



Institute for Pure and Applied Mathematics
University of California, Los Angeles presents a program in

Grand Challenge Problems in Computational Astrophysics

March 7 – June 10, 2005

Members of the Organizing Committee include: **Mark Morris**, Chair (UCLA, Physics & Astronomy), **Willy Benz** (Bern, Physikalisches Institut), **Philip Colella** (Lawrence Berkeley Lab, Mathematics), **Richard Klein** (UC Berkeley, Astronomy), **James McWilliams** (UCLA, IGPP & Atmospheric Sciences), **Joseph Monaghan** (Monash University, Mathematical Sciences), **Stanley Osher** (IPAM & UCLA, Mathematics), **Chi-Wang Shu** (Brown, Applied Mathematics) and **Harold Yorke** (JPL, Astrophysics)

Scientific Overview:

The 20th century saw the culmination of efforts to solve the major theoretical problems of **astrophysics** using analytical techniques. Indeed, most of the basic underpinnings of our current understanding of stellar and galactic dynamics, gas dynamics, stellar evolution, and planetary dynamics, were laid out by the heroic efforts of several generations of theorists from Eddington, Chandrasekhar, Schwarzschild and Milne to the likes of Parker, Mestel, Zel'dovich, Ostriker, Goldreich, Rees, Shu and Blandford. However, the complexity of most astrophysical phenomena dictates that accessible analytical techniques are increasingly becoming relegated to limiting cases. In a realistic and complete description of most cosmic phenomena, one must typically face highly non-linear interactions between objects or particles, as well as non-linear couplings between different kinds of interactions, including gravitational, electromagnetic, radiative, and gas dynamical interactions. Consequently, numerical approaches to understanding astrophysical phenomena have become indispensable, and promise to dominate the methodology of theorists well into the 21st century and presumably beyond.

This is an appropriate time for the community to examine these algorithmic limitations to see if creative, new ways can be found to circumvent them, either for limited ranges of problems, or across the board. The program will be structured to identify the barriers to algorithmic efficiency and accuracy, and to provoke participants either to find ways of surmounting those barriers or perhaps to demonstrate decisively that certain limitations are inherently unavoidable.

Some of the topics that will be covered in the program are:

- Those dealing with numerical technique such as Finite difference codes and AMR, SPH, GPM, and other particle methods, and N-body codes.
- Those with a dominant astrophysical theme such as hydrodynamic and magnetohydrodynamic problems, gravitational problems (e.g., stellar dynamics), radiative transfer problems, and mixed problems: accretion disks, cosmological structure formation, star formation

The program aims at bringing numericists together with applied mathematicians to address these challenges, and at stimulating productive exchanges among computational astrophysicists and mathematicians.

Program Schedule:

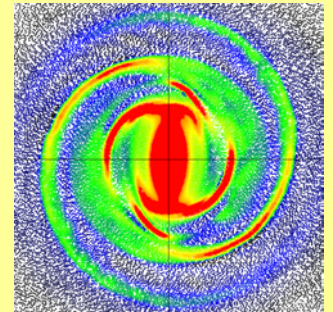
Tutorials. March 8 - 11, 2005

Workshop I: Astrophysical Fluid Dynamics. April 4 - 9, 2005

Workshop II: N-Body Problems in Astrophysics. April 18 - 22, 2005

Workshop III: Relativistic Astrophysics. May 2 - 6, 2005

Workshop IV: Transfer Phenomena. May 16 - 20, 2005



Participation:

This semester program will involve a community of senior and junior researchers. The intent is for long-term participants to have an opportunity to learn about computational astrophysics from the perspectives of many different fields – mathematics, science and astronomy – and to meet a diverse group of people and have an opportunity to form new collaborations.

Full and partial support for long-term participants is available, and those interested are encouraged to fill out an online application at <http://www.ipam.ucla.edu/programs/pca2005>. Support for individual workshops will also be available, and may be applied for through the online application for each workshop. We are especially interested in applicants who wish to be core participants in residence for the entire program (March 7 – June 10, 2005), but give due consideration to applications for shorter periods. Funding is available at all levels. Recent PhD's, graduate students, and researchers in the early stages of their career are especially encouraged to apply. Promoting the careers of women and minority mathematicians and scientists is an important part of IPAM's mission and we welcome their applications.

Please visit our website at

<http://www.ipam.ucla.edu/programs/pca2005>

or email questions to pca2005@ipam.ucla.edu

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