Potential of the Galaxy from the Besançon Galaxy Model including non-axisymmetric components: Preliminary results

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Abstract

We present a preliminary attempt to compute a non-axisymmetric potential together with the previous axisymmetric potential of the Besançon galaxy model (hereafter BGM). The contribution by non-axisymmetric components are modeled by ***Pichardo et al. (2004) method:*** This consists in the superposition of inhomogeneous ellipsoids to approximate the triaxial bar and superposition of homogeneous oblate spheroids for a stellar halo, possibly triaxial. Finally, we have computed the potential and force field for these non-axisymmetric components in order to constraint the total mass of the Milky Way. We present the preliminary results for the new fit to the rotation curve and constraints on the dark halo shape. This approach allows us to use the new dynamical constraints, together with mocked kinematical information to compare with upcoming data from large-scale survey such as RAVE, BRAVA, APOGEE, and GAIA in the near future.

New dynamical scheme of the Besançon galaxy model

The originality of the BGM (Robin et al. 2003) consists in producing a consistent dynamical Galaxy whose results are translated in terms of general star count predictions.

The stellar population model has been updated with a new triaxial bar (Robin et al, 2012) and a modified stellar halo, which may be triaxial (Robin et al 2014). There are presented in Eq. 1 and 2.

The potential has to be computed for these new components in order to check the dynamical consistency, following the scheme presented in Bienaymé et al (1987). In fig.1 we show the modified scheme.

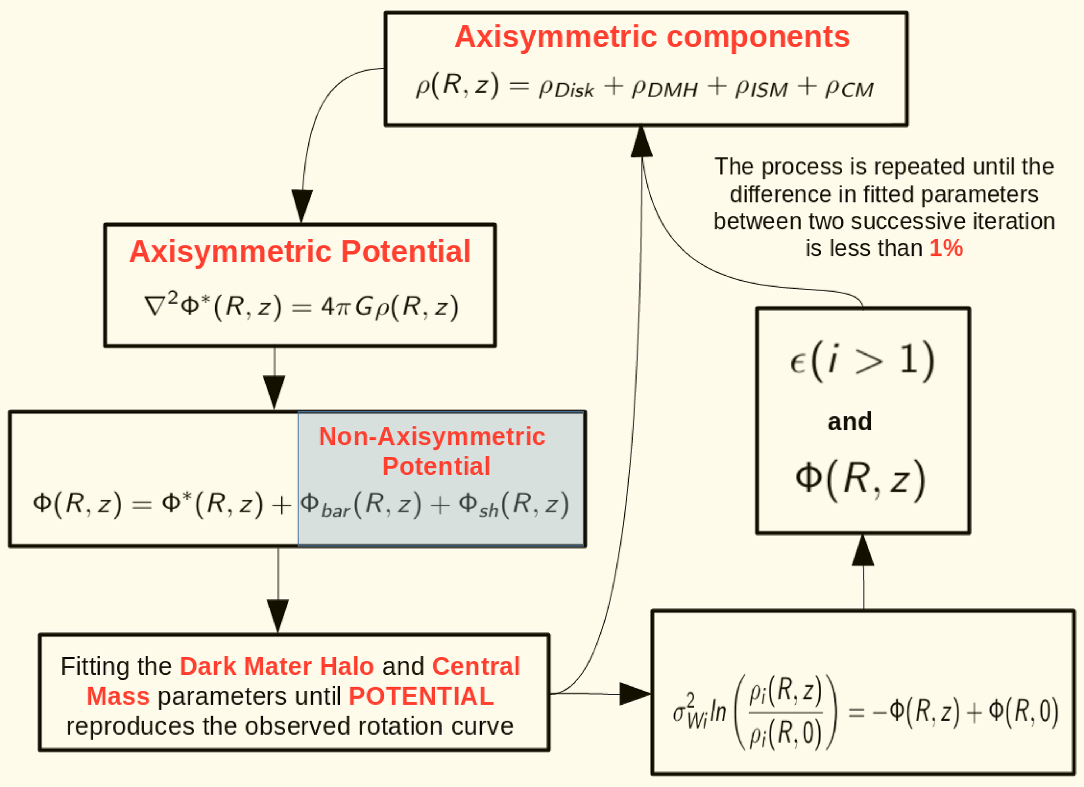

Figure 1: General scheme for dynamical self consistency.

