双恒星级黑洞并合事件是否会有GRB对应体?

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Counterparts candidates?

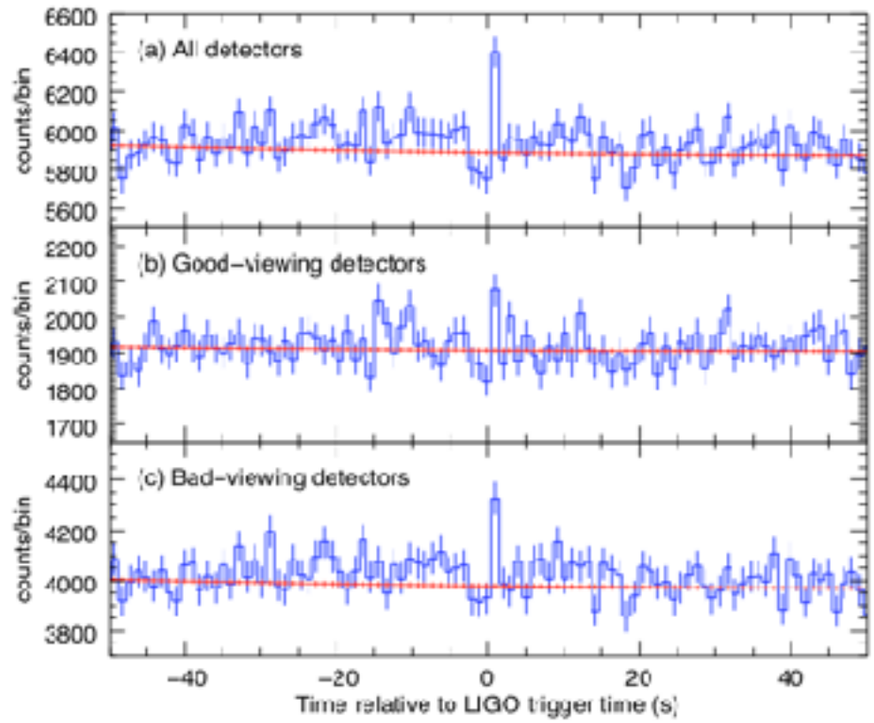
Astrophysics > High Energy Astrophysical Phenomena

Is the GW150914-GBM really associated with the GW150914?

Shaolin Xiong

(Submitted on 18 May 2016)

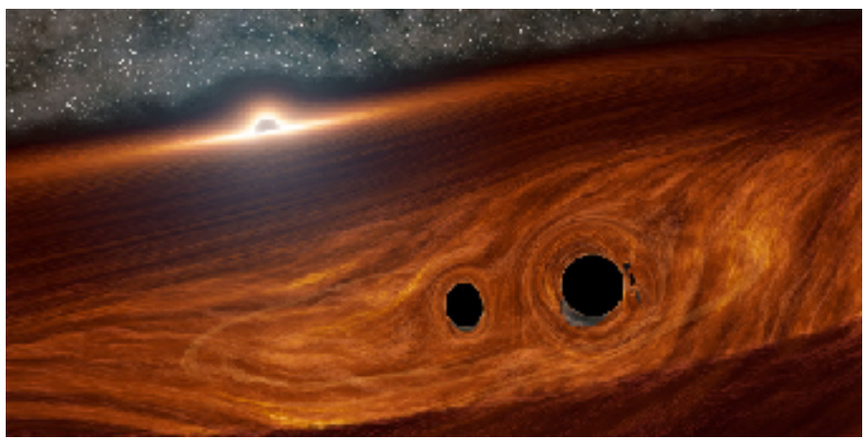
Finding the electromagnetic (EM) counterpart is critically important for a gravitational wave event. Although many efforts have been made to search for the purported EM counterpart of GW150914, the first gravitational wave event detected by LIGO, only Fermi/GBM reported an

