

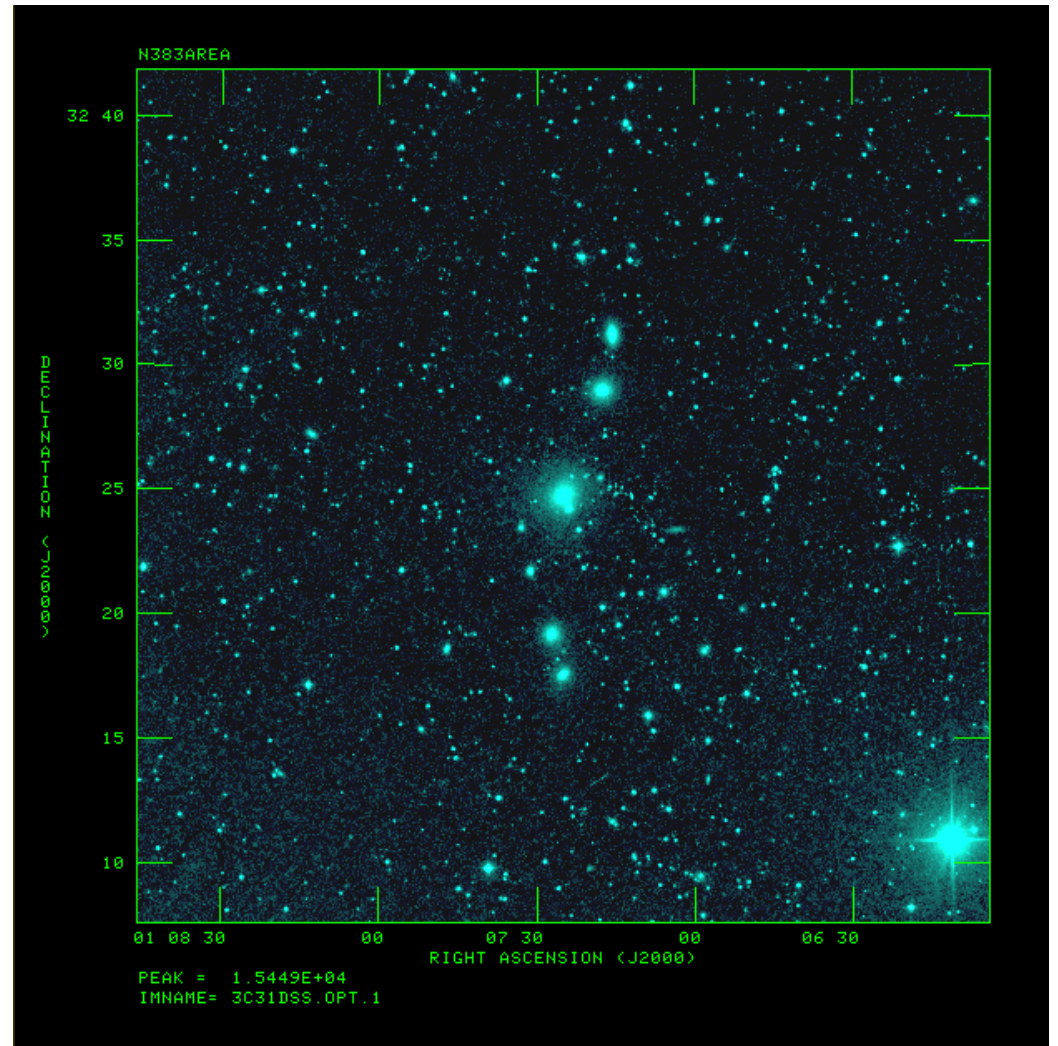
# Radio Jet Propagation in NGC383=3C31

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Robert Laing (Oxford/RAL)

# NGC383 Environs

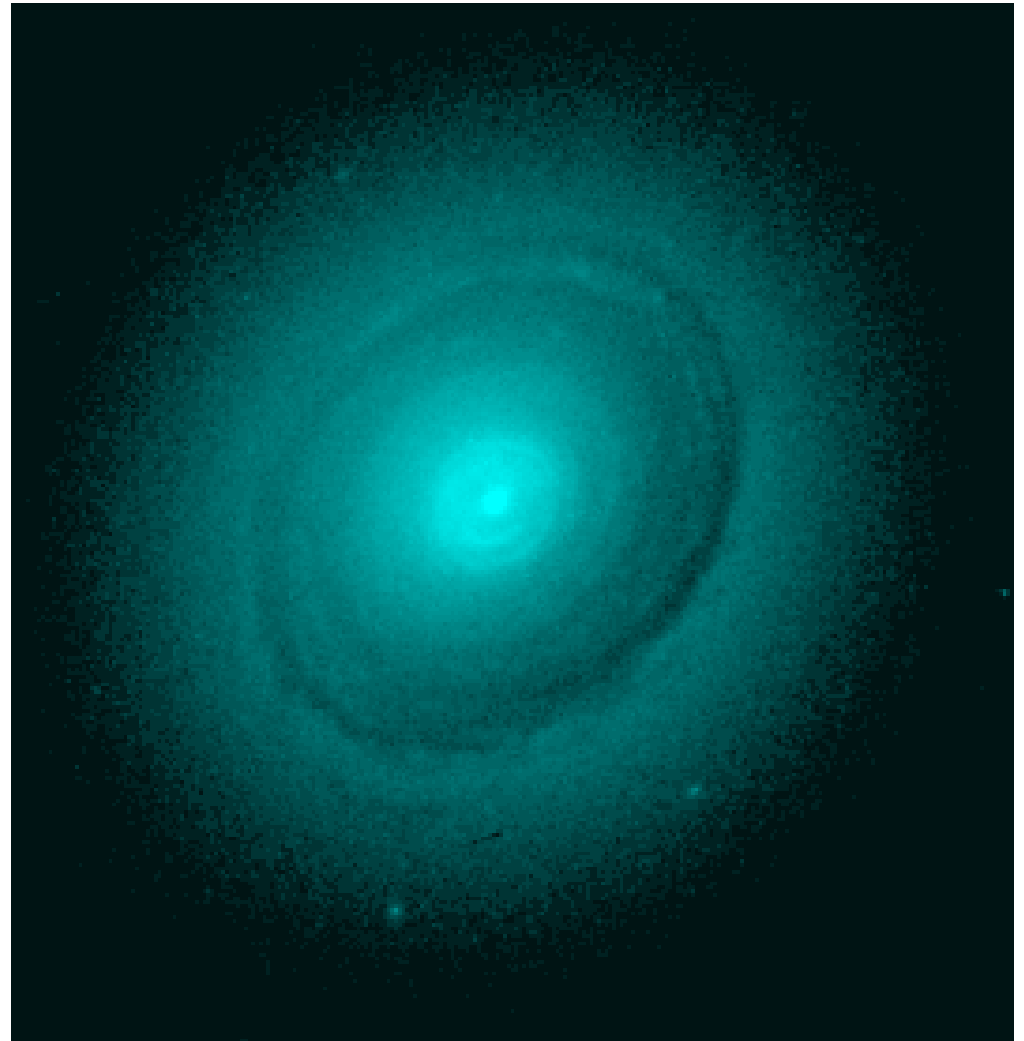
- Brightest in galaxy chain
- $z=0.0169$
- in Perseus-Pisces filament
- one small close companion



