

UNLEASHING THE PREDICTIVE POWER OF TIDAL DISRUPTION EVENTS

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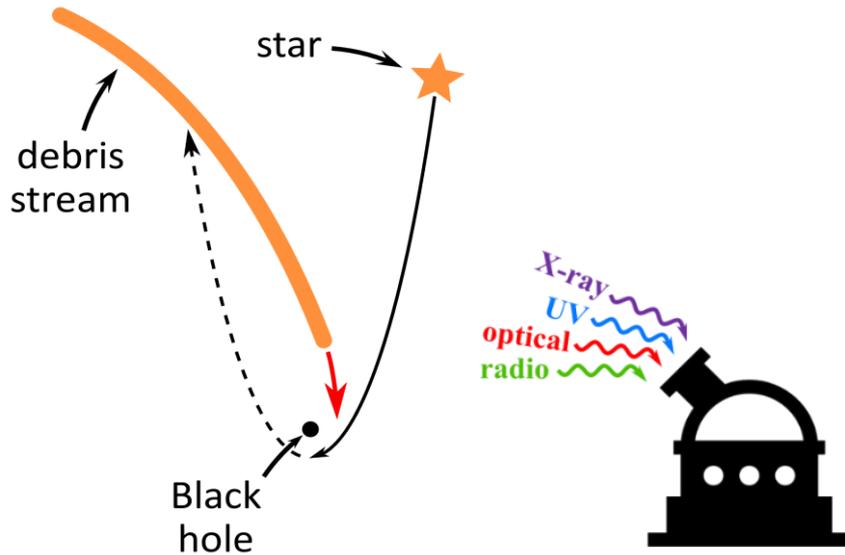


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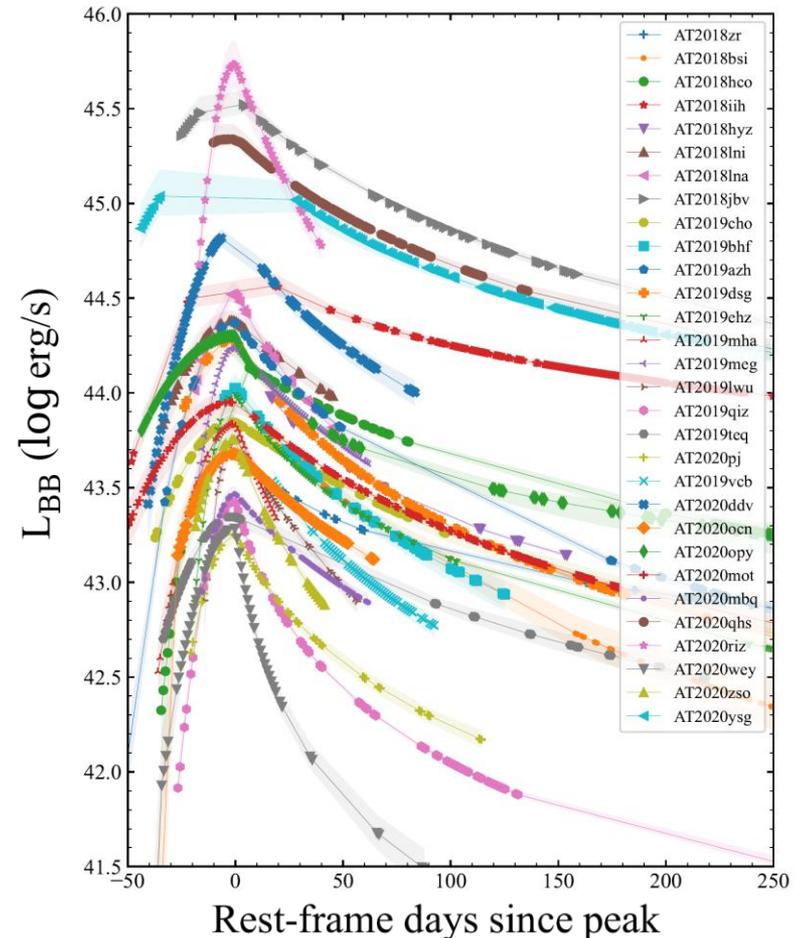
PROBING GALACTIC NUCLEI WITH TIDAL DISRUPTIONS



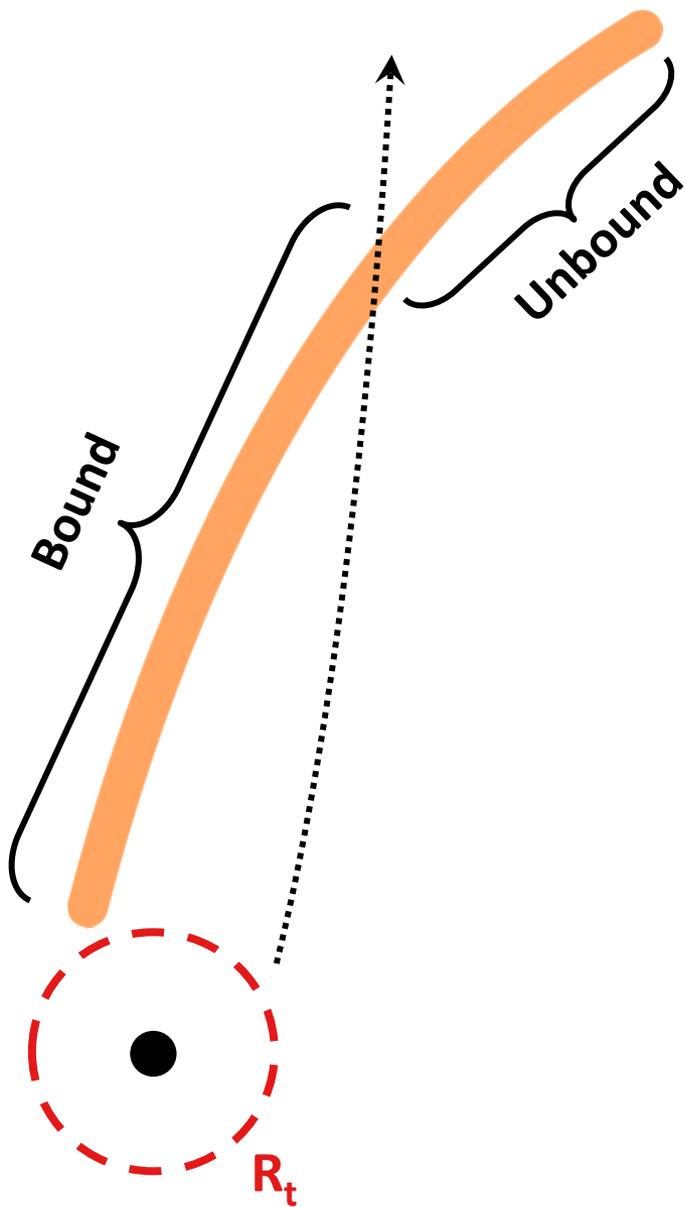
- Month-long flares in **optical/X-rays**
- **Unique probes** of otherwise dormant supermassive black holes
- Entering an **observational golden age** with the Rubin Observatory

