

conditions leading to failure. For some stress states (e.g. those arising in the three-point bend test), the three currently most popular criteria predict identical results using parameters obtained in four-point bend tests. For others (e.g. equibiaxial stress states found in the ball-on-ring test), the strengths predicted from the four-point data differ from each other by 10% (see Fig. 2). This may not seem large but in fact it translates to a 10 times larger failure probability.

So the work at the Centre in cooperation with the ECN, Petten now aims to establish which criterion should be applied to a given multi-axial stress state. The conclusion at present is that statistical predictions can only be relied upon for simple components under simple loading conditions. They are also effectively limited to isotropic, homogeneous materials having a sufficiently high density of defects for statistics to be meaningful. With these restrictions, time dependent effects owing to slow crack growth at moderate temperatures can be handled to some extent.

The contributors emphasized that even this limited application of statistical fracture mechanics requires very careful procedures. A small systematic error in the model parameters extracted from a test translates into a large error in the failure probability predicted for a different configuration. Features of the test and the specimen that must be considered in detail include: friction effects, local stresses at the supports,

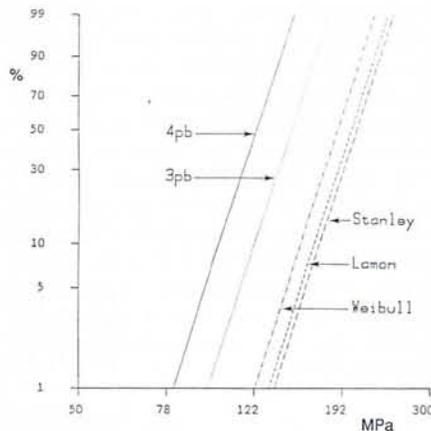


Fig. 2 — A Weibull plot of the biaxial strengths for a ball-on-ring test (with surface defects as the critical defects) predicted by applying statistical fracture mechanics parameters obtained in a four-point bend test. The probability of failure in % is given as a function of the strength in MPa. Three different criteria for failure (after Weibull, Lamon and Stanley) predict failure probabilities varying by a factor of 10.

the specimen's surface condition and internal stresses, procedures for extracting the model parameters from the test data, etc.

Damage Mechanics — A Complementary Alternative

L. Dortmans and G. de With suggested that one way around the problems may be to adopt a completely different, and novel, approach involving continuum damage mechanics [2] instead of fracture mechanics applied to microscopic defects. The simplest form involves introducing a damage parameter describing the amount of isotropically damaged material. The evolution of this damage with time is postulated and failure occurs when a certain level is reached.

The theory was originally completely phenomenological — indeed microstructural information was still neglected. The trick may be to use recent analytic descriptions of the micromechanics of brittle materials [3] to describe the damaged regions. This hybrid approach should allow the effects of structural anisotropy to be handled via continuum deformation theory, but for it to work it will be necessary to determine from the microstructure a concise description of the relevant defects.

REFERENCES

- [1] Chau F.S. and Stanley P., *J. Mater. Sci.* **20** (1985) 1782.
- [2] Chaboche J.L., *Nucl. Engng. Des.* **64** (1981) 233.
- [3] Kachanov M. and Laurs J.-P., *Int. J. Fract.* **41** (1989) 289; Fabrikant V.I., *Acta Mech.* **67** (1987) 39.



Europhysics Notes

Compiled from correspondents' reports.
Contributions should be sent to the Editor.

● EPS

The Society's stock of back issues of journals and review copies of books and conference proceedings formed a useful part of 20 t of materials that were distributed last October to **Romanian universities**. Other important contributors were Professor G. Busch of the ETH Zürich, who donated 2.5 t including invaluable sets of journals from his private library, and several of the ETH's institutes who were happy to put duplicate copies to good use.

Students and staff from the Faculty of Physics unloading books in front of the University of Iași.



