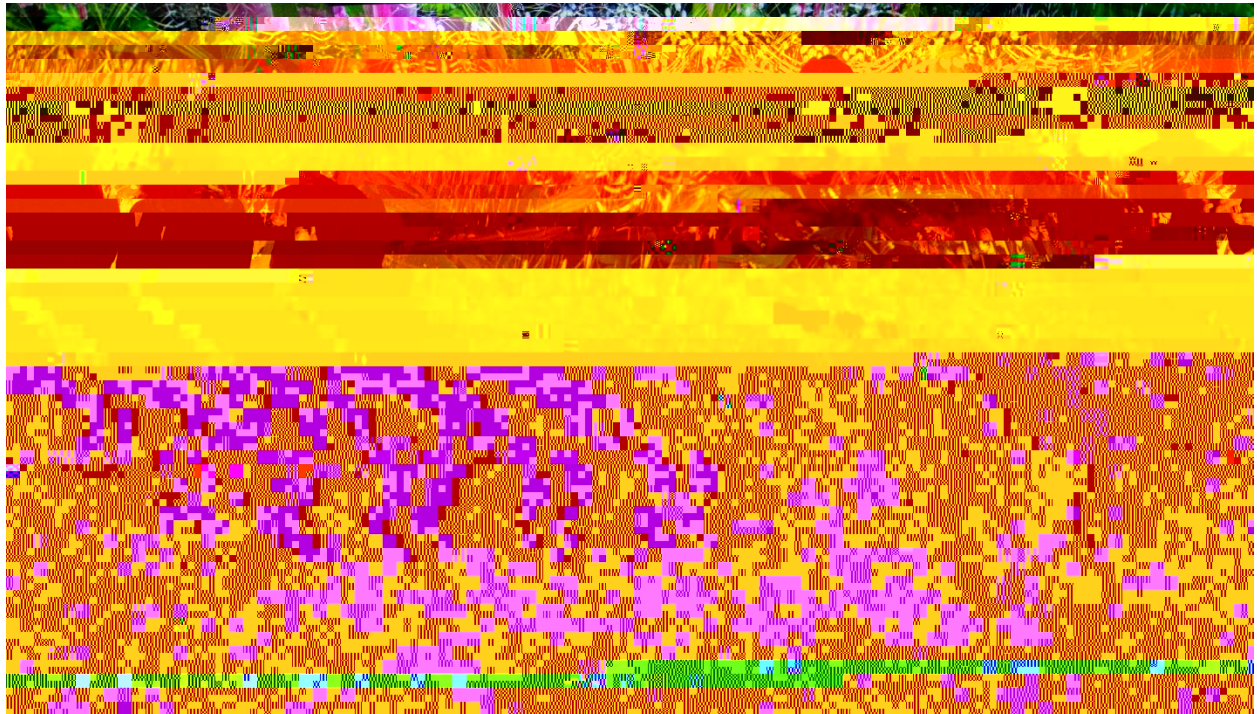


# ANNUAL REPORT 2013



## Compiled by:

Robert G. Deupree, Director

Florence Woolaver, ICA Support

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





In the ICA we are accustomed to think of a Data Cave in terms of a 52.ms2 of a

## **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.

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.









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 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





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 M.-14((as)4hl)-3( )-236oniversiy Thry wocked on a

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