

ANNUAL REPORT 2013



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Robert G. Deupree, Director

Florence Woolaver, ICA Support

Cover Photo: Jeff Harper, Metro News (see next page for caption)

Front Cover Photo Caption

In the ICA we are accustomed to think of a Data Cave in terms of a visualization tool for 3D hydrodynamic simulations. However, “if you build it, they will come”, as evidenced by the presentation of art work created for an immersive environment by Lisa Frank as part of her MFA work at the University of Wisconsin-Madison. In the spring Ms. Frank gave a lecture on her work and the exhibition was open to the public through a series of tours for several weeks afterwards. More than 500 people saw the exhibit. The photo shows ICA Ph. D. student Mr. Diego Castañeda giving a tour of one of the pieces of the exhibit. The lecture and exhibit were sponsored by the ICA and by the Vice-President, Academic and Research of Saint Mary’s University.

Photo courtesy of Metro News

ICA 2013 Annual Report

Institute for Computational Astrophysics
Saint Mary's University

Introduction

The ICA was created in late 2002 to promote the study of complex astrophysical phenomena by numerical simulation. Throughout the past decade the ICA has acquired access, through ACEnet and Compute Canada (in which several ICA members have played very significant roles), to significant high performance computing resources required for these simulations. In addition the ICA has enriched the environment of the Department of Astronomy and Physics by recruiting ten postdoctoral fellows. A number of graduate students have been part of the ICA, and to date twelve MSc. degrees and seven Ph. D. degrees have been awarded to ICA students.

The ICA has six full time faculty members, each of whom is also a faculty member in the Department of Astronomy and Physics. They are Dr. Robert Deupree, Director and Tier 1 Canada Research Chair, Dr. David Clarke, Dr. David Guenther, Dr. Marcin Sawicki, Dr. Ian Short, and Dr. Rob Thacker, Tier 2 Canada Research Chair. Drs. Guenther, Sawicki, and Thacker were on sabbatical during parts of this year.

In addition Ms. Florence Woolaver served as the ICA Assistant for the seventh year. With the retirement of the Astronomy and Physics Department secretary in July, Ms. Woolaver assumed both positions. This was expected to have negative consequences for the ICA and has done so. Attached to the ICA are three ACEnet employees located at Saint Mary's, Mr. Phil Romkey, Mr. Sergiy Khan, and Mr. Stephen Condran.

Events of the Past Year

This has been a banner year for ICA graduate students finishing their degrees, particularly for ICA Ph. D. students. Drs. Chris Geroux, Michael Gruberbauer, David Williamson, and James Wurster all completed and defended their Ph. D. theses this spring or summer. Their respective supervisors were Drs. Deupree, Dr. Guenther, and Dr. Thacker (twice). Drs. Geroux, Williamson, and Wurster have taken up postdoctoral positions in England, Montreal, and Australia, respectively, and Dr. Gruberbauer is taking some time off at home in Austria (he was recruited for several postdoctoral fellowship positions, but wanted a break). The success of ICA Ph. D. students in obtaining postdoctoral positions is one of the positive metrics of the ICA – each of the five Ph. D. students who searched for postdoctoral positions in astronomy (the other two did not for personal reasons) were successful in obtaining them.

ICA Master's students also completing their degree this year were Ms. Anneya Golob (supervised by Dr. Sawicki), Mr. Diego Castañeda (supervised by Dr. Deupree), Mr. Mitch Young (supervised by Dr. Short), and Mr. Chris Cooke (supervised jointly by Drs. Guenther and Short). New ICA students for 2013 are Mr. Maan Hani and Ms. Samantha Pillsworth, working with Drs. Thacker and Clarke, respectively. Ms. Golob, Mr. Castañeda, and Mr. Young are continuing in the Ph. D. program with their Master's supervisors as listed above. Continuing Ph. D. student Mr. Robert Sorba was awarded an NSERC PGS-D fellowship.

