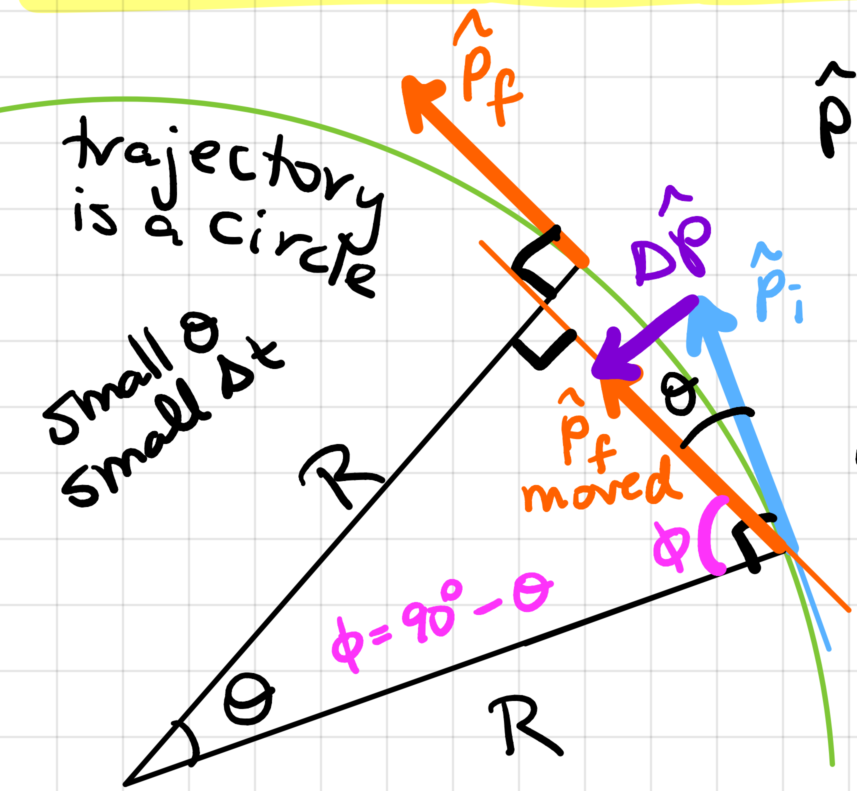
Detailed derivation of $\vec{F}_{net\perp}$



$\hat{p}_i \perp R$ & $\hat{p}_f \perp R$

$\phi = 180° - 90° - \theta = 90° - \theta$
(triangle made by R, R, $\hat{p}_f$)

$\phi + \theta = 90°$ b/c $\hat{p}_i \perp R$

$\Rightarrow$ Angle between $\hat{p}_i$ & $\hat{p}_f$ is θ

Arc length subtended by angle θ between two radiuses: $S = R\theta$

This is also a distance: $S = |\vec{v}|\Delta t$

Putting it together: $R\theta = |\vec{v}|\Delta t \Rightarrow \theta = \frac{|\vec{v}|\Delta t}{R}$

$\Delta\hat{p} = \hat{p}_f - \hat{p}_i \Rightarrow$ direction of $\Delta\hat{p}$ defined as $\hat{n}$

$|\Delta\hat{p}| = |\hat{p}_i|\theta = \theta$ b/c arc length & $|\hat{p}_f| = |\hat{p}_i| = 1$

$$\Delta\hat{p} = \theta\,\hat{n} = \frac{|\vec{v}|\Delta t}{R}\hat{n}$$

$$\frac{\Delta\hat{p}}{\Delta t} = \frac{|\vec{v}|}{R}\hat{n}$$

$$\vec{F}_{net\perp} = |\vec{p}|\frac{d\hat{p}}{dt} = |\vec{p}|\frac{|\vec{v}|}{R}\hat{n} = \frac{mv^2}{R}\hat{n}$$