Methodology: We have computed the potential and force fields for the mass density distribution given by Eq. 1 for the triaxial bar and Eq. 2 for a more realistic stellar halo model. Pichardo et al. (2004) method consists in the superposition of inhomogeneous closed quadratic surface using homogeneous ellipsoids and homogeneous oblate spheroids, according to the formulation presented by Schmidt (1956) and Pichardo et al. (2004) method.

Boxy bar

$$\rho(R_s) = \rho_0 \times sech^2(-R_s) \qquad (1)$$

Stellar halo

$$\rho_{SH}(R,z) = \rho_0 \times \left[\frac{1}{R_a \times (R_{core}+R_a)^n}\right] \qquad (2)$$

Preliminary Results

In fig. 2 we show the results of computing the rotation curve for the density law given by (1) and (2) and Robin et al. (2003) combining non-axisymmetric and axisymmetric components.

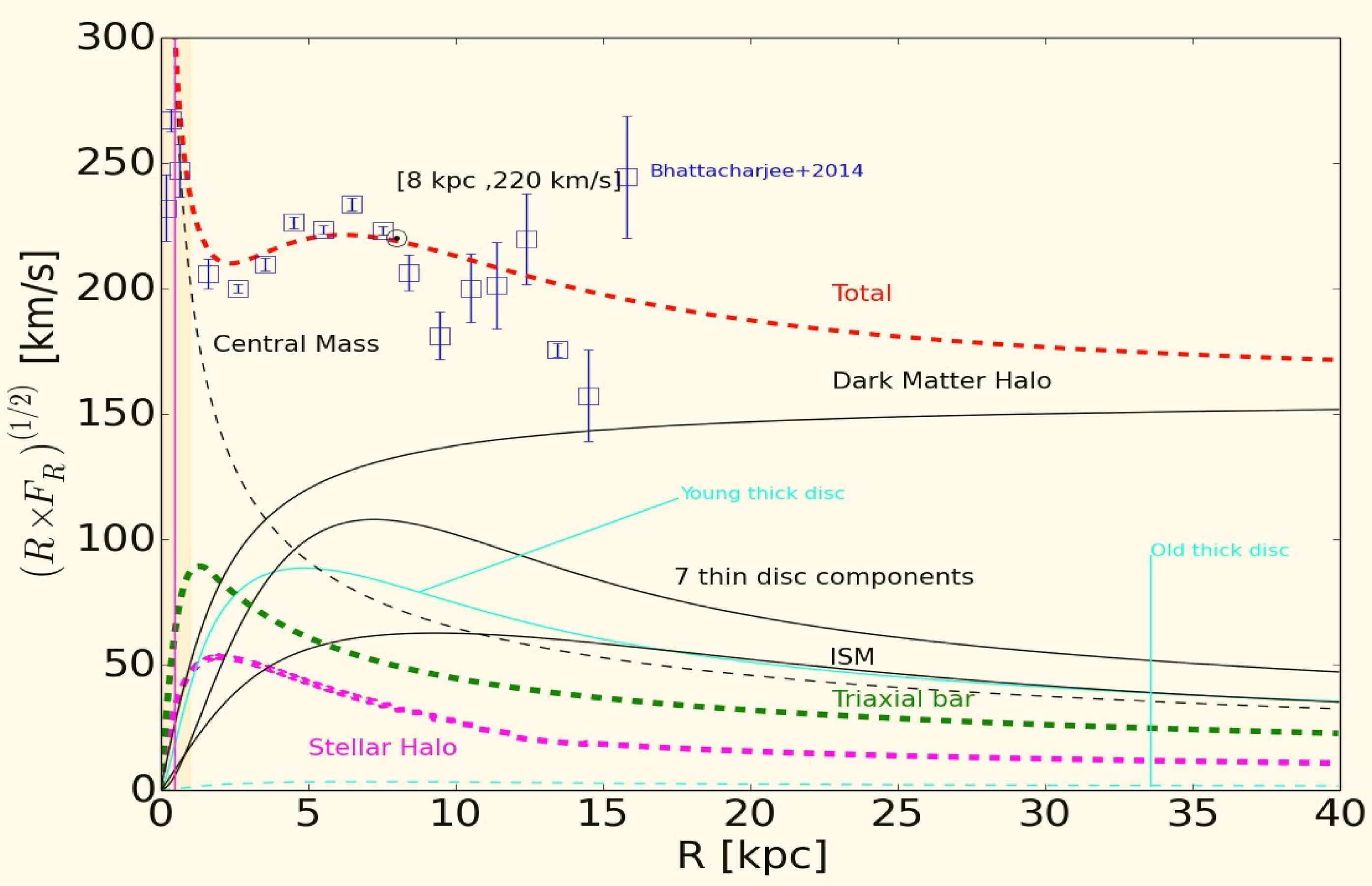

Figure 2: Rotation curve of the Galaxy. The superposition of homogeneous closed quadratic surfaces (triaxial bar and stellar halo, Pichardo et al. 2004 method) are computed together axisymmetric components (Bienaymé et al. 1987 model, see fig. 1) to get a self-consistent dynamical model (red dashed line).

