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ABSENCE OF RADIO COUNTERPARTS TO INFRARED ACCRETION BURSTS IN YOUNG STELLAR OBJECTS

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Abstract:

Does the jet-accretion connection observed in some samples of Young Stellar Objects (YSOs) hold for an individual object in the time domain? We present results of radio VLA monitoring, complemented with infrared studies from the literature, of YSOs known to recently have had an accretion-related burst. In two cases: the bursting class 0 YSO HOPS 383, and the FU-Ori-like Z CMa system, we find no ejection enhancement (as traced by the cm radio jet emission) following the observed accretion bursts (as inferred from infrared observations), at least not within a few years.

Introduction:

YSOs, specially the youngest ones, have radio emission from the base of their jets in the few hundreds of AU close to the central (proto)star. There is an observed correlation between the bolometric luminosity L_{bol} and the radio luminosity $S_{cm}d^2$ of YSOs known to have radio jets. The correlation extends from subsolar luminosities to at least 10^3 L_{sun} (Anglada et al. 2015). This reassures theory because suggests a causal relation between accretion and ejection, as depicted schematically in Fig. 1.

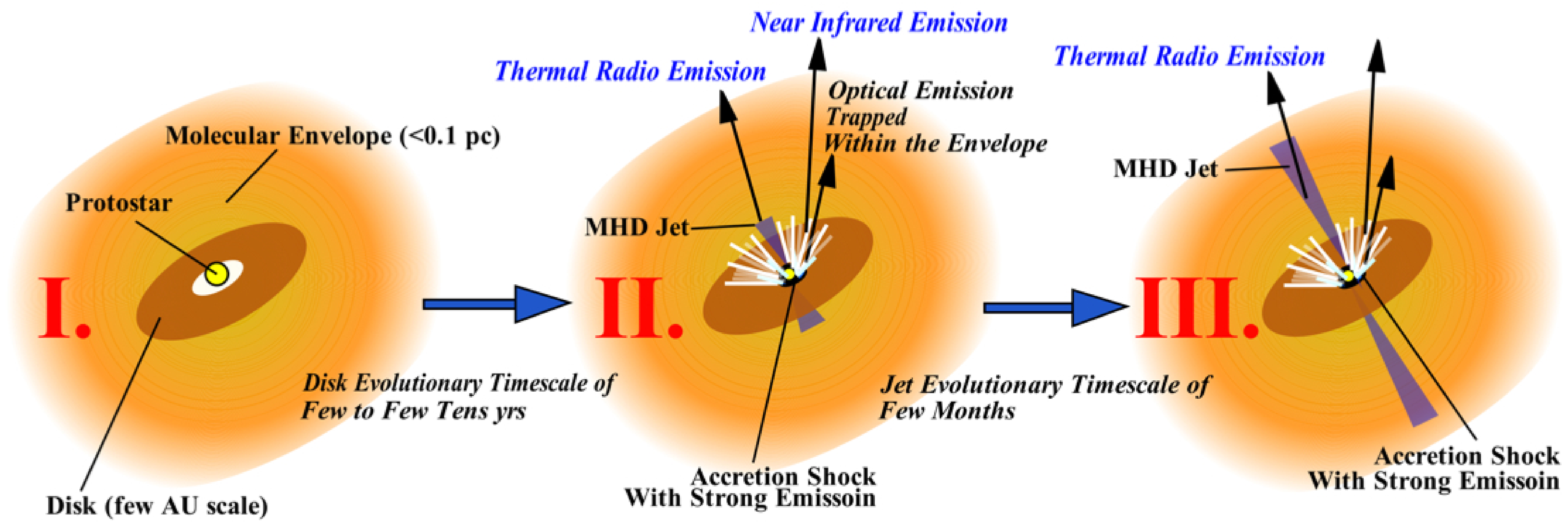

Figure 1. Schematic representation of our naive expectation of enhancements in the observed radio jets following significant accretion bursts.

The Bursting Class 0 Protostar HOPS 383 in Orion:

Safron et al. (2015) reported the first clear burst in a class 0 protostar in Orion: HOPS 383. The burst is most clearly seen at 24 μm but is clear from the near IR to the submm. Safron et al. dates the burst onset between 2004 and 2008, with no significant fading up to 2012. The total luminosity increase is estimated at x35.

We compiled the available VLA data from the 1990s to 2015. Surprisingly, we do not detect a significant flux increment in the associated radio jet. In any case, there is marginal evidence of a flux decrement around the onset of the burst (see Fig. 2).

When resolved, the morphology of the associated radio source is that of a bipolar radio jet, and its spectral index is consistent with optically thin free-free emission.

