

Field lines

Along the gravitational vector field \vec{g}

Density of field lines $\propto |\vec{g}|$

All field lines end on bits of mass

Equipotential surfaces

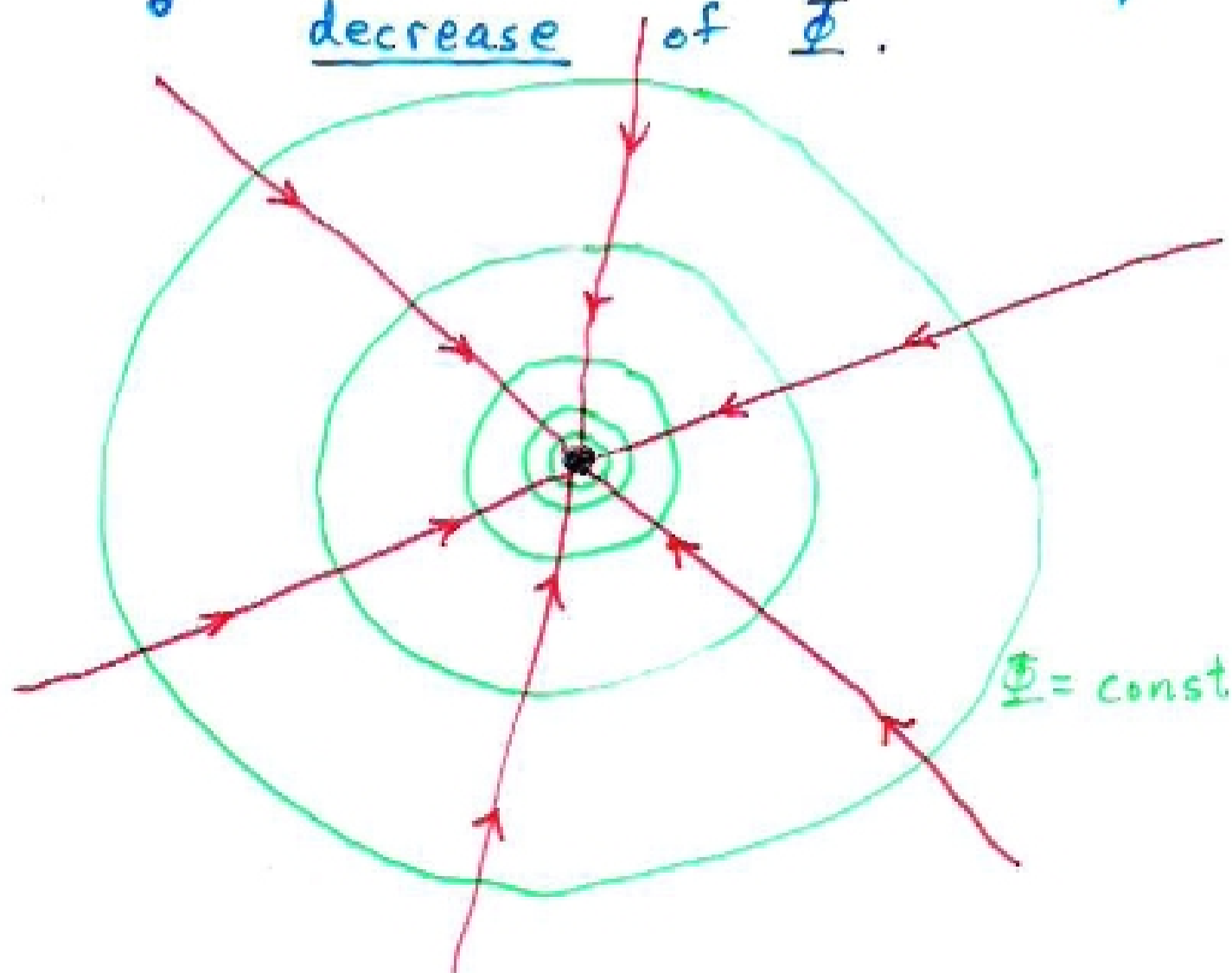
Surfaces of constant value of potential Φ .

Perpendicular to field lines

$$\text{since } \vec{g} = -\nabla\Phi$$

\vec{g} is in direction of most rapid decrease of Φ .

Like a
contour
map



Spiral Galaxies



Face-On



Edge-On



Barred

Example 5.2

Galactic rotation curves.

For central mass M , expect orbits given by

$$\frac{GM}{r^2} = \frac{v^2}{r} \Leftrightarrow v \propto \frac{1}{\sqrt{r}}$$

Observations of stars in spiral galaxies \Rightarrow

$$v(r) \approx \text{constant} \quad \frac{dv}{dr} \approx 0$$

Evidence for dark matter.

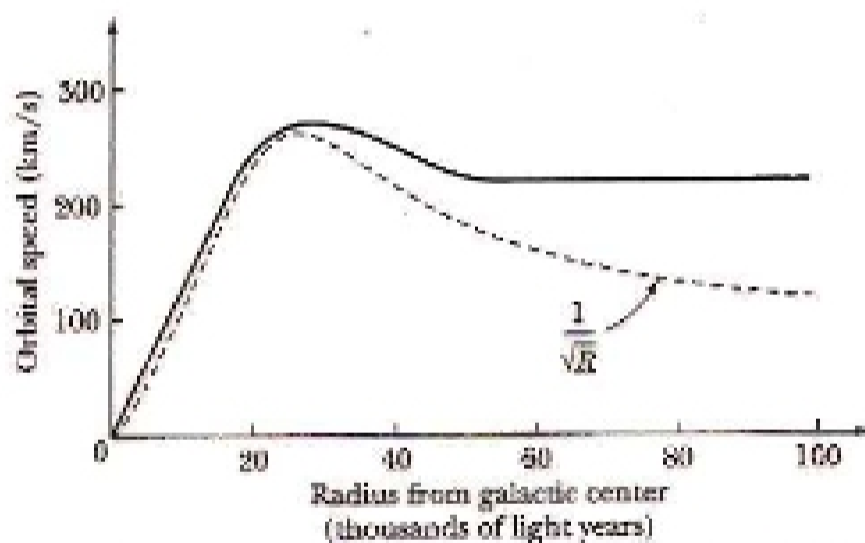


FIGURE 5-5 Example 5.2. The solid line represents data for the orbital speed of mass as a function of distance from the center of the Andromeda galaxy. The dashed line represents the $1/\sqrt{R}$ behavior expected from the Keplerian result of Newton's laws.