HYPERVELOCITY IMPACT SOCIETY

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NEWSLETTER

1996 HYPERVELOCITY IMPACT SYMPOSIUM

A Successful Conference

For the first time, the HVIS Symposium has taken place outside the United States. Thanks to the efforts of conference chairmen, Alois Stilp and Hartmuth Lehr, and their staffs, it was possible to bring the symposium to Germany and ISL, France. It was an experiment, and we believe a successful one, that might also encourage other European HVIS members to apply for the organization of this meeting. Some of them have already expressed their interest.

A total of 214 participants from 13 nations attended the conference. The largest delegation was from the United States with 70 participants, followed by the host country with 38, France with 29, England and Russia with 24 each, Japan with 8, Sweden with 6, the Netherlands with 5, Ukraine with 4, Israel and Italy with 2 participants each, and India and Spain with 1 participant each.

The generous support of the Deutsche Forschungsgemeinschaft, the European Research Office, and the US Army Research Laboratory enabled a number of Russian and Ukrainian scientists to take part in the symposium. The organizers would especially like to thank these institutions.

10 exhibitors from the US, England, France, Sweden and Germany presented scientific instruments and research institutes:

- Century Dynamics, Horsham, UK
- Ernst-Mach-Institut, Freiburg, Germany
- Europulse, Cressenac, France
- French-German Research Institute ISL, Saint-Louis, France
- Hadland Photonics, Hemel Hempstead, UK
- Imco Electro-Optics Ltd., Basildon, UK
- McDonnell Douglas Aerospace, Huntington Beach, CA, USA
- PCO Computer Optics GmbH, Kehlheim, Germany
- Scandiflash, Uppsala, Sweden
- Valyn International, Albuquerque, NM, USA

Generous grants provided by HVIS were given to 10 students from four countries to attend the 1996 HVIS. More information is provided concerning the recipients of these grants later in the Newsletter.

A total of 43 oral contributions and 39 posters in the scientific and technical fields of hyper-velocity impacts were presented. Special highlights of the conference were the presentation of the Distinguished Scientist Award to Burton Cour-Palais and the talks given by Professor Dieter Stöffler, Dr. William J. Nellis, and Andrew J. Piekutowski.

Burt Cour-Palais received the Distinguished Scientist Award in honor of his many contributions to penetration mechanics and the phenomenology of hypervelocity impact research. Bill Nellis talked about their achievement of reaching one of

the holy grails of physics, experimentally observing liquid metallic hydrogen (which, of course, required many of the principles of hypervelocity science). Andy Piekutowski provided a review of his excellent research in debris cloud dynamics. The banquet guest speaker, Professor Stöffler from the Humboldt University Berlin, gave an interesting talk abut *the Ries Crater, Germany: Impact of a Hypervelocity Impact on Global Geoscience and Local Culture* that was also received by non-scientists with enthusiasm.

The Best Paper Award was given to Dennis Grady and Marlin Kipp for their contribution "Fragmentation Properties of Metals".

The tour with the historical train from Freiburg to Riegel and through the Kaiserstuhl to Breisach offered an excellent opportunity for the scientists and their companions to meet old and new friends and to continue the technical discussions in an informal atmosphere.

EMI, as host Institute, also provided guided tours of the laboratories of the impact physics department and made it possible to visit the ballistic range with its various light-gas guns.

NEW BOARD MEMBERS

Charles Anderson and Andy Piekutowski were elected by the Society membership to the Board of Directors to replace the outgoing members. Leaving the Board was Jim Asay. Dennis Orphal, because he was President, remains a Board member for one more term, holding the office of Past President. The Board held a brief meeting at the Freiburg Symposium after election results were announced and elected Lalit Chhabildas to be the President for the current term, and Andy Piekutowski as the Secretary-Treasurer.

PROCEEDINGS

The *Proceedings of the 1996 Hypervelocity Impact Symposium*, being published as Volume 20 of the *International Journal of Impact Engineering*, are currently in production. Due to its size, this 876-page journal volume will be published as two softbound volumes. (The proceedings were published in hardbound volumes for previous HVIS symposia; however, to hold down publication costs, this and future proceeding volumes will be published in the regular journal softbound format.) The volume contains 75 technical articles, including James Asay's Distinguished Scientist paper presented at the *1994 HVIS* in Santa Fe. The volume also contains an author index, a subject index, and a list of attendees to the Freiburg symposium. The volumes are being mailed directly from Elsevier to Symposium attendees. Extra copies of the proceedings will be available; see the section on Subscriptions to obtain a copy.

