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The Triangulum Galaxy (M33) contains approx 4.0×10^{10} stars within itself. Its diameter within the plane is about 60,000 ly

The stars in M33 are orbiting at 179 km/s around the center with a velocity dispersion of 16 km/s

a) Estimate the crossing time of the galaxy

b) Estimate the two-body relaxation time, and explain what it means.

$\frac{D}{2} \rightarrow R \rightarrow$ ly to km $\rightarrow \frac{km}{\frac{km}{s}} \rightarrow$

$\frac{60000 ly}{2} \rightarrow 30000 ly \cdot \frac{9.461 \times 10^{12} km}{ly}$

$\rightarrow 2.838 \times 10^{17} km$

$\frac{2.838 \times 10^{17} km}{179 km/s}$

a) $t_{cross_s} = 1.586 \times 10^{15} s$

$t_{cross_y} = 5.03 \times 10^{7} yrs$

$\frac{t_s}{\pi \times 10^7}$

$t_{cross} = \frac{R}{v}$

$N = 4 \times 10^{10}$ stars

b) $3.25 \times 10^{23} s = t_{relax_s}$

$1.0 \times 10^{16} yr = t_{relax_y}$

$t_{relax} = \frac{N}{8 \ln N} t_{cross}$

Relaxation is the timescale where stellar encounters change the orbits of the stars in the galaxy its in.