$$D < \left\{ \frac{12\mu_0 M |\mathcal{A}|}{\pi B''} \right\}^{1/5}$$

GMAG NEWSLETTER

A Focused Group within The American Physical Society

N^0 4, September 1998, Edited by R Bruce van Dover

$$\frac{12\mu_0 M |\mathcal{A}|}{\pi D^5} > B'' > \frac{m^2 g^2}{2M^2 B_0}$$

To the GMAG Membership:

I would like to update the membership on the many activities which are going on this year. Other articles from various committee chairs will you give you more details, so this is intended as an overview.

Dave Sellmyer (Nebraska) is the current chair of the Nominating Committee, with Larry Rubin (MIT), and Eric Fullerton (IBM) as members. GMAG elections will be coming up sooner than we think, so be sure to contact the committee with suggestions, etc. Don't hesitate to suggest yourself if you have an interest in serving. As you know, Bernel Argyle (IBM) is Chair Elect (Chair for 1999/2000) and Larry Bennett (George Washington University) is Vice Chair (Chair for 2000/2001). The upcoming election will result in a Vice Chair (Chair for 2001/2002) and three members of the Executive Committee (to March 2002).

There is a lot of work in connection with the March 1999 Centennial APS

meeting. First, Jeff Lynn (NIST), our Program Committee Chair, has been working with his committee to organize a Centennial Symposium on the History of Magnetism, jointly sponsored with DMP (Division of Materials Physics). There will also be a symposium on "Magnetism in Technology", and one on "Spin Polarized Tunneling". The Program Committee is working on several Focus Sessions for the March meeting as well (see below).

Second, Phil Wigen (Ohio State) and a vigorous ad hoc committee comprised of Stephen Arnold (NIST), Kevin Heim (Seagate), Bob McMichael (NIST), Dave Pappas (NIST), and Anil Prabhakar (Quantum) are working to establish a number of displays and exhibits for the centennial celebrations. The APS has plans for a substantial exhibition and it is great that our fledgling group is going to be a part of this. This is one project where someone actually has to DO something. Offers of assistance would be appreciated, I am sure! Phil and his committee is working closely with the DCMP (Division of Condensed Matter Physics) and DMP to coordinate displays and exhibits.

Larry Bennett chairs the Fellow Committee. Phil Wigen and Jan Herbst (General Motors) are the other committee members. Please contact Larry if you have suggestions for GMAG members which you believe might be put forward as APS Fellow nominees.

David Jiles (Ames Lab.) worked closely with Don Gubser (NRL), DCMP Secretary, to set up appropriate magnetism categories for the March Meeting. Your feedback on these categories will be very helpful in the further refining of this list for future meetings. Make sure to send David or me your comments when the meeting announcement appears.

I have thought about establishing an ad hoc recruiting committee to help keep our membership growth curve on the upswing. Due to much too much to do, this has not happened. If anyone is interested in helping out here, please let me know. We may have a recruiting effort at some modest level at the upcoming MMM conference in Miami (November 9 - 12, 1998), although nothing definite has been established. Comments and suggestions would be welcome.

Speaking of MMM, I have been exploring, with help and advice from various members of the Executive Committee, ways in which GMAG might establish closer ties with the Conference on Magnetism and Magnetic Materials (MMM) and the International Conference on Magnetism (ICM). One surprising fact in recent months has been the realization that the MMM Conference is not even listed in some of the conference calendars issued by the APS. Moreover, MMM is not even formally endorsed by the APS. I believe that, at a minimum, MMM should be listed in the appropriate APS calendars! Also, as I understand it, APS endorsement is available essentially for the asking! Your thoughts and Ideas here would also be most welcome. If you are presently active in the MMM conference, you might consider inputs in that direction as well.

Of course, the biggest focus of GMAG is on the March Meeting, as we strive to represent the topical area of "magnetism and its applications" for invited talks, symposia, focus sessions, etc. Please help by suggesting suitable invited speakers to the DCMP organizers of the March Meeting and providing input to our Program Committee. You might also consider participating in the "Sorters Meeting" at which the March Meeting program is assembled. I have never done this myself, but I understand it is an exciting and hectic time for all! Please contact me if' you are interested.

