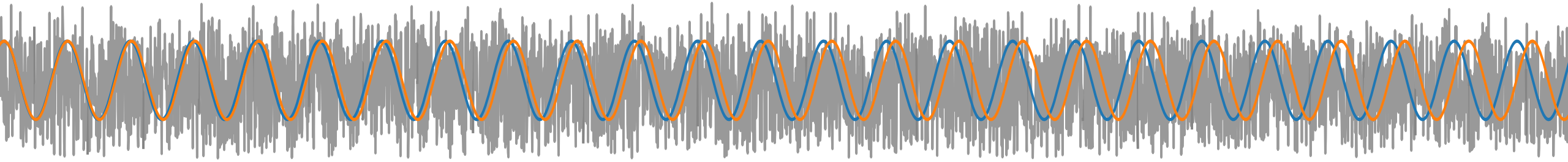
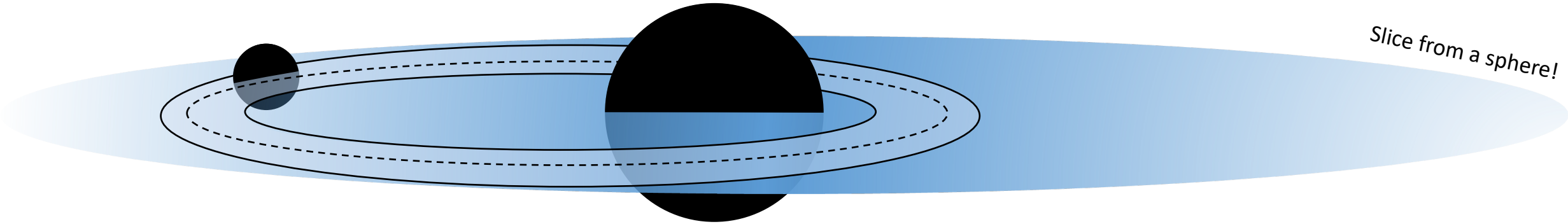


IMRIs in presence of dark matter spikes: The role of eccentricity and accretion

Karydas Theophanes, MSc Student at GRAPPA, UvA

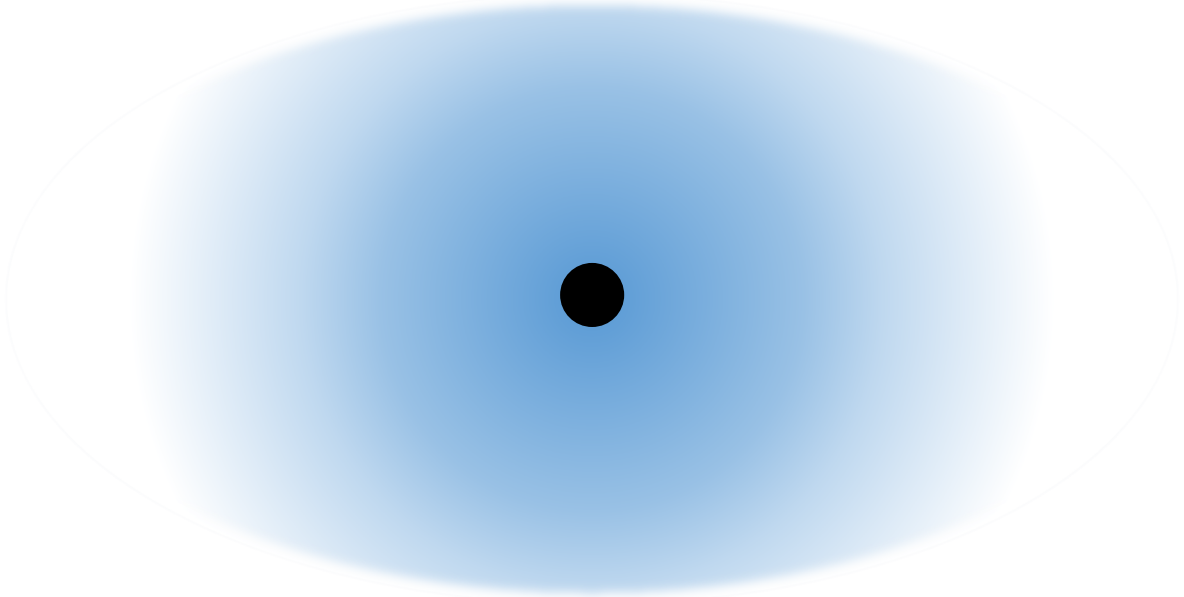
EuCAPT Workshop: Gravitational wave probes of black hole environments