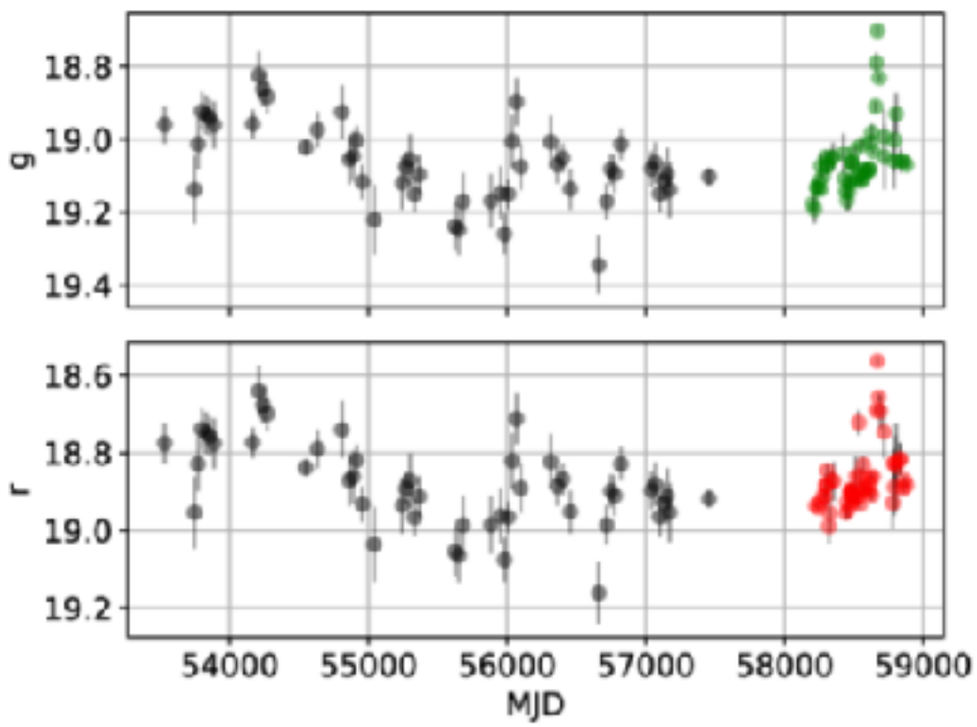


Candidate Electromagnetic Counterpart to the Binary Black Hole Merger Gravitational-Wave Event S190521g

M. J. Graham *et al.*

Phys. Rev. Lett. **124**, 251102 – Published 25 June 2020



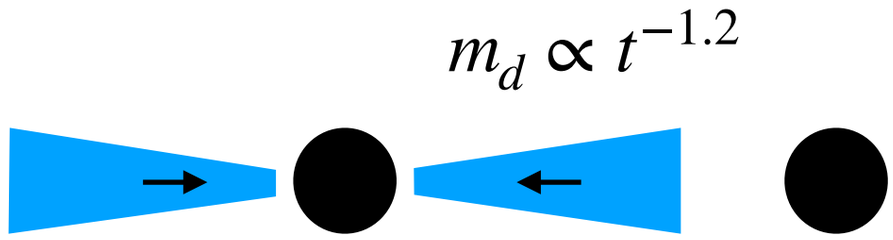


A novel idea: one BH keeps its residual disk

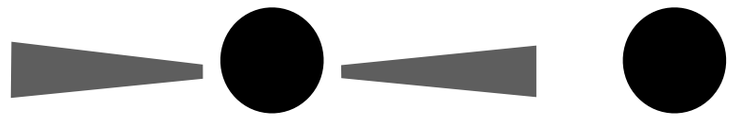
Perna, Lazzati & Giacomazzo (2016)

- One BH forms after a weak SN, and contains a fallback disk.

- As accretion rate decreases, disk T drops below T_{dead} =3000 K, where MRI stops working.