Many of the GMAG officers are also becoming involved with the March Meeting at the organizational level. David Jiles, Bruce van Dover (Lucent Technologies), and myself participated in the Centennial Planning Meeting at the 1998 March Meeting. Other GMAG members wearing different hats were also present. We had the sense that our comments and contributions to that meeting were useful and significant to the others present. As a group, we carry a lot of experience from the long history of MMM and other conferences.

Carl Patton
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GMAG Program Committee

Jeff Lynn (NIST), Chair
Jim Rhyne (University of Missouri--Columbia)
Jeff Urbach (Georgetown University)

The program committee was formed in the Spring, shortly after the March meeting in LA. The primary task of the committee is to organize the GMAG program for the next March meeting in Atlanta, which will be a combined March/April meeting of the American Physical Society in celebration of the Centennial anniversary of the APS. GMAG has two symposia slots allocated for the March meeting, which can be split to organize up to four symposia if sessions are co-sponsored with other units. We solicited the membership in April to request suggestions for symposia, and the Executive Committee approved the following invited sessions:

History of Magnetism, sponsored jointly with DMP (organized by Jim Rhyne of GMAG and Dan Pierce of DMP).

This symposium has been accepted for the Centennial Program.

We are also sponsoring two other symposia:

Magnetism in Technology, sponsored jointly with FIAP (organized by Stu Wolf).
Spin Polarized Tunneling, sponsored by GMAG (organized by Jagadeesh Moodera).

GMAG Focus Sessions

The following three focus sessions are being organized by GMAG. Abstracts should be submitted using the sorting category listed. Please note that the deadline for submitting abstracts for the Centennial meeting is a few weeks earlier than usual:

Abstract Deadline: November 13, 1998

Nonlinear and Macroscopic Quantum Phenomena (Sorting Category 6.9.1)
Abstracts are solicited in the areas of theoretical and experimental studies of nonlinear and macroscopic quantum phenomena in magnetic materials. Topics include, but are not limited to, nonlinear excitations in magnetics, nonlinear spin wave phenomena, nonlinear domain wall effects, dynamical chaos and chaos control, stochastic resonance in magnetic systems, magnetic solitons and instantons, macroscopic quantum tunneling of magnetization in nanoparticles, tunneling of domain walls, thermally assisted magnetization tunneling, applications of nonlinear and macroscopic quantum phenomena in magnetism for the development of sensors and signal processing devices.

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Environmental Magnetism (Sorting Category 6.9.2)
Because the growth of small magnetic particles is strongly influenced by the water content of soils, they are surrogate markers of variations in climate. Therefore the magnetic properties of ancient soils and loesses can provide an indication of ancient climactic changes. Pollutants often contain magnetic minerals, and magnetic measurements can identify sources of environmental pollution.

Abstracts are solicited in these and related areas.
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Magnetism in Soft Matter (Sorting Category 6.9.3)
The interaction between the magnetic environment and a wide range of soft matter, including colloids, polymers, surfactants, liquid crystals, emulsions, biomaterials, and disordered systems, provides an important opportunity to understand the underlying physical properties of the structures, dynamics, and functions in these systems. More importantly, this interaction has made it possible to develop some of most advanced technologies (such as magnetic resonance imaging, magnetic force microscopy, and magnetic resonance force imaging), that benefit not only the scientific community but society generally. This focus session will explore the following two aspects: 1) effect of magnetic field on soft matter, and 2) the importance of magnetism in modern technology in interdisciplinary areas. Both experimental and theoretical work are solicited. Abstracts in the following areas are welcome:
(1)effects of magnetic fields on biological systems.
(2) physics of magnetic soft matter such as magnetic colloids and magnetic fluids.
(3) fluid flow in magnetic fields.
(4) magnetic response of complex systems (polymers, liquid crystals, glasses, spin glasses, and others).
(5) development of modern technology for studying soft matter.
(6) Other applications of magnetism in soft matter.

