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# Newsletter de SOCHIAS

## Newsletter dedicado a todos los aspectos de la Sociedad Chilena de Astronomía

editado por Linda Schmidtobreick

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**Issue No. 5**

**6 Septiembre 2009**

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### EDITORIAL

Junto con saludarles, tengo el agrado de presentarles esta quinta edición del Newsletter de SOCHIAS. Después de una pausa larga, la Directiva de SOCHIAS decidió reactivar este medio de comunicación.

La comunidad astronómica profesional y académica Chilena está en un período de gran crecimiento, y este Newsletter sirve para divulgar las varias actividades de la Sociedad, la comunidad, los observatorios, las distintas instituciones de educación superior, etc.

Empezamos esta edición con la carta de la SOCHIAS a Tim de Zeeuw. Además incluimos el primer anuncio de las reuniones SOCHIAS 2010 y ASTROBIO 2010, tres contribuciones Science Highlights, un puesto de trabajo, un resumen de la ultima olimpíada de astronomía, una descripción de la carrera de Astro-Ingierencia en la PUC, el censo 2009 de astrónomos y un perfil detallado de una de nuestras instituciones, presentando al Grupo de Astronomía de la Universidad Andrés Bello.

Esperamos sus contribuciones para la próxima edición. Pueden mandarnos noticias, anuncios de reuniones pertinentes, science highlights, etc. Por favor, envíenos toda la correspondencia sobre el Newsletter (preferentemente en formato latex - ver la página web de SOCHIAS) a Linda Schmidtobreick: lschmidt@eso.org. Pueden enviarlo a cualquier momento.

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Linda Schmidtobreick  
European Southern Observatory

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## **Fulfill our dreams: to become world leaders in astronomy, time to act is now.**

Chile is in the verge of jumping into a new phase in astronomy. New astronomical facilities are being built or planned by international consortiums at the north of Chile for the next decade. As a consequence, Chile will become, most likely, the most important astronomical center in the world.

Astronomy in Chile has grown from less than 20 professional astronomers working in national institutions 15 years ago to a community of more than 90 today, without counting graduate and undergraduate students. Research in astronomy in Chile is in practice consolidated and growing at a steady pace. However, very little efforts have been taken to develop techniques associated to astronomy and little transfer of technology from the big observatories to Chile has happened. The creation of the BASAL Center of Astronomy and Associated Technologies and efforts made at several universities are extraordinary and unique initiatives but, obviously, not sufficient.

If we want to become world leaders in astronomy we must be pro-active, we must work into attracting the best and largest astronomical facilities to Chile. We know, and every astronomer in the world knows, that the Atacama dessert is the best site for large optical, infrared, millimeter and sub millimeter telescopes on earth.

Realizing this, the Chilean Astronomical Society met in January this year and discussed this issue. Members present in the general assembly decided to actively support the installation of the next generation of big telescopes in Chile. Although efforts were made to ensure that the TMT came to Chile, its board decided to build their telescope in Mauna Kea, Hawaii. Regarding the E-ELT, ESO is studying various sites; three of them are in Chile. SOCHIAS decided to actively promote Chile as the chosen site for the E-ELT. Our Directiva send a letter to ESO Director General expressing our strong support. We reproduce this letter herewith:

Leopoldo Infante  
President SOCHIAS



Santiago, 16 April, 2009

Professor  
Tim de Zeeuw  
Director General  
European Southern Observatory

Dear Professor de Zeeuw,

On behalf of the Directory of the Chilean Astronomical Society SOCHIAS, and as its recently elected new President, I am writing this letter to express the extremely strong interest of our national astronomical community to have ESO's new giant facility, the E-ELT, placed in Chile. Apart from all the well-known and good reasons to choose a site in northern Chile for the E-ELT, we believe that the ever-growing strength of our astronomical community should be another important reason for ESO to give preference to Chile in the selection of the site for E-ELT.

The Chilean astronomical community has had a spectacular development over the past 15 years. In this relatively short period of time, the community has grown from less than twenty to almost seventy active professional astronomers, and the number is still rising. Astronomy programs have been started in five new universities, making research and education in astronomy a truly national endeavour in Chile. Perhaps most importantly, there are currently more than 200 students enrolled in graduate and undergraduate astronomy programs in different universities in the country, and for the coming years we can expect an ever-increasing number of young and well-trained astronomers ready to take up their careers in research, education and instrument development, for which programs have also started very recently. We believe that the availability of these human resources should be of great interest to ESO and provide an important additional argument to choose Chile as the site for the E-ELT, in addition to the climatic and astronomical arguments. I would also like to stress that ESO's contribution to this strong development of astronomy in Chile has been very significant, through the support the community has received through the Joint Committee ESO-Government of Chile for the Development of Astronomy in Chile, and I take this opportunity to express our gratitude to you and ESO for the valuable support received over the years.

We can also assure that there is full support from Chile as a country to the idea to have the E-ELT in Chile. No doubt the Chilean government and its entities will strongly support the project in their own specific ways, including tax exemptions and diplomatic immunities, as it has done in the past. The political climate in the country regarding astronomy is very positive. The presence of ESO in Chile with its strongest facilities, ALMA and E-ELT, is in line with the government policy to accelerate the development of Chile through strong investments in science and technology, as witnessed by the FONDAP and BASAL Centres of excellence.

I would like to encourage you and ESO in the strongest terms, and on behalf of our community, to make the correct decision and bring the E-ELT to Chile. We, here in Chile, are looking forward to this new chapter of astronomy to continue the long tradition of scientific cooperation between ESO, and Chile and its astronomers. Our Society will always be happy to help in any aspects ESO believes SOCHIAS could be useful.

I would like to make this letter public, unless you have any strong feelings and advice me not to so.

All the best,

A handwritten signature in black ink, appearing to read "Leopoldo Infante".

Leopoldo Infante  
President SOCHIAS

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# **INFORMES Y ANUNCIOS DE REUNIONES CIENTIFICAS**

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## **FIRST ANNOUNCEMENT - SOCHIAS 2010**

**January 18-20, 2010  
Universidad de Concepción**

Dear Colleagues,

The next SOCHIAS 2010 Annual Meeting will take place from January 18 - 20 on the University of Concepción Campus. We have continued our efforts to ensure high scientific quality in the presentations, for which we have the participation of renowned international invited speakers.

We have secured the participation of Prof. David Spergel from Princeton University, USA, Prof. Giampaolo Piotto fro Padova University, Italy, Prof. Mariano Moles from the IAA, Spain, Dr. Lucas Macri from Texas A&M University, USA and Lisa Kaltenegger from CFA, USA.

The Scientific Organizing Committee is integrated by Leopoldo Infante (PUC, Chair), Wolfgang Gieren (UDEC, Co-Chair), Valery Kravtsov (UCN), Amelia Ramírez (ULS), Verónica Motta (UV), Andrés Meza (UNAB), Andrés Jordán (PUC), Leonardo Bronfman (UCh), Simón Casassus (UCh), and Ricardo Demarco (UDEC).

The Local Organizing Committee is integrated by Wolfgang Gieren (UDEC, Chair), Ricardo Demarco (UDEC), Michael Fellhauer (UDEC), Doug Geisler (UDEC), Ronald Mennickent (UDEC), Andrés Meza (UNAB), Neil Nagar (UDEC), and Tom Richtler (UDEC).

As in the previous version, the LOC will be assisted in the organization/logistics by Andrea Lagarini (ContactChile Comunicaciones S.A.)

To estimate the number of attendees, we need you to register providing the following information by October 15, 2009 to [reunion0@sochias.cl](mailto:reunion0@sochias.cl):

NAME:

LAST NAME:

INSTITUTION ADDRESS, CITY:

E-MAIL:

ACTIVITY:

PRE-GRADUATE, RESEARCHER, MASTERS, PhD STUDENT, PROFESSOR, POST-DOC, OTHER.

