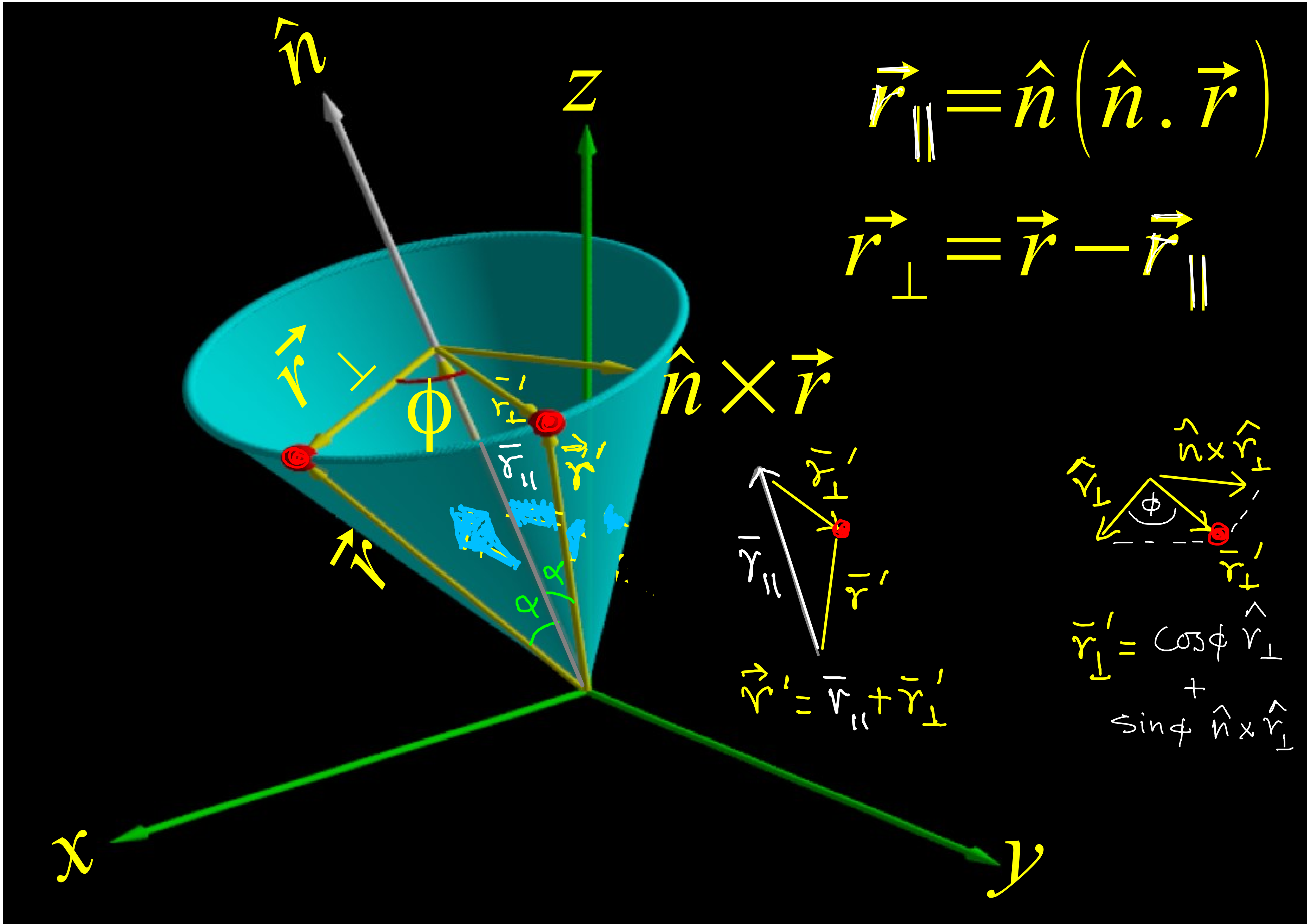
$R(\hat{n}, \phi)$:: Rotating a point about an axis $\hat{n}$ by angle ϕ