For details, please check http://www.physics.ucf.edu/~luo
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Please note that the deadline for submitting abstracts for the Centennial meeting is few weeks earlier than usual:

November 13, 1998

1999 Centennial Celebration Plans

The 1999 Centenary of the American Physical Society to be held in Atlanta in conjunction with the joint March and Spring APS Meetings will be held from March 20-26, 1999. Numerous events are scheduled during the Atlanta meeting, including an International Day on Saturday, March 20, a Moment of Discovery Day on March 21, Plenary Speakers, and Centenary Symposia developed by each APS unit. Year-long events are also planned for 1999. The Topical Group on Magnetism and Its Applications will have two Centenary Symposia at the Atlanta meeting; these talks should be tutorial and reflect the historical and technological developments of magnetism and magnetic materials. Suggestions for topics and speakers should be forwarded to the Chair of the Executive Committee. In addition there will be many special events developed for the Atlanta meeting including an exhibit on science. GMAG is planning to have an exhibit displayed during the meeting. Carl Patton has the responsibility for developing this display; if you have suggestions and/or can volunteer to help, contact Carl. A Speakers Booklet is being assembled by the APS with a group of more than 200 outstanding lecturers who will act as APS Centennial Speakers and give lectures of a general nature at colleges and Universities throughout the United States during the 1998-1999 academic year.

ICM-2000 Conference Announcement

The International Conference on Magnetism -ICM- in the year 2000 will be held at the State Convention Center in Recife, on the Northeastern Coast of Brazil. ICM belongs to a series of triennial conferences held under the auspices of the International Union for Pure and Applied Physics - IUPAP.
ICM is designed to bring together the international community of scientists and engineers interested in recent developments in all branches of fundamental and applied magnetism and to provide a forum for the presentation and discussion of new concepts, properties and developments in materials research and magnetic applications.
The most recent conferences were held in Cairns, Australia (1997), Warsaw (1994), Edinburgh (1991), Paris (1989), San Francisco (1985) and Kyoto (1982). Next ICM will be held in Brazil in August 2000. The main conference will take place in Recife, while satellite conferences and workshops are scheduled for Porto Alegre, Campinas, Rio de Janeiro and Belo Horizonte.

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FURTHER INFORMATION: www.icm2000.org.br

The Institute of Physics Magnetism Group

Thanks to David Jiles, the first contact between the Magnetism Groups of the AIP and the Institute of Physics (IoP) in the UK was established early this year. In April, David wrote an article for the IoP Magnetism Group Newsletter introducing the recently founded AIP Topical Group on Magnetism, their activities and future plans. It is now my pleasure to give an overview of the British activities to the magneticians in the USA.

The Magnetism Group is one of 43 specialised groups in the IoP. It was founded in 1965 and currently has a membership of 440. The aim of the Magnetism Group is to stimulate interest in the subject, to advance the science and technology of magnetism, to provide training opportunities for young researchers, and to represent the views of its professional members. The committee of the Magnetism Group currently has 11 members who meet 4 times a year. In order to represent the many aspects of magnetism research, committee members come from universities, industry, and the UKRI Chapter of the IEEE Magnetics Society.

The Magnetism Group organises a series of events which address different aspects of magnetism and target different audiences.

Two tutorial workshops for postgraduate students are held at the IoP headquarters in London each year forming part of a cycle of 5 workshops. The topics are: 1) Magnetic Measurement Techniques, 2) Structural and Transport Techniques, 3) Magnetic Imaging and Resonance, 4) Preparation of Magnetic Materials and 5) Spectroscopy of Magnetic Materials. The workshops also provide young researchers with the opportunity to meet each other and exchange ideas and experiences.

At the annual Condensed Matter and Materials Physics conference (CMMP'98 in Manchester from December 20 - 23) the Magnetism Group organises the Advanced Magnetism Symposium which consists of two 2 hour sessions with invited and contributed papers as well as a poster session and co-organises with the Materials and Characterisation Group a session on the "Characterisation of Multilayers and Low-dimensional Structures".