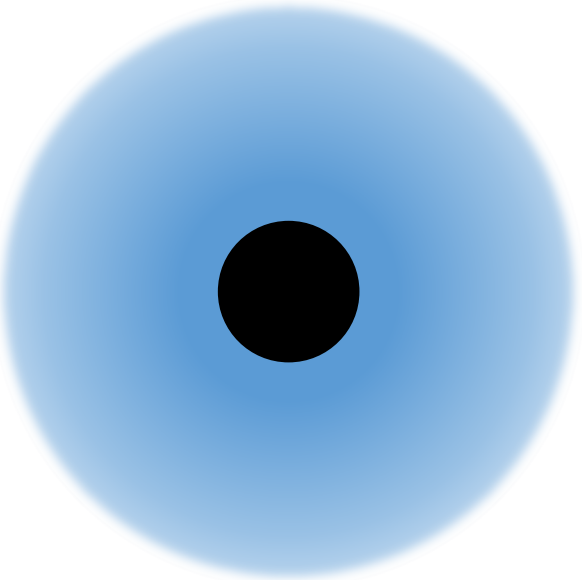


GRAPPA
GRavitation AstroParticle Physics Amsterdam

University of Amsterdam

Motivation for dark matter spikes





Initial density profile

Particles will
(mostly) self-gravitate

Adiabatic growth of central black hole*

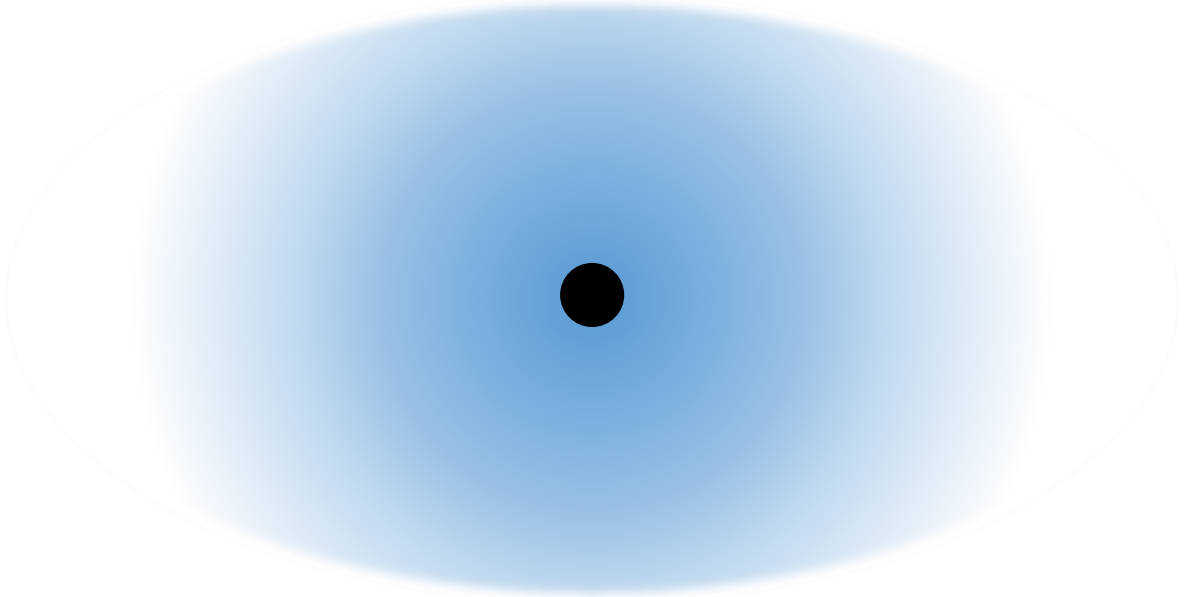
*Final profile sensitive to exact formation

