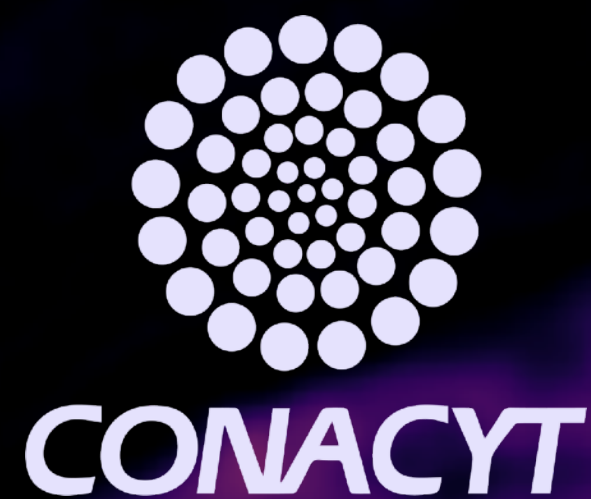
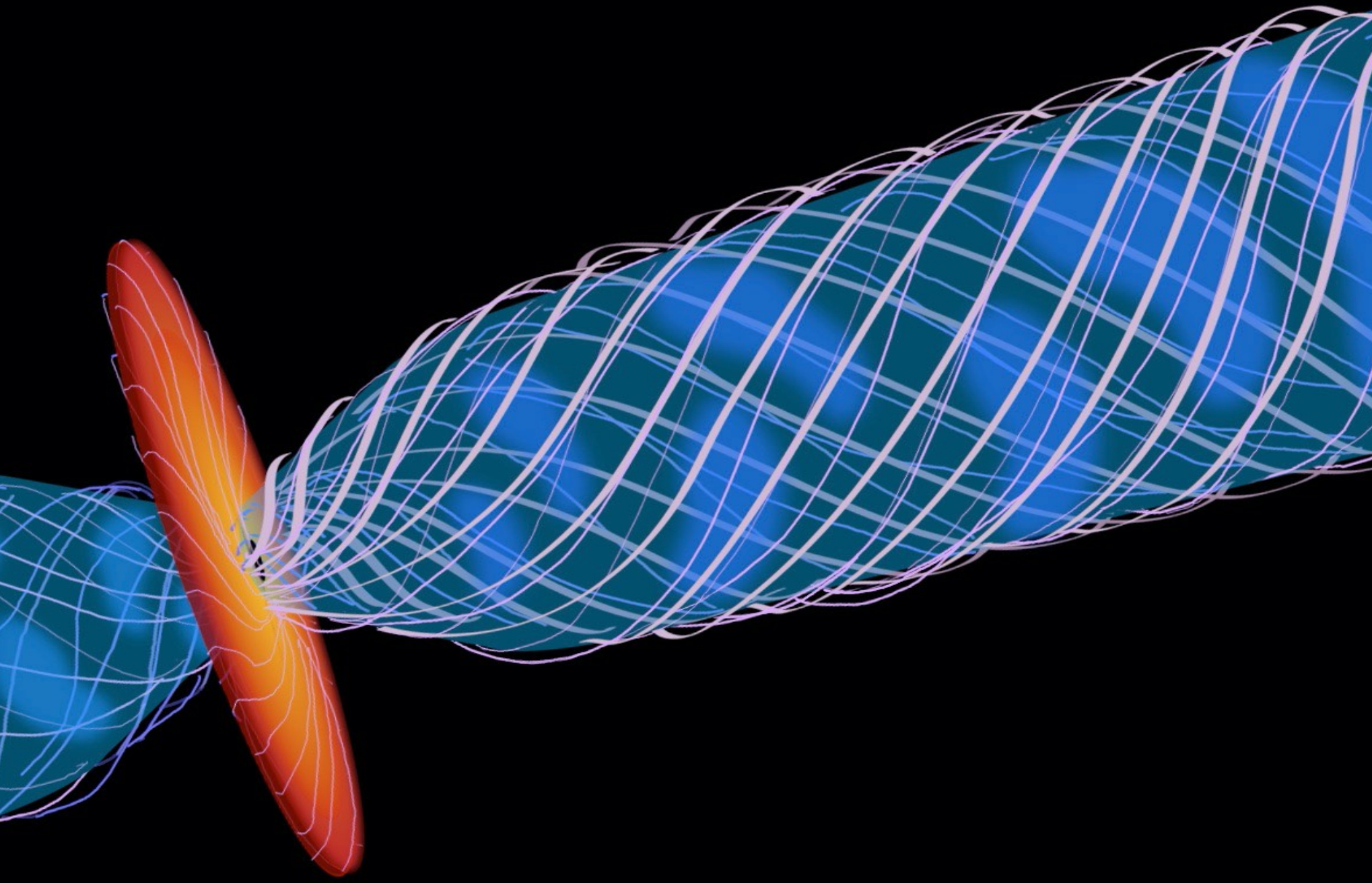


Can we finally map the magnetic field in extragalactic jets?

Alice Pasetto, cátedra CONACyT - IRyA UNAM, Mexico



Magnetic field plays a **fundamental role** for the formation and collimation of jets. Accepted models: assume magnetocentrifugal launching near the BH, and subsequent collimation through a **helical magnetic field** (Blandford & Znajek 1977) (Blandford & Payne 1982).



