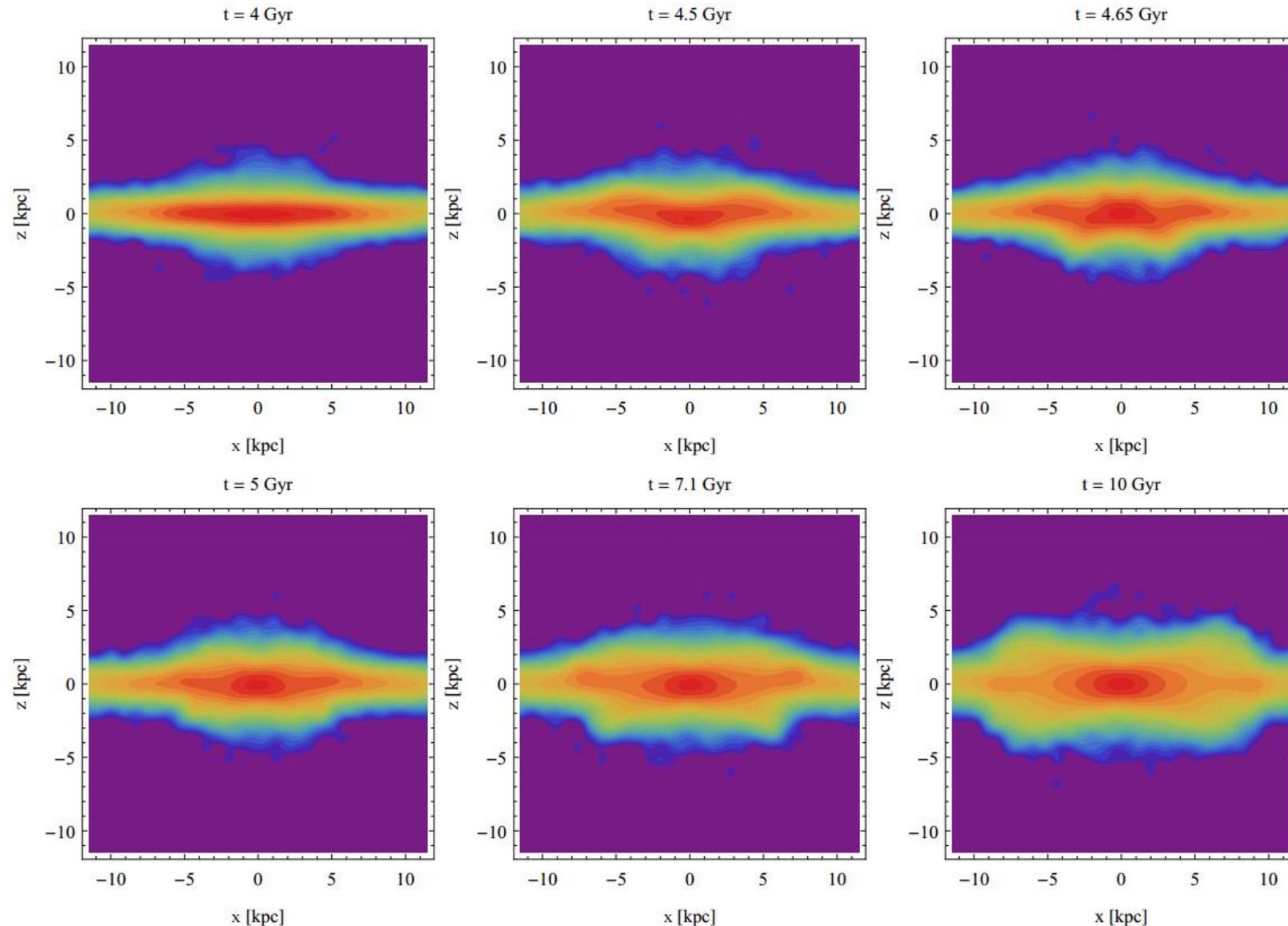


Annual report 2025: Ewa L. Łokas

Published papers:

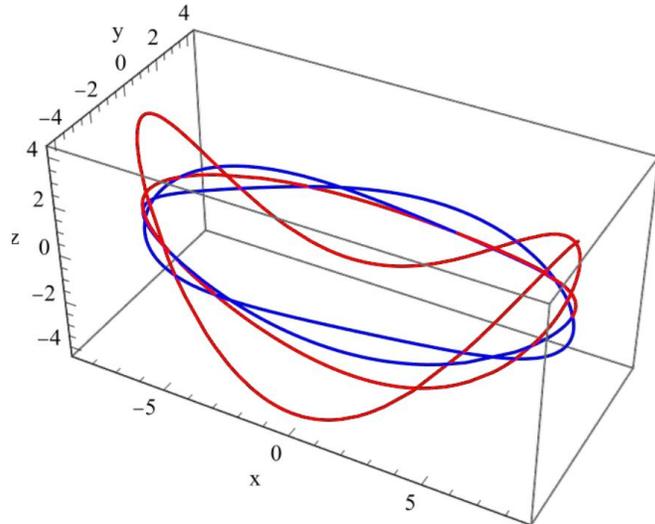
- Łokas, E. L. "On the nature of buckling instability in galactic bars" 2025, A&A, 699, A234
- Łokas, E. L. "The oldest tidally induced bar-like galaxy in the IllustrisTNG cluster" 2025, A&A, 700, A258
- Łokas, E. L. "Tidally induced bar-like galaxies in simulated clusters" 2025, A&A, 702, A7
- Łokas, E. L. "High-redshift Merger-induced Bar-like Galaxies in IllustrisTNG" 2025, ApJ Letters, 991, L52

Buckling instability in galactic bars



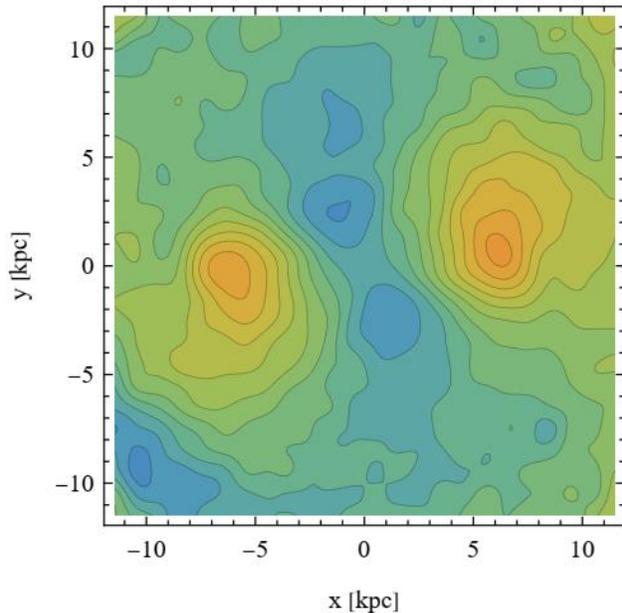
- Strong bars undergo buckling instability which distorts the bar out of the disk plane
- The origin of the instability is still controversial
- I studied the phenomenon in a simulation of a Milky Way-like galaxy evolving in isolation
- I showed the phenomenon can be divided into two distinct phases