The ICA hosted a visit by artist Lisa Frank who recently received her MFA from the University of Wisconsin in Madison. She presented a talk on her work to build a 3D display of her photographic art in the University of Wisconsin data cave, followed by a display of her scenes in the ACEnet data cave here at Saint Mary's. During the month following her visit, ICA members ran demonstrations of her art in the data cave, seen by over 500 members of the public who had not previously been in the data cave (and a number more who had). This far exceeded expectations, and the ICA thanks Ms. Woolaver for arranging and scheduling the visitors in these sessions. Over 100 more people could not be accommodated within the time frame allotted for the exhibition. The ICA wishes to thank Dr.

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Gauthier, Vice-President Academic and Research, for providing partial financial support for the artist's visit.

ICA faculty employed a number of undergraduates as summer researchers this year. These included Mr. Kieran MacLeod (supervised by Drs. Guenther and Deupree), Mr. Chris MacMackin (supervised by Dr. Thacker), and Mr. Logan Francis and Mr. Stephen Campbell (both supervised by Dr. Clarke).

The ICA completed its self-study as part of the university's review process. This raised some issues about the nature of the ICA and its relationship to the Department of Astronomy and Physics and to ACEnet, to which both the Director and the Chair of the Department of Astronomy and Physics responded. Senate passed a resolution continuing the ICA for another five years.

The ICA hosted a number of visitors during the past year besides Dr. Frank, including Drs. Chris Geroux (Exeter), Hugo Martel (Laval), Dr. Travis Metcalfe (Space Science Institute), and Dr. Robert Stellingwerf (Stellingwerf Consulting).

Dr. Deupree announced his pending retirement at the end of July 2014 to allow the university sufficient time to recruit his replacement as a Tier 1 Canada Research Chair. This search is underway.

Upcoming ICA Activities

The ICA has agreed to organize a half-day session for the annual meeting of the High Performance Computing Symposium (HPCS) to be held in Halifax next June. The HPCS is the annual meeting of Canadian high performance computing users. The original intent of the half day session had been to focus on the needs for computing in astronomy in the next decade, but it appears that this will be covered as part of the discussion of the midterm review of the long range plan for Canadian Astronomy at the Canadian Astronomical Society Meeting in Quebec City two weeks prior to HPCS. The ICA has now decided to host a session on data caves.

With the retirement of the Director a search for a new Director will be undertaken in the latter half of 2013 and into the first part of 2014.

ICA Member Service

Members of the ICA play significant roles in service to the university, the community, and the astronomical community on both the national and international scale. Some of the activities are summarized here.

Dr. Deupree has been reducing his external commitments as his retirement approaches. He, along with Ms. Woolaver and Mr. Phil Romkey, organized the artistic exhibit in the Data Cave and the accompanying lecture. Dr. Deupree is also organizing the Data Cave session for next year's HPCS. As a consequence of this, he is also a member of the HPCS Program Committee. He continues to serve on the Department of Astronomy and Physics Graduate Committee.

Dr. Clarke continues to serve on a variety of university committees, including the Science Space Committee, the Science Curriculum Committee, and the Copyright Committee. In addition, he organized the undergraduate summer research symposium held annually in September to give the Department of Astronomy and Physics summer research students a chance to talk about their work.

This past year Dr. Guenther spent most of his time on sabbatical. Dr. Guenther is a member of the BRITE Constellation consortium. The BRITE Constellation is a proposed set of six nano-satellites designed to observe oscillations on the brightest stars in the sky. The project represents a joint collaboration of Canadian, Polish, and Austrian asteroseismologists. Two of the six satellites scheduled for launch in 2013-14 have been launched. Guenther is working with Dr. Thomas Kallinger (Vienna) on modeling the oscillation spectra of red giants obtained from CoRoT, Kepler, MOST, and BRITE.

Dr. Guenther is a member of the MOST Science Team. He continues to analyze the data coming from Canada's first space telescope, MOST. He is in part

responsible for the stellar modeling, oscillation modeling, and interpretation of the data obtained from the satellite.