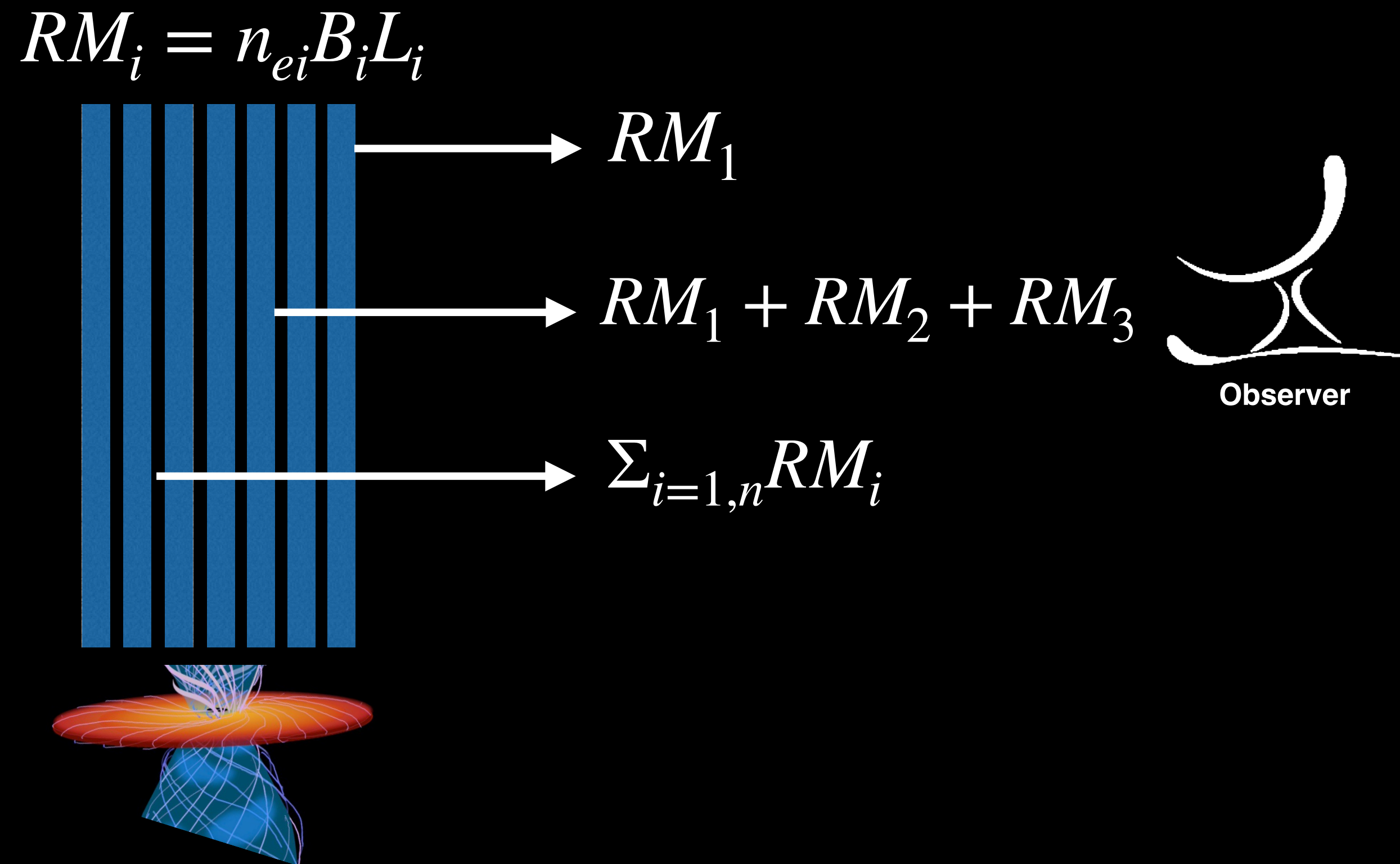
Features interpreted as evidences of a helical magnetic fields **at pc scales** near the AGN (Asada et al. 2002, Gabuzda et al. 2004, Taylor et al. 2010, Mahmud et al. 2013, Gabuzda et al. 2017)

SEARCHING for **HELICAL** magnetic field is possible through **POLARIZATION** studies.

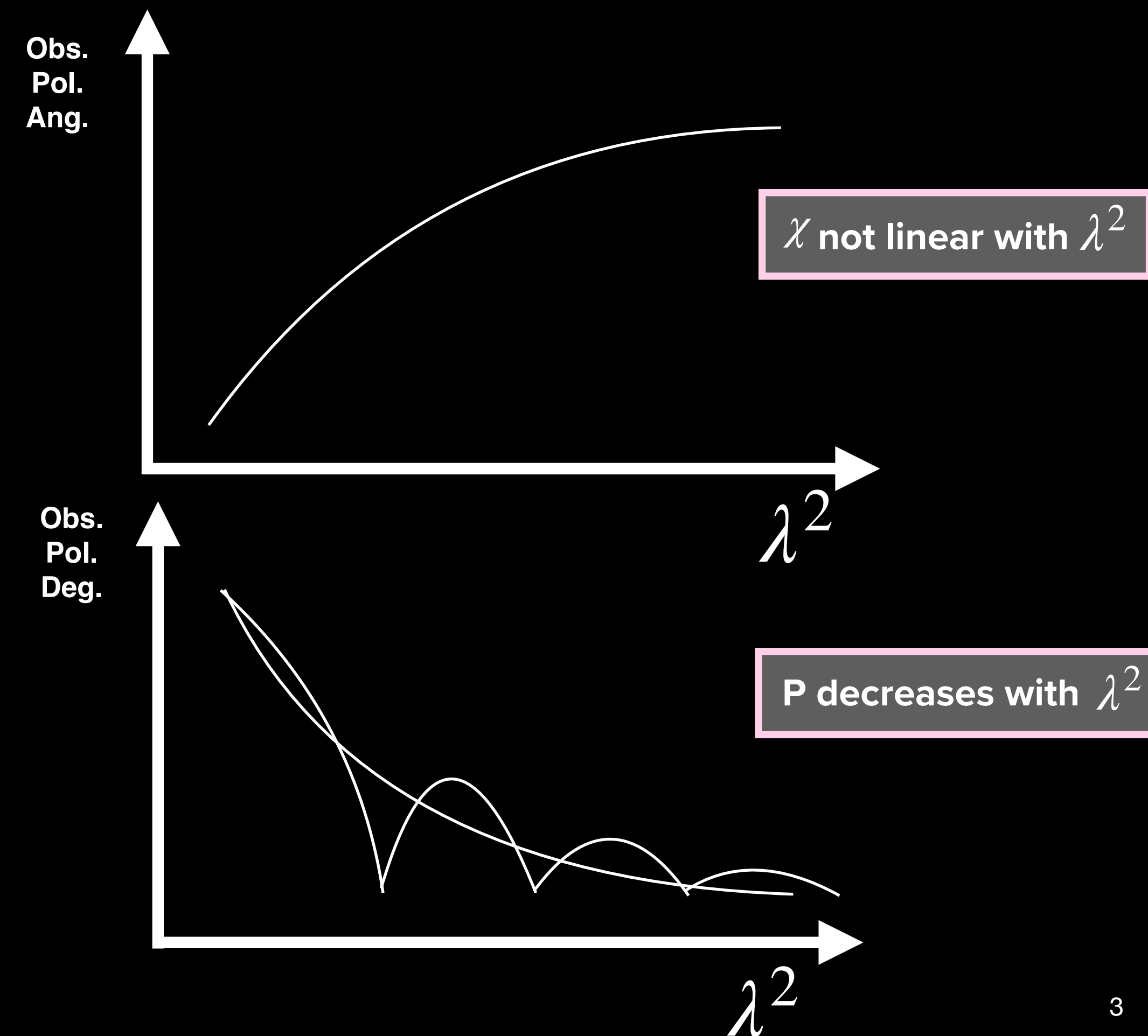
1. Faraday Rotation Measure (**RM**) **gradients** across the jet.
2. **Stratification of p**, the degree of polarization across the jet.
3. **Proper modeling of the polarized light** to infer properties of the B field and material of the jets

A jet could be at the same time an emitting and rotating source.
 Presence of both non thermal and thermal e-

Multiple Faraday screens



Faraday depolarization



What do we need to achieve this purpose?