First phase: transformation into banana-like orbits

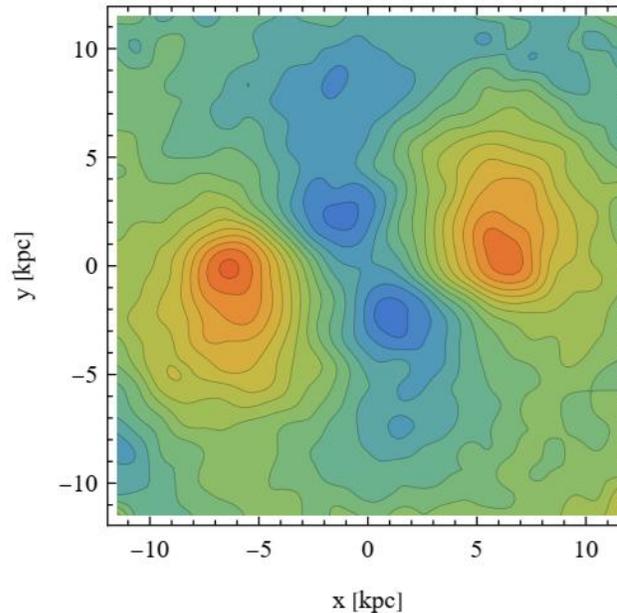


t = 4.4 Gyr

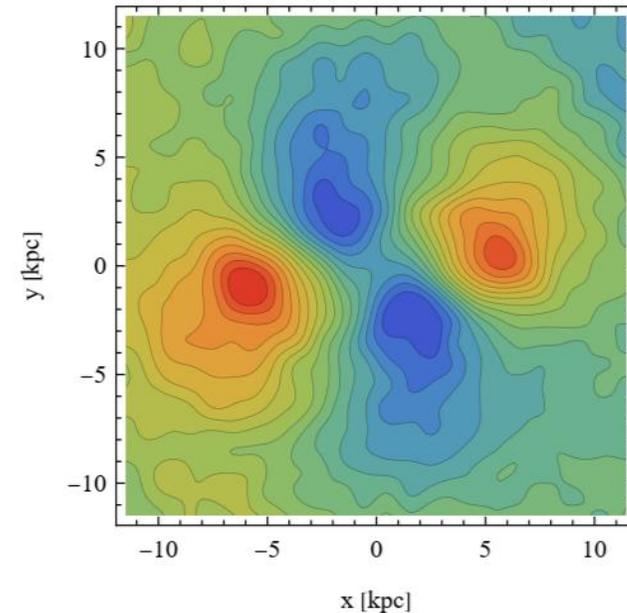
- Initial flat elliptical orbits in the bar transform into banana-like orbits due to vertical resonance
- This explains the growing distortion of the bar in the first phase



