

## 4. Outreach and Interaction

### Industrial Outreach

#### ***Meetings with the Rocket Industry***

Critical interaction has continued during the second year of the CSAR program. Most important among industrial/government laboratory meetings in 1998-99 was a large gathering (30 people) at Edwards Air Force Base, California, on May 24-25, 1999. Hosted by the Air Force Research Laboratory, the meeting was an opportunity for Center staff to brief senior laboratory and industry leaders on the CSAR technical program and to identify new members for the CSAR External Advisory Board. The key outcome from this meeting was an offer to share AFRL data from laboratory-scale solid propellant rocket firings, and a plan to further validate the CSAR integrated code by comparing results with existing Thiokol and AF codes.

On March 24-25, 1999, the sponsors of the UIUC Center for Novel Energetic Materials, a DOD Multiple University Research Initiative (MURI) Center, reviewed the CSAR technical program. The CNEM is the sister-center of CSAR that provides verification data on solid propellants and addresses experimental issues in SP rockets.

NASA and Thiokol teamed to provide the Center with the *Design Data Book for Space Shuttle Reusable Solid Rocket Motor* in 1998. The document contains a detailed description and discussion of the components that comprise the reusable solid rocket motor. The Validation and Specification Team will be working with NASA to get more detailed data to validate the CSAR integrated code in Y3.

#### ***External Advisory Board***

The first meeting of the External Advisory Board was held in August 1999. We anticipate that the EAB will meet annually in future years. The EAB membership is drawn from the DOE DP laboratories and academia, as well as from the commercial rocket industry, the high-performance computer industry, and other relevant companies. The Board reviewed research studies, was invited to make research recommendations, and will continue to provide expertise for translating research findings into practice. The purpose of the EAB is several-fold: assure that the CSAR research program remains aggressive and forward-thinking; gain commercial rocket industry perspective; accelerate high-level technical exchange; catalyze long-term visits; and explore other funding opportunities. Current members of the Board include:

Aerojet	Felix F. Chen	Technical Principal, Engineering
Aerojet	Robert Keenan	Program Manager, Advanced Programs
Air Force Research Laboratory	Gregory A. Ruderman	Mechanical Engineer
Alliant Techsystems	Grant B. Hodson	Technical Manager, Air Force Projects

Army Research Office	David Mann	Associate Director, Mechanics and Environmental Sciences Division
Atlantic Research Corporation	John Sparks	Director of Design Engineering
Atlantic Research Corporation	Guy Spear	Design Engineering
Caltech	Fred Culick	Professor of Mechanical Engineering and Jet Propulsion
Consultant	Robert L. Glick	Consultant
Geisler Enterprises	Robert L. Geisler	Senior Rocket Scientist Consultant
Hewlett-Packard Company	Greg Astfalk	Chief Scientist
Indiana University	Dennis Gannon	Chair, Computer Science
International Business Machines Corporation	Marc Snir	Senior Manager, Parallel Systems Organization
Lawrence Berkeley National Laboratory	David H. Bailey	Chief Technologist, NERSC Division
Lockheed-Martin Missiles & Space	Andy Baldi	Director, FBM Propulsion and Controls
NASA Marshall Space Center	Charles A. Smith	Assistant Manager, Integrated Systems Engineering
Naval Air Warfare Center, China Lake	Fred S. Blomshield	Head, Propulsion Research Branch
Sandia National Laboratory	Paul Hommert	Director, Engineering Sciences Center
SGI	Greg Chesson	Senior Research Scientist
Thiokol Corporation	I. Lee Davis	Senior Research Scientist
Thiokol Corporation	Suresh Kulkarni	Director of DLV Engineering
Thiokol Propulsion	Allan J. McDonald	Deputy and Technical Director, Science and Engineering
University of Colorado	David Kassoy	Associate Vice President for Technology
University of Tennessee Space Institute	Gary Flandro	Boling Chair Professor of Advanced Propulsion
Yale University	Mitchell D. Smooke	Chair, Mechanical Engineering and Applied Science

## Travel and ASCI Technical Interaction

Center personnel traveled extensively in the second year of the ASAP program and were involved in a large number of technical and informational meetings. These included meetings intended to explore rocket science and technology, identify technical collaborators, describe the ASCI/ASAP program, and establish relationships among Center investigators, DOE lab scientists, and industry leaders. Individual CSAR senior investigators and technical staff have traveled to DOE DP labs to serve on ASCI/ASAP panels, to participate in ASAP-wide workshops (materials and computational environment), to offer research seminars and technical interaction, to receive introductory training on the ACSI computational resources, and to discuss ASCI resource issues with the CRT.

