

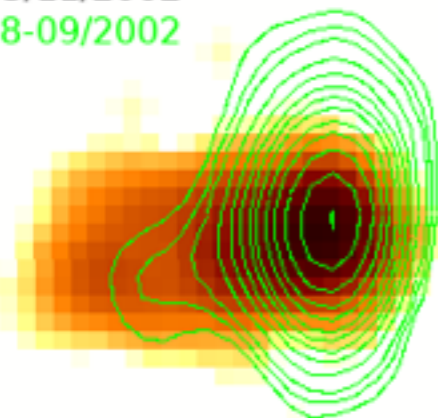
Probing the jet structure: highlights of the observing campaign of the XTE J1550-564 large-scale jets

G. Migliori
(lab. AIM, France)

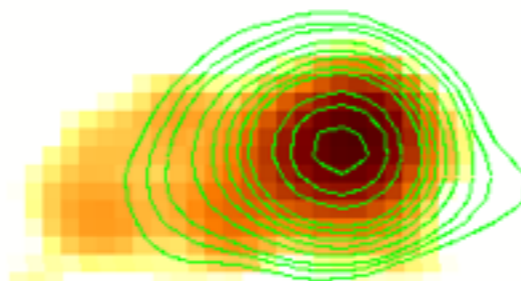
The nice Chandra images' talk

XTE J1550-564 western jet's 2002-2003 Chandra gallery

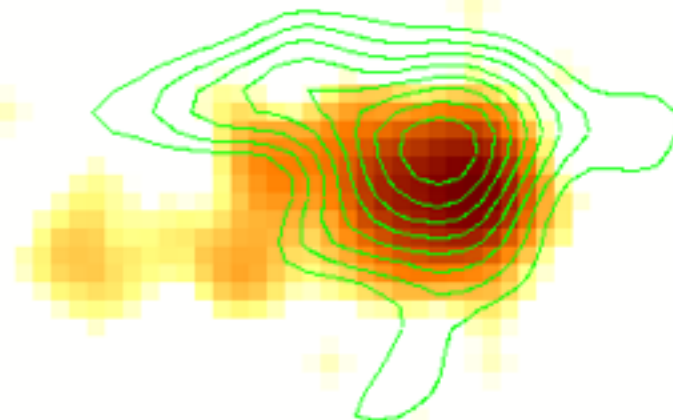
ObsID 3448: 03/11/2002
Obs8+9: 04/08-09/2002



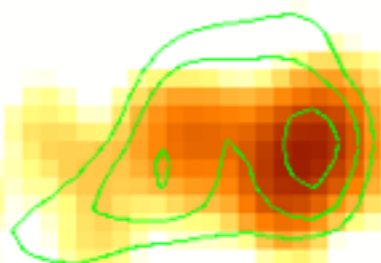
ObsID 3672: 06/19/2002
Obs11: 05/22/2002



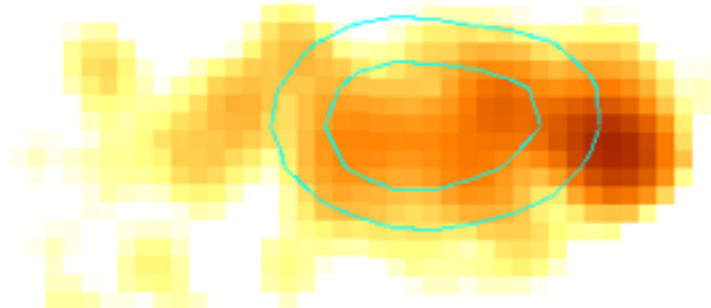
ObsID 3807: 09/24/2002
Obs17: 09/17/2002



ObsID 4368: 01/28/2003
Obs21+22: 01/26-27/2003



ObsID 5190: 10/23/2003
Obs24: 07/25/2003



Migliori+'17

0.077

0.11

0.18

0.31

0.58

1.1

2.2

4.3

8.6

coll.: S. Corbel, J. Tomsick, P. Kaaret, R. Fender, Tzioumis, M. Coriat, J. Orosz

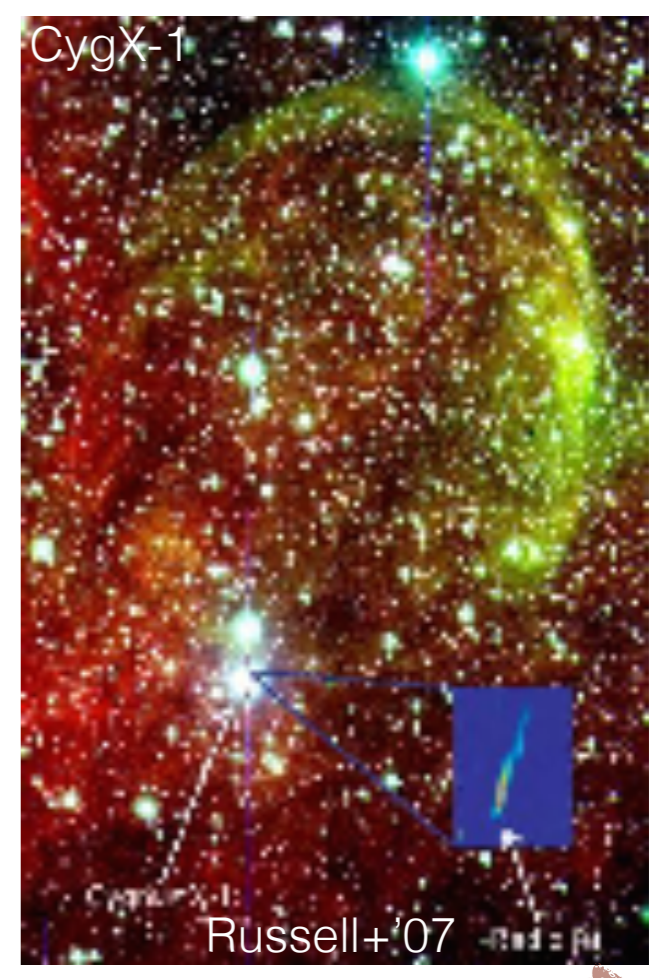
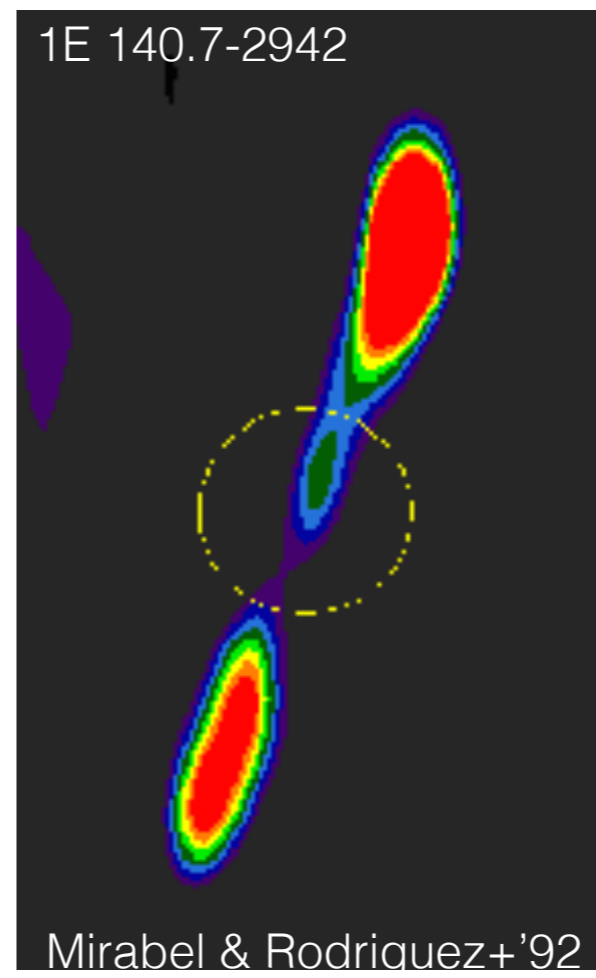
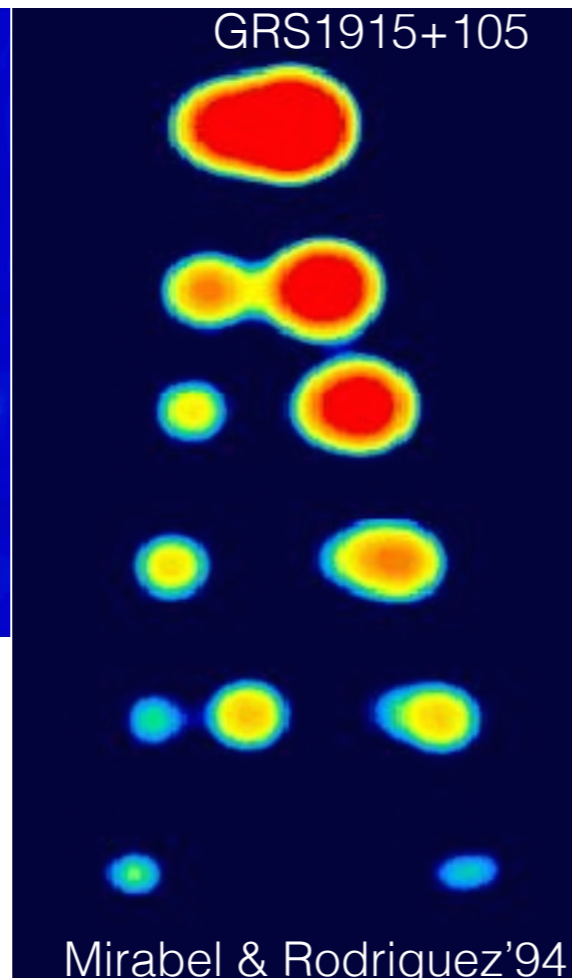
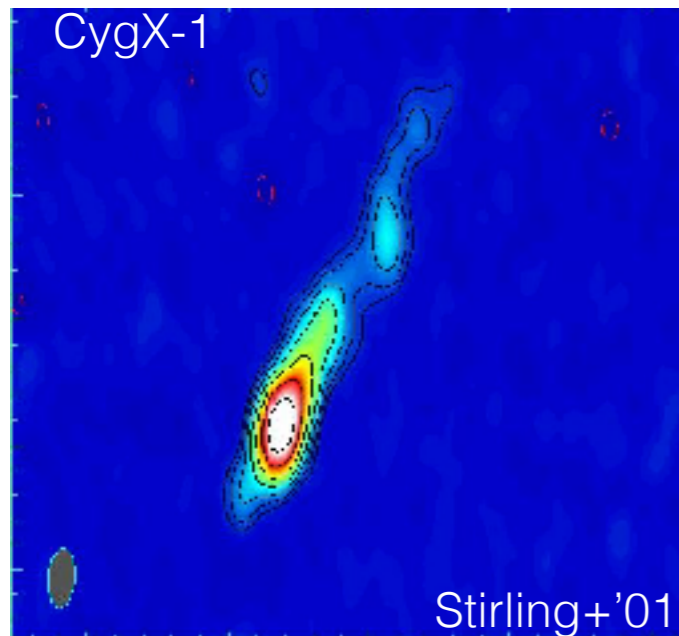
Large scale jets