Approx 700 kpc field, Digitized Sky Survey E plate

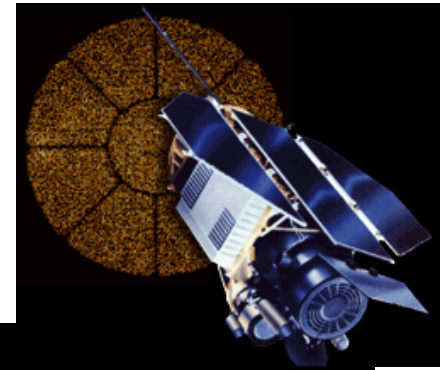
# NGC383

- dusty elliptical
- major axis of dust "disk" about 2.5 kpc

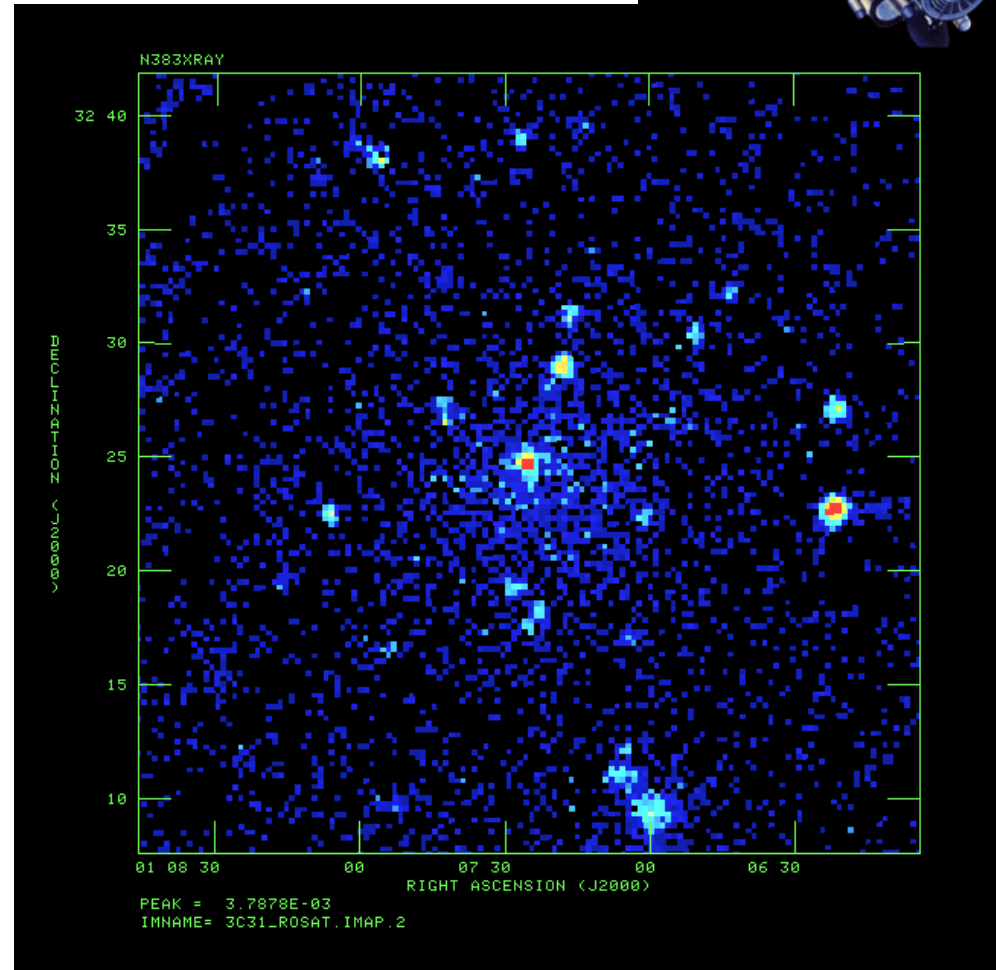


Approx 6 kpc field, HST WFPC2

# NGC383 Group Hot Gas



- Extended X-ray emission offset from NGC383
- → Hot ( $1.7 \times 10^7$  K) group atmosphere
- Also more compact X-ray emission at NGC383 itself