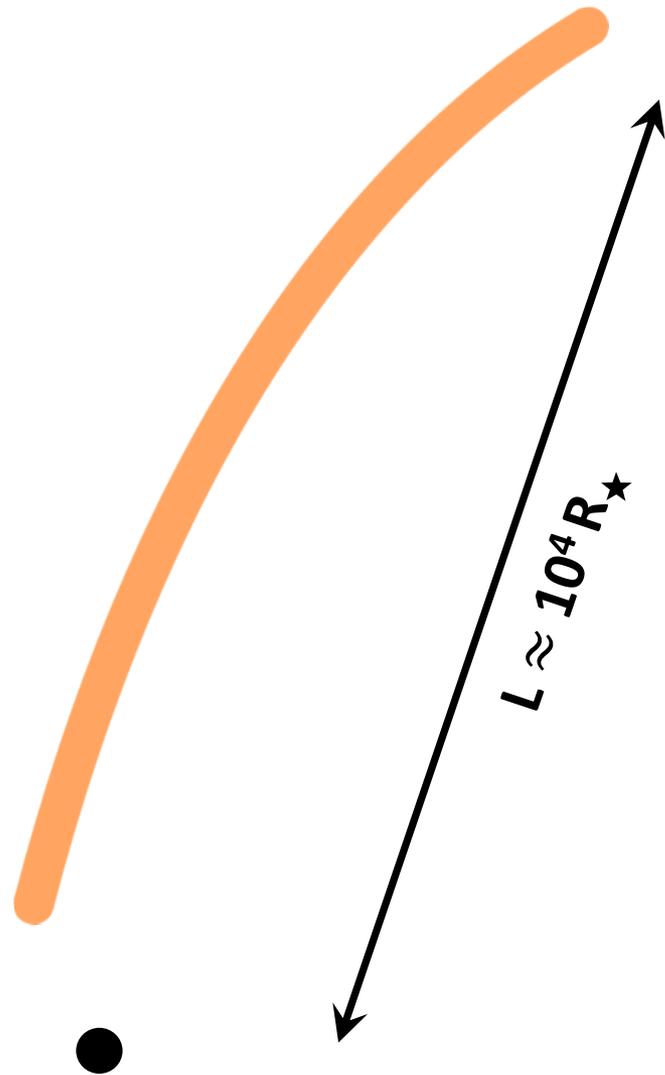
In need of a theoretical paradigm for the detectable emission

(Hammerstein et al. 2023)

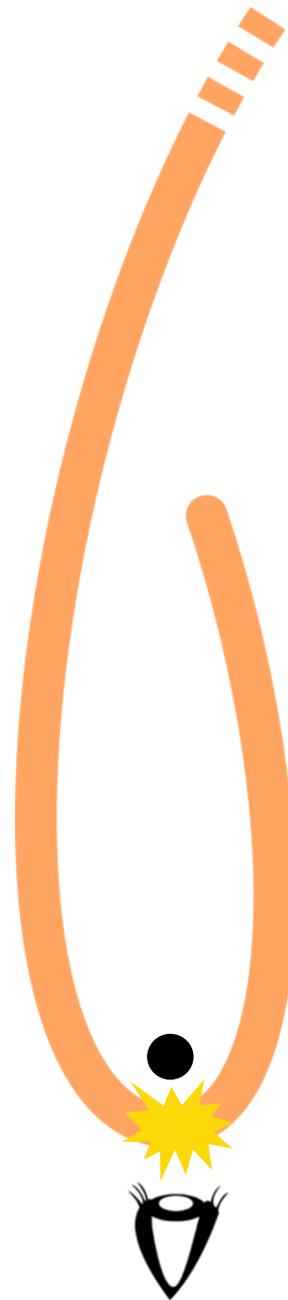
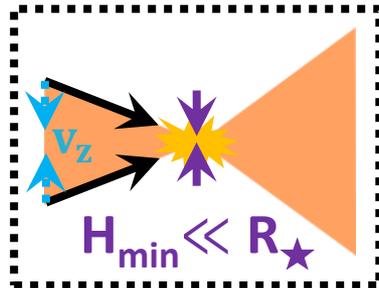