POSTER /TALK - TITLE:

ARE YOU REQUESTING FINANCIAL SUPPORT? YES/NO

Leopoldo Infante, SOC Chair & Wolfgang Gieren, LOC Chair - SOCHIAS 2010

# **ASTROBIO 2010**

## **An International Workshop on Astrobiology**

**D. Minniti<sup>1</sup>, A. Jordán<sup>1</sup> and J. Pullen<sup>1</sup>**

<sup>1</sup> Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Santiago, Chile

**DATES:** 13-15 January 2010

**LOCATION:** CEPAL Auditorium, Santiago, Chile.

**WEB PAGE:** [www/astro.puc.cl/astrobio2010](http://www/astro.puc.cl/astrobio2010)

**EMAIL:** astrobio2010@astro.puc.cl

### **WORKSHOP JUSTIFICATION**

There has recently been great progress on our understanding of the Origins of Life, Chemistry of the Universe, Extrasolar Planetary Systems, and the Search for Life in the Solar System and beyond. These themes bloomed with the creation of Astrobiology, a truly interdisciplinary science that is getting scientists from different areas and from everywhere to work together. We are organizing "ASTROBIO 2010", an International Workshop with the aims to cover the major topics on Astrobiology, to identify opportunities for new studies, and to promote the development of the local community on the subject. This Workshop is intended for professional scientists, post-docs, and students active on the areas of Astronomy, Biology, Physics, Engineering, Medicine, Chemistry, Planetary Physics, Geology and related subjects.

### **TOPICS:**

1. Life on Earth: Origin of Life, Evolution, Climate Change
2. Extremophiles in Local Environments: Antarctica, Atacama, and the Deep Ocean
3. The Solar System: Search for Life on Mars, Europa, Titan, and elsewhere
4. Beyond our Solar System: Search and Study of Extrasolar Planets, Biomarkers
5. Stellar Habitable Zones and Galactic Habitable Zone, Communication
6. Future Perspectives on Astrobiology: ALMA, JWST and the ELTs

### **SCIENTIFIC ORGANIZING COMMITTEE:**

Jorge Alfaro (Universidad Católica) jalfaro@puc.cl

Armando Azúa (Universidad Católica) armandoazua@yahoo.com

Andrea Buccino (IAFE, ARGENTINA) abuccino@iafe.uba.ar

Victor Gallardo (Universidad de Concepción) vagallar@gmail.com

Doug Geisler (Universidad de Concepción) dgeisler@astro-udec.cl

Benito Gómez Silva (Universidad de Antofagasta) bgomez@uantof.cl

Valentin Ivanov (EUROPEAN SOUTHERN OBSERVATORY) vivanov@eso.org

Andrés Jordán (Universidad Católica), ajordan@astro.puc.cl

Dante Minniti (Universidad Católica, Chair) dante@astro.puc.cl

María Teresa Ruiz (Universidad de Chile) mtruiiz@das.uchile.cl

George Schwanek (Universidad del Desarrollo) gswaneck@udd.cl

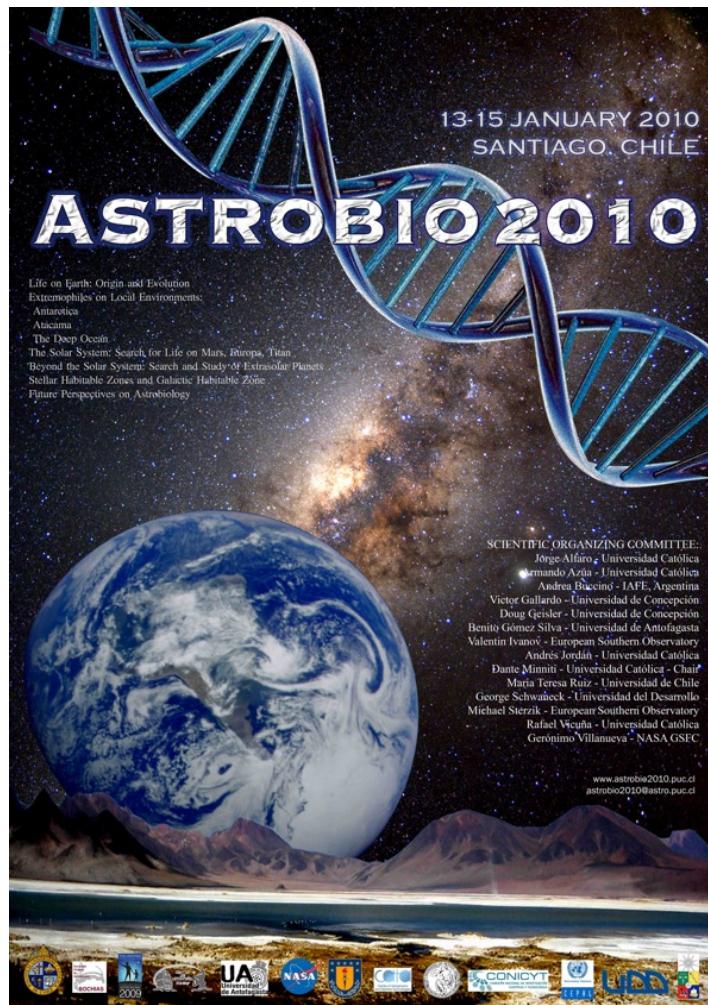
Michael Sterzik (EUROPEAN SOUTHERN OBSERVATORY) msterzik@eso.org

Rafael Vicuña (Universidad Católica) rvicuna@bio.puc.cl

Gerónimo Villanueva (NASA GSFC, USA) geronimo.villanueva@nasa.gov

## LOCAL ORGANIZING COMMITTEE:

Andrés Jordán (Universidad Católica, Chair) ajordan@astro.puc.cl  
Armando Azúa (Universidad Católica) armandoazua@yahoo.com  
Joyce Pullen (Universidad Católica) jbpullen@uc.cl  
Roberto Saito (Universidad Católica) rsaito@astro.puc.cl  
Maren Hempel (Universidad Católica) mhepel@astro.puc.cl  
Leo Vanzi (Universidad Católica) lvanzi@ing.puc.cl  
Mario Durán (Universidad Católica) mduran@uc.cl  
José Gallardo (Universidad de Chile) gallardo@das.uchile.cl  
Andrea Lagarini (Contact Chile) andrea@contactchile.cl



If you are interested on attending the ASTROBIO2010 Workshop, please complete and send the following information via email to [astrobio2010@astro.puc.cl](mailto:astrobio2010@astro.puc.cl)

NAME:

INSTITUTION:

AREA OF EXPERTISE:

EXPECTED CONTRIBUTION: talk, poster, none

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## SCIENCE HIGHLIGHTS

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### Post common envelope binaries from SDSS: Constraining the common envelope efficiency

M. Zorotovic<sup>1,2</sup>, M.R. Schreiber<sup>3</sup>, and B.T. Gänsicke<sup>4</sup>

<sup>1</sup> Departamento de Astronomía, Facultad de Física , Pontificia Universidad Católica, Santiago, Chile

<sup>2</sup> European Southern Observatory, Alonso de Cordova 3107, Santiago, Chile

<sup>3</sup> Departamento de Física y Astronomía, Facultad de Ciencias, Universidad de Valparaíso, Valparaíso, Chile

<sup>4</sup> Department of Physics, University of Warwick, Coventry CV4 9BU, UK

Virtually all compact binaries ranging from low mass X-ray binaries to double degenerates or pre-CVs form through common envelope (CE) evolution. A CE phase is believed to be initiated by dynamically unstable mass transfer from the evolving more massive star to the less massive main sequence star (Paczynski, 1976; Webbink, 1984; Hjellming, 1989). This situation occurs especially if the evolving more massive star fills its Roche-lobe when having a deep convective envelope (usually on the giant or asymptotic giant branch). Then, as a response to mass transfer, the radius of the mass donor may increase (or stay constant) while its Roche-radius is decreasing. The resulting runaway mass transfer drives the mass gainer out of thermal equilibrium as it accretes on a time scale faster than its thermal time scale. Consequently, the lower mass star also expands until filling its Roche-lobe too, which then leads to a CE configuration: the core of the giant and the initially less massive star spiral in towards their center of mass while accelerating and finally expelling the gaseous envelope around them.

