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От Сильченко О.К.

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## The relative efficiencies of bars and clumps in driving disc stars to retrograde motion

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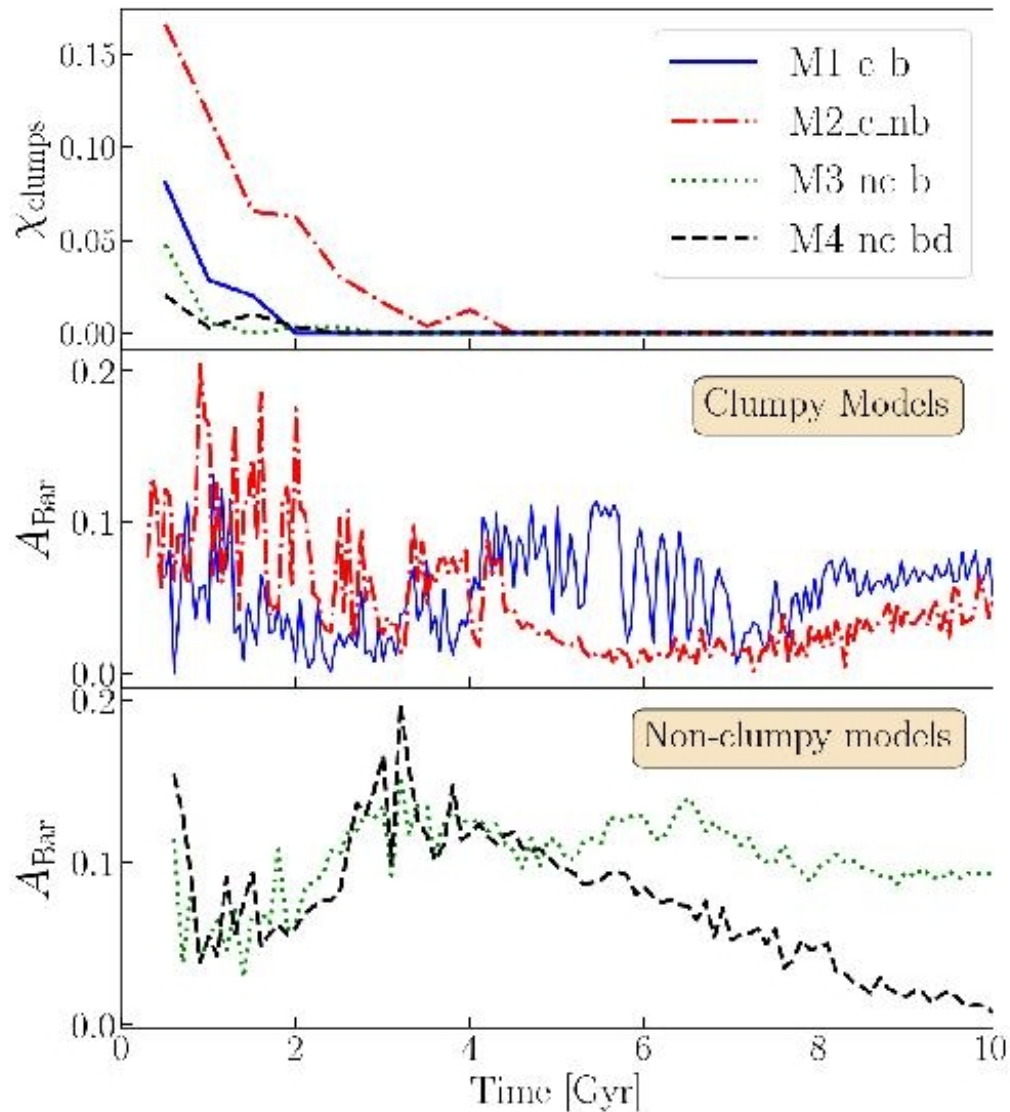
### ABSTRACT

The presence of stars on retrograde orbits in disc galaxies is usually attributed to accretion events, both via direct accretion, as well as through the heating of the disc stars. Recent studies have shown that retrograde orbits can also be produced via scattering by dense clumps, which are often present in the early stages of a galaxy's evolution. However, so far it has