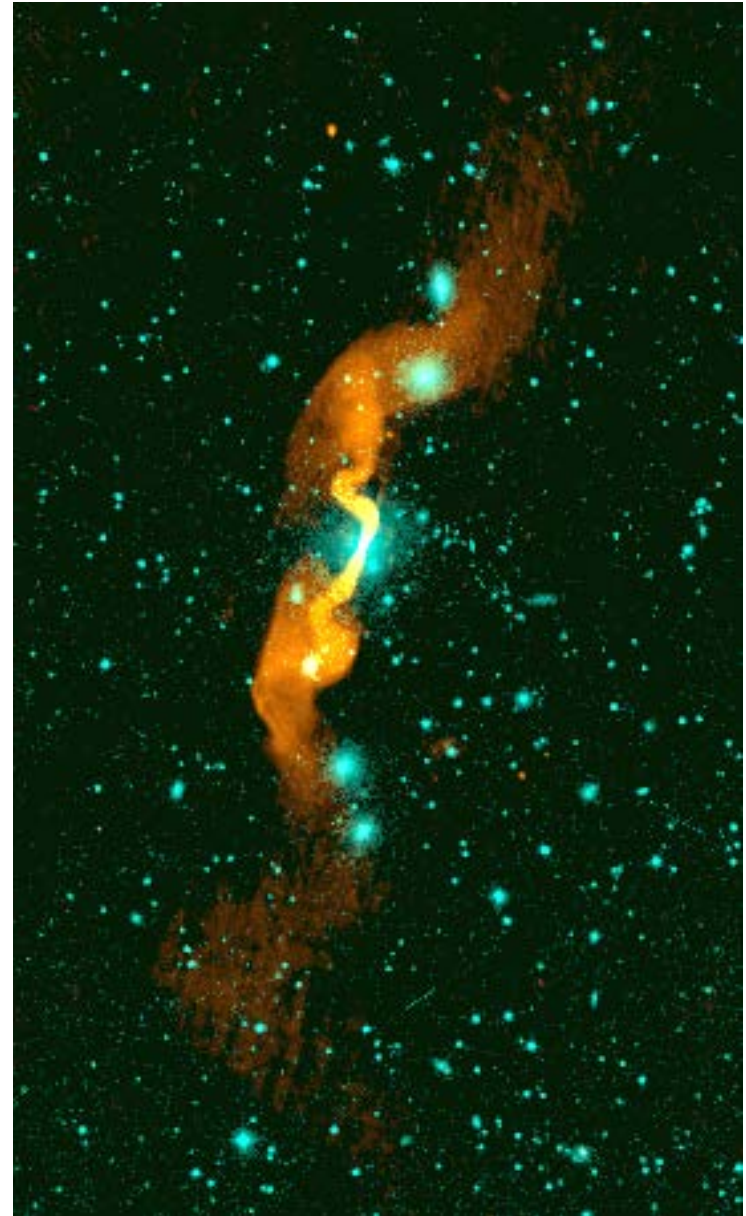


Approx 700 kpc field, ROSAT PSPC image

# 3C31/NGC383

## large scale

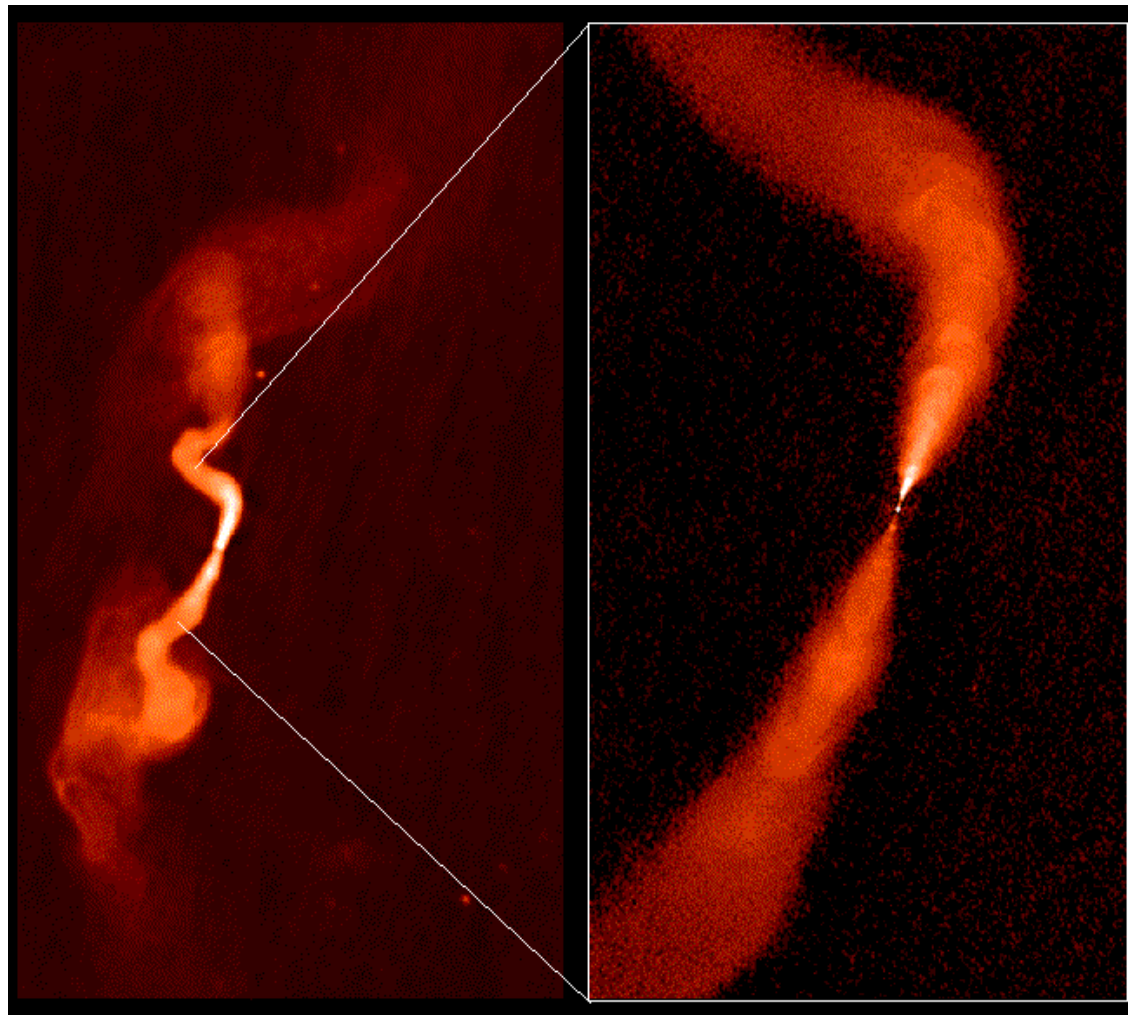
- Flame: 3C31  
VLA radio image
- Blue/green:  
DSS red image
- Scale of jet  
bending and  
plume formation  
10+ kpc



