

Unveiling radio polarimetry in X-ray binaries with MeerKAT

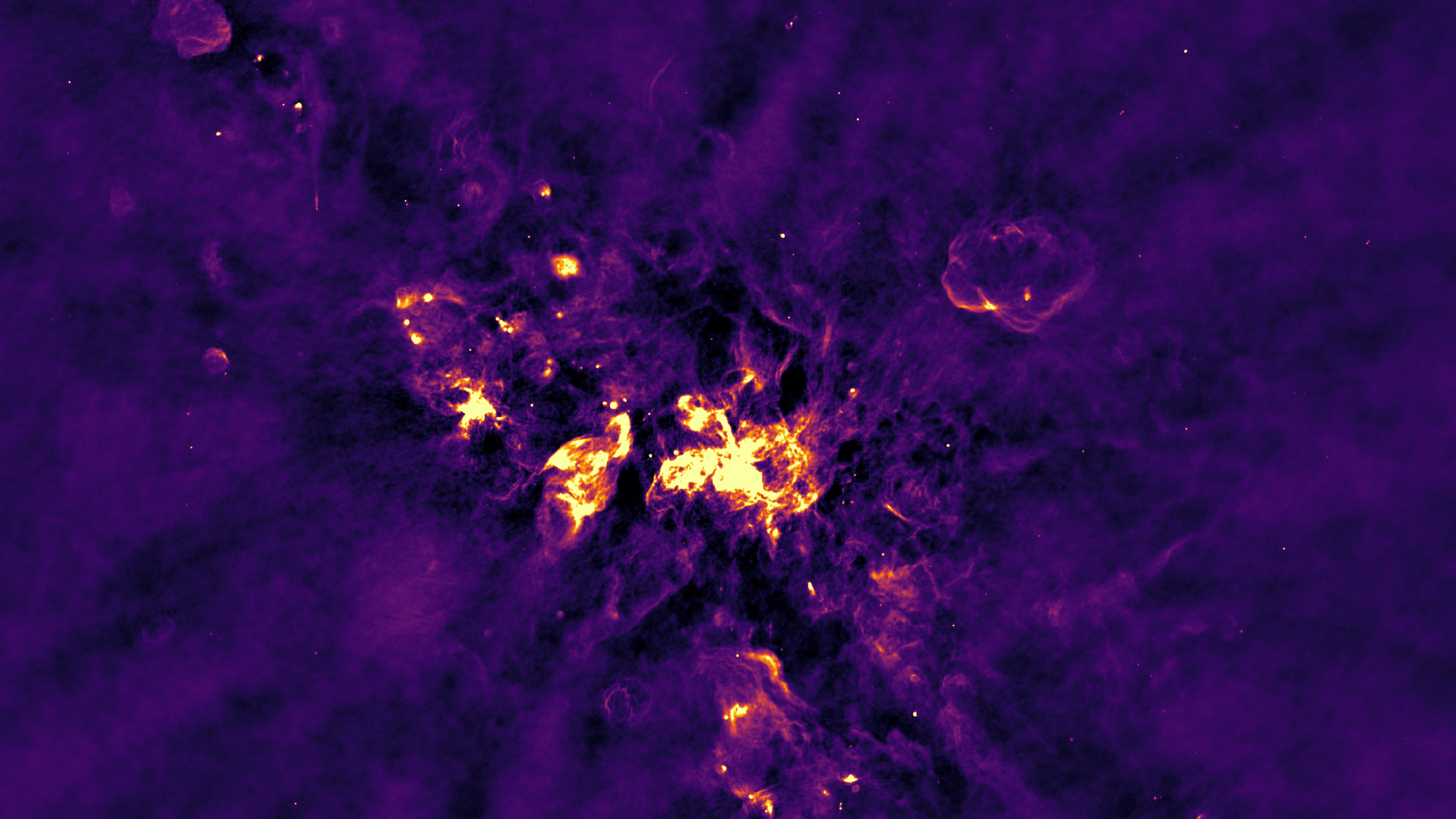
The case study of 4U 1630-47

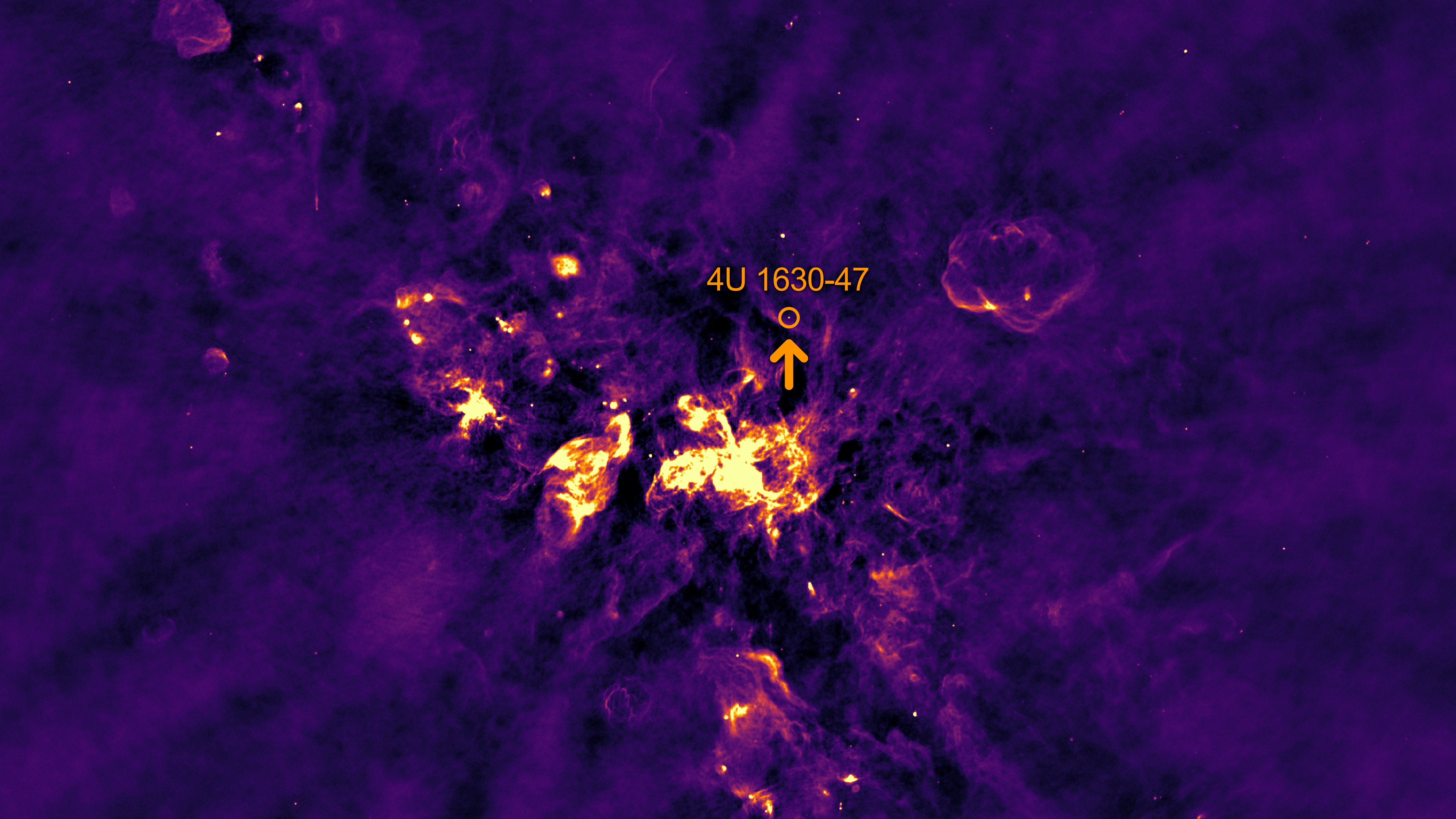
Isabella Mariani (INAF-OAB/University of Milano-Bicocca)
& Sara Motta, Andrew Hughes, Melania Del Santo, Cristina Baglio
On behalf of the X-KAT collaboration
V SKA Workshop Bologna 2025



