# Disc Formation from Tidal Disruption Events

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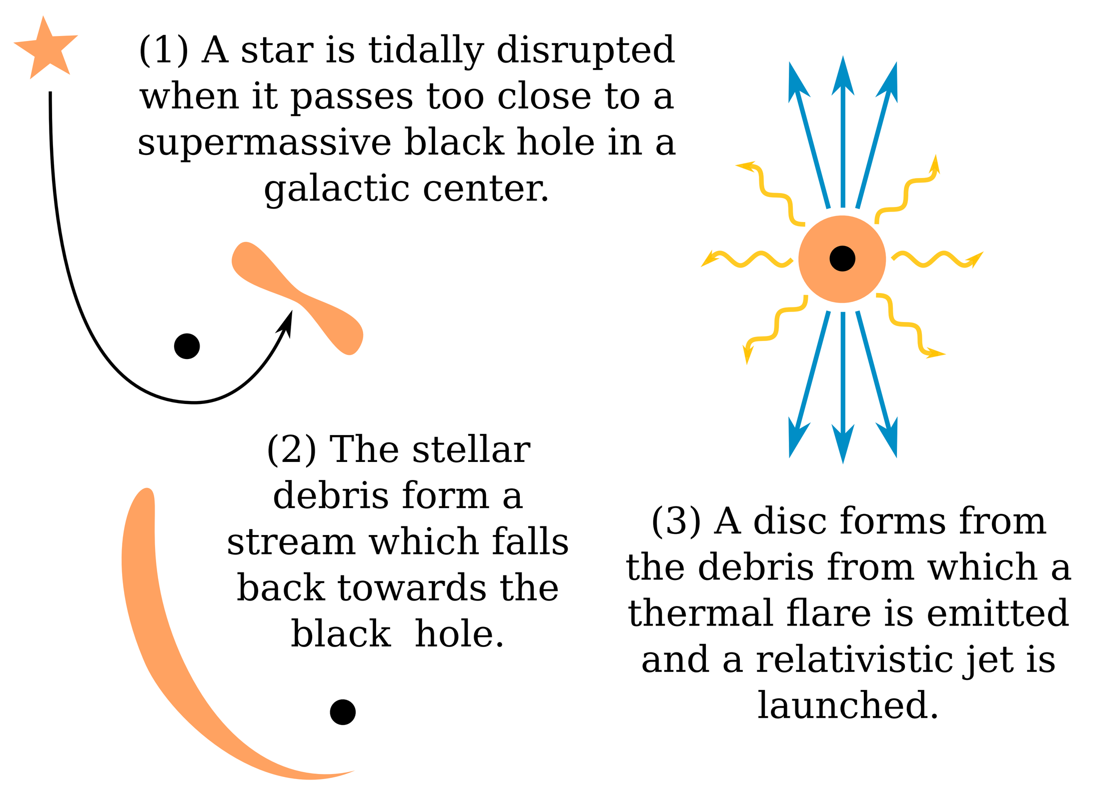
## Overview




## SPH simulations

We investigated the disc formation process from the debris produced by the tidal disruption of stars on eccentric orbits [1]. This study has been carried out by means of smoothed-particle-hydrodynamics (SPH) simulations using the code PHANTOM [2, 3]. Three parameters anticipated as important have been varied:

(1) the gravitational potential, relativistic [4] or Keplerian,
(2) the gas cooling, efficient or inefficient,
(3) the orbit of the star, varying both the depth and the eccentricity of the disruption.

Movies of the simulations presented in this poster are available at `http://home.strw.leidenuniv.nl/~bonnerot/research.html`. They can be accessed by scanning the opposite QR code with a smartphone. It requires a QR code scanner which can be downloaded freely as an application.

## Impact of relativistic precession

For a **relativistic potential**, the stream of debris self-crosses due to relativistic precession which generates shocks. Assuming an efficient cooling, it causes the debris to **form** a thin and narrow ring located at the circularization radius. For a Keplerian potential, there is no self-crossing as the stream follows a closed orbit. Consequently, the debris do not form a disc.

