

## IMAGES TO ORDER

Using a big research telescope in Hawaii is a dream for most amateur sky watchers. That dream recently came true for two Canadian amateur astronomy groups. On May 15 their stunning images were unveiled during a special ceremony at the Canadian Astronomical Society annual meeting held at the Université de Montréal (Montréal, QC) from May 15 to 17.

The two images both show stars in early stages of their life. The 8-m diameter Gemini North telescope was used to image RY Tau, a star emerging from its stellar cocoon (Figure 1), at the request of the Club d'astronomie de Dorval, Quebec. The Big Sky Astronomical Society of Vulcan, Alberta requested an image of the Pleiades (figure 2), to be taken with the 3.6-m diameter Canada-France-Hawaii Telescope.

The groups won the opportunity to request these images after a Canada-wide contest. The contest, which began in 2004, solicited proposals from more than a

hundred amateur astronomy clubs throughout Canada as a way to thank them for the work they do to support and excite the public about astronomy. The winning proposals were selected by a process similar to that used by professional astronomers, where selection criteria include scientific merit and an assessment of the uniqueness of the observation.

Gilbert St-Onge is a member of the Quebec group that requested the image of RY Tau. "Our group knew that this object was unique and hadn't been observed in detail with a big telescope like Gemini," he says. "I feel like we've not only made a pretty picture, but probably provided some new and valuable data for the pros!"

Gemini Astronomer Tracy Beck, who studies these stellar incubators, agrees. "This object is a classic, and one of the first-known examples of the remains of a stellar nursery," she said. "I believe this is by far the deepest and most detailed image ever taken of this object and scientists will no doubt use this data for important research in the future." The Gemini image was taken with a camera known as GMOS (Gemini Multi-Object Spectrograph), which was partially built in Canada.

The image of the Pleiades requested by the Alberta group will also have its uses. "I firmly believe that a beautiful image of the Pleiades will inspire many students across the country to develop a life-long interest in the science of astronomy," James Durbano wrote in his winning proposal. "It could even influence a young mind somewhere in our great country to pursue astronomy as a career."

The selection committee agreed, and also said that such an image has never been taken at high resolution by such a large telescope before. They also felt the group's request was an excellent use of MegaCam, the new giant camera on CFHT. This camera can capture in one pose a surface of more than one square degree, which is four times the surface on the sky covered by the Sun or the full Moon. The Pleiades star cluster covers a relatively large area on the sky, and other modern telescopes would not be able to photograph the entire thing.

The contest to request the images was organized by a team of scientists who coordinate Gemini observations for Canada (through the Canadian Gemini Office) at the National Research Council of Canada's Herzberg Institute of Astrophysics in Victoria (BC). The contest will probably be run again in the future.

The two winning proposals can be viewed at: [www.hia-ihp.nrc-cnrc.gc.ca/cgo/contest\\_e.html](http://www.hia-ihp.nrc-cnrc.gc.ca/cgo/contest_e.html). In addition, the CFHT image of the Pleiades and the Gemini image of RY Taurus can be downloaded at: [www.gemini.edu/pr2005-4/images](http://www.gemini.edu/pr2005-4/images).



Figure 1 – Image of stellar nursery RY Taurus obtained by the Gemini Multi-Object Spectrograph as part of a Canadian contest for amateur astronomers. The image reveals tremendous detail in the wispy remains of the gas cloud that formed the bright star at bottom/centre. This system is approximately 140 parsecs (450 light years) away, and spans about 2/3 of a light year across. The central object is a variable star that ranges in visual magnitude from about 9 to 11 with an irregular period.

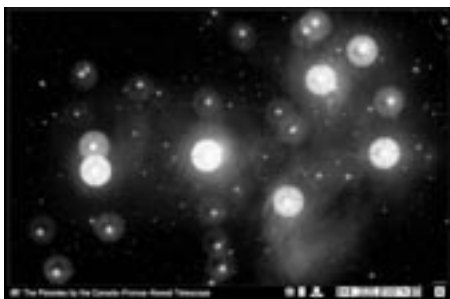


Figure 2 – The Pleiades (M45) taken with the new MegaCam on the 3.6-m diameter Canada-France-Hawaii Telescope.

Since then, the billions of years ago when Mars was formed, has never been a particularly common or planet, but is it commoner systems throughout the galaxy, which has studied the planet. Since its formation, it has changed its orbit and the development of the Tharsis feature, an eight-kilometre high feature that covers one-eighth of the Martian surface, and shows volcanic activity. As a result of these and other factors, its polar axis has not been stable relative to other features and is known to have wandered through the cone as Mars rotated around it and revolved around the Sun.

Now, a Canadian researcher has calculated the location of Mars' ancient poles, based upon the location of the great impact basins on the planet's surface. Alan Aravamudan of York University's Department of Physics has determined that these five basins, named Argyre, Hellas, Isidis, Tharsis and Utopia, all lie along the arc of a great circle. This suggests that the poles when they moved the basins originated with a single equator and that the equator traces the Martian equator before Mars' impact, which was prior to the development of the Tharsis impact. The findings are in the *Journal of Geophysical Research: Planets*. Aravamudan calculates that the source of the five impact craters was an asteroid that had been orbiting the Sun in the same plane as Mars and that of the other planets. At one point it passed close to the planet, until

the force of Mars's gravity surpassed the tensile strength of the asteroid, at which point it fragmented. The five large fragments would have remained in the same plane, that of Mars' then-equator. They hit at different spots around the Martian globe, due to Mars' rotation as its then-axis and the differing lengths of time the fragments took before impacting on Mars.

Aravamudan details the locations of the resulting basins, only three of which are well preserved. The two others have been detected by analysis of Martian gravitational anomalies. The great circle they describe on the Martian surface has its centre at latitude  $-34^\circ$  and longitude  $173^\circ$ . By realigning the map of Mars with that spot as the South Pole, the great circle marks the ancient equator.

Aravamudan estimates that the mass of the asteroid captured by Mars was about one percent of that of Earth's Moon. Its diameter was in the range of 44 to 1000 kilometres, depending upon its density, which cannot be determined.

The significance of Aravamudan's findings, if borne out by further research, is that the extent of presumed underground water on Mars would have to be reassessed. "The region near the present equator was at the pole when running water most likely existed," comments Aravamudan. "As surface water diminished, the polar cap remained the main source of water that most likely penetrated to deeper strata and has remained as permafrost, overlain by a thick groundwater reservoir. This is important for future manned missions to Mars." ☀

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