- High angular resolution transverse to the jet
- High sensitivity (both continuum and pol. intensity)
- High spectral sensitivity

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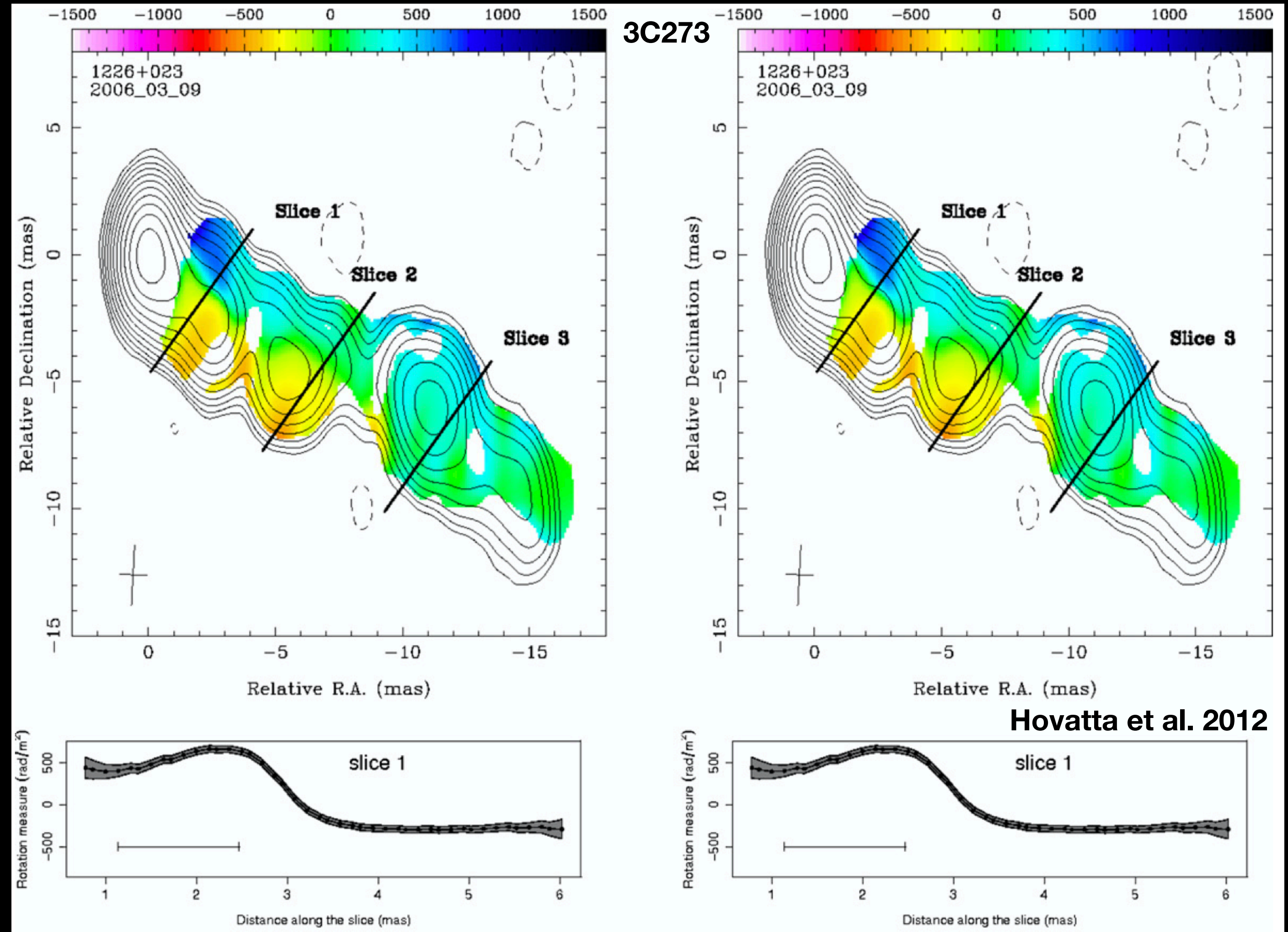