# Structures in 3C31

300 kpc field, 1.9 kpc FWHM

40 kpc field, 85 pc FWHM

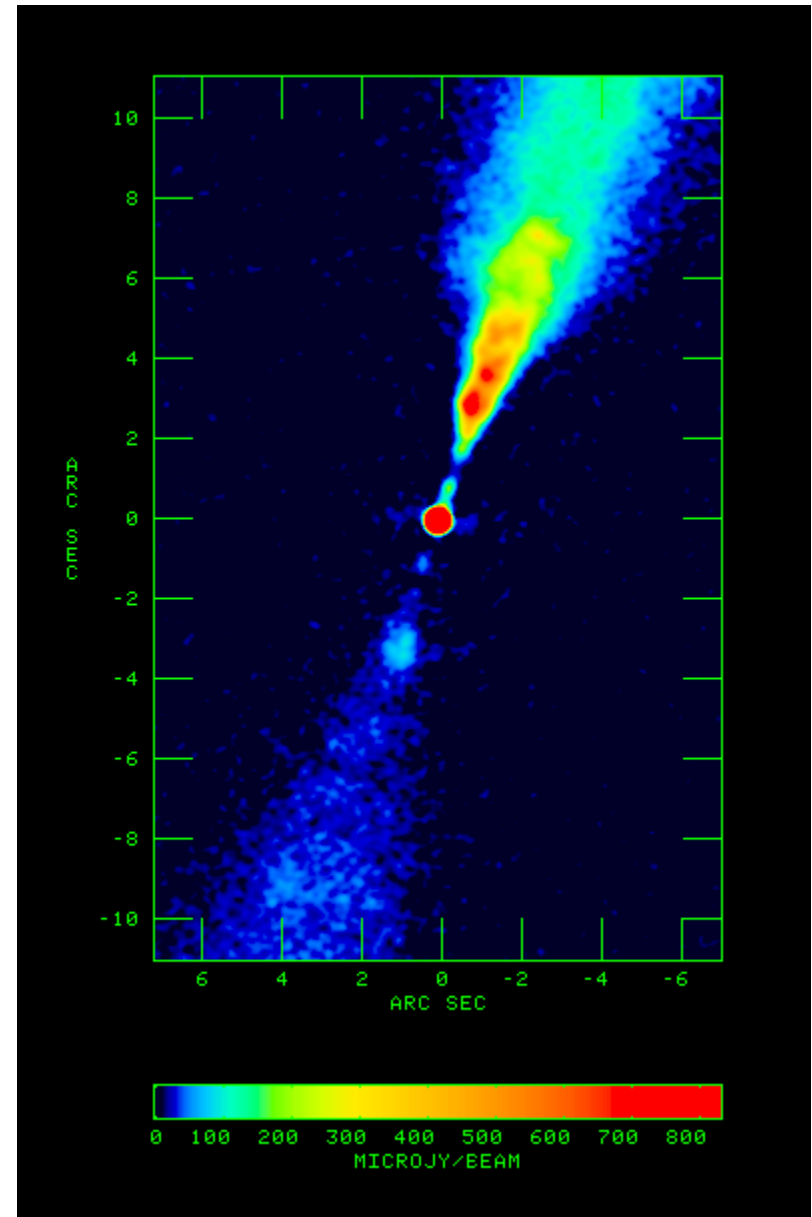


**1.4  
GHz**

**8.4  
GHz**

# 3C31 inner jet

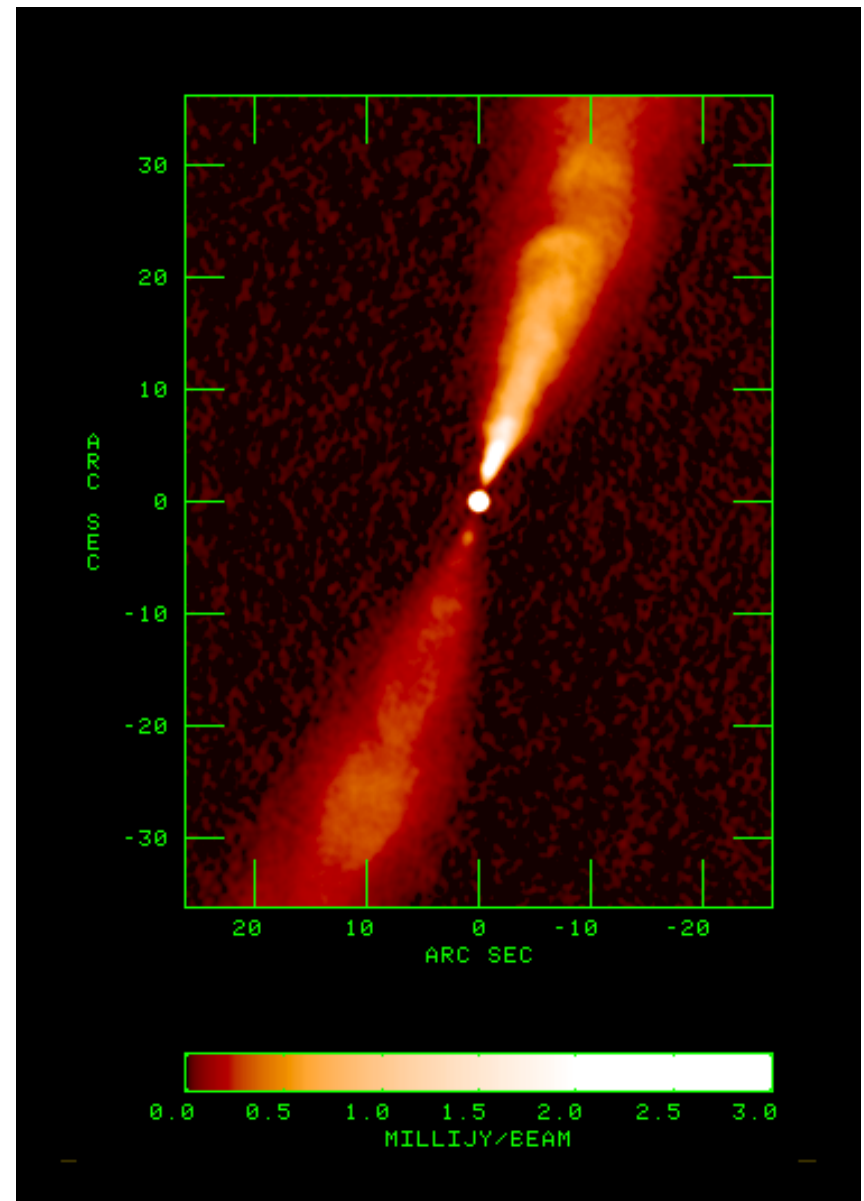
- 85 pc FWHM
- First 2" (680 pc) narrow, well-collimated
- Flares, brightens next 5.5" (2 kpc)
- Bright knots in flaring region



8.4 GHz VLA ABCD config 0.25" FWHM

# 3C31 recollimation

- 250 pc FWHM
- Beyond 2 kpc, both jets recollimate
- North jet stays brighter on-axis
- Edges are more symmetric

