

- Talk about the negative heat capacity of the Keplerian orbit, and self gravitating systems in general

The key idea of astrophysics

- stars
- magnetorotational Instability

→ If we can't choose the plane to describe the 2-body motion, we need to deal with the orbit in 3D space:

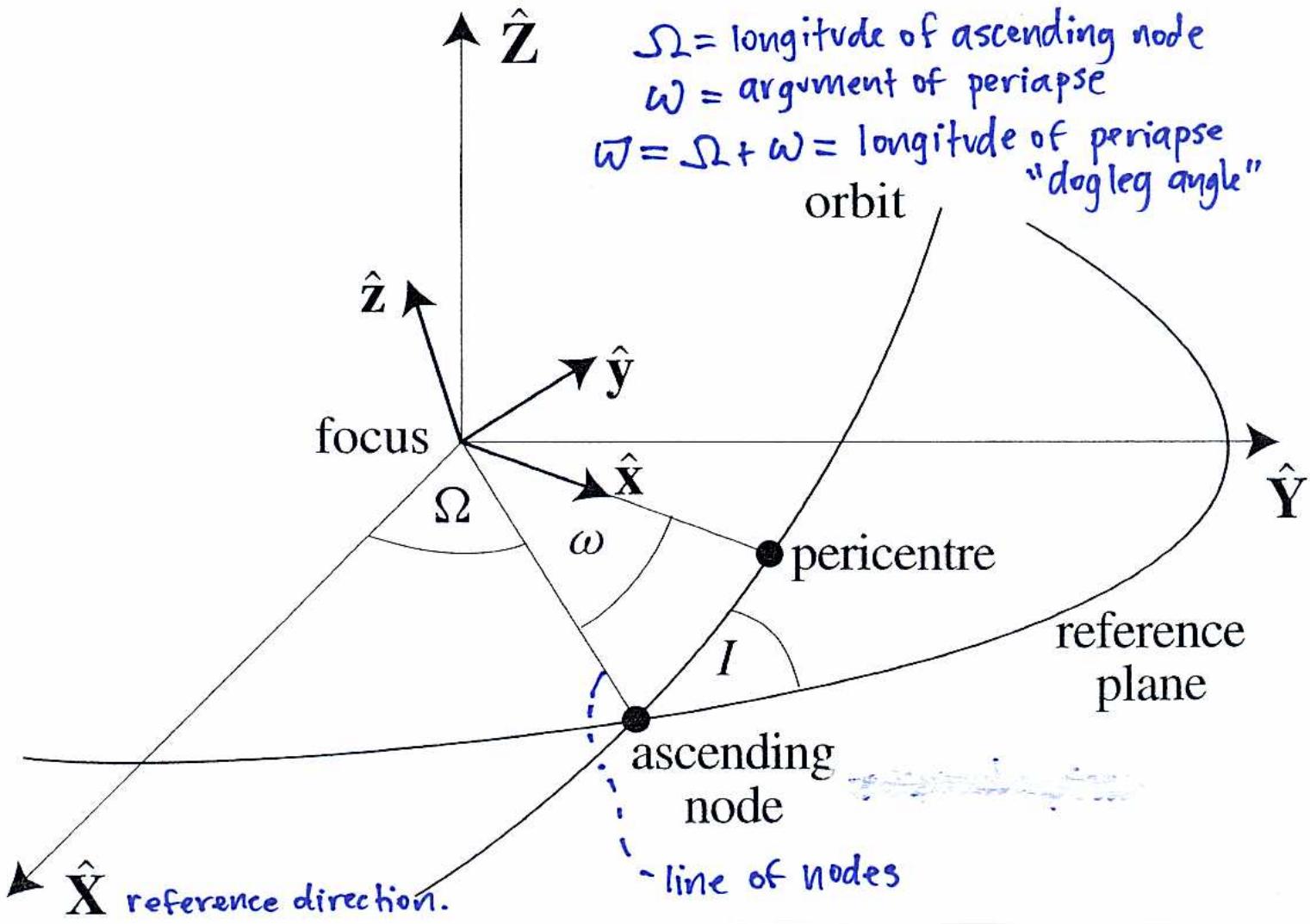
$I$  = inclination

$\hat{Z}$

$\Omega$  = longitude of ascending node

$\omega$  = argument of perihelion

$\varpi = \Omega + \omega$  = longitude of perihelion  
orbit "dog leg angle"



Orbital elements  
cartesian  $\vec{x}, \vec{v}$

$a, e, M, \Omega, \omega, I$  are equivalent to  
 $x, y, z, v_x, v_y, v_z$

↳ see routines in integrator.f.

$M$  is the only non-conserved element...