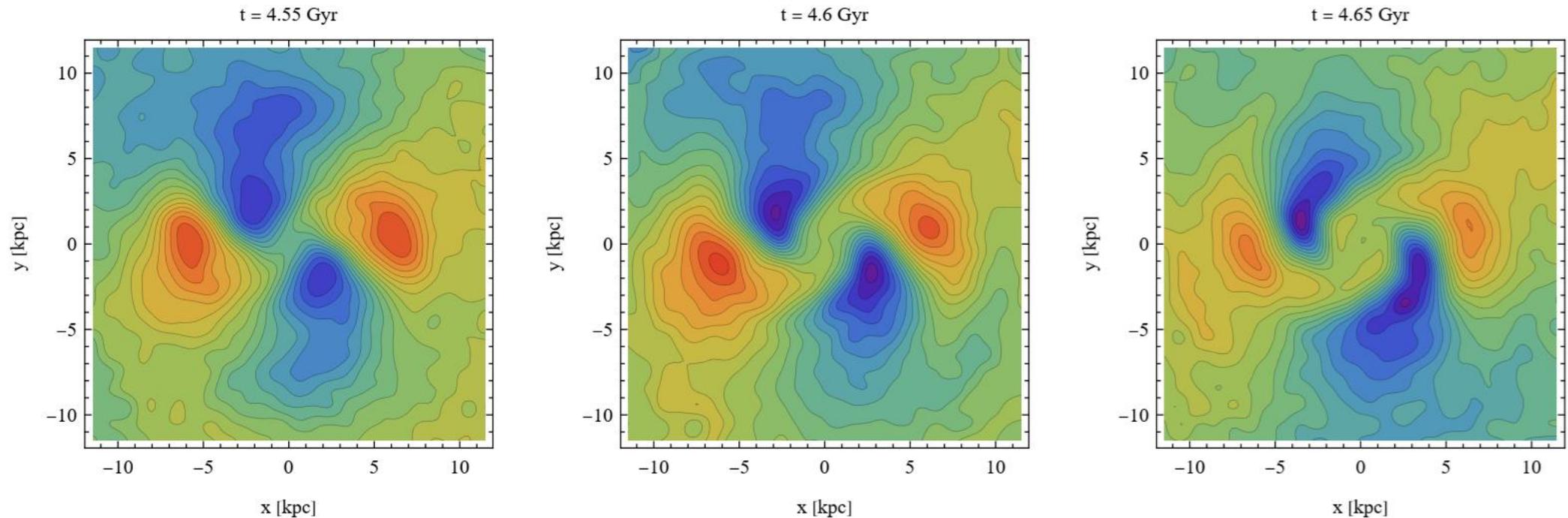
t = 4.45 Gyr



t = 4.5 Gyr

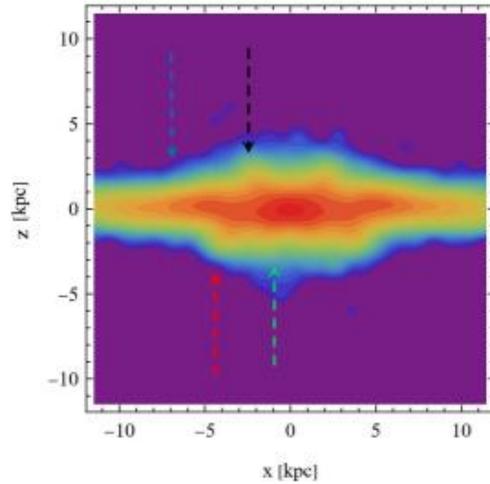
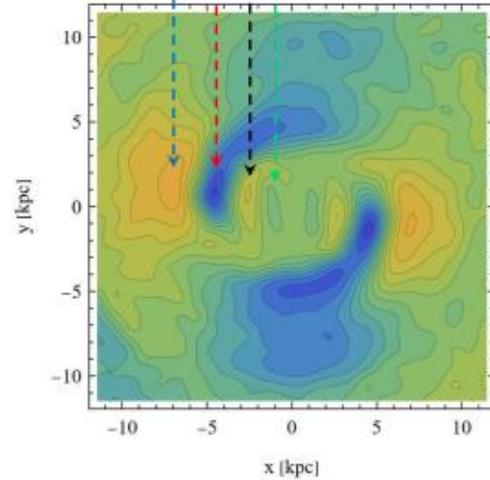
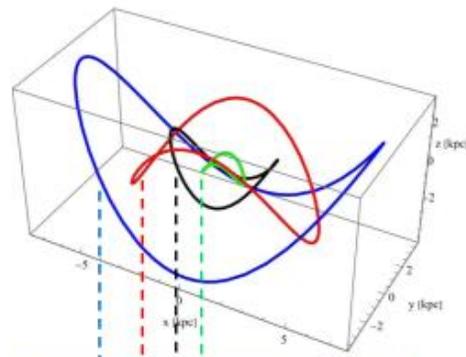
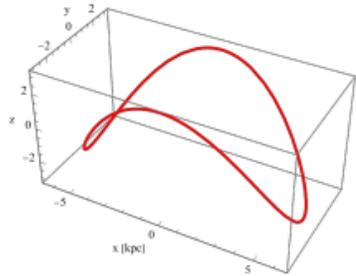
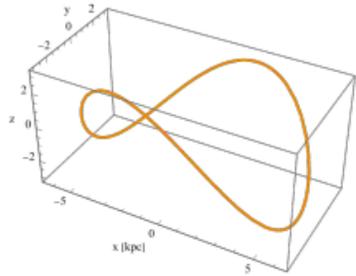
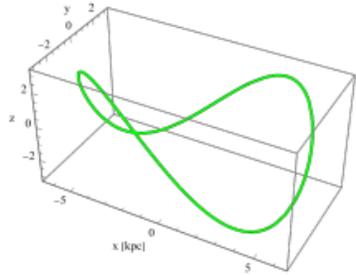
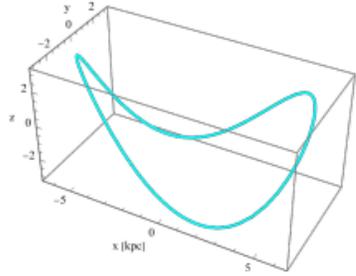
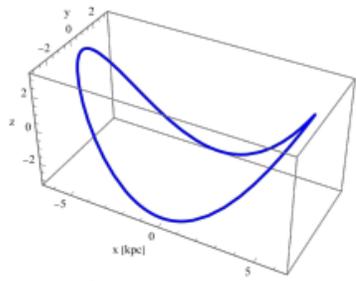