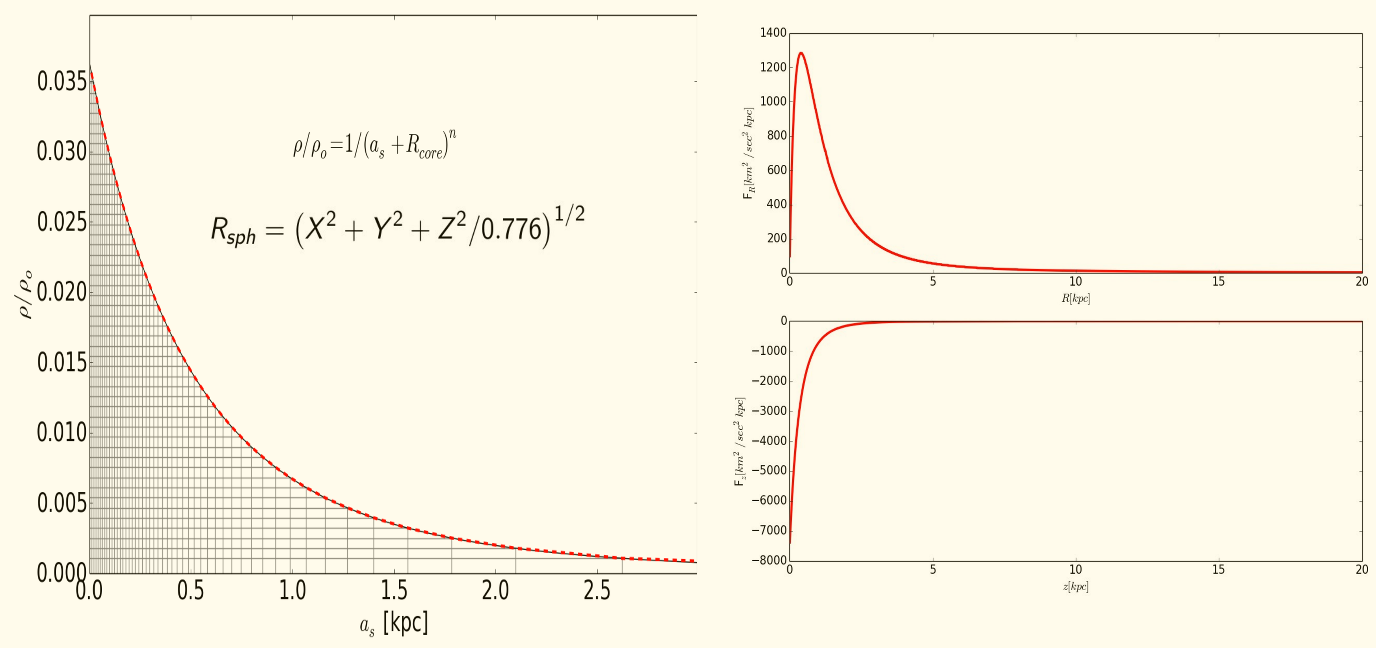

Figure 3: **Left:** Superposition of homogeneous oblate spheroids to approximate the density law for the stellar halo given in Robin et al. (2015, in preparation); *n = 4.39* and R_{core} *= 2.128* kpc. **Right:** Force field along the