The University of Sydney

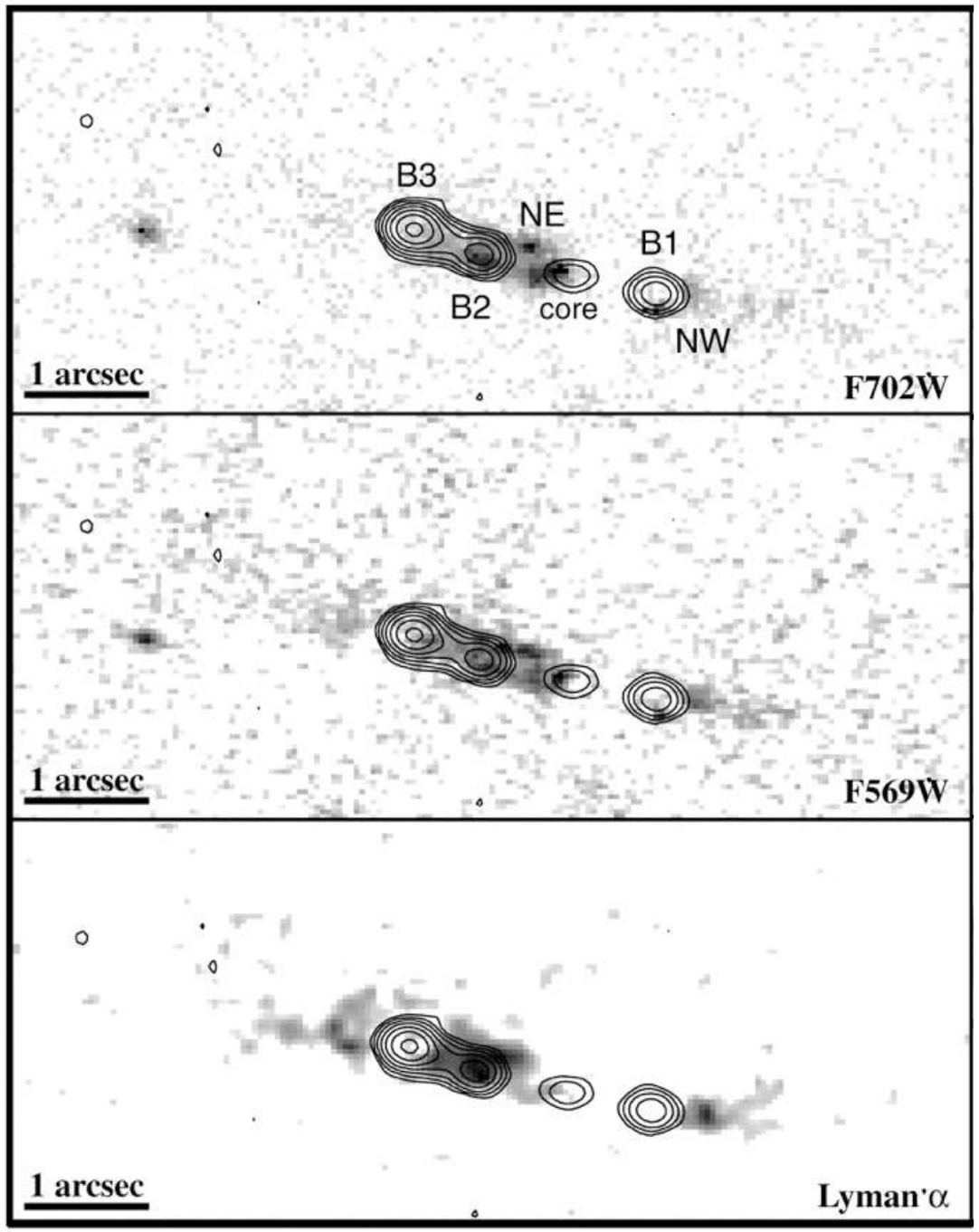
Shock Induced Star-formation in the Outer Filament of Cen A

Simon Ellis

Joss Bland-Hawthorn, Ralph Sutherland, Sylvain Veilleux

Michael McDonald, Ed Cackett, Ilana Feain, Alice Quillen

Jet Induced Star-formation at high z



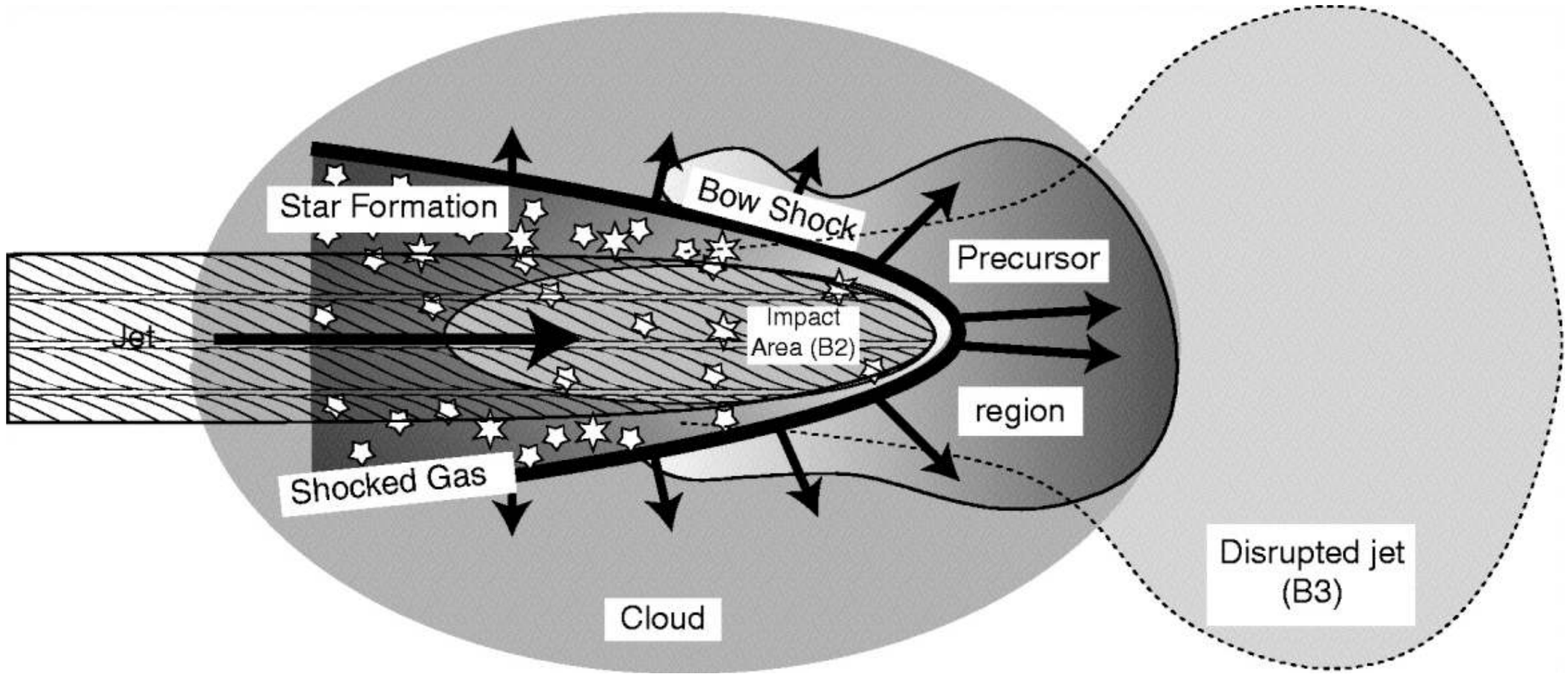
Bicknell et al. 2000

4C 41.17
z = 3.8

UV emission is aligned with non-thermal radio emission

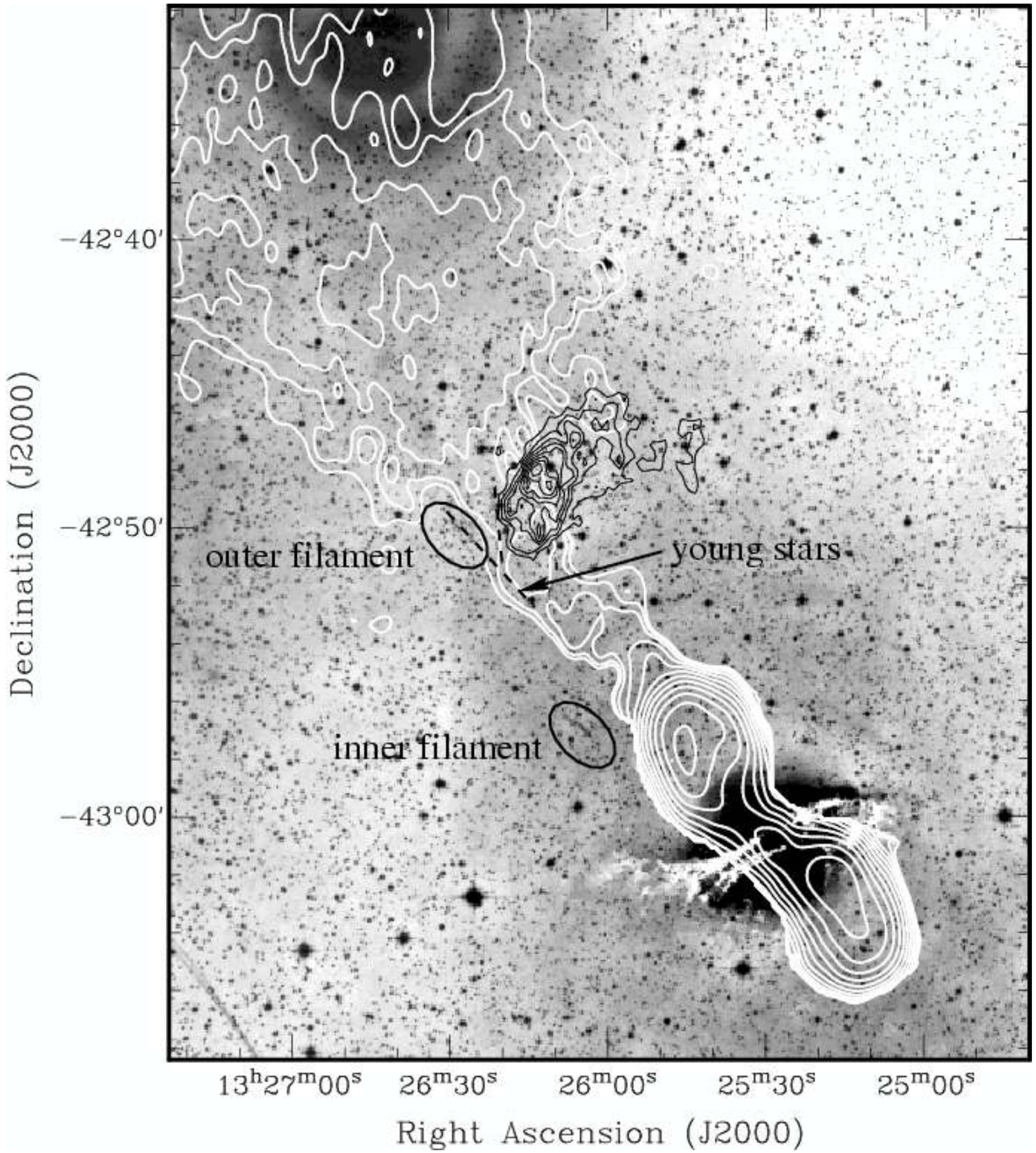
Jet-induced star-formation

Jet Induced Star-formation at high *z*



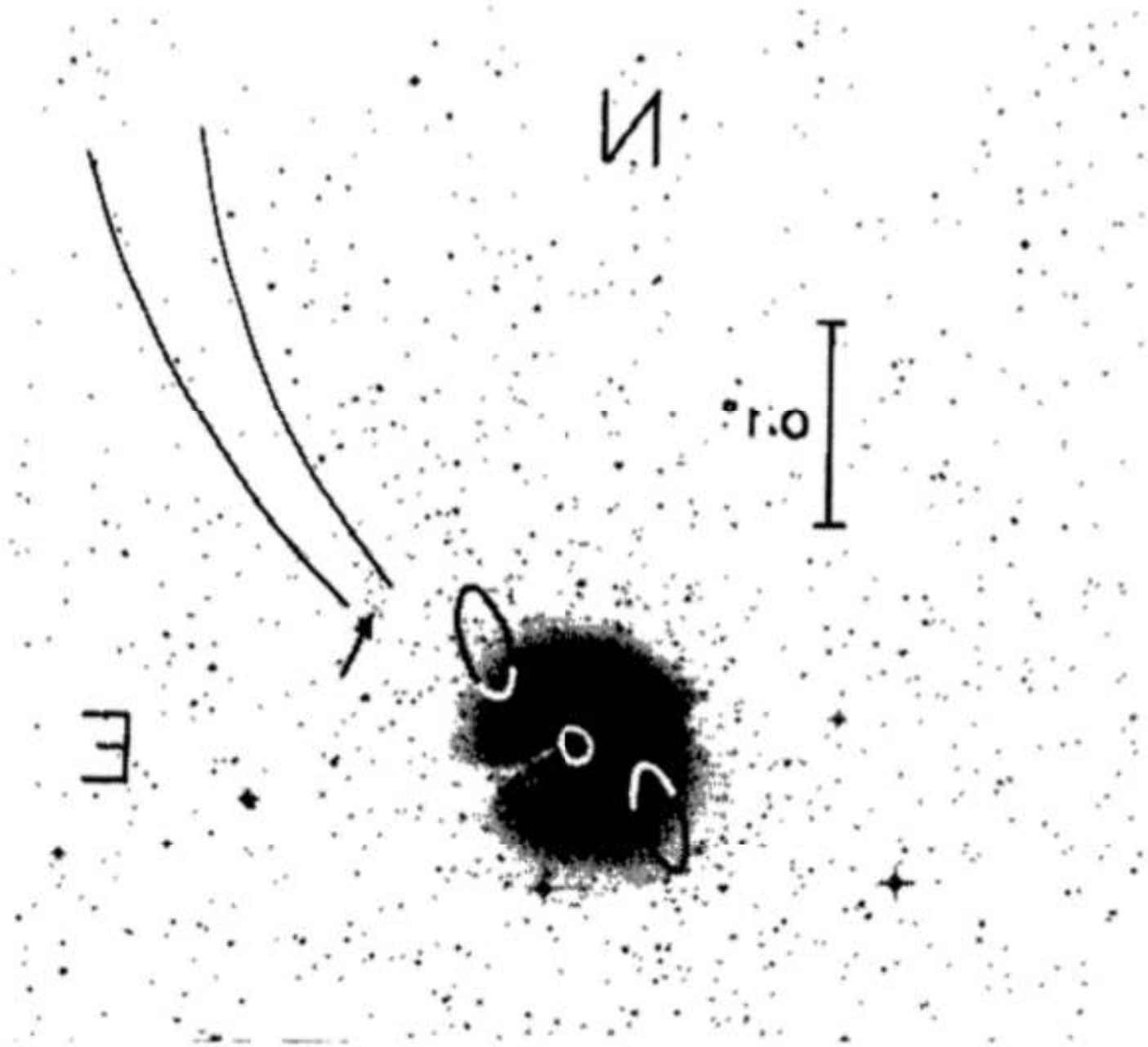
Bicknell et al. 2000

Jet Induced Star-formation at low z - Cen A



Oosterloo et al. 2005

The Outer Filament



Peterson, Dickens & Cannon 1975

The Outer Filament

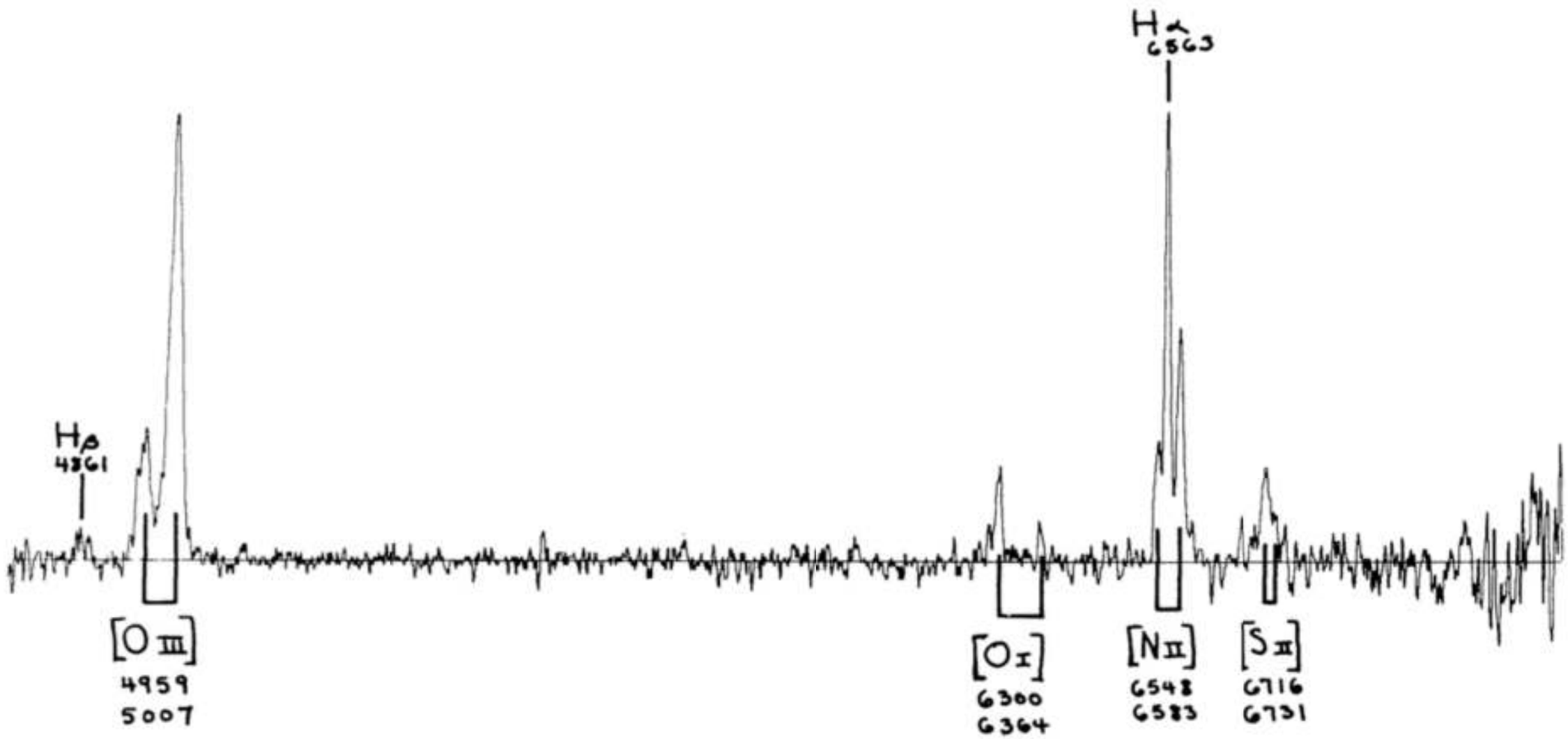


Figure 2. Spectrum of the knot in the optical filament of Cen A. The spectrum was obtained in March 1975 with the Image Dissector Scanner on the 4-metre Anglo-Australian Telescope.

Peterson, Dickens & Cannon 1975

The Outer Filament

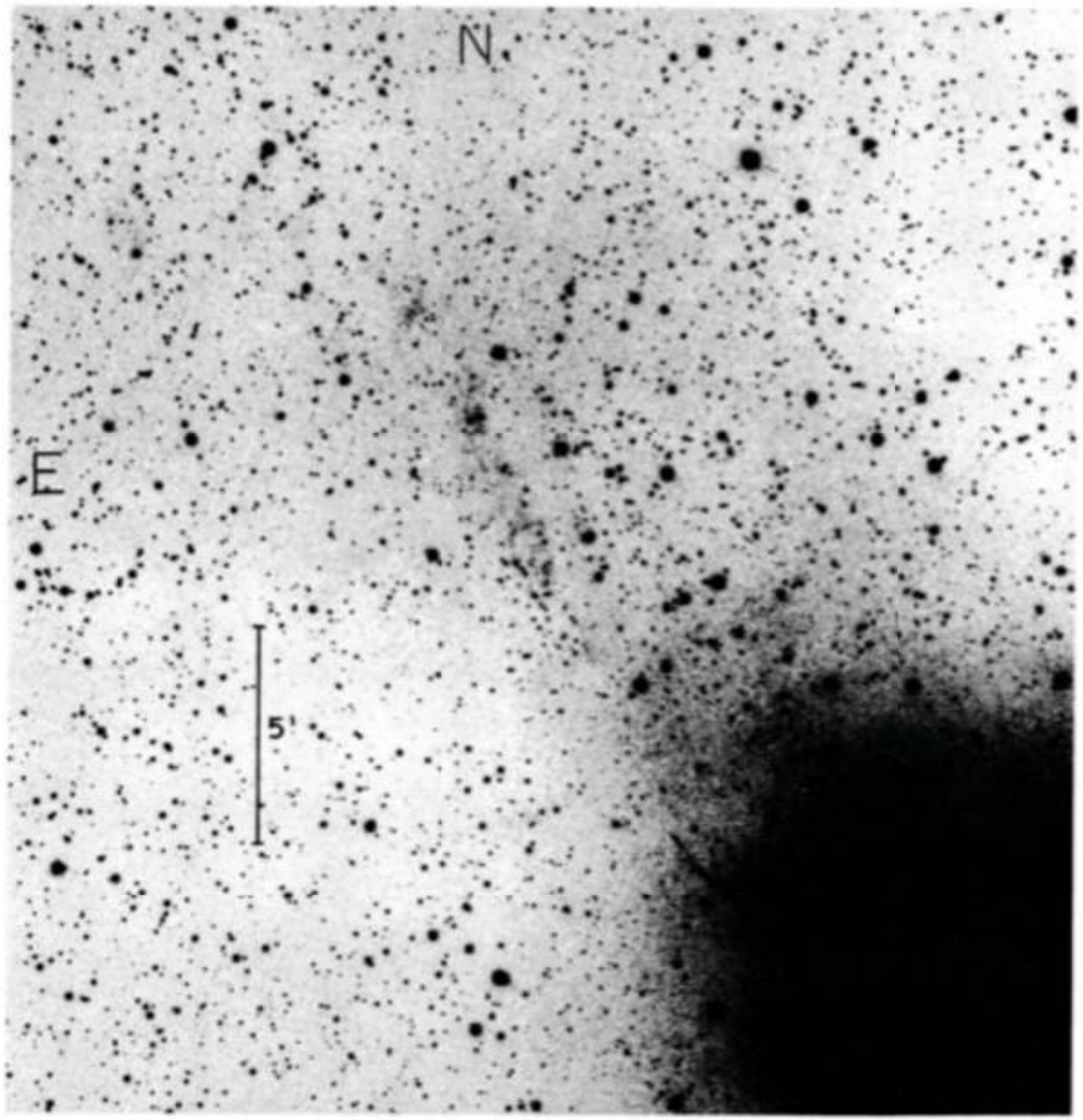
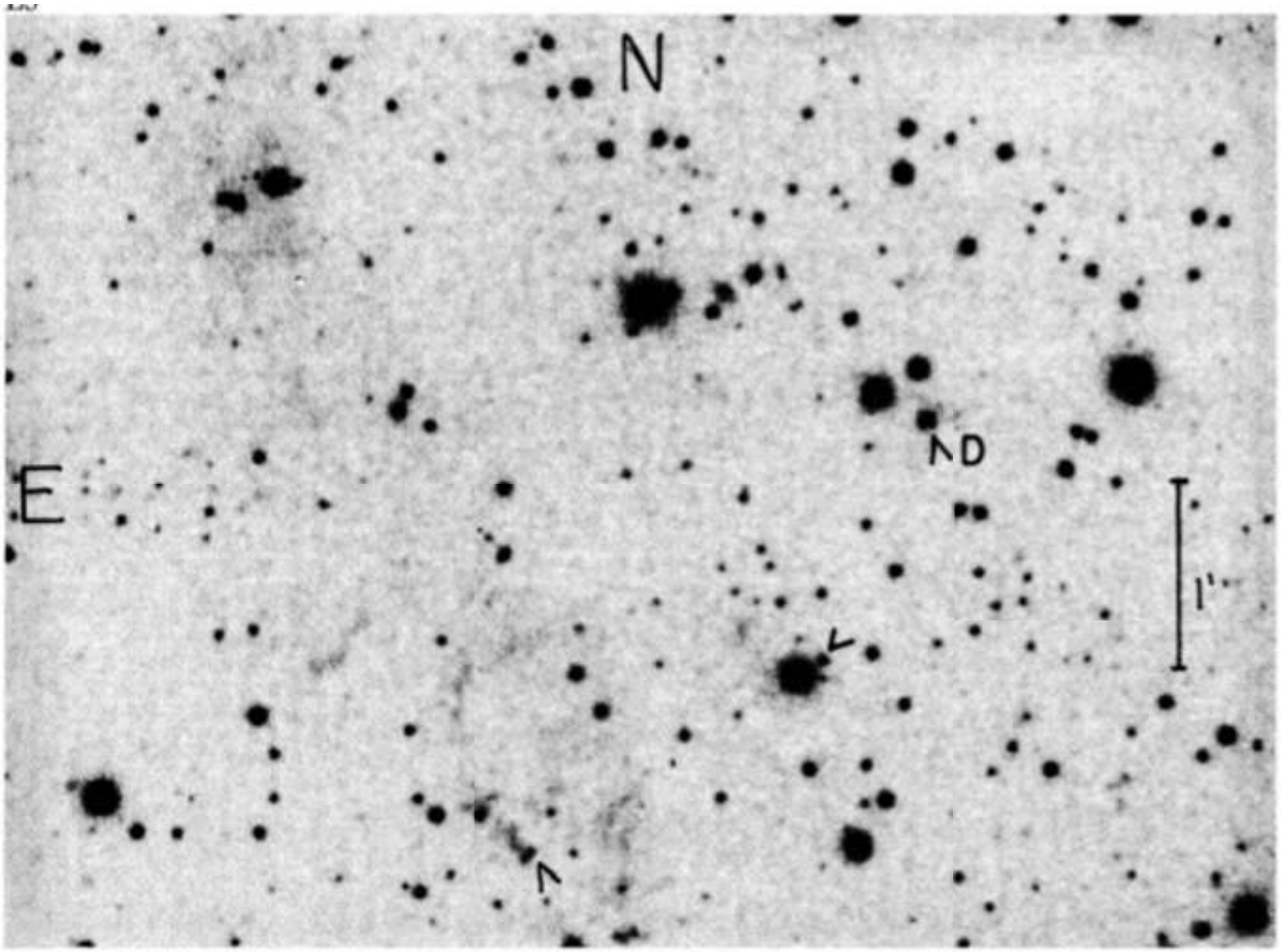


