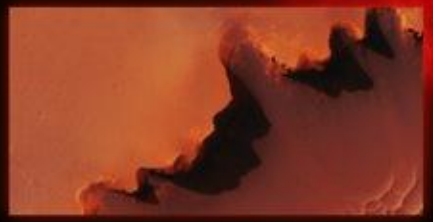
National Aeronautics and Space Administration

NASA Science

Weekly Highlights
August 2, 2013


EARTH SCIENCE

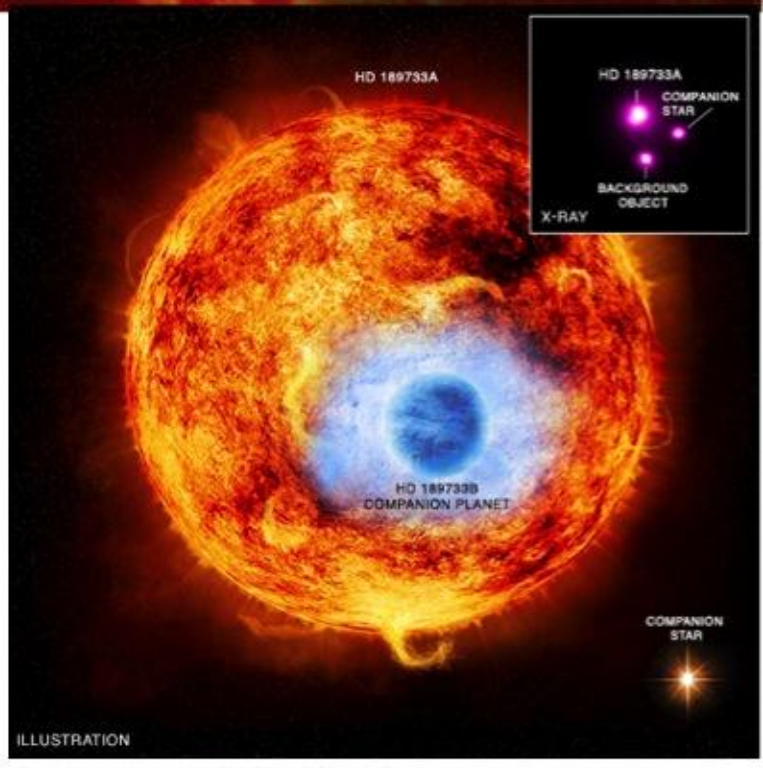

HELIOPHYSICS


PLANETARY SCIENCE


ASTROPHYSICS

HD 189733: Chandra Sees Eclipsing Planet in X-rays for First Time

- This graphic depicts HD 189733b, the first exoplanet caught passing in front of its parent star in X-rays. NASA's Chandra X-ray Observatory and the ESA's XMM Newton Observatory have been used to observe a dip in X-ray intensity as HD 189733b transits its parent star.
- The main figure is an artist's impression showing the HD 189733 system, containing a Sun-like star orbited by HD 189733b, an exoplanet about the size of Jupiter. This "hot Jupiter" goes around the star once every 2.2 days, as determined from previous observations. Also in the illustration is a faint red companion star, which was detected for the first time in X-rays with these observations. This star orbits the main star about once every 3,200 years.
- The inset contains the Chandra image of HD 189733. The source in the middle is the main star and the source in the lower right is the faint companion star. The source at the bottom of the image is a background object not contained in the HD 189733 system.
- The exoplanet itself cannot be seen in the Chandra image, as the transits involve measuring small decreases in X-ray emission from the main star. The authors estimate that the percentage decrease in X-ray light during the transits is about three times greater than the corresponding decrease in optical light. This tells them that the region blocking X-rays from the star is substantially larger than the region blocking optical light from the star, helping to determine the size of the planet's atmosphere. The extended atmosphere implied by these results is shown by the light blue color around the planet. Recent observations of HD 189733b with the Hubble Space Telescope have confirmed that the lower atmosphere of the planet has a deep blue color, due to the preferential scattering of blue light by silicate particles in its atmosphere.
- For about a decade astronomers have known that ultraviolet and X-ray radiation from the main star in HD 189733 are evaporating the atmosphere of its closely orbiting planet over time. The authors of the new study estimate that HD 189733b is losing between 100 million and 600 million kilograms per second. This rate is about 25% to 65% higher than it would be if the planet's atmosphere were not extended.