INAF
ISTITUTO NAZIONALE
DI ASTROFISICA



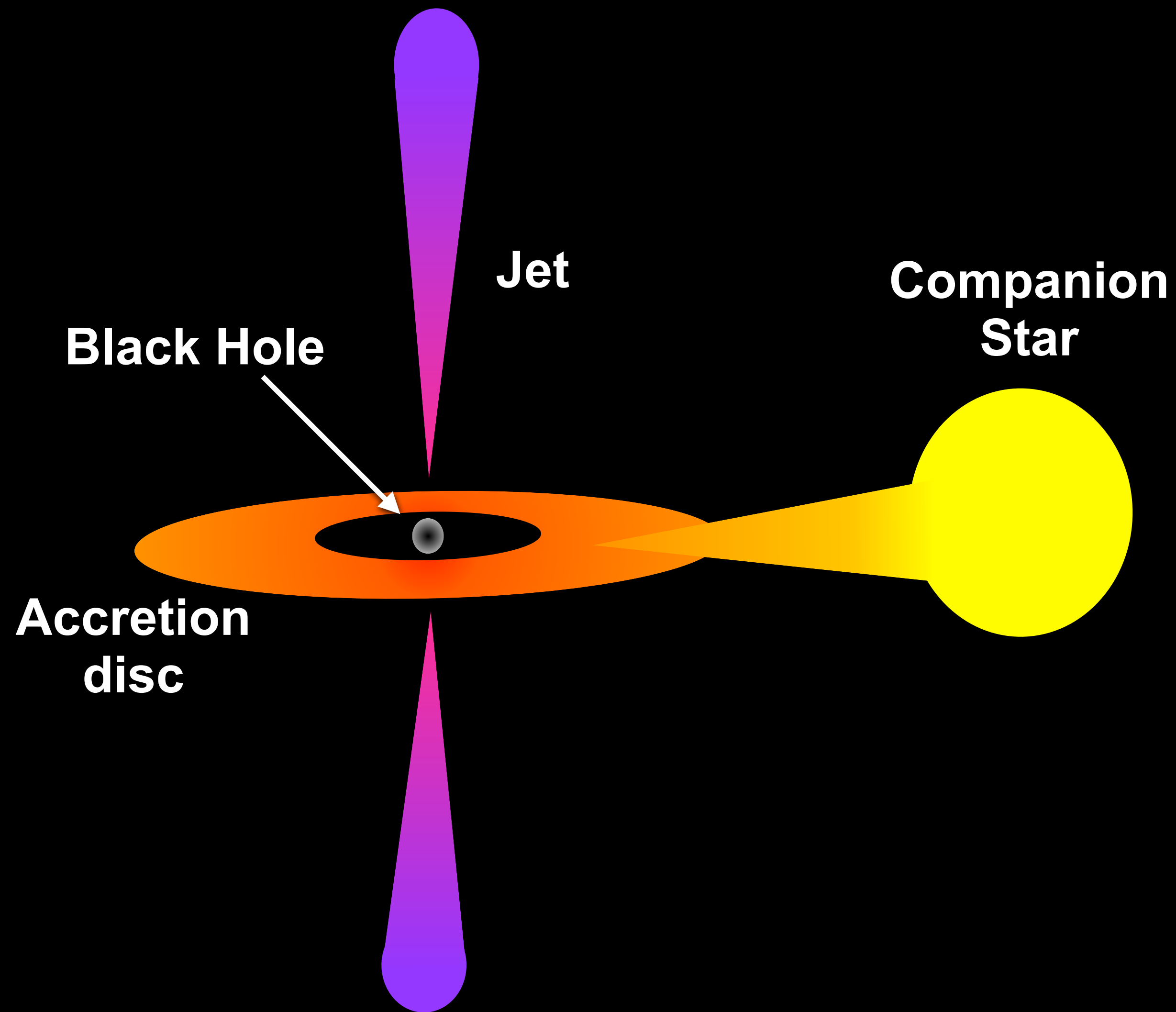




4U 1630-47



4U 1630-47



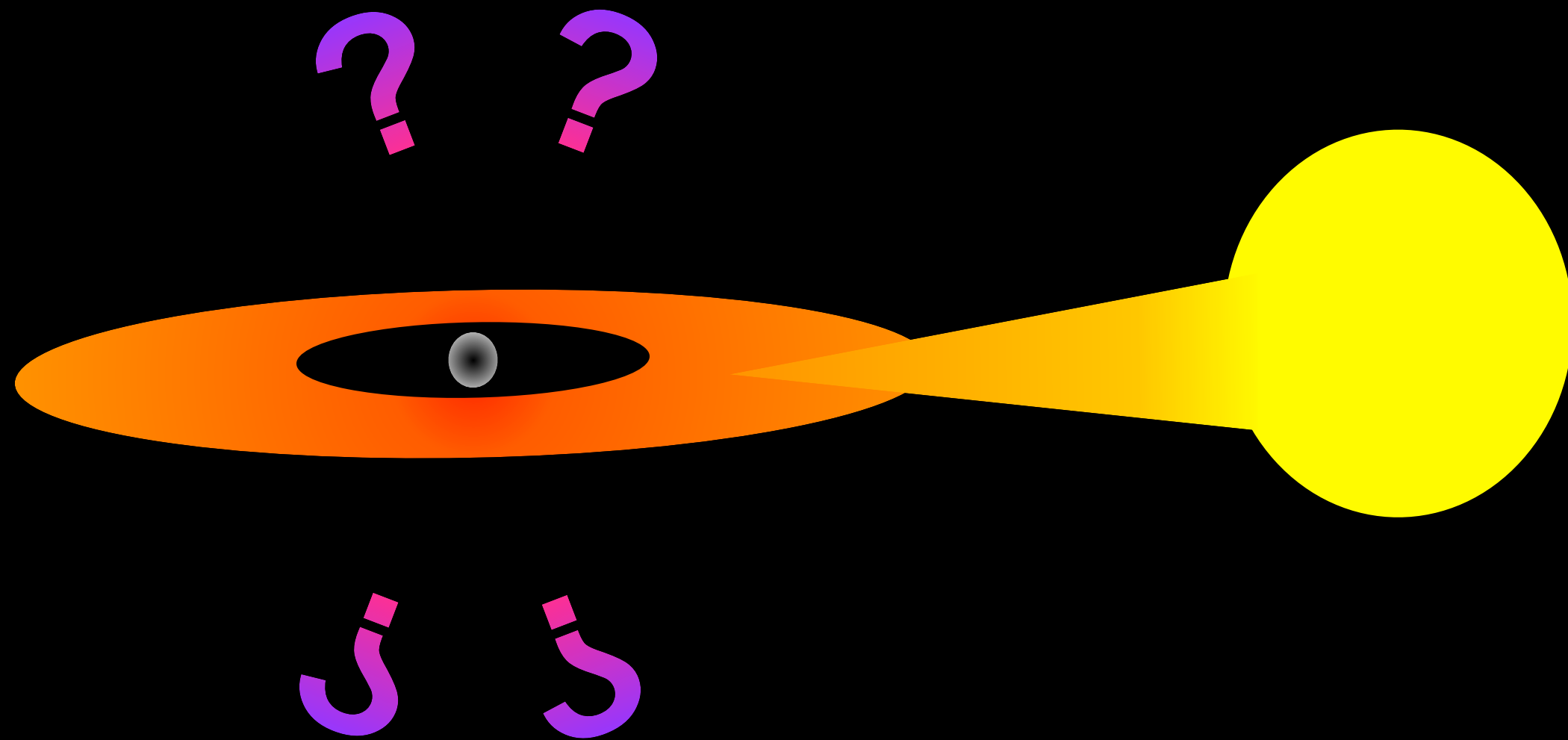
Black Hole X-ray binary
Outburst every ~ 600 days