Dr. Sawicki spent much of the past year on sabbatical. However, he remains a very active contributor to the well-being of Canadian astronomy. He is currently serving as Vice Chair of the Board of Management of the Association of Canadian Universities for Research in Astronomy (ACURA) and is also a member of the Canadian Astronomical Society (CASCA) Board of Directors. He is also involved in leadership roles on a variety of more specific projects; in particular he serves on 1) the Science Management Committee of the Canadian Network for Astronomical Research (CANFAR), 2) the science team for the TFI/NIRISS instrument produced by Canada for NASA's James Webb Space Telescope (JWST), 3) the extragalactic science team for the next generation CFHT (ngCHFT) project, 4) the JAXA sponsored WISH telescope project as the Canadian collaboration contact, and 5) the Canadian Space Telescope (CASTOR) study team. As a member of the CASCA board, Dr. Sawicki serves on the Education and Public Outreach (EPO) and the joint CASCA – Royal Astronomical Society of Canada “Beyond the International Year of Astronomy” committees.

Dr. Short served as a temporary member on the Canadian Time Allocation Committee (CanTac) this past fall. He also is the Saint Mary's University representative on the ACEnet Research Directorate and organized the ACEnet annual meeting on the Saint Mary's campus this past spring. Dr. Short was also on the HPCS Program Committee until it became clear that there was not going to be an astrophysics session at the 2014 annual meeting.

Dr. Thacker spent the last half of 2013 on sabbatical, even during which he continues to support Canadian astronomy in a variety of ways. Perhaps most important was his membership on a six person committee which wrote a 47 page report on the Thirty Meter Telescope (TMT) project in preparation for the NRC to write a Memorandum to Cabinet requesting Canadian participation in the funding of this project. Partly because of this work and Dr. Thacker's work on the Long Range Plan for astronomy, he was asked to head the mid-term review of Canadian astrophysics. In addition to this work for the profession, Dr. Thacker remains

active in public outreach by presenting several talks at the Discovery Centre of Nova Scotia and being interviewed on the CBC, CTV, and News 95.7 radio.

ICA Member Research Contributions

All of the ICA faculty members maintain very active research programs involving graduate students and occasionally undergraduate students and postdoctoral fellows as well as themselves. All faculty not only publish papers in the high quality, refereed astronomical literature, but also serve as referees for many of these same journals. Here we present a brief summary of ICA members' research accomplishments for the past year.

Dr. Deupree, working with Ph. D. student and now postdoctoral fellow Dr. Chris Geroux, completed and published their results of 2D large eddy simulations of full amplitude pulsating RR Lyrae stars. These results show that convection, if able to carry a sufficient amount of flux, is transporting energy out of the hydrogen ionization region when radiative calculations have the energy being "stored" there, thus enabling convection to decrease the pulsational driving near the red edge. This leads to much better agreement between our full amplitude calculations and the observed light curves for those low amplitude stars near the red edge than has been obtained with 1D mixing length formulation full amplitude simulations. They have now begun a survey to determine the effects of zoning and other free parameters of the simulation.

Drs. Geroux and Deupree extended their work to fully 3D calculations and found that the pulsational characteristics, such as the pulsational amplitude, pulsational growth rate, and convective dependence on pulsation phase, were quite close to the 2D simulations, although the convective flow patterns are (of course) quite different. This is very fortunate because it means that much of the scoping work can be done in 2D, leaving 3D calculations until many of the free parameter issues have been settled. The 3D calculations performed to date have been relatively coarsely zoned in the horizontal direction (20 x 20 zones), but the calculations still took about a year because so many time steps were required to obtain full amplitude.

Master's student Mr. Diego Castañeda, working with Dr. Deupree, examined the effects of modest differential rotation (in which the rotation rate increased as the distance from the rotation axis decreased) on the spectral energy distribution (both broadband and individual lines) of models for α Oph. The results were essentially indistinguishable from the uniformly rotating model SEDs they had previously computed.

A key interest of Dr. Clarke's is providing, upgrading, and maintaining the 3D magnetohydrodynamic (MHD) code, ZEUS-3D. In the last five years there have been approximately 400 unique downloads of the ZEUS package (www.ica.smu.ca/zeus3d) including the code (approximately 120,000 lines of FORTRAN), documentation, and support software for researchers to use in their own work. During the last year, Dr. Clarke has developed a new paradigm for solving the MHD equations which would address a "striping instability" suffered by previous versions of the code. It is worth noting that supplying numerical codes was listed as one of the objectives in the founding of the ICA.