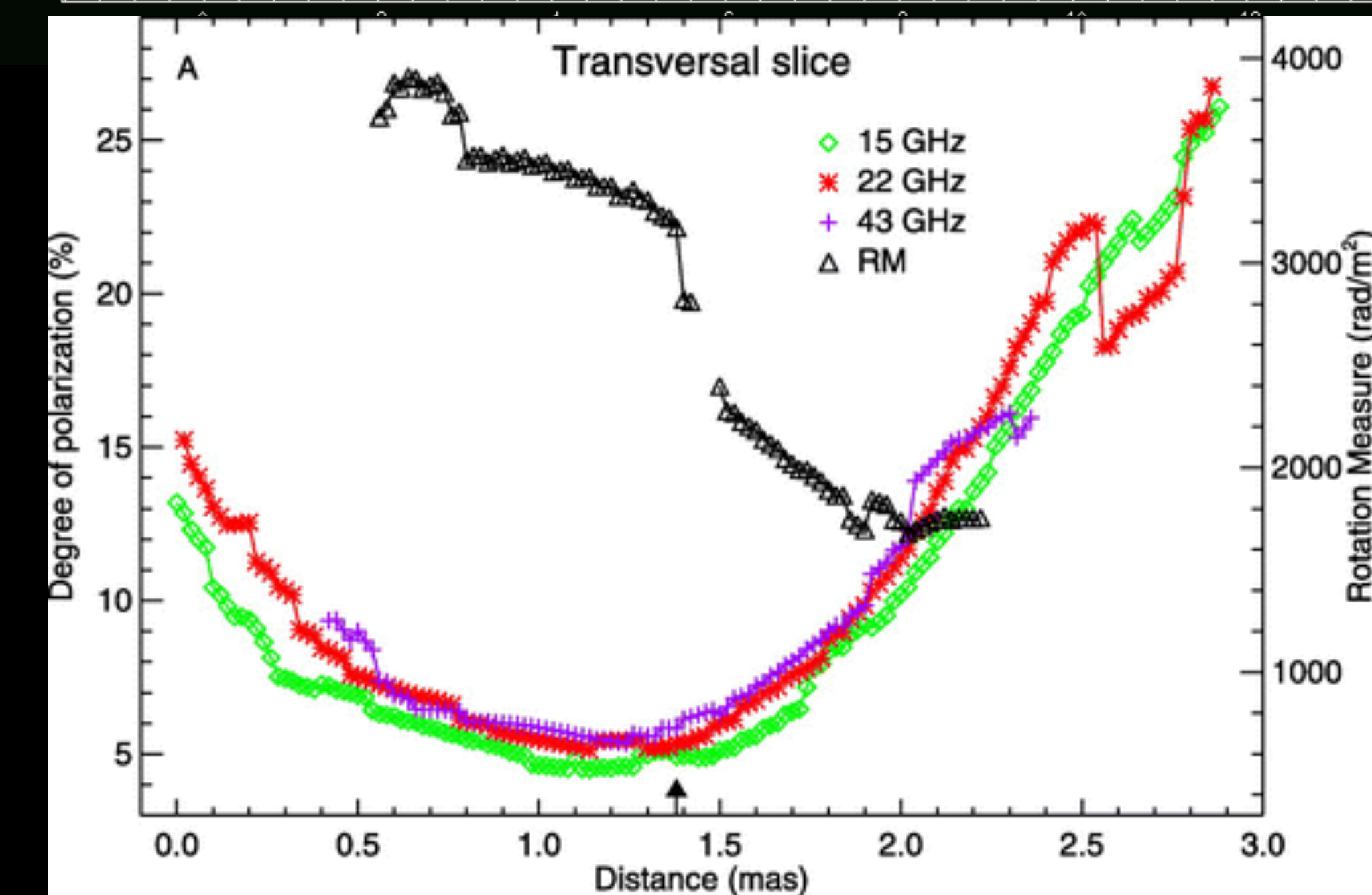
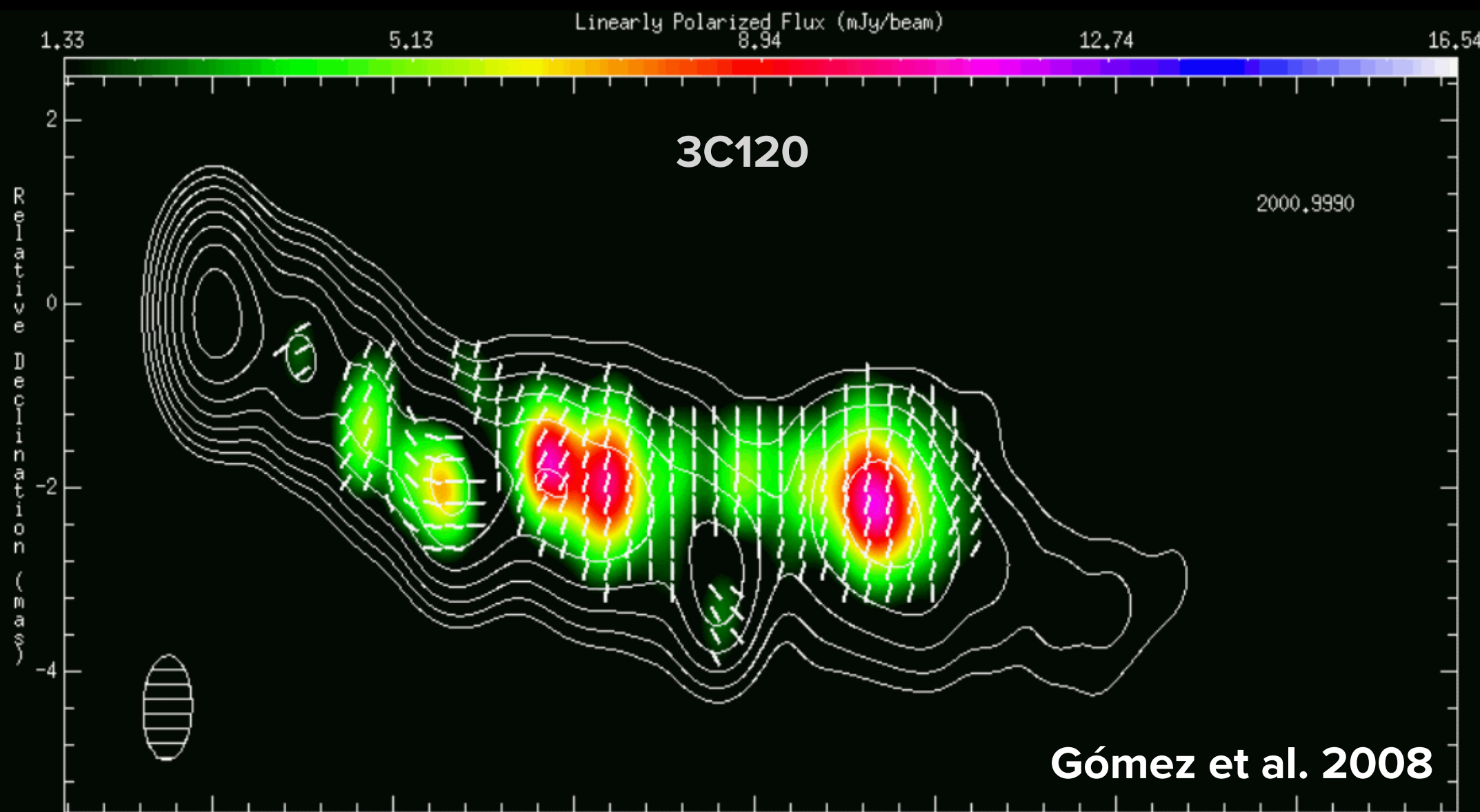
- High angular resolution transverse to the jet
- High sensitivity (both continuum and pol. intensity)
- High spectral sensitivity