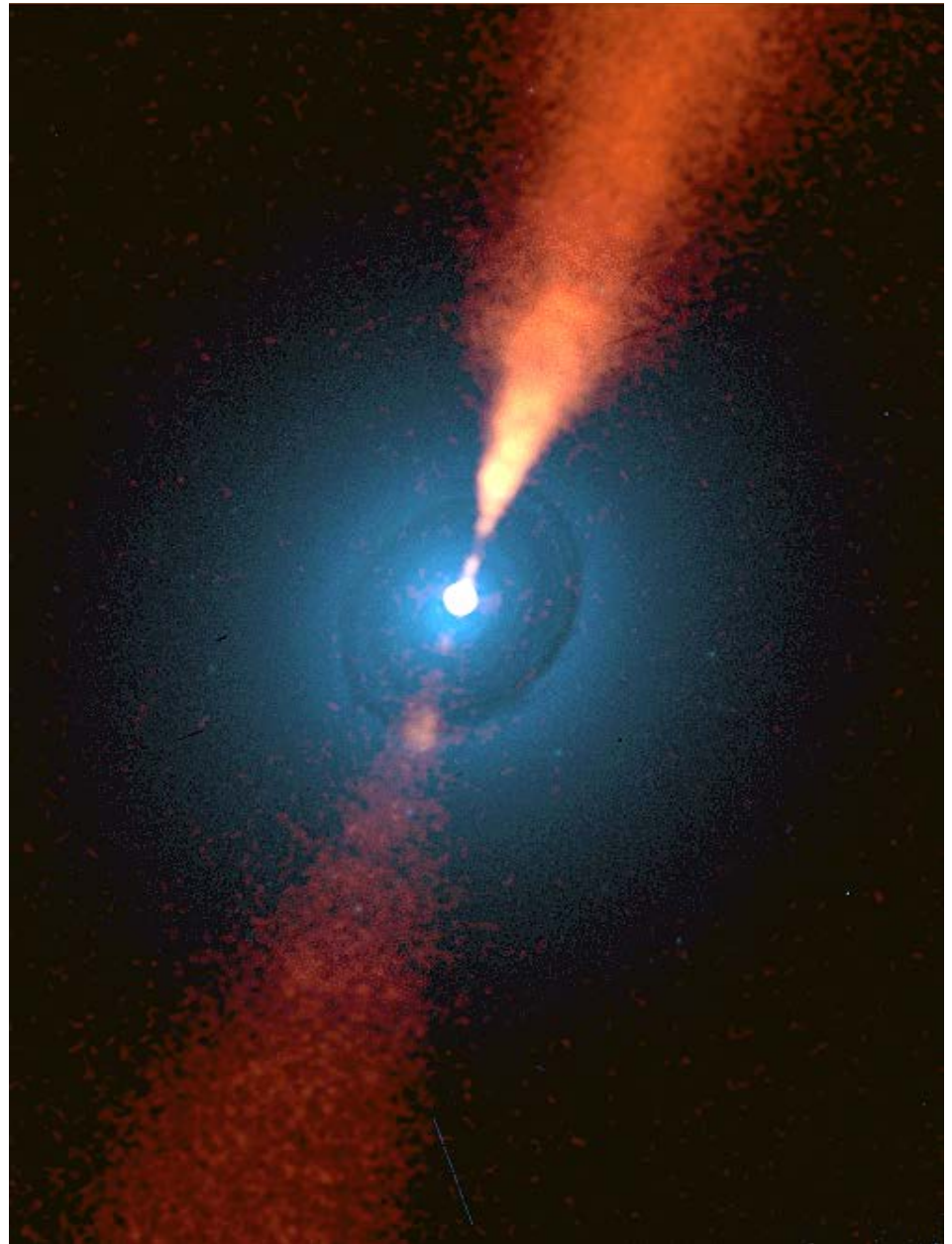


8.4 GHz VLA ABCD config 0.75" FWHM



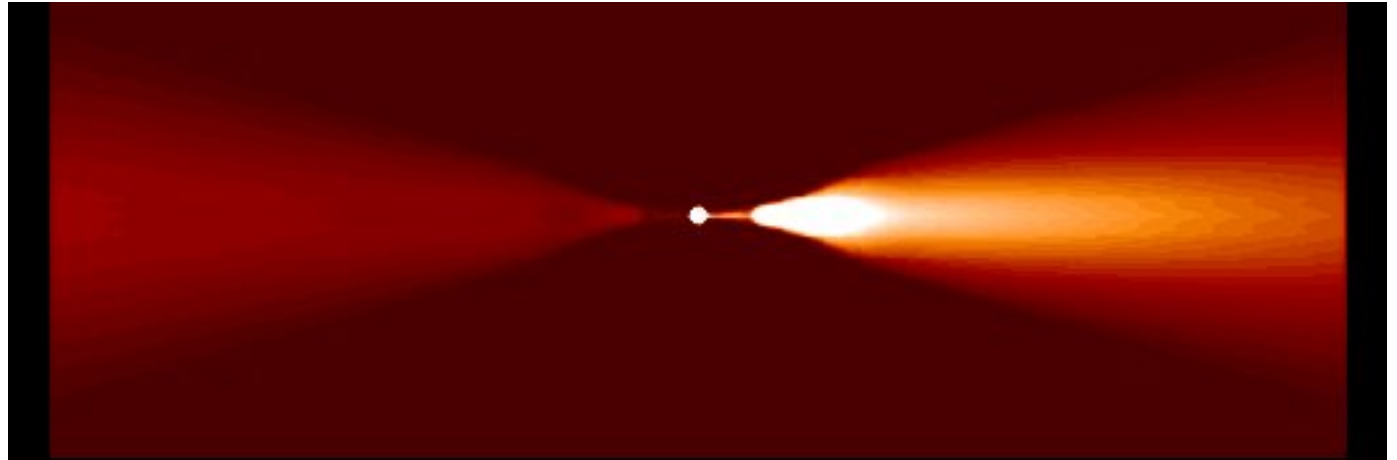
# 3C31/NGC383 superposition

- Flame:  
VLA radio image
- Blue/green:  
WFPC2 image