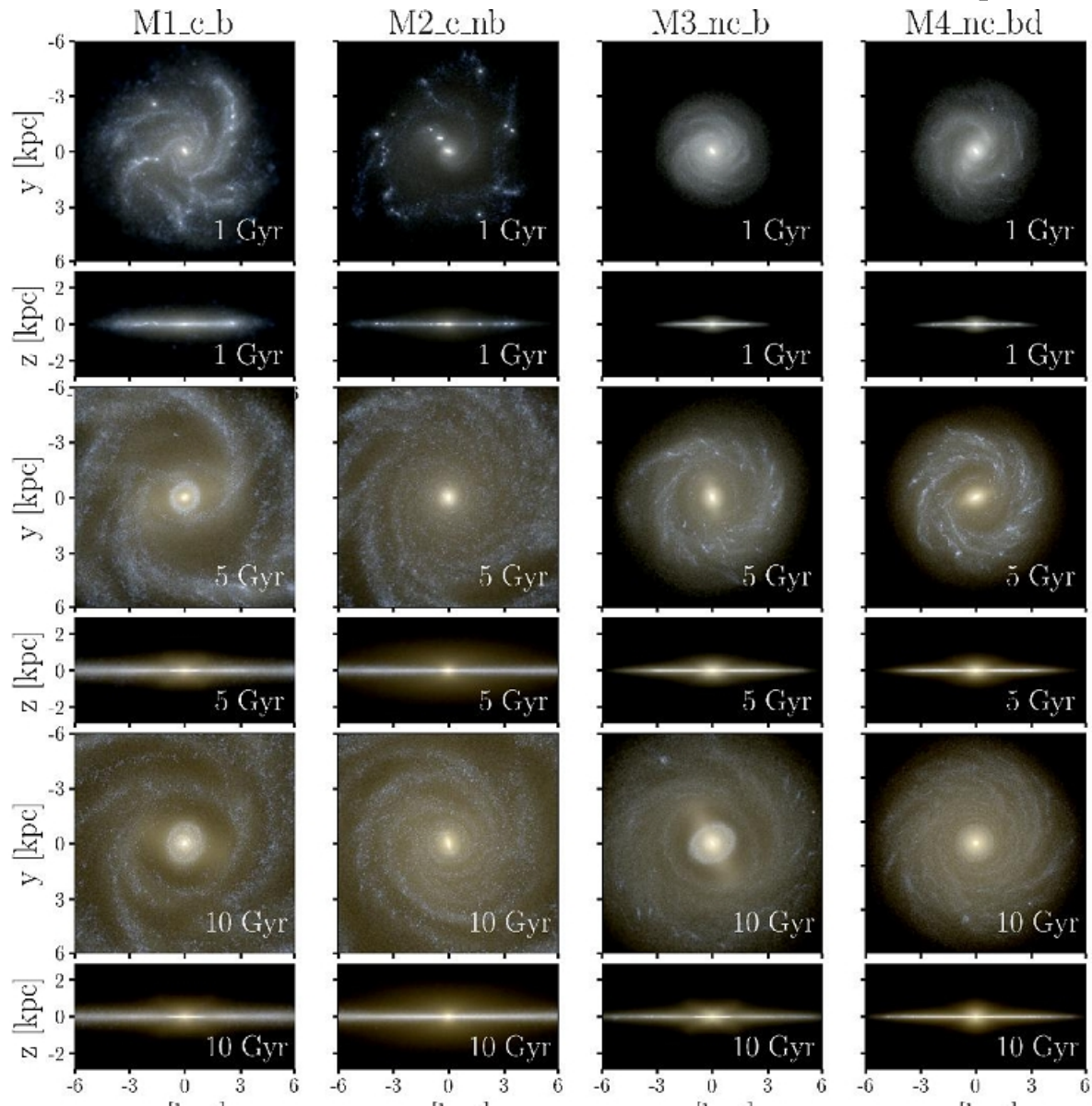
# Четыре модели a la Milky Way

- Масса гало  $10^{12}$  солнечных масс
- Горячий газ 10% по всему объему гало – остывает, оседает, образует звезды
- GASOLINE
- Разрешение для газа (и звезд) 50 пк, для темной материи 100 пк
- Разная мелкомасштабная физика → M1 (сгустки с баром), M2 (сгустки без бара), M3 (только бар), M4 (только бар, и он со временем исчезает).

