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Looking forward to this new managerial structure, Dr. Deupree joined the board of C3.ca this spring. C3.ca has for a number of years promoted the welfare of HPC in Canada, including the Long Range Plan for HPC which many believe contributed greatly to the establishment of the National Platform Fund call in HPC.

ACEnet was able to obtain all required matching funds to its CFI award in the spring of 2006 and began to build its HPC infrastructure. Significant computational resources were placed at Saint Mary's University, St. Francis Xavier University, and Memorial University of Newfoundland in June. Saint Mary's is host to a 168 node Opteron cluster with Myranet interconnects. Mr. Phil Romkey has been hired as the resident ACEnet system administrator at Saint Mary's, with the ICA supplying his administrative support. During the coming year these clusters will be expanded, and new resources will be placed at Dalhousie University and the University of New Brunswick. It should be noted that all ICA personnel have access to all the ACEnet computational resources regardless of location. The ICA also maintains its own small 48 processor cluster for small projects and for testing. Construction continues on the ACEnet Access Grid and Data Cave rooms at Saint Mary's, and it is expected that the Access Grid multi-site, video teleconferencing system will be installed in early to mid January of 2007. The Data Cave is expected to be installed in the spring of 2007 after the construction residue is completely gone. The Access Grid capability will allow ICA members to interact visually and audibly with researchers at multiple institutions at once. The NIC proposed that all major academic research institutions in Canada acquire Access Grid as part of the National Platform proposal so that we expect to work

Within the past five years, Dr. Tom Jones and his group at Minnesota published some false images of radio jets and lobes with both magnetic fields and a realistic description of the particle spectrum. The latter was accomplished by solving the so-called Skilling equation, which is actually a 4-D problem including three spatial dimensions and one momentum dimension. This work represents a major leap forward in understanding why ERS emit the way they do but, unfortunately, it also requires the solution of a technically difficult equation on a 4-D grid, rendering such simulations impractical for most applications.

Dr. Clarke's and Mr. MacDonald's idea is to model the particle spectrum as a two-index power law (which the Jones' work largely confirms), with the break in the power law being tracked for each zone as a simple advected quantity. With the break in the power spectrum known (and affected by both aging and shock-reacceleration), they hope to reproduce all the qualitative effects found by the Jones group, and much of the quantitative results as well, with a much simpler scheme.

Dr. Clarke, ICA visitor Dr. Toru Okuda, and Dr. Alex Razoumov have made a first attempt at installing a radiative transport module in ZEUS-3D which, when complete, would be migrated to AZEuS. Dr. Okuda is interested in the physics of accretion discs surrounding compact objects, and needs the self-gravity and MHD aspects of ZEUS-3D with his radiative transport modules to advance his investigations. This work is still at a very early stage.

With Dr. Phil Bennett (adjunct faculty at Saint Mary's University) and Dr. Wendy Hagen-Bauer of Wellesley College in Massachusetts, Dr. Clarke is a co-Investigator on a recently submitted NSF proposal to study the peculiar binary system VV Cep. This system consists of two very massive stars, one slightly more massive than the other. The more massive star is a supergiant, while the less massive star is still a compact MS object. While the supermassive star has not filled its Roche lobe (the stars are in a highly elliptic orbit of several thousand AUs), it does launch a significant wind, some of which is trapped and accreted by the compact companion. Dr. Clarke has been asked to help the group understand what role the hydrodynamics of such a complex system might have in modifying the observed spectra and variability, data which will be gathered by extensive HST time. The team also includes Dr. Ted Gull at NASA Goddard, who is the deputy PI of the project that developed the Space Telescope Imaging Spectrograph (STIS), which will play an important role in the observations anticipated for this project.

The paper by Ms. Catherine Lovekin and Drs. Deupree and Short (ApJ, 643, 460) that determines the observed spectral energy distribution for a 2D rotating stellar structure model by performing a weighted integral of the emergent intensity over the stellar disk has been published. The rotating model provides the latitudinal variation of the effective temperature and surface radius, and the intensities are interpolated in effective temperature and gravity through a grid of

PHOENIX model atmospheres. The resultant spectral energy distribution for a given model produces a deduced luminosity and effective temperature as a function of the inclination between the observer and the rotation axis. These results were compared to results calculated using von Zeipel's law and found to disagree noticeably for rapid rotating stars.

