Stars trapped at bar resonances

Master's Student at Observatory of Paris (PSL)

LIU at GEPI, Observatory of Paris

Adrian Szpilfidel, *supervised by Paola Di Matteo*

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Observatoire de Paris | PSL

Stars trapped at bar resonances, long term evolution

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Stellar bars in disk galaxies

- Barred galaxies : $\sim 70\%$ of disk galaxies
- Mostly made by stars
- Rotates at a certain velocity : the pattern speed Ω_{p}

NGC 1300. Credits : HST

The orbital resonances

Corotation

$$\Omega - \Omega_\mathrm{p} = 0^*$$

The star is rotating at the same speed as the bar.

$^*\Omega$ (azimuthal frequency)

Inner Lindblad

$$\Omega - \Omega_\mathrm{p} = \frac{\kappa}{2}_*$$

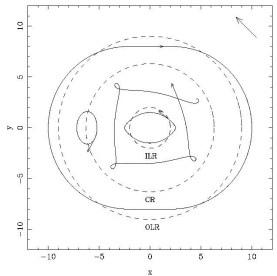
One anticlockwise rotation, two radial oscillations.

$^*\kappa$ (radial frequency)

Outer Lindblad

$$\Omega - \Omega_\mathrm{p} = -\frac{\kappa}{2}$$

One clockwise rotation, two radial oscillations.



Credits : F.Combes, Fueling the AGN, 2000.

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2 Method

How to do it ?

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I. Generate initial conditions using AGAMA (E.Vasiliev, 2018)

1. Define the galactic potential (Thin disk + Thick disk + Dark matter halo)
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- Long-Murali potential (Long & Murali, 1992)
- Corotation radius : 6 kpc
- Pattern speed : $\Omega_{\mathrm{p}} = 31.85$ km/s/kpc

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III. Integration over a large timescale (5 Gyr)

- Tstrippy code (S.Ferrone and al. 2023)

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IV. Calculation of orbital frequencies

- Compute Fast Fourier Transform on all particles

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3 Results

Initial conditions

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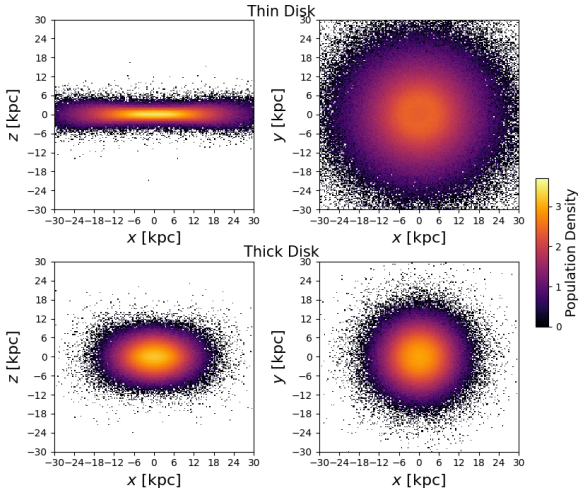
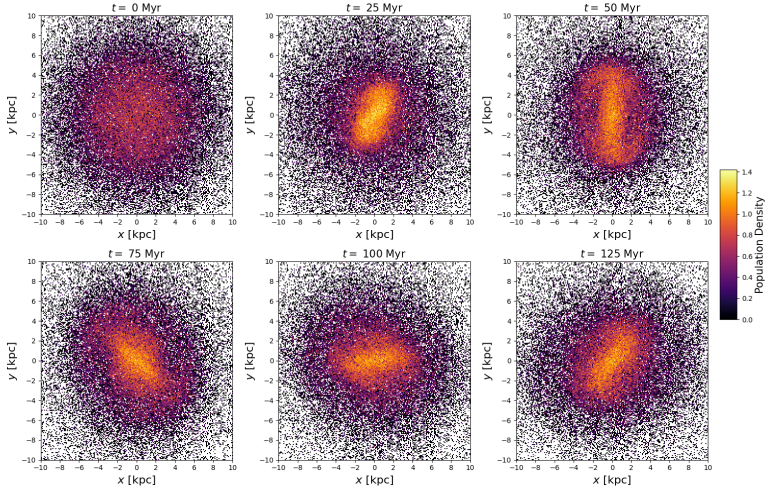


Initial disks with 2×10^6 particles

Bar formation

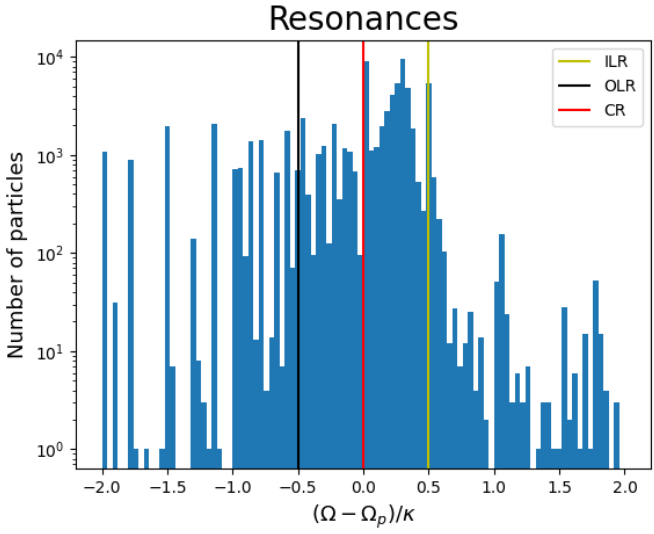
3 Results



Integration of 80×10^3 particles

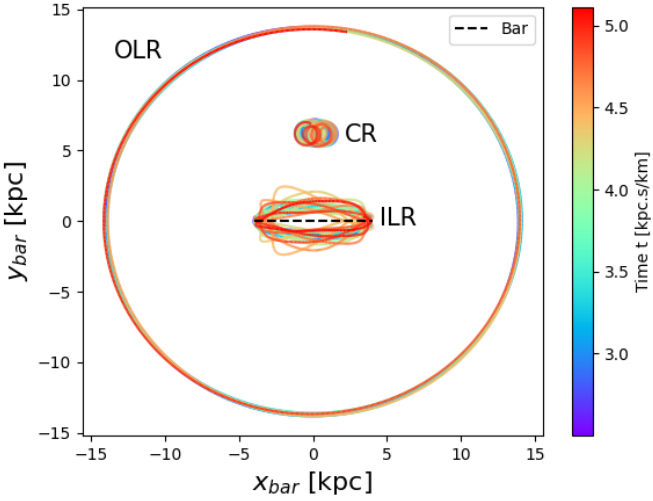
Resonances

3 Results



Resonances

3 Results



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4 Conclusion

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- This numerical simulation has shown presence of orbital resonances due to the bar
- New use of the tstrippy code
- Improvement : Noise in the resonance histogram affects the resonance selection
- Perspectives : make the bar grow progressively, modify the bar features (mass and pattern speed) during the integration

Thank you for listening!
Any questions?