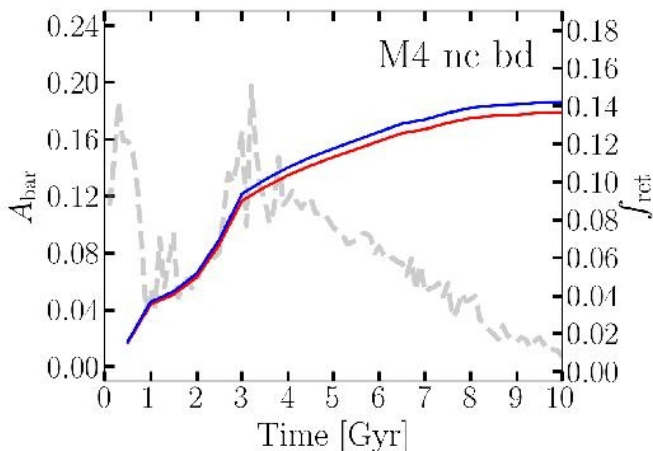
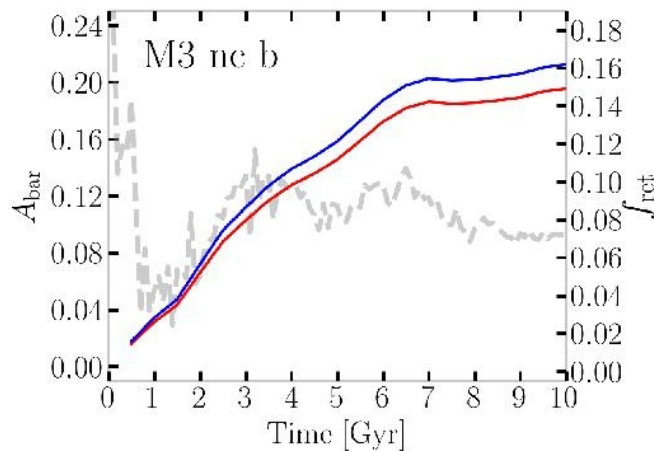
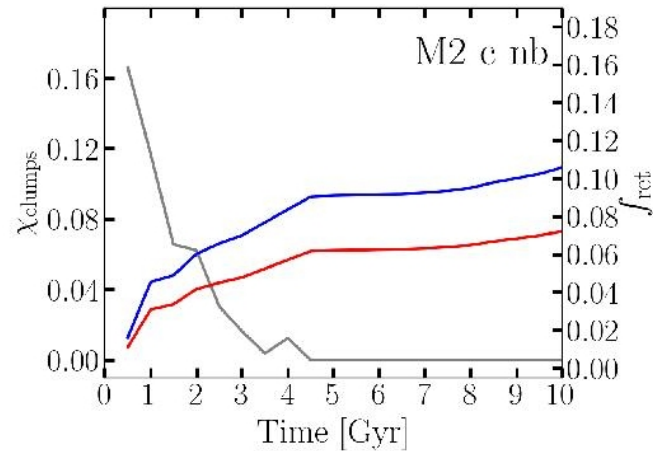
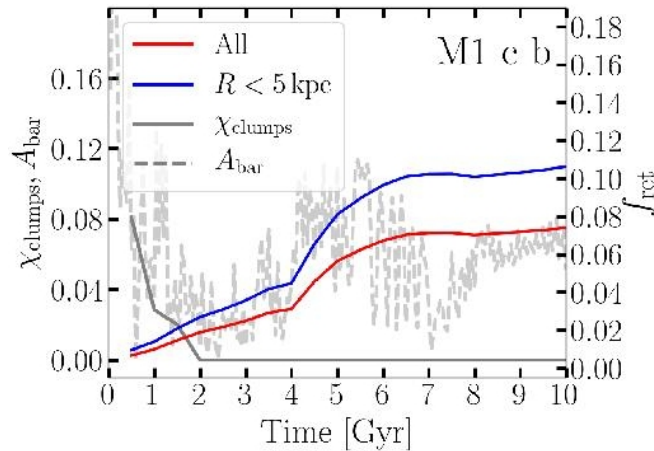
# Эволюция в течение 10 млрд лет



