

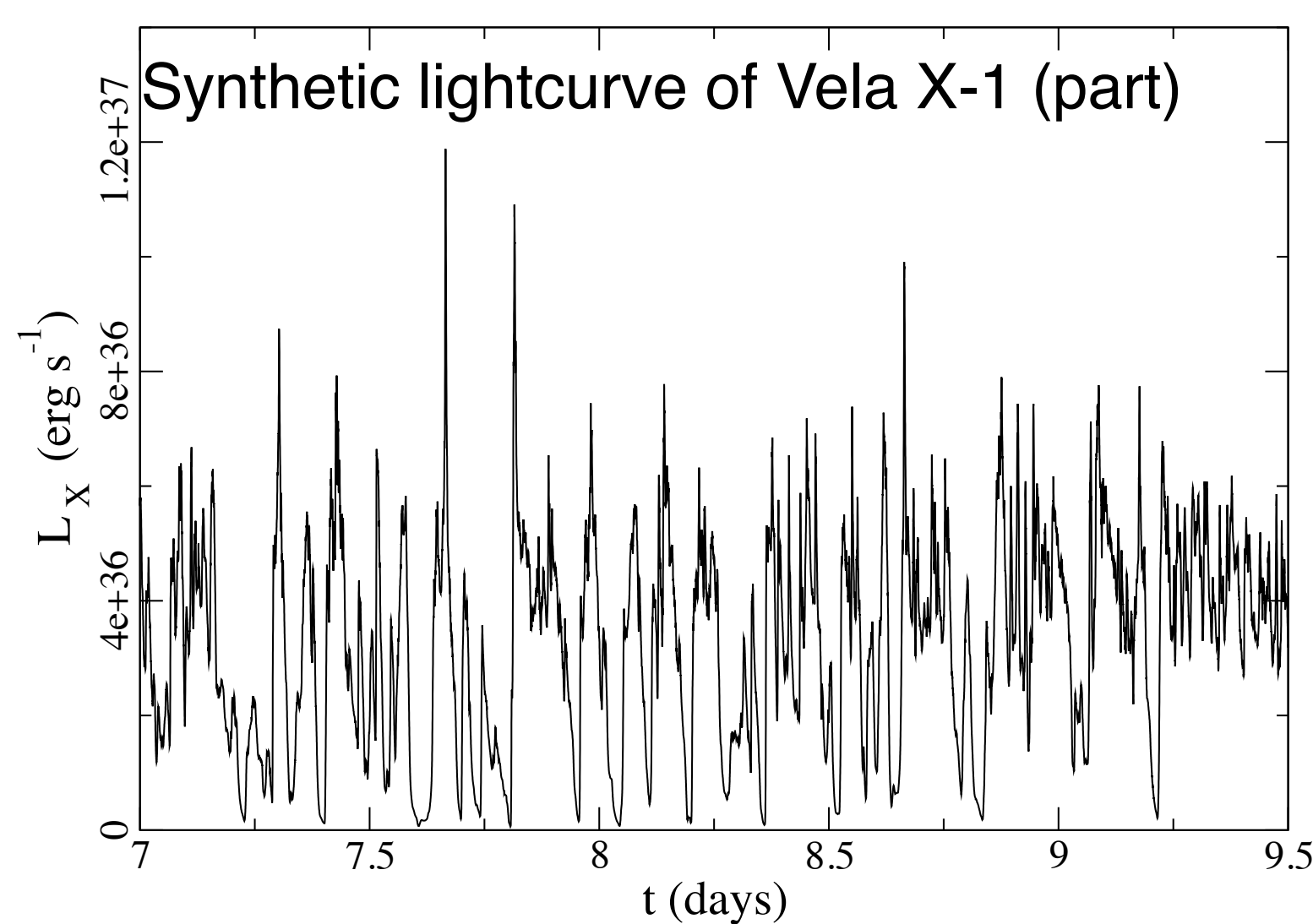
Modeling accretion in sgHMXB: Origin of the off-states in Vela X-1