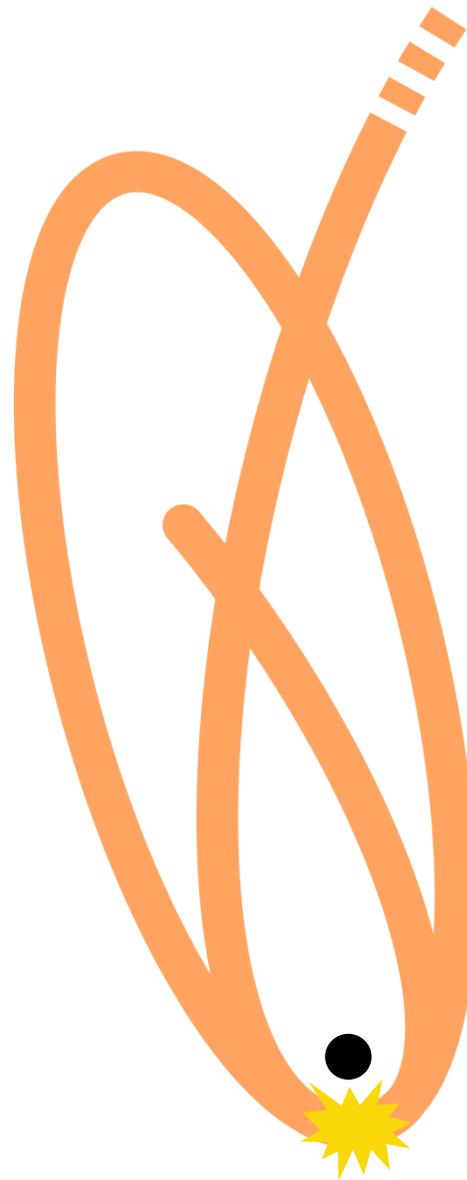
Resolution
bottleneck for
simulations



**(1) Nozzle
shock**

$$L \approx 10^4 R_{\star}$$

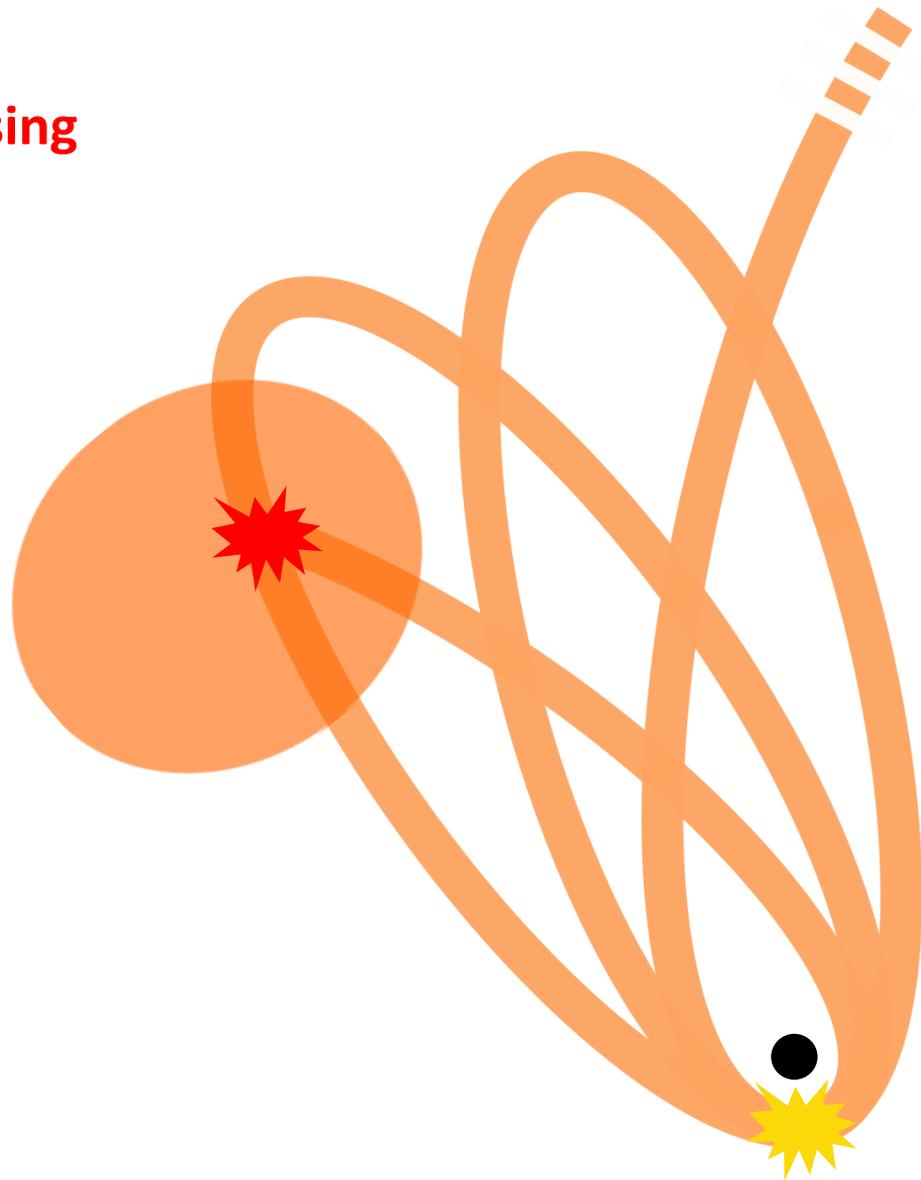
**(missed collisions due to
black hole spin)**