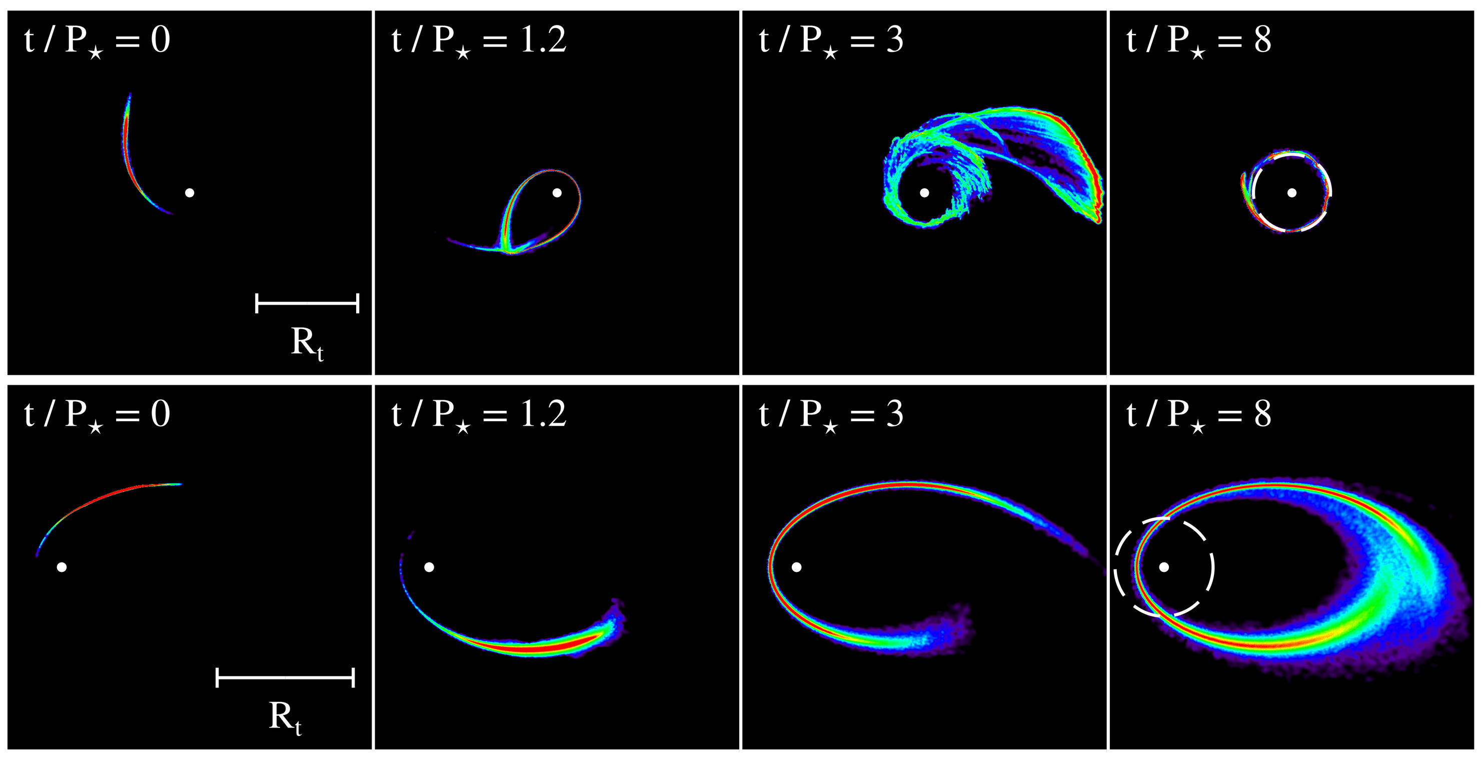



**Figure 1:** Snapshots of the fallback of the debris for a relativistic (upper panel) and a Keplerian (lower panel) potential assuming an efficient cooling.

## Influence of the cooling efficiency

The self-crossing of the stream leads to the formation of shocks which inject thermal energy into the debris. Assuming an **inefficient cooling**, it induces the formation of a **thick** and extended torus located between the circularization radius and the semi-major of the star.

