THE PHYSICS OF CLUSTER MERGERS (C. SARAZIN) in "MERGING PROCESSES IN CLUSTERS OF GALAXIES", KLUWER, 2002 (see ADS)

MERGER KINEMATICS

eq. 10

$R_{max} \to d_0$

$M_{TOT} = M_1 + M_2$

From bimodal model

$$\left(t = \left(\frac{R_{max}^3}{8 G M_{TOT}} \right)^{1/2} (x - \sin x) \right.$$

x development angle

$x = \pi \quad R = R_{max} \quad T = T_{max}$ expansion)

$t_{merger} \approx 2 t_{max}$

$|E| \propto M \sigma_v^2 \quad M \propto \sigma_v^3$

$|E| = a M^{5/3}$

From eq. 17 to eq. 18

assuming that

$$\Rightarrow J = \frac{\lambda G}{a^{1/2}} M^{5/3} \quad \text{(eq. 17)}$$

$$J_1 = \frac{\lambda G}{a^{1/2}} M_1^{5/3} \qquad J_2 = \frac{\lambda G M_2^{5/3}}{a^{1/2}}$$

$$J_{TOT} = J_1 + J_2 + J_{ORB}$$

$$J_{ORB} = J_{TOT} - J_1 - J_2 = \frac{\lambda G}{a^{1/2}} \left[(M_1 + M_2)^{5/3} - M_1^{5/3} - M_2^{5/3} \right] =$$

$$= \frac{\lambda G}{a^{1/2}} (M_1 + M_2)^{5/3} \left[1 - \frac{M_1^{5/3} + M_2^{5/3}}{(M_1 + M_2)^{5/3}} \right]$$

$$|E_1| = a M_1^{5/3} \qquad |E_2| = a M_2^{5/3} \qquad |E_{TOT}| = |E_1| + |E_2| + E_{orb}$$

$$E_{orb} = |E_{TOT}| - |E_1| - |E_2|$$

$$\underbrace{-\frac{G M_1 M_2}{d_0} + \frac{1}{2} \frac{M_1 M_2}{M_1 + M_2} V_0^2}_{\text{eq. 11 ?}} = -a \left[(M_1 + M_2)^{5/3} - M_1^{5/3} - M_2^{5/3} \right]$$

$$a = \frac{\frac{G M_1 M_2}{d_0} - \frac{1}{2} \frac{M_1 M_2}{M_1 + M_2} V_0^2}{\left[(M_1 + M_2)^{5/3} - M_1^{5/3} - M_2^{5/3} \right]}$$

$$J_{ORB} = \frac{\lambda G \; (M_1+M_2)^{5/3}}{\left(\frac{G(M_1+M_2)}{d_0} - \frac{1}{2} v_0^{\,2}\right)^{1/2} \left(\frac{M_1 M_2}{M_1+M_2}\right)^{1/2}} \cdot (M_1+M_2)^{5/6} \cdot \left[1 - \frac{M_1^{5/3}+M_2^{5/3}}{(M_1+M_2)^{5/3}}\right]^{3}$$

$$= \frac{\lambda G \; M_1 M_2}{\left(\frac{G(M_1+M_2)}{d_0} - \frac{1}{2} v_0^{2}\right)^{1/2}} \cdot \underbrace{\frac{(M_1+M_2)^{3/2}}{M_1^{3/2} \cdot M_2^{3/2}} \left[1 - \frac{M_1^{5/3}+M_2^{5/3}}{(M_1+M_2)^{5/3}}\right]^{3/2}}_{f(M_1,\, M_2)}$$

eq. 18

eq. 19