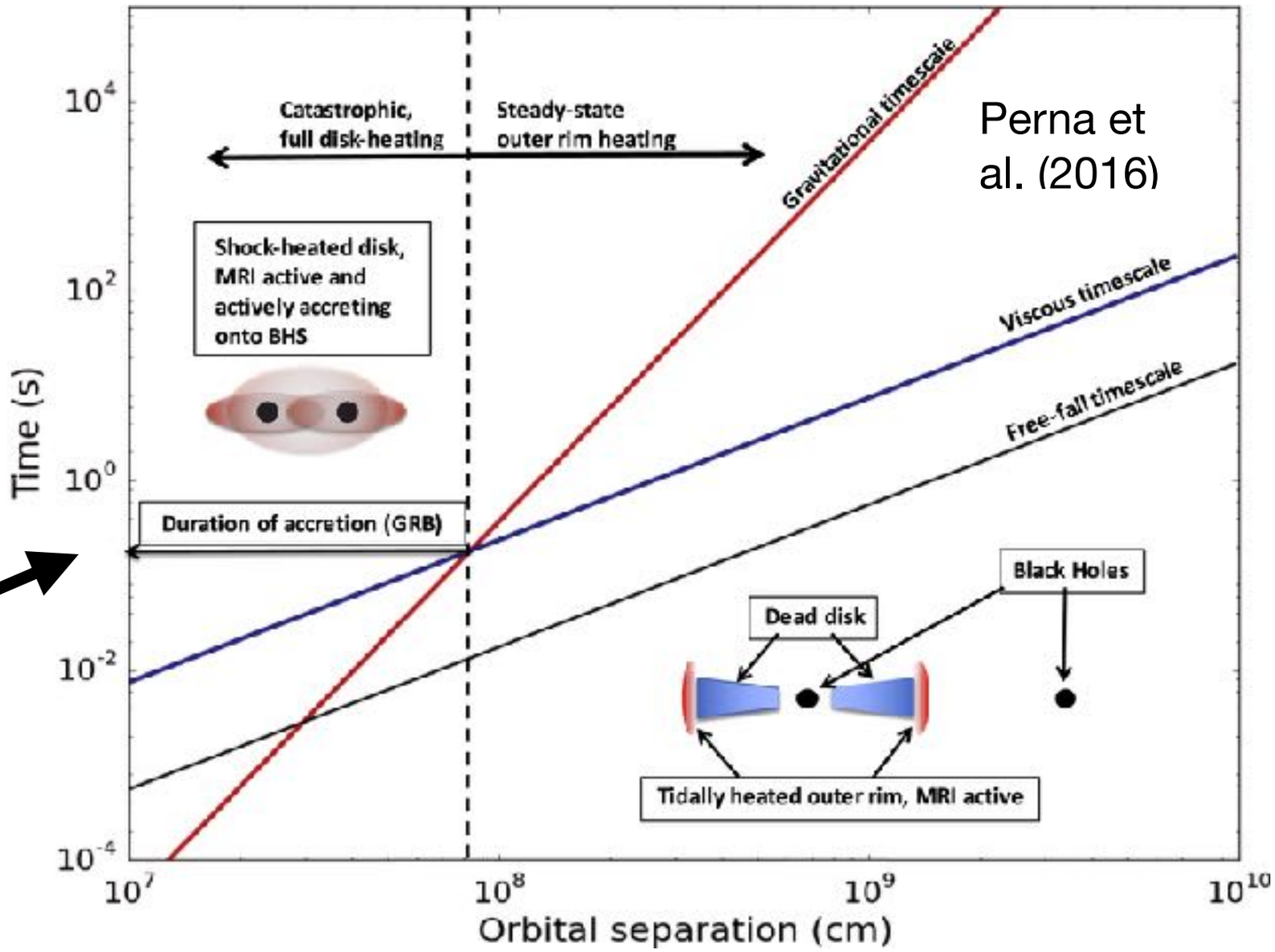


- The “long-lived dead” disk maintains a mass $m_{dead} \sim 10^{-4} M_{\odot}$ until the merger.