Although the basic ideas of CE evolution have been outlined already 30 yrs ago, it is still the least understood phase of close compact binary evolution. Theoretical simulations have shown that the CE phase is probably very short,  $\lesssim 10^3$  yrs, that the spiral in starts rapidly after the onset of the CE phase, and that the expected form of post-CE planetary nebula is bipolar. Despite of the just mentioned important findings, hydrodynamical simulations that properly follow the entire CE evolution are currently not available. Therefore, a simple equation relating the total energy of the binary before and after the CE phase is generally used to predict the outcome of CE evolution. These equations are usually scaled with uncertain dimensionless parameters, called the structural binding energy parameter ( $\lambda$ ) and the CE efficiency ( $\alpha$ ). The values of these crucial parameters could not be constrained so far, neither observationally nor theoretically.

The theoretical research presented in this work has become possible due to large observational efforts in the last decade. First of all, the SDSS has turned out to efficiently identify white dwarf/main sequence (WDMS) binary stars. We performed an extensive follow-up program to identify and characterize a large sample of those WDMS systems that suffered from CE evolution, named post common envelope binaries (PCEBs). In this work we reconstruct the evolution of a now available large sample of 55 PCEBs (35 new systems identified with SDSS and 20 previously known systems) aiming to derive new constraints on current theories of CE evolution in general and the CE efficiency  $\alpha$  in particular.

## Post common envelope evolution

It is believed that after the CE phase, PCEBs lose angular momentum via gravitational radiation and magnetic braking. Here we follow Schreiber & Gänsicke (2003) and reconstruct the post-CE evolution of the PCEBs in our sample. We assume the latest prescription of disrupted magnetic braking as given by Hurley et al. (2002) and normalized by Davis et al. (2008).

The next key ingredient for analyzing the post-CE evolution is to derive the age of the PCEBs by interpolating cooling tracks of white dwarfs (Wood (1995) for CO WDs and Althaus & Benvenuto (1997) for He WDs). This finally allows to calculate the orbital periods the PCEBs had at the end of the CE phase ( $P_{\text{CE}}$ ).

## Common envelope phase

According to the standard common-envelope formalism proposed by Paczyński (1976, the standard  $\alpha$ -formalism) it is generally assumed that the outcome of the CE phase can be approximated by equating the binding energy of the envelope and the change in orbital energy and by scaling this equation with an efficiency  $\alpha$ , i.e.

$$E_{\text{gr}} = \alpha \Delta E_{\text{orb}}, \quad (1)$$

where  $\Delta E_{\text{orb}} = E_{\text{orb},i} - E_{\text{orb},f}$  is the total change in orbital energy during the CE phase and  $E_{\text{gr}}$  is the gravitational (or binding) energy given by

$$E_{\text{gr}} = \frac{GM_1M_e}{\lambda R}, \quad (2)$$

where  $M_1$  is the mass of the primary,  $M_e$  the mass of the envelope, and  $\lambda$  is a structural parameter (that depends on the structure of the primary star).

## The reconstruction algorithm

As in Nelemans & Tout (2005), we determine the possible masses and radii of the progenitors of the WDs in all the PCEBs in our sample from fits to detailed stellar evolution models. We assume that the observed WD mass is equal to the core mass of the giant progenitor at the onset of mass transfer and we use the equations from Hurley et al. (2000) to calculate the luminosities and radii of all giant stars that have exactly such a core mass. We do this for initial masses  $M_1$  of  $1.0, 1.01, 1.02, \dots M_\odot$  up to the mass for which the core mass at the end of the main sequence is larger than the observed WD mass. Then we assume that the giant radius has been equal to the Roche-lobe radius at the onset of mass transfer. As the secondary mass is assumed to remain constant during the CE phase, this allows to determine the orbital separation just before the CE phase. The remaining quantities in the CE equation are then the CE efficiency ( $\alpha$ ) and the binding energy parameter ( $\lambda$ ), and we can derive  $\alpha\lambda$  for each possible progenitor. In other words, from Roche geometry and the energy equation, we get one value for  $\alpha\lambda$  for each parameter set consisting of the progenitor mass, core mass (= current WD mass), secondary mass (= current secondary mass), and final orbital period ( $=P_{\text{CE}}$ ).

The structural parameter  $\lambda$  has generally been taken as a constant (typically  $\sim 0.5$ ). Detailed stellar models taking into account the structure of the envelope show that this is a reasonable assumption for progenitors on the first giant branch (FGB). However, according to e.g. Dewi &

Tauris (2000); Podsiadlowski et al. (2003),  $\lambda = 0.5$  is probably not a very realistic assumption for progenitors on the asymptotic giant branch (AGB) as it slightly underestimates the binding energy of envelopes around low and intermediate-mass stars (i.e.  $1\text{--}6 M_{\odot}$ ) and significantly overestimates it for more massive stars.

If one additionally assumes that a fraction of the internal energy of the envelope supports the process of envelope ejection, the situation is once more changing dramatically. Especially extended envelopes of luminous AGB stars can be very loosely bound. Consequently, the internal energy of the envelope might be a very important factor to explain the existence of long orbital period systems. Han et al. (1995) introduced a parameter  $\alpha_{\text{th}}$  (between 0 and 1) to characterize the fraction of the thermal energy that is used to expell the envelope. Using this, the equation for the standard  $\alpha$ -formalism becomes

$$\alpha \Delta E_{\text{orb}} = E_{\text{gr}} - \alpha_{\text{th}} E_{\text{th}}. \quad (3)$$

Alternatively one can revise  $\lambda$  to incorporate the internal energy  $E_{\text{th}}$ . If a fraction of the internal energy contributes to expelling the envelope, the binding energy writes