compact, persistent
radio jets (~ 10 AU)

transient, relativistic
radio jets (~ 100 s AU)

large scale jets
(up to ~ 10 s pc)

radio lobes/
cavities



milli-arcsec

arcsec

arcmin \rightarrow degree

accretion & ejection
relation

interaction with the ISM,
& radio duty cycle

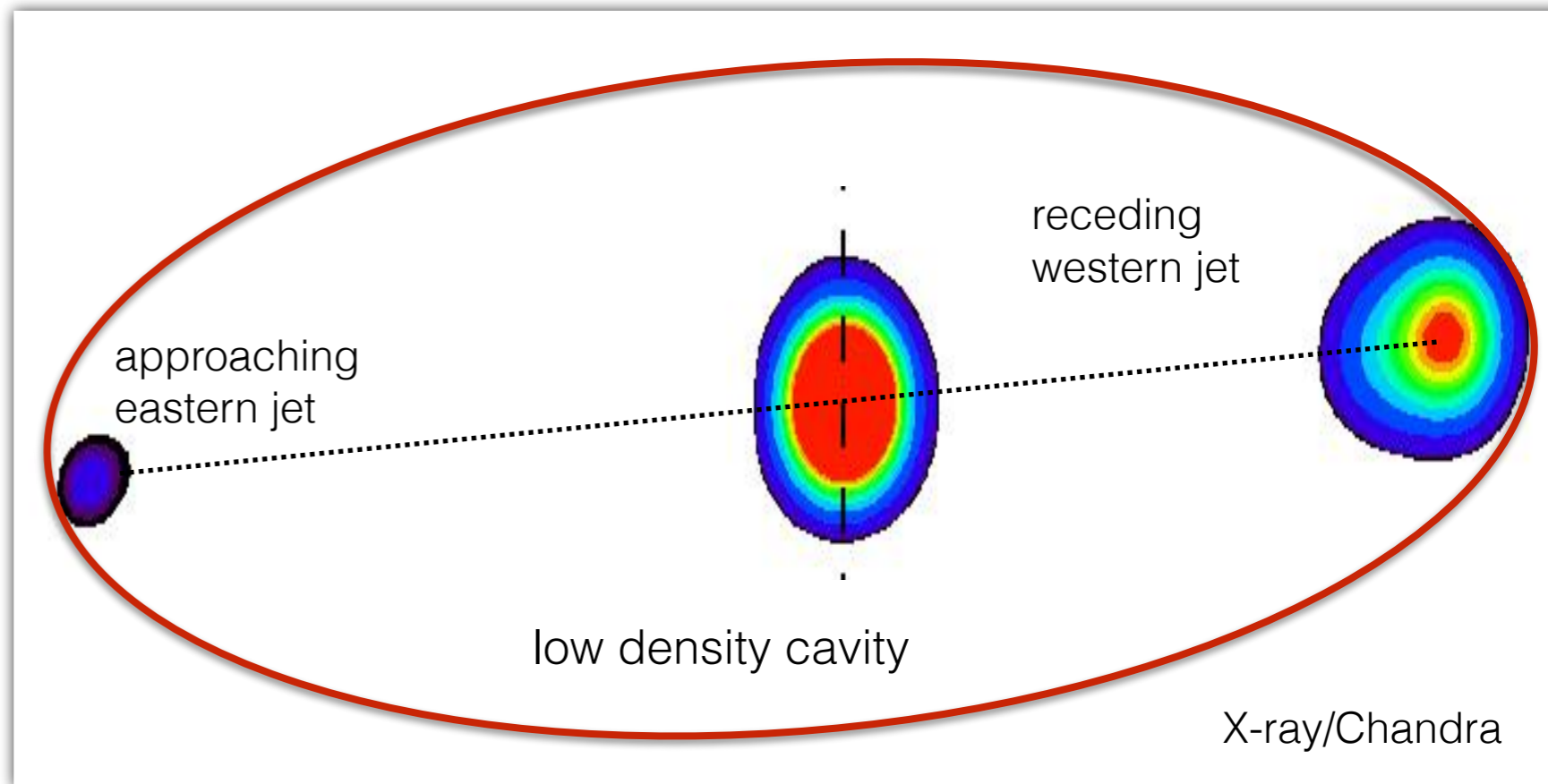
XTE J1550-564 large scale jets

Low Mass X-ray Binary:

- September 1998: X-ray outburst + the detection of relativistic compact jets ($v_{app} \sim 1.7c$, Hannikainen+09);
- June 2000: discovery of large-scale ($\sim 0.5pc$) radio & X-ray jets (Corbel+'02)

$$\langle v_{app, eastjet} \rangle = 1.0c \text{ to } 0.1c;$$

$$\langle v_{app, westjet} \rangle = 0.55c \text{ to } 0.4c.$$



Dynamical Model:

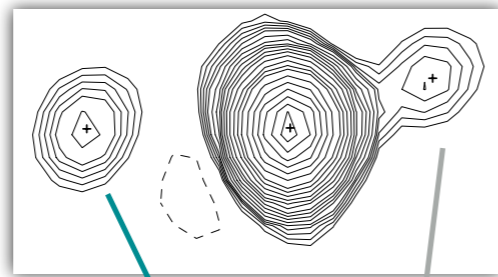
the jets propagate unseen in an under-dense ISM cavity and become visible when they impact the cavity's boundaries (Wang '03; Hao & Zhang '09, Steiner+'12).

Follow-up of the western jet:

✓ X-rays: 8 Chandra observations;

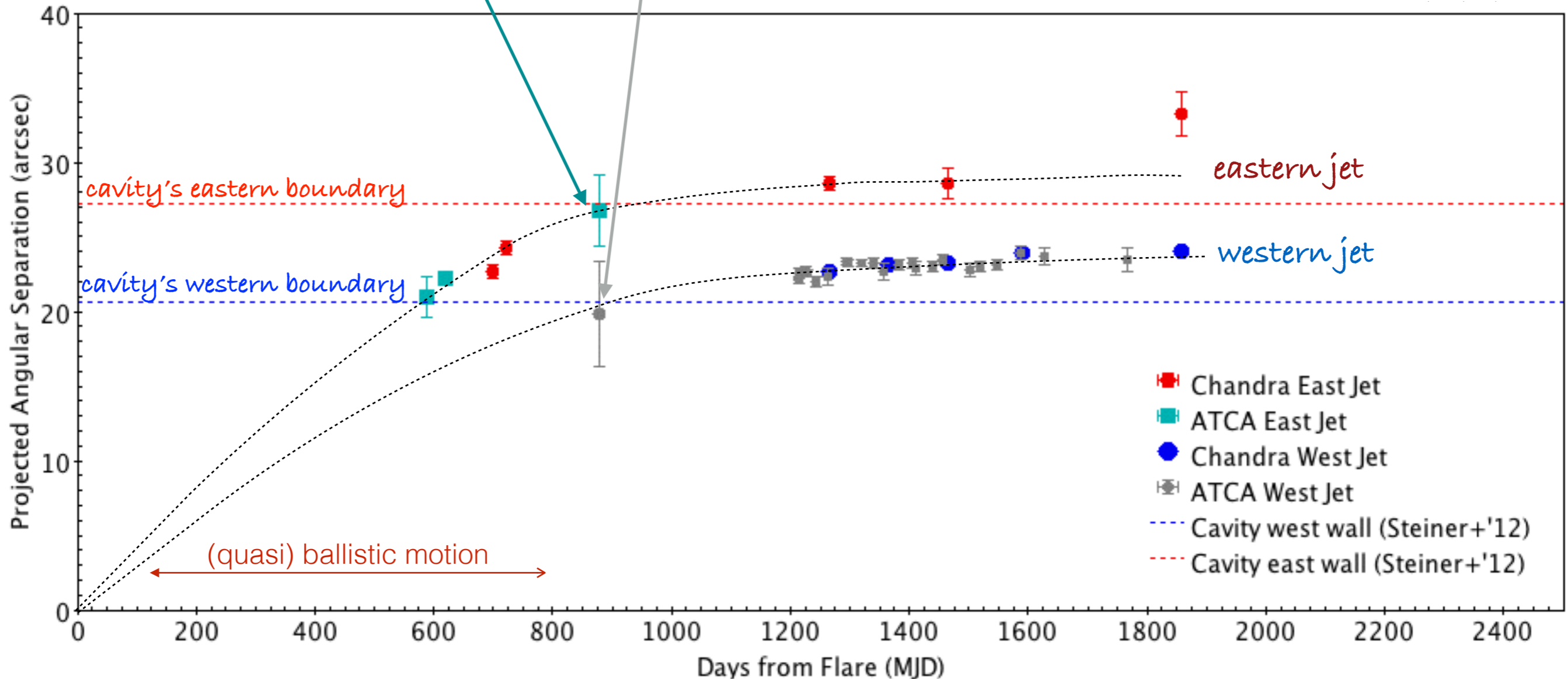
★ Radio: 24 ATCA observations (1.4 GHz, 2.5 GHz, 4.8 GHz, 8.6 GHz).

XTE J1550-564 jets: dynamics



western jet first detection in 2001

beginning of the deceleration phase



(quasi) ballistic motion

Flux:

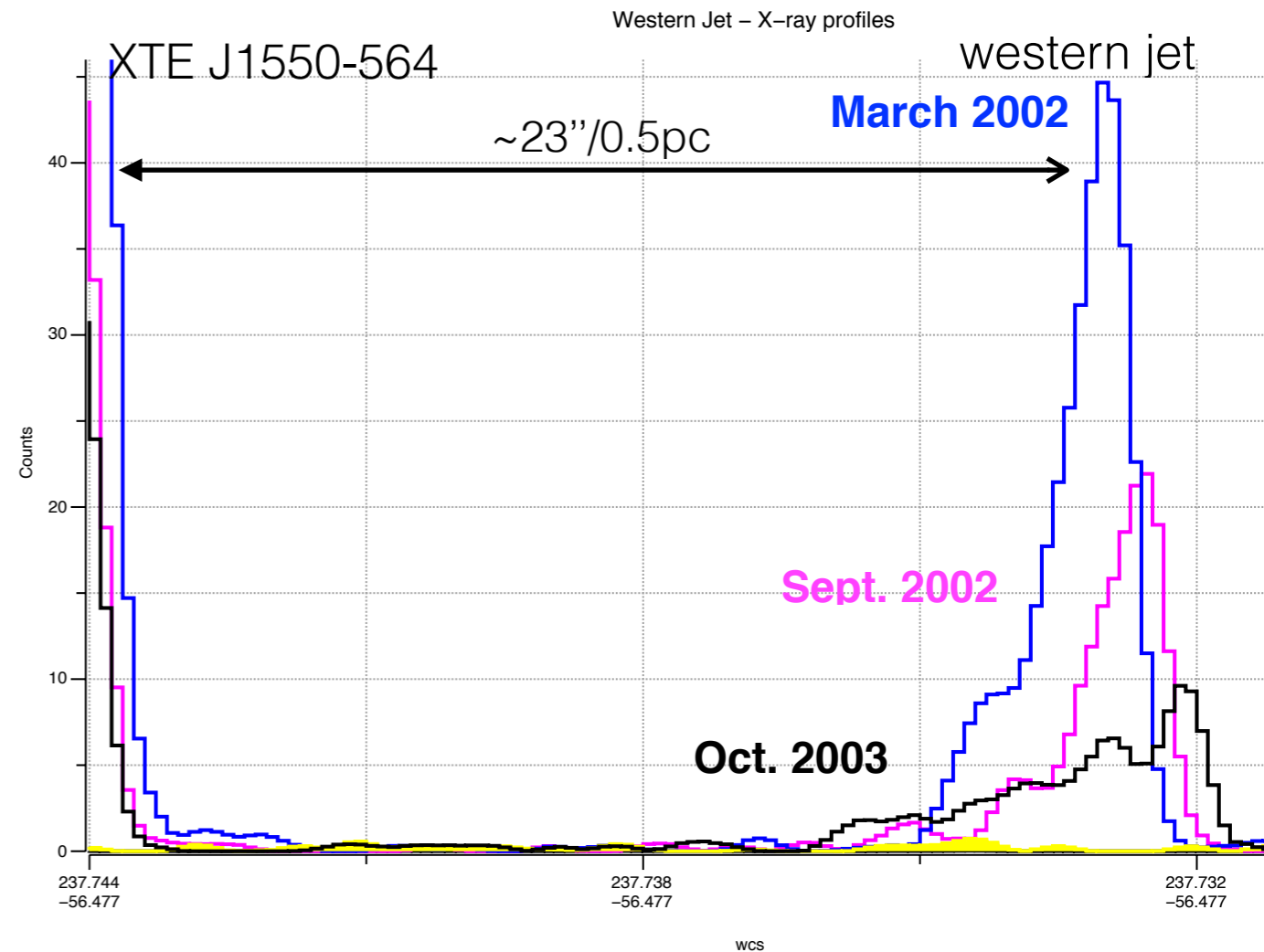
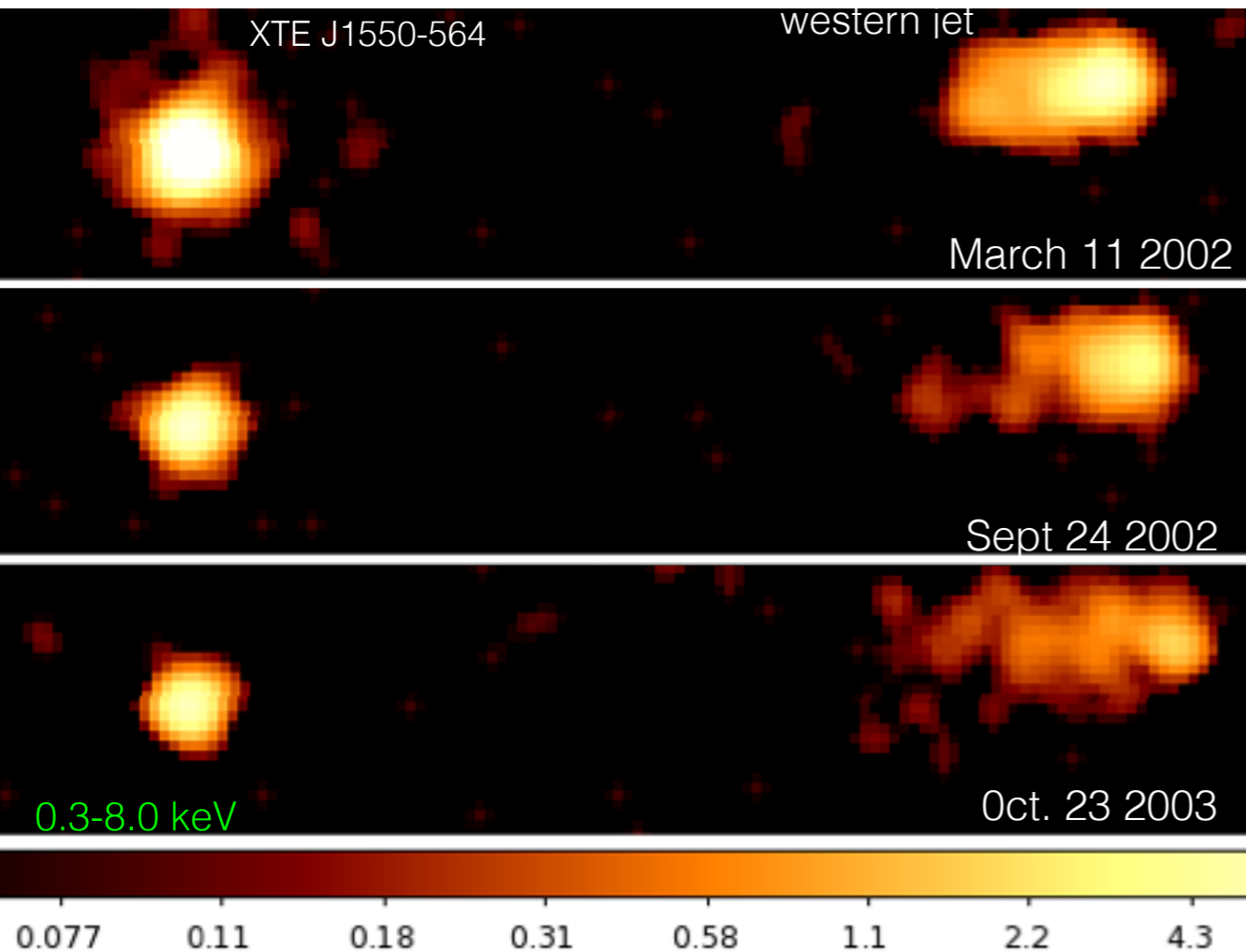
↑
rising phase

↔ radio plateau

↔ decay phase

Jet structure

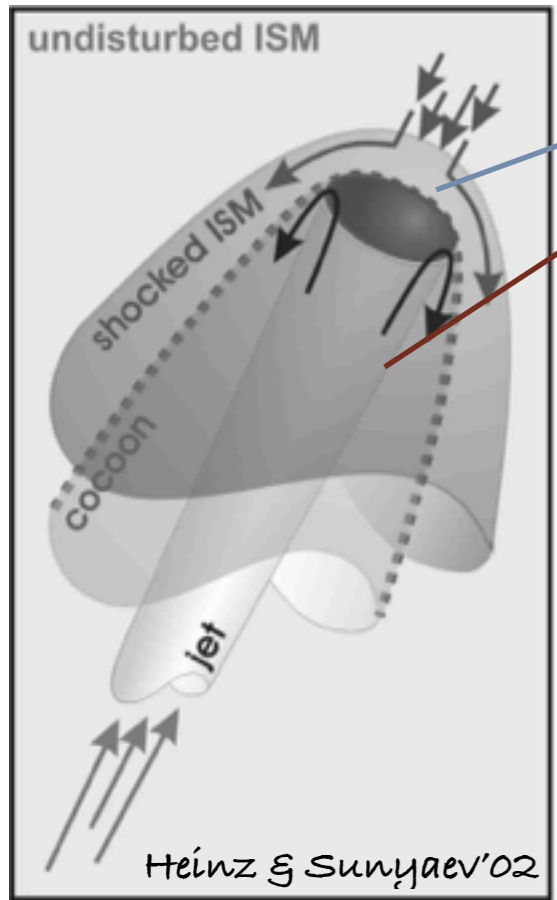
Spatially resolved X-ray jet:



Evolution in ~ 1.5 yrs of the X-ray morphology:

- deceleration of the main peak ($v_{app} \sim 0.07c$);
- formation of an apparently receding tail ($v_{app} \sim -0.10c$);