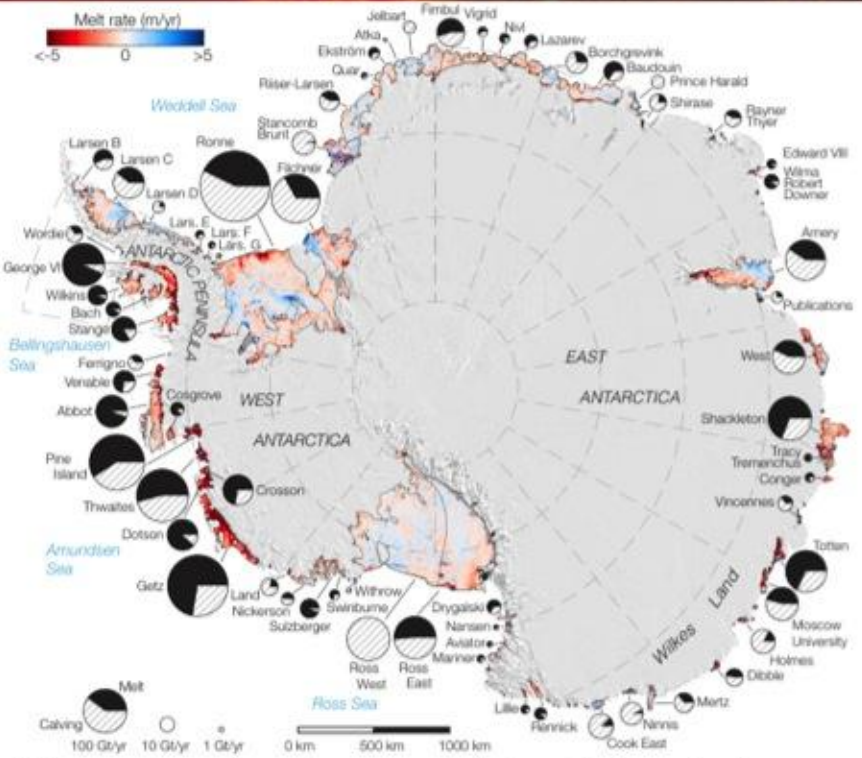
Credit: X-ray: NASA/CXC/SAO/K.Poppenhaeger et al; Illustration: NASA/CXC/M.Weiss

- At a distance of just 63 light years, HD 189733b is the closest hot Jupiter to Earth, which makes it a prime target for astronomers who want to learn more about this type of exoplanet and the atmosphere around it.
- Chandra was used to make observations of six transits by HD 189733b and the team also used archival data from XMM-Newton for one transit. These results are available online and will appear in a future issue of The Astrophysical Journal.

Ice Shelf Melting Around Antarctica

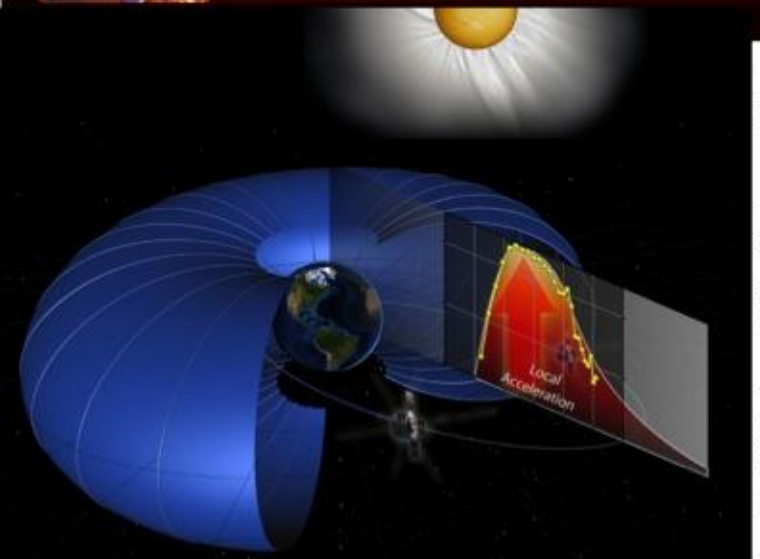
Rignot et al. (2013), Science, doi: 10.1126/science.1235798

- As dynamic features that control the flow of ice from the interior, understanding changes in ice shelves is critical to determining Antarctica's contribution to current and future sea level rise.
- NASA-funded scientists used ice thickness and altimetry data—from **Operation IceBridge**, ground-based radar echo sounding, and interferometric SAR (inSAR) satellite data—along with reconstructions of surface accumulation to complete a comprehensive survey of Antarctic ice shelves.
- They discovered that ***ice shelves lose the most mass to melting as opposed to calving***, which had traditionally been thought to be the far-dominant mechanism for ice removal. Overall, they estimated the basal melt rate to be 1325 +/- 235 Gt/yr, compared to an iceberg calving flux of 1089 +/- 139 Gt/yr.
- **They also found that the massive ice shelves in the Ross and Weddell seas are melting the least, with the majority of melt produced by smaller ice shelves along the Antarctic Peninsula, and West Antarctica, where warmer ocean waters consume the outflow of ice from glacier inflows within a few km of the coast.**