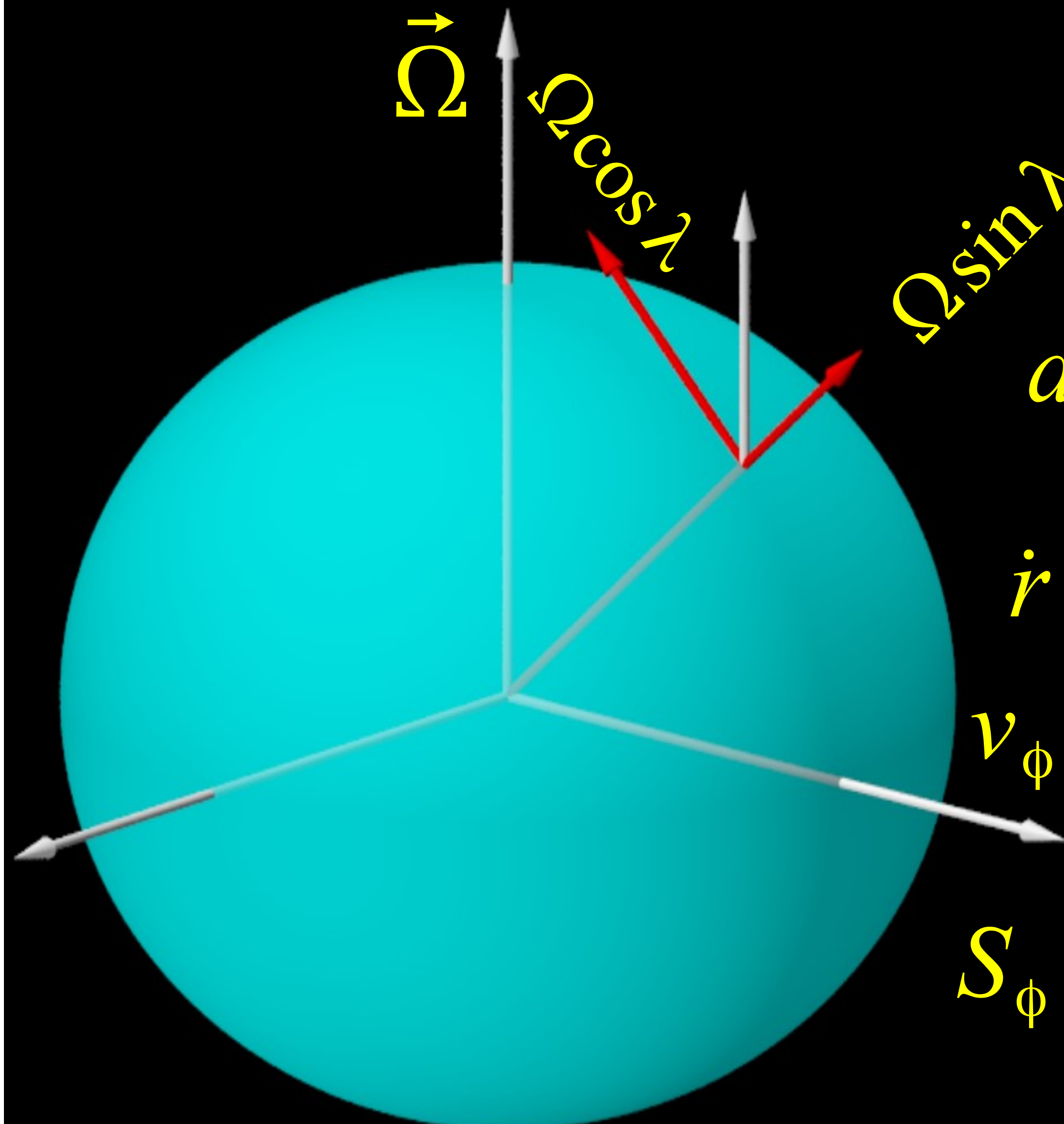
$$\vec{r}\,' \equiv R(\hat{n}, \phi)\vec{r} = \vec{r}\cos\phi + \hat{n}(\hat{n}.\vec{r})[1-\cos\phi] + (\hat{n}\times\vec{r})\sin\phi$$

$R(\hat{n}, \phi)$:: Rotating a point about an axis $\hat{n}$ by angle ϕ

$$
\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} =
\begin{bmatrix}
\cos\phi + n_x^2(1-\cos\phi) & n_x n_y(1-\cos\phi) - n_z\sin\phi & n_x n_z(1-\cos\phi) + n_y\sin\phi \\
n_x n_y(1-\cos\phi) + n_z\sin\phi & \cos\phi + n_y^2(1-\cos\phi) & n_y n_z(1-\cos\phi) - n_x\sin\phi \\
n_x n_z(1-\cos\phi) - n_y\sin\phi & n_y n_z(1-\cos\phi) + n_x\sin\phi & \cos\phi + n_z^2(1-\cos\phi)
\end{bmatrix}
\begin{bmatrix} x \\ y \\ z \end{bmatrix}
$$

In the limit of $\phi \rightarrow 0$ the matrix will become an Identity matrix + infinitesimal anti-symmetric matrix. That is the part which can be represented by a cross product