The initiative was organized by Werner Reichart, a nuclear physicist with the Physik Institut, Schönberggasse 9, CH-8001 Zürich. He arranged collection of lots weighing more than about 50 kg by unpaid volunteers and obtained credentials from several organizations to ensure a speedy passage by truck. The six Romanian universities or their equivalents are expanding rapidly, with student intakes set to increase by 3–5 times this year. The exception is Braşov which aims to build dormitories at first. Timișoara's physics department received the EPS book collection and part will be distributed to students. Craiova, Cluj, Iași and Braşov, the latter is building a new mathematics/physics building, received conference proceedings and abstracts for their libraries. Dr Reichart hopes to finance another distribution so the collection scheme still operates. He would also like to introduce greater precision by encouraging the Romanian universities to specify detailed requirements, and to then find some way of meeting them by perhaps having individuals pay for the purchase of specific titles.

Members of the EPS Condensed Matter Division have been offered a special **20% discount** on the prices of all Adam Hilger and American Institute of Physics books (including some 50 titles in condensed matter) by IOP Publishing, Bristol, BS1 6NX, UK.

● European Astronomical Society

Following this year's ballot showing that there was considerable interest for a European Astronomical Society, astronomers met during the 12th Regional Meeting of the IAU in the Hôtel Europe, Davos, Switzerland on 2 September to announce the formation of the **new society**. It was decided that L. Woltjer would chair a group including M.C.E. Huber, the Chairman of the A. and A. Division, charged with establishing the society. A committee chaired by R.M. West was also set up to nominate members of an EAS Council within about six months. Proposals on how EPS collaboration with the EAS could be structured to preserve the strong links between physicists and astronomers are being discussed. Dr. Huber has in the meantime proposed that the A. and A.

Board co-opt W. Mattig, Chairman of the Solar Physics Division — one of the larger groups of astrophysicists — as a member. He will also wait until the EPS Executive Committee and the EAS Council have reached agreement on collaboration before calling for the re-election of the Board of the Division (that could be renamed Astrophysics to reflect a primary interest). The agreement will need to take careful stock of the needs, wishes, proposed activities and resources of all concerned, including the four national astronomical societies that are presently Collaborating Societies of EPS.

● Numeric databases

A report on the status of the CNRS, Orsay GRAPHYOR on-line database of atomic, molecular, gas and plasma properties at the ESCAMPIG conference of the Atomic and Molecular Physics Division in Orleans, France highlighted the difficulty of ensuring complete coverage in spite of the adoption of the latest spreadsheet reporting techniques by the network of 15 correspondents. It seems that half the 194 000 entries for 1987-89 originated from just 20% of the 102 journals that are scanned routinely. Coordination between overlapping databases in the field (the

other major ones originate in the USA and Japan) takes place through meeting sponsored by the International Atomic Energy Agency, Vienna. Information about users remains confidential so it is difficult to judge the problems east European scientists encounter in trying to access these particular databases.

If you are interested in numeric databases, two new sources of information may be useful. The *ISTC Directory of Machine-Readable Numeric Databases* will be published at the end of 1990 in hard copy (available from OSTI, US Dept. of Energy). Meanwhile, the *CODATA Referral Database* provides on diskettes a compilation of international records describing numeric data sources in science and technology (from CODATA Secretariat, Paris).

UPPSALA UNIVERSITY UPPSALA, SWEDEN

announces openings for

- a) Professor of Theoretical Physics
- b) Professor of Theoretical Electronics,
especially Plasma Physics

The Professors will be responsible for research and teaching within the Division of mathematics, physics, technology and computing sciences.

a) The Chair in **Theoretical Physics** is expected to reinforce and widen the current research activities of the Division. In addition to the activities at the Department of Theoretical Physics, the relevant scientific environment includes theoretical chairs in subatomic physics, condensed matter physics, astrophysics and quantum chemistry. On the experimental side one can mention modern spectroscopies, surface and molecular physics and the The Svedberg Laboratory with the CELSIUS storage ring for experiments in nuclear and particle physics. The Division is equipped with two mini-supercomputers.

Changes in the institutional organization may affect this Chair.

b) The Professor in **Theoretical Electrotechnics, especially Plasma Physics**, is expected to reinforce and widen the current research activities of the Division. In addition to the activities in theoretical plasma physics at the Department of Technology, the relevant scientific environment includes theoretical chairs in astrophysics and space physics. There exists also possibility of research collaboration with the Hannes Alfvén facility in Stockholm, in applied fusion research, a joint Euratom-Sweden programme.