VLBI is one of the best instrument to investigate on such topic!
Best angular resolution.

BUT VERY DIFFICULT

It explores regions very close to the central engine where the jet is very narrow
=> very difficult to resolve its width
it collects sparse radio data

BEST CASES



VLA is another important instrument for such investigation

It traces kpc scales => **up to which scale** helical magnetic field is propagating
High sensitivity also for spectral analysis (broad-band data)

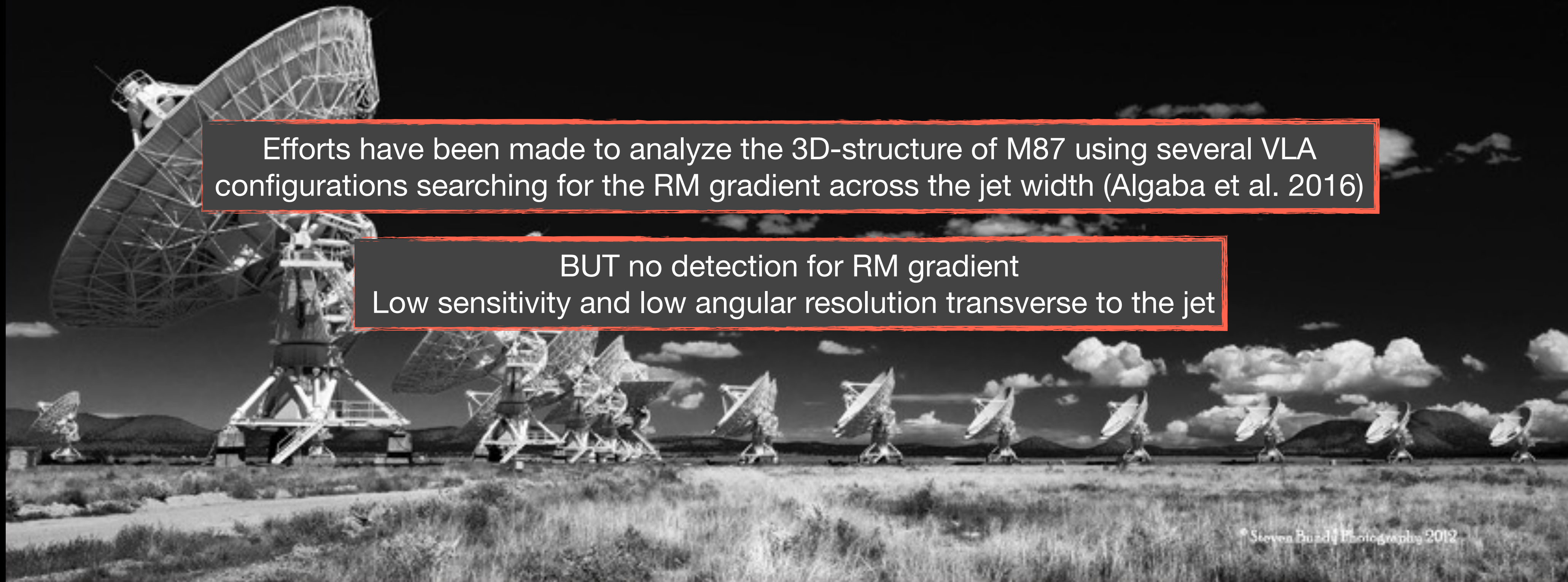


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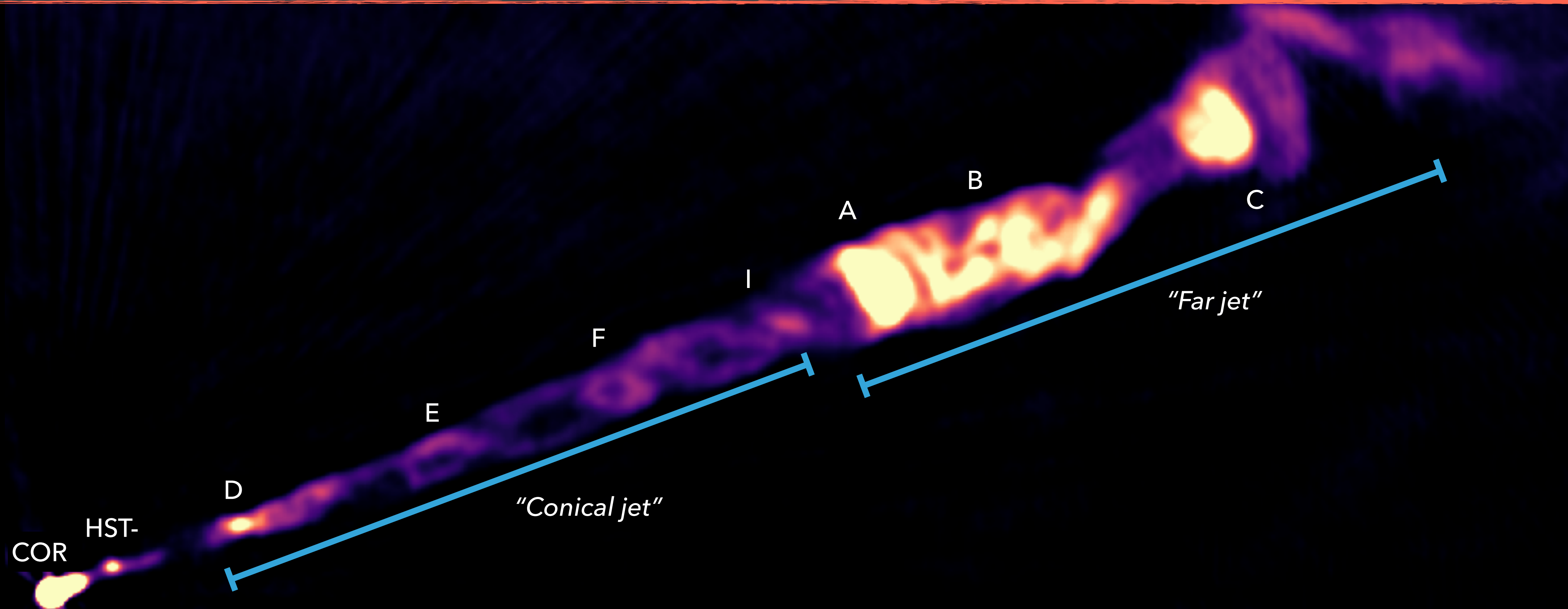
Efforts have been made to analyze the 3D-structure of M87 using several VLA configurations searching for the RM gradient across the jet width (Algaba et al. 2016)

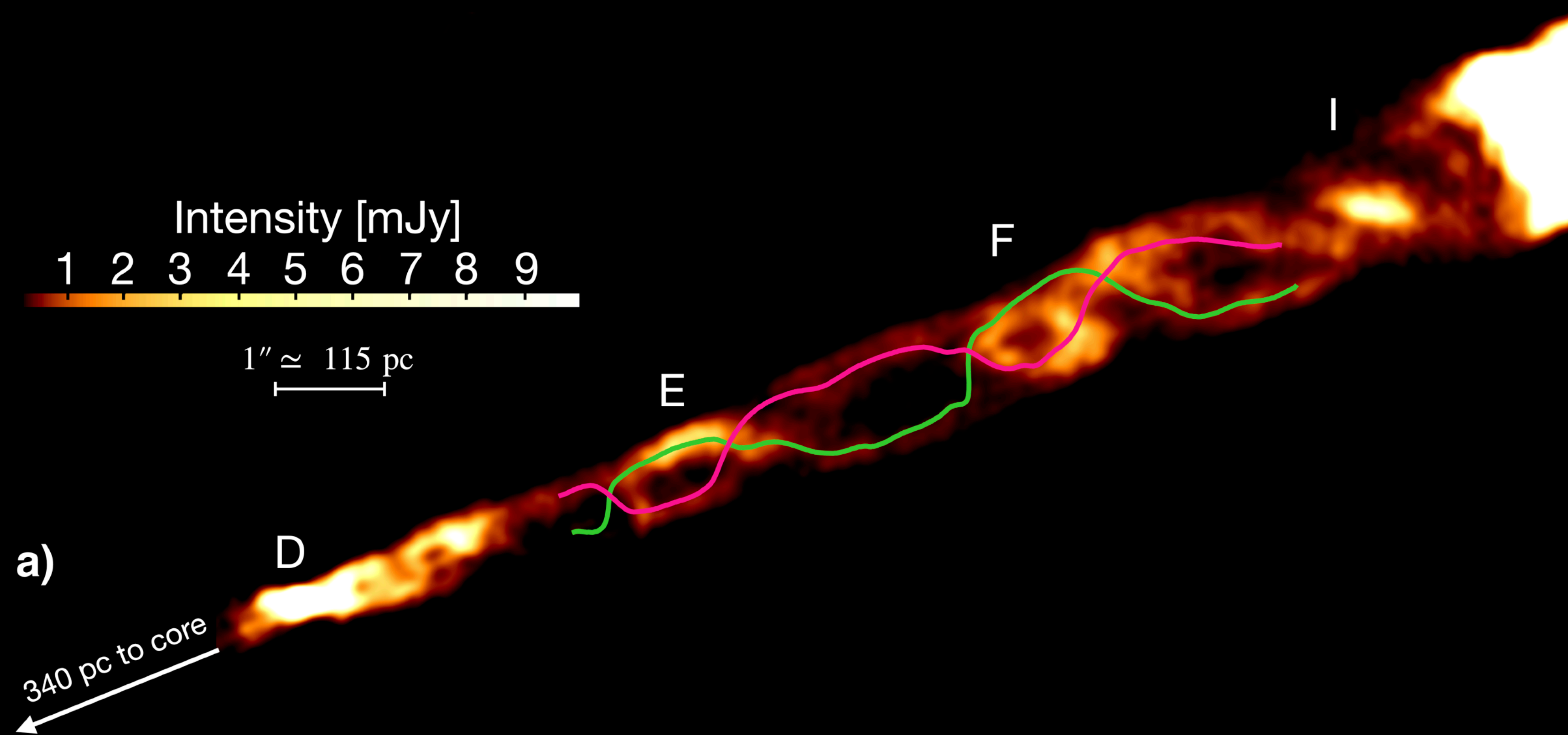
BUT no detection for RM gradient
Low sensitivity and low angular resolution transverse to the jet