- The companying BH tidally heats the disk's outer rim, but only serves to shrink the disk while piling up the mass over there.
- 。。。until GW in-spiral time scale << viscous time scale.

$$t_{GRB} \approx t_{vis} \sim 0.1\ s$$



Perna et al. (2016)

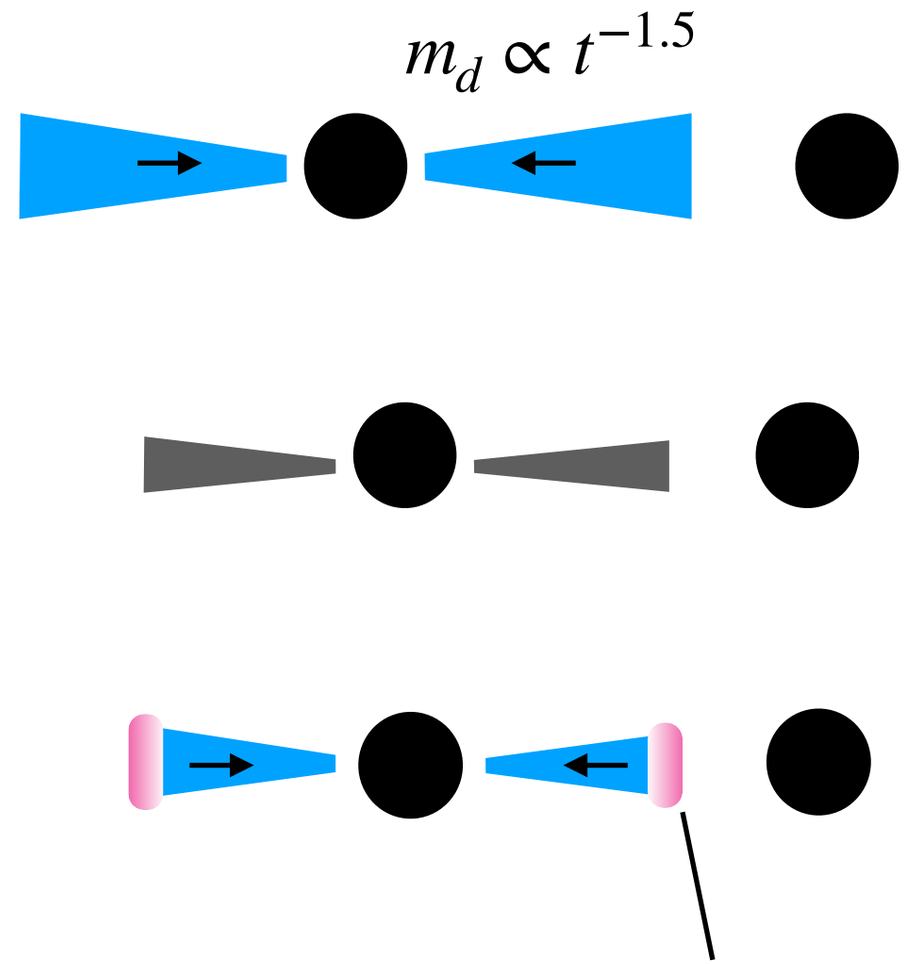
Improvement