A MESSAGE FROM THE PRESIDENT

The Hypervelocity Impact Society since its inception in the mid eighties was primarily an outcome of a few visionary scientists and investigators such as Drs. Harry Fair, (IAT), Charlie Anderson, Jr. (SwRI), Burt Cour-Palais, (NASA-JSC), Walter Herrmann (SNL) and many others. The society is relatively young and has flourished rather well through the able and dynamic leadership provided by the past presidents, the board of directors, and the many committee chairmen. We have matured since those very early days; we are now an international organization with approximately three hundred members, and we have held our first successful Symposium outside the United States. With your help, we intend to continue the tradition of excellence established by the Society.

The next Hypervelocity Impact Symposium will be held November 1998, in Huntsville, Alabama. The symposium chairman is Professor William Schonberg, University of Alabama at Huntsville. Huntsville, both in the past and present, is one of the hypervelocity research centers in the United States. Many technical institutions from the government, industry, and the university are strategically located in Huntsville, which therefore makes it an excellent venue for the 1998 symposium. It is your participation in the symposium, reporting new technological, scientific and applied accomplishments, that is going to make it a success. We hope to see you there.

Please feel free to call upon me or any of the current board of directors if you have new ideas, and especially if you are willing to help. We are always looking for volunteers to serve on our many

committees. Your participation is extremely crucial for the continued vitality and success of this society. We face many challenges in maintaining technical and political interest in this area. I am optimistic that the Hypervelocity Impact Society will continue to provide a valuable service to scientists and engineers in this and related fields.

Lalit Chhabildas
President

A MESSAGE FROM THE PAST PRESIDENT

It has been a great privilege to be President of the Hypervelocity Impact Society the last two years and I thank the Society for the opportunity. 1996 marks the tenth anniversary of the "modern" Hypervelocity Impact Symposia. That ten year period and the five Symposia correspond to very significant advances in hypervelocity science. The Hypervelocity Symposia are widely recognized for their excellence and the Proceedings published in the *International Journal of Impact Engineering* provide a permanent record of the progress and status of our science. Efforts continue to expand the influence of the Society and its service to its members. During the last two years there have been several notable accomplishments in this regard of which the Society should be proud. The 1996 Symposium was the first held outside the United States. This presented a number of new challenges, but was accomplished, I think all would agree, very successfully. The success of the 1996 Symposium was due in large part to the excellent work of our hosts, the Ernst Mach Institute in Freiburg, Germany, and the Institute of Saint Louis in France. Hopefully, it will be possible in the future to hold the Hypervelocity Impact Symposium outside the U.S. on a regular basis. That is a goal.

Another accomplishment associated with the 1996 Symposium was the large delegation from Russia and the Ukraine. We first had representation from Russia at the 1994 Symposium in Santa Fe, but the size and prominence of the delegations from Russia and the Ukraine at the 1996 Symposium achieved a new level. Arranging for participation by these scientists was not easy, given current conditions in these countries. A lot of work was required, but was, I think, well worth the effort. Bill Gooch of the U. S. Army Research Laboratory deserves all our thanks for the tremendous effort he made in arranging for the participation of the Russians and Ukrainians. Working with Dr. Fortov, the new Deputy Prime Minister of Russia for Science and Technology, we hope that participation of the Russian and Ukrainian scientists will continue in future Symposia and, hopefully, will be much easier to arrange.

Another first for the Society the last two years was the initiation of the Student Intern Program. The Society sponsored five undergraduate students this last year in summer work programs involving hypervelocity impact. This was very successful and, if finances permit, the Society hopes to continue this program on a regular basis. Also, as we did for the 1994 Symposium in Santa Fe, the Society sponsored students to attend the Symposium itself. This year we sponsored 10 students from four countries. Both of these programs are due to the efforts of Gordon Johnson, Chairman of the Educational Outreach Committee, and his committee members.

Finally, thanks to the efforts of Charlie Anderson, the Society Newsletter has achieved a frequency of about an issue semi-annually. We hope the members find the Newsletter informative, useful and enjoyable. All members are encouraged to contribute to the Newsletter by contacting Charlie Anderson. Again, thank you for the privilege of being President of the Hypervelocity Impact Society the last two years. It has been an honor and I have enjoyed working with you. I'm looking forward to continuing my participation in the Society the next two years as Past-President, working with the new Board of Directors and our new President, Lalit Chhabildas. We hope when we call on you for your help. you'll be there, as you have been in the past. It's your Society and you can be proud of it.