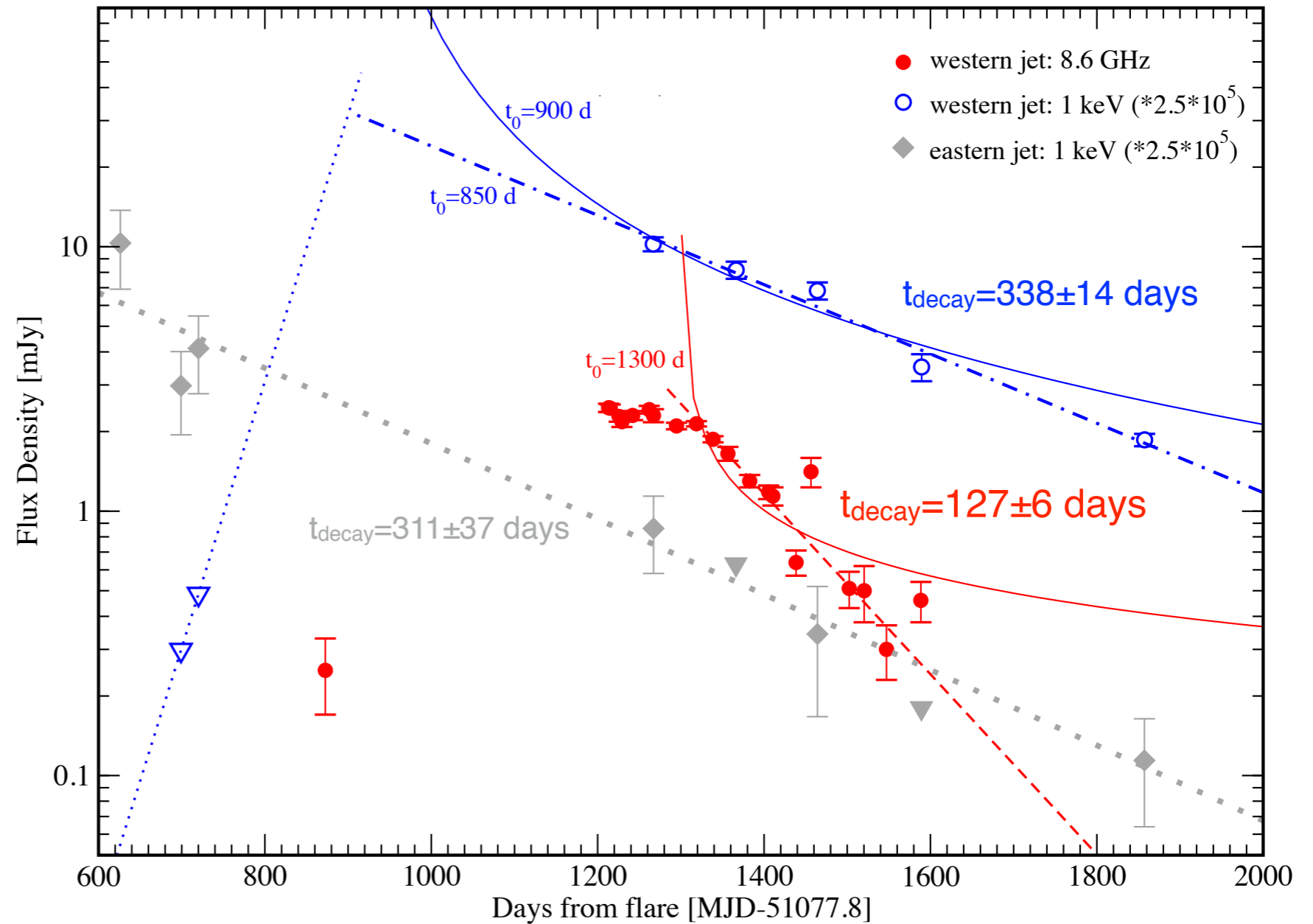
X-ray tail: reverse shock



Forward shock => ISM

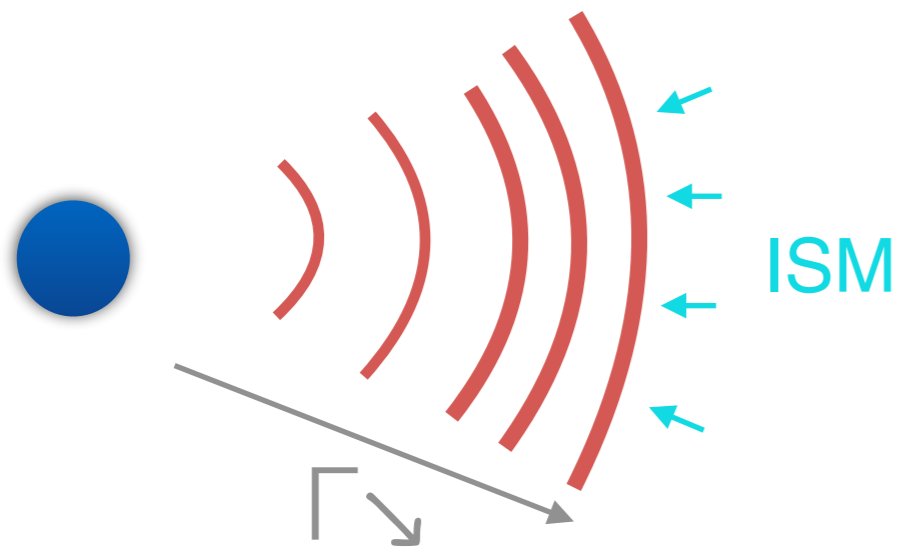
Reverse shock => jet plasma

☑ Steep decay ($F \propto t^{-2}$): synchrotron radio & X-ray emission from the reverse shock (Wang '03; Hao & Zhang '09, Steiner+ '12)



☐ Chromatic decay: faster in radio than in X-rays?