Second phase: winding-up the distortion

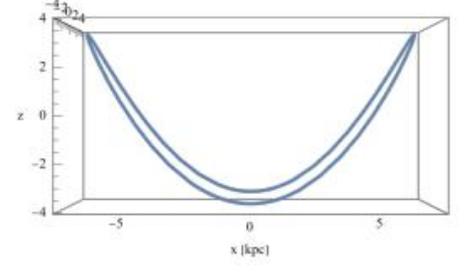
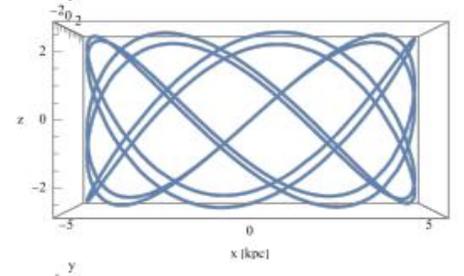
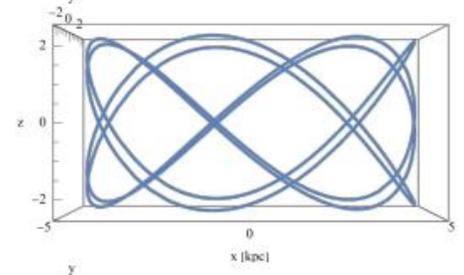
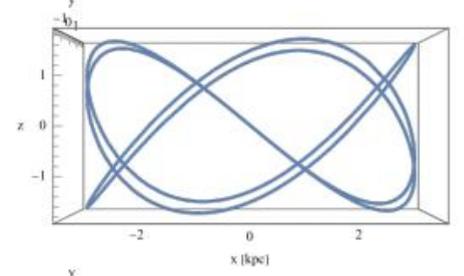
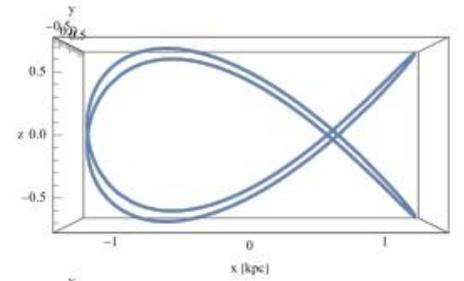


- The pattern later winds up and the distortion disappears
- The bar becomes thicker and gets a boxy-peanut shape