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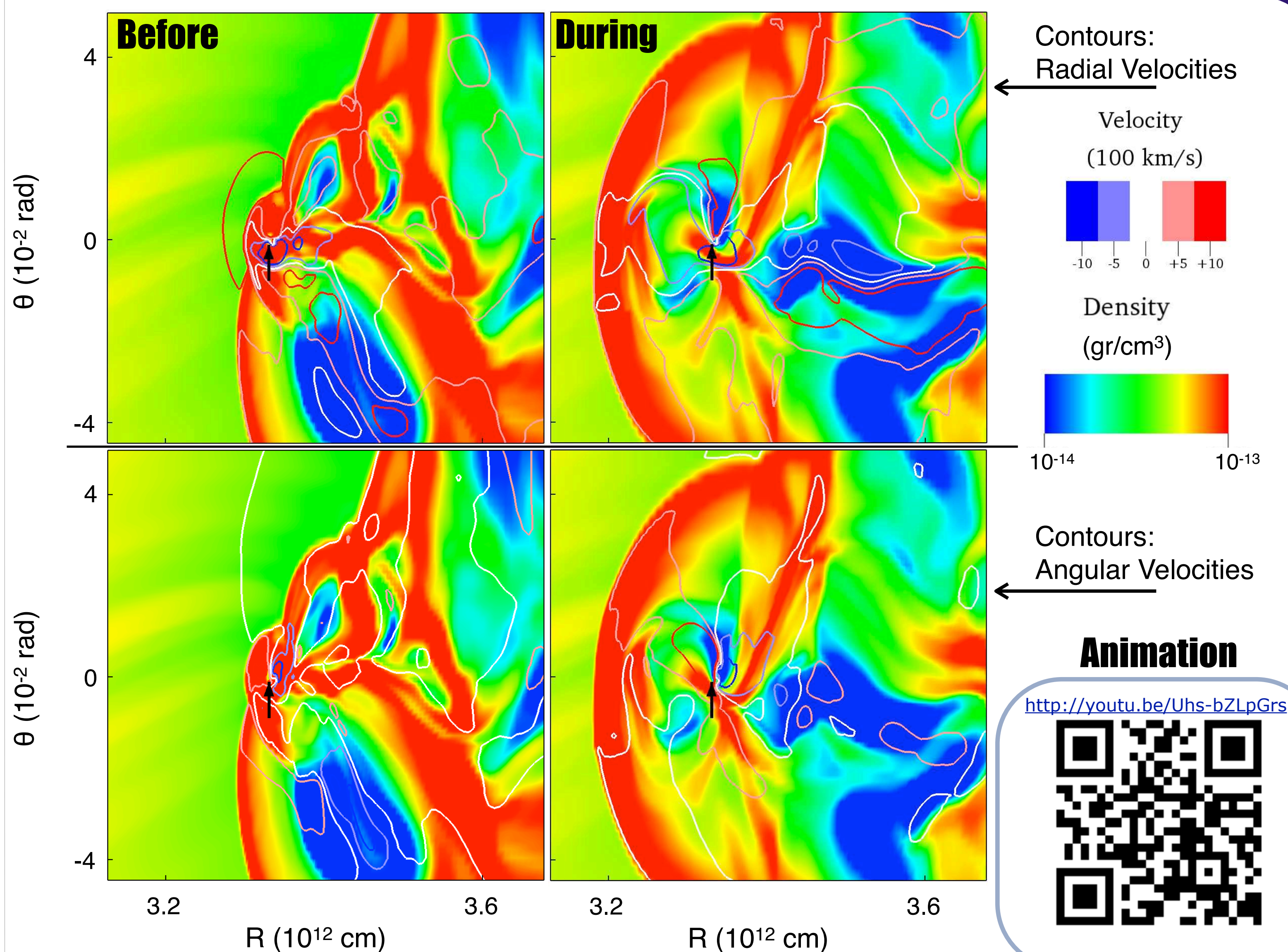
Abstract

Supergiant High Mass X-ray Binaries (sgHMXBs) are a unique laboratory for studying accretion phenomena in nature. Vela X-1 is the best studied classical sgHMXB system. INTEGRAL revealed a rich variability at hard X-rays, featuring flares and off-states. The accretion of matter on the neutron star in sgHMXB is dominated by unstable hydrodynamical flows. We are confirming that the observed behavior could be explained without invoking exotic phenomena. The hydrodynamic code VH-1 is employed to simulate Vela X-1 and study accretion onto the neutron star. The results of these simulations are very similar to the observed variability. The histogram of the observed and simulated light-curves is characterized by a log-normal distribution. Off-states are predicted with a duration from ~ 5 to 120 minutes corresponding to transit low density ‘bubbles’ forming around the neutron star. Flares are also predicted. Self organized criticality of the accretion stream is the main reason for the observed variability.

