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CMRR Report

Center for Magnetic Recording Research

Number 19 Winter 1995

TMRC Reception

The fifth annual Magnetic Recording Conference was held on the UC San Diego campus in August. The majority of the conference organizers were from CMRR sponsor companies: Roger Hoyt (IBM Almaden Research Center, San Jose), conference chairman; Tomasz Jagielinski (Eastman Kodak Co.), local chairman; Robert Swanson (Eastman Kodak Co.), publicity chairman; and Joost Mortelmans (IBM Corporation, San Jose), treasurer. Additionally, CMRR's Professor Jack Wolf served as the program chairman. CMRR hosted the conference participants during an evening reception August 15. The program featured displays of each of the CMRR research groups' activities along with a reprint/preprint table of recent publications. Attendees also had the opportunity to visit the laboratories for demonstrations of on-going research activities and to engage in scientific discussions with faculty, researchers, and students.

Nadimpalli to Hewlett-Packard

Sekhar Nadimpalli left CMRR last August in order to take up a position as a development engineer in the Disk Memory Division of Hewlett-Packard in Boise, Idaho. Sekhar had joined the Center in November 1992 as a post doctoral student in the Talke lab, where he worked on pole tip recession and the tribology of carbon coated sliders. A paper covering some of his research "Pole Tip Recession: Investigation of Factors Affecting Its Measurement, Its Variation With Constant Start/Stop and Constant Speed Drag Testing" has been accepted by The *Journal of Tribology.* At Hewlett-Packard, Sekhar works on advanced head/media reliability with Steve Howe's group.

Berkowitz—IEEE Distinguished Lecturer

Professor Ami Berkowitz has been named as one of two distinguished lecturers for 1995 by IEEE Magnetics Society. This is his second appointment as a distinguished lecturer. Any IEEE Magnetics Society chapter can arrange for a talk with a distinguished lecturer. With advance notice the talk can be tuned to a specific audience.

Professor Berkowitz's talk covers new magnetic materials which have recently been discovered in the search for ever-increasing magnetic storage densities. With the blurring between basic and applied research in resolving magnetic materials issues, we find a need to understand and control magnetic behavior in structures at the atomic scale. Some of the topics discussed include: magnetic viscosity, exchange anisotropy, anomalous finite size effects, and giant magnetoresistance in heterogeneous alloy films.

Prior to Professor Berkowitz's appointment at the Center for Magnetic Recording Research at UCSD, he was with GE at the research lab in Schenectady, N.Y.; with IBM at Yorktown Heights, N.Y. and Burlington, Vt.; and the Franklin Institute Research Labs in Philadelphia, Pa. He received a bachelor of science degree from Duke University in 1947 and a Ph.D. from the University of Philadelphia in 1953, both in physics.

Currently he is director of the recently established NSF-funded Materials Research Science and Engineering Center at UCSD. His research interests are generally concerned with the synthesis, characterization, and analysis of the behavior of magnetic materials, with particular emphasis on problems associated with magnetic storage. He has published about 100 papers, holds about twenty patents and co-edited, with Eckart Kneller "Magnetism and Metallurgy" published by Academic Press in 1969. He is a member of the Magnetics Society, the American Physical Society, and the Materials Research Society.

Professor Berkowitz can be contacted at (619) 534-5627 (voice), (619) 534-2720 (fax), aberk@ucsd.edu (email).

Barbosa Appointed as Research Scientist

LINEU BARBOSA

Dr. Lineu Barbosa was appointed to a post-retirement research scientist position in CMRR in August, after having served as a visiting researcher in Professor Jack Wolf's signal processing group since 1991. His professional experience includes research in private industry, at TRW Systems and the IBM Almaden Research Laboratories, and as a university professor at Santa Clara University and San Jose State University.

Lineu is a world-renowned expert in the field of signal processing and communication research and provides particular expertise to the Wolf research group in the design of equalizers. He also collaborates with Professor Neal Bertram on a project which relates fundamental microstructure of thin film recording media to the final system error rates. This is a critical area of research, since both media manufacturers as well as channel design engineers in industry want to know how variations in medium properties effect system performance; or conversely, how one can optimize a channel for given medium characteristics. Upcoming projects include a new eighteen-month research project with the Department of Defense, NSA (one of our CMRR sponsors) to perform erasure studies of high coercivity disk media.

