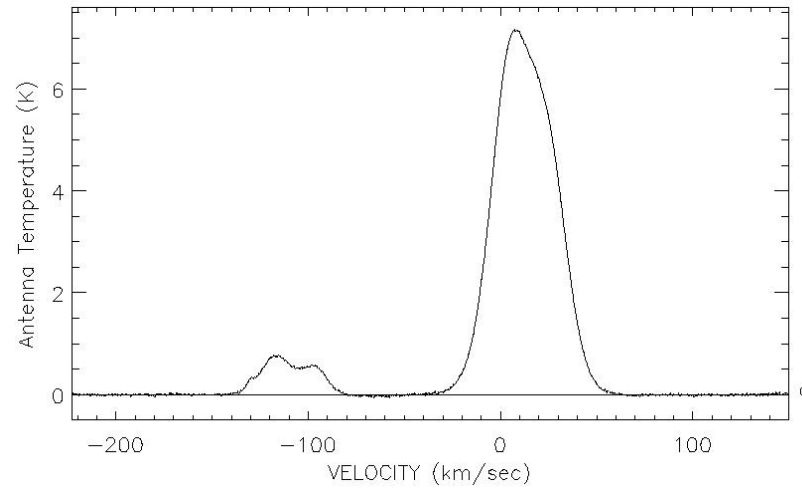




# Expanded View: S206



# M17S



# Expanded View: M17S