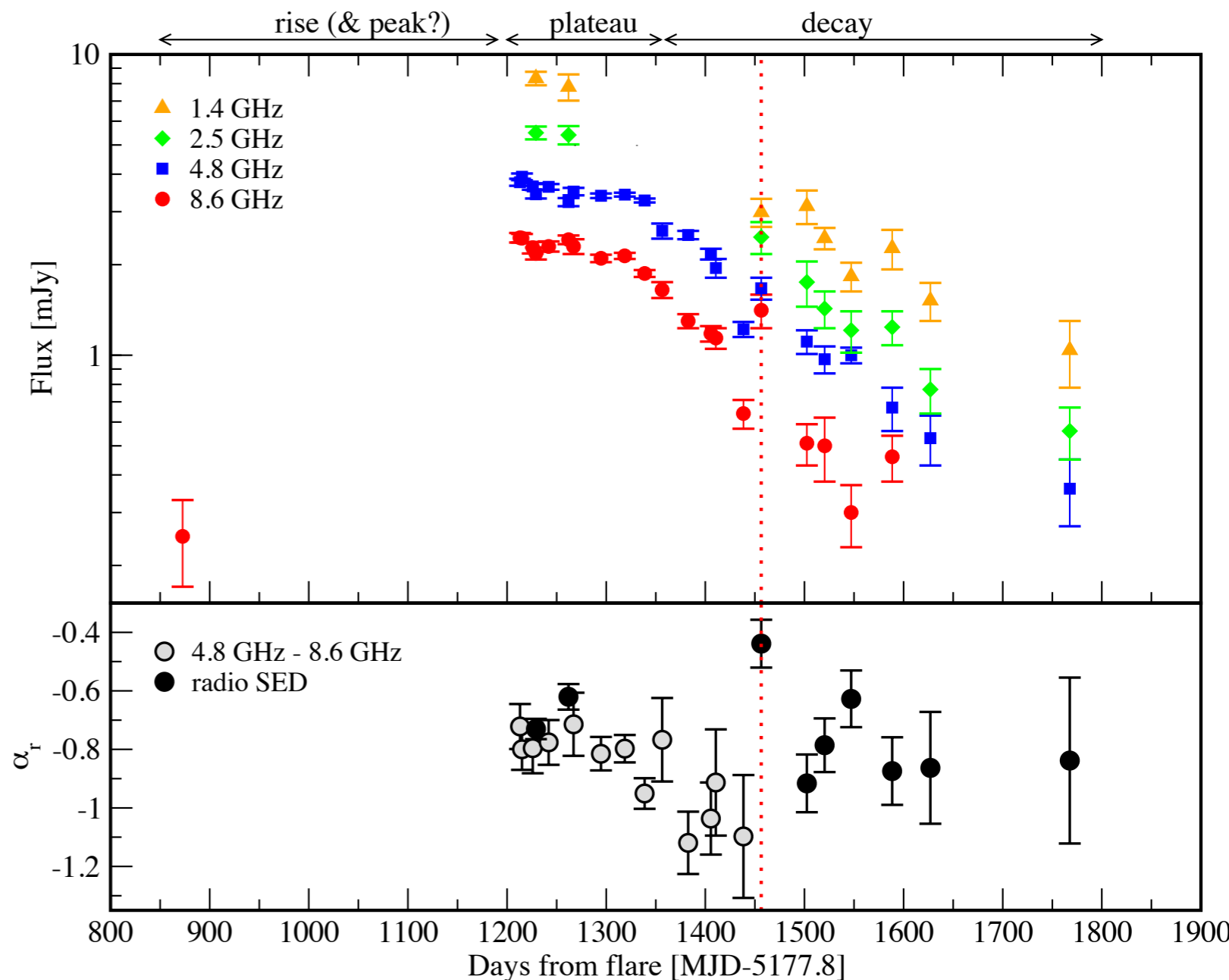
X-ray tail: colliding shells



emission from internal shocks formed by colliding shells (models for compact jets of microquasars, prompt emission of GRBs, blazars, Kaiser+'00, Jamil+'10, Malzac+'14, Sari & Piran '97, Spada+'01)

A second X-ray & radio outburst in 2000 (Corbel+'01):

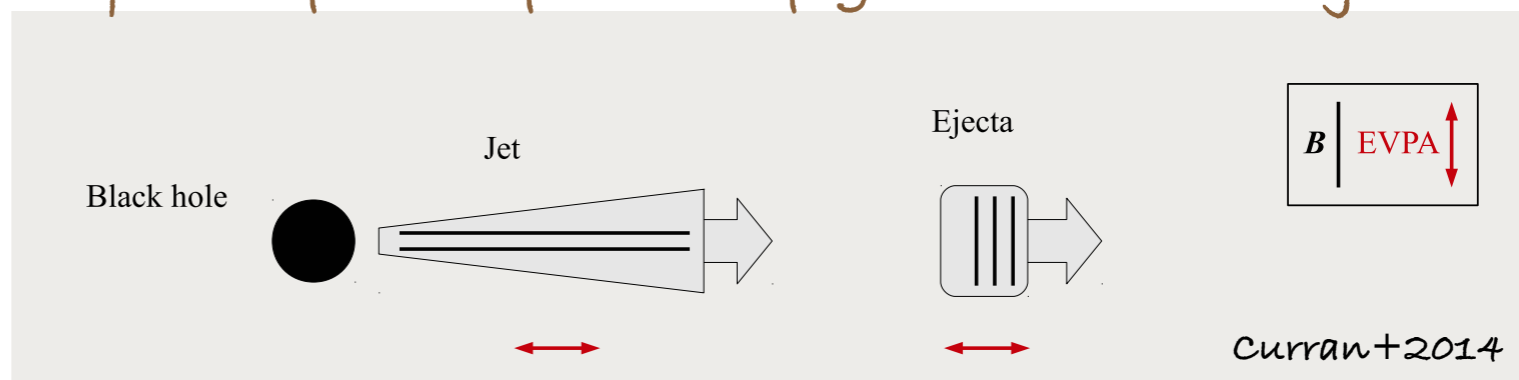
- ☑ assuming same jet velocities, the new ejecta reached the large scale jet location in ~2002;
- ☑ @8.6 GHz: flux re-brightening + spectral flattening in September 2002.



Polarized radio emission

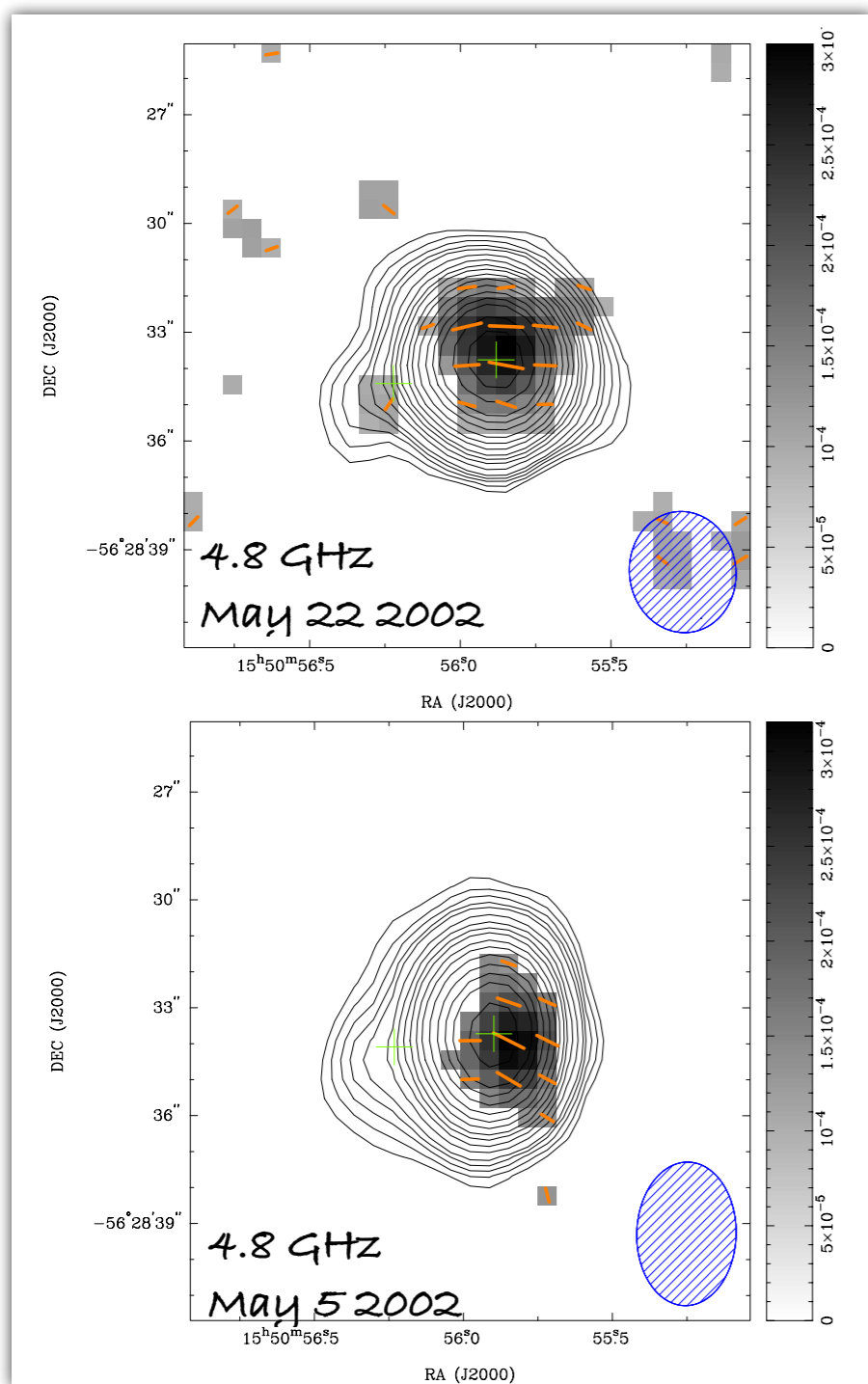
- up to 9% linearly polarized flux @4.8 GHz and 8.6 GHz;
- E vector parallel to the jet axis;
- polarization angle changes on < month timescales.