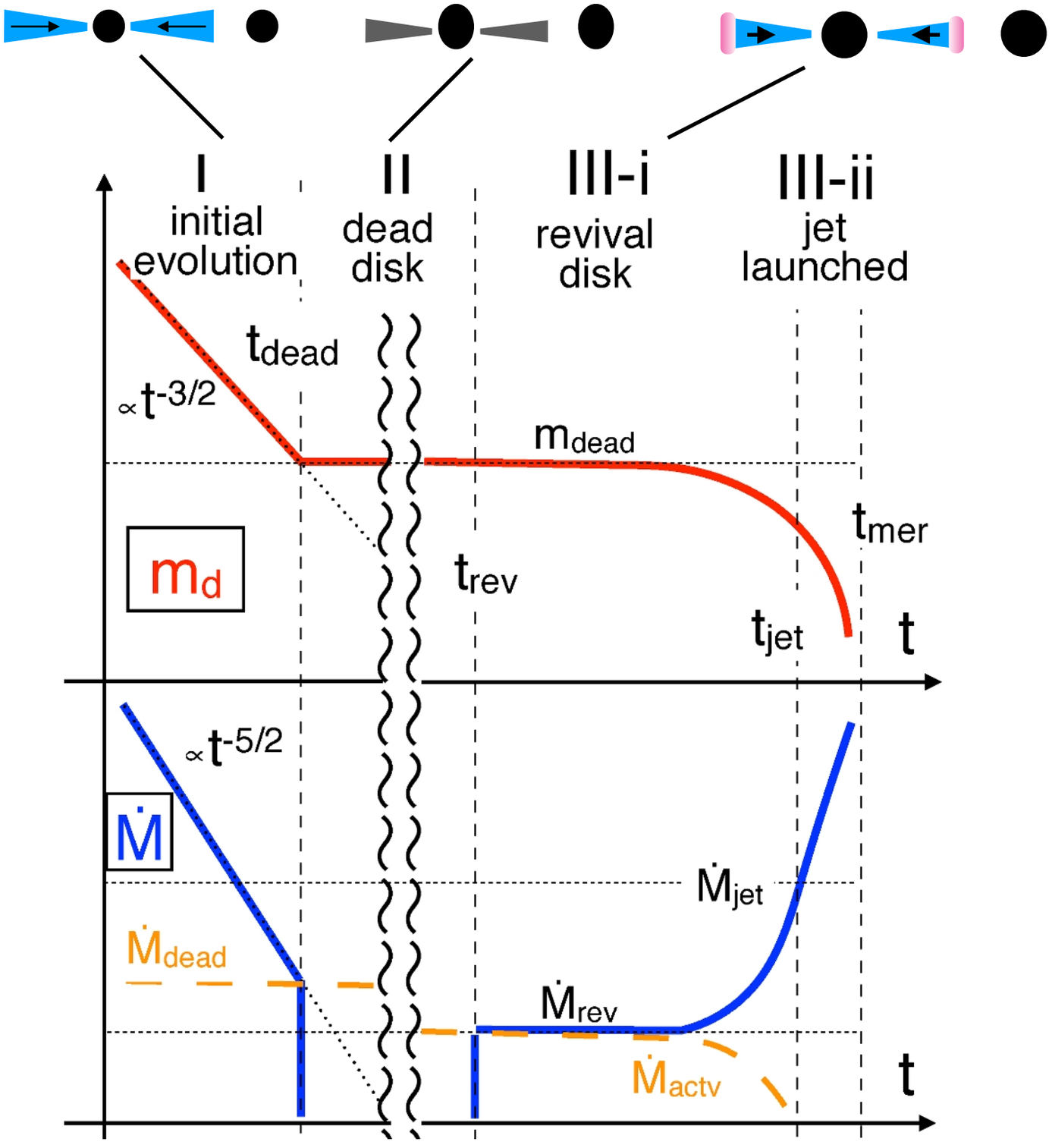
Kimura, Takahashi & Toma (2017)

- A confined disk drains its mass faster $\rightarrow$ $m_{dead} \sim 10^{-7} M_\odot$

- When tidal heating reactivates MRI in the outer rim, the disk **inner region** is reactivated as well.

- The disk accretion is revived much **earlier** than the final merger.





