Piecing together the disc-jet-corona puzzle in MAXI J1348-630

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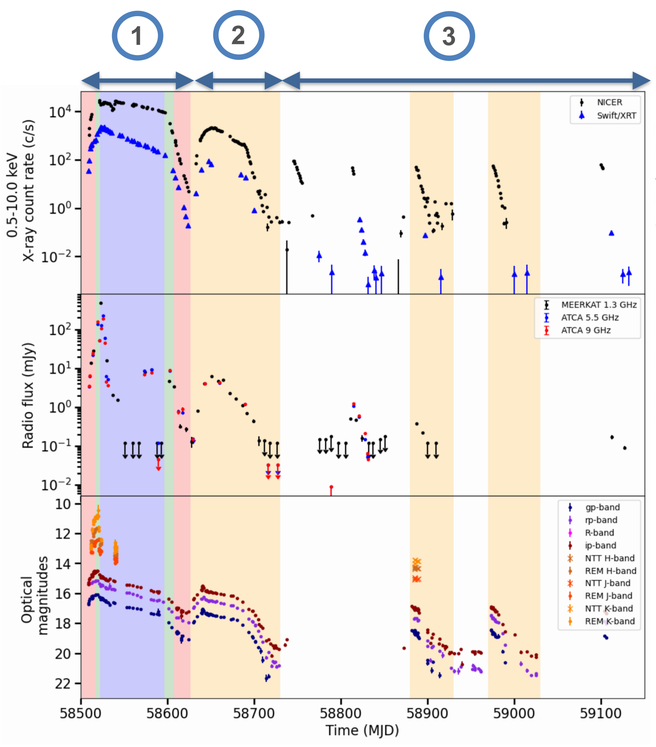
WHAT DOMINATES THE OPTICAL AND NEAR-INFRARED EMISSION DURING BLACK-HOLE LMXB OUTBURSTS?

Black-hole low-mass X-ray binaries (BH LMXBs) brighten by several orders of magnitude during outbursts, while the disc, corona and compact jet evolve with spectral state. In the optical and near-infrared, their contributions overlap, and none of them comes with a label. MAXI J1348-630 is a BH LMXB particularly well suited to disentangling these contributions because it combines long-term LCO optical monitoring with quasi-simultaneous radio, near-infrared, UV and X-ray observations. We place this broadband evolution in the context of published NICER spectral-timing constraints on the inferred coronal geometry.

Main outburst · reflare · mini-outbursts



Long-term X-ray, radio, and OIR/UV evolution of MAXI J1348-630. Shaded intervals mark the spectral states.

Low/hard state (LHS)

Intermediate state (IS)

High/soft state (HSS)

Reflare and mini-outbursts (in the LHS)

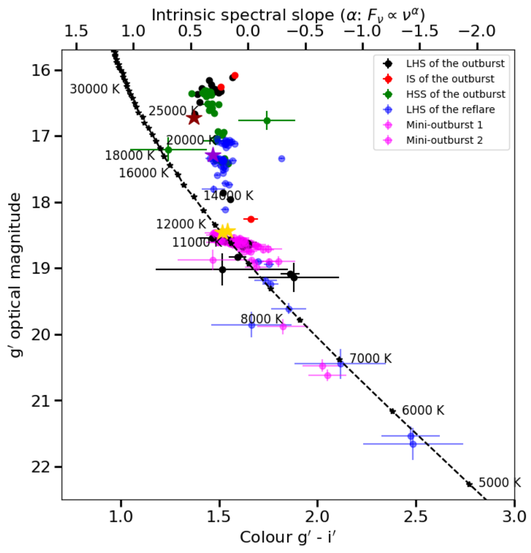
1 **Main outburst:** Bright event showing all the spectral states

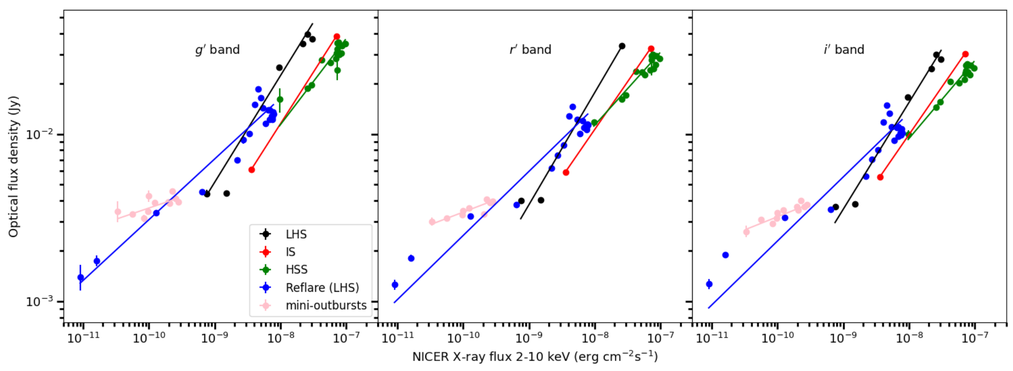
2 **Reflare:** Lower-luminosity event during which the system remained in the hard state