Dr. Deupree and Mr. Patrick Rogers expanded the work done by Drs. Deupree and Karakas (ApJ, 633, 418) on 2D binary star evolution. The earlier work had calculated the stellar structure and evolution of each of two members of a binary system assuming that the gravitational potential of the other member could be treated as that of a point source. Mr. Rogers for his Honors thesis wrote a code to take the stellar structure of each of the two stars and their separation and calculate the total gravitational potential on the surface of each star. This potential was compared with the total potential calculated by Deupree and Karakas and was found to agree to with 0.5%. This suggests that the Deupree and Karakas calculations give an acceptable representation of the stellar structure of each of the two binary members.

Dr. Deupree and Mr. Joel Tanner are completing a project examining the radial fundamental mode Beta Cephei stars in NGC 3293. This work combines 2D stellar evolution sequences of rotating stars, the 2D stellar pulsation code of Clement (ApJS, 116, 57) for determining the pulsation modes of rotating stars, and the integration code of Lovekin, Deupree, and Short to properly place the individual stars in the HR diagram as a function of the inclination between the rotation axis and the observer. They show that they can fit the radial fundamental mode for each of the four Beta Cephei stars in the cluster identified to pulsate in that mode, as well as determine the inclination and rotational velocity from the models, and match the observed location in the HR diagram and the observed projected rotational velocity. The results suggest this approach will be useful as a probe in determining the structure and interior angular momentum distribution of rapidly rotating stars.

Dr. Deupree and Mr. Chris Geroux have developed a code for creating synthetic cluster HR diagrams. The code allows for the individual stars to be assigned an arbitrary rotation rate and random inclination between the rotation axis and the observer. The code interpolates among 2D stellar evolution sequences and uses the integration code of Lovekin, Deupree, and Short to determine the deduced effective temperature and luminosity as functions of inclination. Clusters are now being simulated to determine the probability that stars of a given rotation rate dominate a given portion of the observed HR diagram. This may help in being able to determine the relative distribution of angular momentum among stars when compared with observed clusters.

Dr. Deupree and Mr. Aaron Gillich are expanding on the work of Lovekin, Deupree, and Short to include modeling line profiles as well as the entire spectral energy distribution.

Dr. Guenther continued his work with

atmospheric models and spectrum synthesis incorporate tens of thousands of the most important spectral lines in NLTE.

With Drs. Pierre Demarque and Christian Straka (Yale University) Dr. Short has begun a collaboration to model the outer boundary condition of M dwarf interior structure models more realistically by accounting for hydrodynamic atmospheric turbulence. Dr. Short will be calculating mean radiative opacities suitable for radiation hydrodynamic simulations. The goal is to resolve the discrepancy between the observed and computed mass-radius relation among M dwarf stars.

The relatively cool barely evolved standard star Procyon (Canis Minoris) has been the subject of much interest recently. It has been the target of a recent interferometric study in the near IR band that has provided unprecedented information of the variation of the visibility with wavelength tantalizingly close to the visible band. This is a major step toward imaging the surface of a dwarf star other than the Sun at optical wavelengths. Moreover, Procyon was a target of

dynamical evolution of the cluster. This collaboration resulted in a paper that was submitted to ApJ.

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COLLOQUIA GIVEN BY ICA MEMBERS

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Ian Short, "Stellar atmospheric models and the problem of chemical composition", Saint Mary's University Astronomy and Physics Colloquium, March 2006.

Ian Short, Acadia University Physics Department Colloquium, "Stellar atmospheric models and the problem of chemical composition", March 2006.

Robert Deupree, "Deconstructing Rotating Stars", Yale University Astronomy Department Colloquium, April 2006.

Robert Deupree, "Future of High Performance Computing in Canada", Invited talk, High Performance Computing Symposium, St. John's, NL, May 2006.

Ian Short, "Stellar atmosphere and spectrum modeling", Invited talk, Undergraduate Workshop of CASCA 2006 Annual Meeting, Calgary, June 2006.

Ian Short, Yale University Astronomy Department Colloquium, December 2006.

CONCLUDING REMARKS

This year is probably the most hectic that the ICA has faced. The time required in planning and running three conferences, in finalizing the ACEnet financial issues, and in the preparation of the National Platform Fund proposal has been significant. Yet both the addition of a third post doctoral position and the increased research potential of the ICA graduate students are helping the ICA make progress on the research front as well. The coming year will see continued growth in our capital resources through the arrival of the Data Cave, the high quality visualization computers, and more computational power through ACEnet. The anticipated arrival of Dr. Thacker next summer and two more post doctoral fellows in the next few months through the SUN-ACEnet post doctoral fellowship program will continue to energize the institution.