Moments of Inertia

Body	$I/(MR^2)$
Mercury	0.33
Venus	0.33
Earth	0.33
Moon	0.393
Mars	0.366
Jupiter	0.254
Saturn	0.210
Uranus	0.23
Neptune	0.23
Io	0.375 ± 0.005
Europa	0.348 ± 0.002
Ganymede	0.311 ± 0.003
Callisto	0.358 ± 0.004

If gravitational potential energy from the contraction of the Sun was its main source of power, then if we assume half of its energy is radiated away and

$$E_\odot^{rad} = \frac{1}{2}\Delta E_B = \frac{1}{2}\left(\frac{3}{5}\frac{GM^2}{R}\right)$$

$$\sim \frac{3}{10} \times \frac{(20/3 \times 10^{-11})(2\times10^{30})^2}{(7\times10^8)}$$

$$\sim 10^{41} \text{ Joules}$$

Kelvin-Helmholtz timescale

$$\tau_{KH} \sim \frac{E_\odot^{rad}}{L_\odot} \sim \frac{10^{41}}{4\times10^{26}} \sim \frac{2}{3}\times10^7 \text{ years.}$$

Lifetime of the Sun if only gravitational potential energy was available.
Problem resolved by the discovery of nuclear reactions.

Deviations from spherical symmetry

The main reasons for violation of spherical symmetry for a planetary body are

1). Rotation
2). An external gravitational field (eg. tides).

Rotation deformation, symmetric around the rotation axis is driven by the ratio

$$\mu_c = \frac{R^3\omega^2}{GM}$$

(ratio of rotational energy to gravitational binding energy of the body.

$$\left(\mu_c \sim \frac{I\omega^2}{GM^2/R} \sim \frac{MR^2\omega^2}{GM^2/R} \right)$$

Helmerts parameter

On the surface the deformation is measured by the oblateness (assumed small)

$$\epsilon = \frac{R_e - R_p}{R} \simeq \mu_c$$

R_e equatorial radius
R_p polar radius
R mean radius

The oblateness is enhanced by collapse or compression