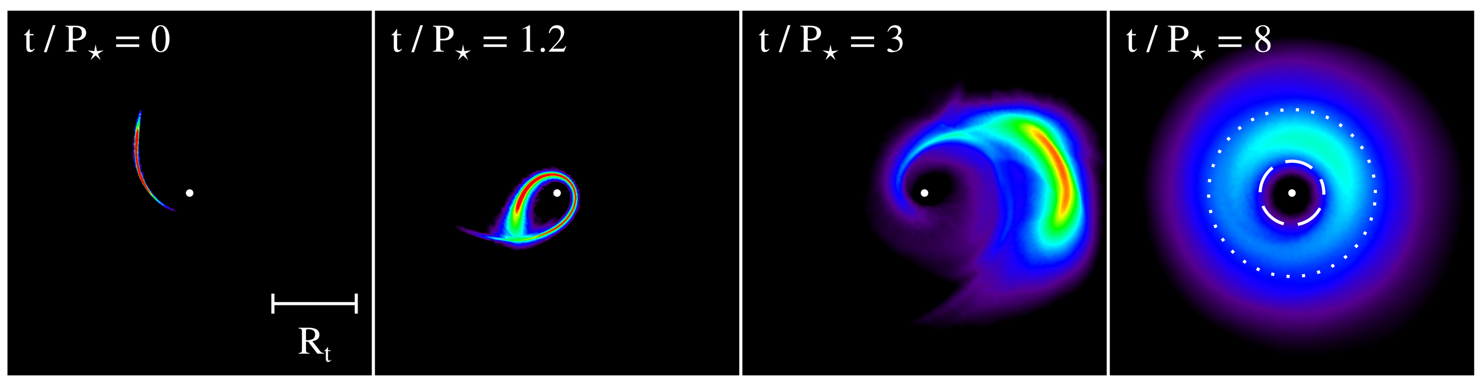



**Figure 2:** Snapshots of the fallback of the debris for a relativistic potential assuming an inefficient cooling.

## More shallow disruption

For a **more shallow** disruption, the stream passes further from the black hole which reduces relativistic precession and leads to weaker shocks. The formation of the ring is therefore **slower**.

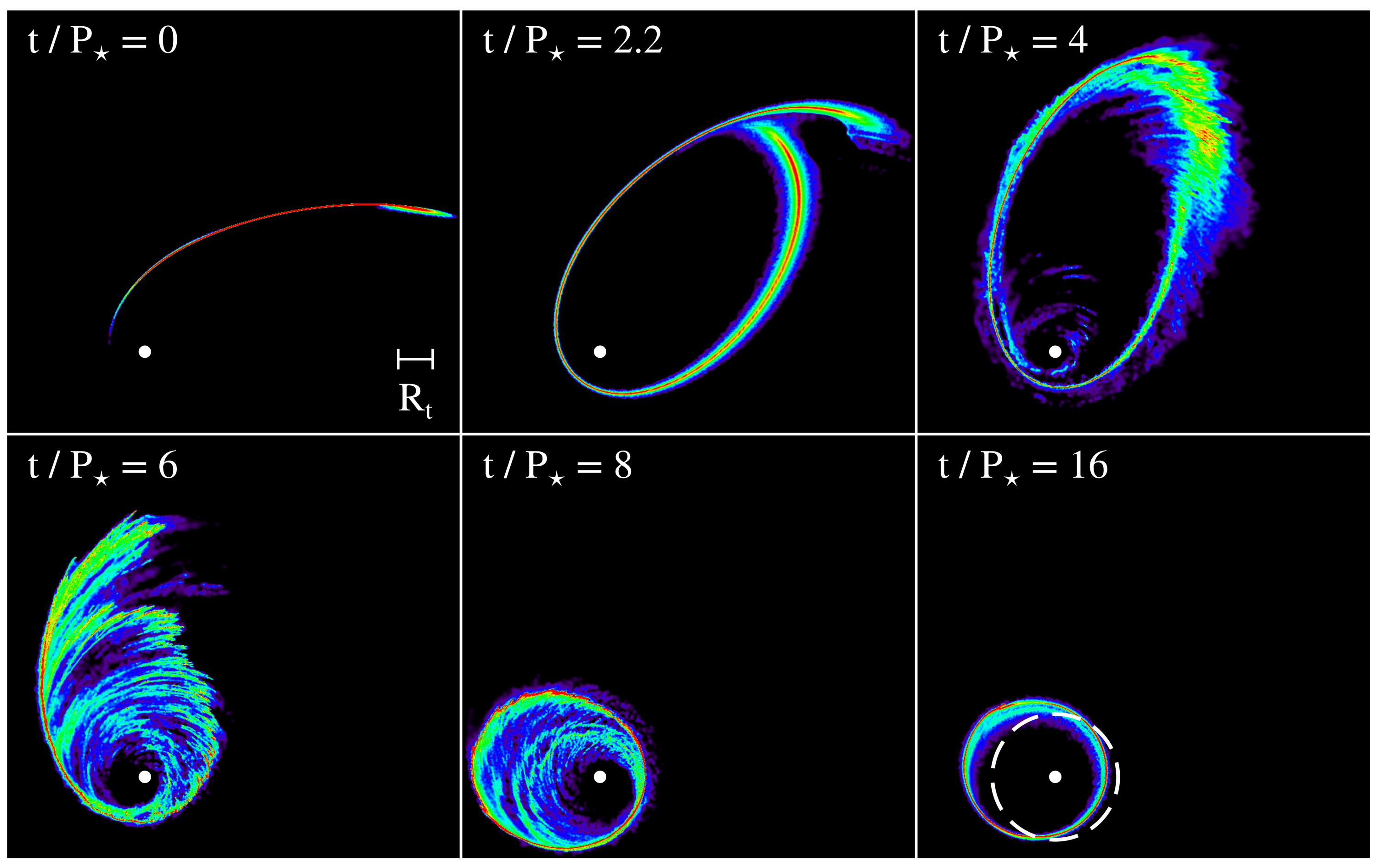



**Figure 3:** Snapshots of the fallback of the debris after a more shallow disruption for a relativistic potential assuming an efficient cooling.