- Scales of jet  
flaring and  
recollimation are  
also few kpc



# Relativistic jet modeling

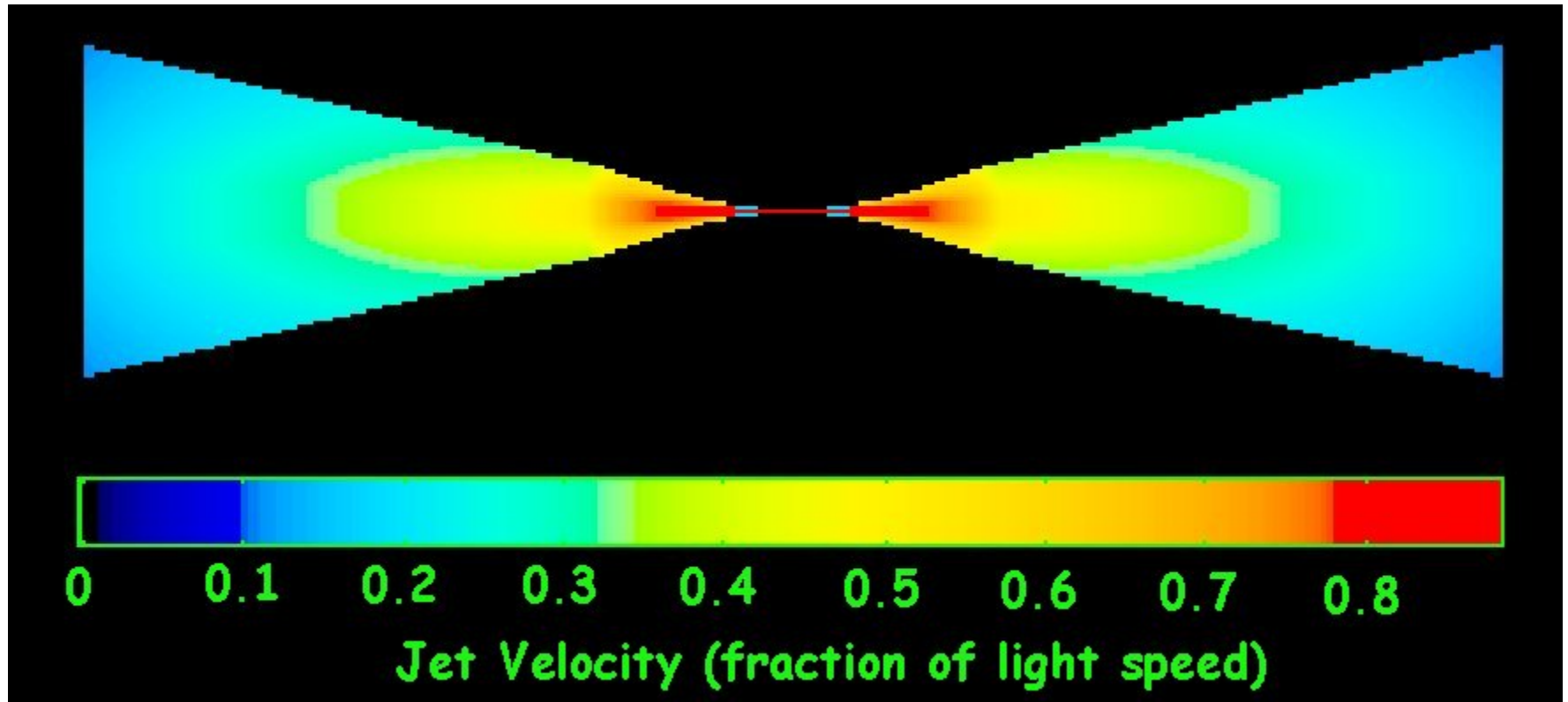
Predicted  
radio  
emission  
from  
slowing  
relativistic  
twin-jet



