

Central Forces Orbits

Keep in your notebook

In the Mathematica worksheet, <http://physics.oregonstate.edu/ph426/mathematica/cforbits.nb>, you will be examining how various parameters affect orbits.

1. **Work through the worksheet until you have plotted the effective potential.** Look at the graph of the effective potential. Draw your prediction of the shape of the orbit using information from the graph of the effective potential. Indicate on your plot the vectors \vec{r}_{\min} and \vec{r}_{\max} .
2. **Continue through the worksheet.** Compare the plot of the orbit to your prediction.
3. The blue dots on the orbit plot are points of the orbit at equal time intervals. Why are the dots more widely spaced in some places? What information about the spacing can you get from the effective potential diagram?
4. **Go through the worksheet several times, experimenting with different parameters.** What values of the parameters give you elliptic orbits? hyperbolic? circular?
5. (Challenge) Try some other potentials such as:
Harmonic Oscillator: $U(r) = \frac{kr^2}{2}$
First Order General Relativistic Correction: $U(r) = -\frac{k}{r} + \frac{\delta}{r^3}$, for δ very small.