Dr. Clarke's research efforts with former Ph. D. student Dr. Jon Ramsey are continuing. These efforts are related to completing and publishing some detailed results related to Jon's thesis work on protostellar jets. There is now some urgency to complete this work because the thesis research Dr. Clarke's new Master's student, Ms. Samatha Pillsworth, will pick up from where Mr. Ramsey's work finished.

Dr. Clarke is working with undergraduate student Mr. Logan Francis to install and test a self-gravity solver based on fast Fourier methods for ZEUS-3D. For his honours thesis, Mr. Francis will perform some preliminary calculations on how a rotating magnetized cloud fragments as it collapses under the force of its own gravity.

Dr. Clarke will also be working with undergraduate Mr. Stephen Campbell to examine how twin jets from extragalactic radio sources form. These jets are associated with the cores of galaxies, and numerous questions remain about why the jets are as asymmetrical as they are and what the origin of their emission distribution may be. This past summer Mr. Campbell installed a new routine in

ZEUS-3D which allows movies to be made directly from the simulations, and for his honours thesis work he will add the effects of magnetism and synchrotron aging, both of which are required as part of the explanation of the observed emission distributions.

Dr. Guenther continues his work with the Yale Convection Group on calculating 3D surface convection zones and their asteroseismological ramifications. Mr. Joel Tanner, Dr. Guenther's former Master's student, is finishing his Ph. D. thesis on the convective modeling, and they are applying these results to the asteroseismology of Procyon.

Dr. Michael Gruberbauer completed and defended his Ph. D. thesis applying his formulation of the methodology of Bayesian statistics to surface effects in asteroseismology. Dr. Guenther and undergraduate Mr. Kieran MacLeod are applying this methodology to a study of bumped frequencies for several stars observed with Kepler.

Dr. Guenther continues his collaboration with Dr. Konstanze Zwintz of the University of Vienna on modelling the oscillation spectra of pre main sequence stars obtained with MOST and CoRoT. Dr. Michael Casey, who completed his Ph. D. with Dr. Guenther two years ago, gave an invited talk at the pulsation conference in Poland this past summer.

Dr. Guenther has completed his development of a combined stellar evolution – nonradial pulsation code, allowing the computational of pulsation frequency spectra of models of stars as they are evolved. This incorporates components of the Yale Rotation Evolution Code (YREC), written by Drs. Demarque, Guenther, and Pinsonneault) and Dr. Guenther's linear, nonadiabatic, nonradial stellar pulsation code. Dr. Guenther wrote routines to compute convective core overshoot based on the Kuhfuss model and to compute mass loss or gain. The new code has been used to explore the effects of convective core overshoot on models of Procyon.

Dr. Sawicki's research interests are the formation and evolution of galaxies in the distant universe. His research is on the observational side and he and members of his research group use HPC to process and analyze large observational

datasets and carry out associated simulations. Under Sawicki's supervision, Mr. Robert Sorba is working on spatially-resolved spectral energy distribution (SED) fitting of galaxy images, where it is found that traditional methods (which essentially treat each galaxy as a point source) may underestimate a galaxy's stellar mass by up to 15%. Ms. Liz Arcila-Osejo has been using the very deep and large-area Canada-France-Hawaii Telescope Legacy Survey (CFHTLS) data to characterize the populations of passively-evolving and actively-star-forming galaxies at redshift $z \sim 2$: a paper on the stellar mass function of these galaxies has been published and one (led by former post-doc Dr. Taro Sato) that looks at spatial clustering properties of these objects is about to be. Ms. Anneya Golob is in the first year of her PhD studies and involved in several projects related to the quenching of star formation in galaxies at low and high redshift. During the first half of 2013 Dr. Sawicki was on sabbatical research leave at Tohoku University in Sendai, Japan, to collaborate with Dr. Toru Yamada and other staff members on the WISH space telescope project and other endeavors; under Dr. Sawicki's leadership the Canadian effort to join WISH is accelerating, with over a dozen Canadian astronomers now involved in lobbying the Canadian Space Agency towards that end.