Dennis Orphal
Past President

EDUCATIONAL OUTREACH COMMITTEE

The HVIS has created two programs to further the development of hypervelocity phenomenology throughout the world. These programs are directed toward young investigators in the field. The

programs provide support in several ways to encourage contact among the active researchers and the newcomers who are beginning their careers in hypervelocity impact experimentation and/or modeling.

The Society is interested in stimulating the interests of students in hypervelocity research so that it will become a lifetime occupation. There is no university or institute that has a program dedicated to hypervelocity studies. Therefore, a student starts their studies in a traditional discipline like physics, engineering, materials science, or chemistry and develops a special interest in high energy/high velocity impact phenomenology. This being a rather narrow and limited discipline, there are not many investigators in it. It is in the best interests of the Society for the preservation of research in this area to sponsor interns so that there will be new blood in the field.

Support for Meetings

One program provides direct support for advanced undergraduate and graduate students to attend the bi-annual meeting of the Hypervelocity Impact Society. These people are nominated by their faculty advisors. The Society provides up to $1000 to defray expenses of the student to attend the Society meeting. This includes transportation, lodging, registration, a meeting with the Board of Directors, and a copy of the proceedings of the meeting. The intangible benefit to the student is the ability to listen to the latest research in the field and to rub shoulders/enter into discussion with these scientists. Among other things this may stimulate the student's research and invigorate their enthusiasm for the project in which they are involved.

The Society supports and encourages world wide participation of students to attend its meetings. In 1996, 10 students attended the meeting in Freiburg, Germany. The home countries of these students included Great Britain, Germany, Russia, and the United States. As the Society matures and the knowledge of this program spreads, we expect even broader participation from those engaged in hypervelocity research. The students in attendance at the Freiburg meeting are listed below along with their faculty sponsor, the university or institute which they attend, and a brief description of their work.

Support for Interns

The second program provides direct support for research activities of both undergraduate and graduate students. Again the student is nominated by his/her faculty sponsor or work sponsor. The support of the student intern takes a different approach. Funds up to the amount of $3000 per student are provided in conjunction with a research institution to support on-going work. The students together with their faculty sponsors seek out a location at which to do research. The institution conducting the research must agree to provide a temporary position for the intern, support the research, and provide one half of the monetary support for the intern.

The type of research can vary widely from experimental to theoretical or any combination of the two. What is being supported currently is experimental work tied closely to modeling efforts as you will see by the project descriptions below. The length of support is negotiated between the student and the supporting institution. In some cases it can be similar to a cooperative student program where the student attends classes for a period and works for a period. In other cases it can be similar to a summer intern program of intense research for a short period of time. For the 1996-97 period the Society has sponsored the following individuals in their research.

Sabrina Birnbaum is an undergraduate student majoring in mechanical engineering with a minor in earth and planetary sciences at MIT specializing in modeling impact phenomenology. She worked with Century Dynamics of San Leandro, CA to extend the modeling capabilities of AUTODYN by incorporating smooth particle hydrodynamics into this code. Malcolm Cowler of Century Dynamics asked her to spend full time on this project during the summer of 1996 and the Christmas holiday season of 1996. During the school year she has devoted part time to working on the code. She uses 2D and 3D Lagrangian hydrocodes to model impact on spacecraft protective shields. She is also trying to incorporate SPH into an ALE code for both Century Dynamics and UK/DRA.

Student	Sponsor	Area of Investigation
Paul Hazell Royal Military College of Science	John Hetherington	studying HV impact of ceramics to create damage model and model penetration mechanics
Michael Hiltl Ernst Mach Institut	H. Nahme & A. Stilp	HV loading of glass ceramic over broad range of temperatures to study micromechanical
Gregory R. Kruse Univ. of Alabama Huntsville	Wm. P Schonberg	analytic modeling of debris cloud formation using collected test debris
Andrus G. Kuprin Inst. of Problems Electrophysics St. Petersburg	A. A. Bogomaz	optimization of EM launcher parameters and shock compression of carbon
Peter Schneider Fachhochschule Aachen	Wilfried Ley	behavior of high pressure gas vessels under HV impact
James Shih UC San Diego	Marc A. Meyers	investigating how damage is initiated and accumulated in Cercom armor grade silicon carbide
Emma A. Taylor Univ. of Kent, UK	J. A. M. McDonnell	characterizing crater and BAD as a function of density diameter, and velocity in soda-lime
Igor Ye. Telichev Samara State Aerospace Univ.	L. G. Lukashev & A. G. Prokhorov	physics of HV impact and residual toughness of flight apparatus/components
Konstantino Tsembelis Univ. of Kent, UK	Mark J. Burchell	analyzing impacts of space dust on float glass and modeling these impacts
Kasushige Yano North Carolina State University	Yukie Horie	studying complex interaction associated with shock loading of porous media; e.g., Meteor impact on planets

