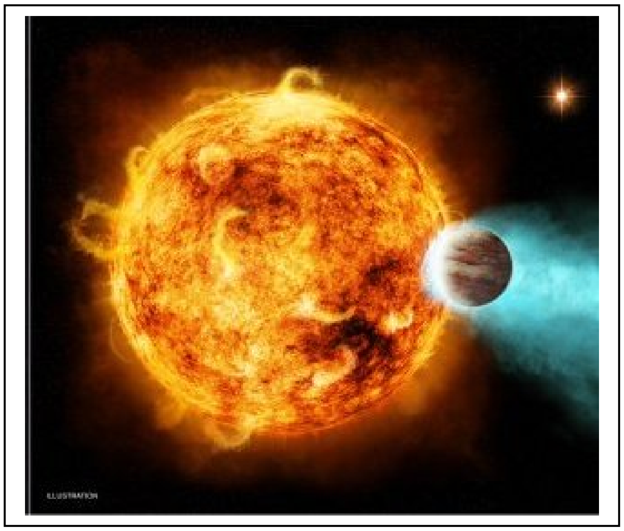
Chandra 'Sees' a Distant Planet Evaporating



NASA's Chandra Observatory has discovered that the star CoRot-2a is a powerful X-ray source. This is unfortunate because it is also known that a planet orbits this star at a distance of only 5 million kilometers. Called CoRoT-2b, the planet is three times the mass of Jupiter, and probably has an atmosphere similar to that of Jupiter given its size. Every second, the planet loses about 5 million tons of matter due to its star's radiation.

The star CoRoT-2a is located 880 light years from Earth. The planet orbits its star once every 1.7 days.

The star, CoRoT-2a is similar to our own sun while the planet is about 1.4 times the diameter of Jupiter. The heating of its upper atmosphere to temperatures of 1,500 K have caused the planet to 'puff out' in size due to the added heat energy.

A simple model of this planet's interior suggests that its atmosphere might account for as much as 50% the mass of the planet. By comparison, the mass of Jupiter is about 1.9×10^{27} kilograms or 315 times the mass of Earth.

Problem 1 - About what is the mass of the atmosphere of CoRoT-2b in kilograms?

Problem 2 - Based on the rate at which the planet is being evaporated, about how many years might the planet survive before losing all of its atmosphere if the rate is constant the whole time? (1 ton = 1000 kg)

Problem 1 - About what is the mass of the atmosphere of CoRoT-2b in kilograms?

Answer: Mass = 0.50 x 3.0 Jupiters x (1.9 x 10^{27} kilograms / 1 Jupiter)
= **2.9 x 10^{27} kilograms**

Problem 2 - Based on the rate at which the planet is being evaporated, about how many years might the planet survive before losing all of its atmosphere if the rate is constant the whole time? (1 ton = 1000 kg)

Answer: The mass loss rate is stated as 5 million tons per second .In terms of its loss per year R = 5 x 10^{6} tons x (1000 kg/1 ton) x (3.1 x 10^{7} seconds/ 1 year)
= 1.6 x 10^{17} kilograms/year

The mass of the planets atmosphere is M = 2.9 x 10^{27} kilograms, so
Time = Amount / Rate and so
Time = 2.9 x 10^{27} kilograms / (1.6 x 10^{17} kilograms/year)
= **18 billion years**.

Note: Mass loss rates for planets can sound HUGE, but with few exceptions, planets can usually survive for a period of time longer than the lifetime of their star (10 - 20 billion years) even with such very high rates of mass loss!