From the Director

One of the major news articles in this issue concerns our new "MRSEC" grant. In brief, we have previously had an MRG (Materials Research Group) award from the National Science Foundation which provided support for part of our materials, micromagnetics, and advanced instrumentation program. When our MRG came up for renewal approximately eighteen months ago, we learned that the NSF had plans to replace the traditional MRG and MRL (Materials Research Labs) with a new program, whose acronym, MRSEC, stood for Materials Research Science and Engineering Center.

The competition for the new MRSEC programs was fairly intense. First, our original MRG core group of faculty (Bertram, Berkowitz, Fredkin, Schultz, and Thomas) was expanded by inviting additional faculty from UCSD and other universities. This new group submitted a White Paper outlining their continuing interests in magnetic media, numerical simulations, micromagnetic theory and experiment, and the associated instrumentation development. That document passed the initial screening, and we were invited to submit a full proposal. After peer review, we were selected for the "final sixteen championship round" in Washington. And finally, we were informed that we were amongst those selected from that group for funding as a MRSEC!

We would like to welcome and introduce here, the additional participating faculty to the MRSEC. At UCSD they include Lea Rudee (former Dean of Engineering), who is investigating the application of electron beam holography to magnetic field imaging; Theresa Cheeks (formerly at BelCor), who is setting up a new laboratory for thin film media and magneto-optics; and Harry Suhl, who joins our theoretical effort on the dynamics of micromagnetism. Three other faculty, Axel Scherer (formerly at BelCor and now at CalTech), who is an expert in all forms of nanolithography; Conrad Williams (Morgan State University), thin film preparation and characterization; and R. Ramesh (also formerly at BelCor and now at the University of Maryland), TEM, laser ablated films, and CMR (Colossal Magneto-Resistance), have also come onboard. We look forward to introducing these new associated faculty of CMRR at one of the future Research Reviews as their programs develop.

Mention of a future Research Review, is a natural lead-in to our next one, which is scheduled for May 3 and 4. If you have never attended a prior review, or are not on our mailing list for an invitation, please do not hesitate to call/e-mail/or FAX the Center to get on our "exclusive" list. All employees of our Industrial Sponsor Companies are eligible to attend, and while the two days are a fully packed schedule, with most of our students, postdocs, and faculty providing brief reports of their current research activities, it is the most efficient way to get to know what is going on at the Center. In addition, there is time set aside for lab tours and personal conversations with the specific groups of your interest. One more observation, we have started the tradition of featuring a selected topic for a special focus at each meeting, and this time it will be "A Review of Tape Recording Research at CMRR." When you add the good food and opportunity to meet your industrial colleagues in an informal atmosphere, it becomes an event you don't want to miss. So here are the numbers you need to contact us. Of course, if you have questions, or want to visit at any other time, please let us know.

Shelly Schultz
CMRR: phone 619-534-6198, e-mail chacker@ucsd.edu,
FAX 619-534-8059

CMRR Faculty Awarded an NSF MRSEC

And who, might you ask, is **Mr Sec**? For those at UCSD's CMRR, and five other institutions, as well as collaborators from private industry, who worked so laboriously on this project, it seemed to have taken on its own persona. Their efforts were rewarded when the NSF announced that the Mr Sec, or more correctly MRSEC, (which stands for Materials Research Science and Engineering Center) project had been awarded in the amount of $4.05M effective September 1, 1994. The fifty-four month project is a direct continuation of the Materials Research Group (MGR) program initially funded by the NSF in 1990. Competition was keen for the new award with 156 pre-proposals, 30 full proposals, 16 selected for interviews, and finally only 11 awards. Professor Ami Berkowitz is the project director with Professors Neal Bertram, Donald R. Fredkin, Sheldon Schultz, and Gareth Thomas (UCB) as co-principal investigators.

The UCSD MRSEC research thrust is to train students and perform research and development which will have a direct impact on advancing the state of the art in magnetic information storage. The research program addresses magnetic recording materials, with emphasis on clarifying the underlying physical phenomena. As with the preceding MRG, our program also includes development of new techniques and instrumentation which advance the state of the art in magnetic measurements.