Dr. Short has continued his research into the determination of the effective temperatures of old bright red giant stars using the PHOENIX NLTE stellar atmospheres code. With undergraduate Mr. Eamonn Campbell, Dr. Short has shown that 1) massive NLTE modelling leads to a reduction of about 50K in the effective temperature inferred from modelling the SED of the stars' visible band light, 2) adoption of an enhancement in the abundances, $[A/H]$, of light even-atomic-number α -process elements in models of slightly "metal"-poor RG stars lowers the derived effective temperature value further by ~ 50 K, and 3) effective temperature values vary by about 25 K, depending on the choice of adopted reference solar abundances. The inferred values of different elements depend for any star depend on the effective temperature adopted; for example, the log of barium to iron ratio drops by about 0.03 for an 80K increase in the effective temperature for these stars.

Mr. Mitchell Young completed his Master's thesis with Dr. Short studying the effects of NLTE and horizontal variations of the effective temperature, such as might be induced by turbulence in the large scale surface convection zone, affect

the spectral energy distribution in red giants. They found that the effective temperature deduced increased as the variation in horizontal temperature increased and, as noted above, the LTE models provided higher deduced effective temperatures than did the NLTE models.

Mr. Christopher Cooke, working with Dr. Short, computed a number of model atmospheres with the goal of determining the upper boundary condition that should be used in asteroseismology calculations where models are interpolated in a coarse grid of evolution models. The emphasis was on the accuracy of various numerical interpolation schemes. It turns out that no one of the interpolation procedures led to significantly more accurate results than the others that were tested.

While on sabbatical Dr. Thacker visited his former Ph. D. student, Dr. James Wurster, now a postdoctoral fellow at Monash University. They worked on a follow up paper to their previously published feedback model comparisons. They have now extended that work to compare observations of star formation and AGN activity to see how they correlate. The results are interesting in that there appears to be a clear distinction between models that is related to the assumed accretion law for the black hole. They also only reproduce observed correlations for entire galaxies at certain epochs of the evolution. These results should contribute to a better understanding of the observations and how they reflect the evolution of the underlying systems.

Appendix 1: Publications and Talks of ICA Members
October 2012 – December 2013

Refereed Publications

Arcila-Osejo, Liz; Sawicki, Marcin, "The numbers of $z \sim 2$ star-forming and passive galaxies in 2.5 square degrees of deep CFHT imaging", 2013, [MNRAS, 435, 845A](#)

Casey, M. P., Zwintz, K., **Guenther, D. B.**, Weiss, W. W., Amado, P. J., Díaz-Fraile, D., Rodriguez, E., Kuschnig, R., Matthews, J. M., Moffat, A. F. J., Rowe, J. F., Rucinski, S. M., Sasselov, D., "MOST observations of the Herbig Ae delta-Scuti star HD 34282", 2013, [MNRAS, 428, 2596](#)

Dragomir, D.; Matthews, J. M.; Eastman, J. D.; Cameron, C.; Howard, A. W.; **Guenther, D. B.**; Kuschnig, R.; Moffat, A. F. J.; Rowe, J. F.; Rucinski, S. M.; Sasselov, D.; Weiss, W. W., "MOST Detects Transits of HD 97658b, a Warm, Likely Volatile-rich Super-Earth", 2013, [ApJ, 772, 2](#)

Geroux, C. and Deupree, R., "Radial Stellar Pulsation and Three Dimensional Convection II. Two Dimensional Convection in Full Amplitude Radial Pulsation", 2013, [ApJ, 771, 113](#)

Golubov, O., Just, A.; Bienaymé, O., Bland-Hawthorn, J., **Gibson, B. K.**, Grebel, E. K., Munari, U., Navarro, J. F., Parker, Q., Seabroke, G., Reid, W., Siviero, A., Steinmetz, M., Williams, M., Watson, F., Zwitter, T., "The asymmetric drift, the local standard of rest, and implications from RAVE data", 2013, [A&A, 557A, 92](#)

Gruberbauer, M., Guenther, D. B., MacLeod, K., Kallinger, T., "Bayesian Analysis of 23 Solar-like Kepler Targets", 2013, [MNRAS, 435, 242G](#)