Applications should be directed to the Swedish Government and should be received no later than 24 January 1991 at the following address:

**The Registrar's Office, Uppsala University,
Box 256, S-751 05 Uppsala, Sweden.**

The applications should contain (in four copies) a curriculum vitae and a written account of research and teaching activities with certified copies of degrees and other documents that the applicant wishes to supply, a numbered list of scientific publications and four separate parcels of these publications.

The applicants are asked to point to those 10 of their scientific publications that they themselves would consider of highest relevance and to which they personally have made the most valuable contributions.

For further information, please contact:

**Prof. Mats Olsmats, Dean of the Division;
Tel.: (018) 18 30 72; Telefax: (018) 15 50 95.**

International Meeting on
**Optics of Excitons
in Confined Systems**
24-27 September 1991
Giardini Naxos, Sicily, Italy

Further information from:

Prof. A. Quattropani
Institut de Physique Théorique
PHB-Ecublens, CH - 1015 Lausanne
Tel: ++41 (21) 693 34 21
Fax: ++41 (21) 693 44 44
Decnet: chgate::eldp::quattro
Bitnet: quattro@eldp.epfl.ch



Mathematica™

*A System for Doing Mathematics by
Computer*

A Wolfram Research Inc. product

Numerics - Works with numbers of arbitrary magnitude and precision.

Symbolics - Encyclopaedia of mathematical functions and operations used in arithmetic, algebra and analysis.

Procedural, functional and mathematical programming.

Graphics - 2D, 3D and animated PostScript graphics.

Text processing - Fully interactive reports and textbooks.

Runs on - MS-DOS based computers; Macintosh, Apollo, Hewlett Packard, IBM AIX/RT, MIPS, Silicon Graphics, Sony, Sun, VAX.

Now available in Europe from:

MathSoft Overseas, Inc.

**POB 641, 1211 Geneva 3, Switzerland
Tel. ++41 (22) 46 52 60
Fax ++41 (22) 46 59 39**

● EC science programme

Activities making up the current **SCIENCE Plan** 1988-92 programme within the European Community's overall Framework Programme for research and technical development will continue under the so-called "line 6" (Management of Intellectual Resources) of the next Framework Programme 1990-94. A budget of 458 MECU was approved by the Commission and the Council of the EC in April. Details of its implementation will now not be finalized until well into 1991 as a key step in a four-step procedure, namely adoption of a common position by Council for submission to the EC Parliament, is unlikely before next Spring. It now seems that line 6 may resemble more closely the current SCIENCE Plan, with its roughly 80/20 blend of project financing and training grants, than was originally envisaged (see *Europhysics News* 21 (1990) 152). The delay in implementing line 6 could affect general activities such as the financing of conferences and those seeking extensions to existing projects. However, the 1991 European Research Conferences co-sponsored by the CEC and the ESF, Strasbourg (the six in physics are organized in collaboration with EPS) are not affected.

● Fusion energy

The Commission of the European Community has adopted three proposals to Council concerning **magnetic fusion**. The first would allow the JET joint venture (Abingdon, UK) to continue until 1996 to provide scientific evidence for the feasibility of thermonuclear fusion; and to support implementation of a specific R. and D. programme, forming part of the third Framework Programme 1990-94, to provide the design basis and industrial preparation for the construction of the NET experimental reactor. The third proposal concerns a negotiating directive for the EC, Japan, US, USSR cooperation for the construction of the 600 M\$US ITER reactor that would be technically equivalent to NET. A recent report of the Fusion Programme Evaluation Board by Prof. U. Colombo of ENEA that was transmitted to Council in August recommended that funding in the 12 Member States plus Switzerland and Sweden remain at current levels. The CEC component implies this with 413 MECU from Framework 1990-94 split as follows: — JET: 45-55%; general research: 20-30%; NET design: 15-20%; groundwork for a long-term, electricity producing reactor, DEMO: 5-10%. The JET contribution covers the 75% EC share of the 100 MECU p.a. JET operating budget required until December 1996 after present funding expires in April 1992.

