

DAY 03

WEDNESDAY, AUGUST 5th, 2009

## OPENING CEREMONY WITH BRAZILIAN SPICE

With a wide range of different presentations, the XXVII General Assembly of IAU got its official kickoff yesterday, highlighting the speedy progress of science in Brazil over the last years and the great success of the International Year of Astronomy. Several local authorities were present, including Eduardo Paes, Mayor of the City of Rio de Janeiro, Sergio Cabral, Governor of the State of Rio de Janeiro, and Sergio Rezende, Minister of Science and Technology.

They were preceded in stage by a brief message from the IAU President, Catherine Cesarsky, and by a short speech from the President of the Brazilian Academy of Sciences, Jacob Palis. "Brazilian science is at its best performance ever", said Palis. As to make that point even clearer, Minister Rezende anticipated that a newly-formed Committee within the Ministry of Science and Technology will come up with a plan for what was described as "the next major step in Brazilian astronomy."

For a change of pace, the Folklore Company of Rio presented, literally, "A Taste of Brazil". The performance combined dance and music to display the diverse Brazilian cultures – with, of course, a lot of samba!

The official ceremony for the Gruber Foundation Cosmology Award came up next. The Prize was awarded to Wendy Freedman, Robert Kennicutt and Jeremy Mould, for their measurement of the Hubble constant with HST. The winner of the Gruber Fellowship, Thijs Kouwenhoven, from University of Sheffield, was also announced.

Finally, two short presentations: a talk by Clive L. N. Ruggles on astronomy and UNESCO's World Heritage project, and an overview of Brazilian astronomy, presented by Kepler de Oliveira. After a short break, Union members went on to conduct the first session of the GA. ☺

SALVADOR NOGUEIRA



TO SEE THE VIDEO OF THE EVENT, ACCESS [http://www.video.mp.br/overmedia/videos.jsp?\\_contexto=grupo&\\_idContexto=57](http://www.video.mp.br/overmedia/videos.jsp?_contexto=grupo&_idContexto=57)

## ARE EXOPLANETS "PLANETS"?

The IAU Working Group on Extrasolar Planets (WGESP) was charged in 1999 with maintaining a list of extrasolar planets. A prerequisite for developing this list was defining what is an exoplanet. A working definition was agreed upon in 2001 and updated in 2003. IAU Commission 53 on Extrasolar Planets (C53) replaced the WGESP in 2006. But the WGESP definition of an exoplanet remains the official IAU definition, though C53 may decide to revisit it in the future.

### According to the WGESP:

1) Objects with true masses below the limiting mass for thermonuclear fusion of deuterium (about 13 Jupiter masses for objects of solar metallicity), that orbit stars or stellar rem-

nants, are "planets", no matter how they formed. The minimum mass/size required for an extrasolar object to be considered a planet should be the same as that used in our Solar System.

2) Substellar objects with true masses above the limiting mass for thermonuclear fusion of deuterium are "brown dwarfs", no matter how they formed nor where they are located.

3) Free-floating objects in young star clusters with masses below the limiting mass for thermonuclear fusion of deuterium are not "planets", but "sub-brown dwarfs" (or whatever name is most appropriate).

The WGESP left the question of the minimum planet mass to be decided

on the basis of the Solar System's planets. In 2006, the IAU GA voted to require that, in addition to being in orbit around the Sun, a Solar System planet must be massive enough to be nearly round and to have cleared the neighborhood around its orbit. The latter constraint resulted in Pluto becoming a "dwarf planet". The lowest mass exoplanet to date is a pulsar planet, PSR B1257+12-A, on a 25-day orbit and with a minimum mass of 0.015 Earth masses, about 7.5 times more massive than Pluto. ☺

More details at: <http://www.dtm.ciw.edu/users/boss/iauindex.html>

ALAN BOSS

## BRAZILIAN ASTRONOMY: RESEARCH GROUPS AND GRADUATE PROGRAMS

There are presently 500 people involved in research activities in Astronomy in Brazil. This is an impressive number, considering that systematic research in Astronomy is relatively recent in the country. Until 1970 there was very little astronomical research, and the main research groups formed at the same time that specialized graduate courses were established, which occurred in the late 1960s and early 70s.

However, these activities proceeded at a very fast pace, leading to approximately 500 researchers in Astronomy, including professionals with the title of PhD or equivalent, and graduate students. Most of these have obtained their degree in one of the Brazilian graduate programs, which amount to a dozen institutes today. Despite this growth, the fraction of astronomers to the total population of the country is still a tenth of what it is in developed countries.