4U 1630-47

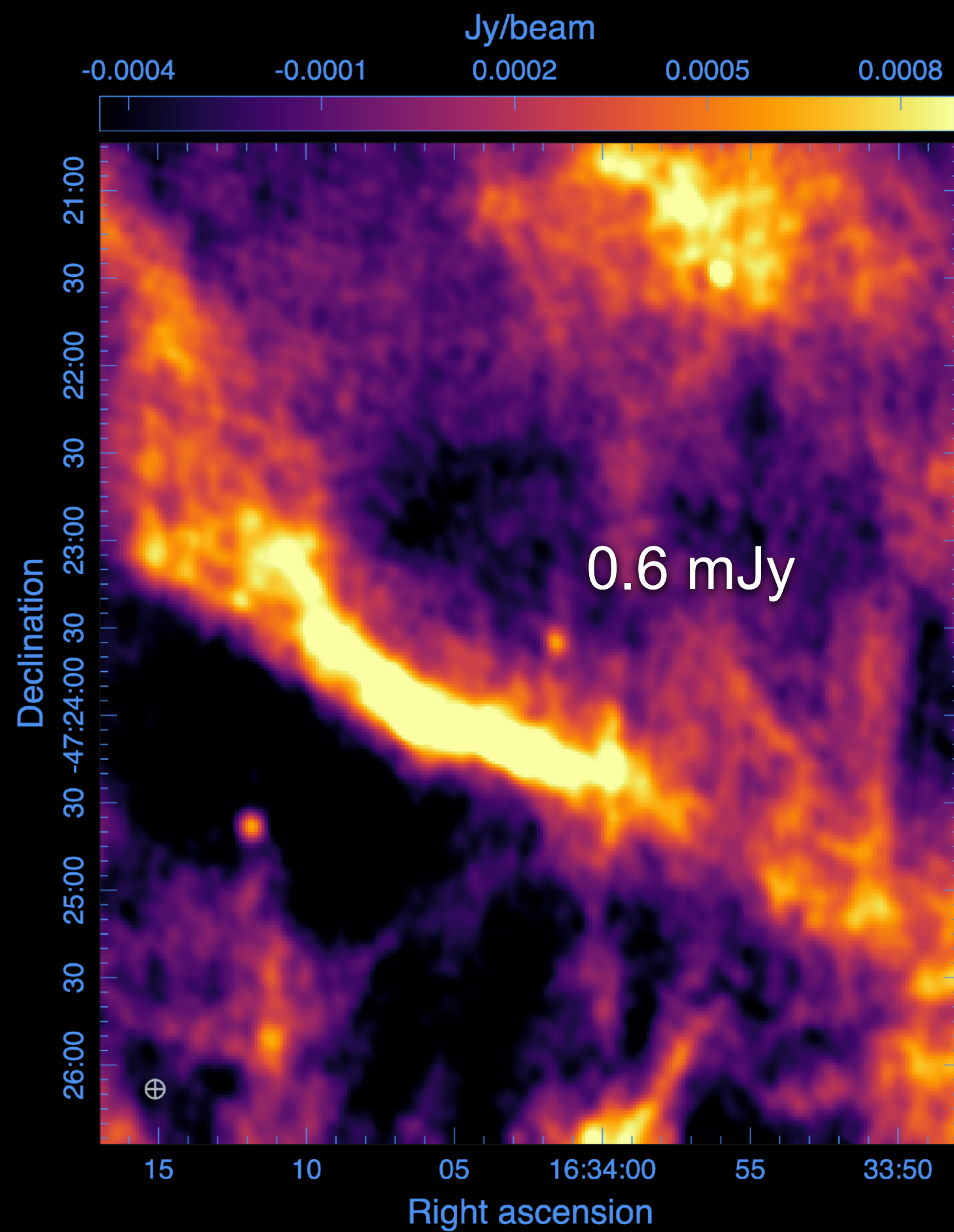
Black Hole X-ray binary

Outburst every ~ 600 days

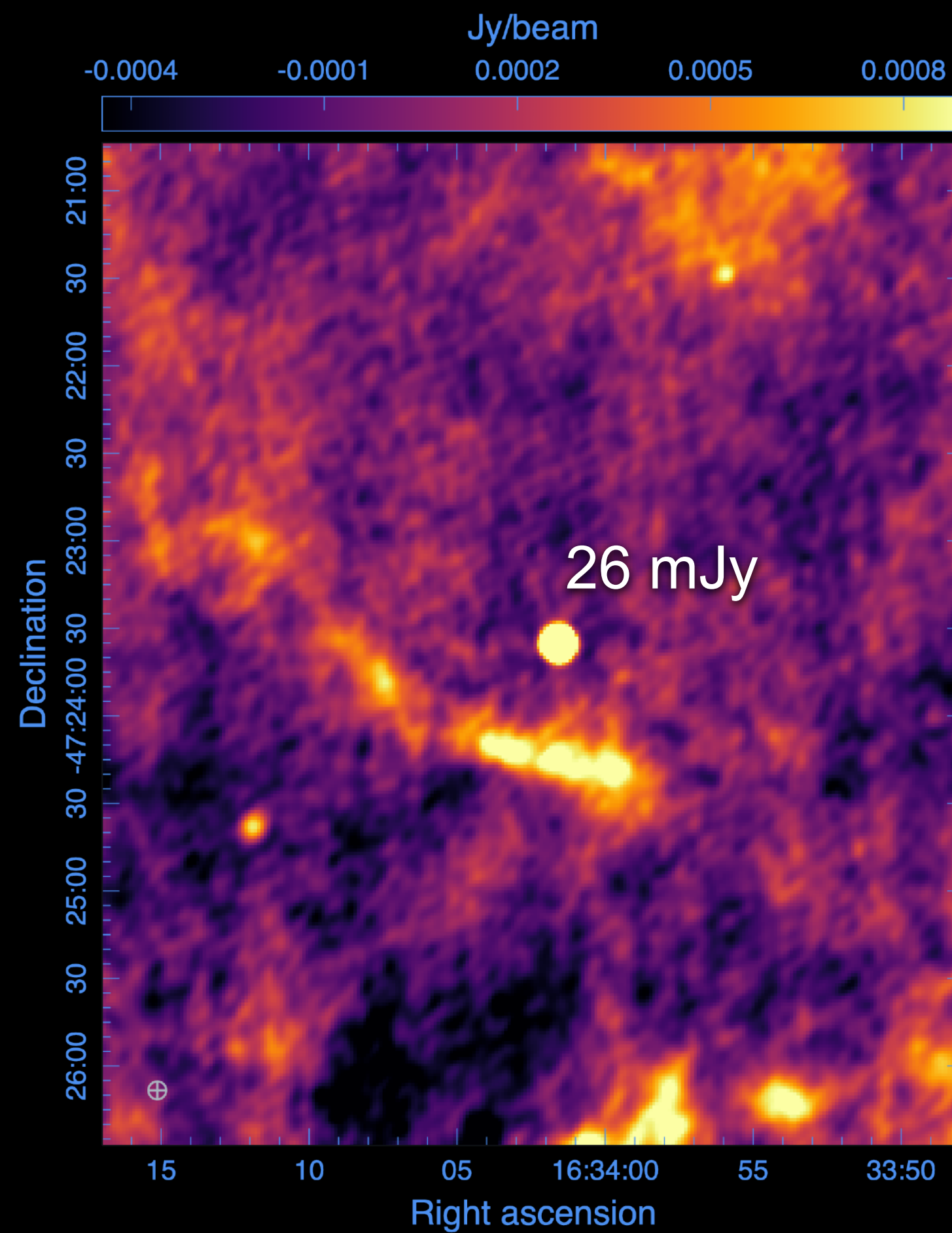
Radio emission absent most of
outbursts



12/04/2025



21/04/2025



4U 1630-47

X-KAT: outburst 2025



15 epochs (Apr-Jul):

L band (1.28 GHz)

Unusual radio bright state

[Mariani et al. 2025, ATel #17139]

[Mariani et al., in prep.]

4U 1630-47

Unusual bright radio state:

Brightest ever

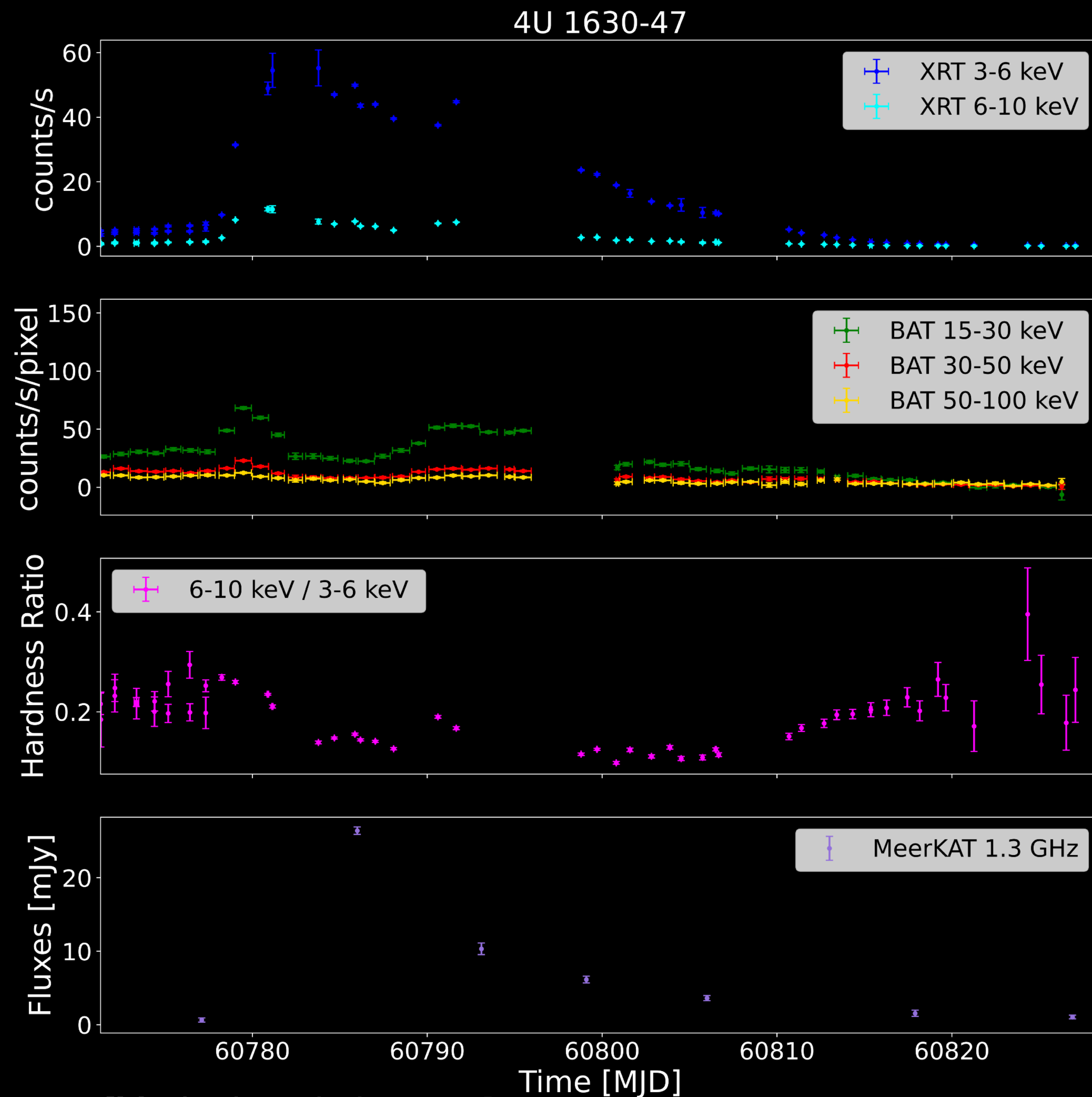
X vs radio $\rightarrow$ intermediate-soft

state $\rightarrow$ **Transient jet**

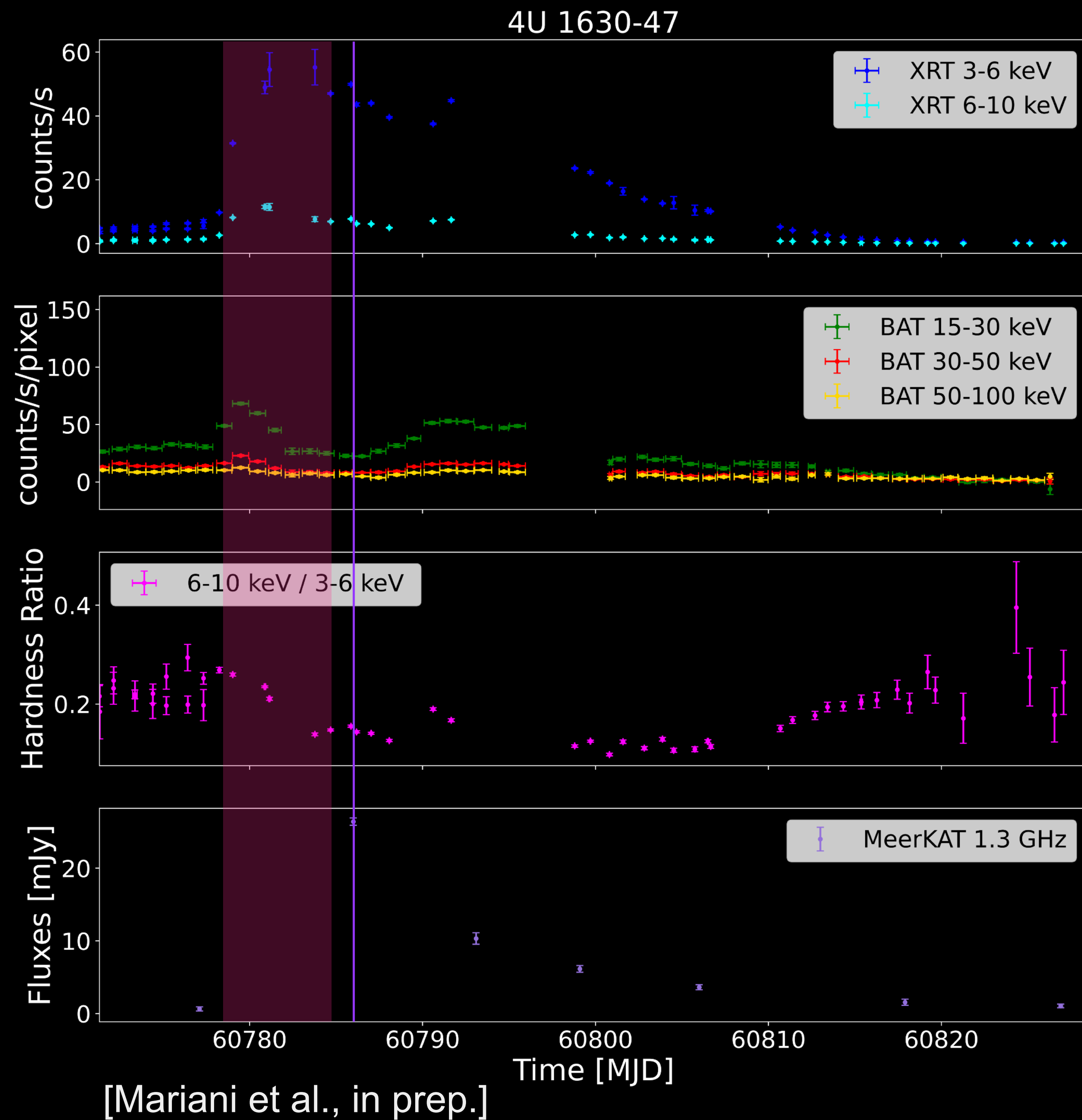
BUT

Flat radio spectrum, no proper

motion $\rightarrow$ **Compact jet**



[Mariani et al., in prep.]