<b>Nature of Collaboration</b>	<b>DP Lab</b>	<b>Lab Contact</b>	<b>CSAR Contact</b>
<b>ASCI and Lab Travel</b>			
Seminar on work concerned with nematic elastomeric materials	SNL Livermore		E. Fried
Seminar on non-linear studies; November 1998	LANL		R. Adrian
Lectures on (new) iterative solvers for linear systems of equations; March 1999	SNL	R. Lehoucq	E. de Sturler
Seminar on analysis of iterative methods; March 1999	LANL	M. Benzi	E. de Sturler
<b>Code sharing</b>			
Pronto2D and 3D	SNL		
3D mesh generation tools: LAGriT and GEOMESH	LANL		
<b>Joint research</b>			
Curing of viscoelastic composites, residual stresses	SNL	D. Adolf	H. Hilton
Laser ignition of explosives	LANL	S. Son	Q. Brewster
Fracture behavior of the nickel base superalloy 690	Atomic Power Lab	D. Symons, Bettis	P. Sofronis
Dislocation-based analysis of micromechanical phenomena in materials	LLNL	D. Lassila	P. Sofronis
Potential joint efforts among CSAR, LANL, and NCSA	LANL	A. White and J. Reynders	M. Heath
Discuss potential speakers and topics for a major SIAM conference in 2000 focusing on CSE, and especially on ASCI-scale interdisciplinary simulation	LLNL	S. Ashby	M. Heath
Iterative methods for sparse linear systems	LLNL	S. Ashby and S. Lee	P. Saylor
Pycnonuclear fusion calculations	LLNL	B. J. Alder	D. Ceperley
Simulation of systems at high magnetic fields and correlated electron gas	LLNL	M. Jones and G. Ortiz	D. Ceperley
Development of a polycrystal finite element model	LANL	U. F. Kocks	A. Beaudoin
Experimental testing and the fitting of data to constitutive models	LANL	M. Stout, S. R. Chen, M. Lovato	A. Beaudoin
Applications of polycrystal plasticity models	LANL	C. Tome	A. Beaudoin
Modeling of plastic inhomogeneity using finite element codes	LANL	P. Maudlin	A. Beaudoin
<b>Software/Hardware Visits from Labs</b>			
SIERRA software — Feb 1999	SNL	L. Taylor	
OVERTURE software — Feb 1999	LLNL	B. Hanshaw and D. Quinlan	
Computational resources needed by CSAR — Feb 1999	LANL	A. White	
Blue Pacific — Dec 1998	LLNL	M. Seagar and J. Shuler	
<b>Summer Student Interns</b>			
Graduate student D. Pattillo spent summer 1999 as a participant in the Engineering Science Summer Institute Program	SNL Livermore	M. Horstemeyer	P. Sofronis
Extensive email and some in-person discussion with of on combinatorial problems in scientific computing. Graduate student A. Pinar spent Summer '99 at SNL.	SNL	B. Hendrickson	M. Heath
Interaction on mesh generation. Graduate student Alper Ungor spent summer '99 at SNL	SNL	S. Mitchell	S. Teng

New method for simulations of high pressure hydrogen. Graduate student B. Militzer spent the summer 1998 and 1999 at LLNL.	LLNL	E. L. Pollock, Nellis, Cauble, Alder	D. Ceperley
Graduate student M. E. Bange, spent summers (1999 and 1998) doing mechanical testing	LANL	M. Stout	A. Beaudoin
<b>Selected Technical Discussions</b>			
Modeling of damage in solids	SNL Livermore	D. Bammann and M Horstemeyer	E. Fried
Conical intersections in TATB and PETN and possible connections to detonation sensitivity	LLNL	C. Wu	T. Martinez
Role of electronic excited states in shock-induced chemistry	LLNL	C. Tarver	T. Martinez
Parallel C++ based frameworks, supporting irregular computations	LLNL	D. Quinlan and B. Henshaw	L. Kale
Detonation physics, multiphase flow, ignition and combustion of energetic materials, advanced numerical algorithms and strategies	LANL	J. Bdzil, T. Aslam, B. Asay, P. Howe, R. Menikoff, L. Hill, S. Son, L. Hull	S. Stewart
Detonation physics modeling in thin layers	SNL	A. Ratzel	S. Stewart
Combustion Modeling	LLNL	C. Westbrook	S. Stewart
Computational Materials Science Summer lectures and the NCSA Alliance program	LLNL	G. Galli and F. Gygi	D. Ceperley

### ***Technical Conferences***

The Center provides travel funds to investigators to participate in conferences in core areas both to enhance their technical expertise and to build global awareness of the ASCI/ASAP simulation program.

### **Student Interns at DOE Labs**

Five graduate students served as research interns in 1998-99. Students were placed at Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratory (2), and Sandia-Livermore National Laboratory.