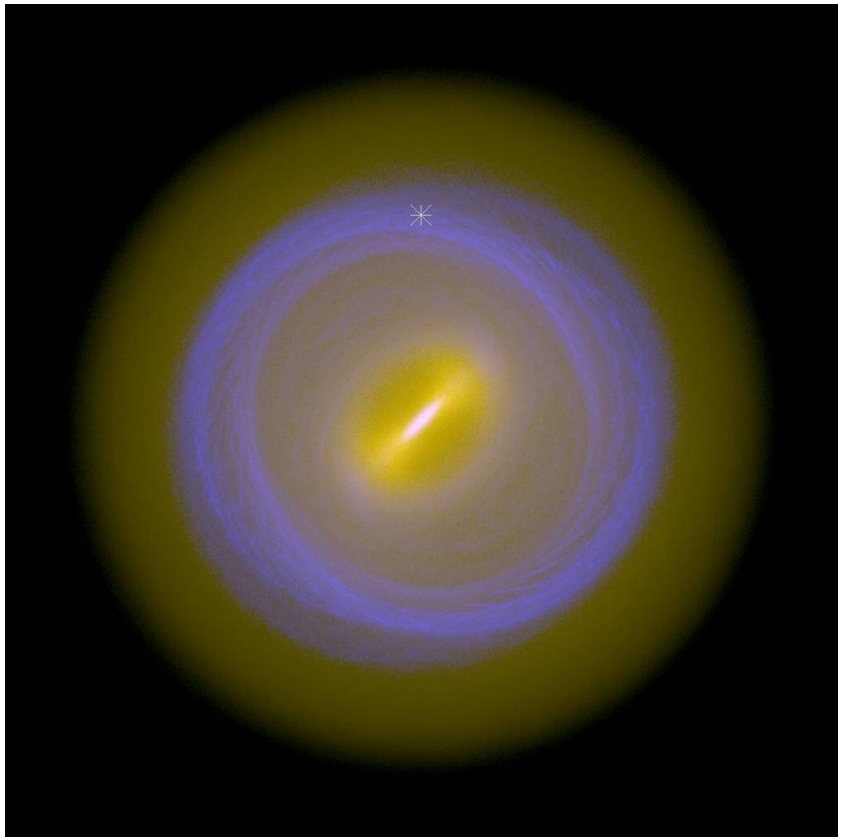
Modelling of the Galactic kinematics

A.M. Mel'nik and P. Rautiainen



The velocities
of young stars
in some
stellar-gas
complexes
can be explained
by the presence
of the outer ring
of class
R1R2'
in the Galaxy.

Models with analytical bars

Motions of massless gas particles in the analytical potential.

Mel'nik & Rautiainen (2009)

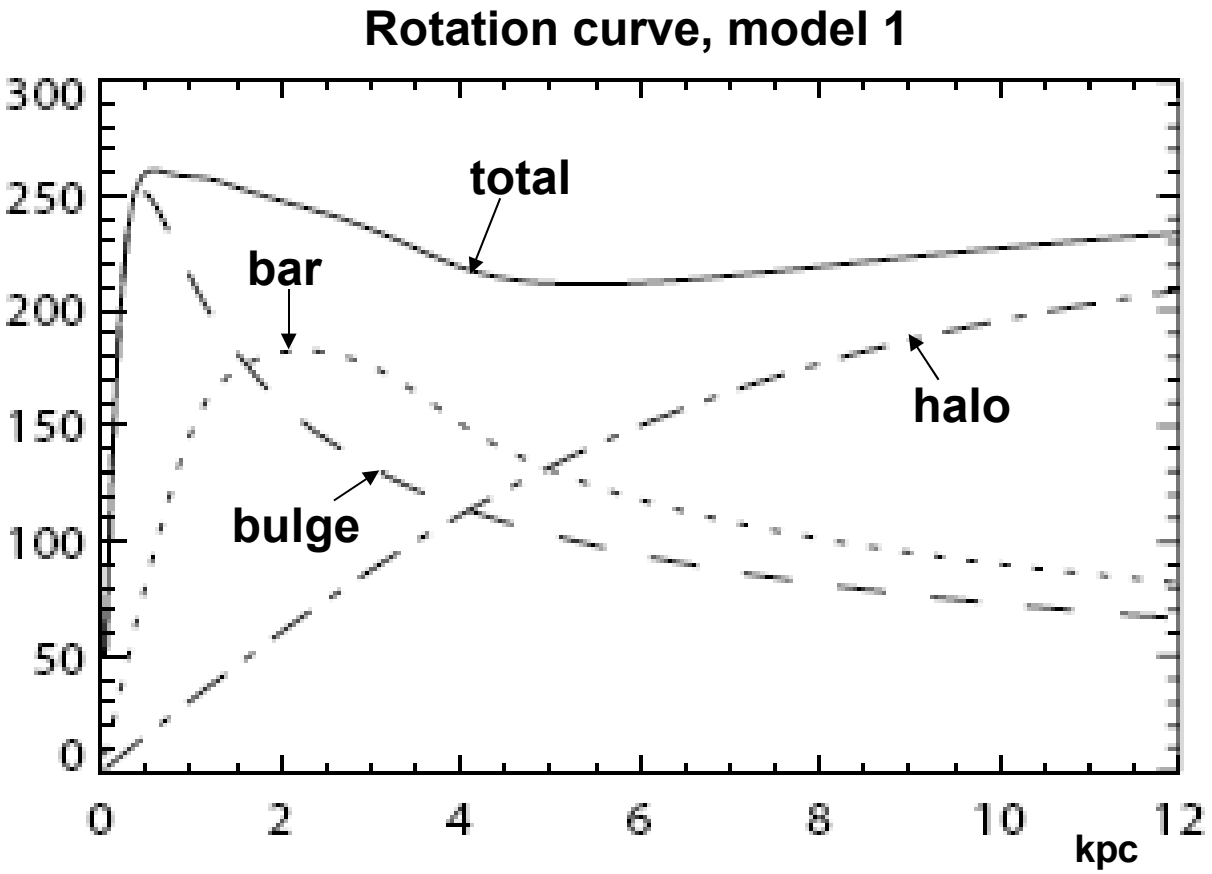
The bar is a Ferrers ellipsoid (n=1)