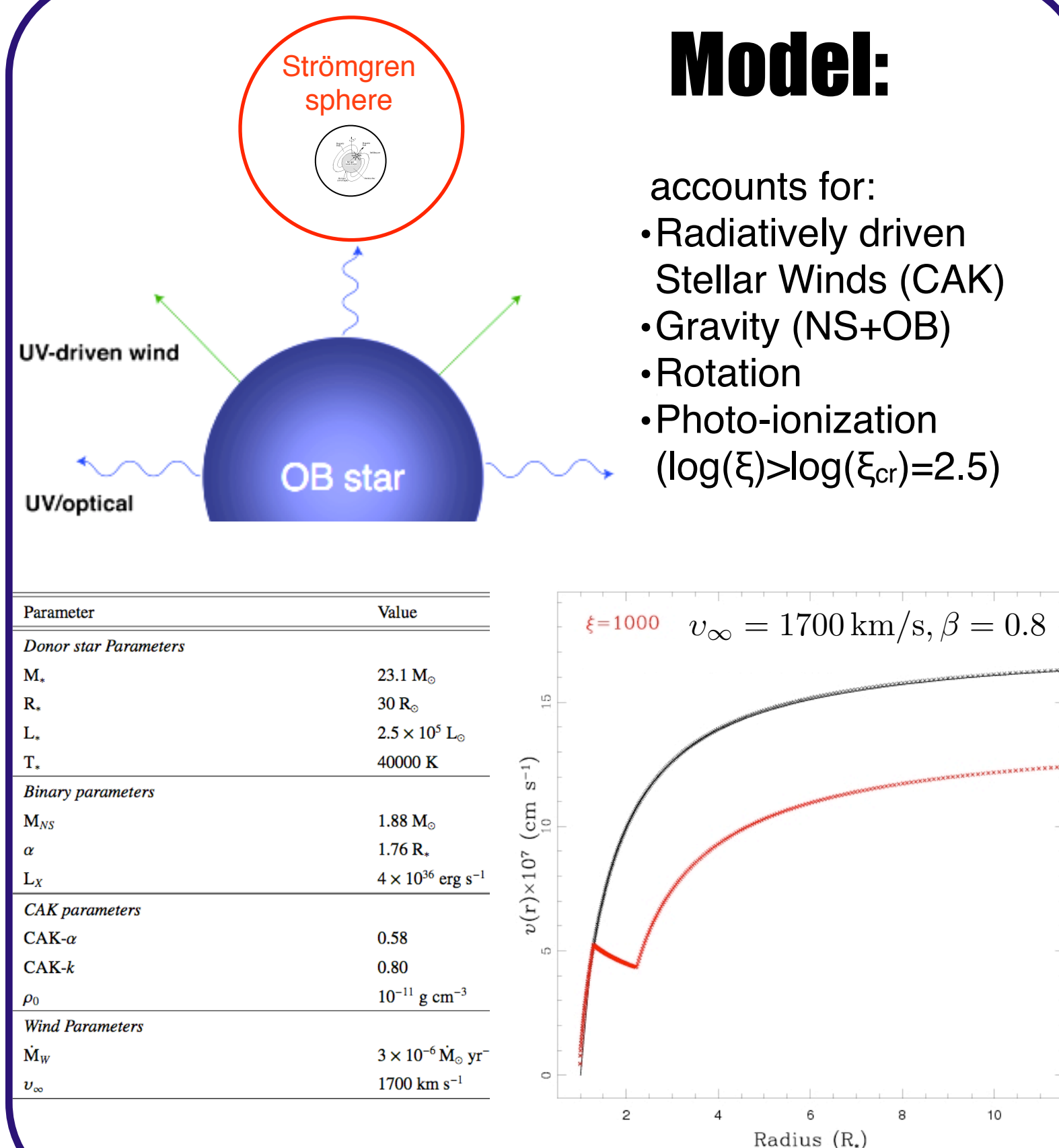
Simulations/Results



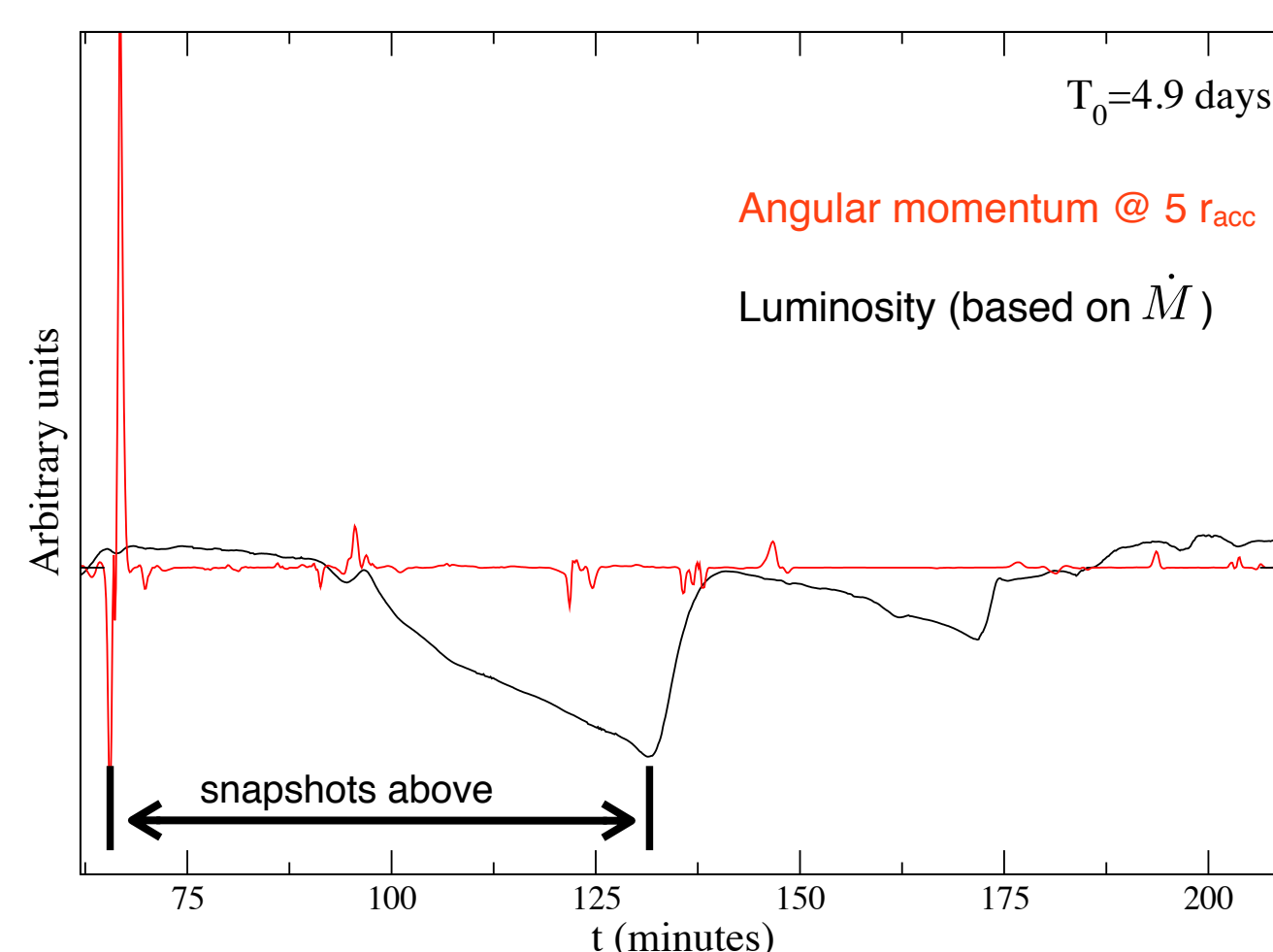
VH-1 Hydro code: 2D simulations.
Spatial Resolution @ NS: $\sim 10^9$ cm
Temporal resolution: ~ 1 sec