Reports of the US DoE's Fusion Policy Advisory Committee issued in July and September recommended hosting the en-

gineering design phase of ITER, a steady-state, low magnetic field device, and the construction of a smaller, complementary, high (pulsed) field device like the Compact Ignition Tokamak to demonstrate significant fusion power production. Behind these proposals was an awareness that alternative magnetic confinement concepts should be explored, including stellarators and reversed field pinch.

In believing that physical separation of the reactor and the driver (that supplies the energy to implode a fuel pellet) could ultimately be an advantage, the reports also recommended greater emphasis on **inertial fusion**, including the construction of a facility to demonstrate pellet ignition preceded by the development of reliable steady-state drivers (krypton-fluoride lasers and ions — both light and the more promising heavies) as opposed to the single-shot drivers now being explored for short-term military applications.

The US Government's response, in view of budget constraints and the need for a credible energy plan, was a request for an assessment of the steps to reach specific milestones that would attract commercial involvement.

● Paul Scherrer Institute

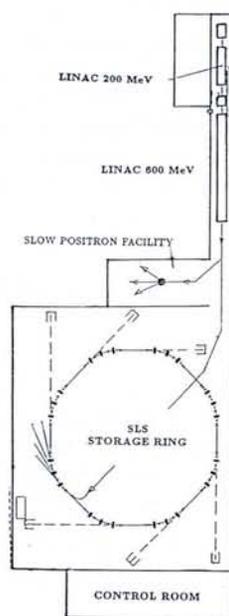
A proposal discussed during a special session of the Swiss Physical Society's annual meeting on 3 October for a synchrotron radiation facility (the SLS — **Swiss Light Source**) at the Paul Scherrer Institute near Zürich, highlighted important developments in the field. G. Margaritondo of the EPFL, Lausanne and formerly

Assistant Director of the Aladin source in Wisconsin, USA argued that ultra-high brightness made a considerable difference to the type of experiments one could perform. Aside from industrial interest in X-ray microlithography, recent work has demonstrated remarkable opportunities in spectroscopy and microscopy, notably scanning photoemission spectroscopy using the new multilayer X-ray optical devices to produce micrographs of each element in each chemical state at sub-micron resolution. Applications include the observation of chemical changes during the functioning of brain cells. Perhaps more intriguing are photoelectron holograms (first proposed only two years ago) of a metallic (copper) crystal that have been reconstructed to show individual atoms.

The current approach for raising the brightness by adding increasing numbers of insertion devices (magnetic structures to repeatedly bend the electron beam) has given spectacular improvements. Future progress, however, will need low emittance and high levels of beam coherence and reliability obtained using innovative techniques which will challenge accelerator physicists. Interestingly, electron densities in the beam will then be only 10-100 times smaller than those for metallic crystals — a sort of "free electron crystal" with an intriguing internal dynamics.

The PSI proposal described by Ch. Walter envisages a 1.5 GeV e^+e^- storage ring device (180 m in circumference — see figure) giving a very reliable source of extremely bright, coherent, soft X-rays (7.2 nm) with a long lifetime (> 10 hours) and a short bunch length (6 mm). Radiation with similar characteristics has to date only been produced for short periods at low energies using a linear accelerator combined with bending magnets. Characteristic design features would include a large chamber for the beam to avoid shielding, the use of metallic getters or "pumping strips" in addition to conventional pumps to attain a low static vacuum (10^{-10} torr), and a relatively high frequency (500 MHz) for the RF power. In line with Professor Margaritondo's thinking, state-of-the-art insertion devices in especially long (8 m) straight sections would provide tuning and selectable polarization for a flexibility which is usually unavailable. The price is estimated to be 100–150 MSFR, with an additional 18 MSFR for beam-line equipment in experimental areas that are limited in number but well equipped. Construction within 4 years starting after completion of PSI's spallation source in 1992 is feasible.

Switzerland currently has 25-30 users in about 10 groups, so based on estimates showing that the number elsewhere has doubled every 6 years, there could be 50-60 potential users once the SLS is ready sometime after Trieste's Elettra



A sketch of the proposed Swiss Light Source synchrotron at the preferred site in the grounds of the Paul Scherrer Institute.

starts operation in 1993-4. The next meeting of the Swiss user community in February 1991 will consider once more the interest in SLS. Establishing a larger constituency of critical mass will depend on a number of local factors, notably the outcome of a proposal to build a 2 nm source for fabricating micromechanical devices using the new LIGA process at Karlsruhe in Southern Germany; the possibility that a new version of the French Super ARCO machine will be built in Strasbourg; and the likelihood that the Austrian community will have decided to participate in Elettra.