a=4, b=1.3 kpc

2D-simulations.

No self-gravity.

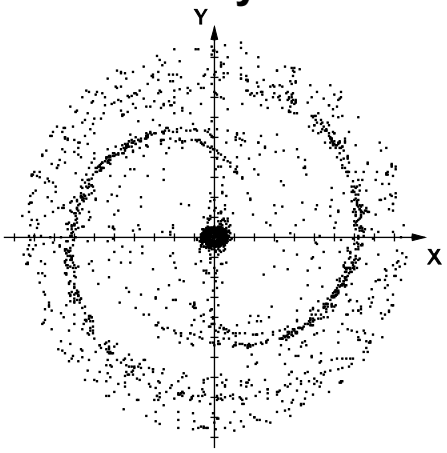
50 000 particles which can collide inelastically.



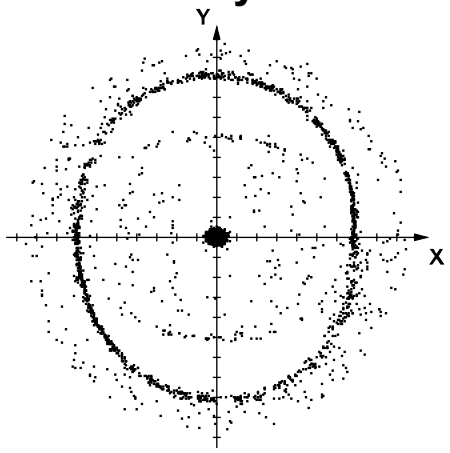
Distribution of OB particles

Analytical bars
Models 1 and 3

T=0.5 Gyr

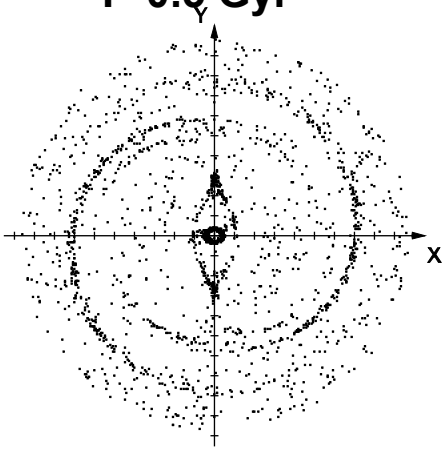


T=1.0 Gyr

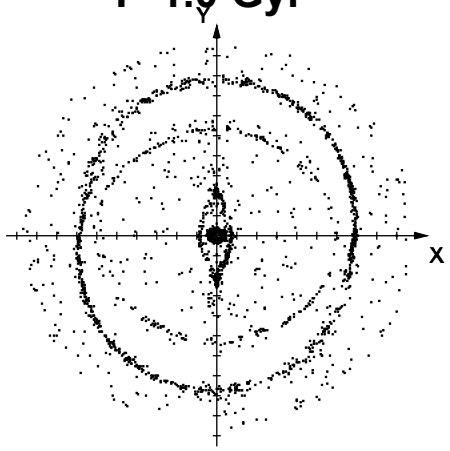