Most (90%) work in state universities and institutes, either federal universities and institutes (57%) or universities sponsored by one of the Brazilian states (33%). Only 6% work in private universities, but it should be mentioned that this number has grown at a faster pace in the last few years. Most people (77%) work in the Southeast, 11% in the South and 9% in the Northeast. The remaining 2% are working abroad as post-docs, while the central region and northern Brazil practically do not carry professional astronomical activities, with less than 1% of the total. ♪



1.6 M PERKIN-ELMER TELESCOPE IN OPD

W. J. MACIEL



OBSERVATÓRIO PICO DOS DIAS

## SHOULD WE GO FOR ELECTRONIC PROCEEDINGS ONLY?

A surefire way to start a lively conversation with another astronomer is to mention conference proceedings! Scientists probably have been complaining about them since the days of parchment and quill pens, but the advent of electronic publishing has intensified the debate. Are printed proceedings another dinosaur that should become extinct along with printed journals, or do they offer something unique and precious that needs to be preserved?

When I discuss the topic with my colleagues (usually at meetings like this one!), I find that opinions are deeply divided, and roughly along lines of seniority and age. Most senior people tend to loathe having to write up their talks in conference proceedings, whatever their form. Many of them know from experience that few other people read them, and almost nobody will cite them (a study several years ago showed that proceedings papers are cited 20 times less than papers in refereed journals). Moreover the timeliness of a proceedings article tends to decline much more rapidly, as the results they contain are published in the journals. A potential advantage of electronic proceedings (or web pos-

tings of the talks themselves), is their rapid dissemination, while the papers are most valuable. In short, if we left the fate of printed proceedings to the senior astronomers they would probably disappear quickly, and I doubt whether their electronic replacements would last much longer.

However there is another side to the story, and to hear it you need to talk to the younger members of our profession, students and postdocs in particular. For many of them proceedings provide a unique and vital introduction to major subfields and problems, where much of the latest research in a subject is presented together, and where the reader has the opportunity to compare different approaches and points of view. A seasoned expert in the field may be able to glean much of that from a selective reading of the journals, but that is much more difficult for a scientist who is new to a subject. Proceedings were a critical resource to me early in my career, and I am impressed to see them fulfilling that same function today, despite all of the other changes in our profession in the meantime.

So where does that leave printed proceedings today? In principle all

### SOME NUMBERS

In the period of 2005 to 2007, 142 students completed their graduate studies, either MSc (83 students) or PhD (56 students). In 2008 there were 220 students overall, being 90 MSc students and 130 PhD students. Most of these (96 students) work in the two largest institutes, the University of Sao Paulo and the National Observatory in Rio. Five of the graduate programs have started their activities very recently, so their first students are expected to complete their courses in the next few years.

of the advantages highlighted above could be incorporated into an electronic proceedings, just as they have for e-journals. But I remain skeptical; some time ago I was asked to write up a proceedings talk for web posting alone, and I, along with about half of the speakers, decided it was not worth our effort. Moreover, I have yet to see a viable business model for all-electronic proceedings (or monographs for that matter) that really works. The real question probably is not the role of electronic versus printed proceedings, but the future of proceedings themselves. So what does the future hold? These issues are not unique to our profession, so I suspect that this is an area where future experimentation will be needed, to see whether another model works. In the meantime the IAU should appreciate the special legacy of its premier conference proceedings, and be very cautious toward changing a model that has served our profession so well for more than 50 years. ♪

ROBERT C. KENNICUTT

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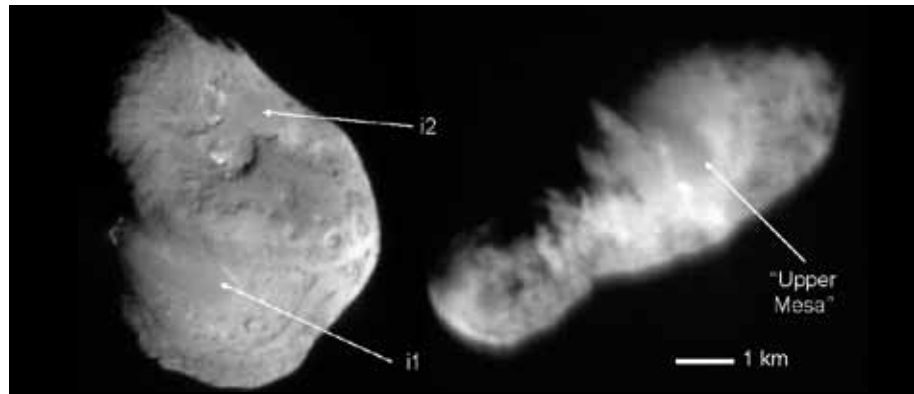
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## ACTIVE COMETARY NUCLEI