FIG. 1.—Hα interference filter photograph of the filamentary structure extending from NGC 5128

Hα filaments observed

Blanco et al. 1975

The Outer Filament



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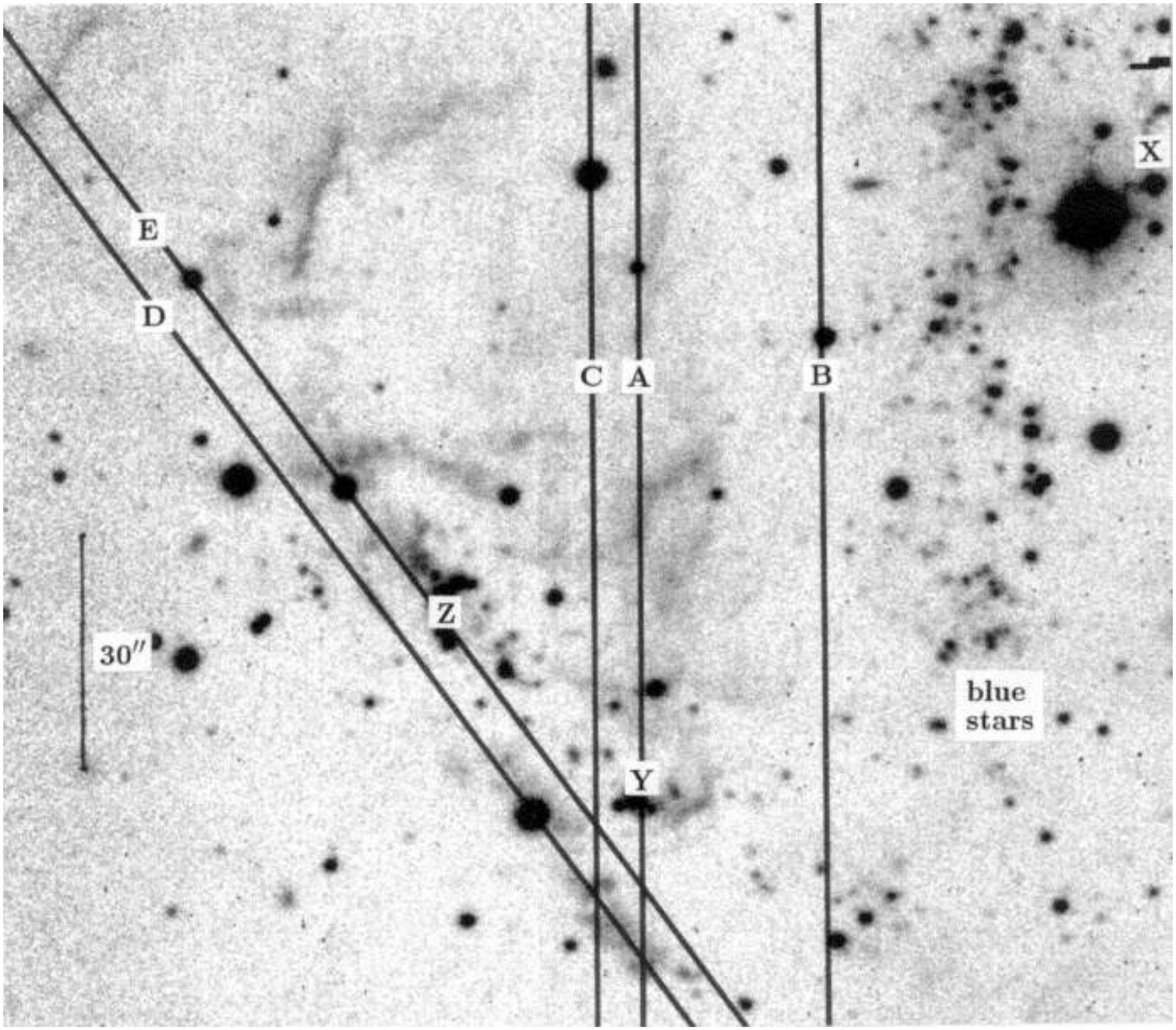
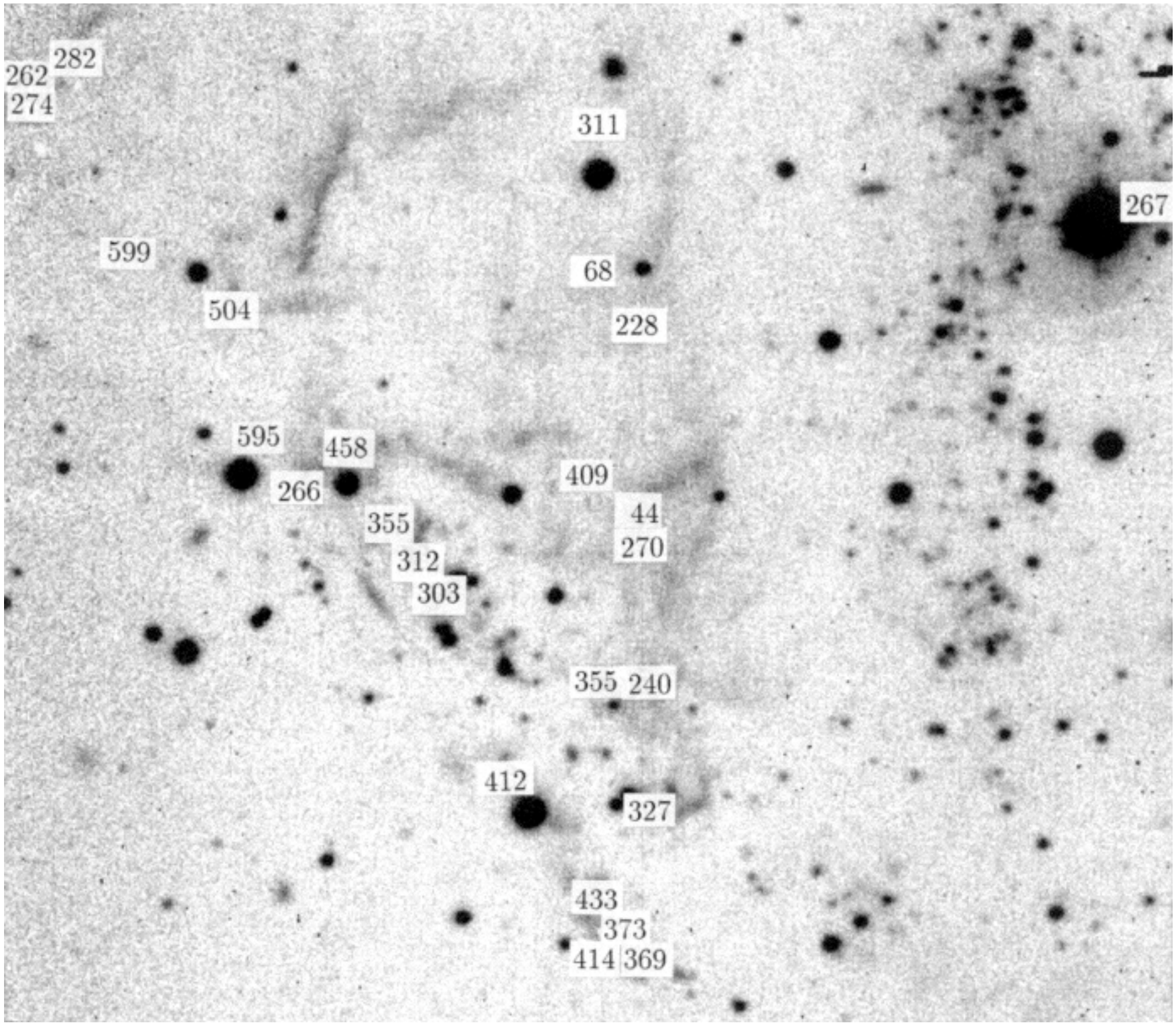