probe of the B field configuration in the ejecta:



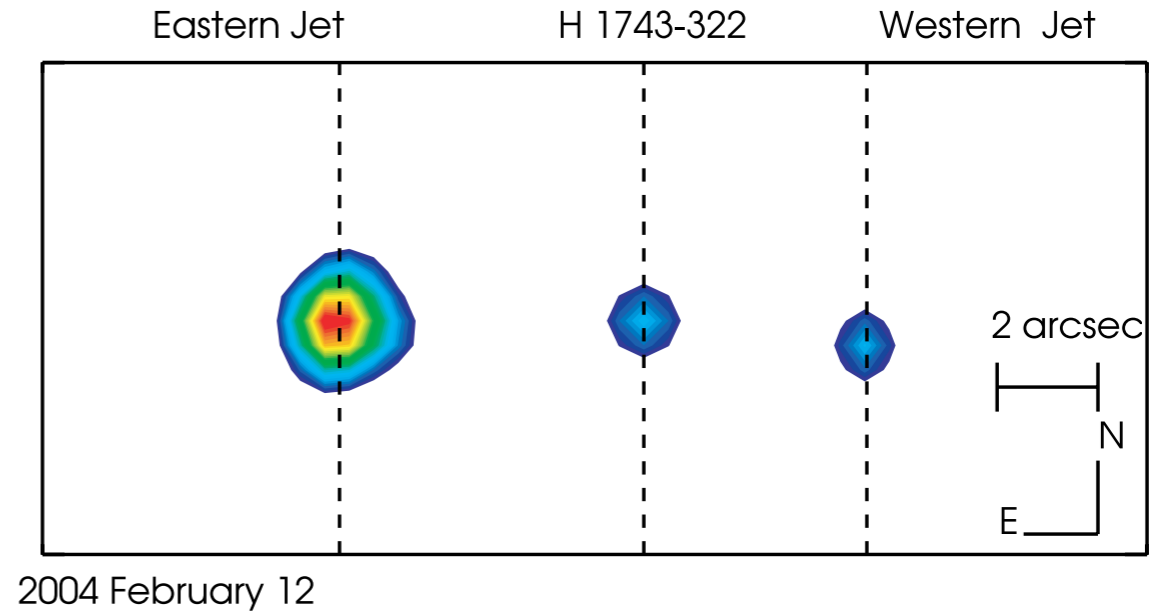
shock-compressed B field
+
evolution of the jet internal
structure

Radio & X-ray high resolution observations allowed to probe the structure of large scale jets in XTE J1550-564. More jets are needed!



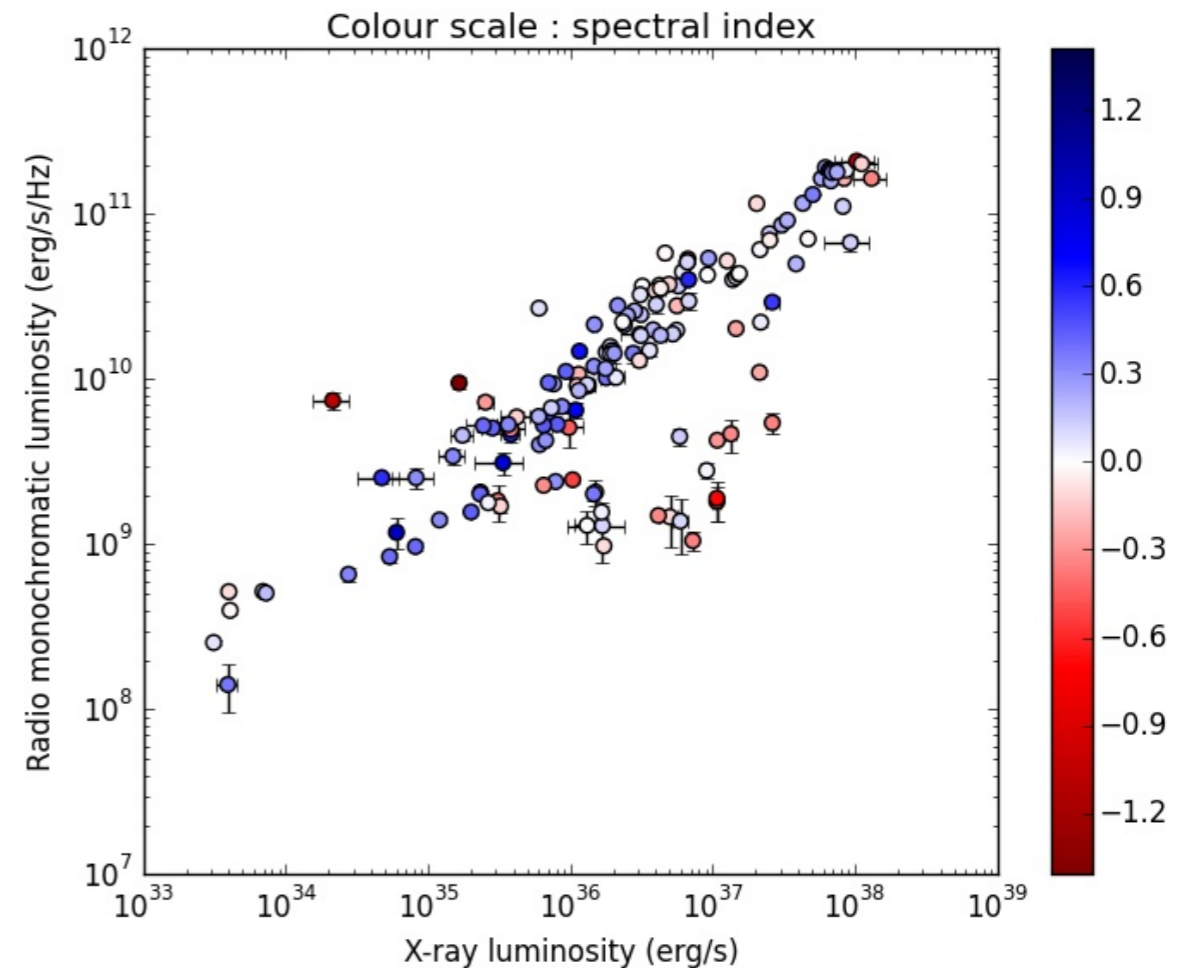
Observations: H 1743-322

Large-scale radio & X-ray jets in H1743-322
(Corbel + '05)