Each year the Peter Wohlfarth memorial lecturer is selected by the Magnetism Group committee in conjunction with the UKRI Chapter of the IEEE Magnetics Society and the award lecture presented in a plenary session at the CMMP conference. The 1997 Wohlfarth lecturer was Dr. Mary Doerner from IBM.

Each Spring, the one day meeting *Current Research in Magnetism* is held at a central research facility. On the occasion of the 50th anniversary of the National Health Service this year, the meeting was opened by an invited talk on MRI in medicine. At this meeting, postgraduate students have the opportunity to gain experience in presenting their work to an audience.

Members of each magnetism research team (academic and industrial) come together every two years at the Joint Magnetics Workshop which is jointly organised with the UK Magnetics Society, the IEE and the IEEE. The next 2-day workshop will be held at the University of York from July 5 - 7, 1999.
(http://www.york.ac.uk/org/mg/iop/jmw99.html).

To facilitate research students attending international meetings to present their results, the Magnetism Group has a small fund to assist in travel expenses. A group newsletter, which is circulated twice a year to all members, contains news, conference reports, and

information on future events. The newsletter will soon be available on the Magnetism Group web site (http://www.iop.org/IOP/Groups/MA). In the meantime copies can be obtained from the newsletter editor (mg21@york.ac.uk).

Finally, I would like to point out a few other important aspects in the life of the magnetics community in the UK. Earlier I mentioned the UK Magnetics Society which amalgamates companies producing magnetic materials and devices or offering services and academic institutions. This society organises a number of seminars on applied topics such as GMR, losses in electrical steels and permanent magnets. Their international newsletter 'Magnews' appears 4 times a year. Until their website is in operation information can be obtained from the editor Magaret Swadling (The UK Magnetics Society, Berkeshire Business Centre, Post Office Lane, Wantage, Oxfordshire OX12 8SH, UK, e-mail: ukmagsoc@compuserve.com).

Further aspects of applied magnetism are represented by the UKRI Chapter of the IEEE Magnetics Society who organises a number of meetings based on a theme around one of the IEEE distinguished lectures (http://www.ieee.org.uk/magnetic.html).

Funding for research in magnetism in the UK has two main sources. Until the year 2000, the Engineering and Physical Sciences Research Council (EPSRC) operates a focused programme, the Advanced Magnetics Programme. The aim of this programme is to support and coordinate research of the highest scientific/technical quality in four main areas: 1) Structured films, 2) Information storage, 3) Advanced hard and soft magnetic materials and 4) Characterisation of advanced magnetic materials. The coordinator of this programme, Prof. Kevin O'Grady from the University College of North Wales in Bangor is also a member of the Magnetism Group committee. In addition, a number of groups participate in European networks funded by the European Union which links university and industrial research groups from different countries in order to better exploit instrumental and human resources across the European Union. A list of the current networks and their web sites can be found on the main EU information web site (http://www.cordis.lu/).

I hope to have given an overview over the activities concerning magnetism research in the UK. It would certainly be beneficial for both Magnetism Groups to establish closer links and I would like to encourage anybody in the USA who wants to contribute to joint activities to get on touch with the 'nearest' Magnetism Group committee member.

—Dr. Matthias Gester
University of York
Department of Physics

Editors note:

Following is a brief technical article on a timely subject. We hope that you will find it interesting. If you enjoy finding this sort of article in our newsletter, let us know. Better yet, suggest another topic and author so we can solicit a contribution. Best of all, volunteer to write a similar article!

—***Bruce van Dover***

MAGNETOCALORIC EFFECT/MAGNETIC REFRIGERATION

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Although the magnetocaloric effect has been known for 118 years, research on this phenomenon and its application as a means of cooling has practically been non-existent until the 1990's, except for the use of adiabatic demagnetization to attain very low temperatures. However, two major breakthroughs announced in 1997 have greatly changed the situation.