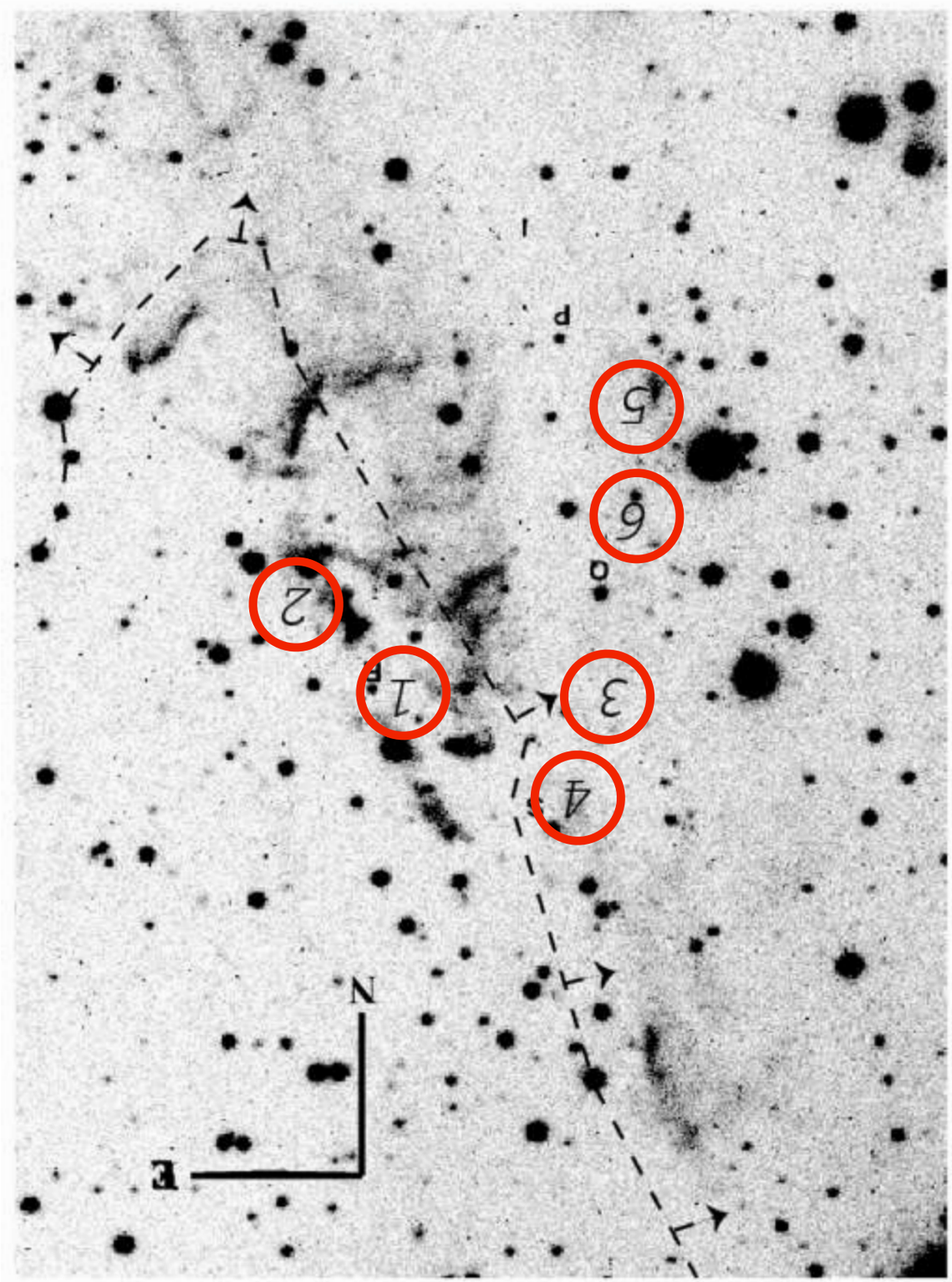
Graham 1998

The Outer Filament



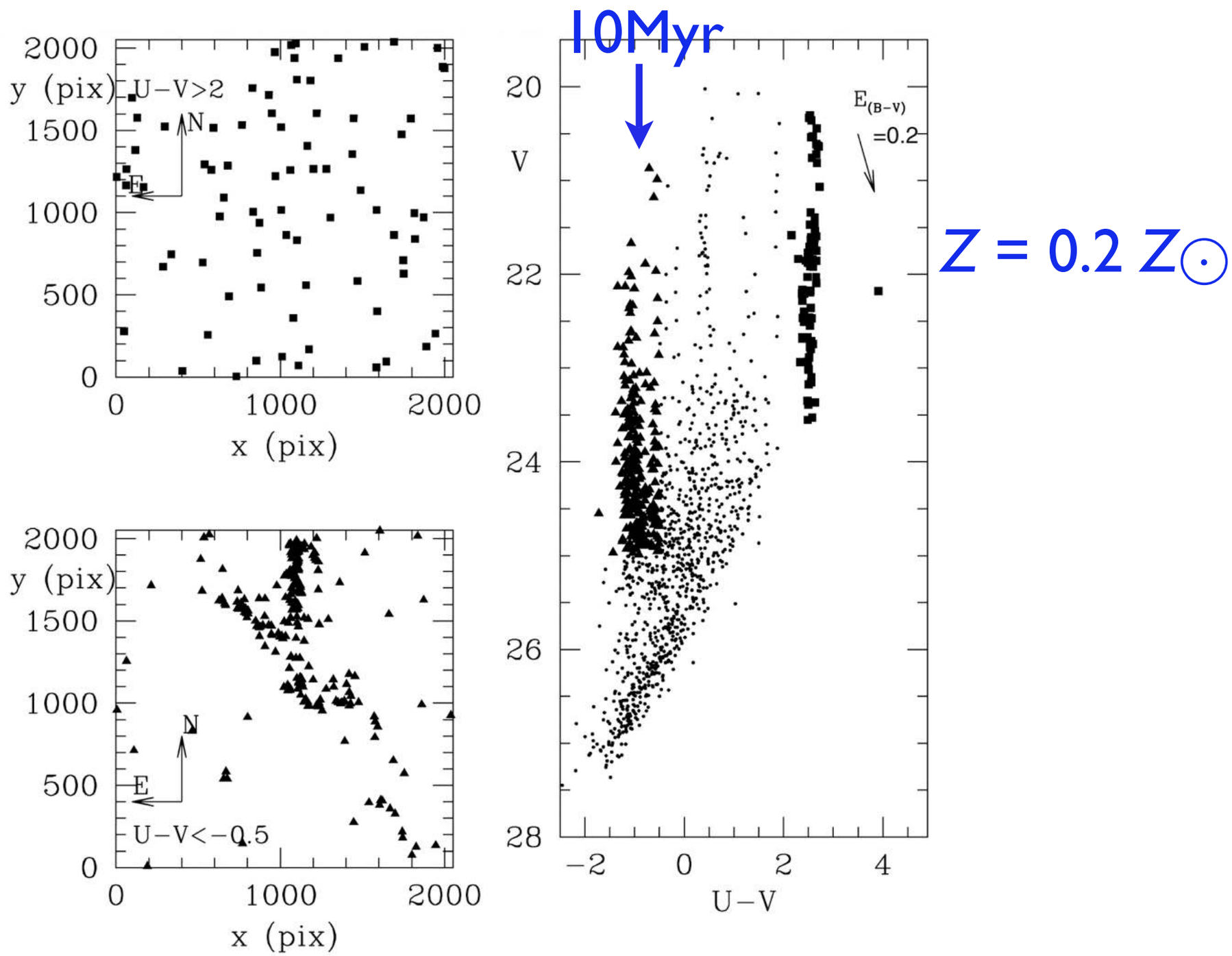
Graham 1998

Jet Induced Star-formation at low z - Cen A



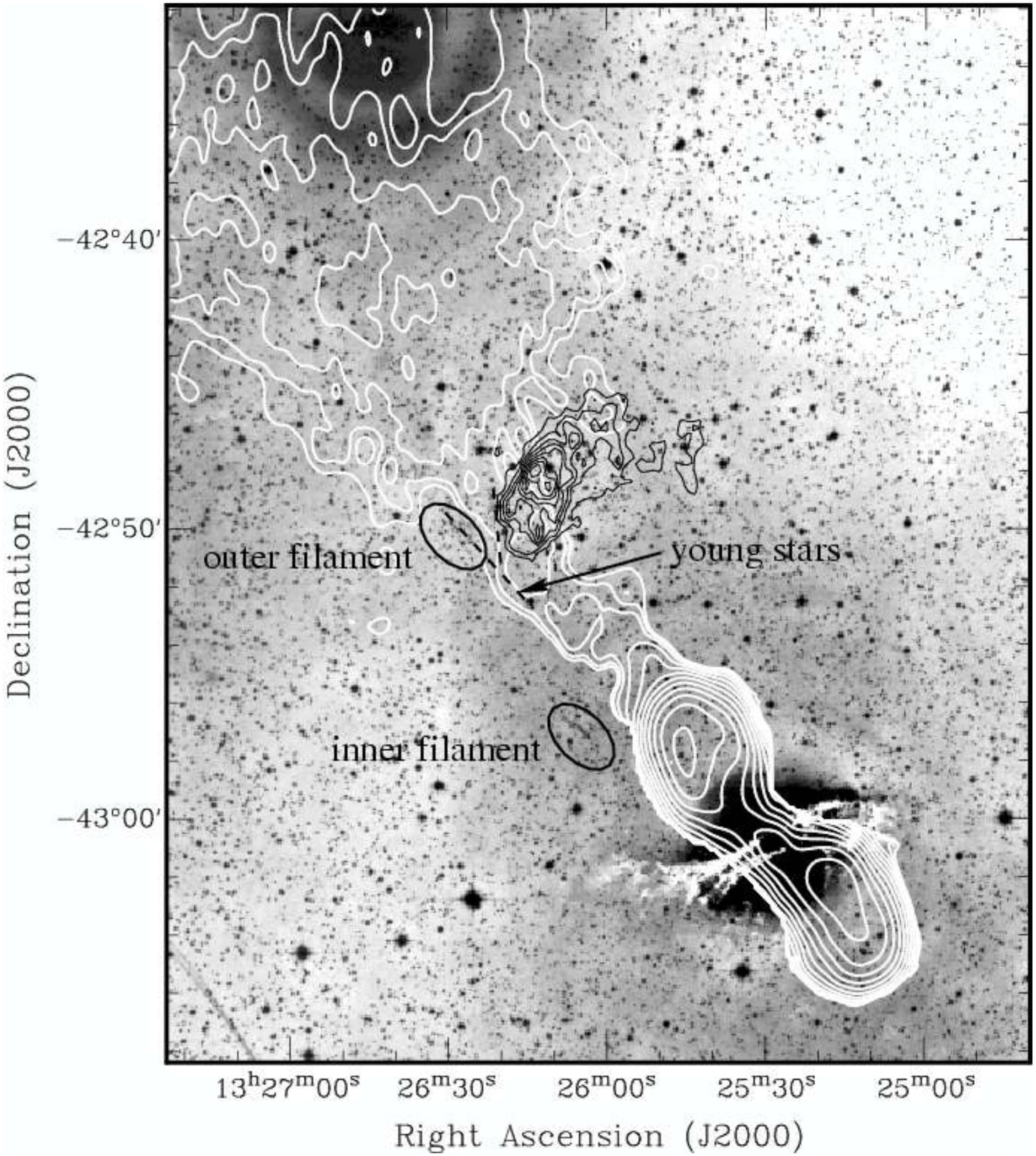
Mould et al. 2000

Jet Induced Star-formation at low z - Cen A



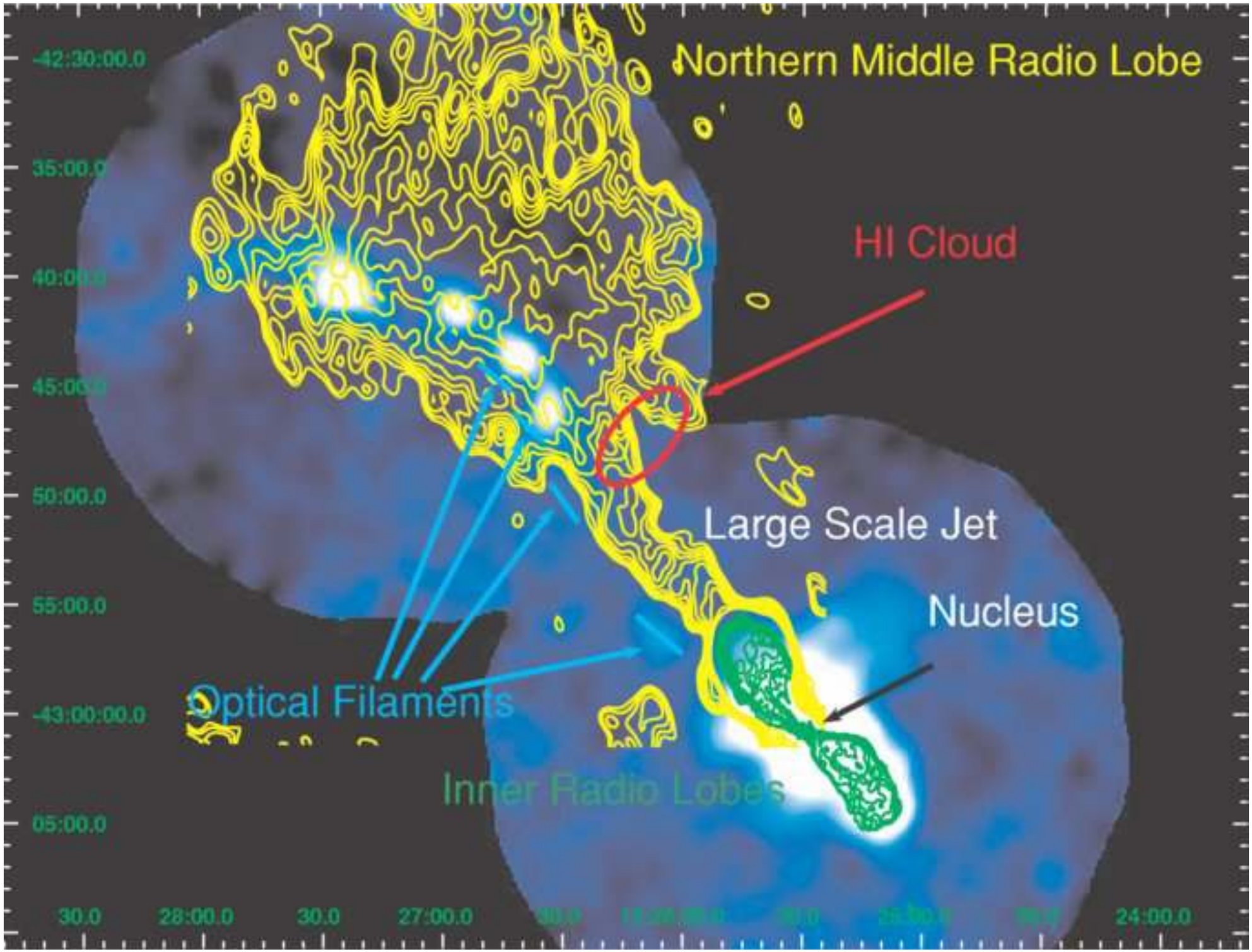
Rejkuba et al. 2002

Jet Interaction with HI Cloud



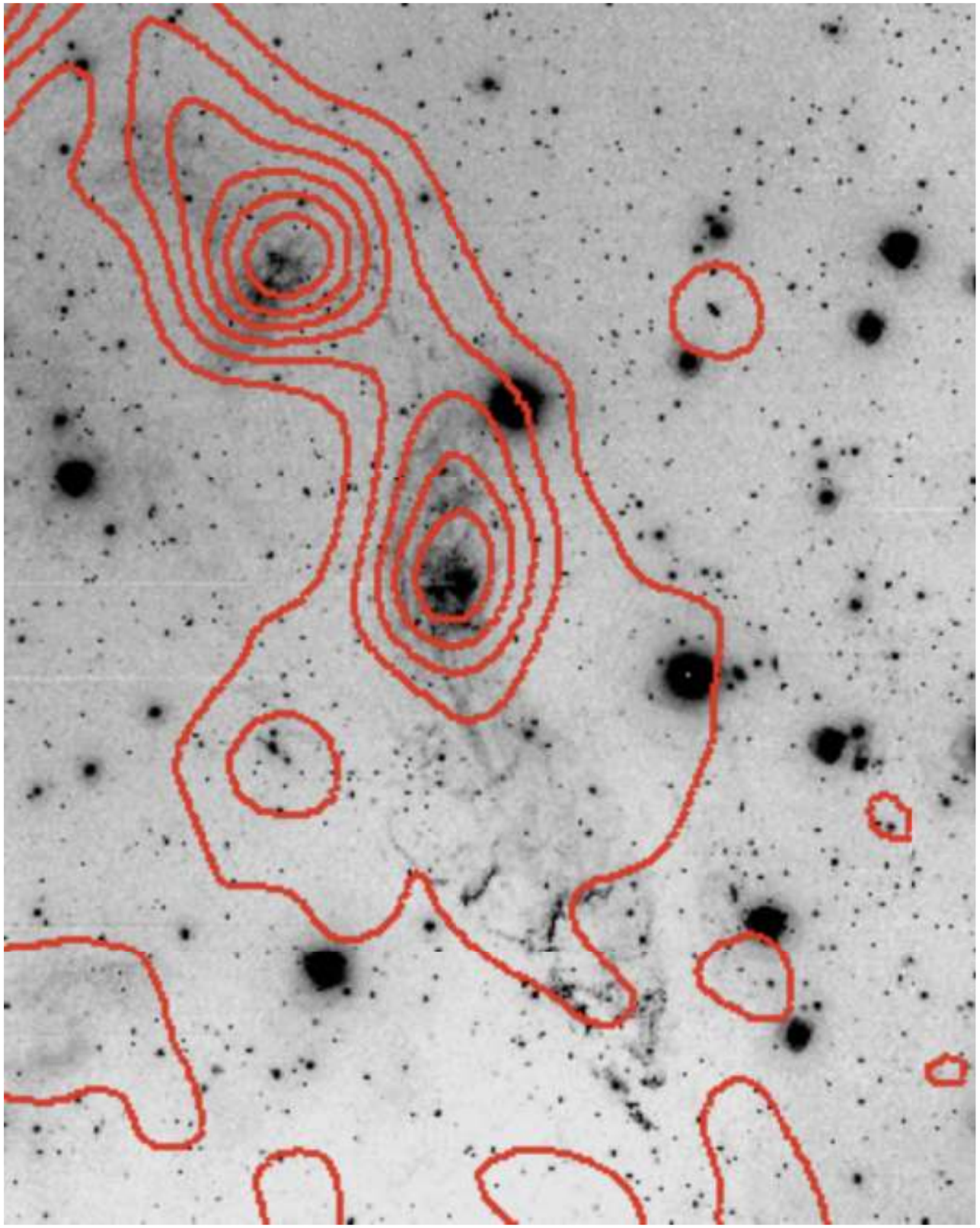
Oosterloo et al. 2005

X-ray Emission in Northern Middle Lobe



Kraft et al. 2009

Shocked Gas