New ideas on the processes that govern the internal structure of comets and the origin of their activity are surfacing as a result of the *Deep Impact* mission to comet 9P/Tempel 1 and the missions that preceded it to 81P/Wild2, 19P/Borrelly and 1P/Halley

Three of these comets may show evidence of geologically recent flows on their surfaces. In one case the origin of the flow is associated with a large, circular, collapse feature and an enhancement of water ice content of a small surface region. One explanation argues for gas-fluidization of particulate material in the interior and its episodic transport to the surface – a process that could be described as cryogenic volcanism. The accompanying figure shows a compari-



THE ARROWS POINT TO POSSIBLY GEOLOGICALLY RECENT FLOWS ON THE SURFACE OF COMETS 9P/TEMPEL 1 (LEFT) AND 19P/BORRELLY (RIGHT) THAT COULD BE THE RESULT OF COMETARY CRYO-VOLCANISM (COMPARISON COURTESY L.A. SODERBLOM).

son of such flows on comets 9P and 19P.

Comet 9P was shown to have repetitive (nearly-periodic) mini-outbursts which occur at places on the surface near the ends of the long axis of the

roughly prolate shaped nucleus. The mini-outbursts occur both at night and during the day indicating that a process operating in the interior is probably responsible. Observations of all four

comets, from both the Earth and spacecraft, show that most of the active areas on the nucleus also occur in “preferred” places: near the ends of the long axis and at one or both of the rotation poles. These and other facts provide a basis for strong arguments that interior processes may be at work in producing even “normal” cometary activity.

It appears that the space exploration of comets is paying off in ways previously unsuspected and that, even in objects as small as comets, nature is again showing us its power to both evolve and to confound us. ,

MICHAEL J.S. BELTON

## ASTEROID ‘SHOWERS’ EARTH

The amount of volatile elements in meteorite parent bodies and comets shows an evident correlation with heliocentric distance. This suggests a negative gradient of temperature throughout the proto-planetary disk. Consequently, the planetesimals that were originally in the terrestrial planet region are expected to have formed from refractory materials – the only ones that could condense in such high-temperature regions of the disk. Thus, they should have been essentially deprived of water. However, about 0.1% of the Earth’s mass is made of water; how is this possible?

For decades, astronomers thought that Earth formed dry and later acquired a late veneer of water and other volatile elements through the bombardment of comets. We now know that this is unlikely. The probability of comets to strike Earth is tiny, so that even a massive disk of comets in the giant planets region and beyond could not have brought enough water to our planet. In addition, the isotopic (D/H) composition of water in comets appears diffe-

rent from that of Earth. Finally a recent model for the isotopic equilibration of the Earth and the Moon during the giant impact event that led to the formation of our satellite implies that Earth was already water-rich at that time.

So, water delivery could not be a late veneer.

Modern computer simulations, though, show that Earth and the other terrestrial planets, during – but towards the end of – their growth history, should have accre-

ted a significant fraction of their mass from objects originally formed in the outer asteroid belt. Outer belt asteroids, i.e. the parent bodies of carbonaceous chondrites, are quite water rich, so they could have been enough of a source for Earth’s water. Moreover, the water of carbonaceous chondrites has the same isotopic content as that of our planet, providing additional evidence for such a genetic link. ,

ALESSANDRO MORBIDELLI

## HOW WAS SEDNA PLACED ON ITS ORBIT?

Sedna is a Solar System icy body presently at  $13 \times 10^9$  km from the Sun. Not much is known about its physical properties but its orbit is conspicuous enough so as to raise important questions on the origin of the Solar System. Although Sedna’s perihelion distance at  $11 \times 10^9$  km is relatively small as compared to its average distance from the Sun ( $75 \times 10^9$  km), it is nevertheless more than twice Neptune’s distance from the Sun.

Since the most accepted Solar System formation models predict that Sedna’s perihelion was primordially much closer to Neptune’s orbit than it is today, an explanation turns out to be required to account for the detachment of Sedna’s present orbit from Neptune’s orbit.