Gruberbauer, M. & Guenther, D. B., "Bayesian Seismology of the Sun", 2013, [MNRAS, 432, 417](#)

Jerzykiewi, M., Lehmann, H., Niemczura, E., Molenda-Zakowicz, J., Dymitrow, W., Fagas, M., **Guenther, D.B.**, Hartmann, M., Hrudková, M., K. Kamiński, Kuschnig, R., Leto, G., Matthews, J.M., Moffat, A.F.J., Rowe, J.F., Ruciński, S.M., Sasselov, D., and Weiss, W.W., "mu Eridani from MOST and from the ground: an orbit, the SPB component's fundamental parameters, and the SPB frequencies", 2013, MNRAS, 432, 1032

- Karoff, C.; Campante, T. L.; Ballot, J.; Kallinger, T.; **Gruberbauer, M.**; García, R. A.; Caldwell, D. A.; Christiansen, J. L.; Kinemuchi, K., "Observations of Intensity Fluctuations Attributed to Granulation and Faculae on Sun-like Stars from the Kepler Mission", 2013, *ApJ*, 767, 34,
- Pascual-Granado, J.; Grigahcène, A.; Díaz-Fraile, D.; **Gruberbauer, M.**; Garrido, R.; Amado, P.; Suárez, J. C., "On the Origin of the Dense Frequency Spectra of Space Observed Intermediate Mass Pulsating Stars", 2013, [ASSP, 31, 33](#)
- Recchi, S., Calura, F., **Gibson, B. K.**, Kroupa, P., "The $[\alpha/\text{Fe}]$ ratios of very metal-poor stars within the integrated galactic initial mass function theory", 2013, [MNRAS, tmp, 2644](#)
- Richardson, Mark L. A.; Scannapieco, Evan; **Thacker, Robert J.**, "Hybrid Cosmological Simulations with Stream Velocities", 2013, [ApJ, 771, 81](#)
- Siebert, A., Famaey, B., Binney, J., Burnett, B., Faure, C., Minchev, I., Williams, M. E. K., Bienaymé, O., Bland-Hawthorn, J., Boeche, C., **Gibson, B. K.**, Grebel, E. K., Helmi, A., Just, A., Munari, U., Navarro, J. F., Parker, Q. A., Reid, W. A., Seabroke, G., Siviero, A., Steinmetz, M., Zwitter, T., "The properties of the local spiral arms from RAVE data: two-dimensional density wave approach", 2012, [MNRAS. 425, 2335](#)
- Siwak, M., Rucinski, S. M., Matthews, J. M., Kuschnig, R., **Guenther, D. B.**, Moffat, A. F. J., Rowe, J. F., Sasselov, D., Weiss, W. W., "Photometric variability in FU Ori and Z CMa as observed by MOST", 2013, [MNRAS, 432, 194](#)
- Short, C. Ian, Campbell, Eamonn A.**, "Modeling the Near-ultraviolet Band of GK Stars. III. Dependence on Abundance Pattern" 2013, [ApJ, 769, 136](#)
- Townsend, R. H. D., Rivinius, T., Rowe, J. F., Moffat, A. F. J., Matthews, J. M., Bohlender, D., Neiner, C., Telting, J. H., **Guenther, D. B.**, Kallinger, T., Kuschnig, R., Rucinski, S. M., Sasselov, D., Weiss, W. W., "MOST Observations of σ Ori E: Challenging the Centrifugal Breakout Narrative", 2013, [ApJ, 769, 33](#)
- Wurster, J. and Thacker, R. J.**, "A comparative study of AGN feedback algorithms", 2013, [MNRAS, 431, 2513](#)
- Wurster, J. and Thacker, R. J.**, "Accretion disc particle accretion in major merger simulations", 2013, [MNRAS, 431, 539](#)

Zwintz, K., Fossati, L., **Guenther, D. B.**, Ryabchikova, T., Baglin, A., Themessl, N., Barnes, T. G., Matthews, J. M. Auvergne, M., Bohlender, D., Chaintreuil, S., Kuschnig, R., Moffat, A. F. J., Rowe, J. F., Rucinski, S. M., Sasselov, D., Weiss, W. W., "Regular frequency patterns in the young delta Scuti star HD 261711 observed by the CoRoT and MOST satellites", 2013, [A&A, 552, 68](#)