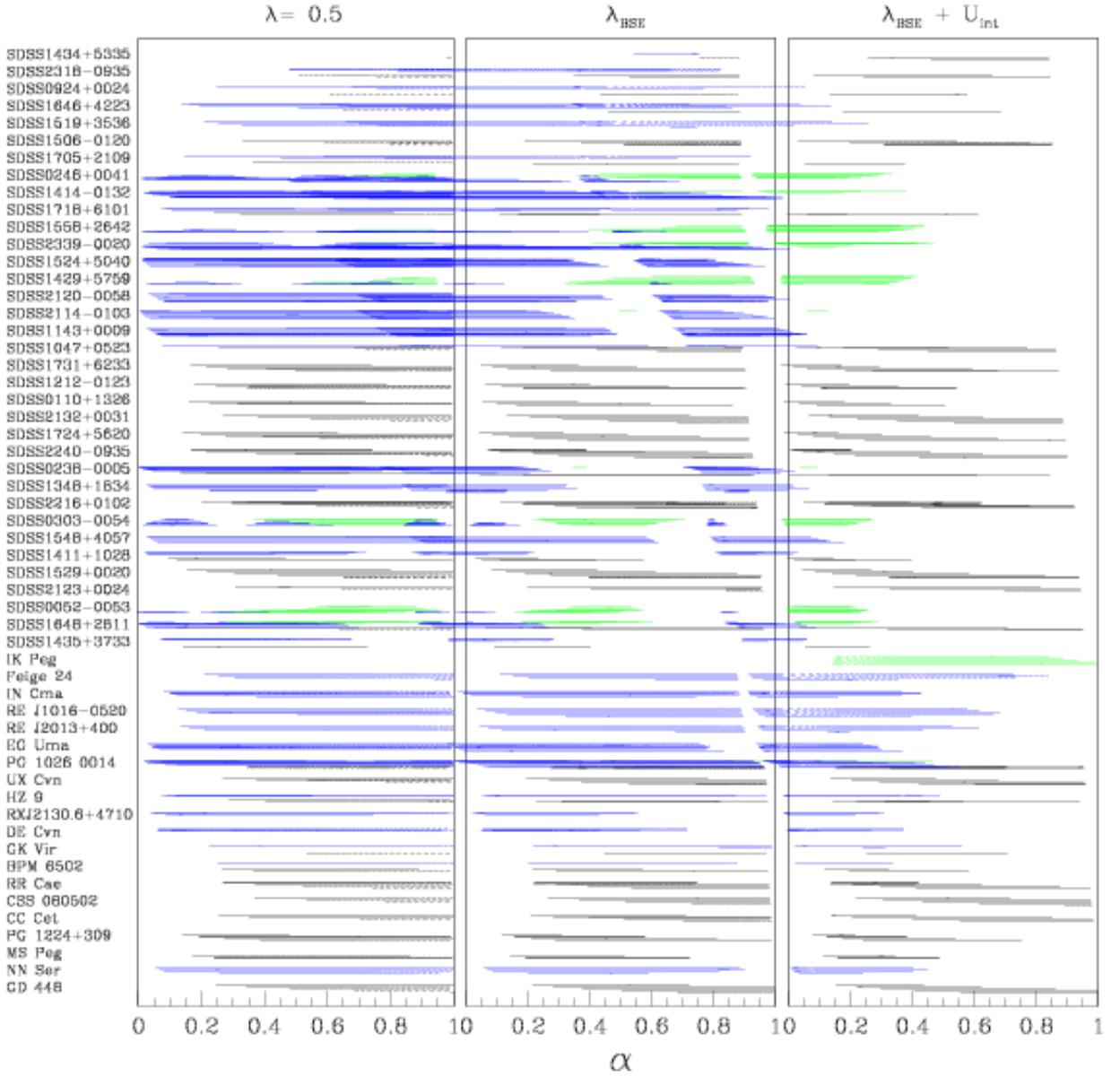
$$E_{\text{bind}} = \int_{M_c}^{M_1} \left( -\frac{GM(r)}{r} + \alpha_{\text{th}} E_{\text{th}} \right) dm. \quad (4)$$

Detailed calculations of this expression have been preformed by various authors (e.g. Dewi & Tauris, 2000; Podsiadlowski et al., 2003) who demonstrate that the binding energy depends significantly on the mass of the giant, its evolutionary state, and of course,  $\alpha_{\text{th}}$ . Clearly, to include the effect of the internal energy and the structure of the envelope in the simple energy equation (Eq.1) one may equate  $E_{\text{bind}}$  with the parametrized binding energy  $E_{\text{gr}}$  from Eq.2 keeping  $\lambda$  variable. The latest version of the BINARY STAR EVOLUTION (BSE) code presented by Hurley et al. (2002) includes an algorithm that computes  $\lambda$  in the just described way.  $E_{\text{bind}}$  has been calculated using detailed stellar models from Pols et al. (1998) and approximated with analytical fits (Pols, in preparation). There is no obvious reason to assume different efficiencies for the internal energy of the envelope and the orbital energy (Webbink, 2007). Therefore, we compute the values of  $\lambda$  in two different cases: without internal energy, and including a fraction  $\alpha_{\text{th}} = \alpha$  of the internal energy of the envelope.

In Fig. 1 we plot the possible values of  $\alpha$  for each PCEB in our sample assuming  $\lambda = 0.5$  (left), calculating  $\lambda$  with the BSE algorithm but without internal energy (center), and including a fraction  $\alpha_{\text{th}} = \alpha$  of the internal energy (right). Each horizontal line represents possible values of  $\alpha$  for different masses of the progenitor for a given white dwarf and secondary mass. The different lines for each object represent different values of the white dwarf mass within  $0.05M_{\odot}$  from the best fit value. Values obtained for FGB progenitors are shown in black while early and second AGB progenitors are in blue and green respectively.

Our results indicate that the structural parameter is quite well approximated by assuming  $\lambda = 0.5$  for FGB progenitors. However, the effect of calculating  $\lambda$  and including the internal energy is of utmost importance for AGB progenitors: the green and blue lines in Fig. 1 move towards smaller values of  $\alpha$  especially if a fraction of the internal energy is assumed to contribute to the energy budget of CE evolution. The effect is most obvious for IK Peg as we only find solutions with  $0 \leq \alpha \leq 1$  if the internal energy is included.

Inspecting the right panel of Fig. 1 in more detail, it becomes obvious that including internal energy allows to find solutions for all the systems in a small range of CE efficiencies, i.e.  $\alpha = 0.2\text{--}0.3$ .



**Figure 1:** Reconstructed  $\alpha$  values for all the possible progenitors of the PCEBs in our sample with  $\lambda = 0.5$  (left),  $\lambda$  calculated using the BSE code without internal energy (center), and with  $\lambda$  calculated including a fraction  $\alpha_{\text{th}} = \alpha$  of the internal energy (right). Black points are for progenitors in the FGB, blue for progenitors in the early AGB and green for progenitors in the second AGB. While  $\lambda = 0.5$  seems to be a reasonable assumption for FGB progenitors, calculating  $\lambda$  and particularly including internal energy becomes important for progenitors on the AGB (blue and green). While  $\alpha$  is only slightly moved towards lower values in the central panel, taking into account the internal energy leads to dramatically smaller values of  $\alpha$  for AGB progenitors (right panel). For example, we only find solutions for IK Peg in the range  $0 \leq \alpha \leq 1$  if a fraction of the internal energy is assumed to contribute to the energy budget.

## Conclusions

We have developed a new algorithm to reconstruct the common envelope evolution of PCEBs. In contrast to previous attempts we included a proper treatment of the binding energy parameter  $\lambda$  taking into account the internal energy of the envelope. We have applied the new algorithm to the largest and most homogeneous sample of PCEBs currently available. For all the systems in our sample, we find possible progenitors assuming energy conservation if the internal energy of the envelope is taken into account. For each individual system the possible solutions cover rather broad ranges of values for the CE efficiency  $\alpha$ . However, there exists only a small range of values, i.e.  $\alpha = 0.2 - 0.3$  for which we find solutions for all the systems in our sample. So, if a universal value for the CE efficiency exists, it should lie in this range.

Naively our result of  $\alpha = 0.2 - 0.3$  could be interpreted as the final answer to the most fundamental question in close compact binary evolution. However, it is still not at all clear whether a universal constant value of  $\alpha = 0.2 - 0.3$  can explain CE evolution in general. Answering this question requires to observationally establish representative and large samples of all types of PCEBs - not only WDMS.

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# What Can Polarization Teach About the Fate of the Universe?

Jason L. Quinn

Type Ia SNe are invaluable to the astronomer for testing cosmological theories. They provide a so-called "standard candle" by which distances can be estimated. Using them, astronomers discovered that the universe is expanding and accelerating (Schmidt et al, ApJ 1998; Perlmutter et al, ApJ 1999): a profound result that not only implies the existence of a "dark" form of energy but that it is the dominant energy density in the universe. The physical origin of this energy is completely not understood and likely lies in physics beyond the Standard Model. The present state of dark energy research involves not just the measurement of the dark energy density but its rate of change. At present the results are consistent with no change with lookback time.

It is an over-simplification to call Type Ia SNe standard candles because they do have a experimentally determined, but now well-known, relationship between absolute luminosity and their decline rate (frequently as measured by the decline in brightness 15 days past maximum in the B-band). This relationship can be used to "calibrate away" the dispersion hence the more appropriate phrase "standarizable candles" is often used (Riess, Press, & Kirshner, ApJ, 1995).