## More eccentric disruption

For a **more eccentric** disruption, the stream of debris is longer. As a result, the self-crossing involves a larger fraction of the debris which causes the ring to form **faster**.

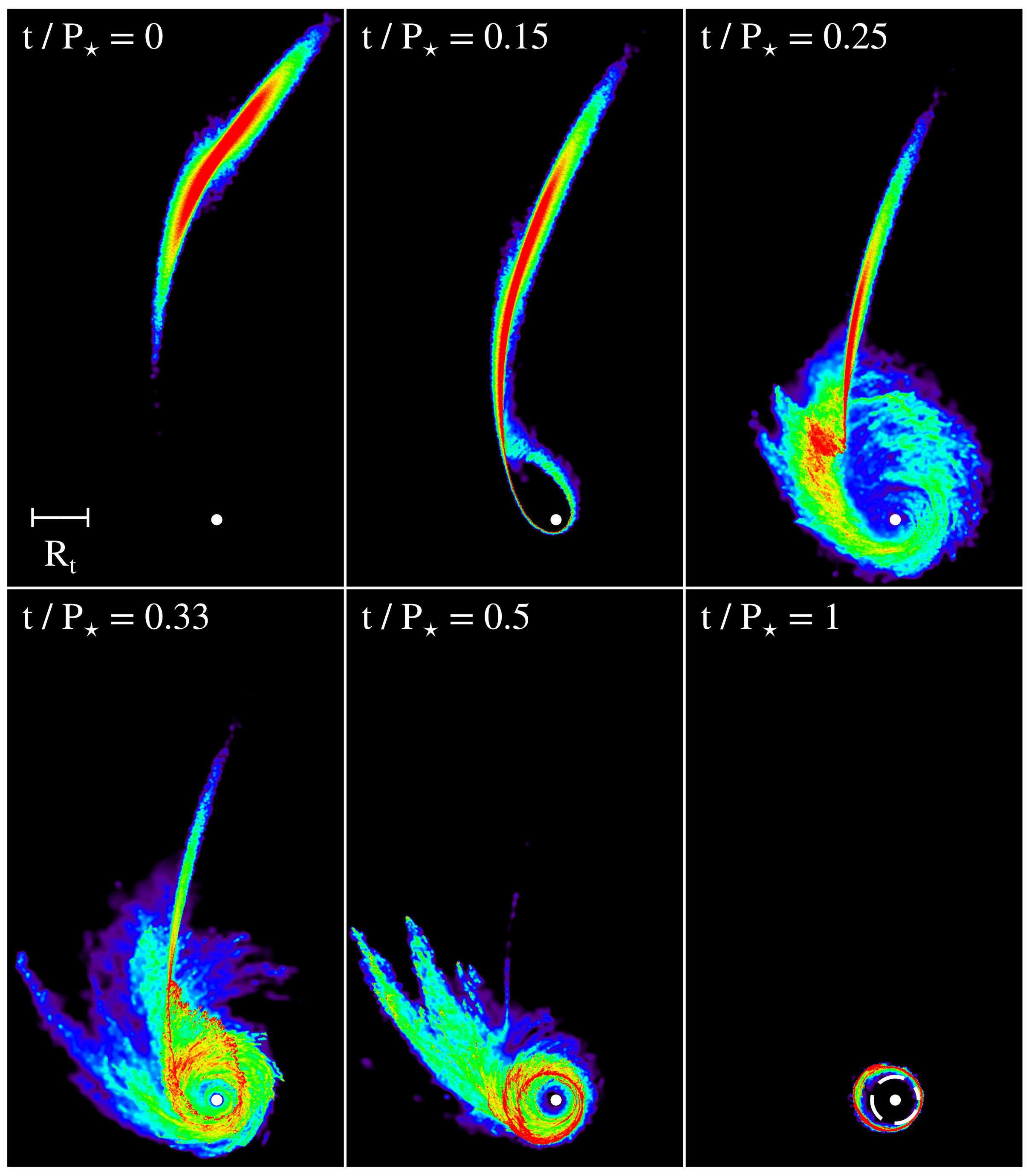



**Figure 4:** Snapshots of the fallback of the debris after a more eccentric disruption for a relativistic potential assuming an efficient cooling.

## References

[1] Bonnerot C., Rossi E. M., Lodato G., Price D. J., 2015, ArXiv e-prints
[2] Price D. J., Federrath C., 2010, MNRAS, 406, 1659
[3] Lodato G., Price D. J., 2010, MNRAS, 405, 1212
[4] Tejeda E., Rosswog S., 2013, MNRAS, 433, 1930

## Summary

(1) Disc formation is driven by relativistic precession which causes the stream of debris to self-cross.
(2) The debris form a thin ring if cooling is efficient and a thick torus if it is inefficient.
(3) Disc formation occurs faster if the disruption is more eccentric and slower if it is more shallow.