4U 1630-47

Unusual bright radio state:

Brightest ever

X vs radio → intermediate-soft

state → **Transient jet**

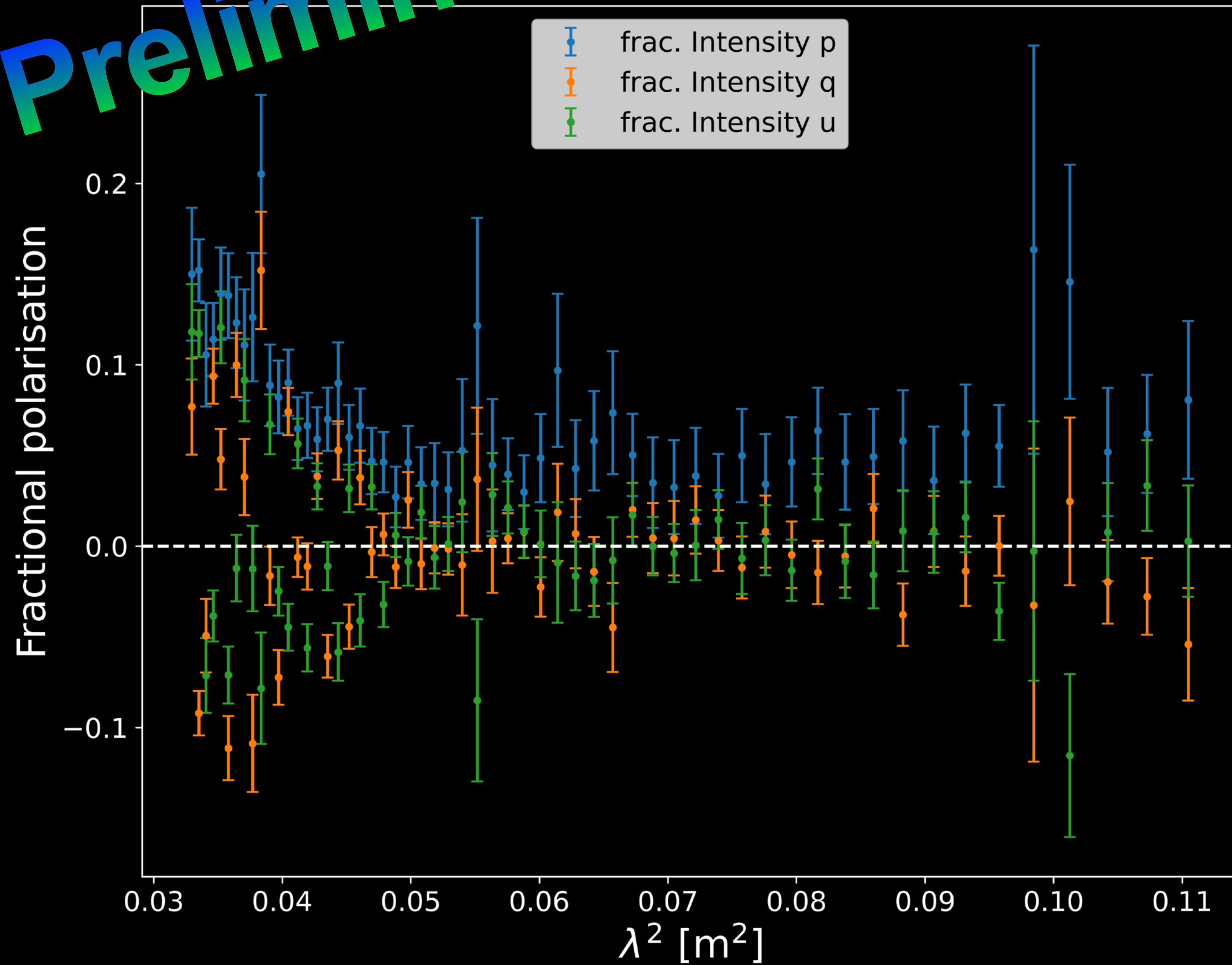
BUT

Flat radio spectrum, no proper

motion → **Compact jet**

Preliminary!

21/04/2025



[Mariani et al., in prep.]

4U 1630-47

Polarimetry results

Polarimetry → system's geometry

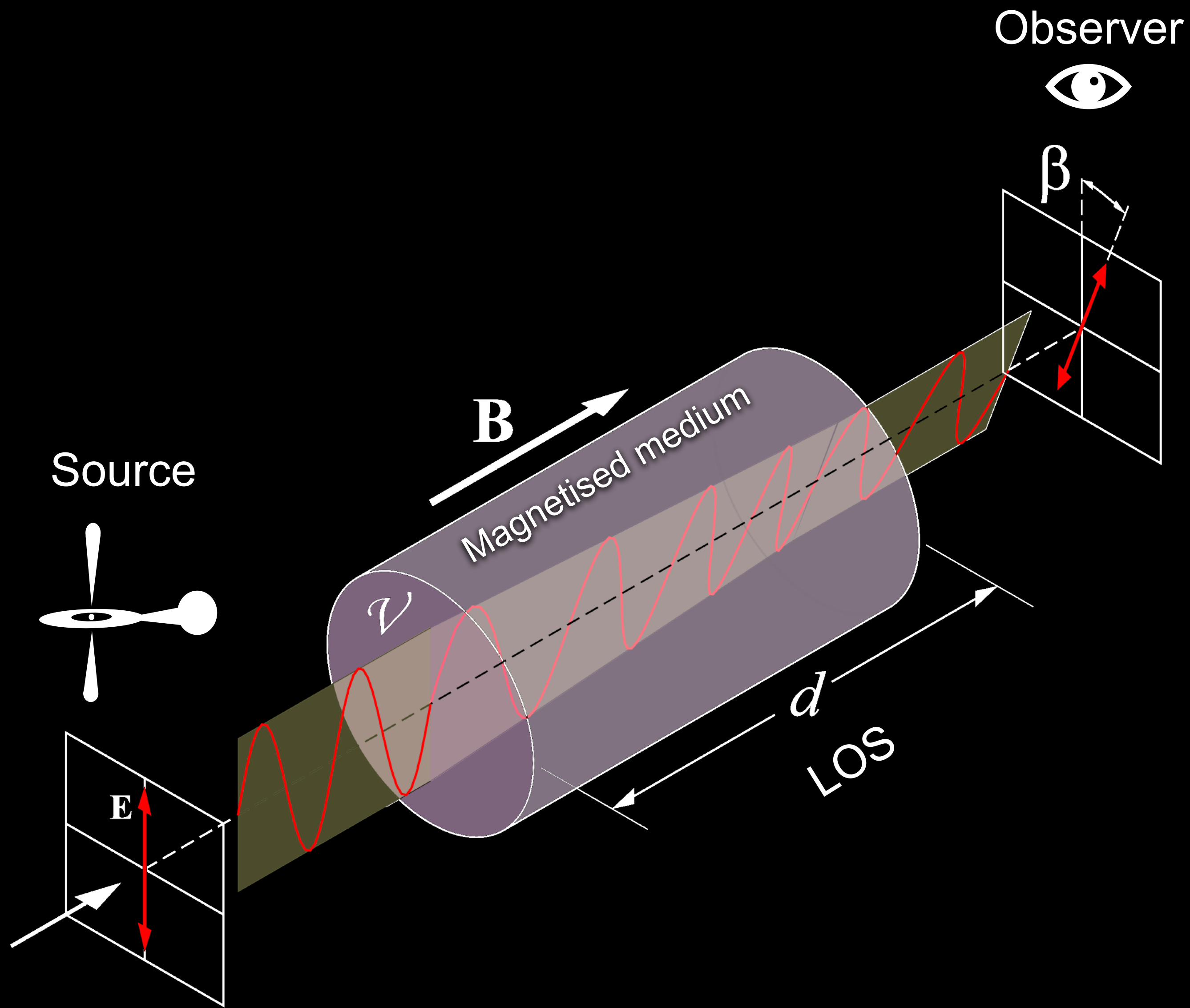
(Linear) polarisation from the jet

Thin synchrotron ~70%

Thick synchrotron $\lesssim 20\%$



Depolarisation: **Faraday effect**



4U 1630-47

Polarimetry results

Depolarisation at higher $\lambda \rightarrow$ Faraday depolarisation (FD)