**(1) Nozzle
shock**

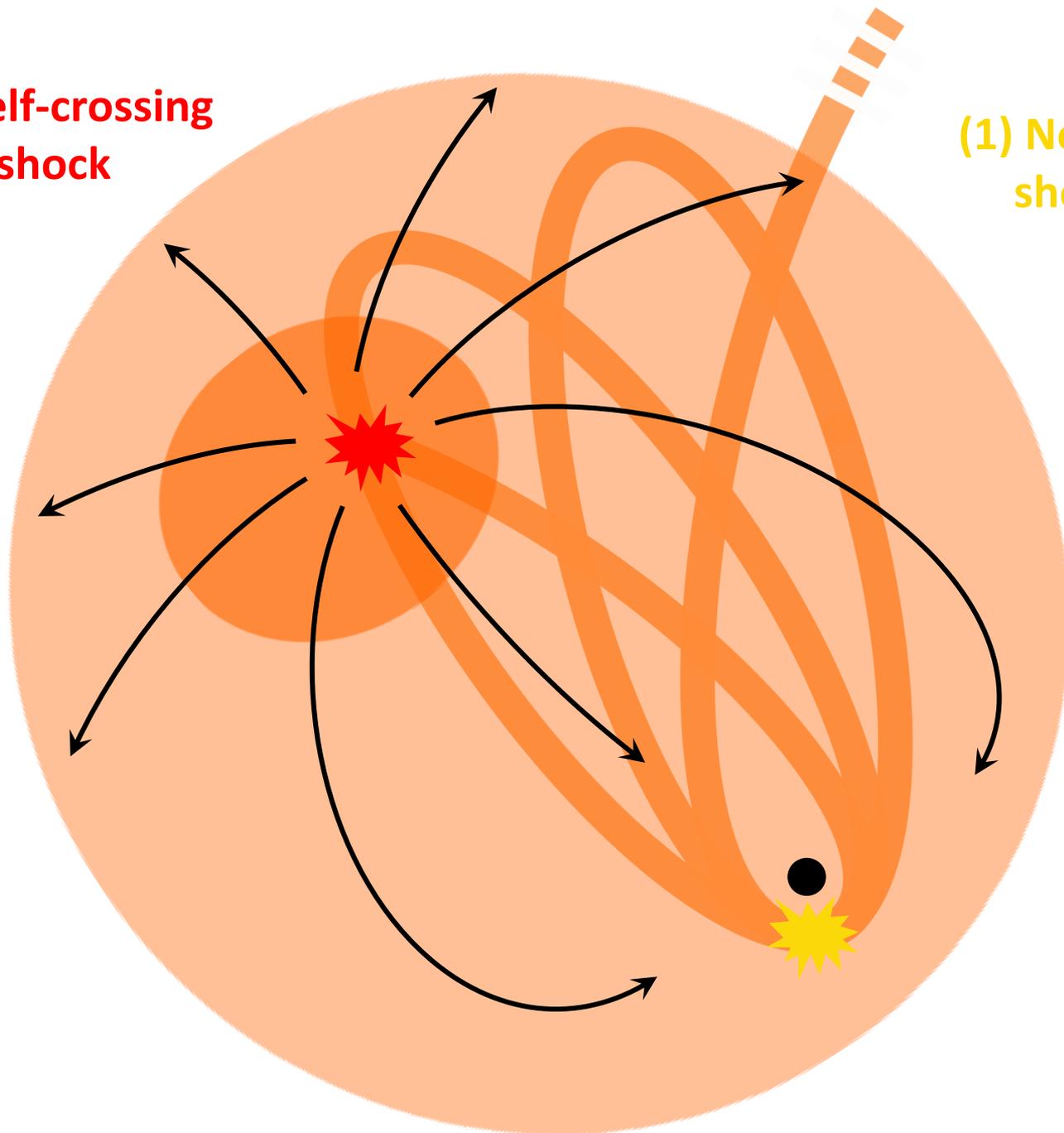
**(2) Self-crossing
shock**

**(1) Nozzle
shock**



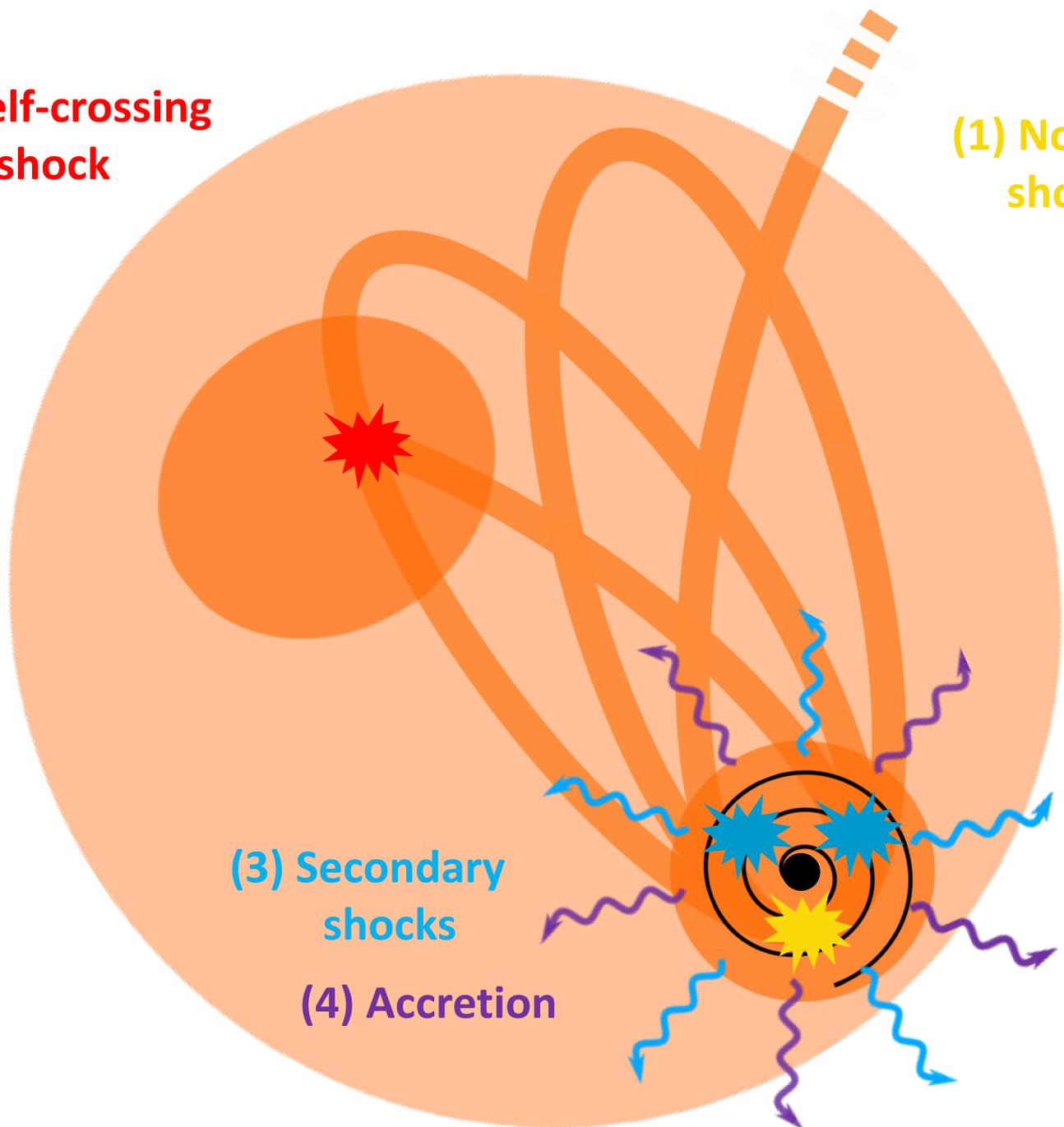
(2) Self-crossing shock

(1) Nozzle shock



(2) Self-crossing shock