Sean Bulla is investigating a new thermal protection concept for nose cones of HV missiles and penetrators under the direction of Prof. Dennis Wilson in the Mechanical Engineering Department at the University of Texas. His work is being performed at the Austin Division of Applied Sciences, Inc. An array of small cavities is placed in the nose of the missile/penetrator. The cavities act as Helmholtz resonators which can influence the flow field in the stagnation region of the nosetip. They provide thermoacoustic cooling by an adiabatic expansion-compression mechanism. Using both contact and non-contact observational experimental techniques he will measure temperatures, pressures, and shock wave patterns to determine the effectiveness of the cavities.

Keith Barton, Simon Stephenson, and Stephen Champion are characterizing ceramic response to HV impact in the range of 1-4 km/s. The work, under the direction of Prof. John Hetherington at RCMS, Shrivenham, has a threefold experimental approach coupled closely with modeling of each of these areas. Using novel target arrays, they will monitor stress wave propagation in composite targets. They will then examine the residual damage in these targets and to targets positioned behind armor applique plates. They will also examine terminal ballistic performance of segmented rods fired from a high velocity powder gun.

The Outreach Committee

There are 10 members of the HVIS Outreach Committee. It is currently chaired by Dr. Gordon Johnson at Alliant TechSystems. We describe here the process for advancing a candidate to the committee for consideration for either type of support. Candidates are normally nominated by a faculty advisor, but can be nominated by a company who is willing to support that intern. Members of the

society can nominate people for attendance at the meetings. All nominations are sent to the Chair of the Outreach Committee who, in turn, has established a review committee. Each candidate is reviewed against a set of criteria and evaluated against their fellow nominees and rank ordered. The amount of support then is divided among the candidates according to need for attendance at the meeting or according to agreement with the university/institute for the interns. Each successful candidate is then notified by letter from the Outreach Committee Chair. Dr. Johnson can be reached at Alliant TechSystem, MS 11-1614, 600 Second St. NE, Hopkins, MN 55343-8384 USA. His telephone number is 612-931-5905; fax is 612-931-6523; e-mail is gordon_johnson@atk.com..

Bob Skaggs
Educational Outreach

THE 1998 HYPERVELOCITY IMPACT SYMPOSIUM

The 1998 HVIS will be hosted by the University of Alabama in Huntsville—November 17-19, 1998—at the Von Braun Center, Huntsville, Alabama USA. Registration will take place on the evening of November 16th. Classified sessions will be held on November 20, 1998, at the Sparkman Center on Redstone Arsenal, Huntsville, Alabama, and will be strictly limited to attendees having the appropriate clearance.

Social activities will include a registration social at the Hilton (host hotel), a reception during the Poster Session, and a banquet at the space and Rocket Center. A Companion Program is also being developed. Hotel information and local arrangements will be provided in future announcements as well as in an Internet web page under construction.

Topics of discussions will include (but not be limited to)

- Hypervelocity phenomenology studies
- High velocity launchers and diagnostics
- Spacecraft meteoroid/debris shielding and failure analysis
- Material response
- Fracture and fragmentation
- High velocity penetration mechanics and target response
- Analytical and numerical techniques
- Asteroid impact and planetary defense technology
- Penetration mechanics of shaped charges and explosively formed penetrators

The Call for Abstracts has been mailed. Abstracts will be due in January 1998. For more information, call Dr. Bill Schonberg in the U.S. at (205) 890-6117, or consult our web site at "http://www.futureonline.com/hvis" (currently under construction.)

James Wilbeck
Kaman Sciences Corp.

NOMINATIONS COMMITTEE

Lew Glenn and Roger Chéret, co-chairs for the Nominations Committee, are seeking your input and suggestions for possible candidates to be on the ballot for the next Society election for Board members. The election will take place this summer, and results announced at the Symposium in Huntsville, November 1998. Please contact Lew (phone: 510-422-7239; fax: 510-423-6907; e-mail: glenn5@llnl.gov) or Roger (phone: +33-1-69-26-76-74; fax: 33-1-69-26-70-05; e-mail: roger.cheret@cea.fr).

AWARDS COMMITTEE

Jeanne Crews is the Awards Committee chairman. Jeanne is interested in your suggestions for the next Distinguished Scientist Award. Jeanne's phone number is 281-483-5308; fax number is 281-483-5276; her e-mail address is jcrews@ems.jsc.nasa.gov.