PD decreases, PA rotates

Internal/External FD

RM-synthesis

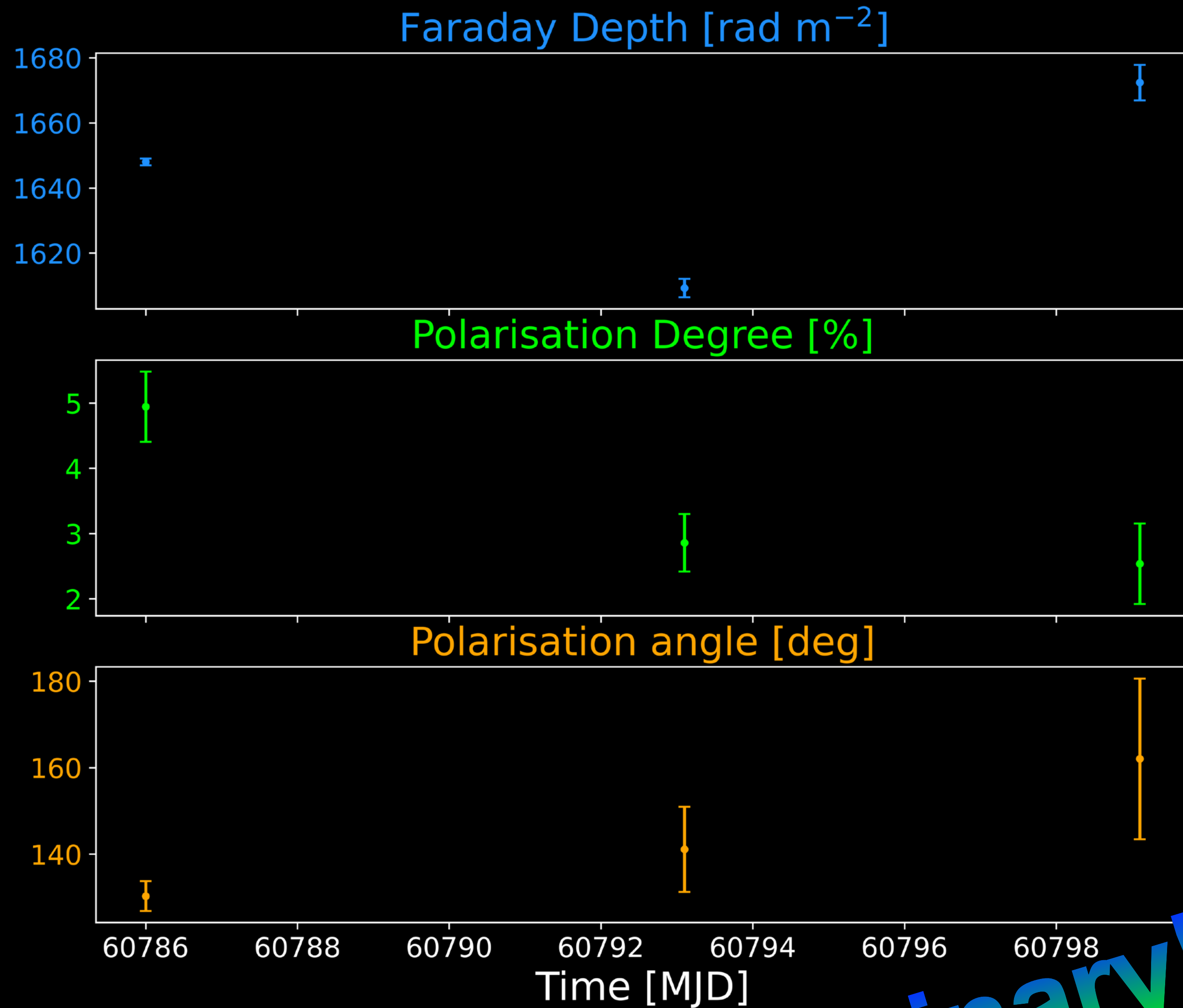
21/04/2025

28/04/2025

04/05/2025

4U 1630-47

Polarimetry results



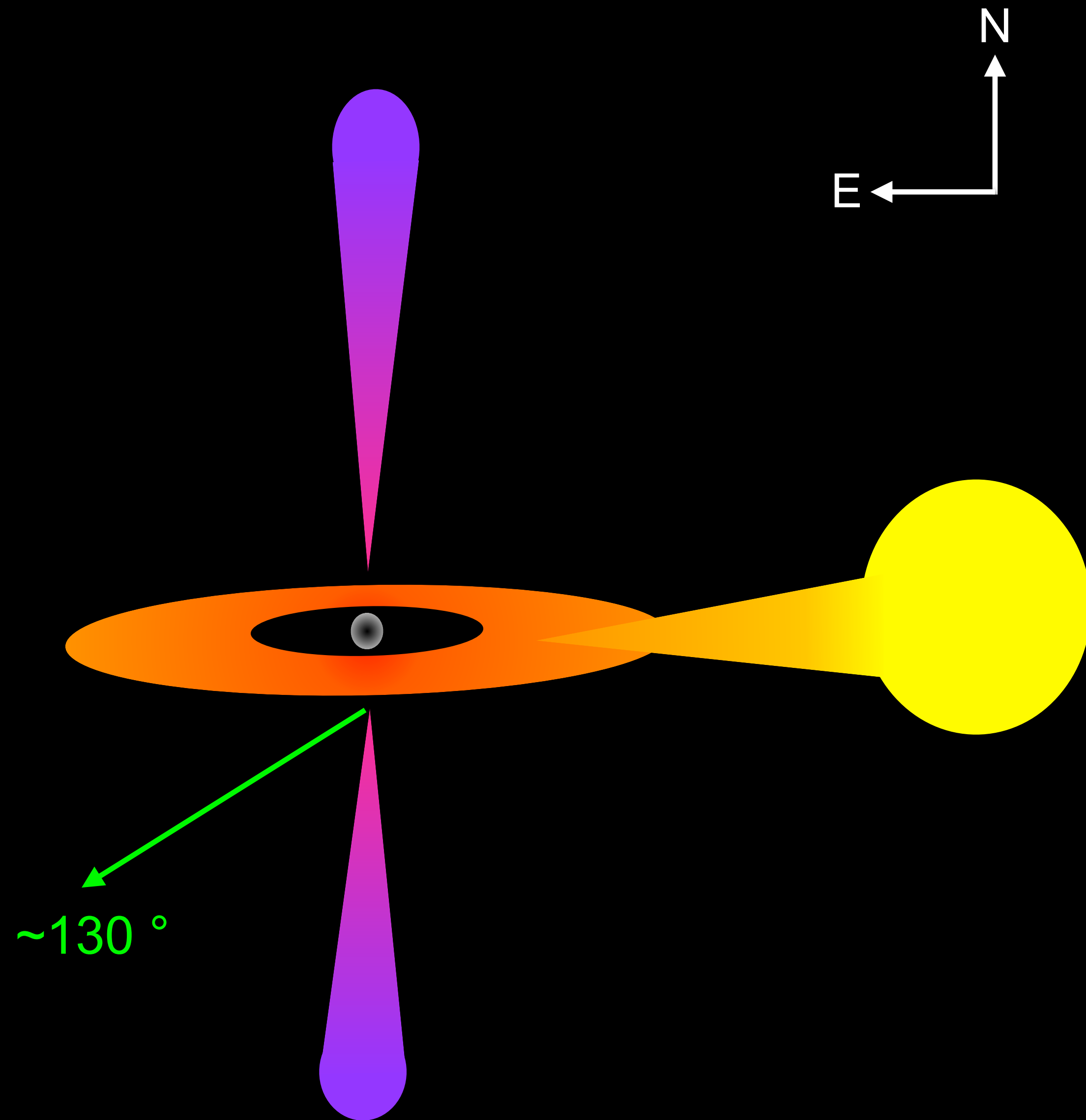
Extremely high RM $\rightarrow \sim 1650 \text{ rad m}^{-2}$

PD decreases with time

PA $\sim$ increase with time

[Mariani et al., in prep.]

Preliminary!