Zwintz, K.; Fossati, L.; Ryabchikova, T.; Kaiser, A.; **Gruberbauer, M.**; Barnes, T. G.; Baglin, A.; Chaintreuil, S., " γ Doradus pulsation in two pre-main sequence stars discovered by CoRoT", 2013, A&A, 550, 121

Papers Submitted to Refereed Journals

Arcila-Osejo, L., Sawicki, M. & Sato, T., "Luminosity function of $z \sim 2$ galaxies from 2.5 square degrees of CFHT imaging", 2012, in preparation

Geroux, C. and Deupree, R., "Radial Stellar Pulsation and Three-Dimensional Convection. III. Comparison of Two-Dimensional and Three-Dimensional Convection Effects On Radial Pulsation", 2013, submitted ApJ

Sorba, R. & Sawicki, M., "On the stellar masses of high-redshift galaxies", 2012, in preparation

Non-refereed publications

Clarke, D. A., "A truly embryonic star", 2012, Natur, 492, 52-53

Thacker, Robert J., "ALMA", Alternatives Journal, 2013, Vol 39, Issue 5

Thacker, Robert J., "Because the Night", Alternatives Journal, 2013, Vol 39, Issue 5

Colloquia and Presentations Given by ICA Members

Ms. Liz Arcila-Osejo, Canada France Hawaii Telescope Users Meeting, Campbell River, BC, "Passive and Star-Forming galaxies at $z \sim 2$ as seen by CFHT", 6-8 May 2013

Dr. Chris Geroux, Saint Mary's University, "The Interaction Between Multi-Dimensional Convection and Radial Stellar Pulsation", 8 February 2013

Mr. Michael Gruberbauer, Saint Mary's University, "The Trouble with Asteroseismology", 15 March 2013

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- Dr. David Guenther, European Southern Observatory, Santiago, Chile
"Astero-seismology of Pre-Main-Sequence Stars", February 2013
- Dr. Marcin Sawicki, Department of Astronomy, Tohoku University, Japan,
"Galaxies at Cosmic High Noon", February 2013
- Dr. Marcin Sawicki, Kavli Institute for the Physics and Mathematics of the
Universe, Tokyo University, Japan, "Life and Death at Cosmic High Noon",
March, 2013
- Dr. Marcin Sawicki, University of Hawaii, Institute for Astronomy, "Life and
Death at Cosmic High Noon", September 2013
- Dr. Marcin Sawicki, Saint Mary's University, "Life and Death at Cosmic High
Noon", 18 October 2013
- Dr. Marcin Sawicki, WISH Science Conference, Tokyo, "Canadian WISH Science
Interests: from the Solar System to First Light", December 2013
- Mr. Robert Sorba, ESO WS, Santiago, Chile, "Deconstructing Galaxies: Structure &
Morphology in the Era of Large Surveys" conference, "Galaxy stellar mass
estimation through pixel-by-pixel SED fitting: the whole is not equal to
the sum of the parts", 20 November, 2013
- Dr. Robert Thacker, Arizona State University, Tempe, Az, "A comparison of
AGN feedback implementations", March, 2013
- Dr. Robert Thacker, "Mind the Gap", Cambridge University, UK, "AGN Feedback
models with accretion disc time-scales", 8-12 July 2013
- Dr. Robert Thacker, Discovery Centre of Nova Scotia, Halifax, "Rockets and
Space", 16 August 2013
- Dr. Robert Thacker, Discovery Centre of Nova Scotia, Halifax, "Beyond the Solar
System", 5 & 26 May 2013
- Mr. James Wurster, Saint Mary's University, "Skeletons in the Closet: A
Comparative Study of AGN Feedback Algorithms", 21 September 2012

Poster Presentations Given by ICA Members

- Mr. Diego Castañeda, Putting A Star into Context: Evolution, Environment, and
Related Stars, Moscow, Russia, "Internal Angular Momentum Distribution
of the A5 III star alpha Oph", 3-7 June 2013