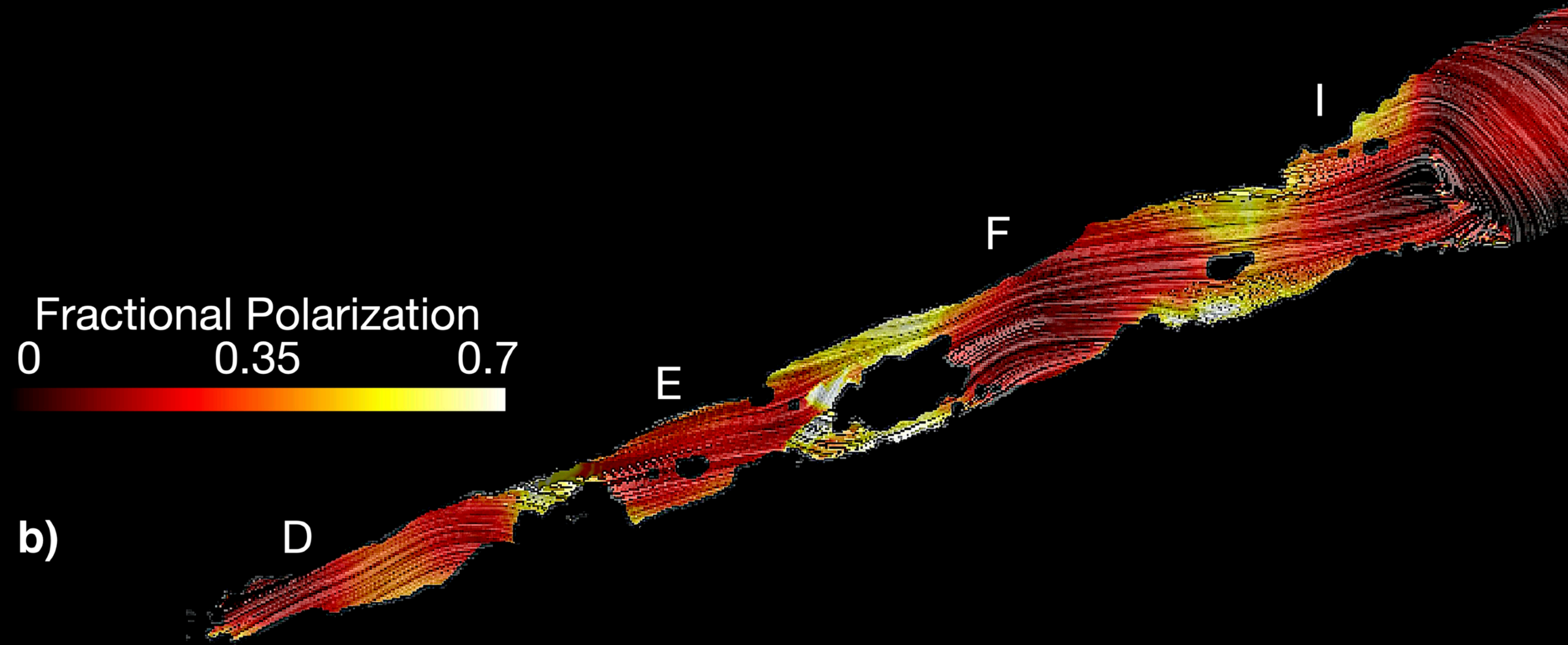
VLA POLARIMETRIC STUDY ON M87

- ▶ Full Stokes polarization data from C to Ku bands => **from 4 to 18 GHz**
- ▶ **Highest sensitivity Total Intensity** map has been performed (resolution $0.09''$ => ~ 10 pc)
- ▶ **DEPOLARIZATION MODELING** has been performed, using EACH SPW (128 MHz width), **PIXEL BY PIXEL** (resolution $0.4''$ => \sim tens of pc)





Double helix detected => most likely due to KH instability



Stratification of fractional polarization detected

high pol. where filaments are separated and depol. where filaments intersect each other

Fractional Polarization
0 0.35 0.7

b)

D

E

F

F

1.5" \approx 170 pc

c)

E

-150 ϕ [rad/m²] 150
Away from observer $B_{||}$ Toward observer

RM gradient detected (from + to -)

Magnetic field lines opens like a funnel

Internal F. depolarization

- - One F. screen (gives the general tendency)
- Two F. screens (reality is complex)



b)

