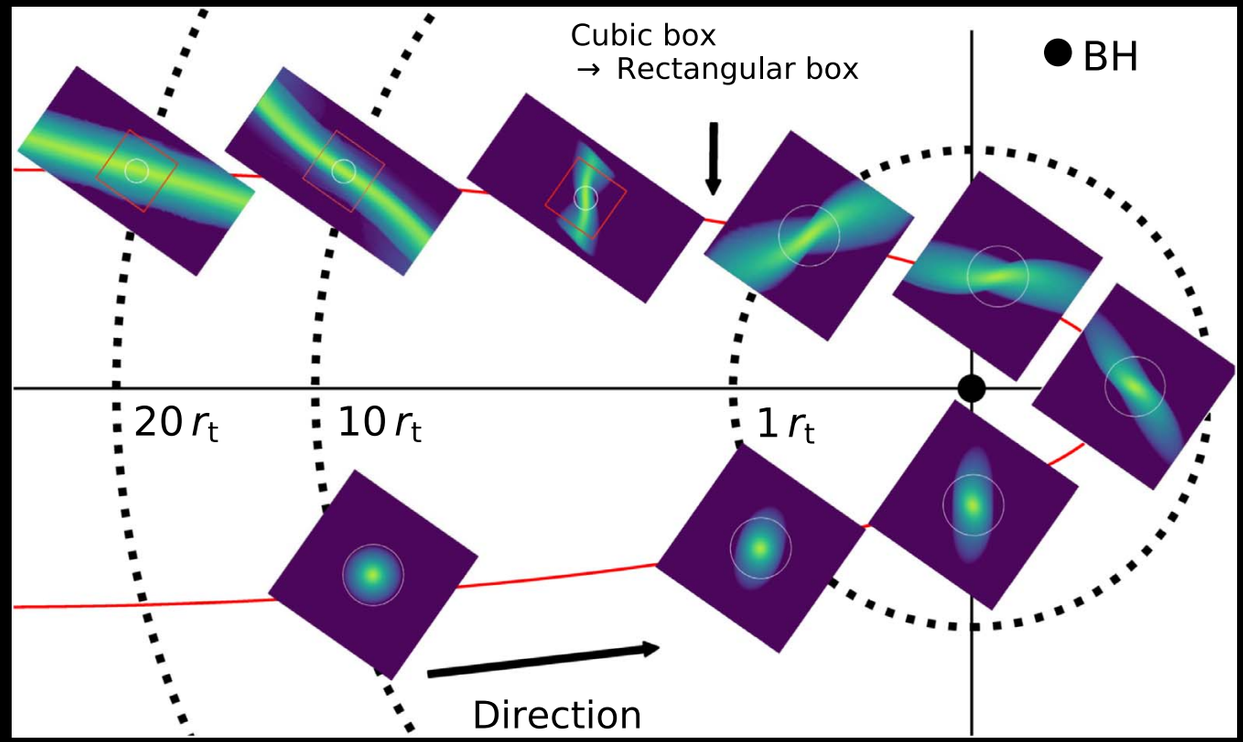
Tidal Disruption of Stars by Supermassive Black Holes

Several NASA missions have seen evidence of a black hole disrupting a star, usually as a burst of high-energy radiation. If we want to understand our observations, as well as gain insight into how stars behave as they are torn apart and how black holes feed and grow, we need underlying theory and simulations about how this dramatic process works.

We used Einstein's general theory of relativity and realistic models to learn about the possible scenarios and conditions leading up to a star's disruption. Including relativity gives us more accurate values for gravity in the model and makes black holes more able to disrupt stars than previously thought. We also looked at how stars orbiting a black hole that are partially disrupted may return to the black hole later and be finished off.

Our work improves scientists' ability to know what conditions lead to an observed stellar disruption event. Our results help us better understand how they start feeding on stars and what kind of light those events produce, which may ultimately let us learn more about the variety of black holes out there.



A star is "squeezed" by the ***tidal*** gravity of the black hole, which in particularly strong cases can lead to the star stretching and tearing apart.

T. Ryu, J. Krolik, T. Piran, S. Noble (663), "Tidal Disruptions of Main-sequence Stars. I-IV", *Astrophysical Journal*, **904**, 2 (2020);