(1) Nozzle shock



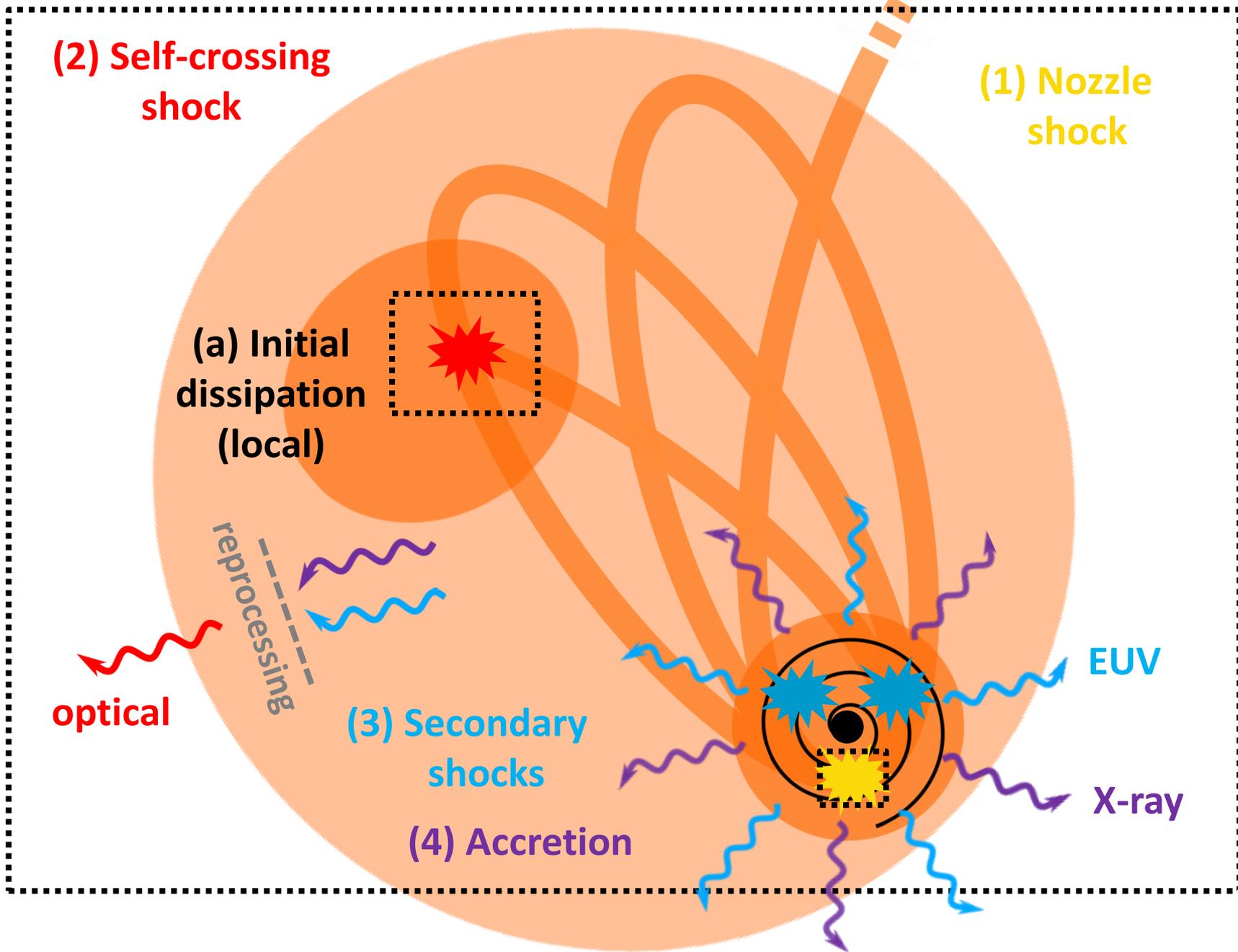
(3) Secondary shocks

(4) Accretion

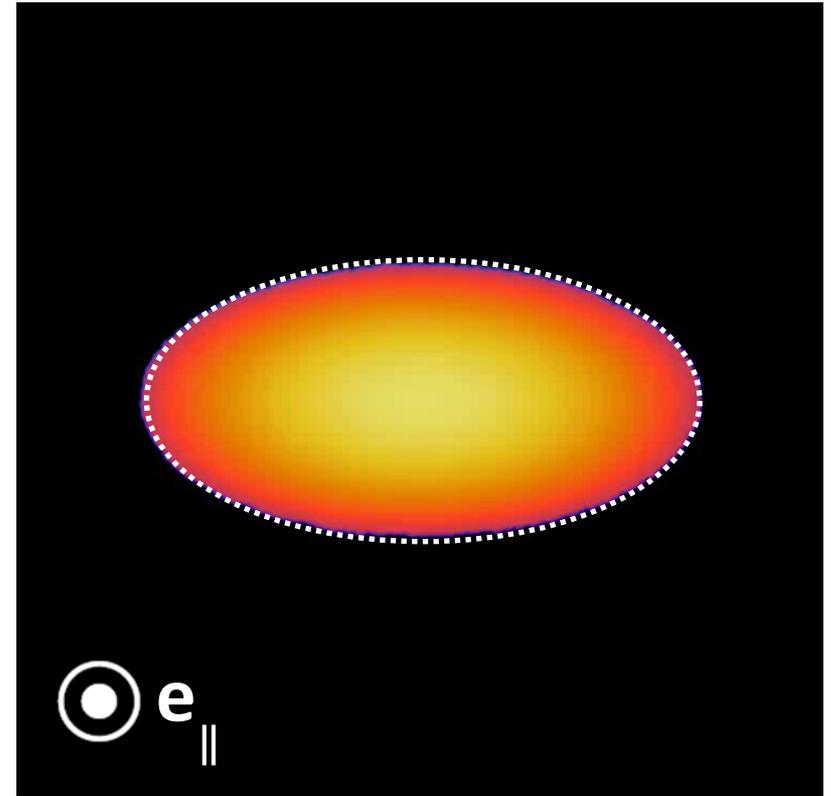
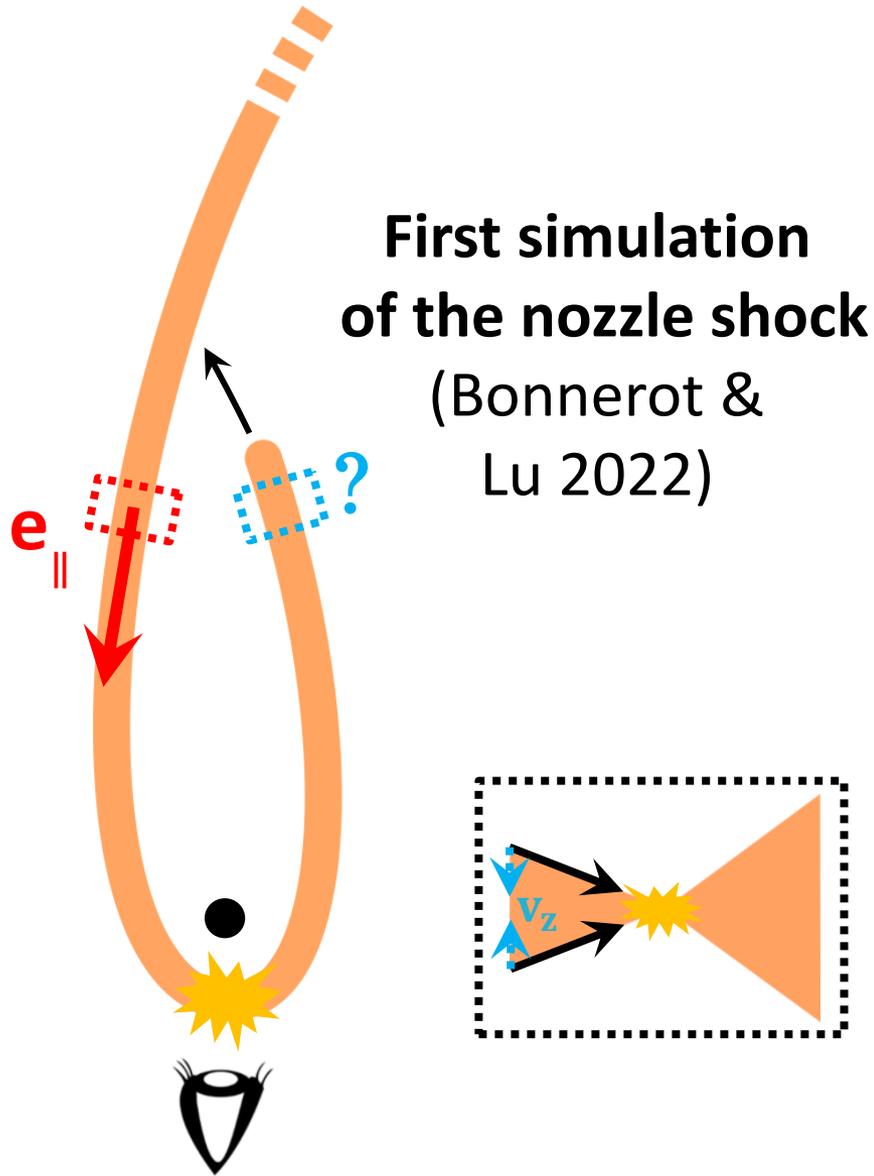
EUV

X-ray

