Episodic accretion during binary star formation

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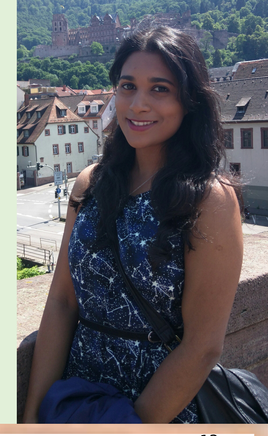

Results: We show a dependence of eccentricity on episodic accretion during binary star formation. We find accretion events are triggered by momentum transfer from circumstellar material to the stars, which excite spiral density waves.

Background: Observations of eccentric short period binaries find that accretion is enhanced at periastron[1,2]. Simulations also show that episodic accretion may be present in longer period binaries[3]. We look at what triggers accretion events and compare with observations to determine whether the behaviour is independent of separation.

Method: We simulate the formation of binaries from turbulent molecular cores using the MHD AMR code FLASH4[4]. We simulate 2 cases with initial turbulence of $M = \sigma_v/c_s = 0.1$ (**T1**) and 0.2 (**T2**).

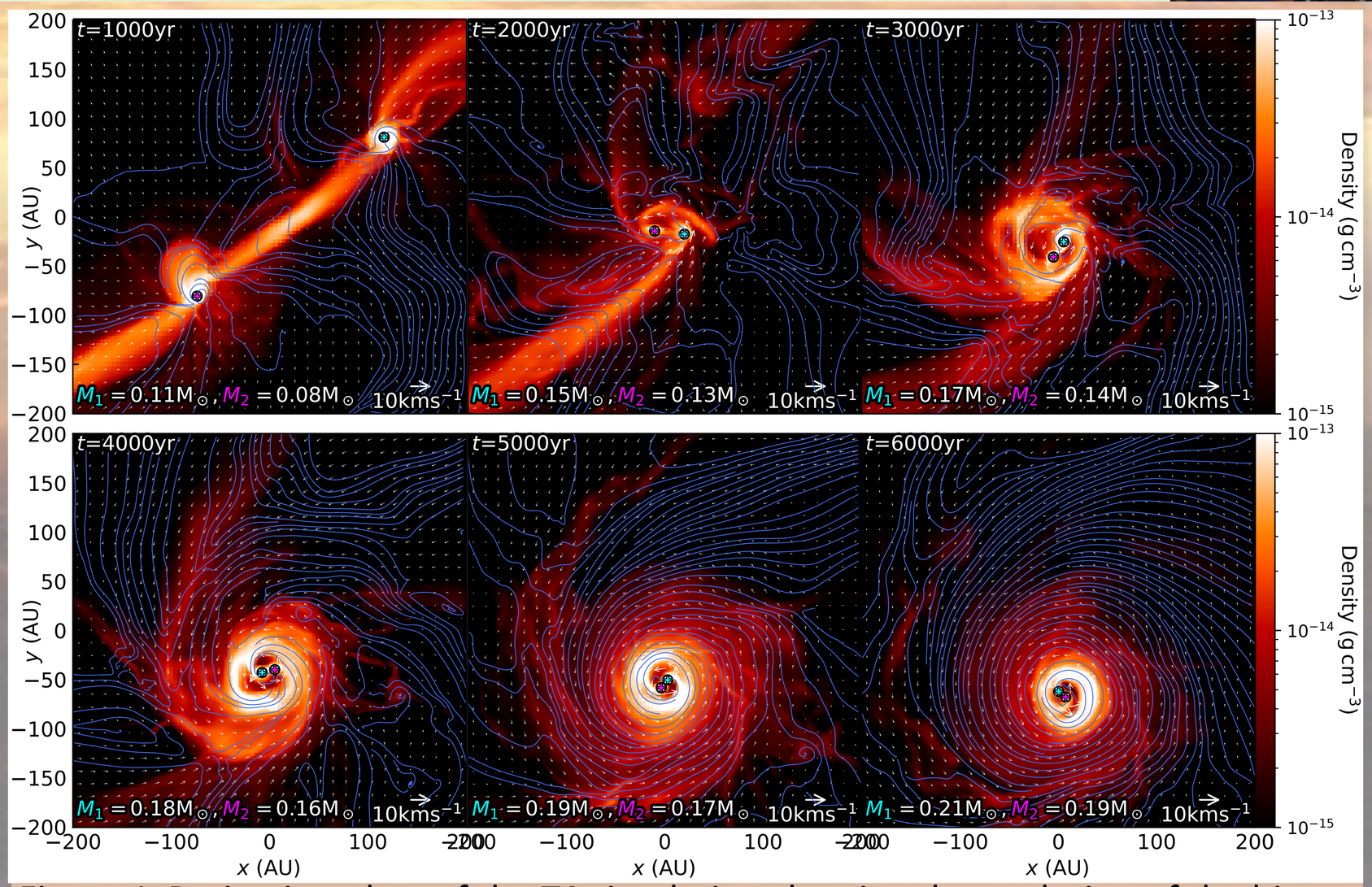

Figure 1: Projection plots of the **T1** simulation showing the evolution of the binary star system. The crosses indicate the position of the sink particles and the black circles show their accretion radius. The blue streamlines annotate the magnetic field. The vectors show the velocity field. We see that as the binary stars interact, mass is ejected outwards building a large circumbinary disc.