3 **Mini-outbursts:** Several still fainter hard-state rebrightenings

One source, three types of events spanning both spectral state and luminosity

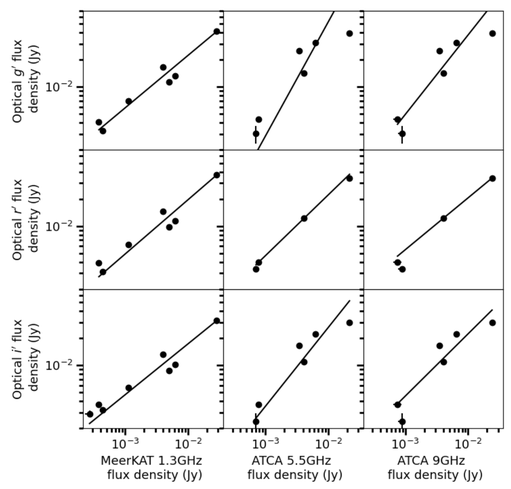
1 Optical emission and the disc





Optical/X-ray slopes $(\beta_{opt/X})$

LHS ~ 0.64; HSS~0.47; reflare~0.39; mini-outbursts~0.16



Radio/optical slopes:
~ 0.57-0.80

CMD results:

Points in the LHS, HSS and reflare lie above the line and converge at spectral indices of ~0.3, consistent with an important disc-related contribution. However, the offset might point to an extra component, like jet or hot flow emission, or X-ray reprocessing.

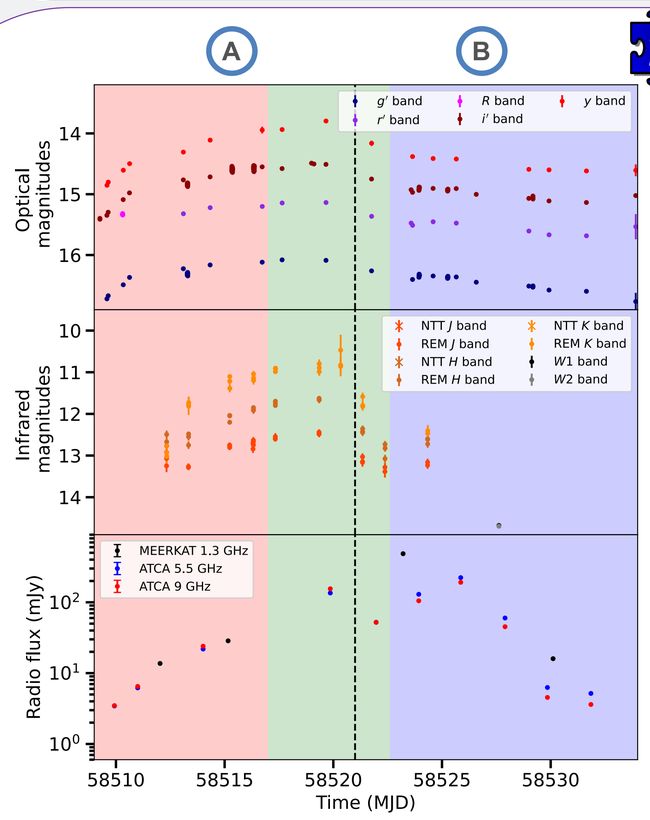
Correlation results:

The correlations change with phase: Slopes are steeper during the main outburst and become flatter during the reflare and mini-outbursts.

The radio/optical correlations suggest that the optical emission is also connected to the compact jet, but the optical emission brightens less strongly than the radio emission.