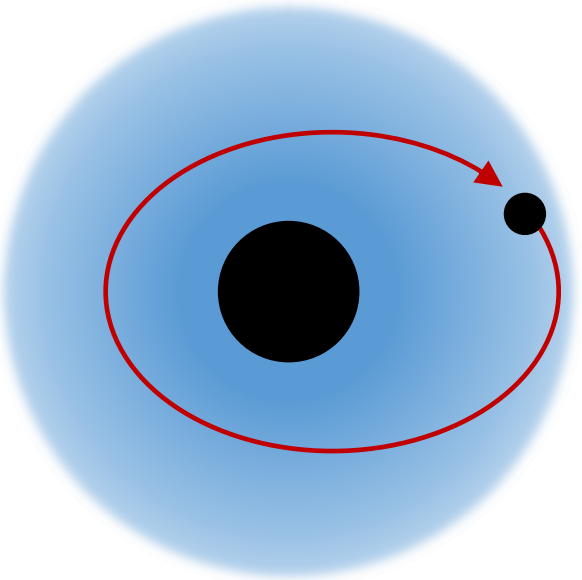
Isotropic power-law 'spike'

Particles are bound
by the central black hole

$$\rho(r) = \rho_{sp}\left(\frac{r}{r_{sp}}\right)^{-\gamma}$$

Motivation for dark matter spikes





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BH companion interactions with dark matter

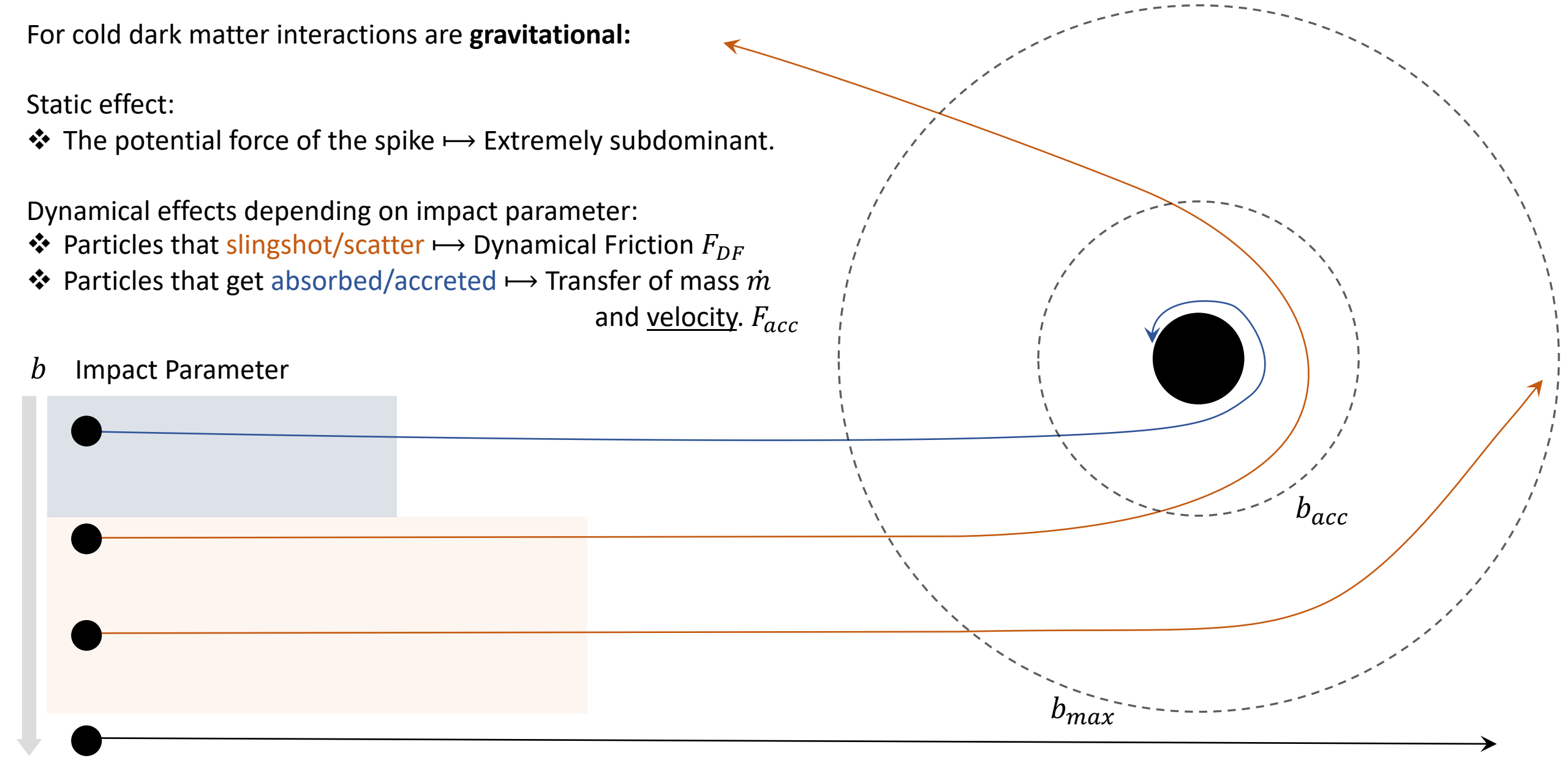
For cold dark matter interactions are **gravitational:**