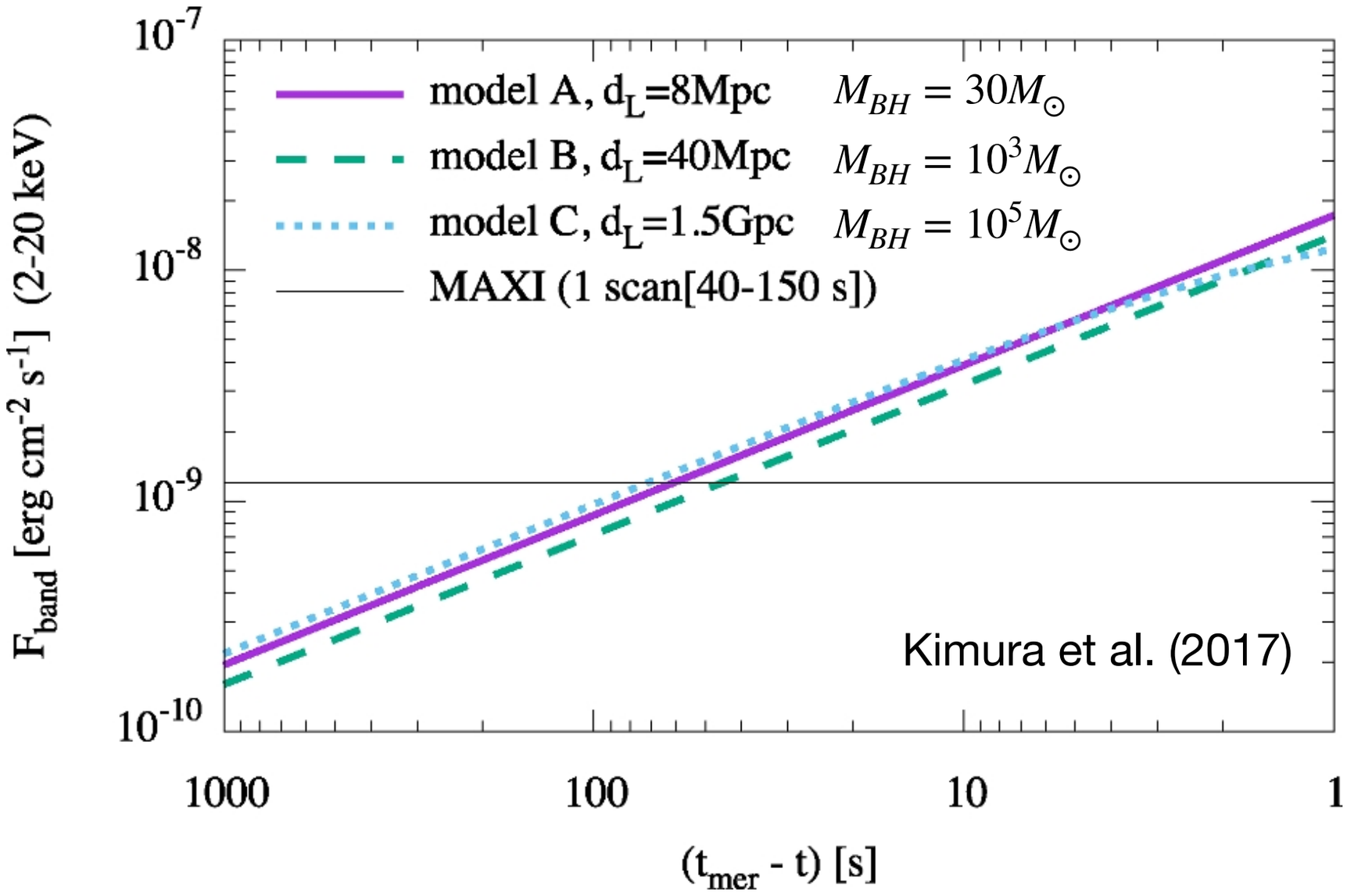
Kimura et al. (2017)

- When $t_{GW} < t_{vis}$, the accretion rate will be controlled by t_{GW}.

- Accretion rate increases rapidly just before the final merger, up to $\sim 10\dot{M}_{Edd}$.

- The super-Eddington accretion likely produces a jet, but with a very modest luminosity $L_j \sim 10^{40} erg/s$.

- A faint X-ray bust BEFORE the GW event?



Summary

- One BH in a binary could keep its residual disk on t_{Hubble}, due to MRI-deactivation, toward the period of final in-spiral.
- It could produce a short GRB, or a faint XRB, depending on whether & how early the disk accretion is reactivated.