Model 1

T=0.5 Gyr

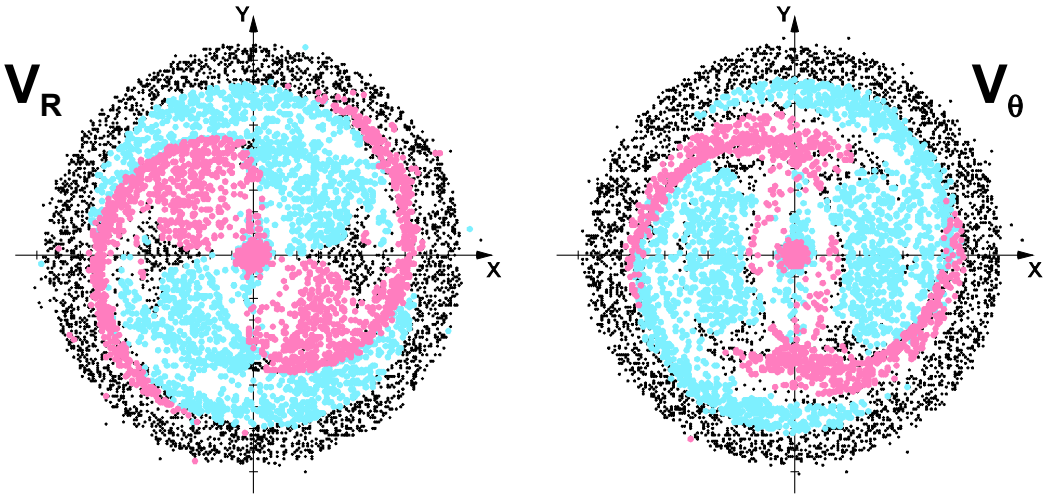


T=1.0 Gyr



Model 3

Kinematics of the pseudorings

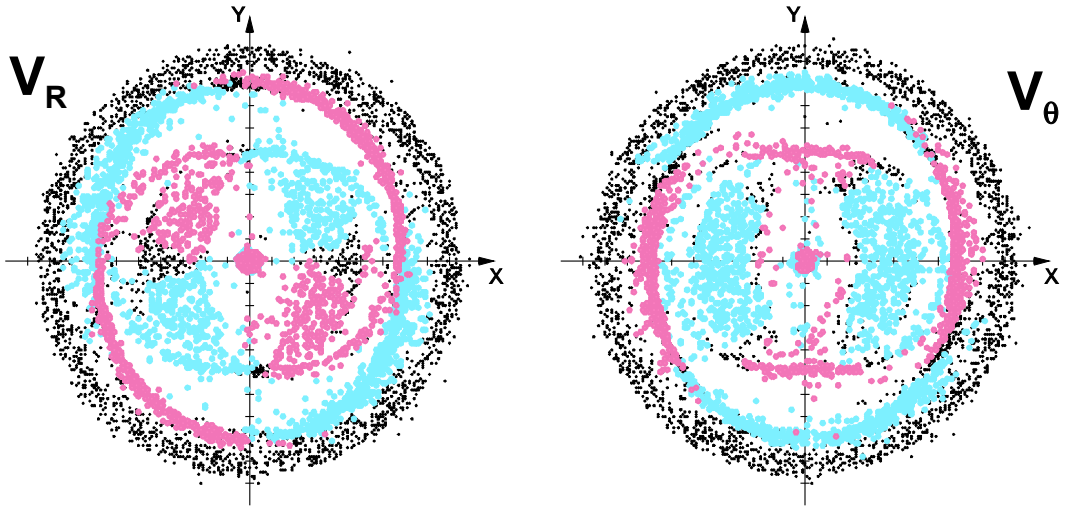


Analytical bars
Model 1

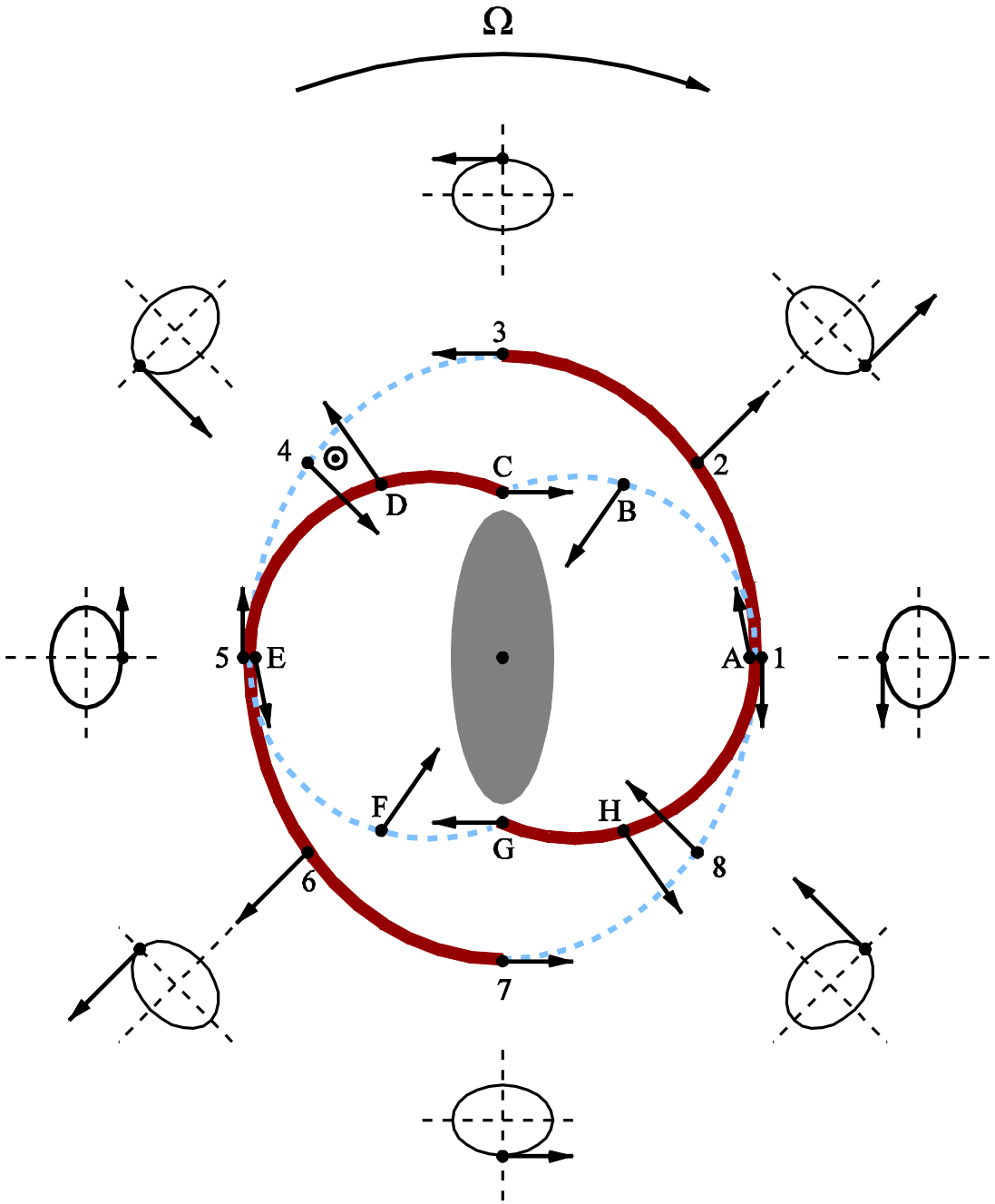
T=0.5 Gyr

Distribution of particles with positive and negative residual velocities

Kinematics of the pure rings