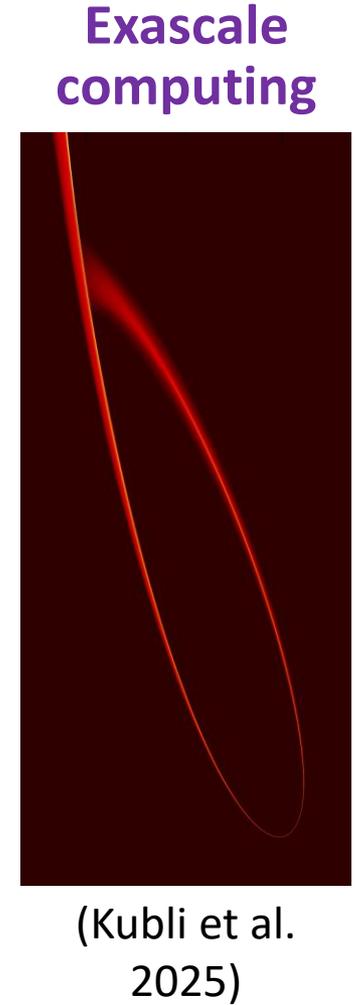
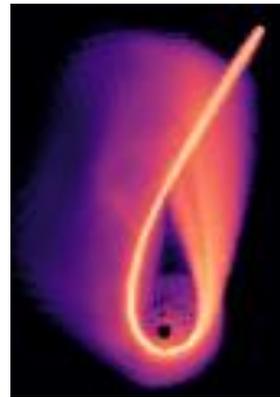
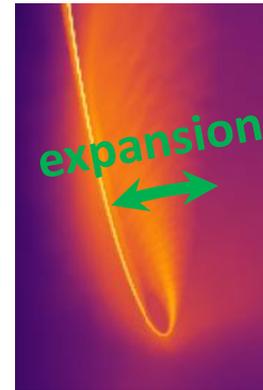
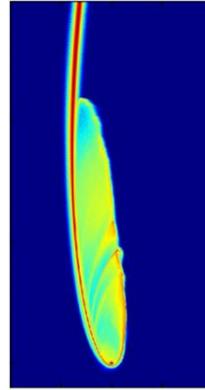
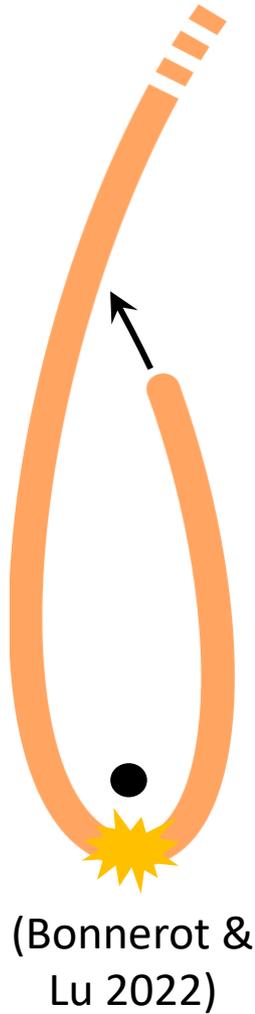
(b) Black hole fueling (global)