A proposed scenario claims that a brown dwarf came quite close to the Sun and delivered part of its putative own disk of icy bodies to the Solar System in which case Sedna would have an extrasolar origin. A present or past Solar Companion of planetary to brown dwarf size could also raise Sedna’s perihelion. A third reasonable scena-

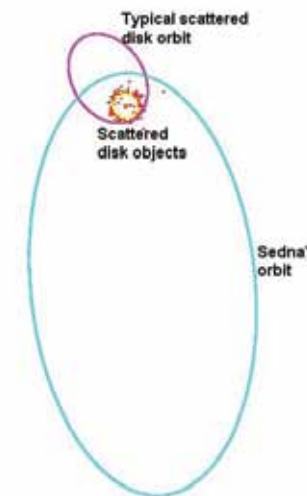
rio requires that the Sun primordially inhabited a dense star cluster in which the potential coming from the cluster gas and the perturbation from passing stars might also have detached Sedna’s perihelion from Neptune’s influence.

Although Sedna presents the most peculiar orbit for a distant detached icy body, there are probably other two such objects (2000 CR105 and 2004 VN112). However, their perihelions are not so distant.

On the other hand, the very observation of these objects at remote distances from the Sun argues for a population of Sedna-like objects of roughly 10 times that of the Kuiper Belt.

The discovery of other members of this population will certainly give new constraints that can enable us to choose among the proposed scenarios and consequently foster a new understanding of the primordial Solar System evolution. ,

RODNEY GOMES



# ARE THE MAIN BELT COMETS COMETS?

Icy minor bodies were known to originate from the trans-neptunian Belt (TNB) and the Oort Cloud. Recently, a third class of objects has been discovered: the Main Belt Comets (MBCs). Currently, only 4 MBCs are known, two of them (133P/Elst-Pizarro and 176P/LINEAR) are within the Themis collisional family of asteroids, a third one, P/2005 U1 (Read) is almost within it, and P/2008 R1 (Garradd) is near the 8:3 mean motion resonance with Jupiter. All of them have Tisserand parameter  $T_1 > 3.15$ , suggesting they have an unlikely cometary origin. 133P is the best characterized having been seen active at 3 perihelion passages, which supports the hypothesis that the activity is driven by sublimation of water ice.

Understanding the asteroidal or cometary nature of these bodies is

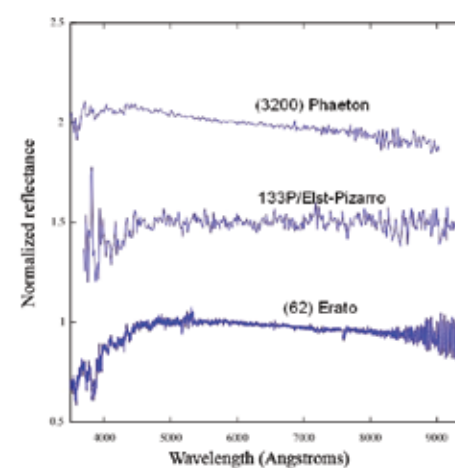
crucial. If they are formed “in situ” and, in particular, if they are members of a collisional family, there should be water ice in a large population of asteroids. If they are captured TNB or Oort cloud comets the mechanisms that drove them to their present orbits needs to be understood.

The asteroidal nature of MBCs is supported by results we present in this Symposium. We present the spectrum of 133P and 176P and show that they are similar to that of Themis family asteroids (see Figure 1) supporting that both MBCs are likely fragments of the collision that formed the family. We also show that they are similar to the spectrum of the Near Earth Asteroid (NEA) 3200 Phaethon, that probably had past activity. Phaethon’s surface contains hydrated silicates and this does not support its possible come-

tary nature. The similarity between Phaethon’s spectrum and MBC’s suggests an asteroidal nature.

In conclusion, there are some “activated asteroids” in the NEA and main belt population that were probably able to retain some water ice that sublimates under certain circumstances.

Exploring the volatile content of icy minor bodies is critical for understanding the physical conditions and the mechanisms of planetary formation, and also addresses the question of the origin of Earth’s water. If the outer main belt has a large population of asteroids with ice, they could have contributed to the water on Earth. Additionally, this indicates the extent and origin of volatiles in asteroids that could be used as resources for space exploration. ☺



FROM TOP TO BOTTOM, VISIBLE SPECTRUM OF 3200 PHAETHON, 133P/ELST-PIZARRO AND THEMIS FAMILY ASTEROID 62 ERATO. THEIR SIMILARITY SUGGESTS AN ASTEROIDAL ORIGIN FOR 133P.