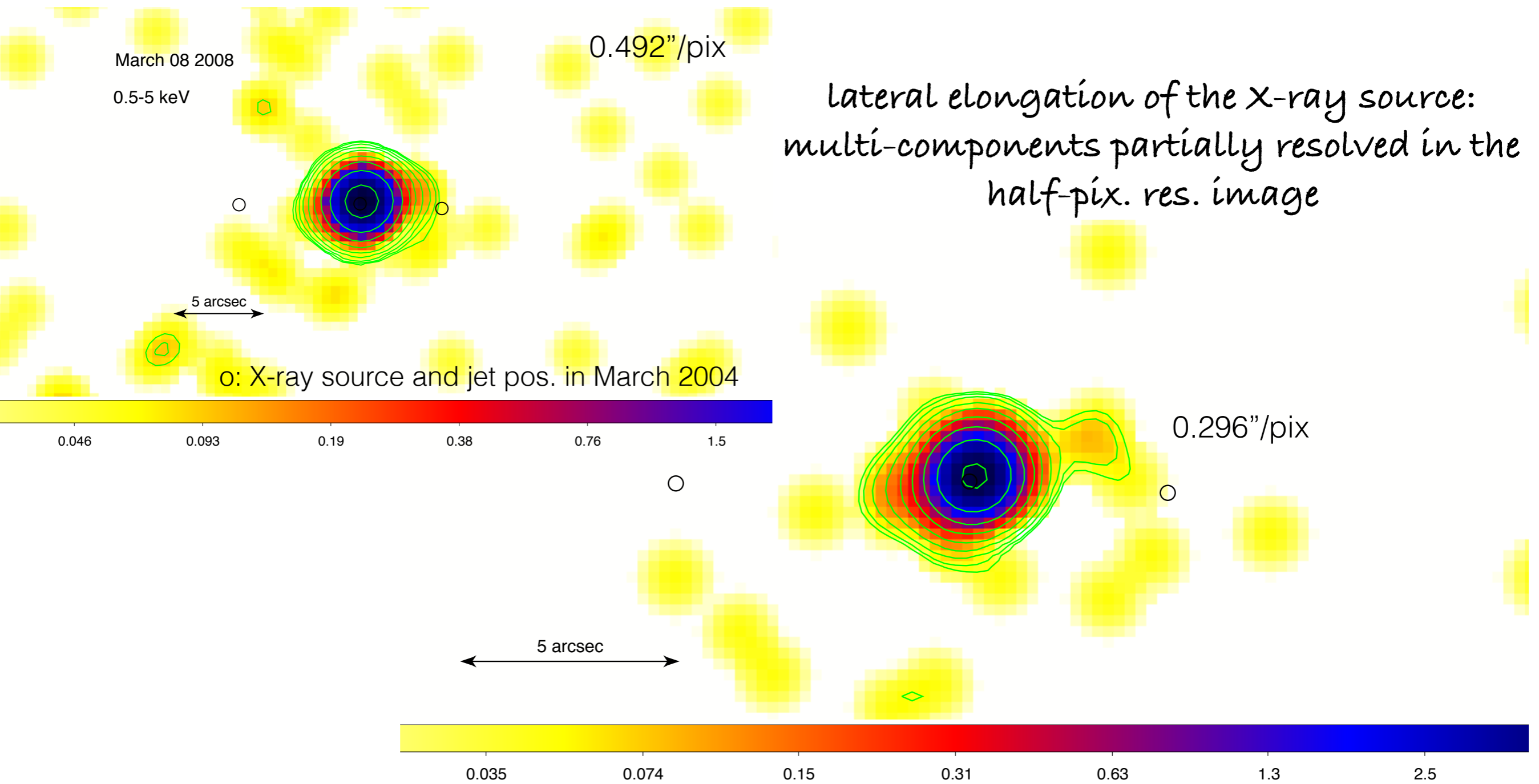
Outburst in 2008: radio and X-ray observations of the decay phase (Jonker et al. 2008):

radio & X-ray flares
+
optically thin radio emission in low-hard state ($\alpha_r = -0.5 \pm 0.15$)
+
outlier in the radio-X-ray lum. relation
(Coriat + '11)



Observations: H 1743-322

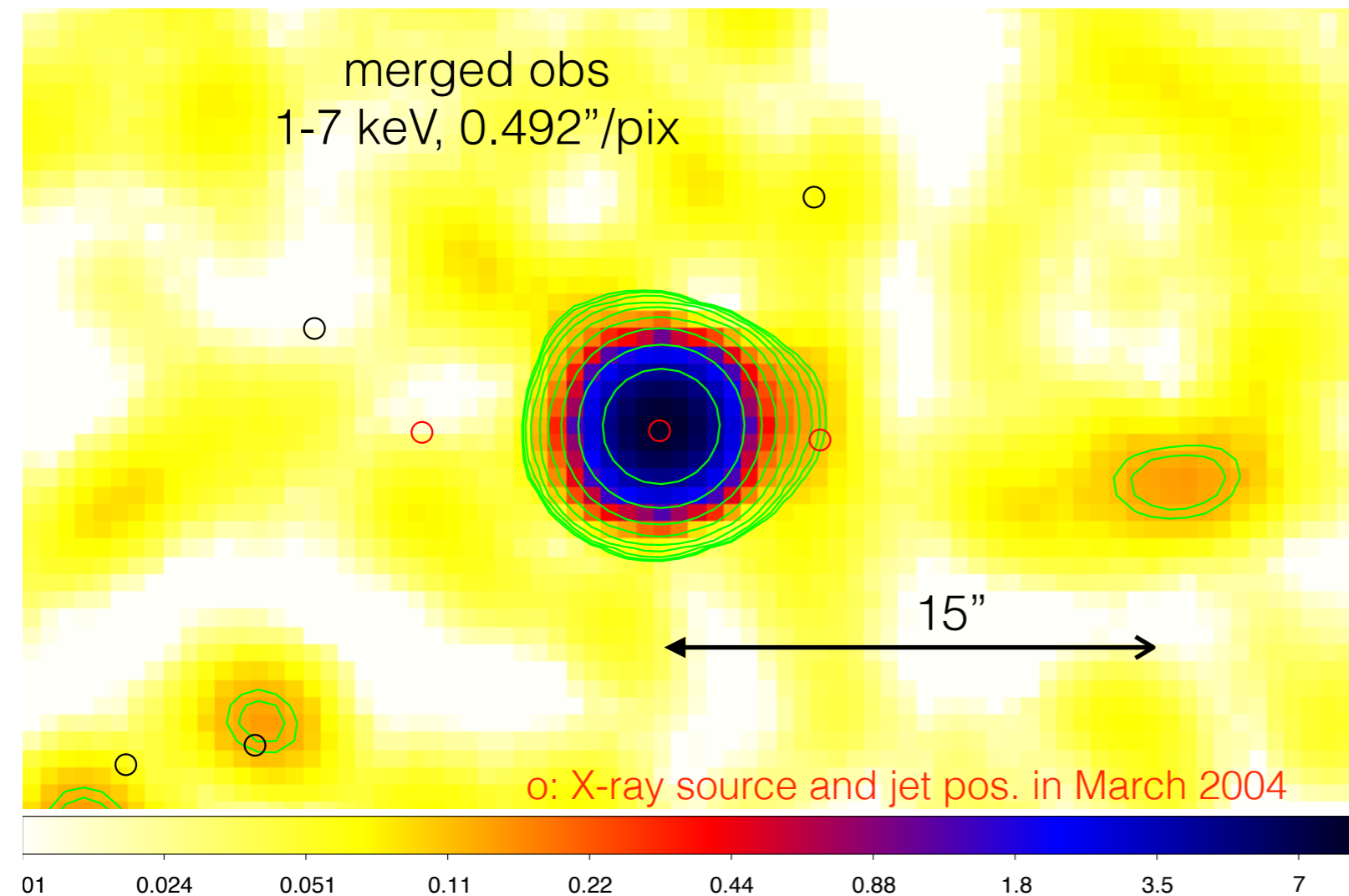
Analysis of the archival Chandra observations (March 8-24 2008):



Lateral elongation of the X-ray source:
multi-components partially resolved in the
half-pix. res. image

Evidences for ejection events in the 2007/2008 outburst:
H1743-322 is an "X-ray jet repeater"?

Observations: H 1743-322



Weak extended source at larger scales:

$$- F(0.5-7) \sim 9e-15 \text{ erg/cm}^2/\text{s};$$

- Trajectory & flux are consistent with the western jet in 2004;
- from Corbel + '05:
 - decelerating jet: the estimated prop. motion is 6.7 ± 5.2 mas/day, $\sim 15''$ (~ 0.6 pc @ 8 kpc) from H1743 => in good agreement with the observed position!

Conclusions

Chandra images are nice...but also necessary to understand jets at large and small scales in μ Qs and AGN