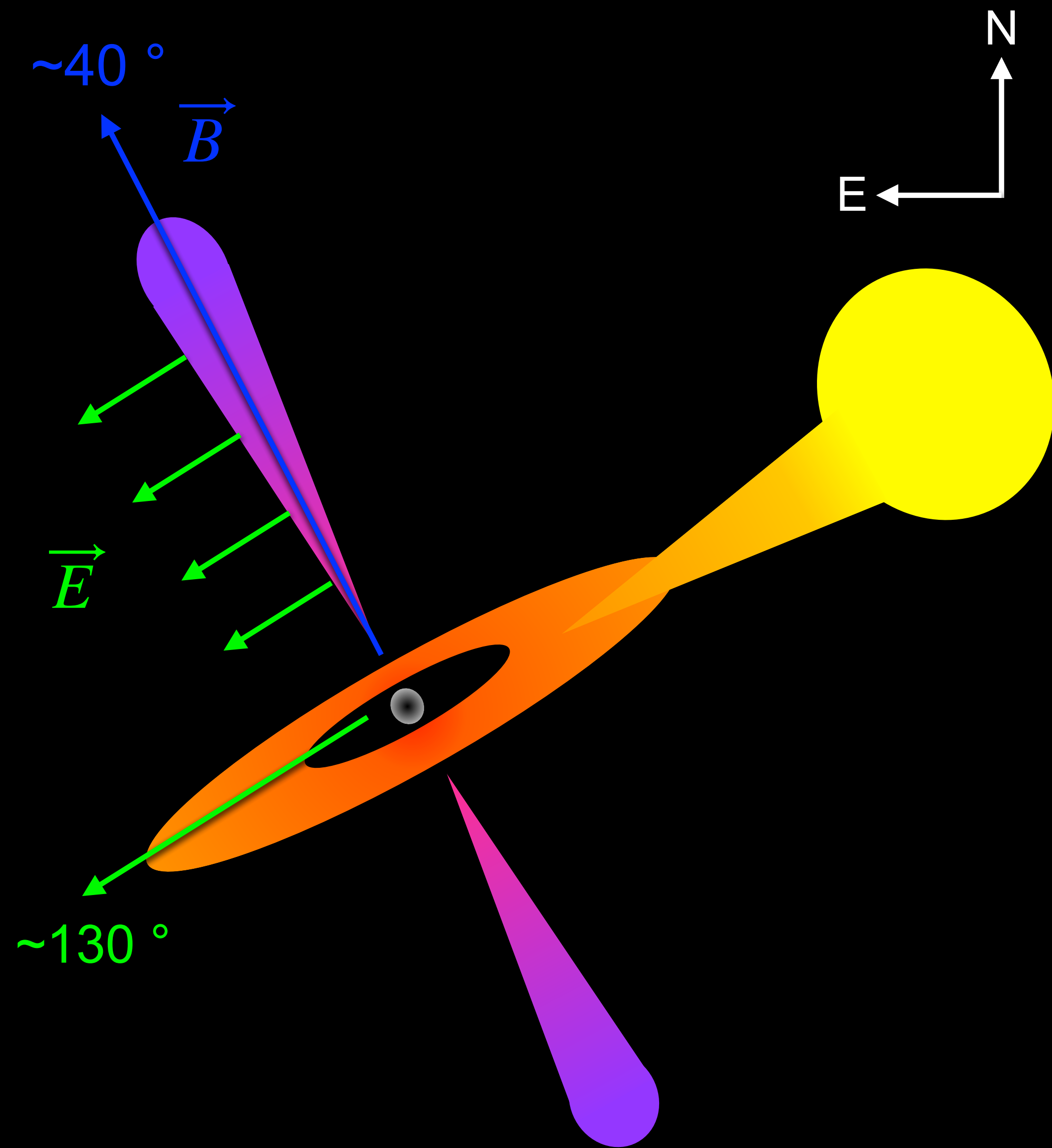
4U 1630-47

Polarimetry results

RM $\sim 1650 \text{ rad m}^{-2}$

PD $\sim 5\%$

EVPA $\sim 130^\circ \rightarrow$ BVPA $\sim 41^\circ$



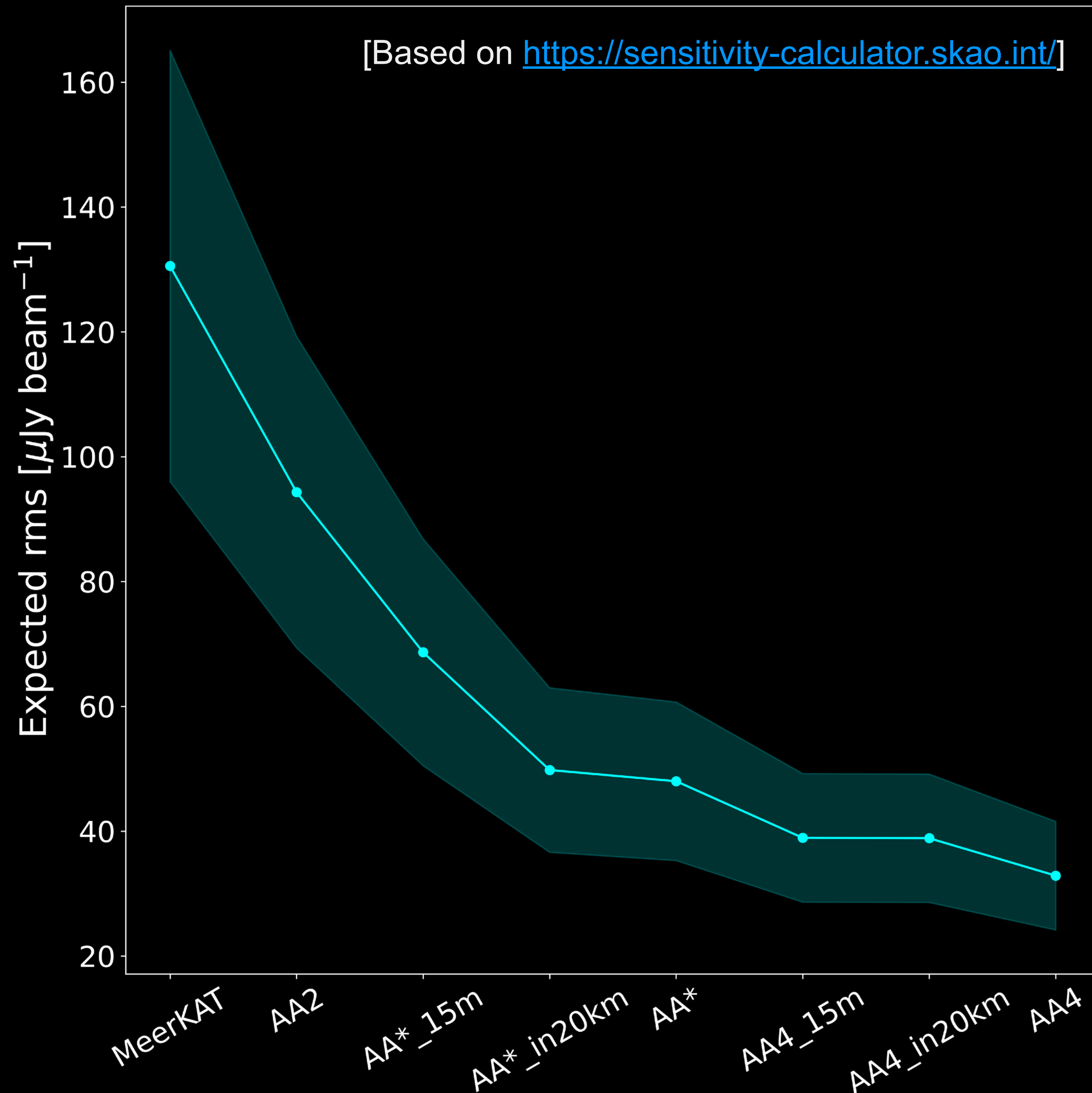
4U 1630-47

Polarimetry results

RM $\sim 1650 \text{ rad m}^{-2}$

PD $\sim 5\%$

EVPA $\sim 130^\circ \rightarrow$ BVPA $\sim 41^\circ$



Towards the SKA (MID)

MeerKAT

64x13.5m

AA2

64x15m

AA*_15m

80x15m

AA*_in20km

64x13.5m - 77x15m

AA*

64x13.5m - 80x15m

AA4_15m

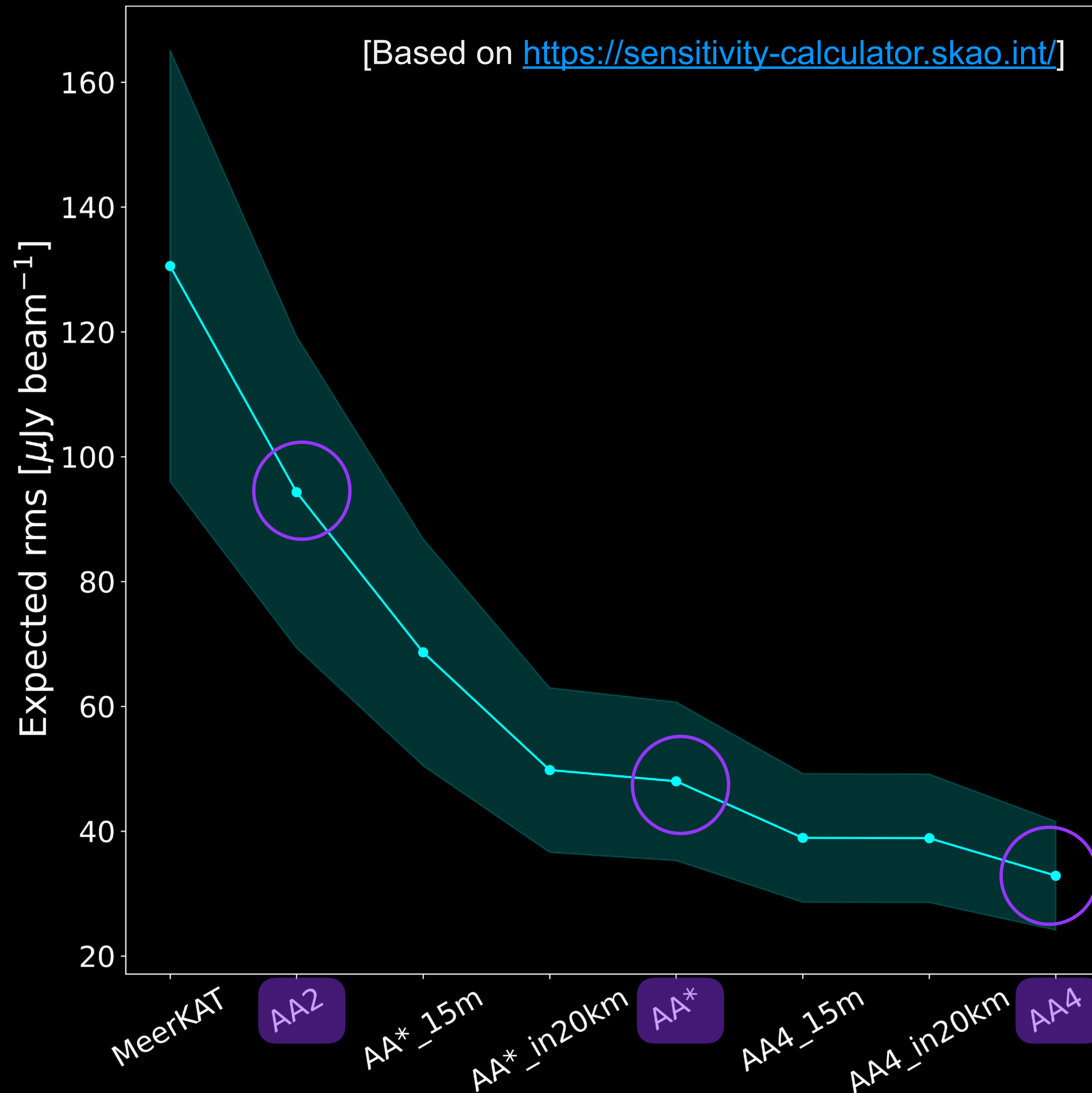
133x15m

AA4_in20km

64x13.5m - 110x15m

AA4

64x13.5m - 133x15m



Towards the SKA (MID)