T=1.0 Gyr



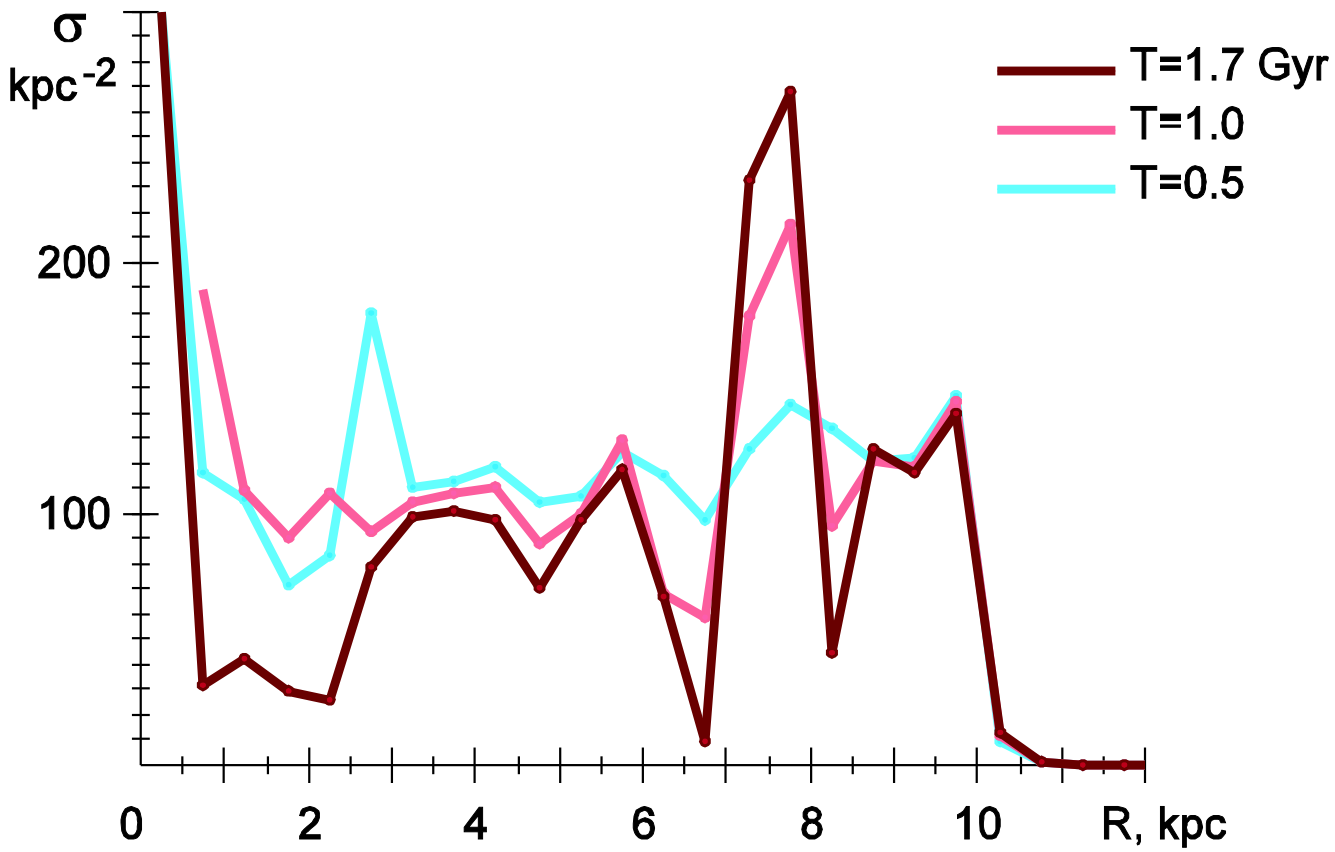
Orbital kinematics in the resonance region

Two main families of periodic orbits in the region of the OLR.

Particles with the positive and negative radial residual velocities

Gas Outflow

Analytical bars
Model 3



N-body simulations

Stellar disk is self-gravitating.