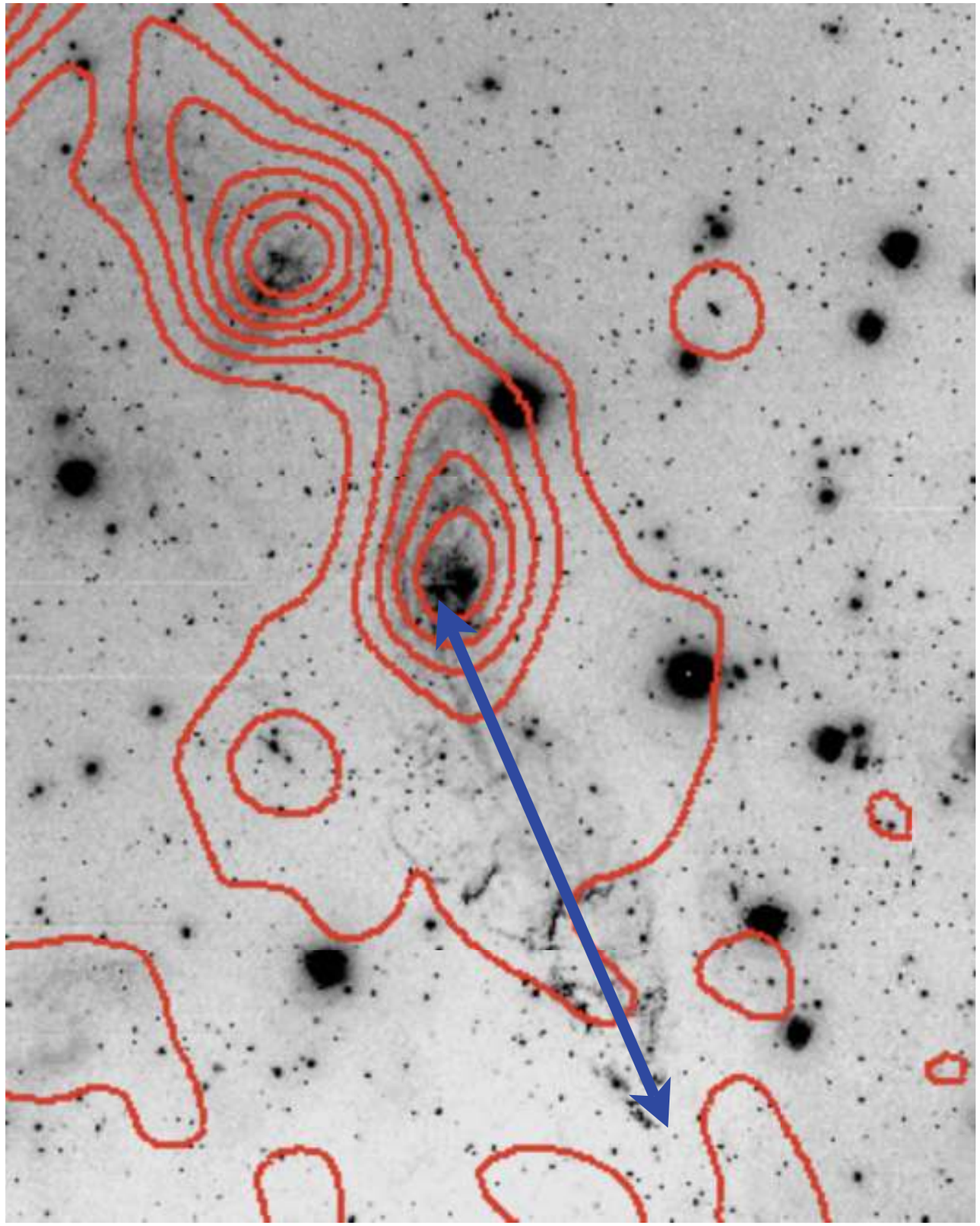


$$T = \frac{3}{16}\ \mu\ m_p\ v_s^2$$

kT=0.39 keV

$\Rightarrow v_s = 510$ km s^{-1}

Shocked Gas



$$T = \frac{3}{16}\ \mu\ m_p\ v_s^2$$

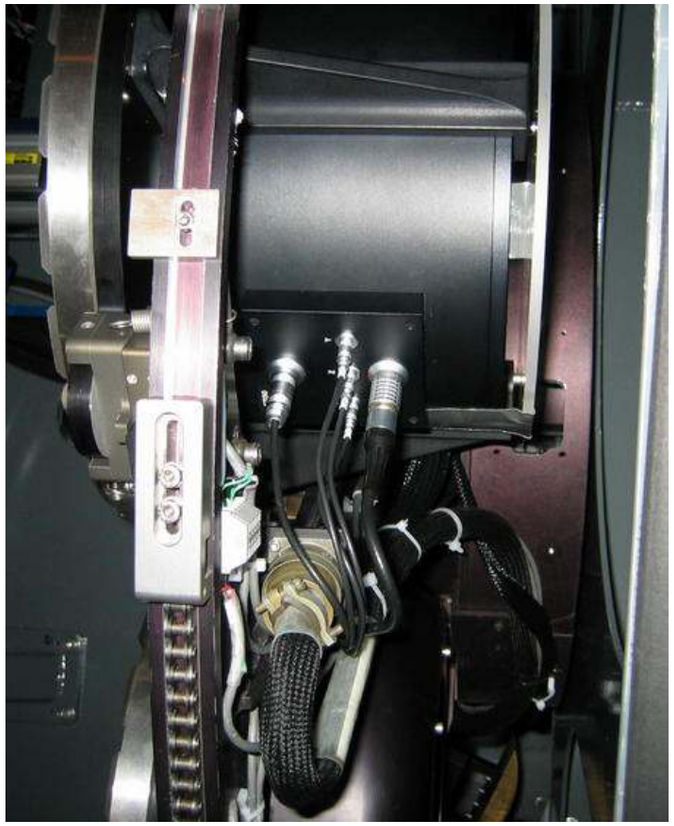
kT=0.39 keV

$\Rightarrow v_s = 510$ km s^{-1}

Travel time = 13 Myr

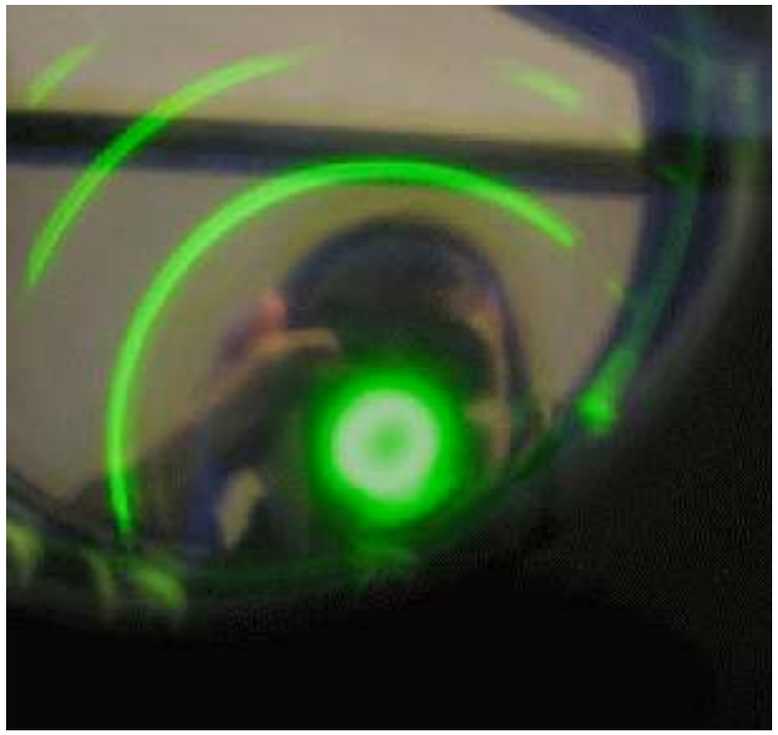
Maryland Magellan Tunable Filter

$1M addition to IMACS on Magellan
PIs: S. Veilleux and J. Bland-Hawthorn



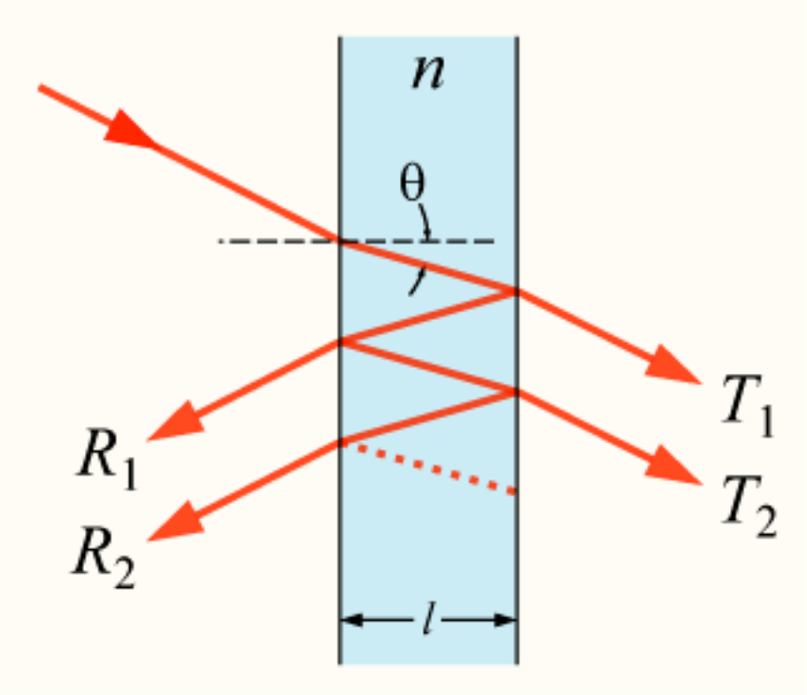
Tunable from 5000 - 9200Å
FoV = 27’