Above: Basal melt rates of Antarctic ice shelves color coded from < –5 m/year (freezing) to > +5 m/year (melting) and overlaid on a 2009 MODIS mosaic of Antarctica. Ice-shelf perimeters in 2007–2008, excluding ice rises and ice islands, are thin black lines. Each circle graph is proportional in area to the mass loss from each shelf, in gigatons (1 Gt = 1012 kg) per yr, partitioned between iceberg calving (hatch fill) and basal melting (black fill).

NASA's Van Allen Probes Discover Particle Accelerator in the Heart of Earth's Radiation Belts



Recent observations by NASA's twin Van Allen Probes show that particles in the radiation belts surrounding Earth are accelerated by a local kick of energy, helping to explain how these particles reach speeds of 99 percent the speed of light. Image Credit: G. Reeves/M. Henderson

- Scientists have discovered a massive particle accelerator in the heart of one of the harshest regions of near-Earth space, a region of super-energetic, charged particles surrounding the globe called the Van Allen radiation belts.

- Scientists knew that *something* in space accelerated particles in the radiation belts to more than 99 percent the speed of light but they didn't know what that something was. New results from NASA's Van Allen Probes show that the acceleration energy comes from within the belts themselves.

- The acceleration source is a region of intense electromagnetic waves that tap energy from other particles located in the same region. Knowing the location of the acceleration will help scientists improve space weather predictions, because changes in the radiation belts can be risky for satellites near Earth.

- In fact, scientists realized that the belts don't even change consistently in response to what seem to be similar stimuli. Some solar storms caused the belts to intensify; others caused the belts to be depleted, and some seemed to have almost no effect at all. Such disparate effects from apparently similar events suggested that this region is much more mysterious than previously thought. To understand – and eventually predict – which solar storms will intensify the radiation belts, scientists want to know where the energy that accelerates the particles comes from.

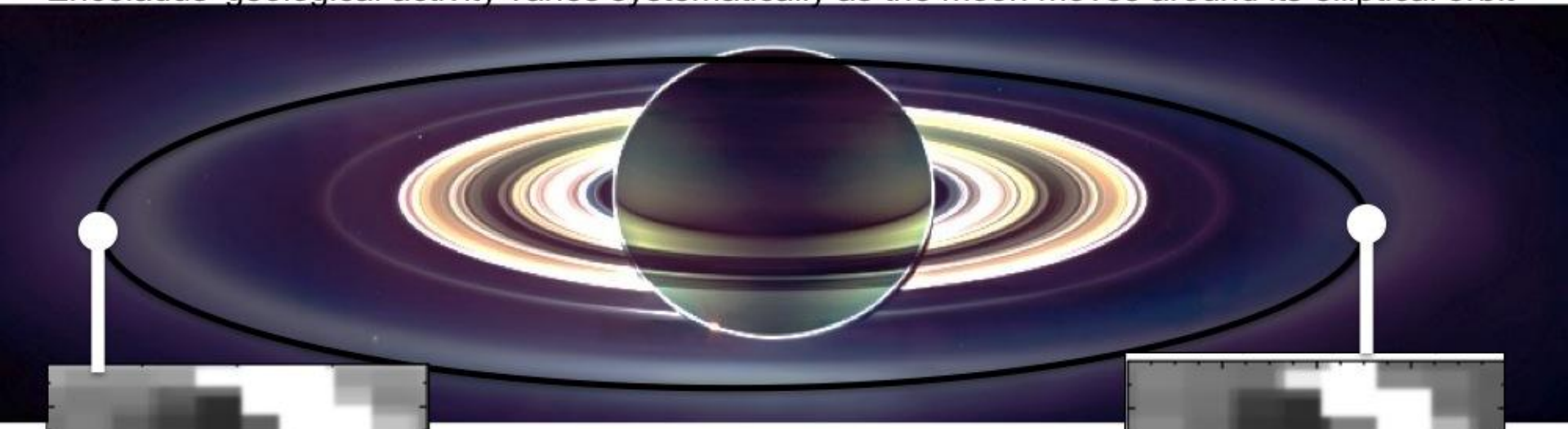
- The Van Allen Probes were designed to distinguish between two broad possibilities on what processes accelerate the particles to such amazing speeds: radial acceleration or local acceleration. The twin Van Allen Probes provide two sets of observations that measure the particles and energy sources in two regions of space simultaneously. Equipped with this data, scientists observed a rapid energy increase of high-energy electrons in the radiation belts on Oct. 9, 2012. The observations showed an increase in energy that started in the middle of the radiation belts and gradually spread both inward and outward, implying local acceleration.