NOZZLE SHOCK

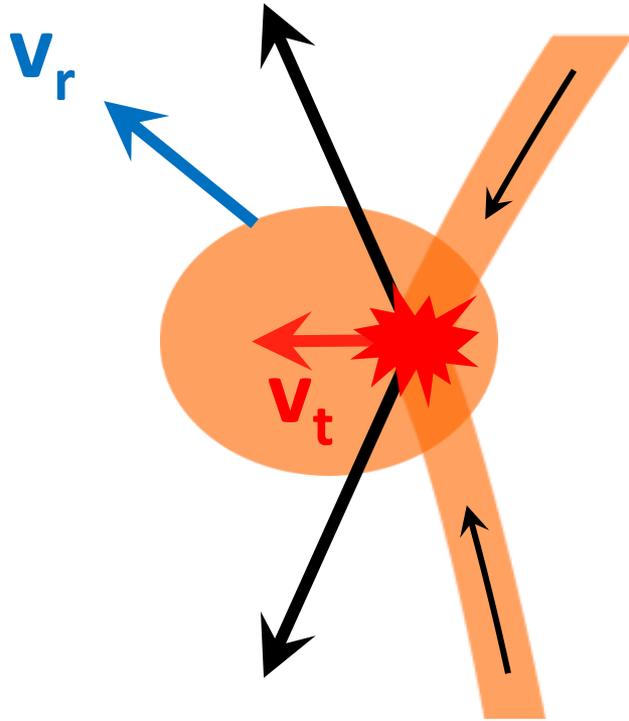


**No significant net
expansion from the
nozzle shock**

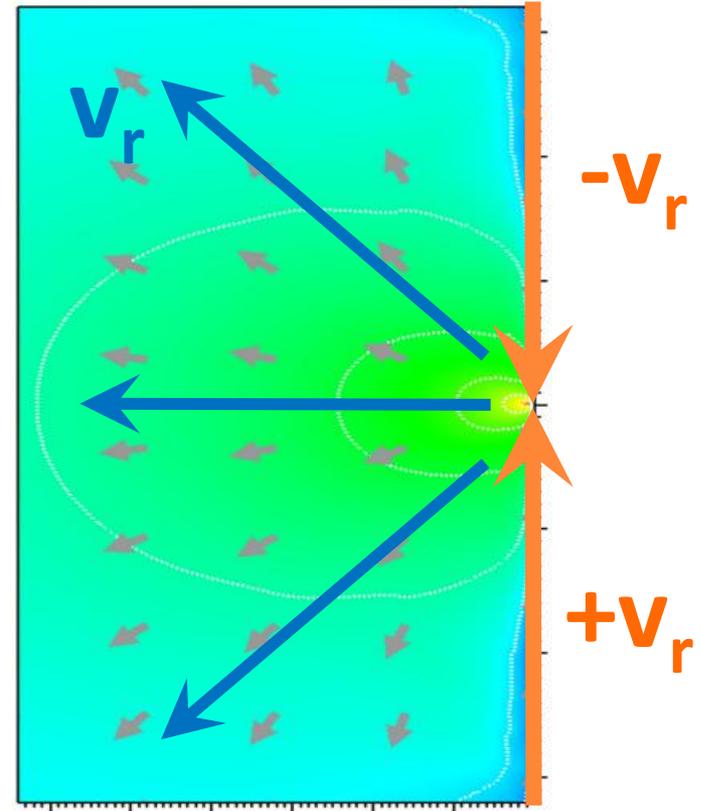


Reaching sufficient resolution in 3D simulations requires exascale capabilities

SELF-CROSSING SHOCK



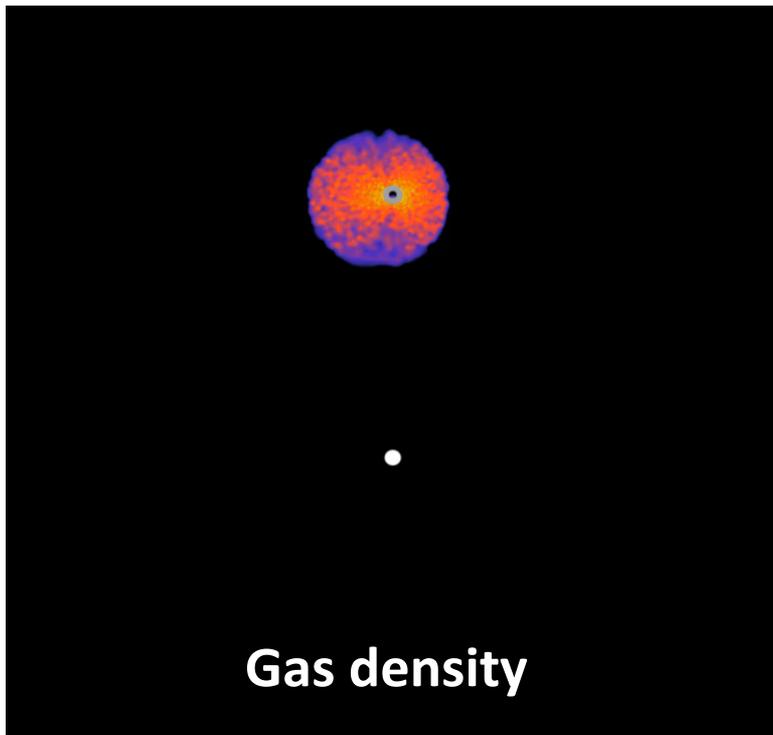
**Quasi-spherical
outflow launched from
the collision point**