D

E

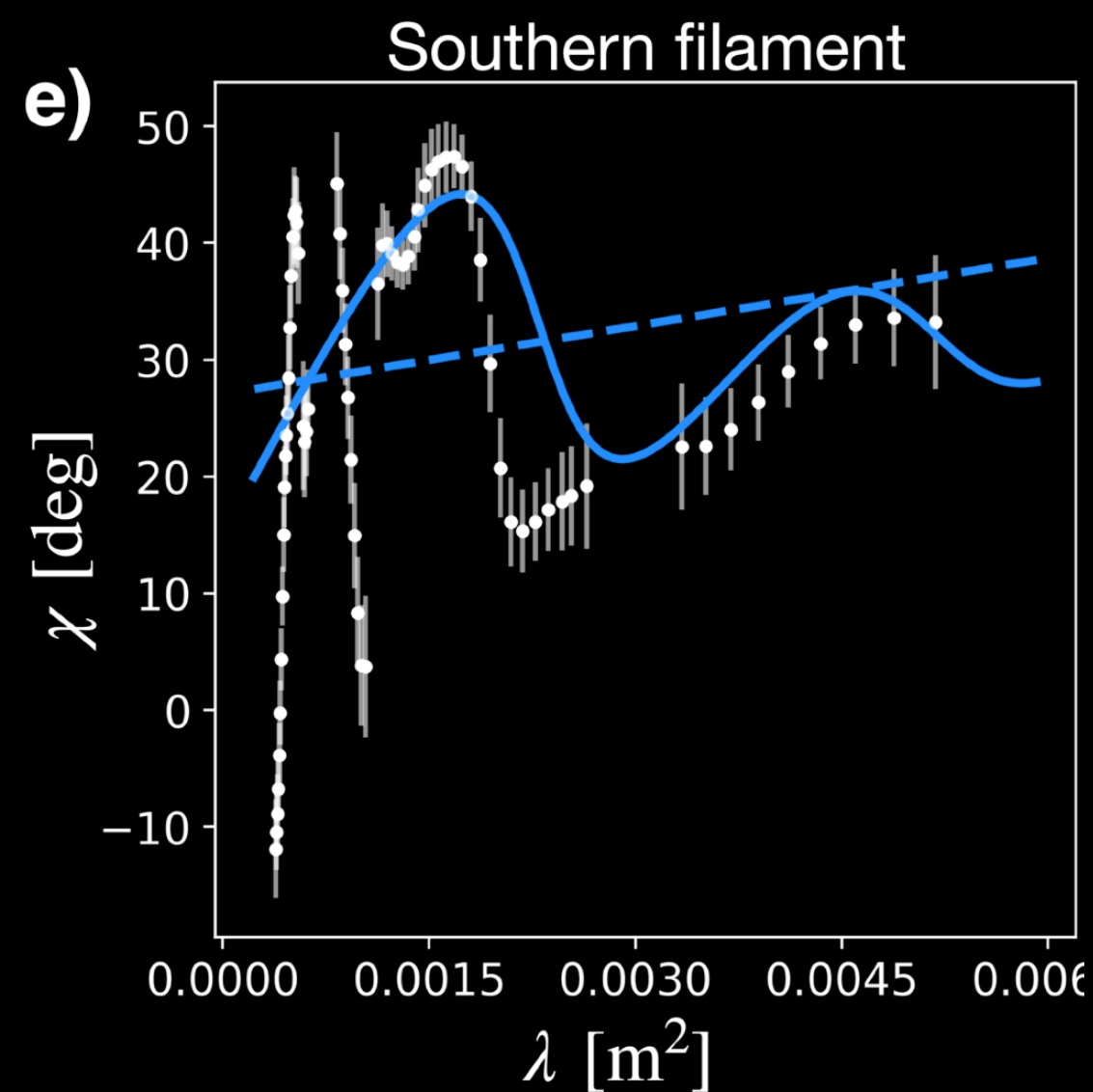
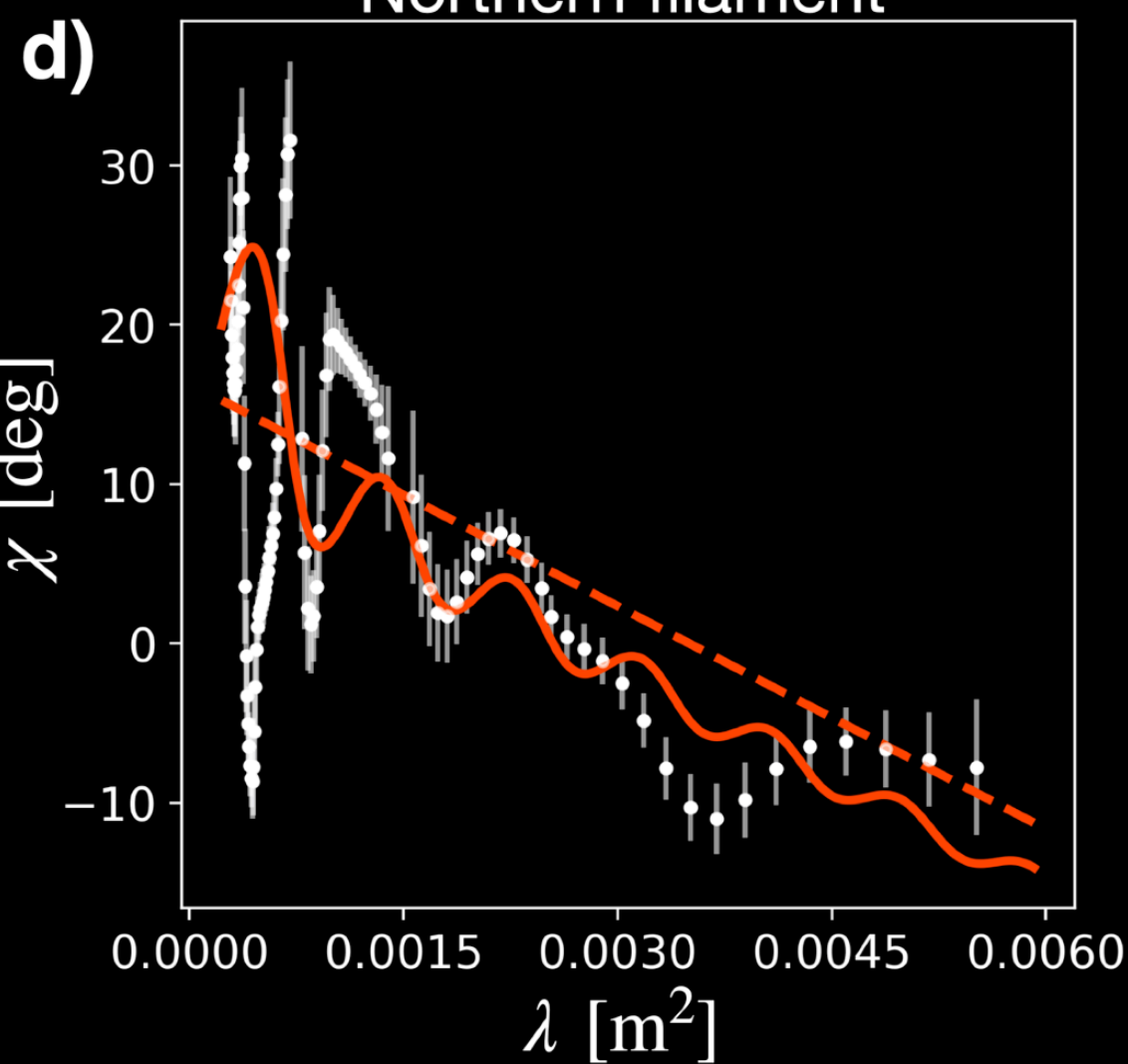
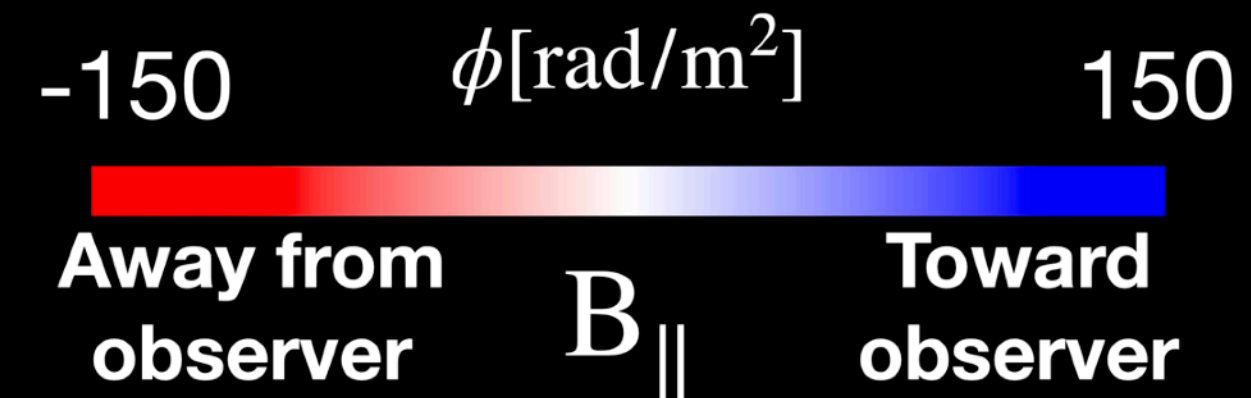
F