# Эволюция в течение 10 млрд лет



# Эволюция доли ретроградных звезд, порождаемых сгустками и баром



# Распределение по радиусу

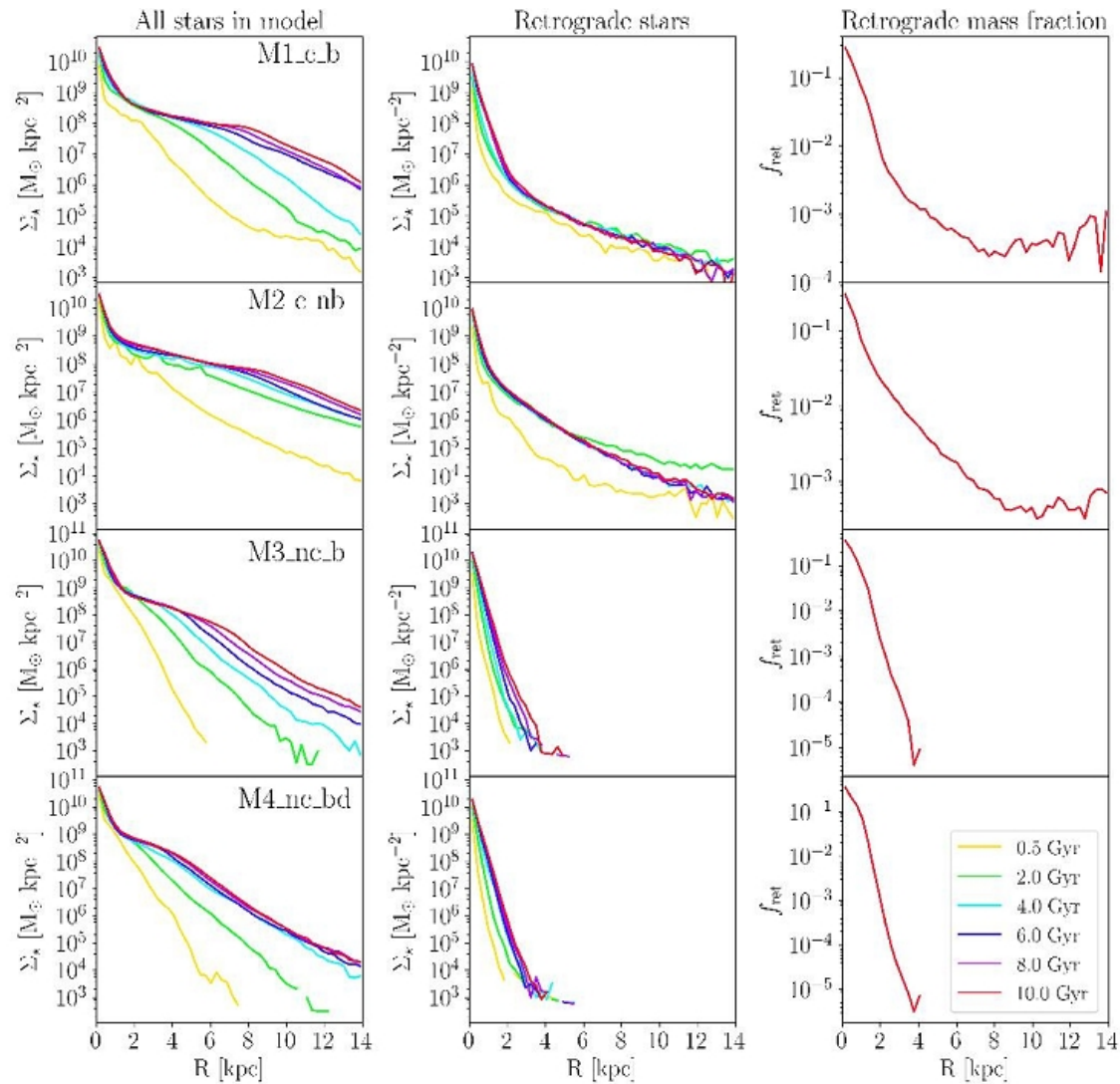
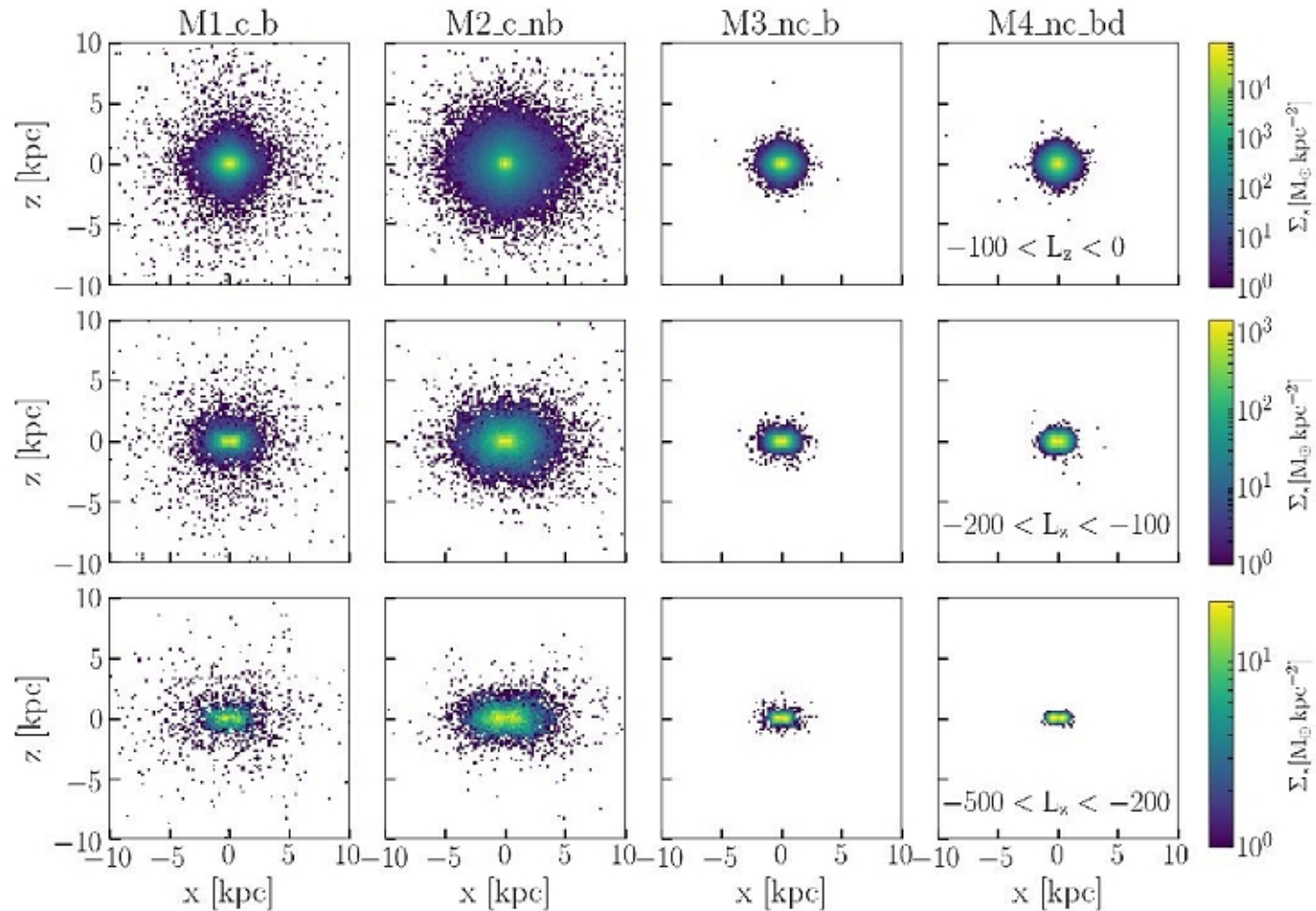


Figure 5. Left: the evolution of the radial density profiles for all stars in each model. Middle: the evolution of the radial density profiles for retrograde stars

# Распределение по z-координате



**Figure 6.** Density distribution plots in  $(x, z)$  plane of retrograde stars at 10 Gyr for each of the models. Each row represents the density distribution of retrograde stars in different angular momentum ( $L_z$ ) bins. The retrograde stars in M1\_c\_b and M2\_c\_nb (first two columns) are found at larger radii due to the clump scattering for all  $L_z$  ranges, compared to centrally concentrated retrograde population in M3\_nc\_b and M4\_nc\_bd. In addition, it is evident that bars also cause some vertical heating, causing some of the bar-driven retrograde populations to be nearly-spherically distributed.



# Выводы

- Рассеяние звезд на сгустках может дать до 10% ретроградных звезд по всему диску.
- Диффузия орбит из бара может дать до 15% ретроградных звезд, но только в центре, в пределах радиуса бара.
- И ни те, ни другие не будут холодным ТОНКИМ ДИСКОМ.