Several components contribute to the optical emission: disc thermal emission, X-ray reprocessing, and non-thermal emission from the jet and/or hot inner flow

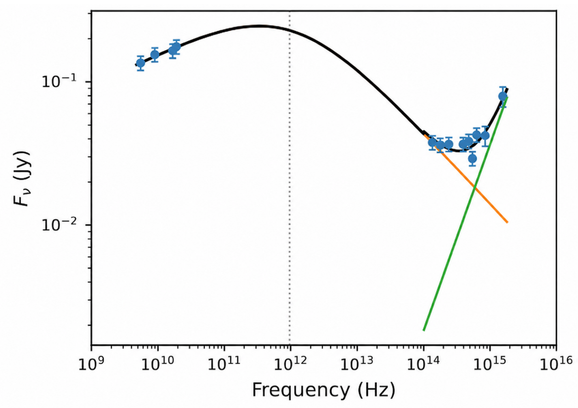
2 Near-infrared emission and the compact jet



Zoomed-in optical, infrared and radio light curves of MAXI J1348-630. The dashed line marks the onset of the OIR decline. A and B label the phases before and after the drop, respectively, compared in Piece 3.

Drop in the light curves:

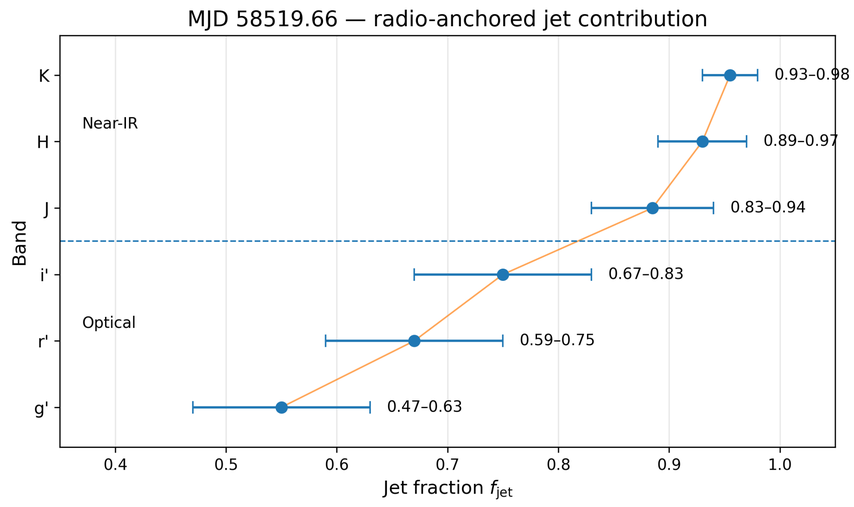
Shortly after the optical and near-infrared maximum (before the dashed line), the *J* and *H* bands drop by ~ 0.5 mag. The optical bands decrease much less: *r′* and *i′* ~ 0.1 mag, while *g′* remains almost constant. Over the same time interval, the radio-core flux drops, consistent with a larger jet-related contribution in the near-infrared.



One acceptable radio-anchored decomposition at MJD 58519.66: total model in black, fitted jet-related component in orange, and disc-related continuum in green.

From the fitted components at each filter:

$$f_{jet} = \frac{F_{jet}}{F_{jet} + F_{thermal}}$$



All acceptable fits show the same trend: the fitted jet-related fraction is highest in *J,H,K* and decreases toward the optical.

Together, the stronger near-infrared decline and the jet fractions estimated from the fit of the SEDs suggest the near-infrared is dominated by emission from the compact jet.

3 Putting the pieces together

Three changes across the same transition:

1 Drop in the infrared and radio fluxes: A → B

2 X-ray timing: Type-C QPO → Type-B QPO

3 Inferred geometry of the corona:

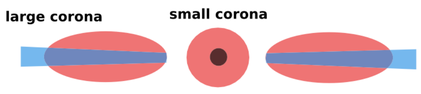
Coronal geometries adapted from Garcia et al. (2021); Bellavita et al. (2022); Alabarta et al. (2025)

Similar inferred coronal geometries, different optical/X-ray correlations:

Main outburst LHS

$\beta_{opt/X} \sim 0.64$

Reflare LHS



$\beta_{opt/X} \sim 0.39$

Near-infrared: The NIR decline occurs around the same time as the initial radio-core drop, the change from a type-C to a type-B QPO, and the reconfiguration of the coronal geometry. This suggests a physical connection between the compact jet and the Comptonizing region.

Optical: The main-outburst and the reflare, during the LHS, show different optical/X-ray correlations despite broadly similar inferred coronal geometries.