Observed  
VLA data,  
fitted by  
model

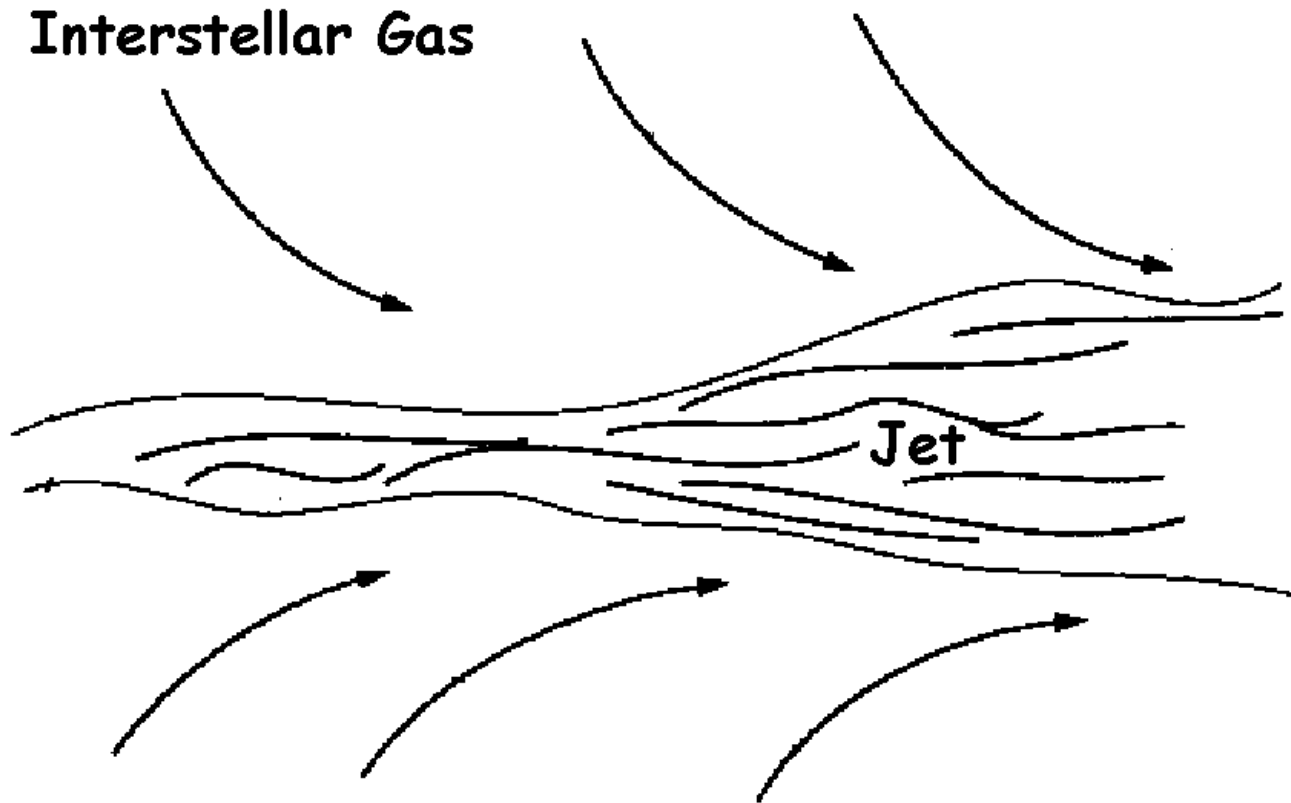


# Inferred jet velocities in 3C31



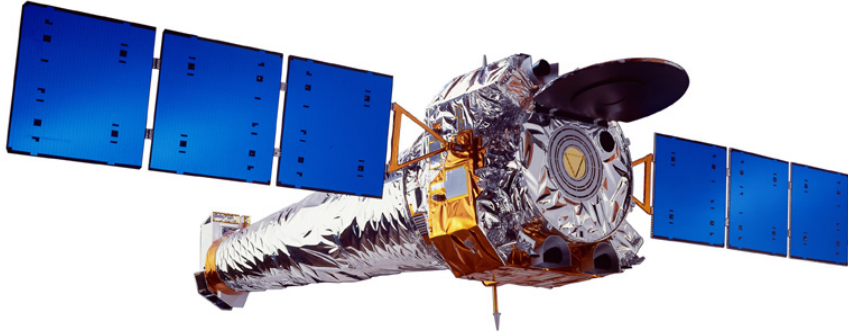
Modeling VLA data shows **how** the jets slow down as they escape from the parent galaxy NGC383, but does not say **why** ... gives kinematics, not dynamics

# Entrainment into Jet



Turbulent boundary layer  $\rightarrow$  eddies  $\rightarrow$  mass ingestion  $\rightarrow$  "loading" of jet  
Interstellar gas ends up inside decelerating jet, we study interaction

