PHY 321, MARCH 18, 2022

$$r = |\vec{r}_i - \vec{r}_j|$$

$$= \sqrt{\left[\underbrace{(x_i - x_j)}_{x}^2 + \underbrace{(y_i - y_j)}_{y}^2 + \underbrace{(z_i - z_j)}_{z}^2\right]}$$

Gravitational potential

$$V(r) = -\frac{G M_\odot M_E}{r} = -\frac{\gamma}{r}$$

Ex 3 $\quad V(r) \propto -\dfrac{V_0}{r^{12}}$ and $\dfrac{D_0}{r^6}$

$$\vec{\nabla} V(r) = -\gamma \vec{\nabla}\left(\frac{1}{r}\right)$$

$$= -\gamma\left(\frac{\partial}{\partial x}\vec{\imath} + \frac{\partial}{\partial y}\vec{\jmath} + \frac{\partial}{\partial z}\vec{k}\right)$$

$$\times \quad \frac{1}{r}$$

$$\frac{1}{r} = \frac{1}{\sqrt{x^2+y^2+z^2}}$$

$$x: \quad \frac{\partial}{\partial x}\frac{1}{\sqrt{x^2+y^2+z^2}} = \frac{x}{r^3}$$

$$y: \quad \frac{\partial}{\partial y} \text{ — " — } = \frac{y}{r^3}$$

$$z: \quad \frac{\partial}{\partial z} \text{ — " — } = \frac{z}{r^3} \Rightarrow$$

$$\vec{F} = -\gamma\left(\frac{x}{r^3}\vec{\imath} + \frac{y\vec{\jmath}}{r^3} + \frac{\cancel{y}\vec{k}}{r^3}\right)$$

$$\vec{r} = x\vec{\imath} + y\vec{\jmath} + z\vec{k} \Rightarrow$$

$$\vec{F} = -\gamma\frac{\vec{r}}{r^3} = -\gamma\frac{1}{r^2}\hat{\vec{r}}$$

$$\frac{\partial}{\partial x}\frac{1}{r^{12}} = \frac{\partial}{\partial x}\frac{1}{(x^2+y^2+z^2)^6}$$

$$\vec{\nabla} \times \vec{F}$$