SHELLS AROUND TUMBLING BARS: THE MASS DISTRIBUTION AROUND NGC 3923

Ch. Dupraz[1,2], F. Combes[2], J.-L. Prieur[3]
1. Physikalisches Institut, Universität Köln, West Germany
2. Observatoire de Meudon, F–92190 Meudon, France
Ecole Normale Supérieure, F–75005, Paris, France
3. Mt. Stromlo Observatory, ACT 2606, Canberra, Australia

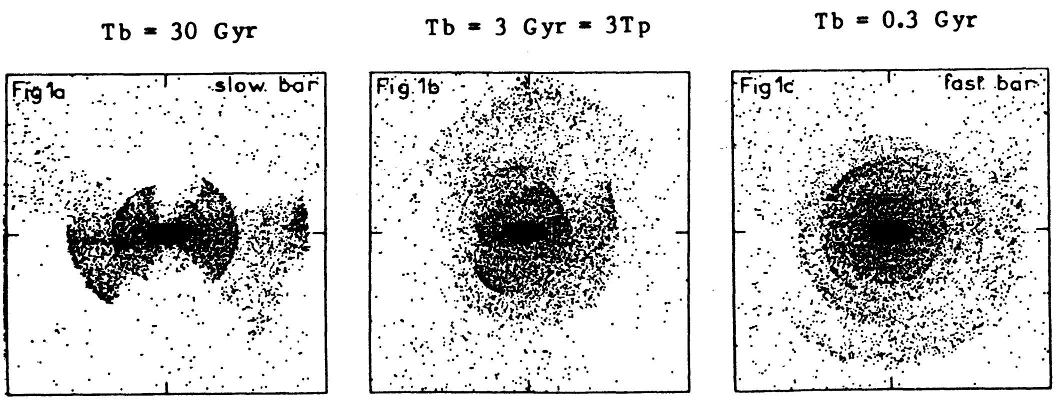
SHELLS AROUND A TUMBLING PROLATE GALAXY

In previous articles (Dupraz & Combes, 1985, 1986a), we showed that shells form with different geometries around prolate and oblate galaxies. However, theory and observations suggest that some ellipticals could be tumbling bars (Miller & Smith 1980; Möllenhoff & Marenbach 1986). Here we simulate the accretion of a small galaxy by a tumbling bar; the tumble period T_b is kept free. Let T_p be the typical period of motion of a particle in the potential of the elliptical galaxy. Then we find (Dupraz & Combes, 1986*b*):

a) When $T_b > 3T_p$ (Figure 1a), shells form with the geometry of a static *prolate* potential, i.e., aligned with the major axis.

b) When $T_b < 3T_p$ (Figure 1c), the particles feel the time–averaged potential, which is oblate: the shells display the typical *oblate* geometry. But there is no confusion with a static oblate shell galaxy, because the tumbling bars must be seen edge–on for the shells to appear.

c) When $T_b \sim 3T_p$ (Figure 1b), the outer shells form with the oblate geometry, the inner shells with the prolate geometry. In between, no shells form, because particles follow *resonant* (non–radial) motions.



T. de Zeeuw (ed.), Structure and Dynamics of Elliptical Galaxies, 469–470.

https://doi.org/10.1017/S007418090018578X Published online by Cambridge University Press

MASS DISTRIBUTION (HALO) AROUND NGC 3923

The radial distribution of shells allows a determination of $M(r)$, the mass inside radius r. We apply various methods (Dupraz & Combes, 1986*c*; Hernquist & Quinn 1986) to the best observed shell galaxy NGC 3923, for which 26 shell positions are taken from Prieur et al. (1986).

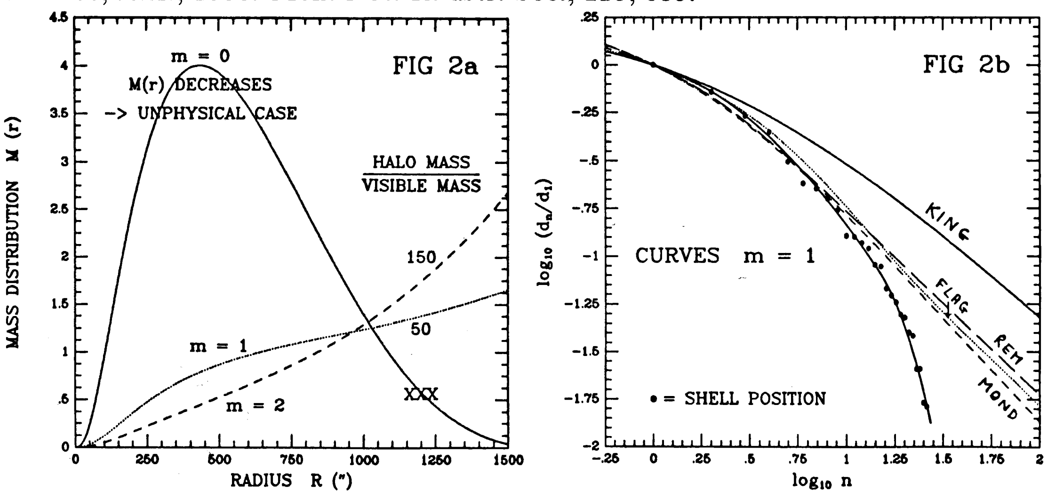
In Figure 2a, we show the best fitted $M(r)$ functions for the shell system, for 3 values of the free parameter m, the number of shells beyond the outermost one, whether vanished or not. Figure 2b shows curves for the following models:

a) King model alone (representing the luminous component).
b) MOND = MOdified Newtonian Dynamics (Milgrom 1983).
c) FLAG = Finite Length-scale Anti-Gravity (Sanders 1984).
d) REM = REvised MOND (Sanders 1986).

Obviously, *the luminous mass in NGC 3923 is not sufficient:* a halo, or a non-Newtonian theory of gravitation, is needed to account for the shell distribution. As far as inner shells are concerned, any model is discrepant; this is due to the effect of dynamical friction (Dupraz, Combes & Gerhard 1986).

REFERENCES

Dupraz, C. & Combes, F., 1985. In *New Aspects of Galaxy Photometry*, ed. J.-L. Nieto, Lecture Notes in Physics, Springer Verlag, Berlin, p. 151.
Dupraz, C. & Combes, F., 1986*a*, *b*, *c* *Astr. Astrophys.*, preprints.
Dupraz, C., Combes, F. & Gerhard, O.E., 1986. Preprint.
Hernquist, L. & Quinn, P.J., 1986. *Astrophys. J.*, in press.
Milgrom, M., 1983. *Astrophys. J.*, **270**, 365, 371.
Miller, R.H. & Smith, B.F., 1980. *Astrophys. J.*, **235**, 793.
Möllenhoff, C. & Marenbach, G., 1986. *Astr. Astrophys.*, **154**, 219.
Prieur, J.-L., Fort, B., et al., 1986. *Astr. Astrophys.*, preprint.
Sanders, R.H., 1984. *Astr. Astrophys.*, **136**, L21.
Sanders, R.H., 1986. *Mon. Not. R. astr. Soc.*, **223**, 539.



Shell Positions (″): 1170, 840, 630, 520, 365, 280, 263, (234), 203, 149, 147, (137), 128, 105, 103, 79, 73, 67, 58, 56, 47, 45, 30, 20, 19.