Static effect:

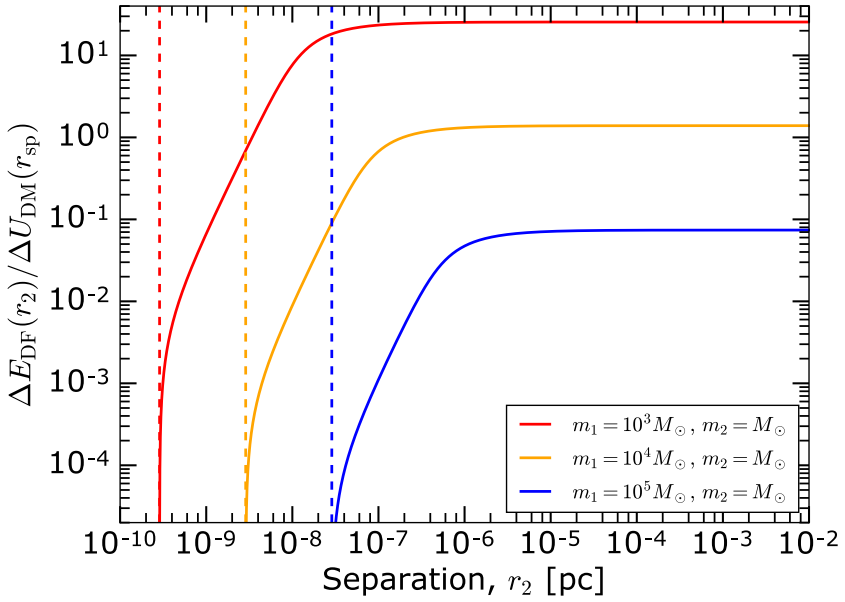
- The potential force of the spike ⟼ Extremely subdominant.

Dynamical effects depending on impact parameter:

- Particles that slingshot/scatter ⟼ Dynamical Friction F_{DF}
- Particles that get absorbed/accreted ⟼ Transfer of mass $\dot{m}$ and velocity. F_{acc}



Energy transfer and mass conservation for IMRIs

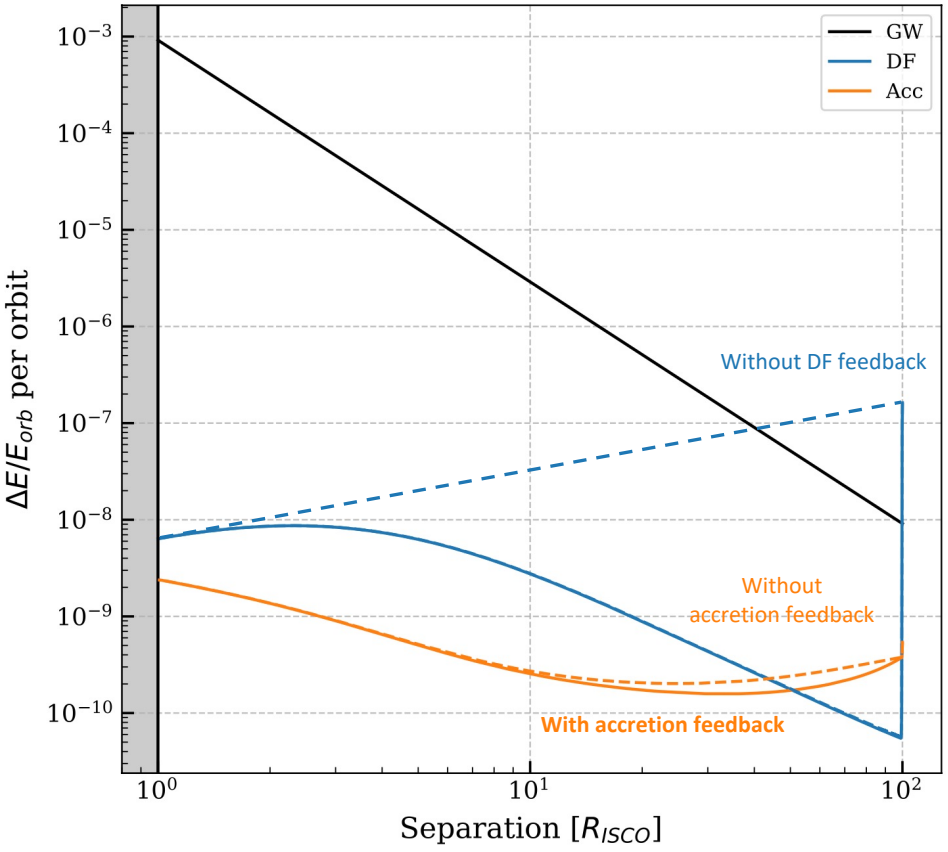


Then

Dynamical friction funnels more energy than what binds the spike*

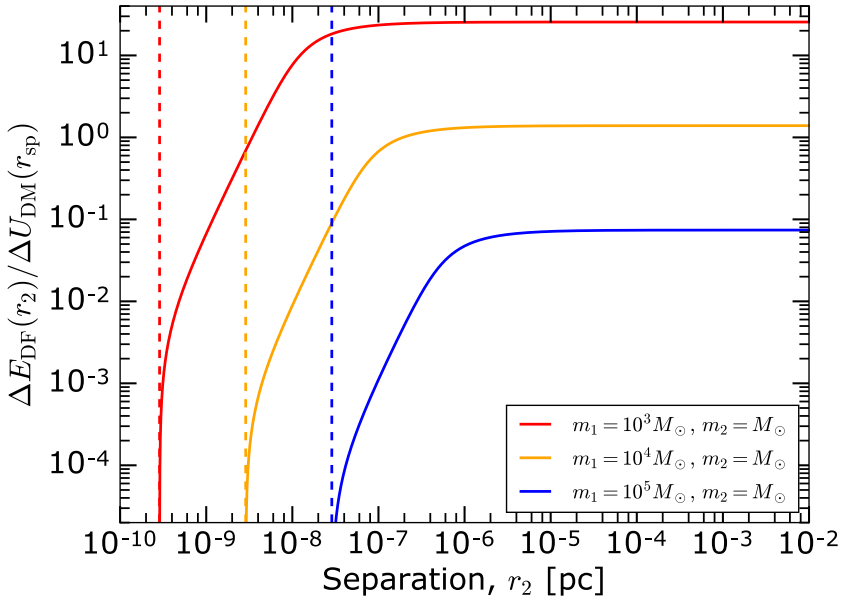
*Kavanagh et al. Phys. Rev. D 102, 083006 (2020)