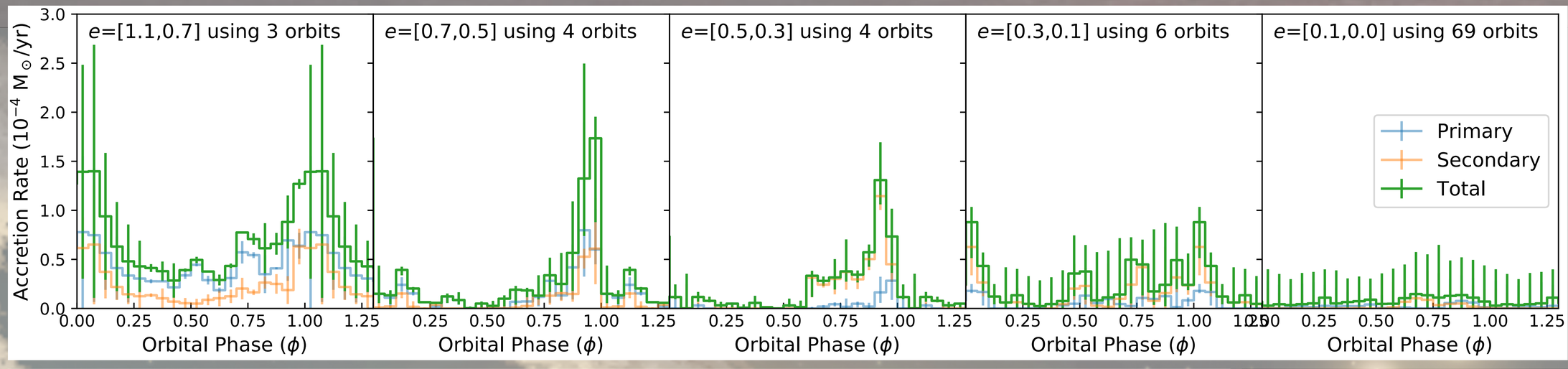

Figure 2: phase-folded accretion for the **T2** simulation for different eccentricity bins. Periastron is at $\phi = 0, 1$.