8 10^6 particles

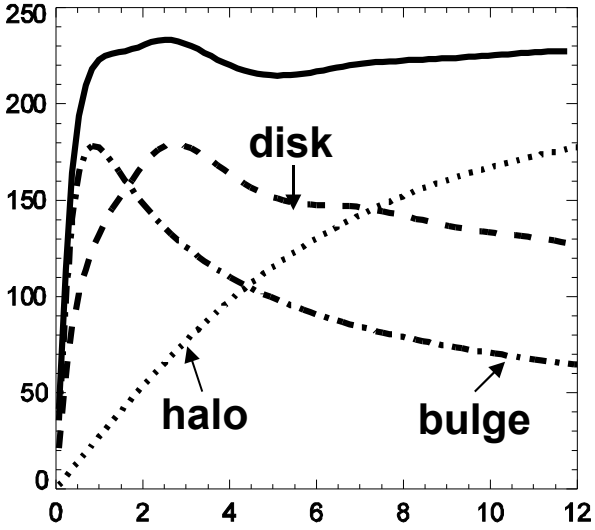
2D

softening 0.2 kpc

M_{disk} = 3.5 10^{10} M_s

Q_T=1.75 at T=0

Rotation curve, T=5.5 Gyr

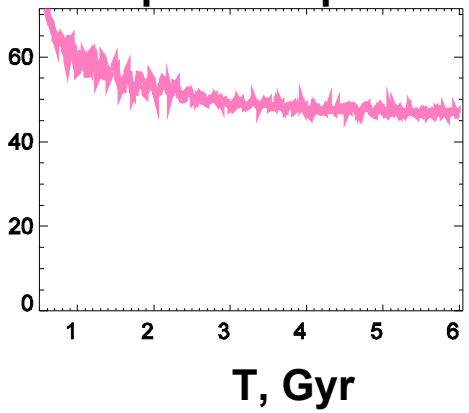


Gas disk is modeled by

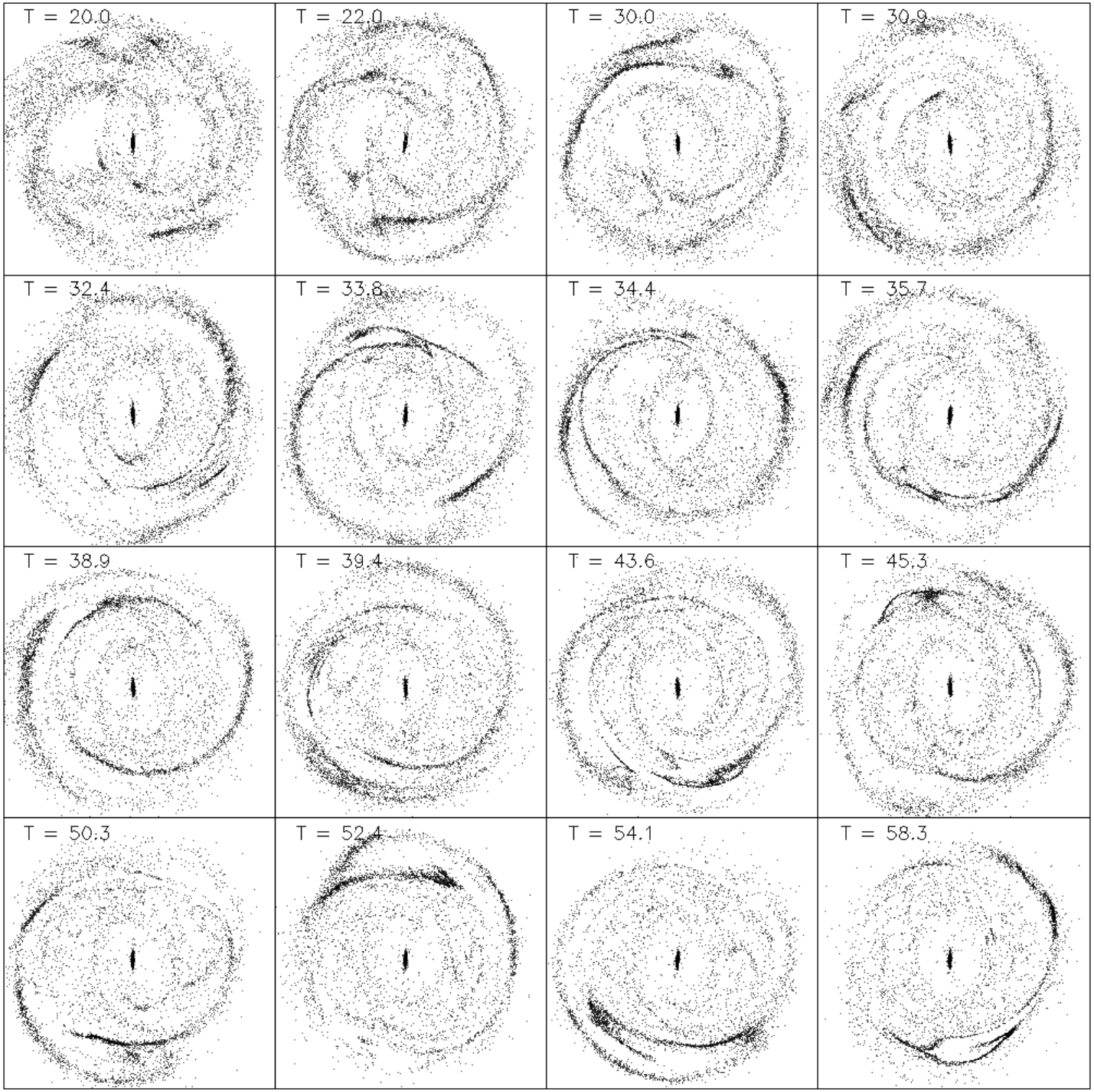
40 000 massless particles

that can collide inelastically

