CLOSE ENCOUNTERS BETWEEN GALAXIES OF DIFFERENT MASSES: SOME DYNAMIC EFFECTS IN A SIMPLE SCHEME

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When a small galaxy of mass M_2 passes in the vicinity of a triaxial or oblate primary galaxy of mass $M_1 > M_2$, some gas could be stripped from the secondary falling down in the gravitational field of the companion and/or lifted from the less bound regions of the last one. These gaseous particles will point out the presence of a torque induced by the disturbing object on the primary. Assuming a homogeneous ellipsoid for the main body, analytical evaluations are made as function of the geometry on the possible co/counter-rotation or polar rings for the gas involved. An application is considered to the well studied galaxy A0136-0801 (Schweizer et al 1983), testing the possibility to form the observed polar ring. We assume the primary is a normal S0 disk and the ring's gas is coming from the disk plane. Due to the axial symmetry, for two symmetric elements of mass $\Delta M/2$ lying on the x-axis at a distance $\ell/2$ from the center of mass, the quadrupole torque due to M_2 passing at distance r with colatitude θ is:

$$\vec{\Gamma_q} = (3GM_2/r^3)\,(\Delta M/2)\,(\ell/2)^2 \sin 2\theta\, \hat{j},\ (\hat{j} \perp \hat{k}, \hat{j} \perp \hat{r})$$

where $\hat{i}, \hat{j}, \hat{k}$ are the frame vectors and G the gravitational constant. Comparing it with the restoring torque due to a homogeneous spheroid of major semi-axis a, miming the main body of the galaxy, we obtain for the ratio:

$$\Gamma_r/\Gamma_q = 2\,(r/a)^3\,(M_1/M_2)\,(1-\varepsilon^2)^{-1}\,[(\varepsilon^2 + k'/a^2)^{-1/2} - (1-\varepsilon^2)^{-1/2} \arcsin((1-\varepsilon^2)(1+k'/a^2)^{-1})^{1/2}]\,(2z/\ell)$$

where ε is the semi-axis ratio, z the height on the equatorial plane and k' the positive solution of the equation for the cofocal spheroid touching the $\Delta M/2$ particle positions. We obtain that the static configuration considered is consistent with the possibility to send mass to the pole assuming: $M_1 = 4.5\ 10^{10}\ M_o$, $M_1/M_2 = 2.25$, $\ell/2 = 10$kpc, a=4kpc, $\theta=45°$ and r=15kpc, if (i) Γ_q lasts for about a revolution period of the $\Delta M/2$ particle and (ii) the mass of the main body is enclosed in a not too much small or large scale length, this last being one of the more strict conditions. The weight of the higher harmonic of multipole has been considered.

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