The debate on the physical progenitor systems of Type Ia systems, while still ongoing, has largely settled on a basic framework. The majority of Type Ia SNe are caused by C-O white dwarfs accreting matter from what is probably a non-degenerate companion as it fills its Roche Lobe causing matter to spill onto the white dwarf. When the mass of the white dwarf reaches the Chandrasekhar mass (1.4 solar masses), the star explodes completely disrupting the white dwarf. The physics of the explosion itself is less certain but the present leading model is the delayed-detonation model whereby the ignition begins as a sub-sonic deflagration and at later transitions into a super-sonic detonation (the transition and how it occurs are not well understood). Factors like magnetic field may also introduce polarization (e.g., Ghezzi et al., MNRAS 2004) Pure deflagration models produce ejecta that are chemically too inhomogeneous to be consistent with observations and vice versa for pure detonation models. Chemical inhomogeneities are leading discriminators for competing explosion models.

The dark energy results make use of the assumptions that Type Ia are uniform luminosity objects (or can be calibrated to uniform luminosity). At some level, this assumption will break down. There are many physical reasons why SN Ia cannot be perfectly uniform. The list of candidates includes rotation, magnetic fields, the secondary star, an accretion disk, asymmetric ignition, asymmetric explosions and so forth. Regardless of the source, asymmetries will have important ramifications for measuring dark energy and its evolution. To what extent are viewing-angle dependencies involved? Are there other parameters that can be used to further standardize Type Ia SNe similar to the luminosity-decline relationship?

The job of the astronomer is almost exclusively an observational one. While it is routine to study light and its spectral properties, light contains more information than that alone in the form of the state of polarization. Spectroscopy and polarization together, that is spectropolarimetry, decipher the complete message contained by light. The polarization state of light was given a convenient and complete theoretical formalism by British physicist Sir George Stokes (1818-1903) under which light can be described by the now-named Stokes parameters, (I, Q, U, V). Here I denotes intensity,

$V$  denotes circular polarization, and  $Q$  and  $U$  are flux differences for orthogonal polarization states measured 90 degrees apart (directly related to the  $x$ - and  $y$ -components of the net electric field).

The spectrum of a Type Ia SN is determined by photospheric emission and line absorption and/or emission (typically absorption at early stages with emission at late stages). The photospheric emission is mostly caused by Thompson scattering of electrons. Thompson scattering is a highly polarizing process but for a spherically symmetric, unresolved source, the net polarization state is zero. For a photosphere with an ellipsoidal projection on the sky the net polarization will not be zero because of incomplete cancellation. This polarizes the continuum. Additionally, a varying line opacity for a given chemical density distribution can selectively obscure parts of the photosphere at the corresponding wavelengths and cause a line polarization signal (Hflich, NewAR 2006). Therefore a non-null polarization detection tells one about the departure from spherical symmetry of the source (e.g., Chornock & Filippenko, AJ 2008). This geometric information is a valuable compliment to the ! purely spectroscopic studies and provides additional clues to the physics of the explosion mechanism. It can potentially reveal the intrinsic variation of luminosity of Type Ia supernovae, for example, via viewing-angle effects, or provide other insights regarding their homogeneity as a class (for example, by detecting physical sub-classes that might otherwise contaminate the sample used for measurements of dark energy).

Nature rarely divulges its secrets so easily in astronomy; in reality there are hurdles to the use of spectropolarimetry for studying Type Ia SNe. The primary complication is the handling of the polarization from the interstellar medium (the ISP). There are a couple of experimentally-determined relations to help understand the ISP such as the Serkowski's Law which relates the wavelength-dependence of the interstellar medium to the wavelength of maximum polarization (Serkowski, Mathewson, & Ford, ApJ 1975), and a polarization efficiency constraint relating the maximum polarization to the extinction (Clayton, Geoffrey, & Mathis, ApJ 1988). The physical origin of this polarization is due to alignment of dust grains along large-scale magnetic fields (usually galactic) for the line of sight (Davis & Greenstein, ApJ 1951). For extra-galactic supernovae, both the host galaxy and the Milky Way can contribute to the total ISP. Estimating their separate contributions and even the net ISP is difficult and depends strongly on various assumptions. Worse still is that any error in the estimation of the ISP can mask itself as intrinsic polarization of the source. The ISP is a major source of uncertainty in the published literature on Type Ia spectropolarimetry. Nevertheless, various techniques have been promoted for its estimation such that it may be removed to study the intrinsic polarization.

The evidence in the literature that Type Ia SNe exhibit diversity is growing. Several teams have introduced spectropolarimetric classes (Leonard et al., AJ 2005; Wang & Wheler, ARAA 2008, among others).

Our group at Pontificia Universidad Católica de Chile, working as part of the Millennium Center for Supernovae Science (MCSS) is beginning a large-scale study of supernovae events using spectropolarimetry with a focus on Type Ia. The group consists of myself (postdoc), graduate student Paula Zelaya, Prof. Alejandro Clocchiatti, Prof. Lifan Wang at the University of Texas, and Nando Patat & Dietrich Baade of ESO. The goals of the project include trying to correlate the spectropolarimetric properties of Type Ia with other aspects such as the light curve properties. Indeed such a relationship has already been proposed by Dr. Wang (Wang, Baade, & Patat, Science

2007). His results indicate that the line polarization of Si-II is correlated with luminosity. Similar undiscovered relationships may yet exist for other polarization features.

Spectropolarimetry has a bright future. As a "photon-hungry" technique it requires the light-gathering power of large telescopes for faint objects such as Type Ia. The coming generations of giant telescopes will open up their study even further. The next time you squint from sunlight reflecting off a lake, before putting on your polarized sunglasses pause to consider how that same phenomena is helping us study the ultimate fate of the universe.

# Equilibrium and Stability of Stellar Magnetic Fields

Taner Akgün

A variety of stars are known to possess magnetic fields. For example, upper main sequence stars (O stars) have radii of about 10 solar radii (or about  $10^7$  km), and magnetic fields of about  $10^3$  gauss. White dwarfs have radii of about  $10^4$  km, and magnetic fields of about  $10^9$  gauss. Neutron stars (in particular magnetars) have radii of about 10 km, and magnetic fields of about  $10^{15}$  gauss. Although these objects are quite different in nature, it is interesting to note that in all of them the magnetic fluxes ( $B R^2$ ) are very similar, about  $10^{27}$  gauss cm<sup>2</sup>. This could be interpreted as flux freezing throughout stellar evolution, although it is clear that this cannot be the complete picture.

Even in the most magnetic stars, the magnetic field is still much weaker in comparison to hydrostatic forces. The ratio of fluid pressure to magnetic pressure ( $P/B^2$ ) is typically of the order of  $10^6 M^2$ , where  $M$  is the stellar mass measured in solar masses. Nevertheless, the magnetic field plays an important role in many astrophysical processes, from highly energetic magnetospheric events, to asteroseismic oscillations, to stellar distortions leading to free precession and gravitational wave emission.

From plasma physics, it is known that magnetic fields are prone to a number of instabilities. In fact, it turns out to be quite difficult to produce stable magnetic fields in laboratories. Yet, stellar magnetic fields are known to survive for significant periods comparable to their lifetimes. Then the obvious question arises: how are these stars able to maintain their magnetic fields over such long timescales? This is the question that has been eluding the astrophysicists for at least the last 50 years, and in our research we hope to gain some more insight as to what the answer might eventually turn out to be.