The first was the announcement on February 20, 1997 that the Astronautics/Ames Laboratory proof-of-principle laboratory demonstration unit had been operational for two months and had attained record cooling power for a magnetic refrigerator (MR). Since then the unit has been operated nearly every working day, logging in over 1500 "maintenance free" hours. Prior MRs ran for a few hours or a day or two at the most. The apparatus consists of two beds each containing 1.5 kg of gadolinium spheres. These beds reciprocate in and out of a magnetic field in such a manner that the magnetic forces cancel each other. The magnetic field which could be adjusted from 0 to 5T, is supplied by a superconducting magnet operating in a persistent mode. The minimum cycle time is

6 seconds (0.17 Hz). The Gd spheres were prepared from commercial [93 at.% (99.7 wt.%) pure] Gd purchased from China. The heat transfer medium is water, but automotive antifreeze can be added if cooling below 273K (00C) is required. The notable achievements attained with this proof-of-principle apparatus are: (1) a cooling power of 600 watts (which is about 100 times greater than that obtained by previous near room temperature MRs; (2) a maximum COP (coefficient of performance, i.e. cooling power divided by input work) of 15 (typical vapor cycle refrigerators have COPs between 2 and 6); (3) a maximum efficiency of 60% of Carnot (the seal friction was subtracted-off); and (4) a maximum temperature span of 380C (the difference in the temperatures of the hot and cold exchangers).[1,2]

The second milestone was the announcement of the discovery of the giant magnetocaloric effect material $Gd_5(Si_2Ge_2)$ on June 9, 1997 in Physical Review Letters.[3] The outstanding magnetocaloric properties are due to a first order ferromagnetic (F) to ferromagnetic (F) transition at 276K, which lies ~25K below a second order paramagnetic (P) to F transition. The F to F transition is maintained in magnetic fields up to at least 7.5T. The adiabatic temperature rise, T_{ad}, for $Gd_5(Si_2Ge_2)$ is ~30% larger than that of Gd (comparing peak values) while the magnetic entropy change, S_m, is ~100% larger. Further work[4] showed that by changing the Si:Ge ratio, the first order F to F transition could be lowered to ~20K for Gd_5Ge_4. That is, one can tune the magnetic ordering temperature from ~280 to ~20K and thus the maximum magnetocaloric properties by changing the Si:Ge ratio. The T_{ad} and S_m values of the $Gd_5(Si_xGe_{1-x})_4$ materials were found to be as much as 200% and 600%, respectively, larger than the corresponding prototype magnetic refrigeration materials. Finally we showed that the magnetic ordering temperature of $Gd_5(Si_2Ge_2)$ could be increased by alloying while maintaining the first order F to F transition.[5] The substitution of 0.33 at.% Ga for Si+Ge raised the Curie temperature by ~10K, however, larger additions of Ga increased T_c but the material no longer exhibited the giant magnetocaloric effect.

The discovery of the giant magnetocaloric effect materials will not only lead to improved performance and efficiencies of MRs, but will open the door to applications previously considered inaccessible to magnetic refrigeration technology. These include automotive and aircraft climate control, home air conditioning and home refrigerator/freezers, cooling the next generation computers and other electronic devices. These applications require permanent magnets which can generate a 1.5 to 2T field in a 5mm gap and we believe this will open a large commercial market for rare earth based permanent magnet materials as magnetic refrigeration becomes an established commercial technology.

This research was partially funded by both the Office of Basic Energy Sciences, Materials Sciences Division and the Office of Computational Technology Research, Advanced Energy Projects and Technology Research Division of the U.S. Department of Energy under Contract No. W-7405-ENG-82.

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1998 Business Meeting

Here are some photos (shot by Marty Sablik) from the dinner held after the 1998 Business Meeting in LA. A good time was had by all! Members are welcome to come to the dinner to be held after next year's business meeting in Atlanta. Come and join us!

(click here to download photo)

Clockwise from left: Yaakov Shapira, Stan Charap, Dave Sellmyer, David Jiles, Jim Rhyne, Jeff Lynn, Carl Patton, Larry Rubin.

(click here to download photo)

Clockwise from left: Ladislav Pust, Mark Novotny, Jeff Linemith, Bruce van Dover, Frances Hellman, Bruce Brandt, Donovan Hall.

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Calendar of Upcoming Magnetism Meetings

(see meetings calendar)

(please email new items to: rbvd@bell-labs.com)