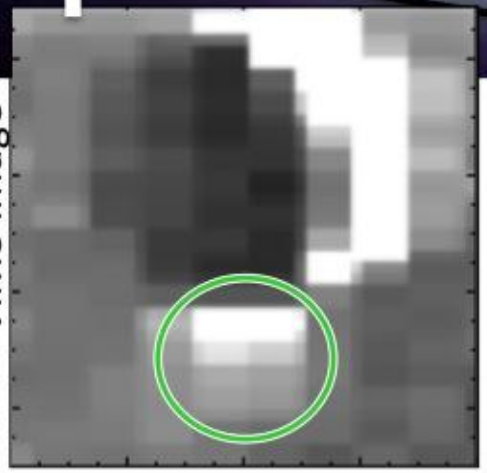
- Scientists believe these new results will lead to better predictions of the complex chain of events that intensify the radiation belts to levels that can disable satellites. While the work shows that the local energy comes from electromagnetic waves coursing through the belts, it is not known exactly which such waves might be the cause. During this set of observations, the Van Allen Probes observed a specific kind of wave called chorus waves at the same time as the particles were accelerated, but additional study is needed to determine cause and effect.

Cassini Finds Tidal Forces Controlling Enceladus' Jets

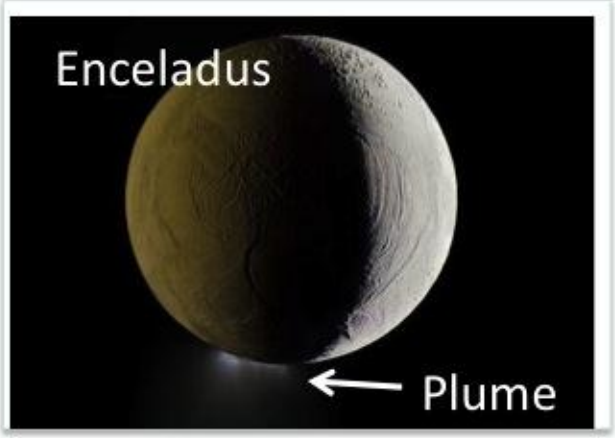
Hedman, et al. An observed correlation between plume activity and tidal stresses on Enceladus (Nature 2013)

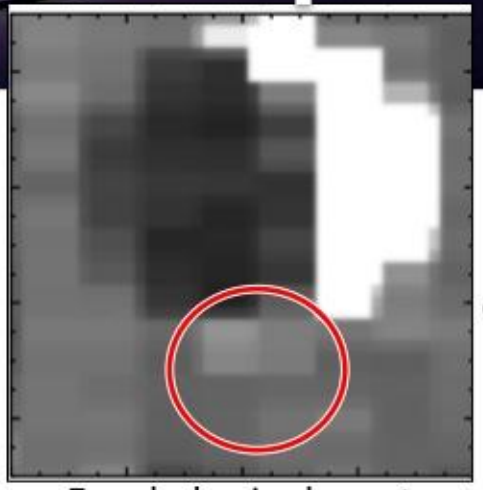
Enceladus' geological activity varies systematically as the moon moves around its elliptical orbit





VIMS Image





VIMS Image

When Enceladus is further from Saturn, fissures might be pulled open and *more material* appears to escape from the moon

When Enceladus is closer to Saturn, fissures might be pushed shut and *less material* appears to escape from the moon

Tactile Books Provide Education Access
National Federation of the Blind Convention 2013

NASA has developed two tactile books to assist blind learners in understanding the appearance of the surface of the Moon and Mars:

- *Getting a Feel for Lunar Craters* NP-2011-05-733-HQ
- 2012 MSL and Gale Crater Tactile Set http://www.hapticallyspeaking.com

The books were showcased at the 2013 National Federation of the Blind convention held recently in Orlando, Florida. They provide learners of all ages with a unique opportunity to learn more about the beauty and complexity of these other celestial bodies, using the sense of touch rather than vision.

The books were updated to reflect the recent *GRAIL* and *MSL* missions, and will be showcased at upcoming *LADEE* and *MAVEN* mission launch events.

The NASA tactile books were a big hit with NFB conference attendees, especially the younger ones!

R: A child exploring one of the tactile books

L: A 13-year-old from Anchorage, Alaska, explores *Getting a Feel for Lunar Craters*