R-plane (top), *z*-axis (bottom) in the superposition model of homogeneous oblate spheroid.

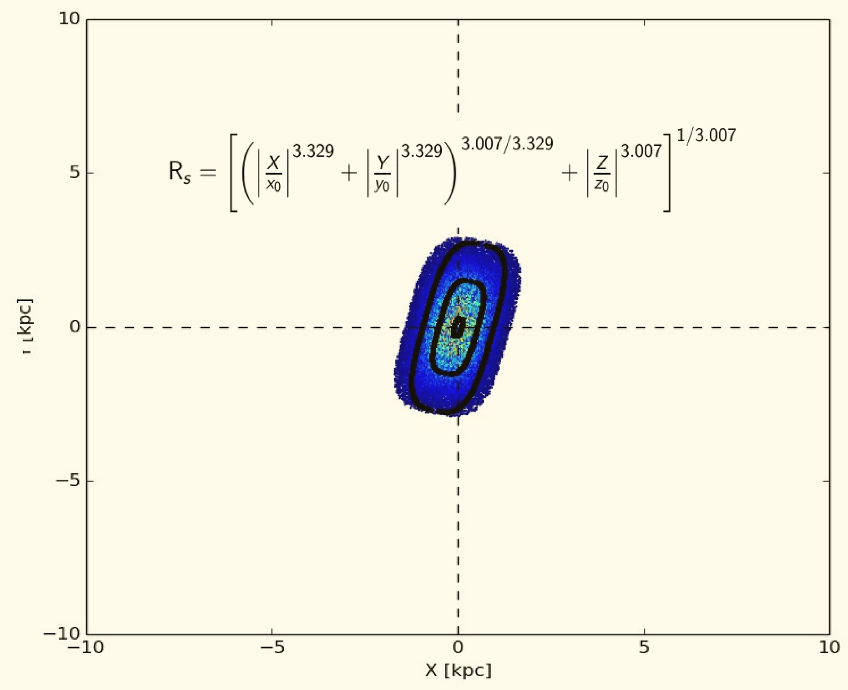

Figure 4: **Boxy bar.** Superposition of eight principal inhomogeneous ellipsoids to approximate the density law Eq. 2. Isodensity contours of R_s.