Bar pattern speed



Rautiainen & Mel'nik, 2010, accepted to A&A

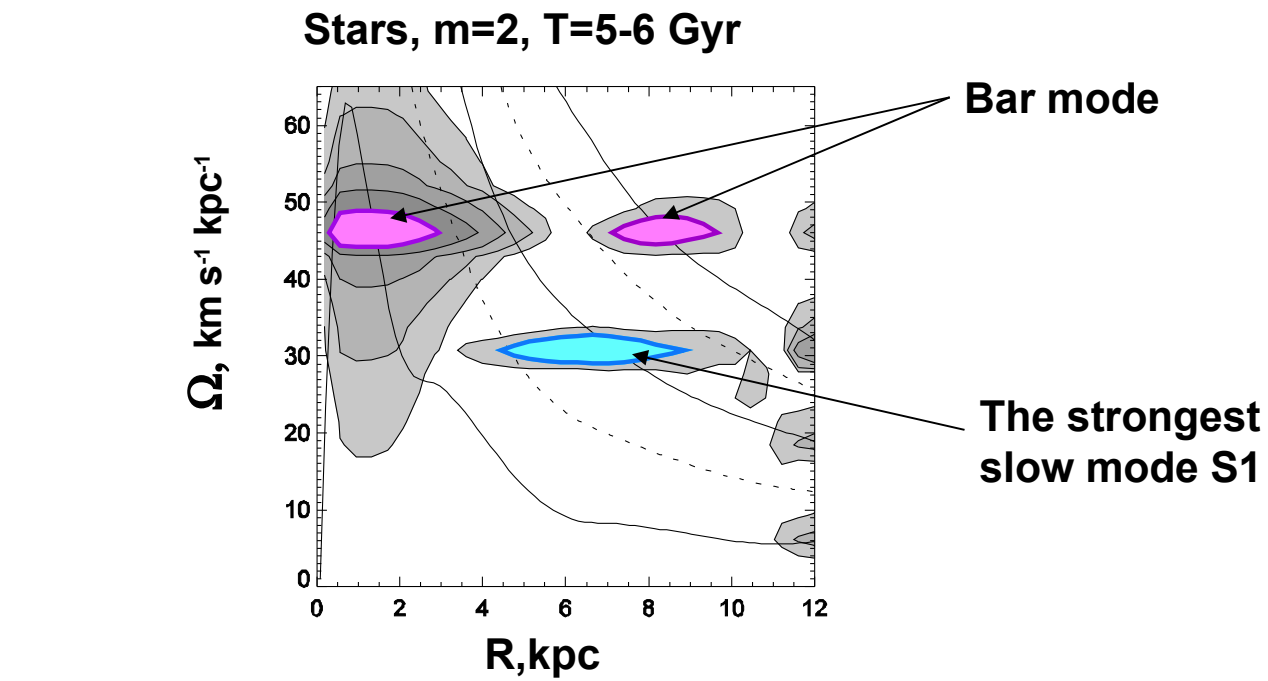


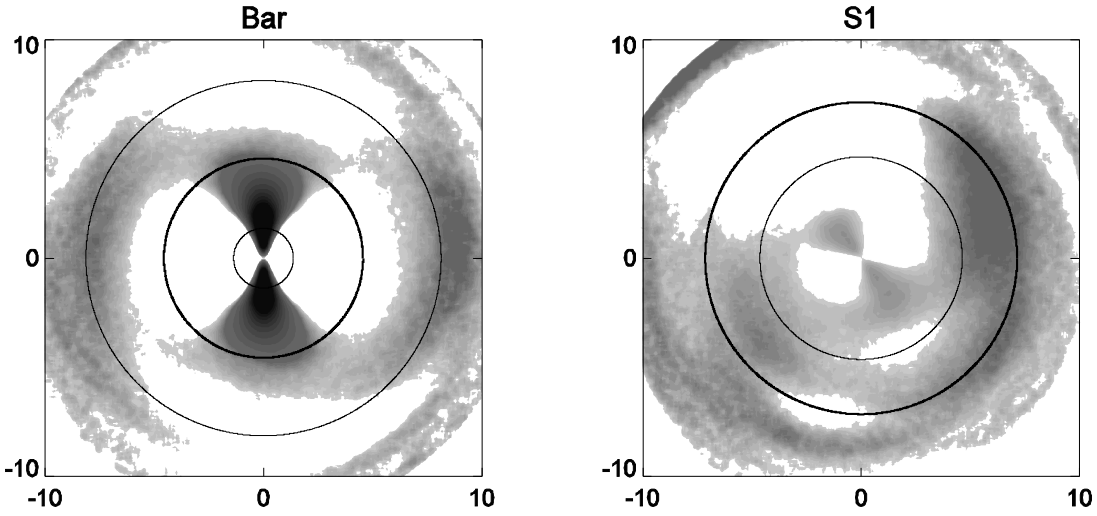
N-body

Distribution of gas particles

N-body

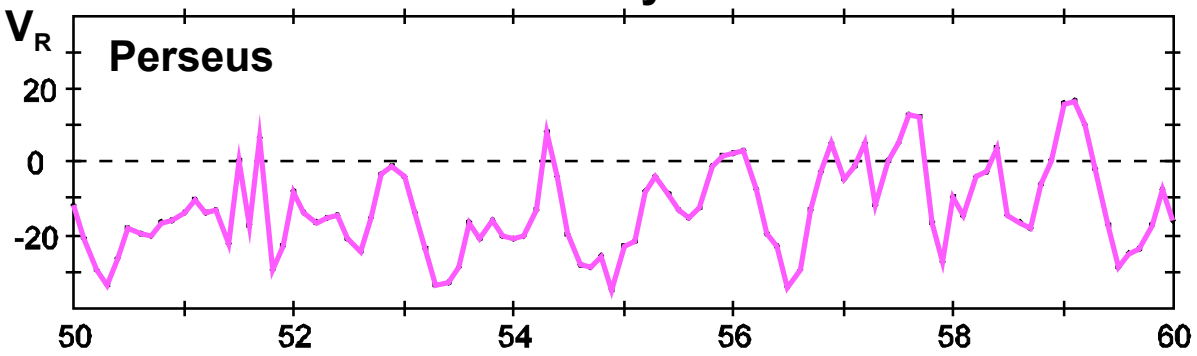
The amplitude spectrum of the density perturbations