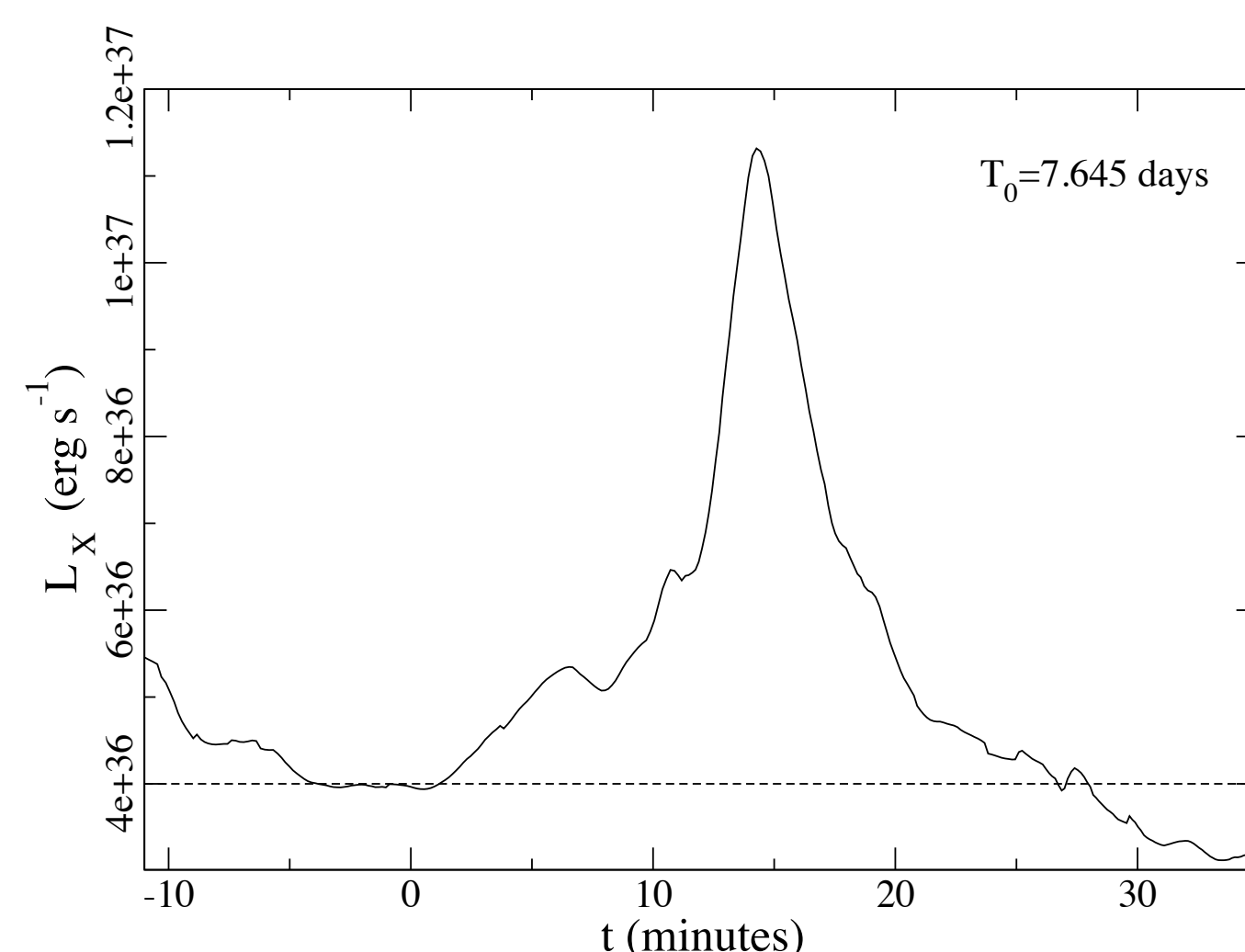
Model:



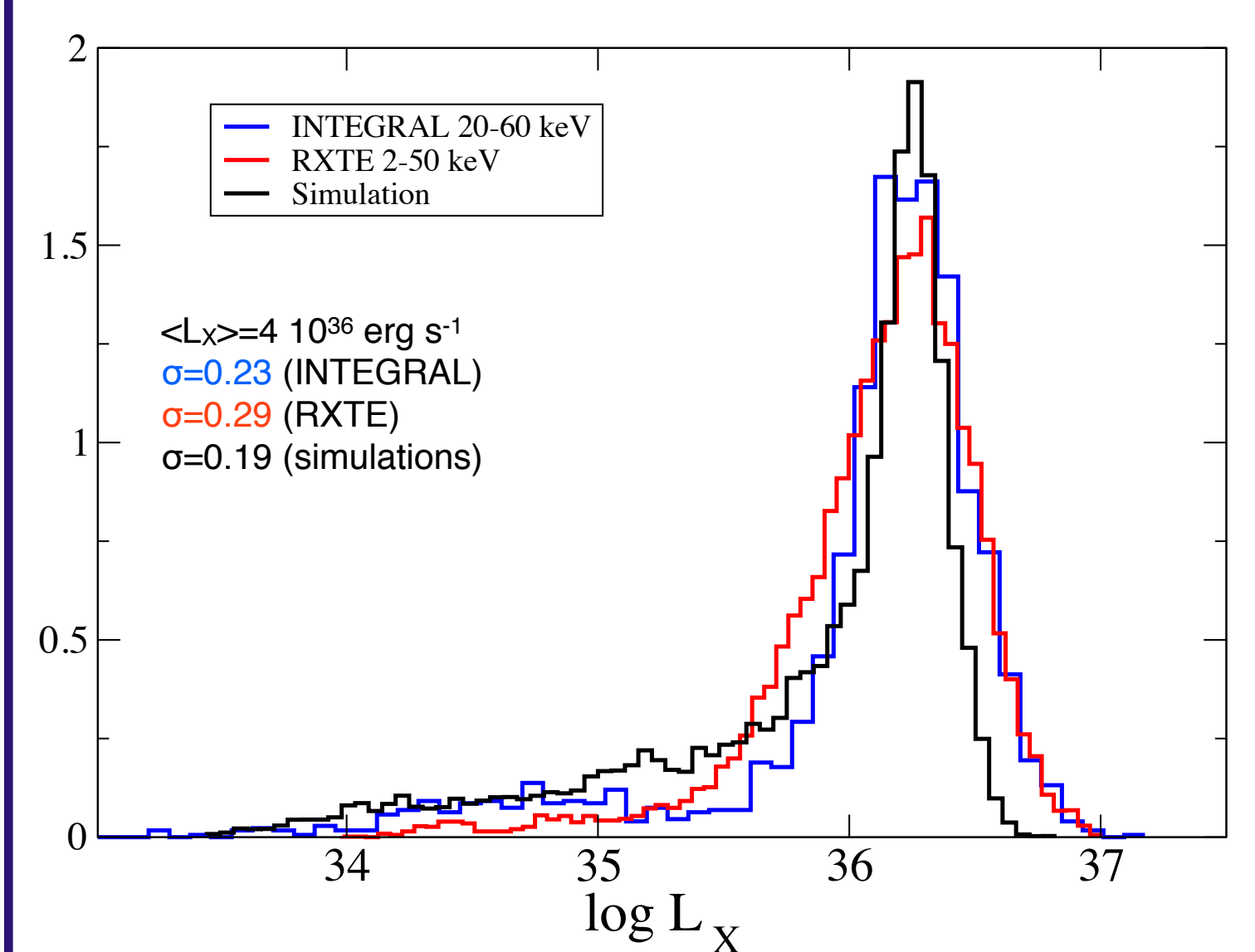
Off-state:



Flare



Log-Normal Distribution



- Off-states and flares reproduced in simulations
- Log-normal flux distribution of luminosity
- Durations of off-states from 5 mins to 2 hours
- Self-organized criticality of the accretion stream is the main reason for the observed variability

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