Maryland Magellan Tunable Filter



Fabry-Perot Etalon
based on Taurus Tunable Filter
(TTF)

$$m\lambda = 2\, n\, d \cos\theta$$
$$\Delta\lambda = \lambda/(m+1)$$



small plate spacing
⇒ large central spot

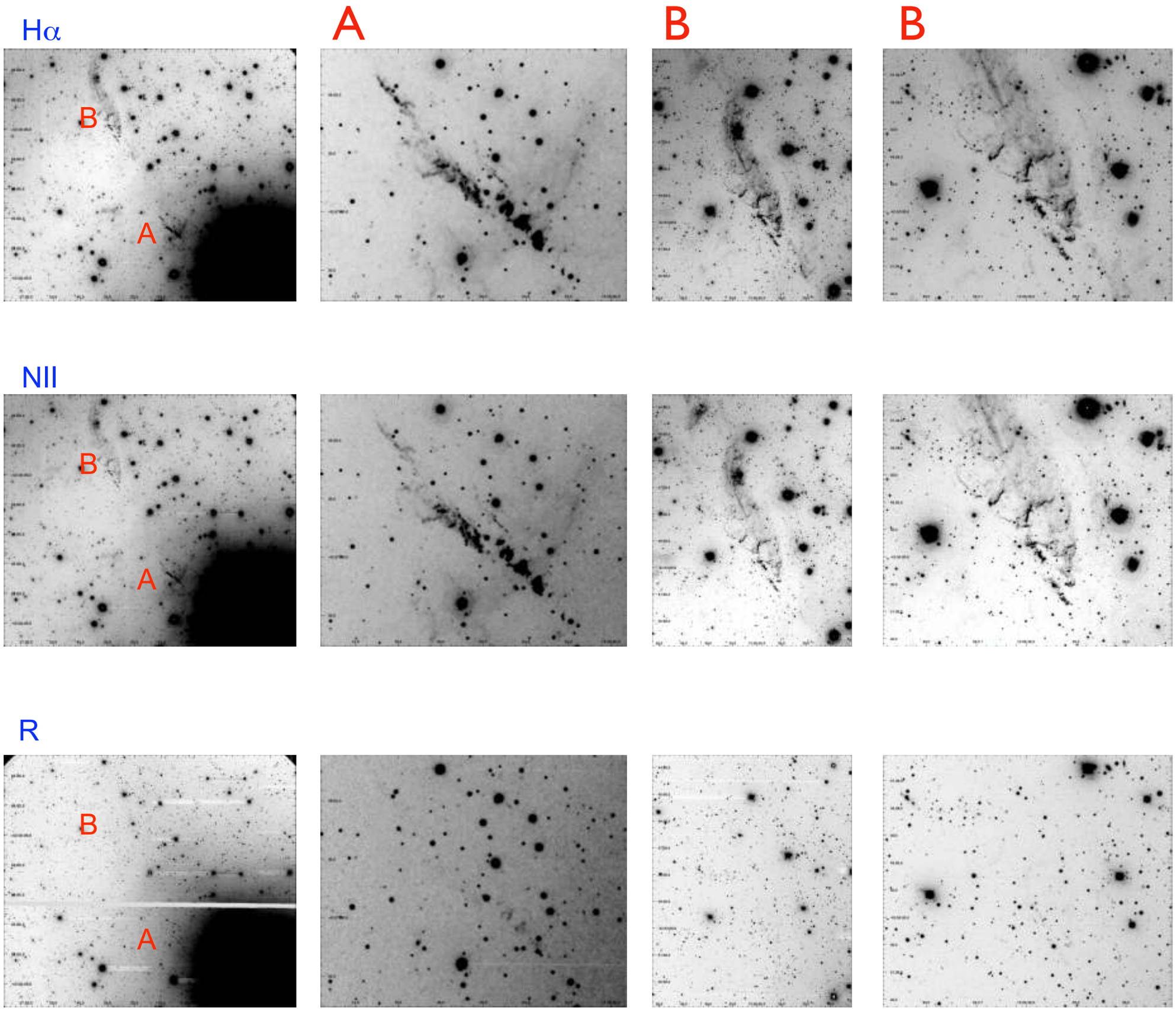
= low resolution

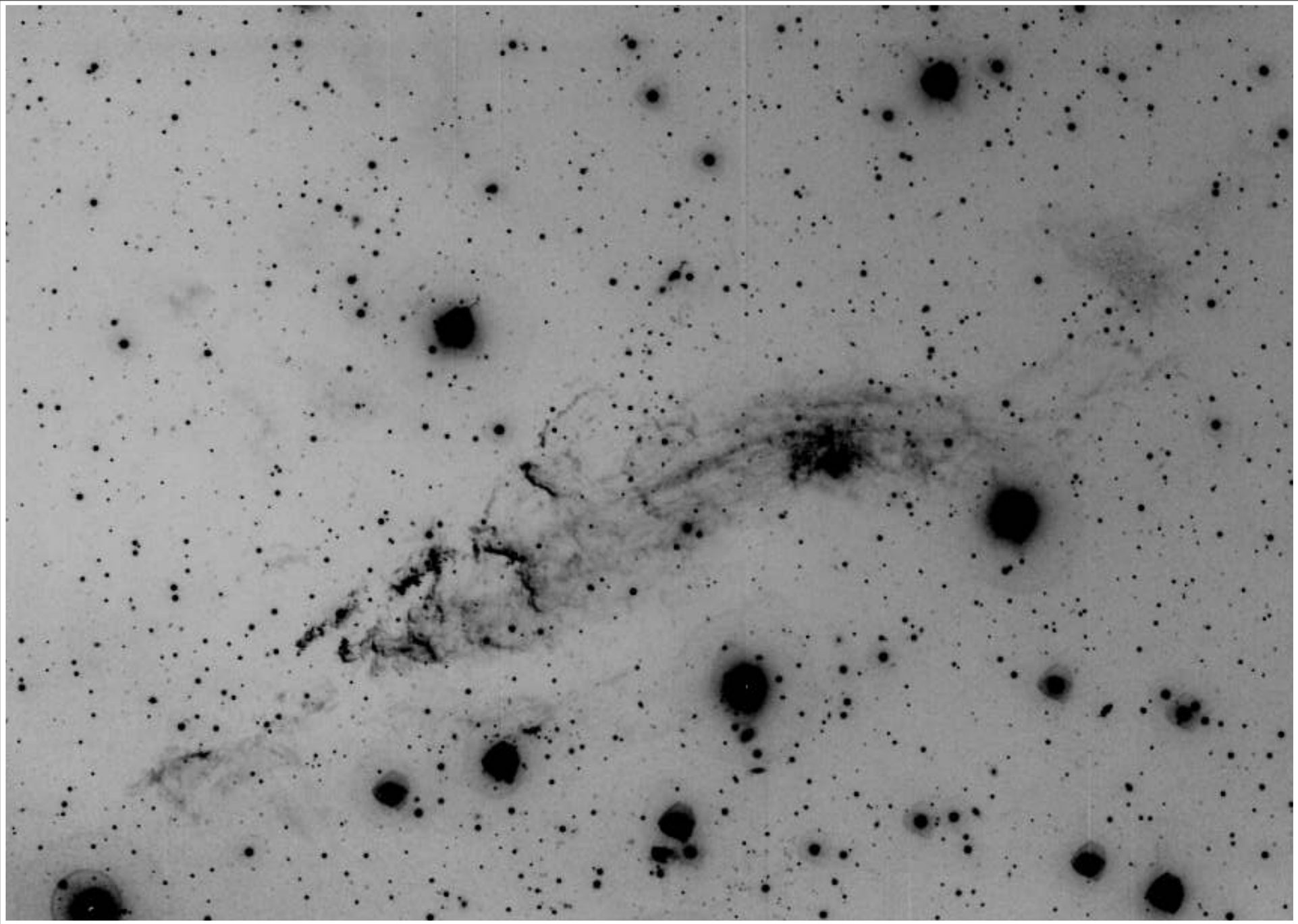
Cen A MMTF Observations

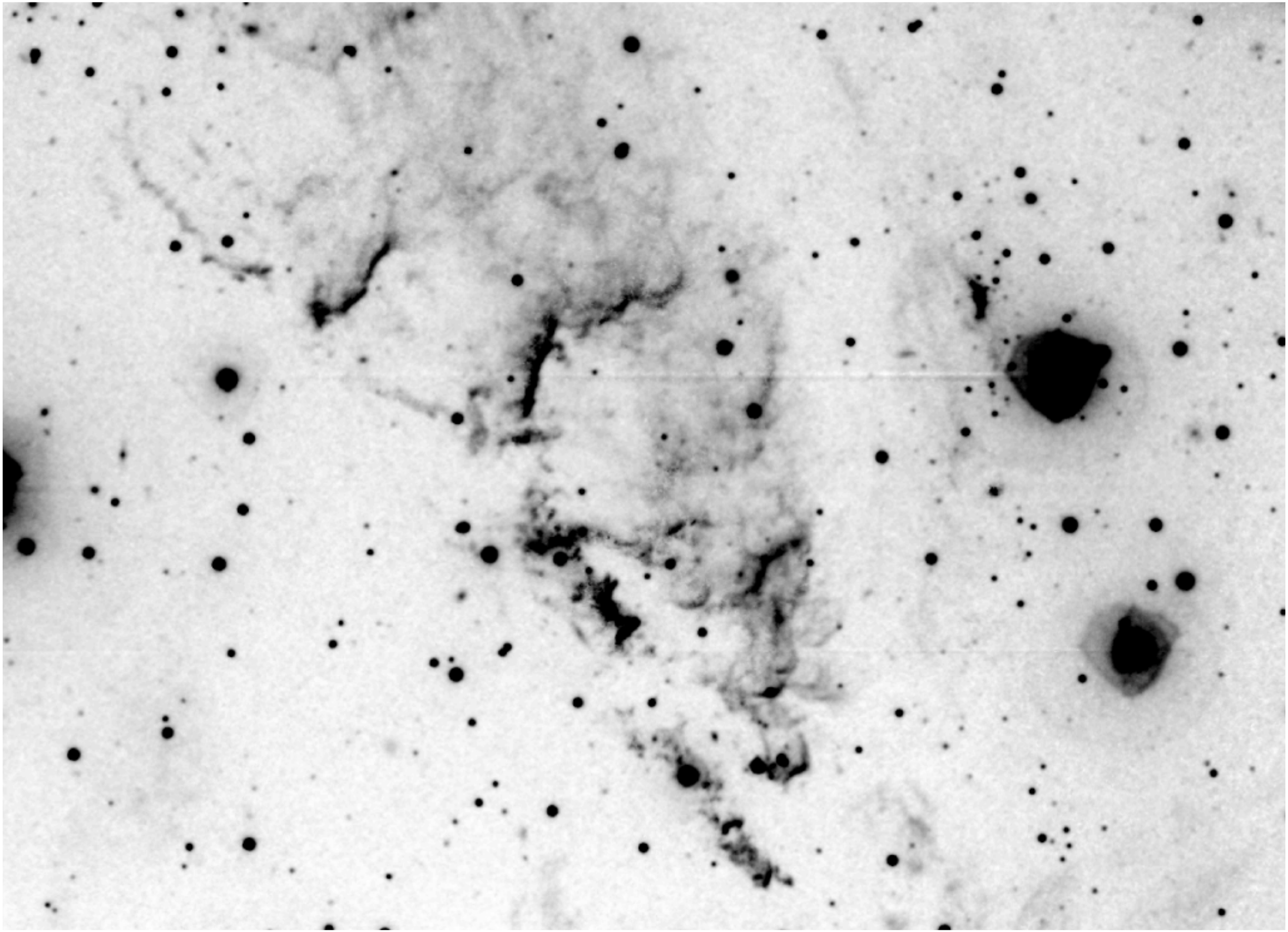
Hα - 6563Å ± 15Å
- 1200s

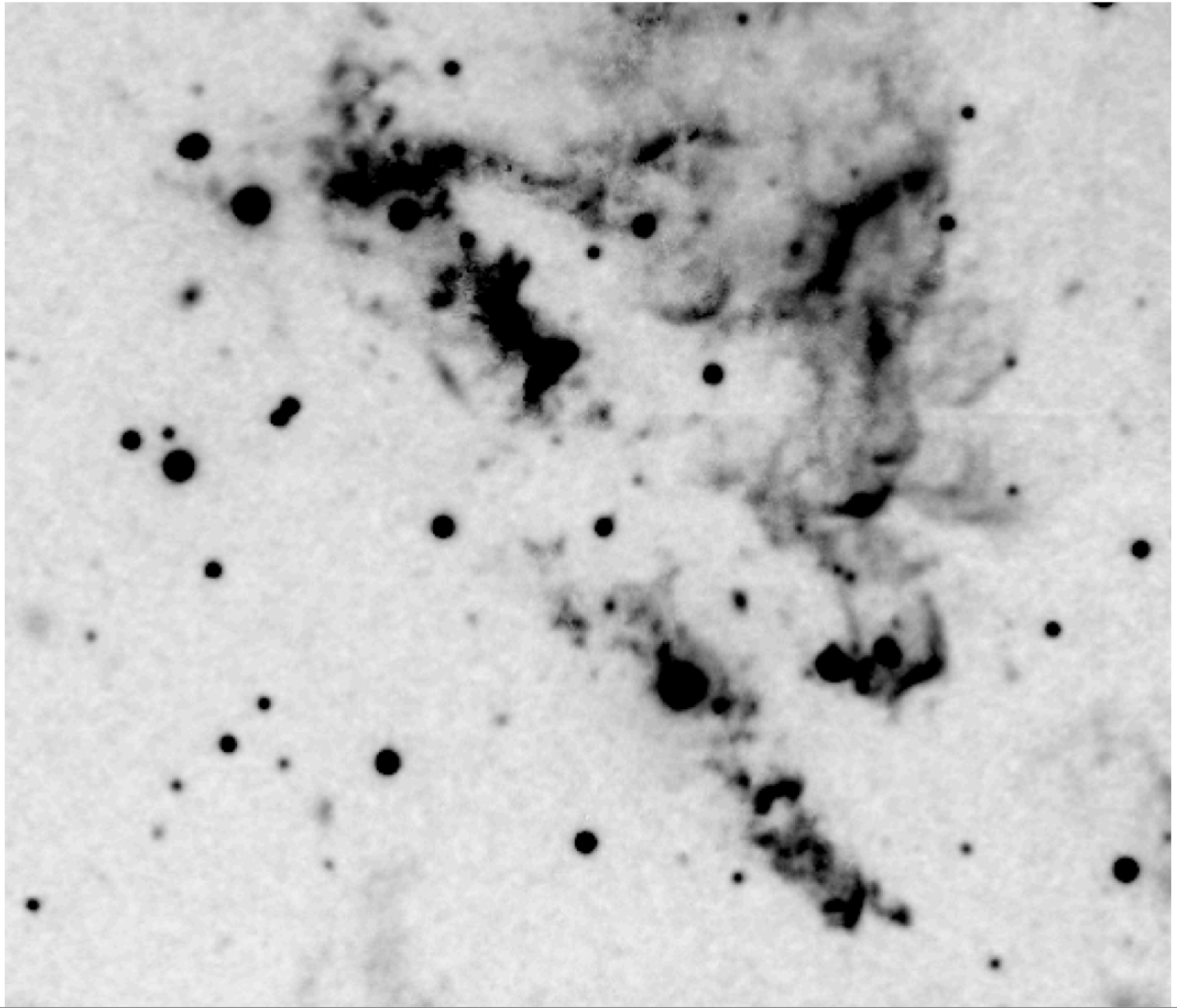