Before considering the stability of a magnetic field, we must first determine its equilibrium structure. If the magnetic field is not in equilibrium, it makes no sense to talk about its stability, as it will be inherently unstable. Within this context, we need to make a distinction between barotropic and non-barotropic stars. In barotropic fluids there is a unique relation between pressure and density. From the equation of equilibrium it then follows that the magnetic acceleration must be expressible as a gradient of a potential. Therefore, magnetic fields in barotropic fluids are strongly restricted. There are many papers in the literature dealing with the precise calculation of the equilibrium structure of magnetic fields in barotropic stars, however, realistic stars are not actually barotropic. As well as density, pressure depends on an additional quantity, for example specific entropy in white dwarfs, and chemical composition in neutron stars. As a result, the above restriction on the magnetic field is lifted, and thus, in non-barotropic stars there is considerably larger degree of freedom in the choice of the magnetic field, which must still satisfy some boundary and regularity conditions at the surface and center of the star.

Any magnetic field can be expressed as the sum of a poloidal and a toroidal component, each completely described by a single scalar function. This is equivalent to saying that two independent functions are sufficient to specify any magnetic field, since it must be divergenceless. For an axisymmetric magnetic field, the poloidal component is in the radial ( $r$ ) and latitudinal ( $\theta$ ) direction, and the toroidal component is entirely in the azimuthal ( $\phi$ ) direction. The magnetic (Lorentz) force for such a field cannot have an azimuthal component, since no counterpart exists in the hydrostatic fluid forces due to pressure and gravity that can act to balance it. This can be shown to imply that the two functions defining the poloidal and toroidal parts must be related in such a way that one can be expressed as a function of the other. A consequence of this is that the toroidal field is entirely confined within the sub-surface poloidal field lines that close inside the star, and where the poloidal lines go through the stellar surface there is no toroidal component.

We next need to consider the stability of the magnetic field. Tayler (1973) showed that purely toroidal fields are prone to the interchange (axisymmetric) and kink (non-axisymmetric) instabilities, and Markey & Tayler (1973) and Wright (1973) showed that purely poloidal fields are also unstable. Therefore, one might hope that a combination of poloidal and toroidal fields may help stabilize each other. Otherwise, we will be left with no simple solution to this problem.

Unlike laboratory plasmas, we also have to deal with gravity, which is much stronger than the magnetic forces. Gravity has a stabilizing effect for non-barotropic fluids. In such cases it is difficult to induce radial displacements – leading to stable stratification (Reisenegger 2009). However, even in stably stratified stars purely poloidal or purely toroidal fields are unstable (Goossens et al. 1981). Fortunately, recent simulations have been able to demonstrate that in stably stratified stars random initial magnetic fields tend to evolve into nearly axisymmetric configurations with both poloidal and toroidal components of comparable strength (Braithwaite & Spruit 2004), which are then able to remain stable for some time. Our aim is to provide an analytic proof for the existence of such fields, and to understand how the poloidal and toroidal components can help to stabilize each other.

To determine stability, we consider small perturbations around the equilibrium. Associated with these perturbations are some frequencies. For stability, all frequencies must be real, corresponding to oscillations around the equilibrium. Conversely, when the frequencies are imaginary, perturbations grow exponentially and instability sets in. An alternative way of assessing stability is to look at the energy of the perturbations. When it is positive, the system is stable, and when it is negative, the system is unstable. This technique developed by Bernstein et al. (1958) is known as the energy principle. In our treatment, we neglect perturbations of the gravitational potential, a simplification commonly known as the Cowling approximation. We also do not include the effects of rotation and fluid motions at this stage. Obtaining a general mathematical proof for the stability of a magnetic field with poloidal and toroidal components is quite difficult. Instead, we hope to be able to show that instabilities present for toroidal fields can be eliminated by adding a poloidal component, and vice versa. While this will not be as comprehensive a proof as one might desire, it will nevertheless help us understand how the two components may be able to stabilize one another.

This project is carried out in collaboration with Andreas Reisenegger and Pablo Marchant from PUC, Chile, and Alpha Mastrano and Andrew Melatos from the University of Melbourne, Australia. It is supported by a FONDECYT grant of CONICYT.

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## **PUESTOS DE TRABAJO**

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### **Faculty positions in Astrophysics and Physics Universidad Andres Bello**

The Department of Physical Sciences at Universidad Andres Bello invites applications for 2 tenure-track positions at the Assistant Professor level, beginning as early as November 1, 2009 but not after August 1, 2010. Candidates should have a PhD in Astronomy or Physics and postdoctoral experience.

Successful candidates are expected to join the research and teaching activities of the Department of Physical Sciences and to strongly interact with our students. While researchers in all areas of astronomy and physics are encouraged to apply, preference will be given to candidates working in areas related to Department of Physical Sciences's interests which include: Supernova Physics, Galaxy and Structure Formation, Extragalactic Astronomy, AGNs, Gravity, String Theory and Computational Material Science. Further information can be obtained from Prof. Rodrigo Aros ([raros@unab.cl](mailto:raros@unab.cl)).

Commitment to teach at both undergraduate and graduate level in physics and astronomy is required. The candidate is expected to be able to teach in Spanish within a year.

Applicants should submit a curriculum vitae, including a publication list, and short statements of research and teaching interests, and arrange for two letters of recommendation to be sent directly to Prof. Rodrigo Aros ([raros@unab.cl](mailto:raros@unab.cl)) or by regular mail to Departamento de Ciencias Fisicas, Universidad Andres Bello, Avda. Republica 220, Santiago, Chile. The deadline is October 10, 2009 but applications will be considered until the positions are filled.

Universidad Andres Bello is an equal opportunity/affirmative action employer.

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## VARIOS

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### Censo 2009 de astrónomos en instituciones chilenas

En representación de SOCHIAS, Andreas Reisenegger realizó en junio de este año una encuesta entre los Directores u otros representantes de los Departamentos o Grupos de Astronomía en las universidades chilenas, para determinar el número de personas en estas instituciones dedicadas a la Astronomía. El resultado de esta encuesta se muestra en la tabla.

**Astrónomos y estudiantes de Astronomía en universidades chilenas (junio 2009)**

	Profesores	Postdocs	Est. Doct.	Est. Mag.	Est. Lic.	Totales
UCh	16	10	12	15	31	84
PUC	11	8	17	8	127	171
UdeC	7	9	6		79	101
UV	6	7			69	82
ULS	4	4		3	32	43
UCN	3			2	118	123
UNAB	3	1				4
UTa	1					1
UMCE	1					1
<b>Totales</b>	<b>52</b>	<b>39</b>	<b>35</b>	<b>28</b>	<b>456</b>	<b>610</b>

## **PRIMERA OLIMPÍADA CHILENA DE ASTRONOMÍA Y ASTRONÁUTICA**

### **Talca, 20-21 de agosto de 2009**

Los días 20 y 21 de agosto recién pasados se realizó la Primera Olimpiada Chilena de Astronomía y Astronáutica. Fue impulsada por la profesora Olga Hernández, Directora del Club de Ciencias del Liceo Abate Molina de Talca, quien estuvo a cargo de la mayor parte del trabajo de organización. Tuvo el apoyo de sus estudiantes del Club de Ciencias del Liceo, de sus estudiantes de Pedagogía en Matemáticas de la Universidad Autónoma de Chile, sede Talca, y de un grupo de astrónomos encabezado por el Dr. Andreas Reisenegger, en representación de la Sociedad Chilena de Astronomía (SOCHIAS), e integrado por los Dres. Andrés Escala, Amelia Ramírez y Mónica Rubio. El evento se realizó en el Centro de Extensión “Pedro Olmos” de la Universidad de Talca. Además de esta universidad, lo patrocinaron la Ilustre Municipalidad de Talca, el Observatorio Interamericano de Cerro Tololo y el programa Explora-CONICYT, y recibió un importante financiamiento mediante un proyecto otorgado a SOCHIAS por el Fondo Gemini-Chile, administrado por el Programa de Astronomía de CONICYT. Fue anunciado a los profesores y estudiantes a través de la página web del Nodo Chileno para el Año Internacional de la Astronomía 2009 ([www.astronomia2009.cl](http://www.astronomia2009.cl)), de Explora-CONICYT y de medios nacionales y locales.