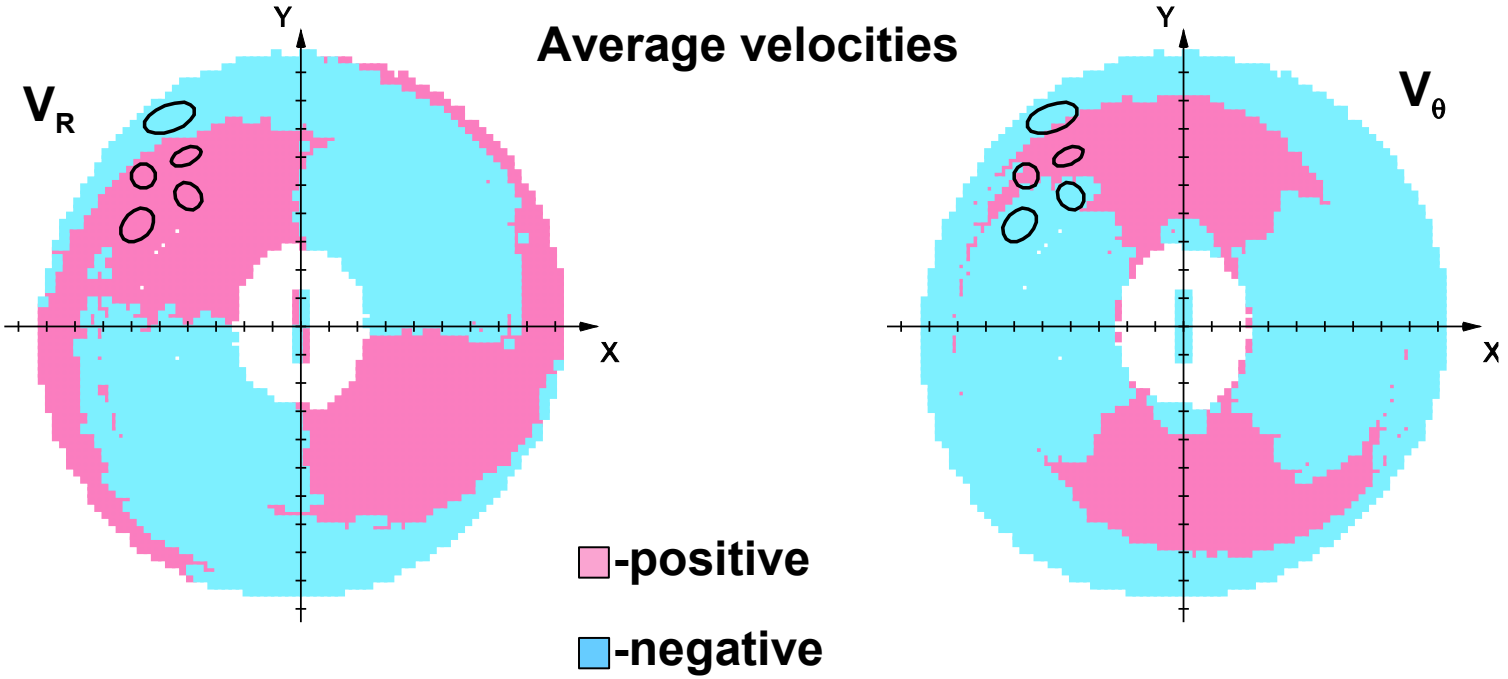
N-body

Momentary velocities



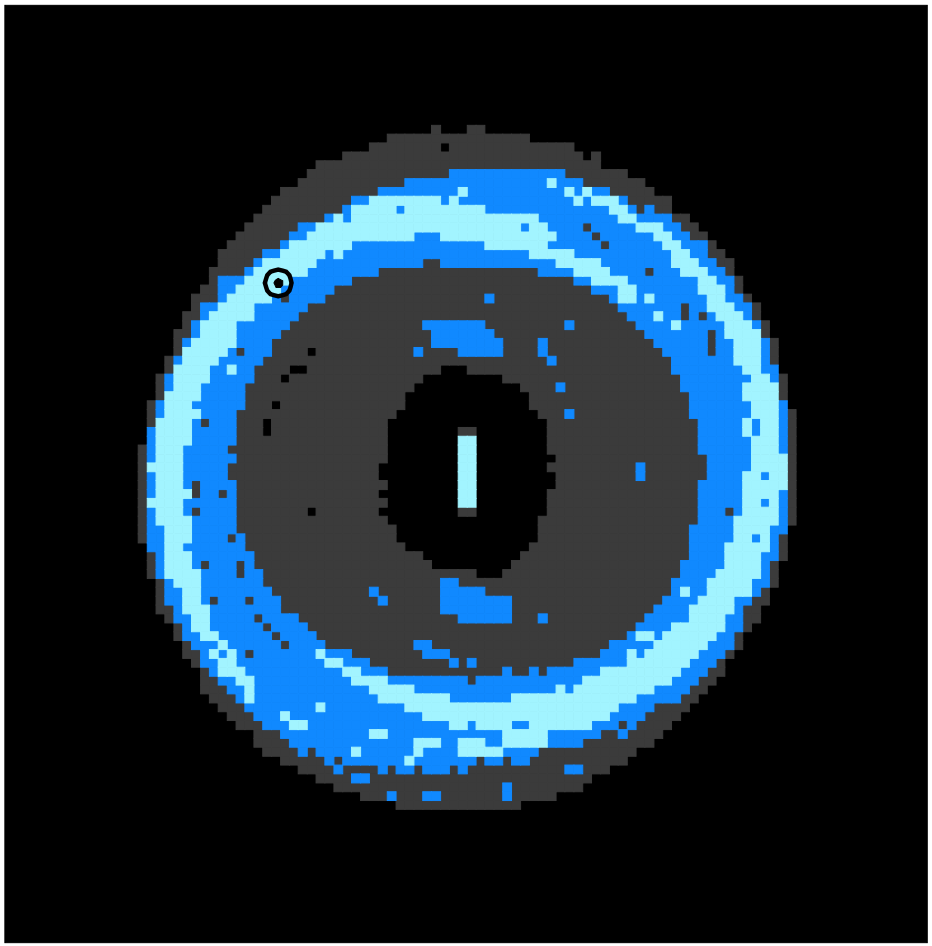
Time 5-6 Gyr

Average velocities



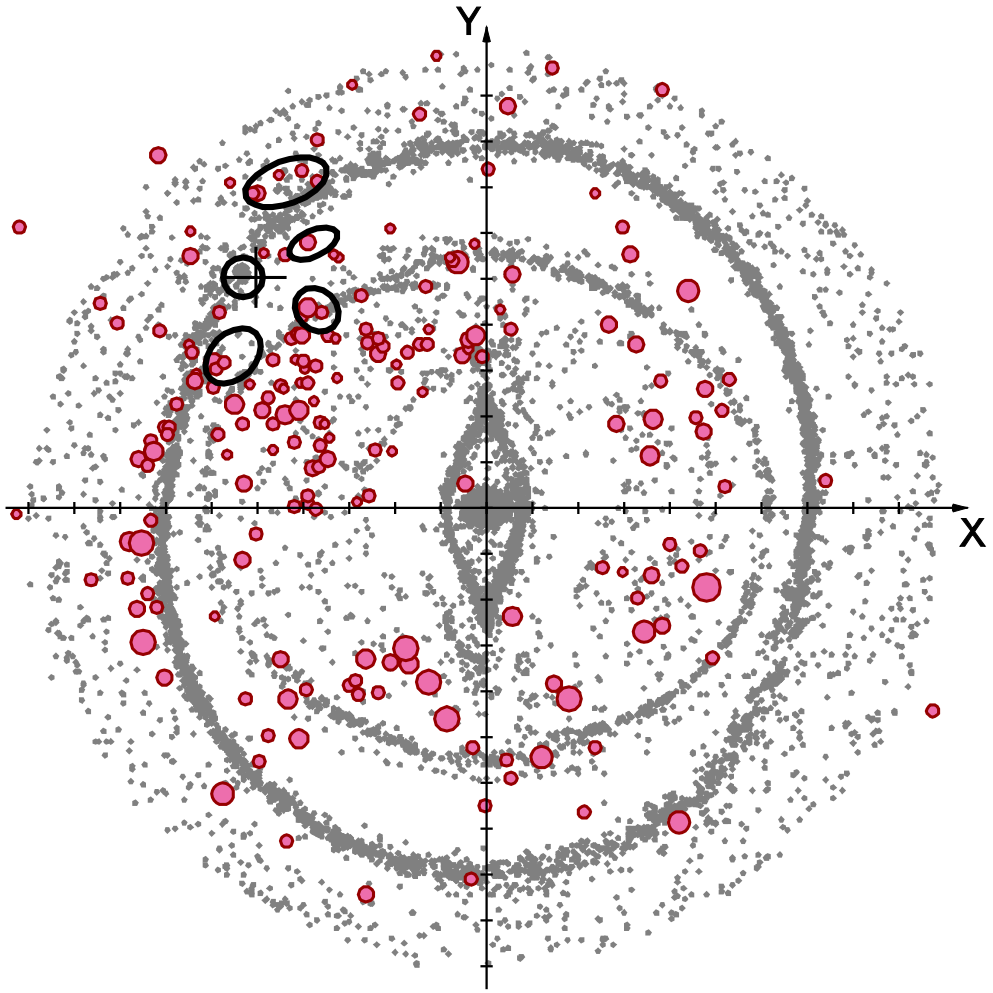
Surface density of gas particles averaged over 1 Gyr

T=5-6 Gyr



N-body

Distribution of giant star-forming regions ● (Russeil, 2003) and OB-particles (•)



Analytical bars
Model 3

Conclusions

Our N-body models reproduce the observed residual velocities in the Perseus and Sagittarius regions and in the Local System.

The mean difference between the model and observed velocities is 3 km s^{-1} there.

The optimal value of the solar position angle providing the best agreement between the model and observed velocities is 45^{o}.

The models with analytical bars also reproduce well the observed velocities in the Perseus and Sagittarius regions. We explain this success by the resonance between the orbital rotation and the epicyclic motion.

The success of N-body simulations with the Local System is likely due to the gravity of the stellar R1-ring which is omitted in models with analytical bars.