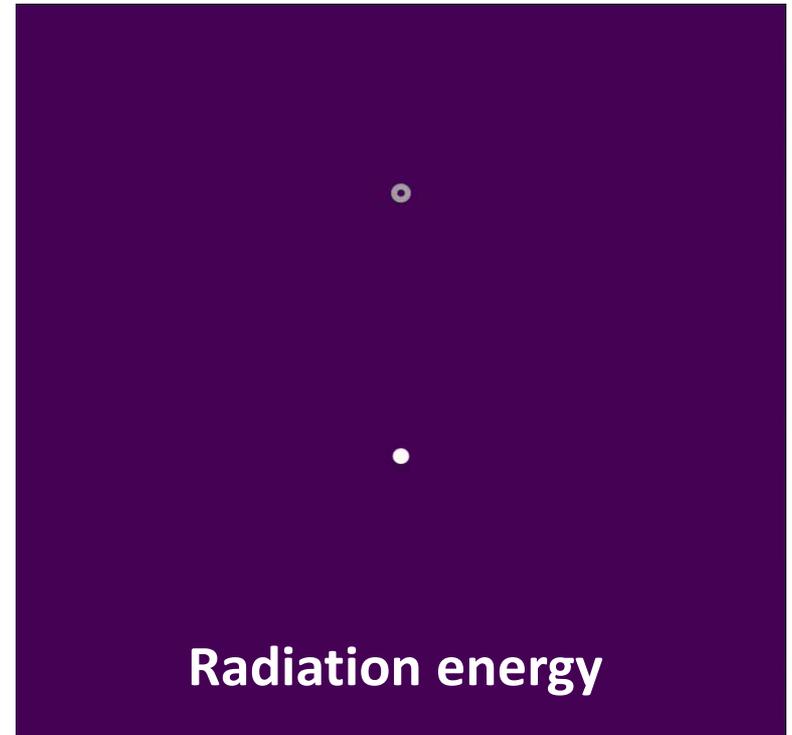
**Local simulation of the
self-crossing shock**
(Lu & Bonnerot 2020)

ACCRETION DISC FORMATION

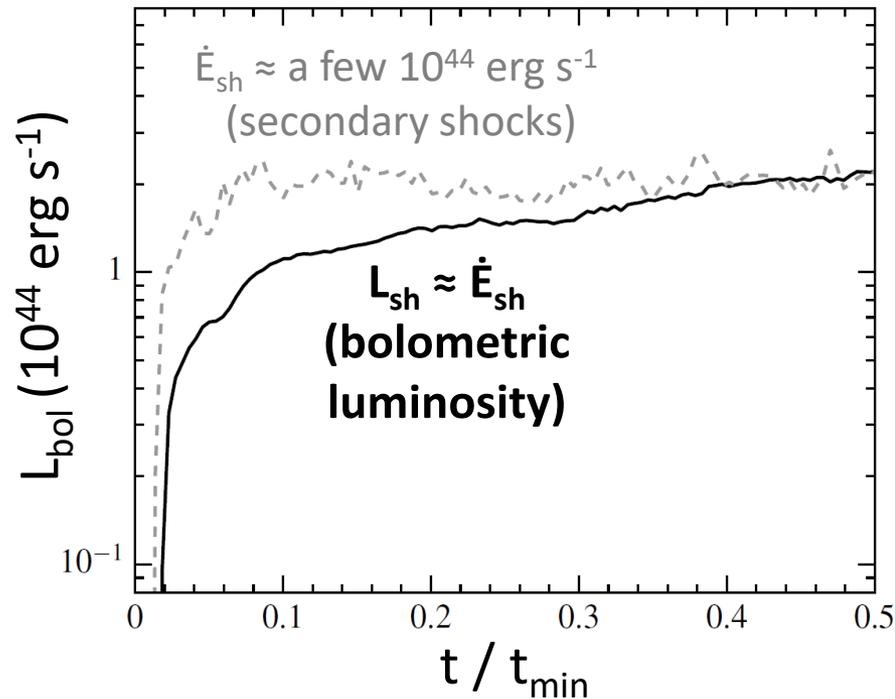
**First radiation-hydrodynamics
simulation of disc formation**
(Bonnerot, Lu & Hopkins 2021)



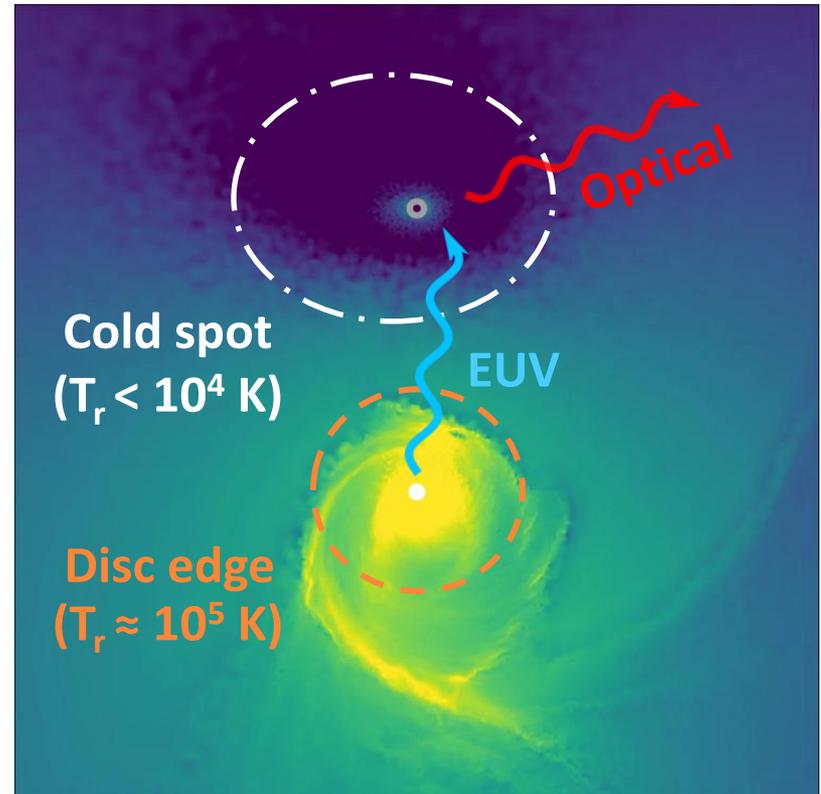
**Rapid formation of
an accretion disc irradiating
the surrounding gas envelope**



EMERGING RADIATION



$L_{sh} \approx \text{a few } 10^{44} \text{ erg s}^{-1}$
accounting for
observed values



Optical emission potentially
resulting from reprocessing
at the cold spot

Paving the way to a robust paradigm for tidal disruption events!