Circular DF Feedback: Dynamical friction weakens by many orders



Karydas Theophanes

Energy transfer and mass conservation for IMRIs



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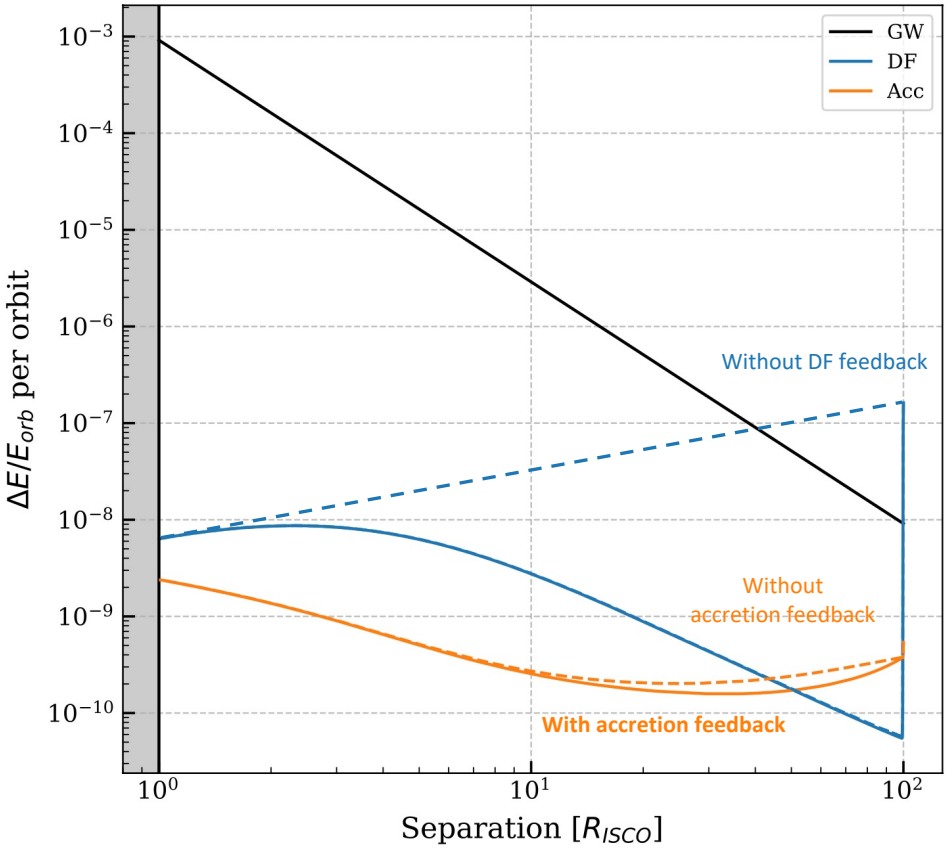
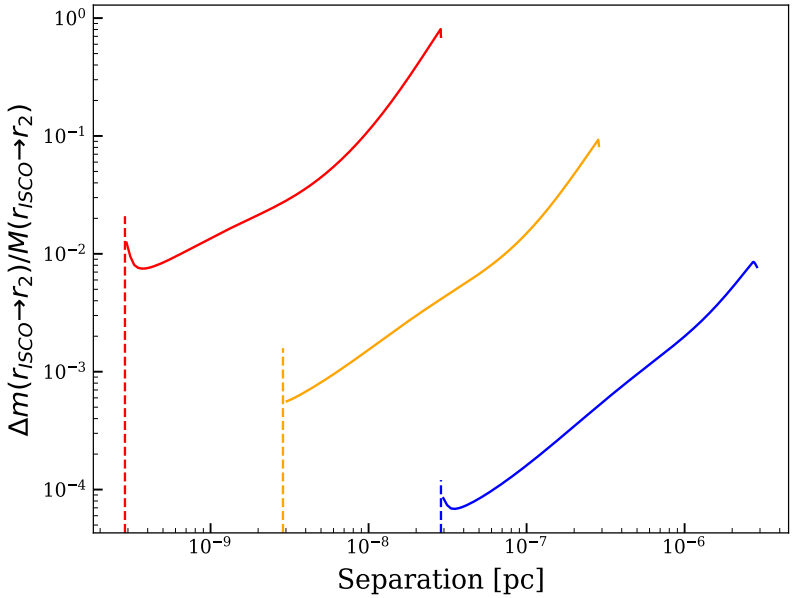


Also now

Accretion can ‘eat’ a good portion of particles in a region.



Developed Accretion Feedback that ‘removes’ orbits

Eccentric inspirals

The punchline:

- ❖ The spike is strongly depleted ⟼ Environmental effects are subdominant to GWs emission.
- ❖ The spike leads to <u>circularization</u>.