[NII] - 6584 Å ± 15Å
- 1200s

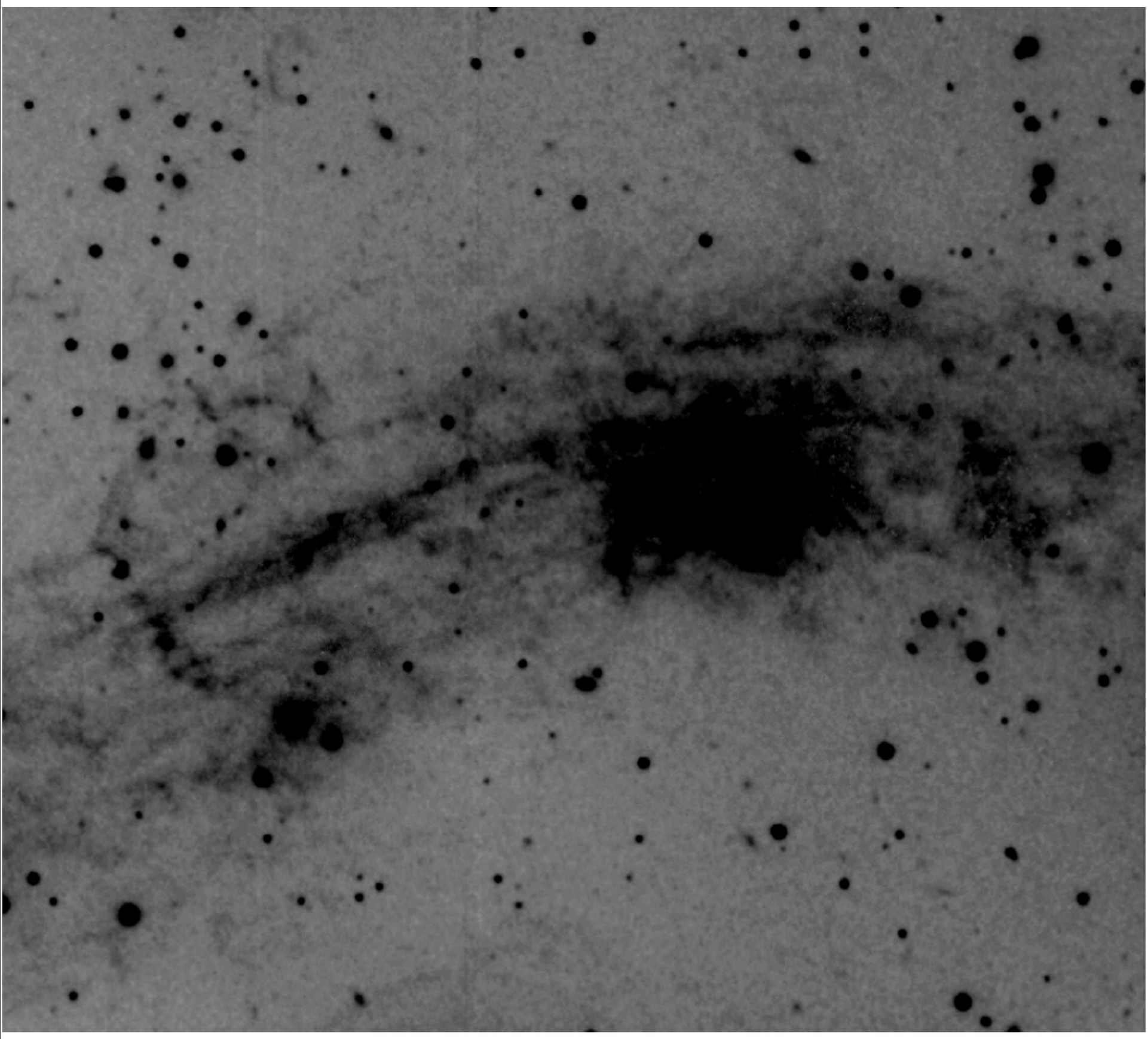
V, R, I - 30s


Hα
A
B
B
B
A
NII
B
A
R
B
A



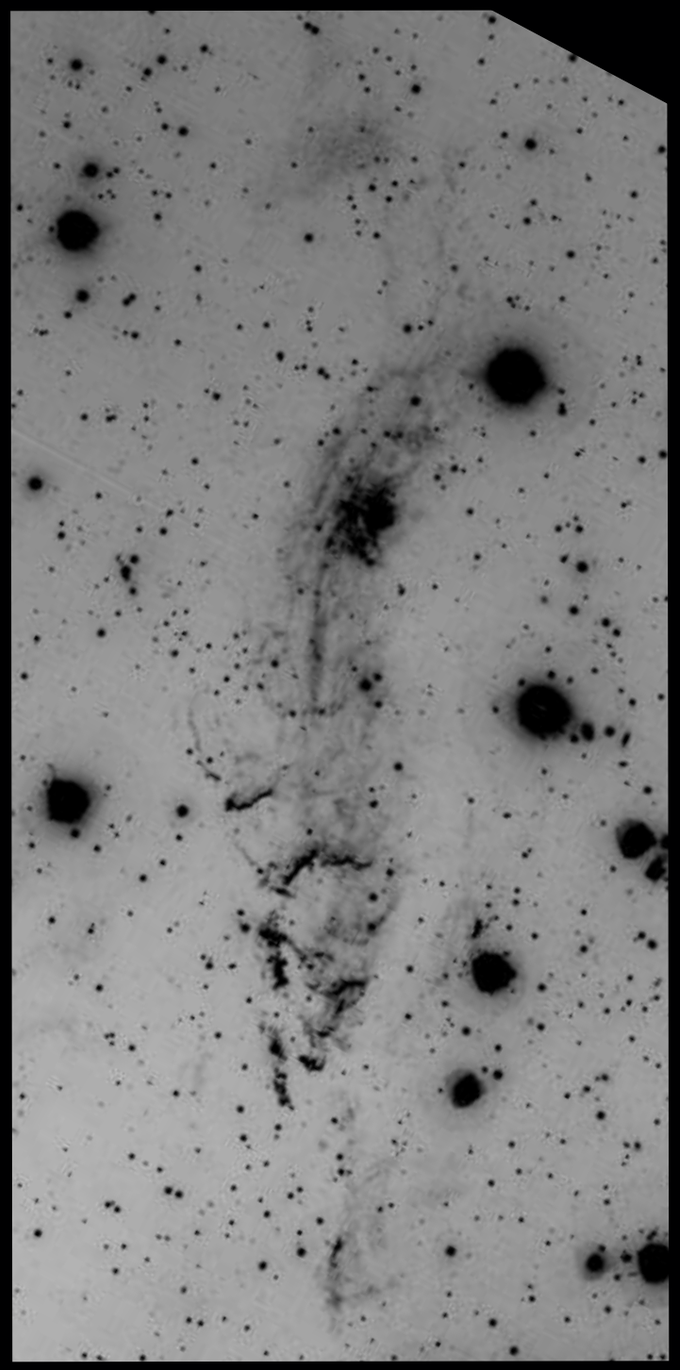






Wind-Cloud Interaction

Simulations by Ralph Sutherland



Size = 9x4.5x4.5 kpc v_w = ~2200 km/s T = 8.6 keV,

$M = 1.8 \times 10^8\ M_\odot$ $Z = 0.1\ Z_\odot$

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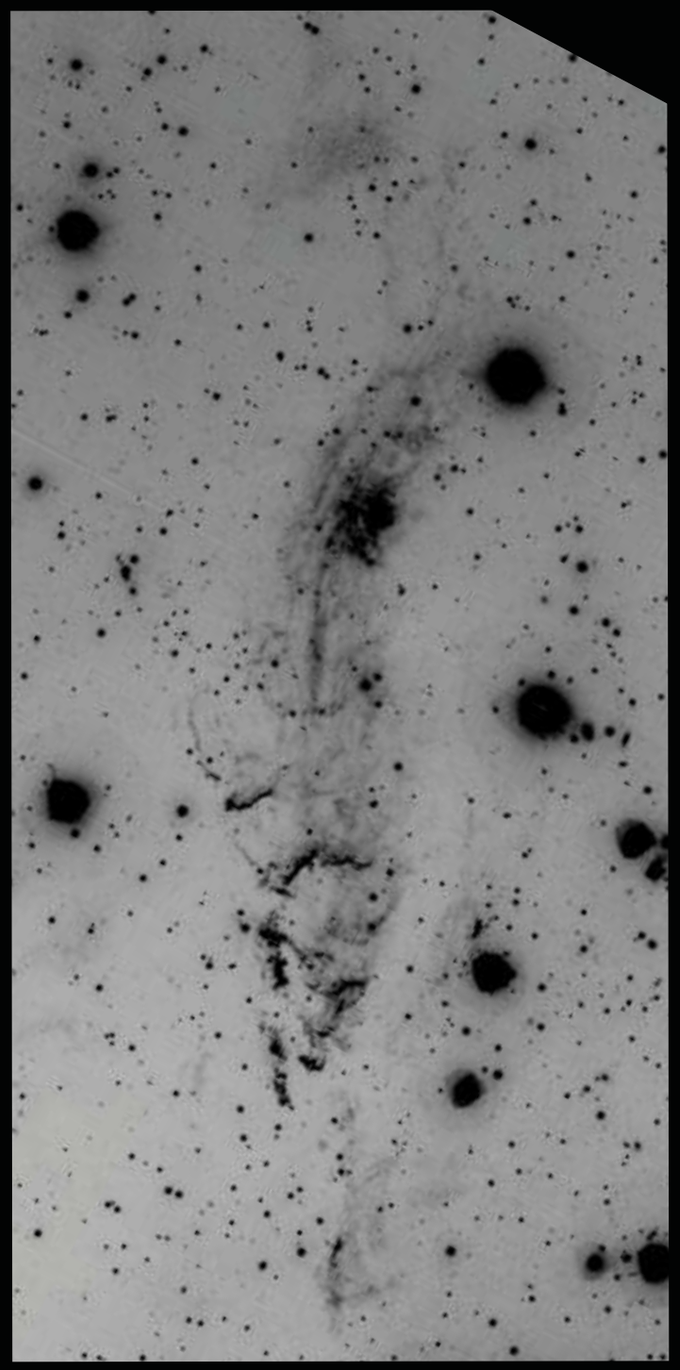