Deviation of a ball dropped from a balloon at height H



Latitude λ

$$a_{COR} = -2(\Omega\cos\lambda)\dot{r}\,\hat{\phi}$$

$$\dot{r} = -g\,t$$

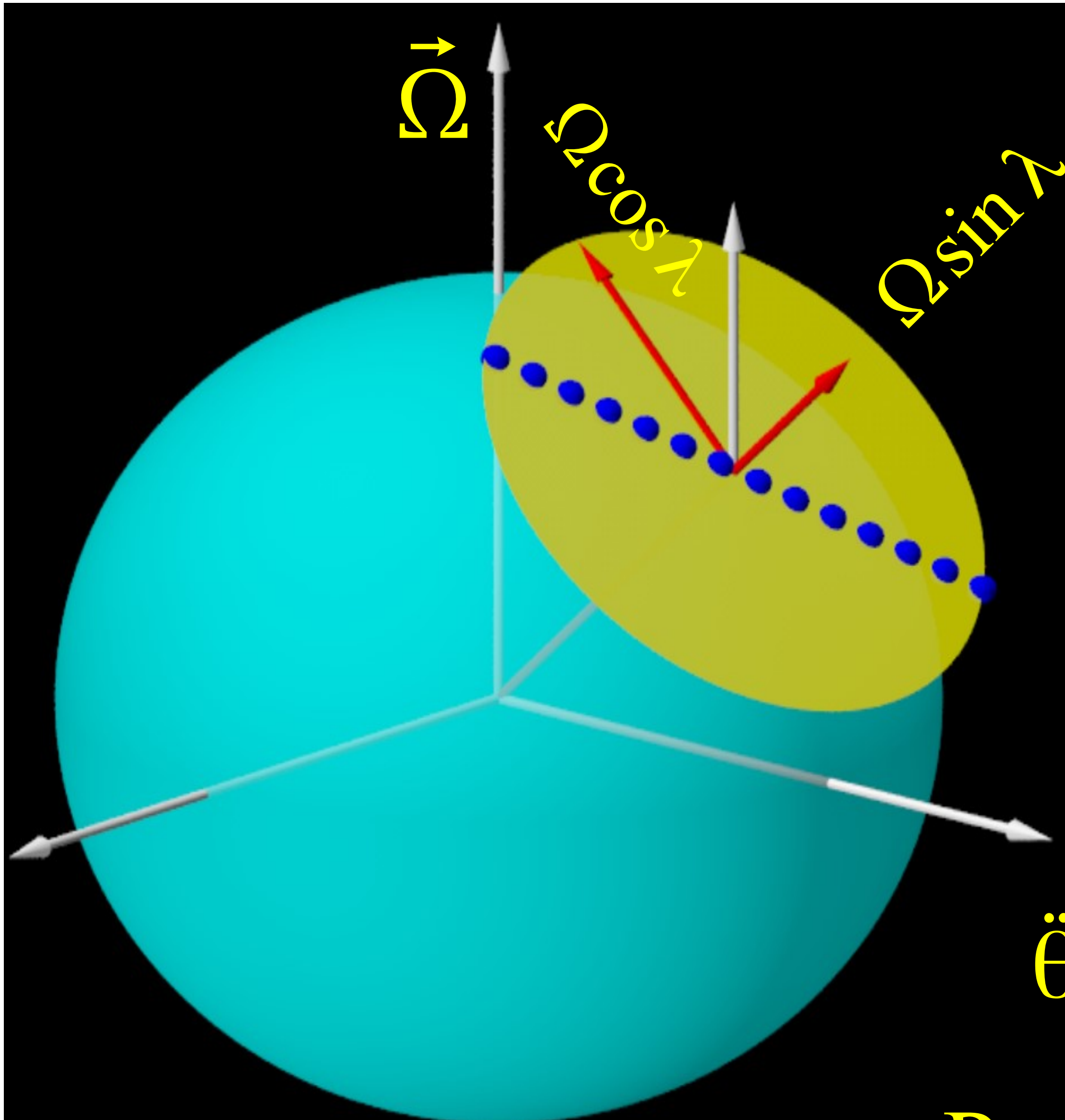
$$v_\phi = \Omega\cos\lambda\, g\, t^2$$

$$S_\phi = \frac{\Omega\cos\lambda}{3}\left(\frac{8H^3}{g}\right)^{1/2}$$

Always to the east.

Q: If a ball is thrown up from ground so that it reaches height H and then comes down, what will be the deviation ? To east or west ?