Slightly more removed is the proposed BESSY II source in Berlin (a government

official announced on 20 November at the ceremony marking the merger of the German and former DDR physical societies that BESSY II would now be promoted after a considerable delay). A source (DELTA) tailored for testing insertion devices is being built in Dortmund. It will probably be converted eventually to a conventional source available to users. Finally, the Daresbury Laboratory in the UK has proposed a soft X-ray source similar to BESSY II.

Several major synchrotron facilities are under construction further afield (ESRF, Grenoble, France; APS, Argonne, USA; ALS, Berkeley; STEP-8, Osaka-Kobe, Japan) — hence the PSI's proposal for a

third generation source offering unique performance features that are not easily available to a large regional community.

● Science for Peace Prize

Professor A. Zichichi, Director of the Erice Centre, has announced that the first Ettore Majorana-Erice-**Scienza per la Pace Prize** has been awarded, in three equal parts, to Professors E. Teller and V.F. Weisskopf and in memory of the late physicists P.A.M. Dirac, P.L. Kapitza and A.D. Sakharov (whose portion was received by Mrs M. Dirac, Mrs A. Kapitza and Mrs E. Bonner Sakharova). The award ceremony took place at the Ettore Majorana Centre, Sicily on 27 November.

Index, Vol. 21, 1990

Principal Subjects

- Applied Physics, Physics in Industry
 - Europhysics Industrial Workshops
 - EIW-4, ion beams, 18
 - EIW-5, ceramic design, 214
 - EIW-7, surface science, 85, Report, 179
- Associate Members
 - Akzo, joins, 107
 - Heraeus-Stiftung, contribution, 59
 - Institut Laue-Langevin, 58, 89
 - News from Associate Members, 58
 - Paul Scherrer Institute, 58, 218
 - World Laboratory, joins, 58
- Astronomy and Astrophysics
 - Barred galaxies, 3
 - Black hole, stars, 143
 - European Astronomical Society, 216
 - FOC, 139
 - Heterodyne spectroscopy, 195
 - Hubble telescope, 85
 - SOFIA, 119, 120
- Atomic and Molecular Physics
 - Ion traps, atomic clocks, 31
- Ceramic components, design, 214
- Chaotic phenomena, systems, 7
- Condensed matter
 - Magnetism, layered structures, 103
 - Phase conjugation, mid-IR, 11
 - Polymers, nonlinear optical, 83
 - Who's Who, 76
- Conference Listings, 46, 183
- Databases, numeric, 217
- Education
 - Software, 10
 - Courses, UK, 107
- Europhysics Notes, 179, 216
- European Community
 - Conference support, 18
 - Funding, 18, 218
 - Researchers' Europe, 99
 - Science Plan, assessed, 152
- European Physical Society
 - Associate Members, 58, 107, 130
 - Collaborating Societies, 129
 - Council delegates, 117, 127, 153
 - Council report, 95, 100
 - Division, Group and Section Boards, 131
 - East-west report, 137
 - EPS-8 General Conference
 - Best poster, 175
 - Closing Ceremony, 174
 - Official Reception, 173
 - Opening, Casimir, H.G.B., 163
 - Parallel Symposia, 168
 - Plenary Sessions, 164
 - Programme, 60, 163
 - report, 179
 - Europhysics News, Board, 115, 117
 - Executive Committee, 127
 - General Meeting
 - Agenda, 135
 - announcement, 30
 - report, 176
 - Invests for growth, 17
 - Meetings, 134
 - Member Organizations, 128
 - New members, 34, 78, 179
 - Organized Conferences (1990), 135
 - President's report, 75
 - Publications, 135
 - Recognized Journals, 135
 - Research facilities, 10
 - Secretariats, 136, 220
 - Travel grants, 15
- European Research Conferences, 135
- Flying Circus, 175
- Fusion
 - AEA Technology, 16
 - Beryllium, benefits, 14
 - Fusion energy, 218
- Hewlett-Packard Europhysics Prize
 - Call for Nominations, 76
 - winners, 18, 72
- High Energy Physics
 - Antiproton, 27
 - Dirac P., impact, 116
 - ECFA survey, 93
 - Gran Sasso, 123
 - LHC, physics, 210
 - Quarks, discovery, 208
 - Superconducting magnets, 90
 - Top quark, 203
- Letters to the Editor, 38, 119, 156, 178
- Mathematical physics, institute, Cambridge, 98
- Neural networks, physics, 108
- Nuclear Physics
 - Address Booklet, 180
 - Berlin reactor, 15
 - Hadronic, with electrons, 213
 - ILL reactor, 89
 - NuPECC, 140, 180
 - Planning, Europe, 111
- Superdeformed bands, 86
- Theory Centre, 113
- Obituaries
 - Amaldi E., 26
 - Bell J.S., 212
 - Harbeke G., 71
 - Lüscher E., 151
 - Van Hove L., 178
- Oort J.H., 90th birthday, 154
- Physics and Development
 - IPPS, Sweden, 118
- Physics and Society
 - Heat store, 76
 - Seminar, Bad Honnef, energy, 94
- Plasma Physics
 - Division Board, 156
- Prizes
 - Gentner-Kastler, 1990 winner, 59
 - Hewlett-Packard, 1990 winners, 18, 172
 - Holweck, 1990 winner, 79
 - Max Born, 1990 winner, 79
 - Nobel Prize, physics
 - 1989 winners, 33
 - 1990 winners, 200, 209
 - Scienza per la Pace, winners, 219
- Quantum Electronics, Board, 117
- Scanning tunneling microscopy
 - Imaging theories, 63
 - Instrumentation, design, 72
 - Microscopes, 74
 - Studies, 68
- Scherrer P., 100th anniversary, 107
- Schools, listings, 54, 191
- Societies
 - Asia Pacific, 180
 - Balkan, 180
 - Czechoslovakia, journals, 180
 - France
 - French physics, 16
 - journals, 180
 - German, unity, 78, 180
 - IOP, Environmental physics, 117
 - Japan, members' rates, 180
 - The Netherlands, physics, 157
 - USSR, 117
- Spain, research spending, 146
- Synchrotron radiation
 - ESRF, Grenoble, 43
 - Swiss Light Source, 218
- Teraflops, 156