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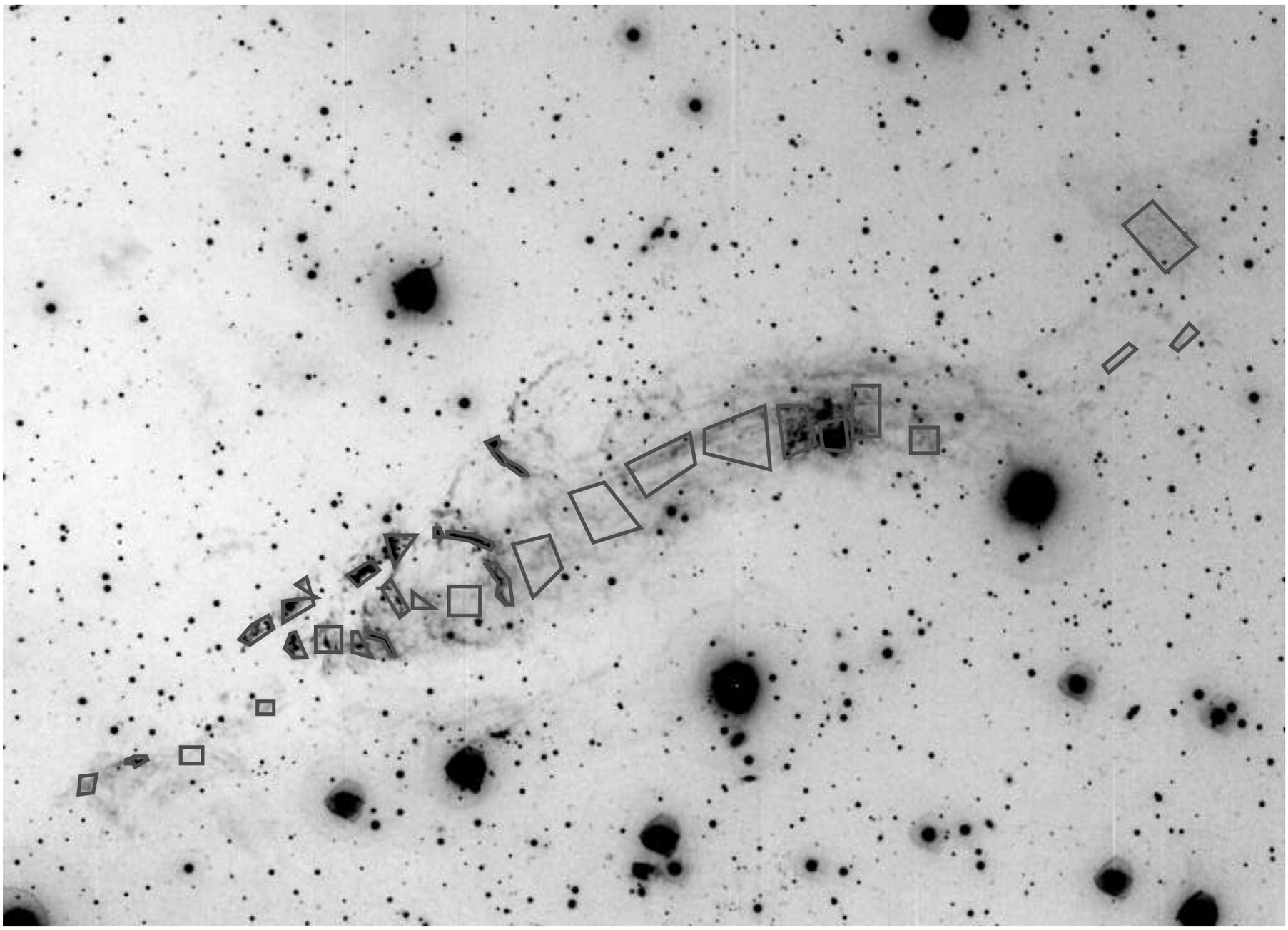

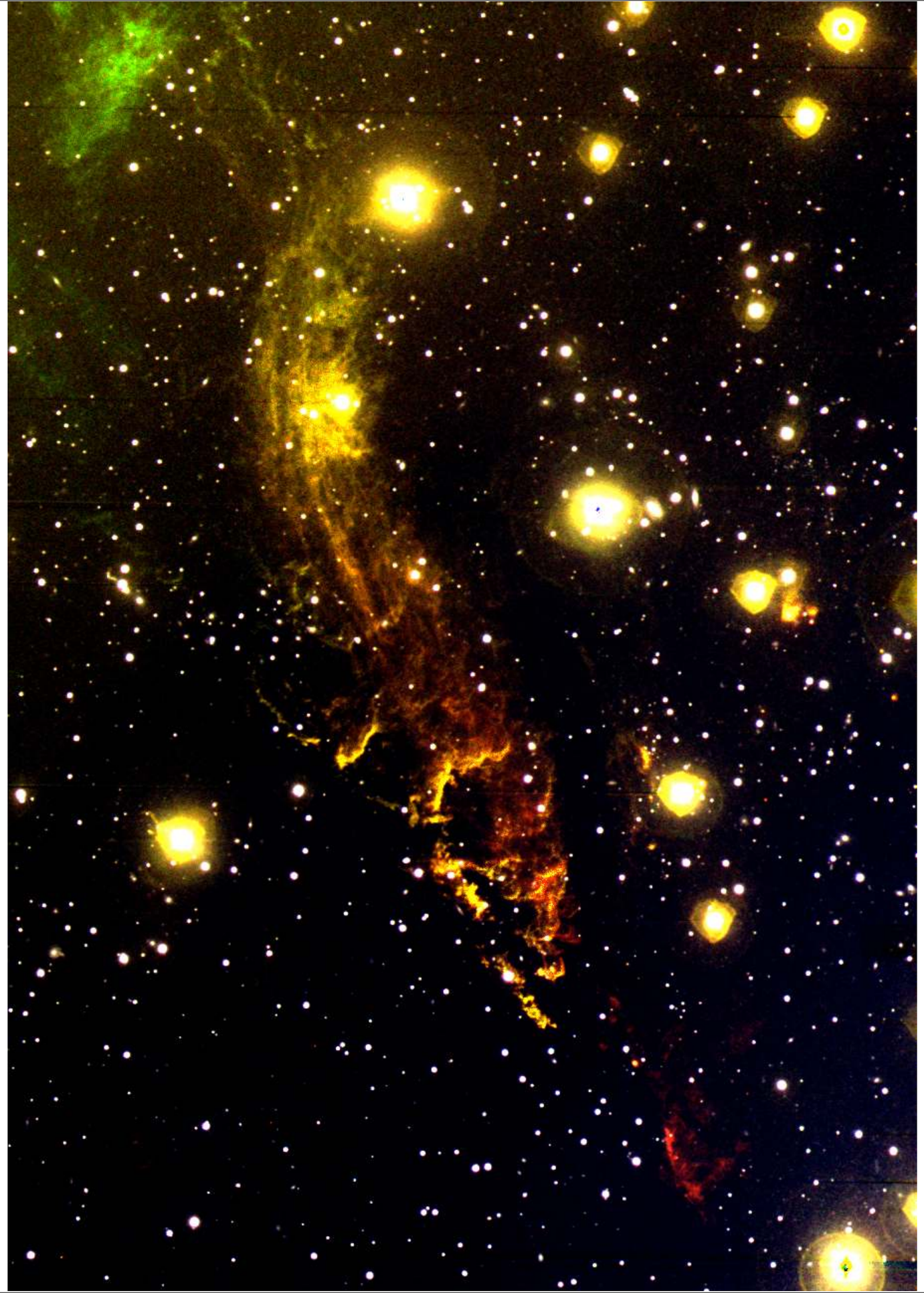

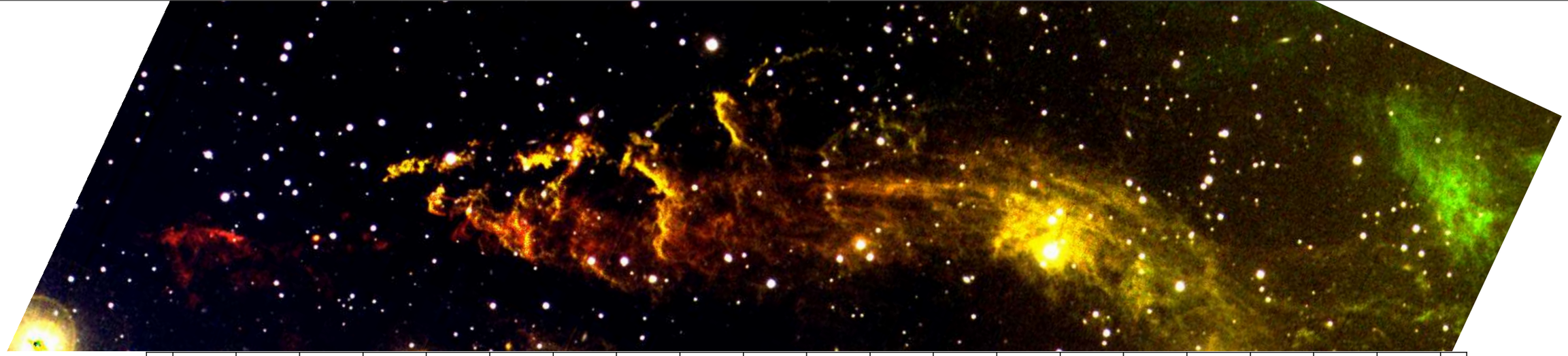

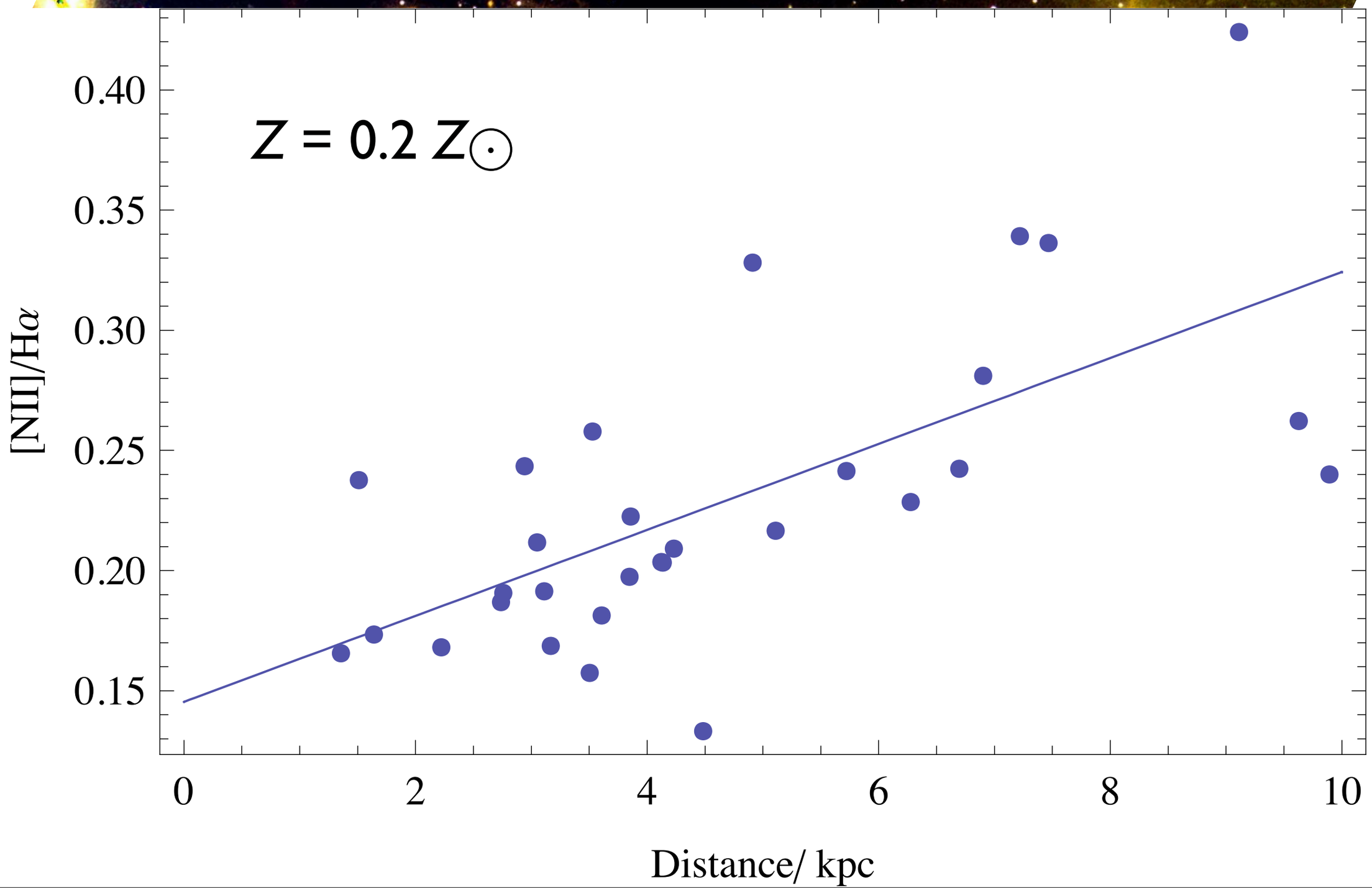
$Z = 0.2\ Z_\odot$
[NII]/Hα
0.40
0.35
0.30
0.25
0.20
0.15
0
2
4
6
8
10
Distance/ kpc

Conclusions

- MMTF imaging reveals a complex morphology
- [NII]/Hα shows a gradient along the filament over 9kpc
- Consistent with a shock, passing through ~10Myr ago
  - form blue stars
  - causing shocked X-ray gas

Conclusions

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But, what about 100Myr stars?

- successive bursts/ winds - why not disrupted?
- one burst, prolonged collapse?
- Is the gas bound to a dark matter halo? Infalling satellite?