Foucault's pendulum at a latitude λ



Latitude λ

Plane of oscillation

$$a_{COR} = -2\left(\Omega \sin\lambda\right)\dot{r}\,\hat{\theta}$$

$$a_r = \ddot{r} - \dot{\theta}^2 r$$

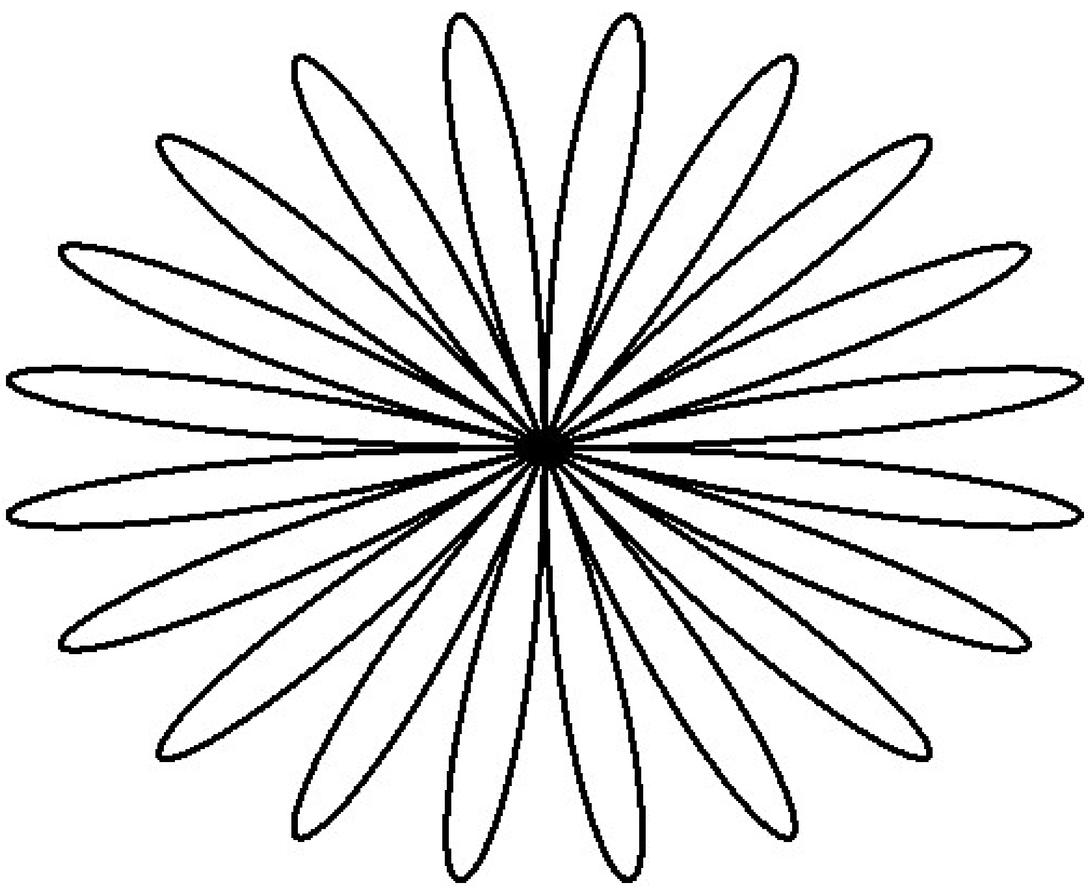
$$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$$

$$\ddot{\theta} \approx 0 \quad \Rightarrow \quad \dot{\theta} = -\Omega\sin\lambda$$

$$\text{Period} = \frac{24}{\sin\lambda}\text{ hours}$$

Foucault's pendulum : The path followed by the bob

$$\left.\begin{aligned} x(t) &= \frac{a}{\sqrt{2}} \sin\omega_0 t \cos\left[\left(\Omega\sin\lambda\right)t\right] \\ y(t) &= \frac{a}{\sqrt{2}} \sin\omega_0 t \sin\left[\left(\Omega\sin\lambda\right)t\right] \end{aligned}\right\} \quad \begin{aligned} T_0 &= \frac{2\pi}{\omega_0} \ll 1 \text{ min} \\ T_F &= \frac{2\pi}{\Omega} = 1 \text{ day} \end{aligned}$$



assuming $\frac{T_F}{T_0} = 10$

In reality $\frac{T_F}{T_0} > 5000$

Too dense to plot !

Does the Corriolis effect differ in northern & southern hemispheres ?

If the velocity of the object is mostly vertical then NO.

e.g. A stone dropped from a balloon will move eastwards irrespective of whether it is done in North or South of equator

If the velocity of the object is horizontal then YES

e.g Wind circulation, Foucault's pendulum etc

Statutory warning : The Corriolis acceleration is a small effect. It is not possible to observe this in a washbasin, bathtub etc. Beware of many such FAKE VIDEOS !!