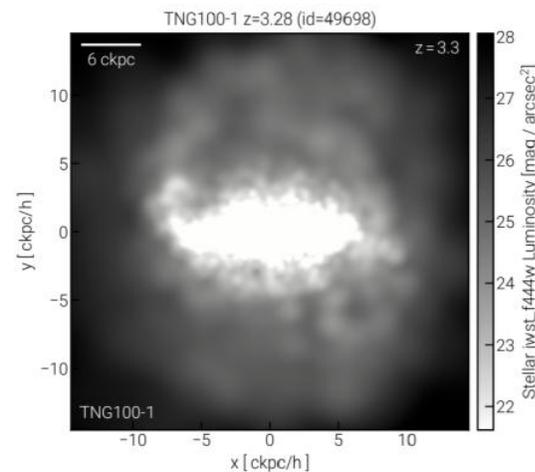
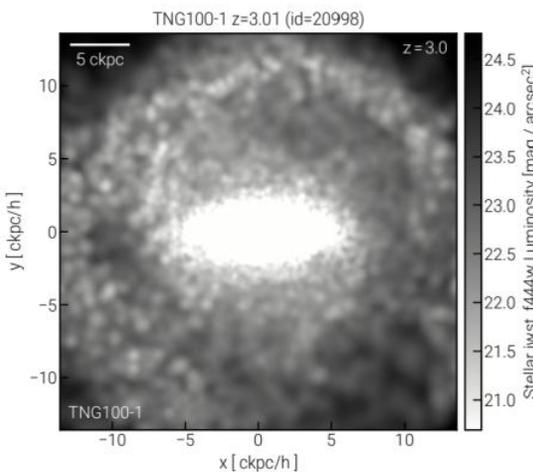
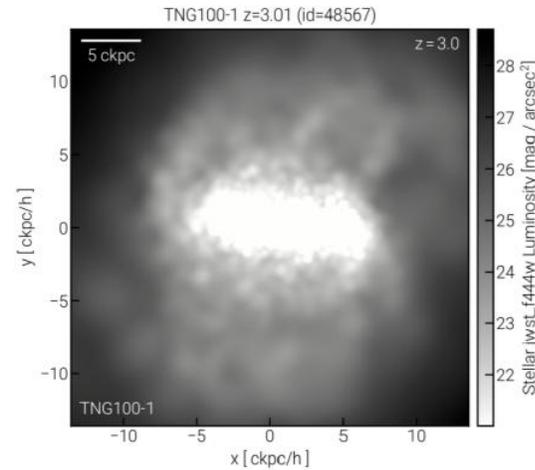
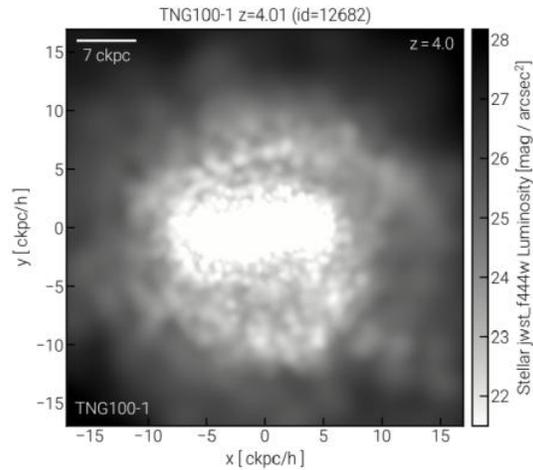
Evolution of the orbits



- Winding-up can be understood as a passage of a bending wave
- Orbits at larger distances are less affected
- Finally the banana orbits are modified into prezel-like orbits



High-redshift merger-induced bar-like galaxies in IllustrisTNG



- Four bar-like galaxies formed by mergers at $z > 3$, including one at $z > 5$, identified in IllustrisTNG-100
- Bars are 3 kpc long, similar to galaxy ceers-2112 discovered by Costantin et al. (2023) with JWST
- Three of them later accreted by galaxy clusters and losing mass
- Survived until the present as quenched, red S0-like objects, not similar to MW

Finally got some funding from NATIONAL SCIENCE CENTRE POLAND

After results of Opus 23, 25, 26, 27, 28



After results of Opus 29

