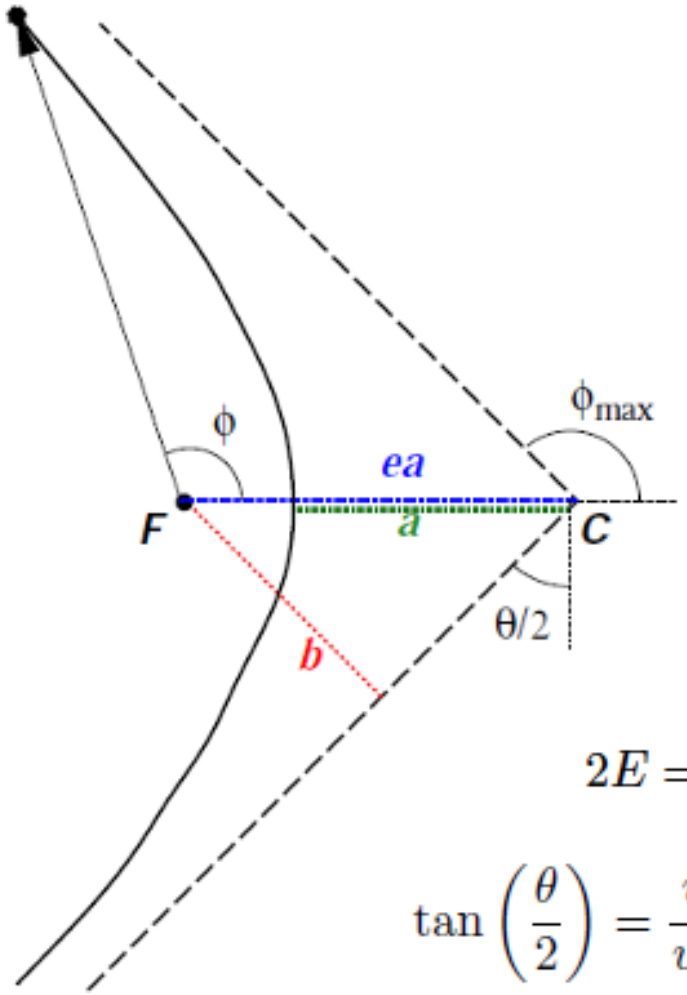

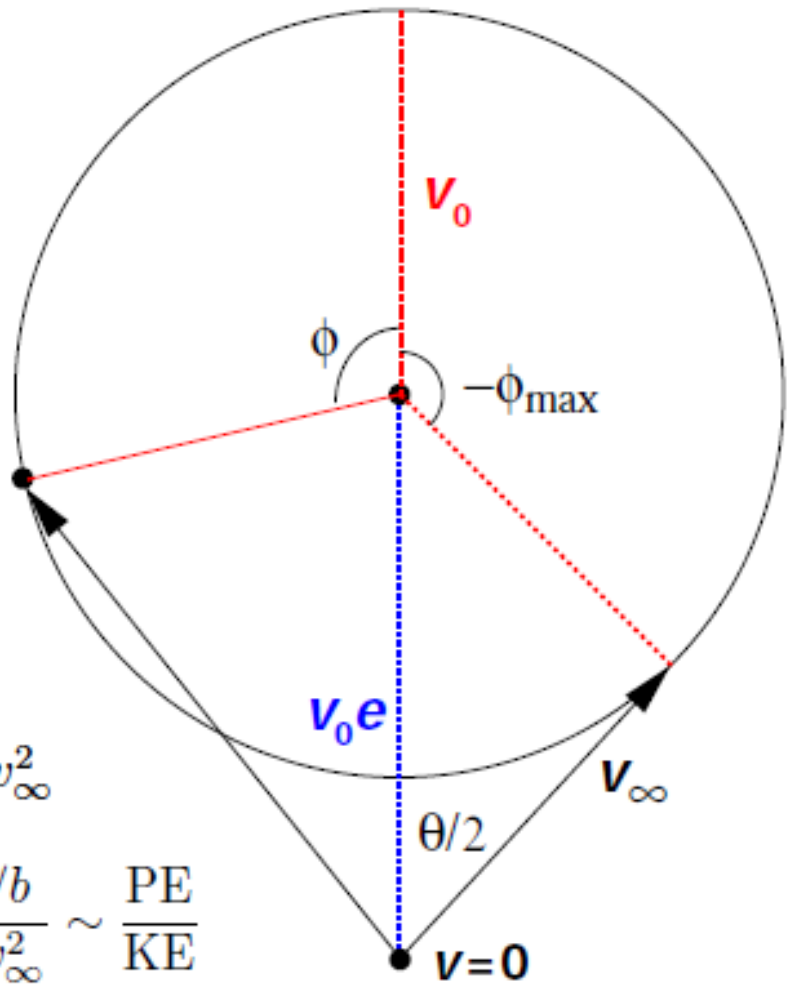

$$2E = \frac{\alpha}{a} = m v_\infty^2$$

$$\tan\left(\frac{\theta}{2}\right) = \frac{v_0}{v_\infty} = \frac{\alpha/b}{m v_\infty^2} \sim \frac{\mathrm{PE}}{\mathrm{KE}}$$

impact parameter: $b = a\sqrt{e^2-1}$

$$\tan\left(\frac{\phi}{2}\right) = \sqrt{\frac{e+1}{e-1}}\,\tanh\left(\frac{u}{2}\right)$$

$$r = \frac{a(e^2-1)}{1+e\cos\phi}$$

$$e\sinh u - u = \omega t \qquad \text{where: } \omega = \sqrt{\frac{\alpha}{m a^3}}$$

$$L = m r^2 \dot{\phi} = m v_\infty b = \sqrt{\alpha m a (e^2-1)}$$

$$v_0 = \sqrt{\frac{\alpha}{m a (e^2-1)}} = \frac{v_\infty}{\sqrt{e^2-1}}$$

$$\cos(\phi_{\max}) = -\frac{1}{e} = -\sin(\theta/2) \qquad \phi_{\max} = \theta/2 + \pi/2 \qquad r = a(e\cosh(u)-1)$$