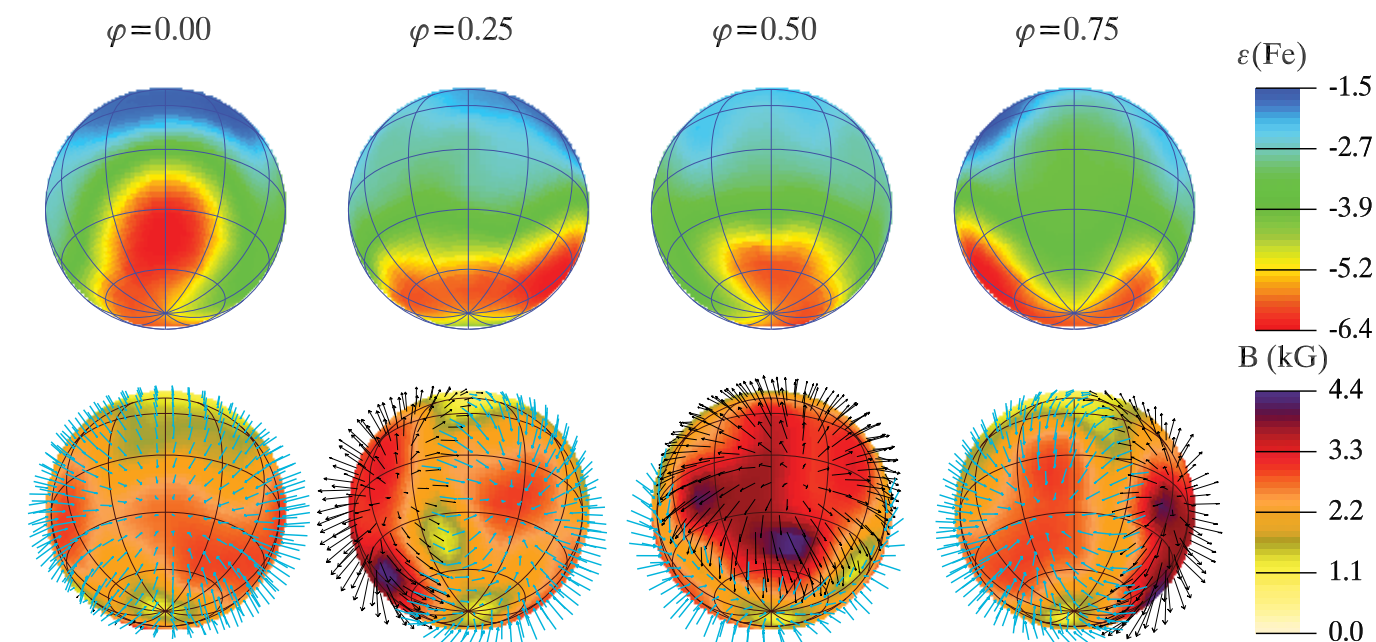
JAVIER LICANDRO AND  
HUMBERTO CAMPINS

## CHEMICALLY PECULIAR STARS AS ASTROPHYSICAL LABORATORIES

Chemically peculiar stars can serve as a starting point to the discussion of a number of physical phenomena that are of relevance to a wide range of astrophysical contexts. Although they have been studied for more than 50 years their relevance as astrophysical laboratories has substantially grown in recent times.

Stellar pulsations, magnetic fields, mixing and separation processes are among the topics to which the study of these stars can bring a significant contribution. What are the signatures left by physical phenomena like these on the observations and what are the techniques required to disentangle and correctly interpret these signatures? Do we understand the relation between these phenomena and stellar evolution?

Ground and space-based new instrument capabilities are expected to have a large impact in this research field. As an example, the GAIA mission (ESA) will lead to a dramatic increase in the number of known Chemically Peculiar stars as well as to a significant improvement in the determination of their global parameters. From the ground, observations with high-resolution spectropolarimetric instruments, such as ESPaDOnS (CFHT), have recently confirmed the presence of magnetic fields



MAP OF CHEMICAL ANOMALIES (IRON ABUNDANCES) AND MAGNETIC FIELD STRENGTH IN A TYPICAL CHEMICALLY PECULIAR STAR

in pre-main sequence and post-main sequence stars, promising a new insight into the origin and evolution of stellar magnetism. At the same time, the disentangling and interpretation of the signatures of the different physical processes taking place in Chemically Peculiar stars require an accurate and detailed modeling of their atmospheres. A challenging problem for these models is the vertical stratification of elements

and the need to take into account departures from local thermodynamics equilibrium when considering elements that accumulate in the uppermost layers of the atmospheres.

These are great challenges that require expertise from the trans-disciplinary fields of laboratory astrophysics, atomic data, instrumentation and theory of stellar astrophysics. We plan to discuss these ideas during the Joint

Discussion 4, on the “Progress in understanding the physics of Ap and related stars”. We hope we can count on the input from all researchers that share with us the will to make some progress in the understanding of any of the above mentioned astrophysical phenomena. ☺

MARGARIDA CUNHA