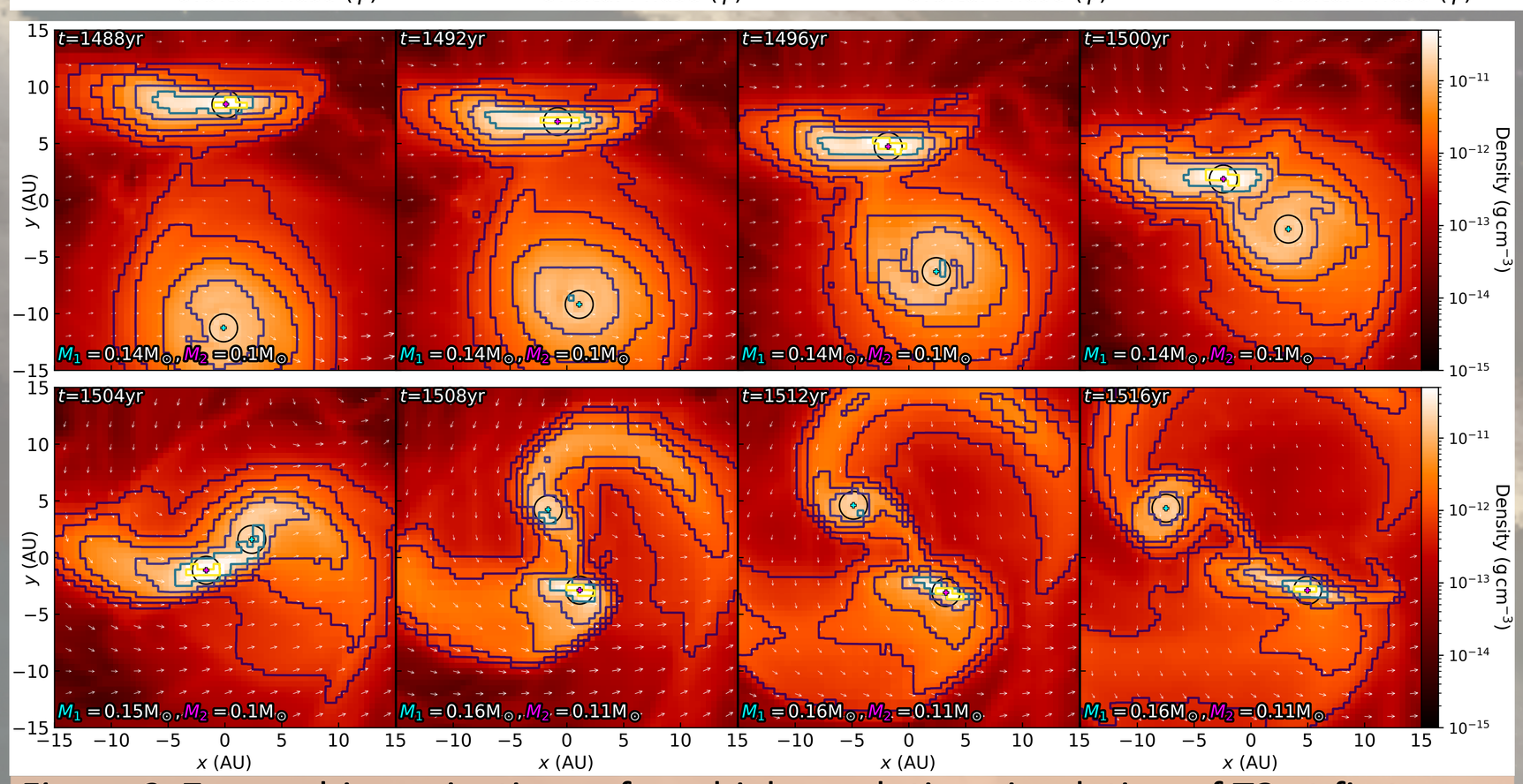

Figure 3: Zoomed-in projections of our high resolution simulation of **T2** at first periastron. Solid lines are density contours. A spiral density wave is excited in the (face on) disc of the primary star. It is triggered by the tidal field of the companion. This is the start of an accretion event that peaks near periastron at t=1504yr, with a corresponding expulsion of material with the excess momentum leading to orbital circularisation, smaller discs, and suppression of accretion after periastron.

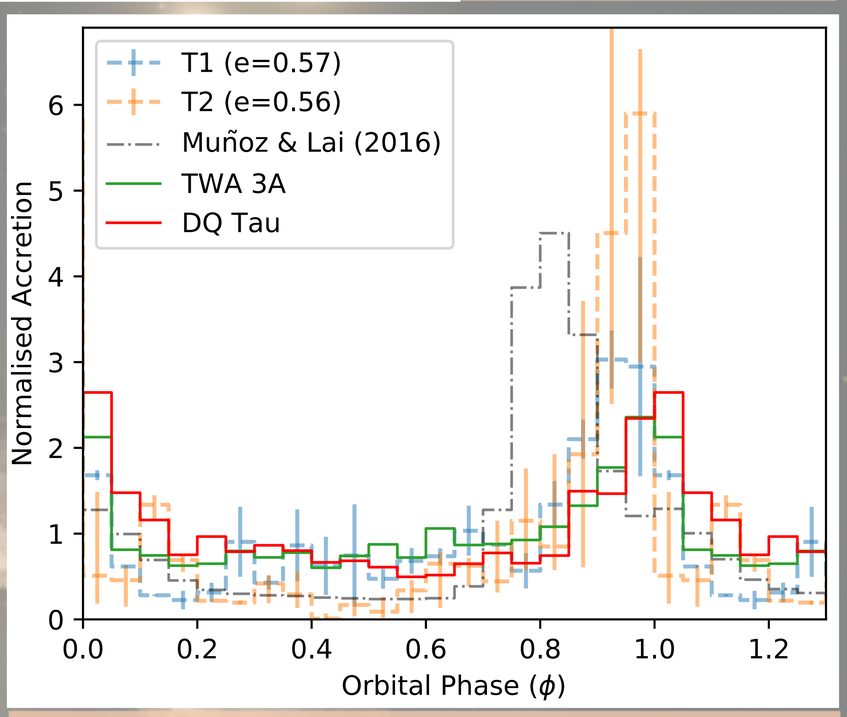

Figure 4: Comparison of our simulations with observations of short period binaries[1,2], and the simulations of Muñoz & Lai (2016)[5]. **T1** has good agreement with observations, however, **T2** produces stronger accretion. Despite this, it seems that the episodic accretion behaviour may be independent of period.

[1]Tofflemire et al (2017) ApJ, 835, 8; [2]Tofflemire et al (2017) ApJ, 842 [3]Kuruwita & Federrath (2019) MNRAS, 486, 3647; [4]Fryxell et al (2000) ApJSS, 131, 273; [5]Muñoz & Lai (2016) ApJ, 827, 43