MeerKAT

64x13.5m

AA2

64x15m

AA*_15m

80x15m

AA*_in20km

64x13.5m - 77x15m

AA*

64x13.5m - 80x15m

AA4_15m

133x15m

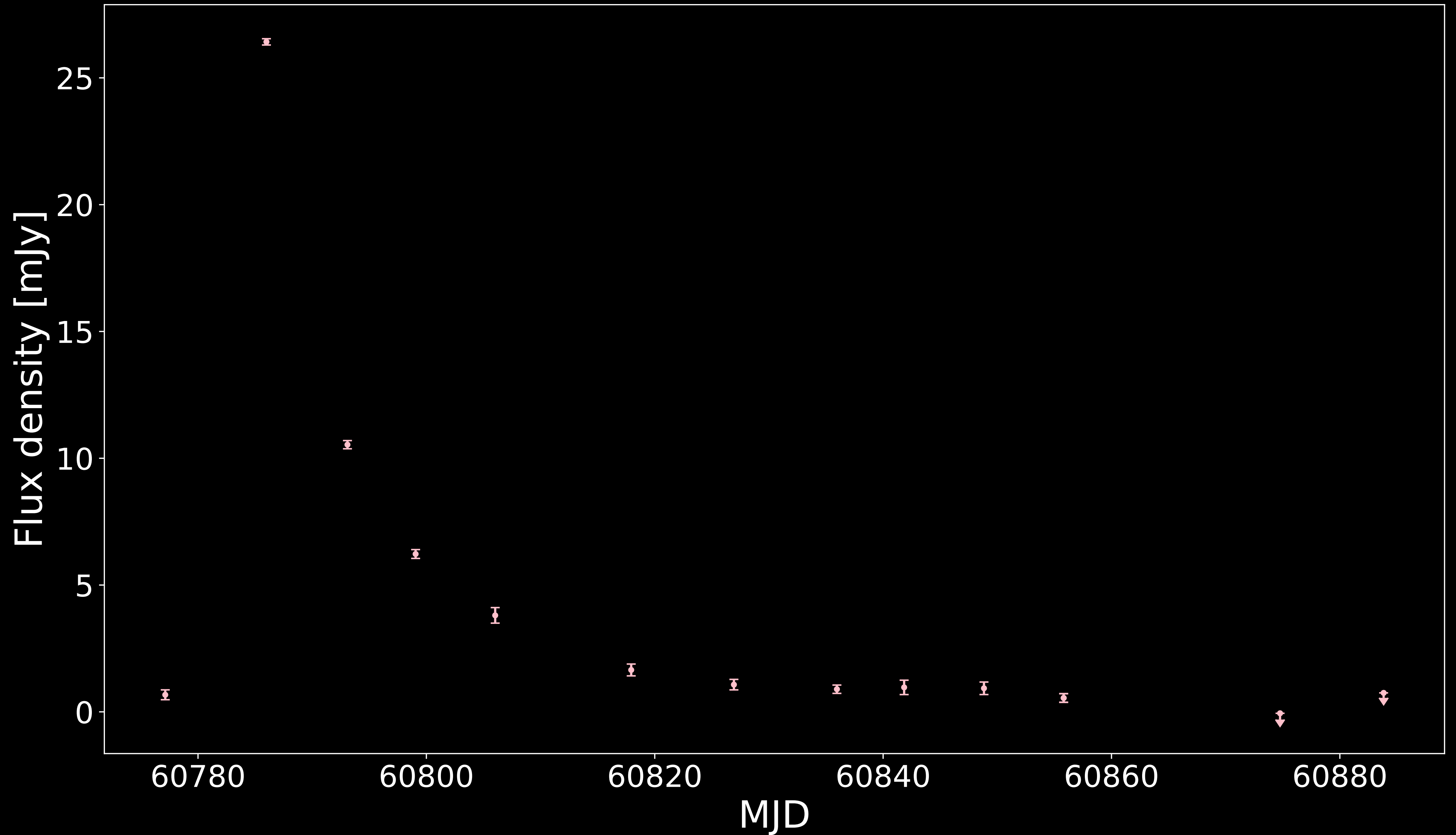
AA4_in20km

64x13.5m - 110x15m

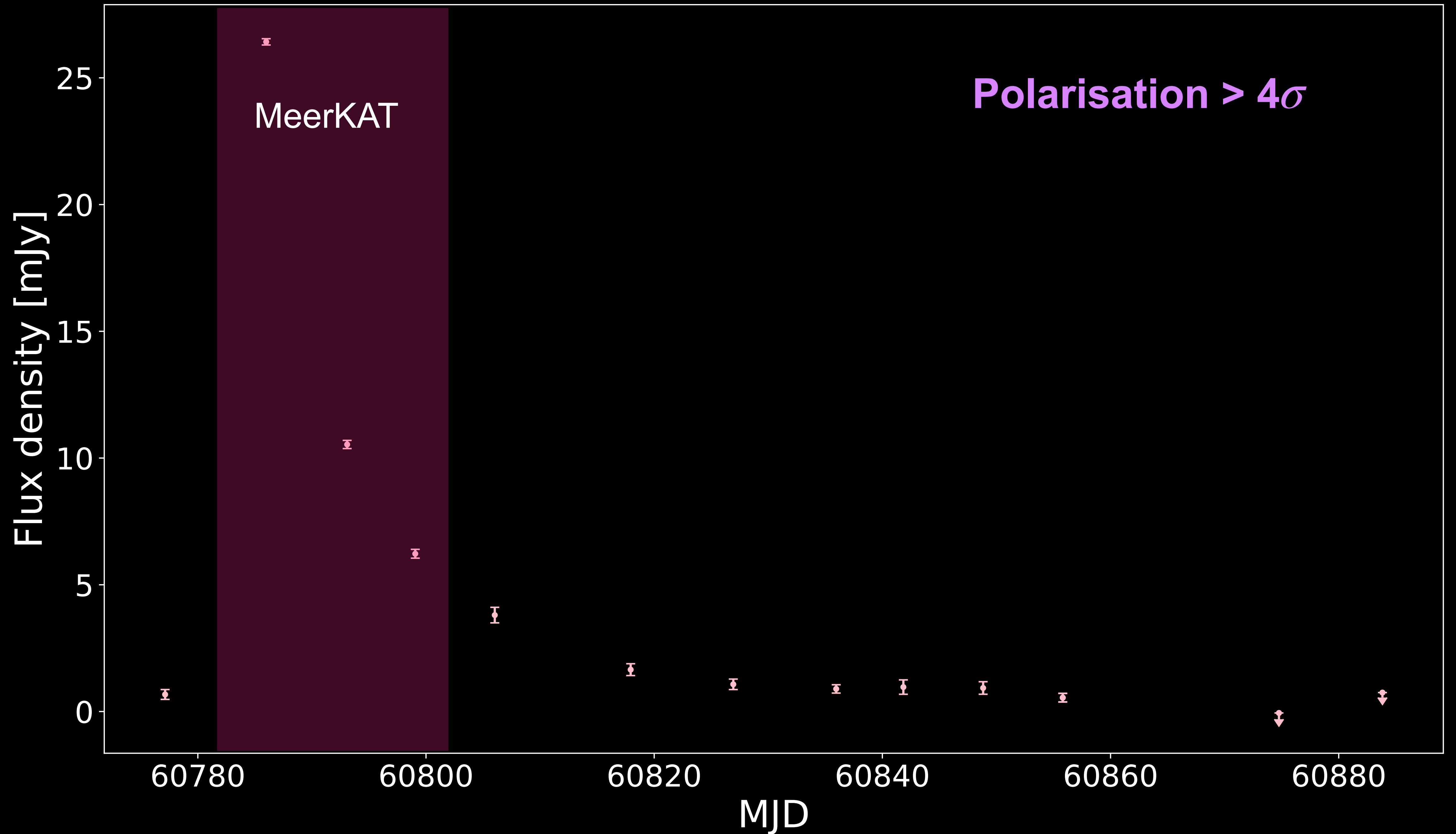
AA4

64x13.5m - 133x15m

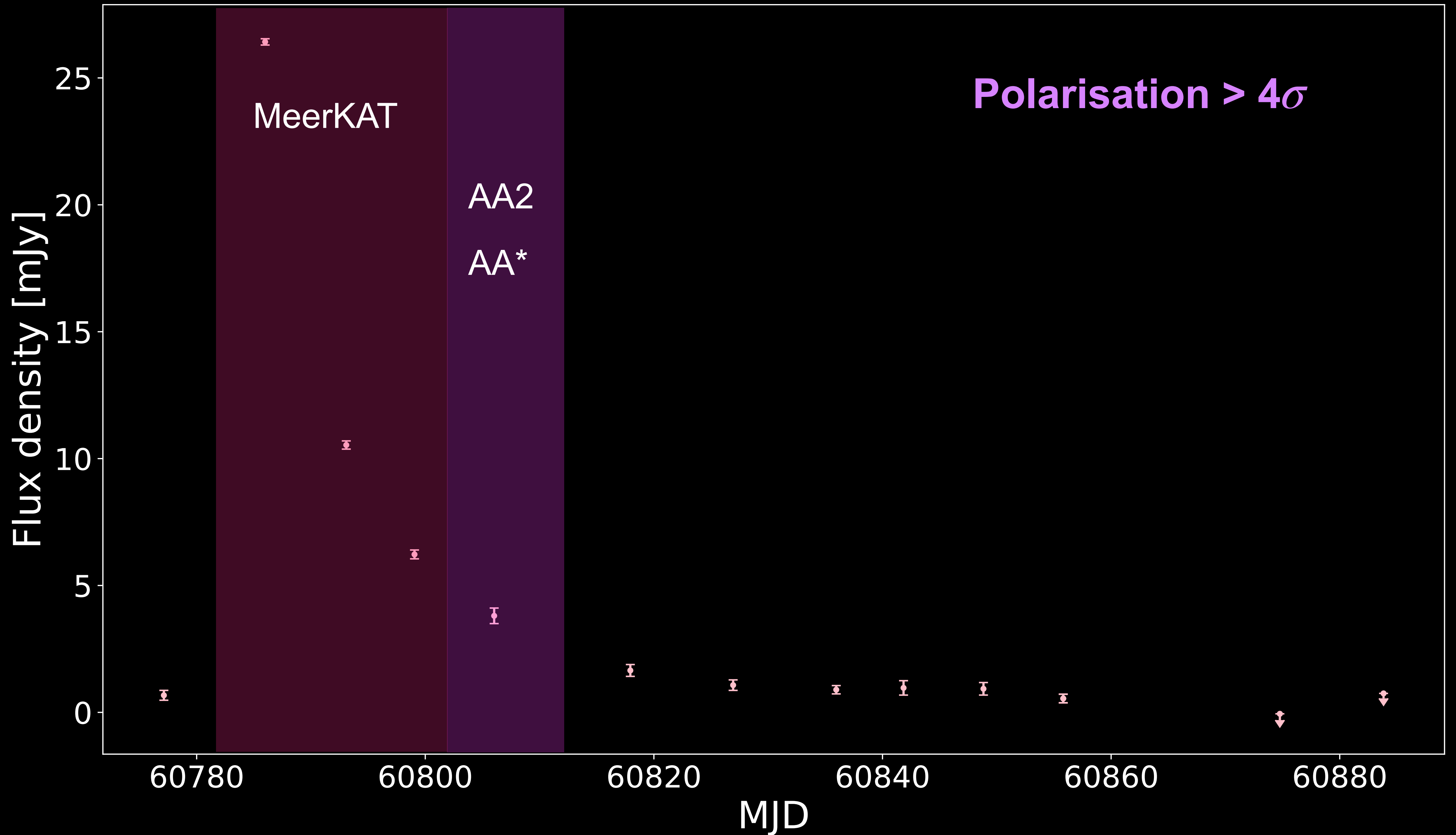
4U 1630-47



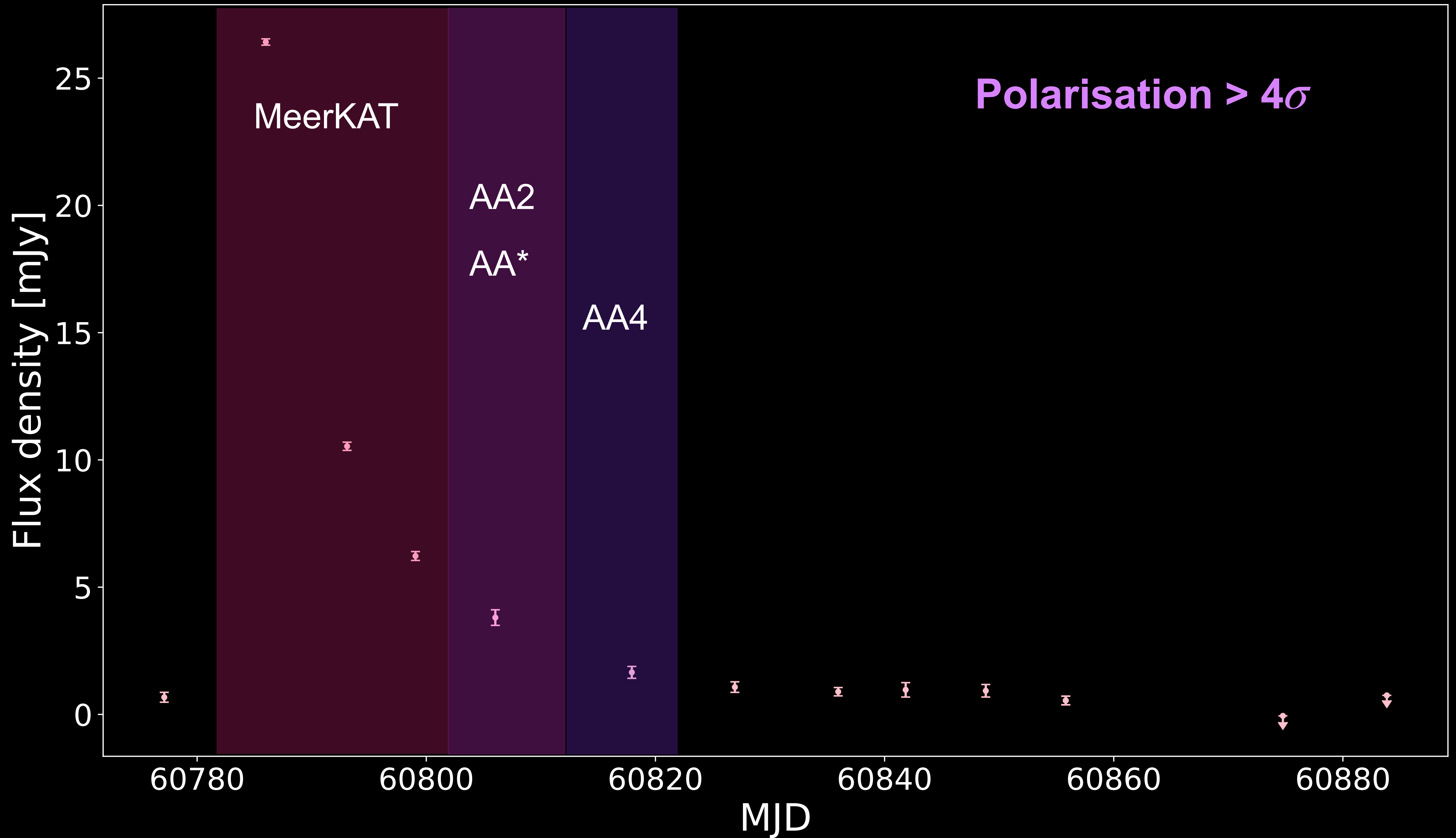
4U 1630-47



4U 1630-47



4U 1630-47



Conclusions

4U 1630-47



Conclusions

Transient or compact jet?

Jet angle? 40°

4U 1630-47



Internal/External Faraday
rotation?

Conclusions

Transient or compact jet?

Jet angle? 40°

4U 1630-47



Internal/External Faraday
rotation?



Conclusions