We interpret our results as showing that there are no enhancements in jet ejection following large accretion increments, at least not within a few years.

What are the physical mechanisms that explain this result? Could the MHD jet be quenched due to excess accretion?

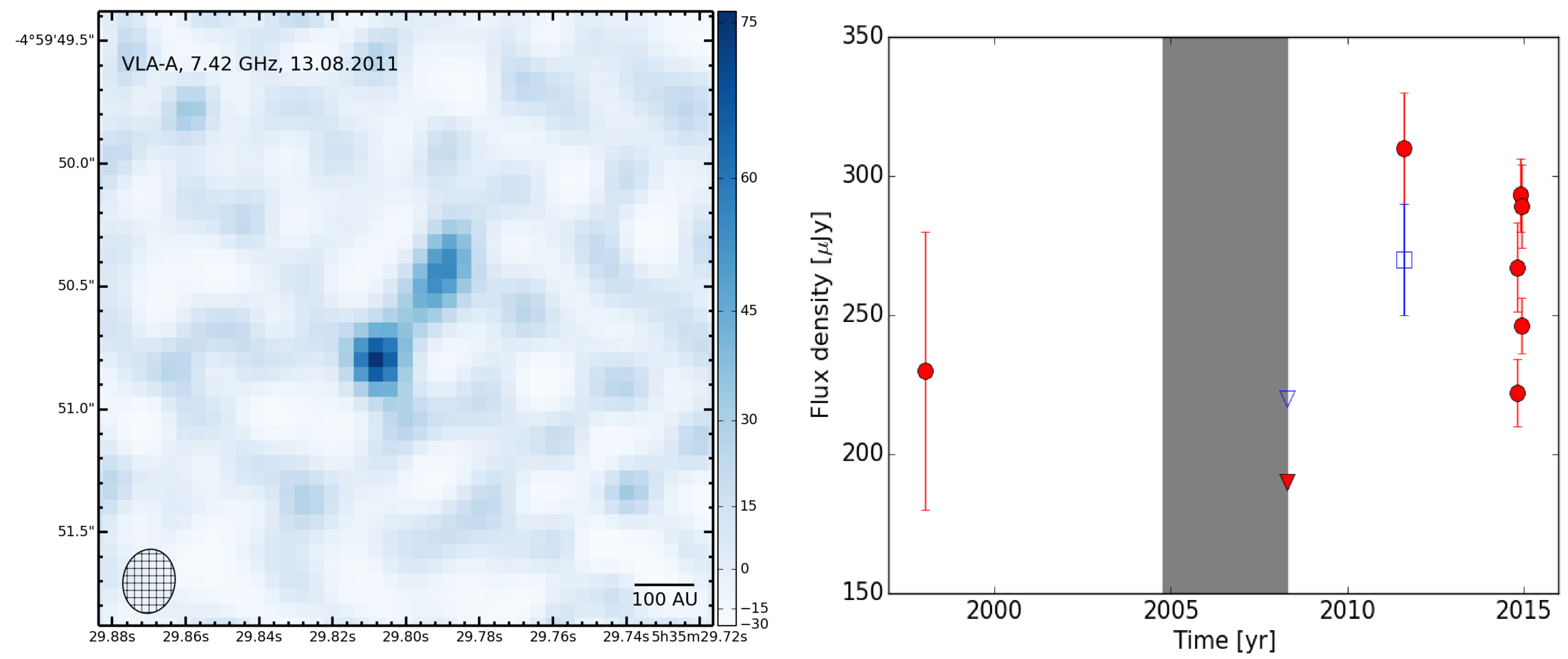

Figure 2. Left: resolved JVLA image of the radio jet counterpart to the bursting class 0 YSO HOPS 383, observed on 13.08.2011 and centered at 7.4 GHz (4.0 cm). The rms noise is 11 μJy/beam. Right: radio light curve of HOPS 383. The red symbols are in X-band (8-10 GHz), the blue symbols are C-band (4-5 GHz). Error bars are ±1σ. The gray stripe marks the interval that Safron et al. (2015) estimated for the onset of the burst. Taken from Galván-Madrid et al. (2015).

The Fu-Ori-like System Z Canis Mayoris:

This system is composed of an FU Ori burster which dominates the optical emission and a Herbig Ae/Be companion which dominates in the IR (van den Ancker 2004), separated by 100 mas. The system had an outburst in 2008 (Grankin & Artemenko 2009).

We obtained JVLA in 2012 to compare with the 1993 observations published in Velázquez & Rodríguez (2001). Surprisingly, the radio jet shows no significant changes in morphology and flux between the epochs (see Fig. 3). Initially, our interpretation was similar to that of HOPS 383. We are revisiting this taking into account the result of Hinkley et al. (2013), who based on high-resolution IR data, concluded that the origin of the recent burst is the Herbig Ae/Be component, not the Fu Ori.