La Olimpiada incluyó las siguientes actividades:

- Evaluaciones escritas separadas para los estudiantes de Enseñanza Básica (una prueba de selección múltiple) y Enseñanza Media (una prueba de selección múltiple y otra de desarrollo), elaboradas y corregidas por Olga Hernández y el grupo de astrónomos mencionado más arriba.
- Charlas acerca de temas astronómicos, impartidas por los profesores Patricio Rojo (U. de Chile y Director del Nodo Chileno AIA2009), Andrés Escala (U. de Chile), Andreas Reisenegger (PUC y Presidente Anterior de SOCHIAS).
- Talleres prácticos y conceptuales de Astronomía para profesores y estudiantes, dirigidos por los profesores Amelia Ramírez (U. de La Serena) y Andreas Reisenegger, los Sres. Roderick Bowen (Director de Extensión de la Asociación Chilena de Astronomía y Astronáutica, ACHAYA), Roberto Zepeda (astrónomo aficionado), Néstor Espinoza y Claudia Araya (estudiantes PUC, miembros del grupo Física Itinerante).
- Actividades de camaradería para todos los participantes: 4 coffee breaks, 2 almuerzos y 1 cóctel.

Los alumnos participantes fueron seleccionados y patrocinados por sus respectivos colegios y acompañados por sus profesores de Física o Ciencias Naturales (salvo en algunos casos, en que éstos fueron reemplazados por apoderados). Participaron 22 estudiantes de Básica y 28 estudiantes de Media, de colegios municipales, subvencionados y particulares de muchas Regiones de Chile, desde Copiapó y Huasco hasta Puerto Varas y Punta Arenas, aunque con una mayoría de la 7<sup>a</sup> Región y la Región Metropolitana.

Los ganadores de Básica, premiados con un viaje y visita al Observatorio de Cerro Tololo, son los siguientes (en orden alfabético):

- Felipe Ignacio Castillo Huerta, 8º Básico, Liceo Mireya Zuleta Astudillo, Huasco, Región de Atacama (1er lugar).
- Mauricio Sebastián Muñoz Reyes, 8º Básico, Colegio de La Salle, Talca, Región del Maule.
- Mario Ramírez Ponce, 8º Básico, Instituto San Martín, Curicó, Región del Maule.

Los ganadores de Media, que representarán a Chile en la Olimpiada Latinoamericana de Astronomía y Astronáutica (OLAA - [www.olaa.pro.br](http://www.olaa.pro.br) ) en Rio de Janeiro, Brasil, desde el 12 al 19 de octubre de este año, son (en orden alfabético):

- Diana Ávila Jaque, 4º Medio, Liceo Abate Molina, Talca, Región del Maule.
- Rodrigo Esteban Espinoza Reyes, 3º Medio, Instituto Nacional, Santiago, Región Metropolitana.
- Camilo Gálvez Jiménez, 4º Medio, Instituto Nacional, Santiago, Región Metropolitana.
- Vicente Iglesias Benavente, 3º Medio, Colegio San Ignacio El Bosque, Providencia, Región Metropolitana (1er lugar).
- Andrés McVey, 4º Medio, Farmland School, Curacaví, Región Metropolitana.

Para financiar la participación de este equipo en OLAA, SOCHIAS presentó un proyecto al Fondo ALMA-CONICYT, y estamos a la espera del fallo.

En general, se notó mucho entusiasmo y una excelente convivencia entre los estudiantes, sus profesores y los organizadores del evento. La Sociedad Chilena de Astronomía tiene la intención de seguir apoyando estos eventos a futuro.

Andreas Reisenegger  
Presidente Anterior y Encargado de Difusión  
Sociedad Chilena de Astronomía

# La Universidad Católica lanza el primer centro de Astro Ingeniería del país

El recinto, coordinado por el Departamento de Astronomía y Astrofísica y el Departamento de Ingeniería Eléctrica, albergará un Laboratorio de Instrumentación Astronómica y otro de Cómputos, donde funciona el computador de cálculos astrofísicos más grande de Latinoamérica.

Por Carlos Oliva

A través de una ventana, en pleno Campus San Joaquín, Nelson Padilla no oculta su sonrisa al explicar los alcances del Centro de Astro Ingeniería de la Universidad Católica (AIUC), el primero del país, y el cual conectará su oficina con los pasillos de ese enclave.

“Probablemente el Centro esté terminado durante el primer semestre de 2010 hasta donde podré transitar desde mi escritorio”, dice el docente, quien no sólo es profesor asistente del Departamento de Astronomía y Astrofísica (DAA), sino también, el encargado de las simulaciones del Laboratorio de Cómputos que, junto al de Instrumentación, conforma la base de este albergue científico.

La existencia de estos dos laboratorios no ha sido casual en este proyecto inaugurado hace dos meses por las autoridades de la UC. Ambos reflejan el trabajo conjunto de los dos departamentos implicados en su construcción: el DAA, de la Facultad de Física, y el Departamento de Ingeniería Eléctrica, de la Facultad de Ingeniería.

El área de Cómputos, administrado por el DAA, será el encargado de realizar simulaciones y manejo de datos astronómicos en base a un supercomputador de cálculos astrofísicos. Mientras que el Laboratorio de Instrumentación, por su parte,

buscará desarrollar tecnologías para los centros astronómicos de Chile, además de servicios técnicos y de reparación.

“Mientras los astrónomos comprenden bien las problemáticas científicas y los requerimientos de los instrumentos para investigarlas, los ingenieros tienen la capacidad técnica para diseñar, construir y hacer funcionar esos aparatos”, sostiene Leonardo Vanzi, astrónomo y coordinador de Instrumentación.

Si bien el edificio de este centro aún no está listo, la sinergia de estos departamentos ya comenzó a tomar forma. Prueba de ello son los 12 miembros que lo conforman: ocho de Astronomía y cuatro de Ingeniería, colaboración que se complementa con los dos cursos del AIUC que hoy se dictan en la Facultad de Ingeniería: Óptica Adaptativa e Instrumentación Astronómica, a cargo de Vanzi y Andrés Guesalaga, respectivamente.

Según estos docentes, una de los objetivos de este recinto será responder a las preguntas trascendentales de la humanidad, como la existencia de vida extraterrestre o el misterio de la materia y energía oscura. “Por eso, responder a estas interrogantes requiere del empleo de las tecnologías más avanzadas en detectores, opto-mecánica, láser, electrónica, control y software”, explican.

Junto a estos objetivos, el Centro también contará con un área de servicios enfocados al soporte técnico de los observatorios del norte. Pero según los profesionales, con el tiempo, estos servicios también se abrirán a la comunidad, pues la instrumentación astronómica puede ser aplicada tanto a materias de corte científico como a la industria, aseveran.

### **Una viaje de largo alcance**

La historia de este futuro enclave científico comenzó hace cinco años. Su gestación incluye las ideas de astrónomos e ingenieros de la UC, quienes, tras largas discusiones, lo presentaron a diversos fondos concursables, logrando importantes financiamientos como el Proyecto Basal y un Fondo de Áreas Prioritarias de CONICYT.

Sin embargo, la prioridad más importante al momento de su gestión, fue la falta de puentes para la transferencia astronómica de los telescopios del norte. Por eso, el AIUC no sólo busca el soporte de instrumentalistas y astrónomos de los observatorios internacionales, sino también, capacitar a expertos locales para facilitar esa trasferencia.

“El AIUC hace de canal tanto en la formación como en la contratación de personal (profesores, técnicos, investigadores), y todo esto en una forma orgánica que responde a un plan de desarrollo”, advierte Leopoldo Infante, actual director del Centro.