Transient or compact jet?

Jet angle? 40°

4U 1630-47

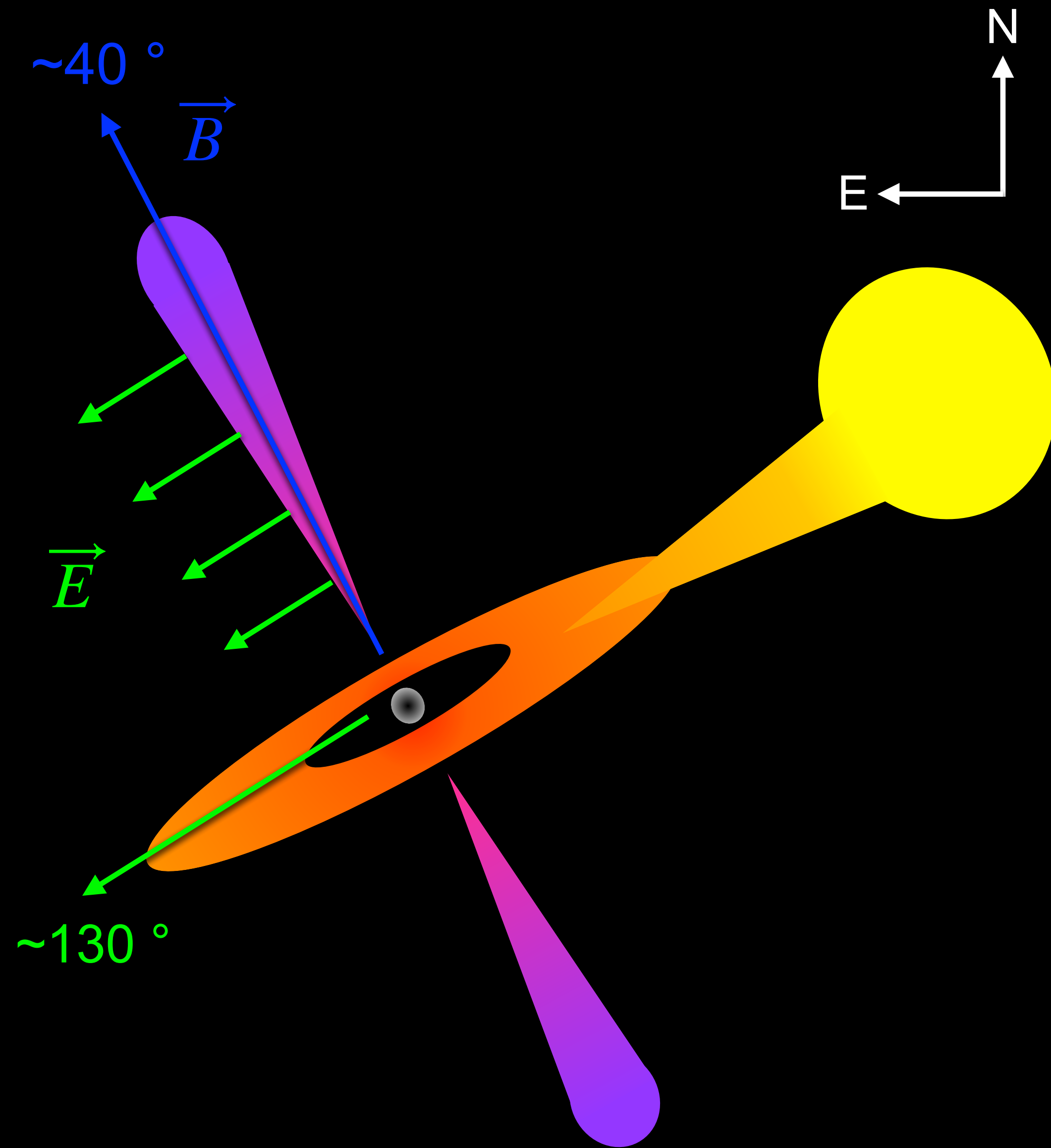


Internal/External Faraday
rotation?

Thank you!



Backup slides



4U 1630-47

Polarimetry results

This study:

RM $\sim 1650 \text{ rad m}^{-2}$

PD $\sim 5\%$

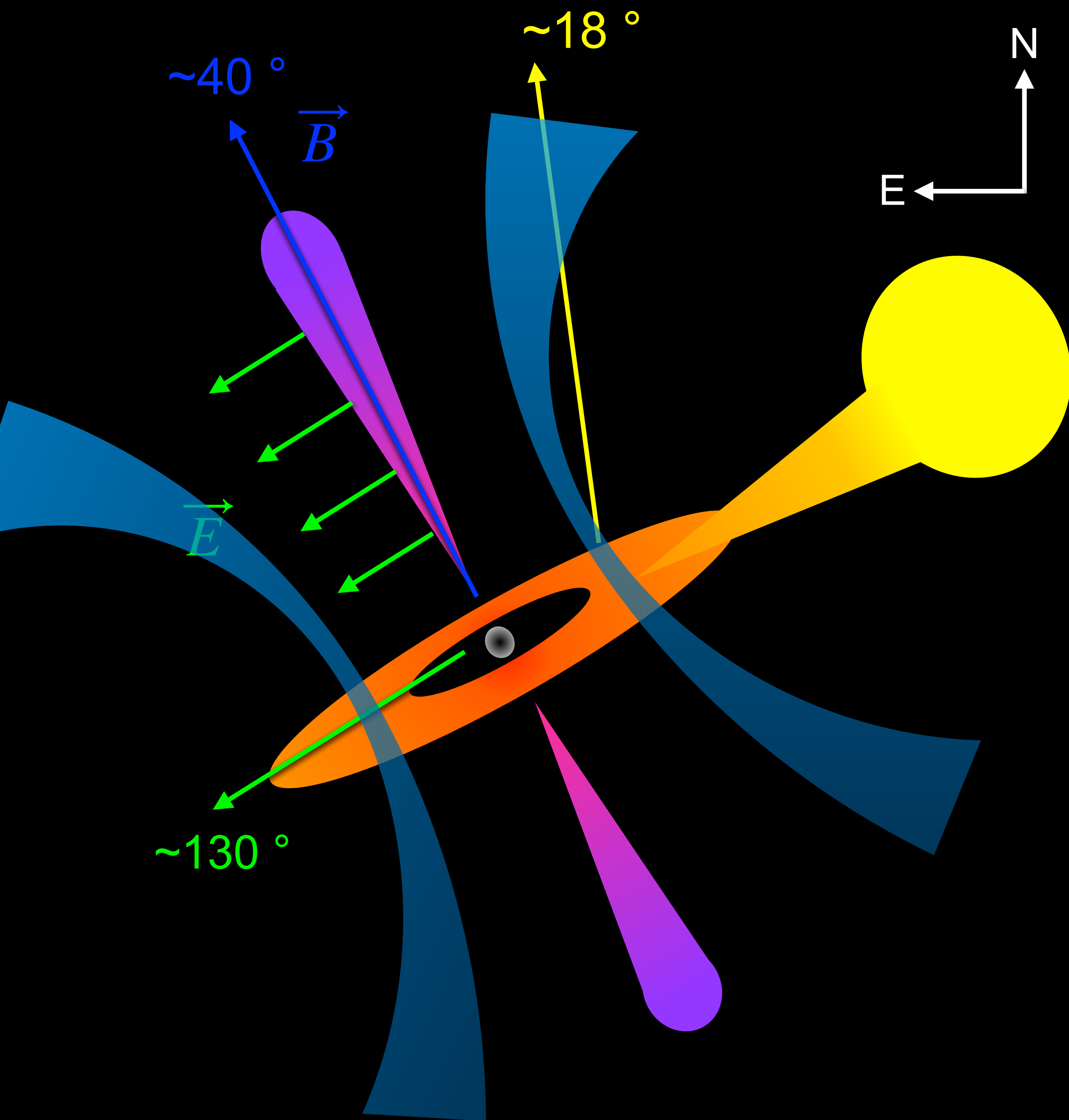
EVPA $\sim 130^\circ$

Hjellming et al., 1999:

RM $\sim 800 \text{ rad m}^{-2}$

PD $\sim 30\%$

EVPA $\sim 131^\circ \rightarrow$ BVPA $\sim 41^\circ$



4U 1630-47

Polarimetry results

This study:

PD $\sim 5\%$

EVPA $\sim 130^\circ \rightarrow$ BVPA $\sim 40^\circ?$

Ratheesh et al., 2024 (IXPE):

PD $\sim 9\%$

EVPA $\sim 18^\circ \rightarrow$ oriented // disc? Wind?