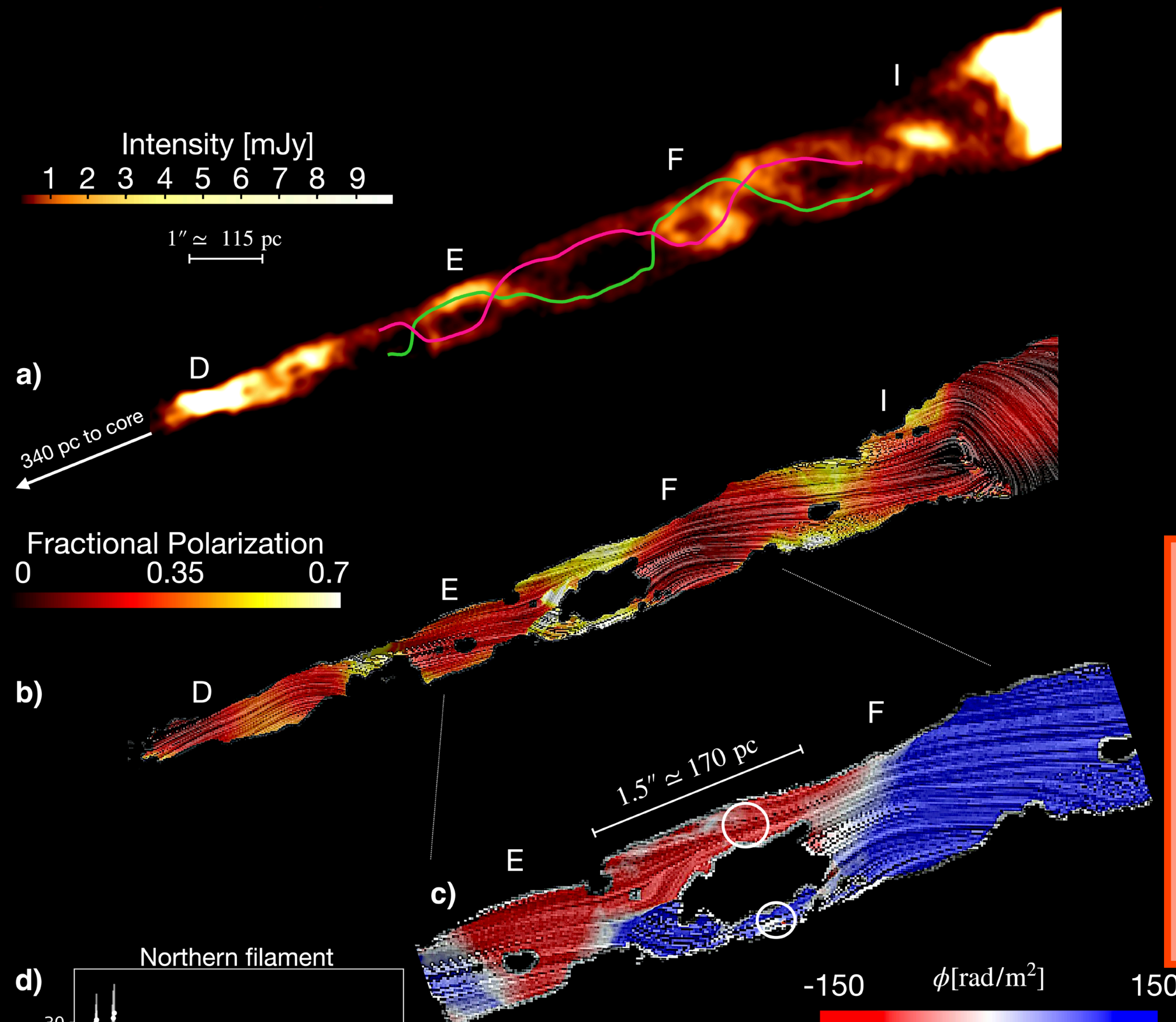
F

c)

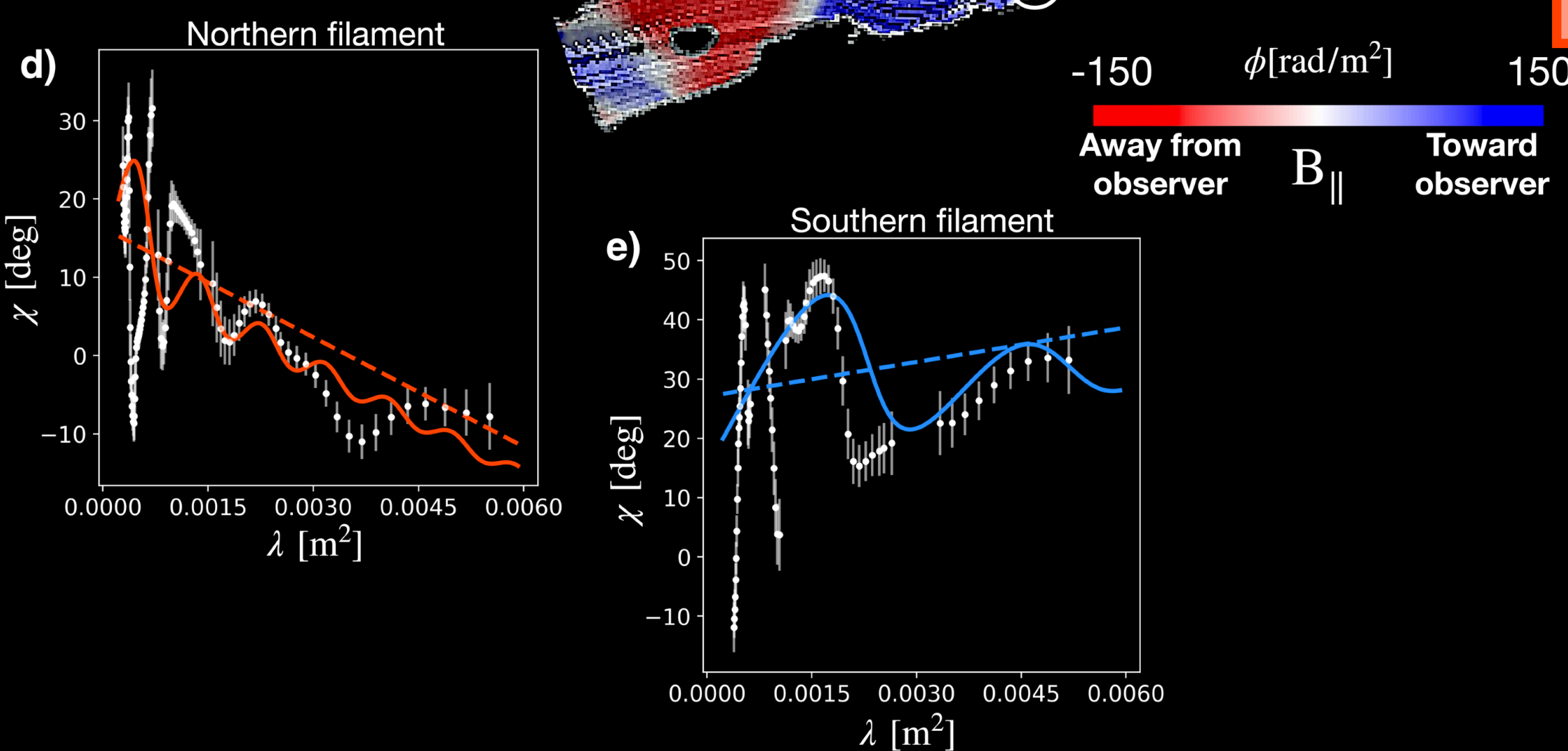
E

1.5" \approx 170 pc





CLEAR EVIDENCE FOR THE PRESENCE OF HELICAL MAGNETIC FIELD @ KPC SCALE!
 (Pasetto et al. 2021)



Thank you

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