Si bien este albergue está dirigido por el profesor Infante del DAA, y actual presidente de Sochias, junto a él existe un directorio de consejeros nombrado por el rector Pedro Pablo Rosso, la plana docente del DAA y las autoridades de Ingeniería.

## **Proyectos astronómicos**

Según sus especialistas, el Centro de Astro Ingeniería se encuentra en una etapa de crecimiento. Por ello cada vez que hay concursos para el financiamiento de proyectos científicos, este enclave intenta participar.

En general, los proyectos de investigación tanto del Laboratorio de Cómputos como el de Instrumentación requieren de grandes esfuerzos económicos. Por eso, aunque el centro haya partido con programas pequeños, muchos financiados por Fondecyt y observatorios internacionales, sus investigadores hoy pueden decir con propiedad que su horizonte tiene proyecciones astronómicas.

“El hecho de tener una meta ambiciosa nos permite enfocar nuestro trabajo y fortalecer nuestro equipo”, explica Vanzi aludiendo al proyecto SIMPLE de 75 millones de euros: un espectrógrafo de alta resolución que se fabrica para el Telescopio Europeo Extremadamente Grande (E-ELT). Allí, SIMPLE observará una banda ancha del espectro de una sola pasada y con un alta resolución, dos características difíciles de hallar entre los telescopios actuales.

Si por un lado SIMPLE es un instrumento para el telescopio europeo de 40 metros de ESO, por el otro, es un consorcio donde trabajan el Instituto Nazionale di Astrofisica de Italia, el Uppsala Astronomica Observatory de Suecia y el TLS Tautenburg de Alemania.

"La pertenencia de la UC en este consorcio es muy importante para Chile, porque lo involucra, después de casi 50 años de presencia de la astronomía europea en el país, en un proyecto de alta y compleja tecnología", dice Vanzi.

Pero al hablar de grandes programas, es imposible para estos docentes no referirse a VISTA, donde el súper computador del Laboratorio de Cómputos aportará más de un cálculo.

Vista será un telescopio infrarrojo que también funcionará en ESO, a través del cual, un equipo comandado por Dante Minniti, profesor de la UC, intentará obtener por primera vez imágenes en tres dimensiones de la Vía Láctea.

De ahí al aporte del súper computador y sus 64 CPU, cada uno con ocho núcleos que operarán por una red de un Gigabyte, además de la memoria de 16 Giga de cada PC, con una memoria total de un Terabyte.

Este súper computador es el más grande de Latinoamérica para cálculos astrofísicos. Y según Nelson Padilla, su administrador, "lo único más cercano en nuestro vecindario es el computador de la Universidad de Buenos Aires: una máquina que apenas es un cuarto de la nuestra", explica con su acento trasandino.

La fabricación de este aparato, capaz de realizar en un mes cálculos que tardarían 500 años a un PC convencional, se hizo indispensable por una razón: poder realizar simulaciones numéricas cosmológicas que fueran competitivas a nivel internacional.

Tal objetivo, afirma el experto, apunta a dos frentes: poder simular volúmenes tan grandes como los surveys de las galaxias disponibles como SDSS y los futuros desafíos que presente el telescopio LSST.

Este cluster computacional también estará preparado para almacenar, procesar y

analizar datos provenientes de telescopios de última generación del tipo GMT, VISTA o VST, instalados en el norte de Chile.

Y para aprovechar de mejor manera las ventajas de este súper PC, el AIUC está organizando una escuela y un taller para generar capacidades en computación paralela, además de análisis de grandes volúmenes de datos. Este evento se realizará en abril del 2010 y contará con expertos mundiales en el tema.

“Este supercomputador astronómico ha sido la primera gran adquisición del Centro, una adquisición sin par en la región, y una característica también que queremos mantener en el tiempo, haciendo inversiones regulares en éste y otros ámbitos. Esta máquina refleja que los proyectos que a va a llevar adelante el Centro será de punta”, apunta con convicción el profesor Padilla.

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## CONOCIENDONOS UNOS A OTROS

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### Grupo de Astronomía de la Universidad Andrés Bello

El Grupo de Astronomía de la Universidad Andrés Bello forma parte del Departamento de Ciencias Físicas. Sus inicios son muy recientes, partiendo en el año 2007 con la contratación del primero de sus miembros. Actualmente, el grupo está formado por 4 profesores y 1 postdoc. Sin embargo, el grupo está aún en formación y esperamos la incorporación de dos nuevos miembros en los próximos años (ver aviso en esta misma newsletter), así como también la incorporación de otros postdocs financiados con fondos externos o de nuestra universidad.

Los integrantes actuales del Grupo de Astronomía son los siguientes:

- Dr. Patricia Arévalo<sup>1</sup>. Profesor Asistente. Ph.D. Max-Planck-Institut für extraterrestrische Physik (MPE), Ludwig-Maximilians-Universität, Alemania. Temas de interés: Propiedades y estructura de núcleos galácticos activos (AGNs). Binarias de rayos X. Física de acreción.
- Dr. Matías Gómez. Profesor Asistente. Ph.D. P. Universidad Católica de Chile. Temas de interés: Cúmulos globulares extragalácticos.
- Dr. Andrés Meza. Profesor Asistente. Director Licenciatura en Astronomía. Ph.D. Universidad de Chile. Temas de interés: Formación de galaxias. Estructura de gran escala. Dinámica estelar.
- Dr. Giuliano Pignata. Profesor Asistente. Ph.D. Università di Padova, Italia. Temas de interés: Física de supernovas. Asteroides.
- Dr. Alessio Romeo. Postdoc. Ph.D. Università di Catania, Italia. Temas de interés: Formación y evolución de cúmulos y grupos de galaxias. Simulaciones cosmológicas.

La formación de este grupo se enmarca dentro del plan de desarrollo de la Universidad Andrés Bello, el cual considera la creación y fortalecimiento de grupos de investigación en áreas focalizadas diferenciadoras en el contexto nacional y la creación de carreras nuevas asociadas a estos grupos. Por este motivo, a contar del próximo año, el Departamento de Ciencias Físicas ofrecerá la carrera de Licenciatura en Astronomía con un cupo inicial para 20 alumnos, la cual se sumará a las carreras de Ingeniería Física y Licenciatura en Física que nuestro departamento imparte desde el año 2007. Estas carreras son las únicas de su tipo en una universidad privada no perteneciente al Consejo de Rectores.

Por otro lado, el Departamento de Ciencias Físicas ha estado organizando una serie de talleres de astrofísica consistentes en mini-cursos de 2 sesiones y charlas invitadas de investigadores de

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<sup>1</sup>Patricia Arévalo se encuentra realizando una estadia postdoctoral conjunta en Shanghai Astronomical Observatory, China y Max-Planck-Institut für Astrophysik (MPA), Alemania. Su incorporación definitiva a nuestro departamento será en agosto de 2010.

universidades chilenas o instituciones extranjeras basadas en Chile. El primer taller se realizó en noviembre de 2008. Los charlistas invitados en dicha oportunidad fueron: Mario Abadi (Observatorio Astronómico de Córdoba, Argentina), Max Bañados (PUC), Matías Gómez (U. Andrés Bello), Mario Hamuy (U. de Chile), Steffen Mieske (ESO), Verónica Motta (U. de Valparaíso), Nelson Padilla (PUC), Andreas Reisnegger (PUC).

El segundo taller se realizará el 2 y 3 de noviembre de 2009 en el campus República de la Universidad Andrés Bello. Los charlistas confirmados a este taller son: Julio Navarro (University of Victoria, Canada), Dante Minniti (PUC), Giuliano Pignata (U. Andrés Bello), Paulina Lira (U. de Chile), Julio Chaname (Carnegie Institution of Washington, USA), Sergio del Campo (UCV), Mario Abadi (Observatorio Astronómico de Córdoba, Argentina).