

## ASTR450 Homework # 7 – The N-Body and 3-Body Problems Due Thursday, April 2

Reading: Read Chapter 8.

1. (Easy) The Last Danby Problem in ASTR450! Page 280, Problem 5. You will need to find  $i$  and  $\Omega$  for Jupiter and Saturn from the appendix, and will need the expressions 6.15.1 on page 203.
2. (Moderate) Chapter 8. Rewrite Tisserand's Criterion so that it applies to i) parabolic-parabolic transitions and ii) parabolic-elliptical and parabolic-hyperbolic transitions. Answer the following questions using the approximations that i) the Tisserand Constant is exactly conserved and ii) Jupiter affects the comet only when it is very close to Jupiter. Can Jupiter put parabolic  $i = 0$  comets onto circular uninclined orbits? Can a prograde parabolic ( $i < 90^\circ$ ) comet be perturbed onto a retrograde ( $i > 90^\circ$ ) parabolic orbit? Onto a retrograde elliptical or hyperbolic orbit?
3. (Moderate/Hard) Finish the subroutines to translate between the mean anomaly  $M$ , the eccentric anomaly  $E$ , and the true anomaly  $\nu$  for elliptic orbits. Find  $E$  and  $\nu$  given  $M = \pi/2$ ,  $e = 0.8$ . Write down an inequality relating the three anomalies over the pericenter to apocenter half of the orbit. How does this change for the apocenter to pericenter half? Please turn in 1) a listing of your code, 2) a transcript of a rigorous series of tests that you subjected it to, and 3) a version of the code that will run on the department computers. You may find the 3D orbit viewer at <http://janus.astro.umd.edu/orbits/3dview.html> useful for checking your conversions.