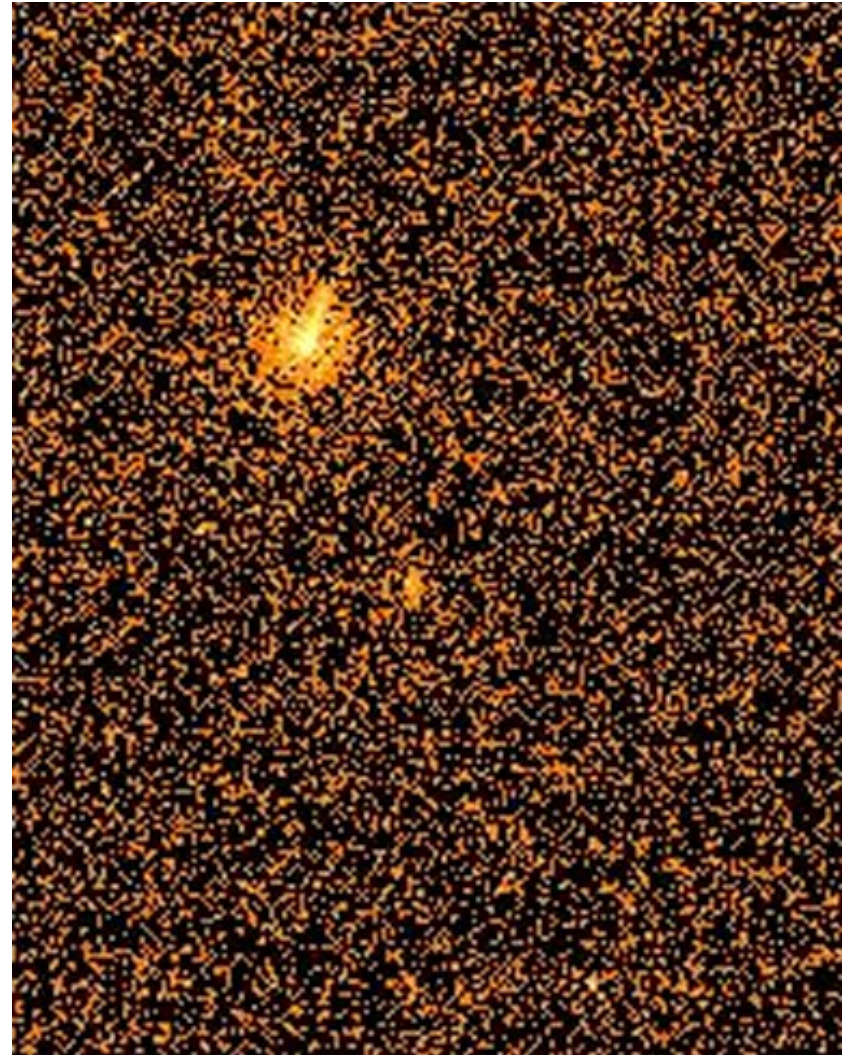
# Chandra X-ray image, Nov 2000



Detects gas in NGC383  
through which jet travels,  
also enhanced emission  
along jet path (origin?)

Will add pressure gradient  
constraint to slowdown  
models → mass flux in jet

Kinematics → Dynamics



0.5 to 7 keV Chandra image

# A Walk Around the Jets in 3C31

Relativistic Jets in 3C31

at different angles to the line of sight

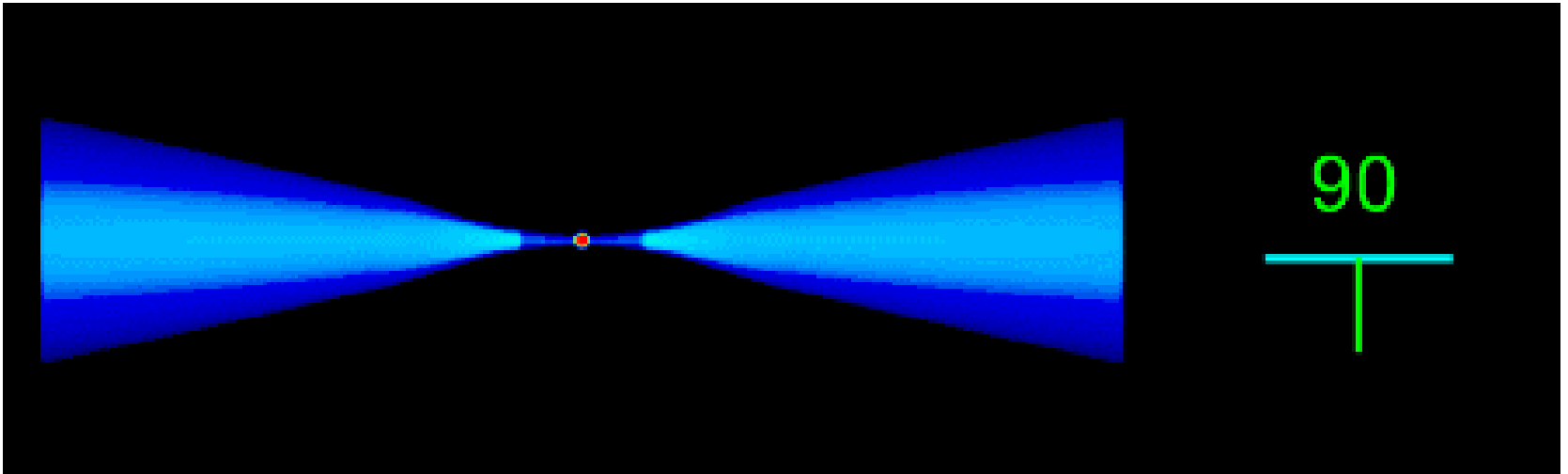
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A.H.Bridle (NRAO)

March 2002

At constant dynamic range, APPARENT sidedness and extent of the jets are both strong functions of viewing angle

# A Walk Around the Jets in 3C31



If the jets could be observed at constant sensitivity, their widening by projection at smaller angles to the line of sight would be much more obvious