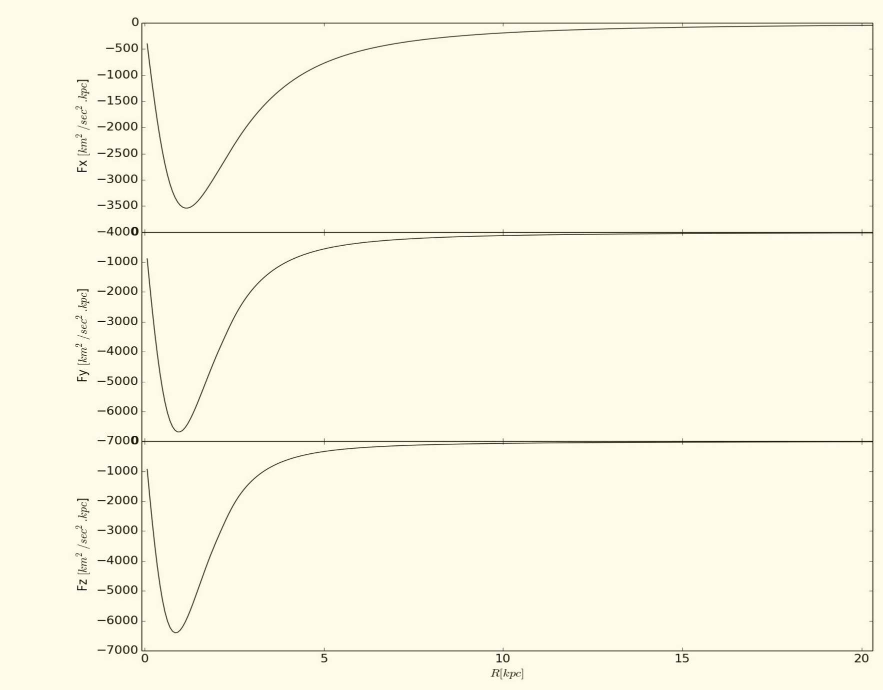

Figure 5: Force field along the *x*-axis (top), *y*-axis (middle), and *z*-axis (bottom) in the superposition model of inhomogeneous ellipsoids.

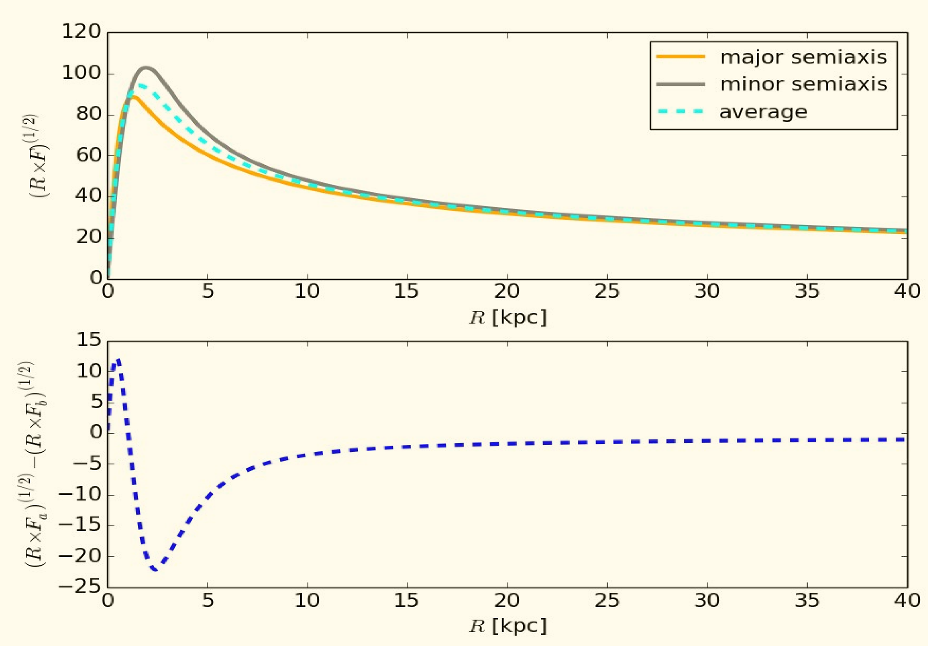

Figure 6: **Top**: Rotation curve along the major and minor axes for triaxial bar. **Bottom:** Difference between the two rotation curve major/minor semiaxis.

On-going Work:

1. Apply the Schwarzschild method to this new potential.

2. Study the influence of the potential produced by a three-dimensional Spiral Arms model (Pichardo et al. 2003) within the BGM.

3. New values for age-velocity dispersion relation are explored, from RAVE data (Robin et al. 2015, in preparation).

4. Performing simulations with test particles, in order to probe the local effect of the bar and derive the general kinematics of the stars under a triaxial bar potential.

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