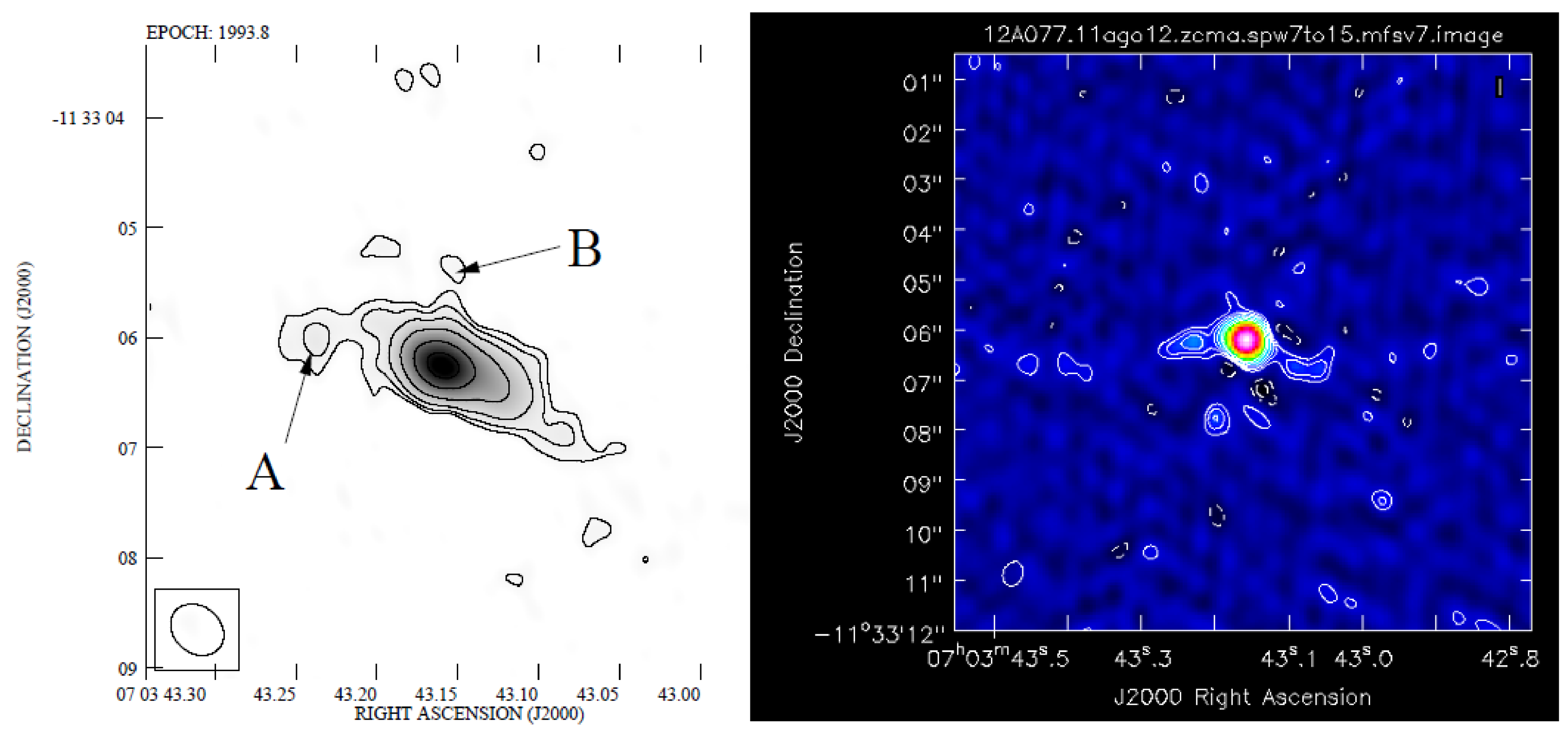

Figure 3. Left: the radio jet in Z CMa in 1993 (Velázquez & Rodríguez 2001). Right: preliminary map of the 2012 data. Although these are not final images, it is clear that there is no significant enhancement in the radio jet.

References:
– Anglada, Rodríguez, Carrasco-González 2015, PoS, AASKA, 121 – Safron et al. 2015, ApJ, 800, L5 – Galván-Madrid et al. 2015, ApJ, 806, L32 – van den Ancker et al. 2004, MNRAS, 349, 1516 – Grankin, Artemenko, 2009, IBVS, 5905, 1 – Velázquez, Rodríguez, 2001, RevMexAA, 37, 261 –
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