MULTI-COMPONENT MODELS FOR DISC GALAXIES

A test case: NGC 5866

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Abstract. We present an application of a new set of detailed, self-consistent, dynamical models for disc galaxies. We start from the hypothesis that each galaxy can be decomposed into a bulge, following the $r^{1/4}$ law, and a disc with an exponential projected density profile; and that the isodensity surfaces of each component can be represented by similar concentric spheroids. After taking into account both the asymmetric drift effects and the integration along the line of sight, we produce the rotational velocity and velocity-dispersion profile, and the approximate shape of the line-of-sight velocity distributions for the stars as parameterized by the $h_3$ and $h_4$ coefficients of the Gauss–Hermite expansion of the line profile. Photometric and kinematical data have been taken from the literature for the test case of the S0 galaxy NGC 5866, for which detailed stellar kinematical data are available at different positions across the galaxy. Apart from the innermost, dust-obscured regions of the galaxy, where observational effects are likely to be dominant, the model successfully reproduces the whole set of dynamical data available as well as giving a good fit to the photometry. The galaxy is shown to have an isotropic velocity-dispersion tensor, thus hinting at a dissipational formation process.

1. Introduction

The study of S0 galaxies could provide the link between the dynamically hot, pressure-supported elliptical galaxies, sustained by the anisotropy of their velocity-dispersion tensor, and the colder, isotropic and rotationally-supported spiral galaxies.

These dynamical differences are likely to be derived from different formation histories: under very simple assumptions, we expect the isotropic structures to de-

<table>
<thead>
<tr>
<th>Scale radius</th>
<th>Axial ratio</th>
<th>Luminosity</th>
<th>Mass [$10^{10} M_\odot$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_b$</td>
<td>$r_d$</td>
<td>$(b/a)_b$</td>
<td>$(b/a)_d$</td>
</tr>
<tr>
<td>35''</td>
<td>15''</td>
<td>0.8</td>
<td>0.15</td>
</tr>
</tbody>
</table>

derive from the dissipational collapse of a spherical distribution (or from the mergers of gas-rich galaxies), and the anisotropic ones to be the result of dissipationless processes such as mergers of gas-poor parent galaxies.

S0 galaxies show a very wide range of dynamical behaviour, suggesting that they might form a somewhat ‘mixed’ class in this respect. In order to investigate the different behaviour of the star kinematics in these galaxies we developed a self-consistent, multi-component dynamical model, which could be used to derive simultaneously both the mass distribution and the mean kinematical anisotropy in S0 galaxies.

We then looked for a test case, taking data from the literature to check the model. We chose the S0 galaxy NGC 5866, mainly because it is an object with good photometric and dynamical data available, and because velocity and velocity-dispersion profiles are present in the literature also out of the major axis. These latter profiles are essential for finding the anisotropy of the velocity-dispersion tensor of the galaxy.

2. The Hypotheses of the Model

The galaxy is assumed to be composed by the superposition of different components. For each component, assume: