

## COLLIDING ATMOSPHERES: MARS VS COMET SIDING SPRING

On October 19, 2014, Comet Siding Spring will pass by Mars only 132,000 km away--which would be like a comet passing about 1/3 of the distance between Earth and the Moon. The nucleus of the comet won't hit Mars, but there could be a different kind of collision. **"We hope to witness two atmospheres colliding,"** explains David Brain of the University of Colorado's Laboratory for Atmospheric and Space Physics. "This is a once in a lifetime event!"

Everyone knows that planets have atmospheres. Lesser known is that comets do, too. The atmosphere of a comet, called its "coma," is made of gas and dust that spew out of the sun-warmed nucleus. The atmosphere of a typical comet is wider than Jupiter.

It is possible that the atmosphere of the comet will interact with the atmosphere of Mars. This could lead to some remarkable effects—including Martian auroras. The timing could scarcely be better. Just last year, **NASA launched a spacecraft named MAVEN to study the upper atmosphere of Mars, and it will be arriving in Sept. 2014 barely a month before the comet.**

MAVEN is on a mission to solve a longstanding mystery: What happened to the atmosphere of Mars? Billions of years ago, Mars had a substantial atmosphere that blanketed the planet, keeping Mars warm and sustaining liquid water on its surface. Today, only a wispy shroud of CO<sub>2</sub> remains, and the planet below is colder and dryer than any desert on Earth. Theories for this planetary catastrophe centre on erosion of the atmosphere by solar wind.

The goal of the MAVEN mission is to understand how external stimuli affect the atmosphere of Mars. When the mission was planned only the effect of the sun and the solar wind were considered. But Comet Siding Spring represents an opportunity to observe a natural experiment, in which additional perturbation is applied and the response of the Martian atmosphere can be studied. **The MAVEN science team, thinks the comet could spark Martian auroras.** Unlike Earth, which has a global magnetic field that shields our entire planet, Mars has a patchwork of "magnetic umbrellas" that sprout out of the surface in hundreds of places all around the planet. **If Martian auroras occur, they would appear in the canopies of these magnetic umbrellas.** Both MAVEN and the Hubble Space Telescope will be looking for this. Any auroras seen will be a very useful diagnostic tool for how the comet and the Martian atmosphere have interacted.

**The atmosphere of the comet includes not only streamers of gas, but also dust and other debris blowing off the nucleus at 56 kilometres per second relative to Mars.** At that velocity, even particles as small as half a millimetre across could damage spacecraft. NASA's fleet of Mars orbiters including MAVEN, Mars Odyssey and Mars Reconnaissance Orbiter will manoeuvre to put the body of Mars between themselves and the comet's debris during the dustiest part of the encounter.

It's not yet clear whether any significant dust or gas will hit the Mars atmosphere, but if it does, it would have the greatest effects on the upper atmosphere. Meteoroids disintegrating would deposit heat and temporarily alter the chemistry of upper air layers. The mixing of cometary and Martian gases could have further unpredictable effects. Although MAVEN, having just arrived at Mars, will still be in a commissioning phase, it will use its full suite of instruments to monitor the Martian atmosphere for changes. **By observing both before and after, it is hoped to determine what effects the comet dust and gas have on Mars, if any.**

Whatever happens, MAVEN will have a ringside seat. AK