SUBSCRIPTIONS TO *IMPACT ENGINEERING*

A special subscription rate to *International Journal of Impact Engineering* is available to Society members in good standing (paid up dues). A subscription to Volume 19, the volume currently in publication, can be made prior to the end of the year (the cost goes up substantially in January

1998); all issues already published will be received. The subscription rates are:

$103.50 Volume 19 (1997), 10 issues
$114.75 Volume 21 (1998), 10 issues

Impact Engineering remains at ten issues for 1998. The subscription rate is $114.75; although this represents approximately a 10% increase over the subscription rate for 1997, the editors anticipate that there will be approximately 13% more pages in the 1998 volume. These subscription rates represent a savings of approximately $1000 over the cost of obtaining the journal directly from Elsevier. As in the past, the Journal will be mailed directly to subscribers from Elsevier.

Additionally, copies of the Proceedings of the *1996 Hypervelocity Impact Symposium*, Volume 20 (1997) are available at $100/copy.

Checks should be made out to the **Hypervelocity Impact Society**, and sent to

Dr. Charles E. Anderson, Jr.
HVIS Publications Chairman
Southwest Research Institute
P. O. Drawer 28510
San Antonio, TX 78228-0510 USA

Please include the address to which you wish the journal to be mailed. If you did not attend the symposium in Freiburg, or have not paid the $100 membership dues, please include the $100.00 in your total. Any questions concerning subscriptions should be addressed to Charlie Anderson (phone: 210-522-2313; fax: 210-522-3043; e-mail: canderson@swri.edu).

MEMBERSHIP

Membership dues are $100 (US) between symposia. Attendees of the Freiburg Symposium automatically received membership into the Society. If you did not attend the *1996 HVIS*, and did not send your dues payment previously, please send a check, made out to Hypervelocity Impact Society, for $100 (US) and send it to:

Mr. Andrew J. Piekutowski
HVIS Secretary-Treasurer
University of Dayton Research Inst.
300 College Park
Dayton, OH 45469

Please make sure we have your current address. Thank you.

CALENDAR OF RELATED CONFERENCES AND SYMPOSIA

Meeting	Location	Dates
Materials Research Society: High Pressure Materials Research	Boston, MA, USA	December 1-5, 1997
Hypervelocity Shielding Workshop	Galveston, TX, USA	March 8-11, 1998
Ballistics '98 (International Symposium on Ballistics)	Midrand, South Africa	March 23-27, 1998
TARDEC Ground Vehicle Survivability Symposium	Monterey, CA, USA	March 30 - April 2, 1998
4th Classified Symposium on Ballistics	Eglin AFB, FL, USA	May 12-14, 1998
48th Bombs & Warhead Technical Symposium	Eglin AFB, FL, USA	May 12-14, 1998
9th EML	Edinburgh, Scotland	May 13-15, 1998
Structural Safety and Protection Symposium	Trondheim, Norway	May 25-27, 1998
New Models and Numerical Codes for Shock-Wave Processes in Condensed Matter	St. Petersburg, Russia	June 1998
Gordon Conference on Research at High Pressure	Meriden, NH, USA	June 21-26, 1998
SUSI 98 (Structures Under Shock and Impact)	Thessaloniki, Greece	June 24-26, 1998
5th International. Conf. on Composites Engineering,	Las Vegas, NV, USA	July 5-11, 1998
1998 ASME Pressure Vessels and Piping Conference	San Diego, CA, USA	July 26-30, 1998
11th Detonation Symposium	Aspen, CO, USA	August 30 - Sept. 4, 1998
Personnel Armour Systems Symposium '98	Colchester, UK	September 8-11, 1998
SES '98 Conference (Society of Engineering Science)	Pullman, WA, USA	September 27-30, 1998
Constitutive Modeling and Penetration Mechanics: Symposium in Honor of Prof. Sol Bodner	Pullman, WA, USA	September 27-30, 1998
Aeroballistic Range Association Meeting	The Hague, The Netherlands	October 5-9, 1998
ICES '98 (Int. Conf. on Computational Engng. Science)	Atlanta, GA, USA	October 6-9, 1998
Hypervelocity Impact Symposium	Huntsville, AL, USA	November 16-20, 1998
3rd International Symposium on Impact Engineering	Singapore, Singapore	December 7-9, 1988
APS Shock Physics Conference	Snowbird, UT, USA	June 27-July 2, 1999
AIRAPT High Pressure Conference	Hawaii, USA	July 1999
Ballistics '99 (International Symposium on Ballistics)	San Antonio, TX, USA	November 15-19, 1999