Authors

- Altarelli M., 43-45
- Andreoni C., 147-151
- Anselmetti D., 72-73
- Appert K., 156
- Bellotti E., 123-126
- Benedek G., 71
- Besenbacher F., 68-71
- Burton W.B., 154
- Cyrot-Lackmann F., 151
- Di Lella L., 203-207
- Dorubantu I.A., 38
- Eades J., 27-30
- Eggen H., 157-160
- Eliel E., 157
- Fierz M., 178
- Frois B., 213-214
- Güntherodt H.-J., 72-73
- Haciniyan A., 7-10
- Hilf E.R., 38
- Jacob M., 178, 208-210, 212
- Janot C., 23-26
- Katgert-Merkelijn J.K., 154
- Kinzel W., 108-110
- Kovalev V.I., 11-14
- Kreigreis A., 119
- Lucas A.A., 63-67
- Luminet J.-P., 143-146
- Mackintosh A.R., 76
- Mathiot J.-F., 213-214
- Merz W.J., 107
- Mezger G., 120
- Möhlmann G.R., 83-85
- Mortensen K., 68-71
- Nazarewicz W., 86-89
- Nieuwenhuizen T., 158
- Nitzschmann B.G.J., 38
- Pals J.A., 18
- Pascovi G., 38
- Perin R., 90
- Pescia D., 103-107
- Pfenniger D., 3-6
- Ricci R.A., 26, 75-76, 174
- Röser H.-P., 120, 195-200
- Schleich E., 31-33
- Schreuder H.E., 160
- Shaw E.N., 115
- Sick I., 111-113
- Stacey D.N., 156
- Steigenburger U., 147-151
- Strizker B., 18
- Szymanski Z., 86-89
- Thomas G., 177
- Veringa M., 214-215
- Walther H., 31-33
- Wesendanger R., 72-73
- Windsor C.G., 147-151
- Zichichi A., 116-117