

Chapter 09: Giant Planets and Magnetospheres Highlights

Gas Giants: _____

Ice Giants: _____

All four giant planets have significant magnetic fields (*Table p.11*)

_____ emit ~twice the energy received by the Sun

We believe _____ have rocky/metallic cores, but we still don't know for sure.

Metallic hydrogen: a degenerate phase of H in which it behaves like an _____. A few university research labs have claimed to have produced metallic H, but it hasn't been rigorously confirmed.

Short calculation: test the claim that Jupiter emits about twice the amount of energy received from the Sun. What is necessary to do this calculation?

$$f_{\text{Jupiter}} =$$

$$f_{\text{Sun}} =$$

$$f_{\text{Jupiter}} / f_{\text{Sun}} =$$

The excess energy emitted by Jupiter can be attributed to gravitational contraction—Jupiter loses energy by shrinking and releases it as thermal energy.

Previously we learned that the gravitational potential energy of a massive object is (see Chapter 5 notes from 01 March 2018):

$PE_{\text{gravity}} =$

Cyclotron frequency

Fortunately, the Earth's magnetopause serves to deflect away much of the Solar wind. However, some charged particles penetrate the magnetopause and become trapped in the magnetosphere (see Dobson Figure 9.23). They are trapped due to the magnetic force acting on a charged particle:

$$F_{\text{magnetic}} =$$

and for a uniform magnetic the motion is circular, implying:

$$F_{\text{magnetic}} =$$

$$r_{\text{circular}} =$$

$$f_{\text{cyclotron}} =$$

Concept question: If the gas giants are substantially gas (and not entirely rocky), why aren't they flattened like planetary and galaxy disks?

The table on page 3 shows that the "moment of inertia factors" for the gas giants are all < 0.4 . What does this imply?

What does it mean for the Earth to have a moment of inertia factor of 0.33?

Dobson Chapter 09 slides 21-24 on Jupiter & Saturn

BBC video on the composition of Saturn's rings

Brief activity: Do the activity on storms on Jupiter & Earth, located under Chapter 09 Tutorials and Group Questions.

Dobson Chapter 09 slides 34-44 on magnetospheres

The aurorae are manifestations planetary magnetospheres