NSA/DOD Grant

Sheldon Schultz, CMRR director, in collaboration with Professor Neal Bertram and Dr. Lineu Barbosa, recently received an eighteen-month contract awarded by the Department of Defense, National Security Administration. The research objective is to perform specialized testing on the erasure characteristics of rigid magnetic disk recording media. This testing will be used to determine whether current security policies can be expanded to encompass new generations of rigid magnetic disk recording media. The current agency erasure security policy for rigid magnetic disk media is limited to media with a coercivity ranging from 350 to 1100 oersteds. New magnetic disk platter formulations with higher coercivity ratings, i.e., 1100 to 3000 oersteds, have been developed and are currently being used to manufacture hard disk assemblies (HDA). The new research initiative will focus on establishing the procedures and specifications for the erasure of rigid disk media over 1100 oersteds.

Schultz—IEEE Mag Soc Chair

CMRR Director Sheldon Schultz, has been named as the new chairman of the San Diego Chapter of the Magnetics Society of the IEEE, and Robert Swanson of Eastman Kodak Laboratories will serve as the co-chair. Schultz replaces Fred Jeffers of Eastman Kodak Laboratories who served in that capacity for the past two years. IEEE meetings are held at CMRR on Thursday evenings at 7:00 p.m. periodically throughout the academic year. Upcoming meetings are scheduled for May 18 and June 15. If you have suggestions for speakers, please contact Shelly Schultz at (619) 534-6210 or Bob Swanson at (619) 535-6923.

Graduating PhD

Steven Slade

Steven Slade completed his Ph.D. in physics in June 1994. His thesis title was "Investigation of the Neel Model of Thermal Activation in Heterogeneous Co-Ag Alloy Films Through the Use of Dynamic Susceptibility Measurements." Steve was one of Professor Ami Berkowitz's first graduate students at CMRR in 1986. As one of the initial group of graduate students he was involved in setting up the Berkowitz lab. In particular, he refurbished the VSM, adding cryogenic capability, designed and built the computer-controlled spark erosion apparatus, and designed and built the high-sensitivity combination B-H looper and ac susceptometer.

Steve undertook his undergraduate degree in physics at Cal Poly San Luis Obispo, graduating cum laude in June 1986. While there he set up the Radionuclide Analysis Laboratory which monitors environmental radiation levels in the surrounding Diablo Canyon nuclear power plant.

In August 1994 Steve began working for Seagate Technology, Inc., in Minneapolis. Working with Brian Zuk in the Electrical Development Engineering Department as an advanced transducer design engineer, Steve is involved in new designs for thin film inductive heads and new wafer manufacturing processes for improving existing designs.

Visiting Scholars

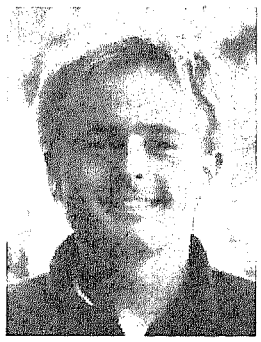
Robin Swain

Robin Swain graduated from City University, London, with a B.S. Class One honors in electrical and electronic engineering in 1988. He then worked for the research and development section of GEC Installation Equipment for a short period, returning to City University where he undertook his Ph.D. in the Department of Mechanical Engineering and Aeronautics. Working in the Thermo-Fluids Engineering Research Center, Robin completed his graduate studies in 1993. His thesis topic was "The Application of Pulsed Laser Electronic Speckle Pattern Interferometry to the Measurement of In-plane Strain on High Speed Rotating Components." This work was financed in large part by Rolls Royce Aerospace and was noted by the Science Education Research Council, London, as "a major contribution to knowledge."

In June 1994, Robin joined Professor Frank Talke's group at CMRR for a one-year post doctoral position. Since coming to CMRR, Robin has worked on the analysis of fringe pattern using Fourier transform methods. A publication entitled "Comparison of Algorithms for Extraction of Spacing Information from Interferometric Fringe Patterns of a Head/Tape Interface," co-authored with Eric Baugh and Frank Talke, has been submitted to the Journal *of Precision Engineering*.

His major research project on the interferometry of the Head/Tape interface of a helical scanner is supported by StorageTek, Colorado.

Havard Stenberg



Havard Stenberg joined the Talke group in September 1994 after completing the course work for his master's degree from the Department of Mechanical Engineering at the Norwegian Institute of Technology in Trondheim, Norway. After considering MIT and The University of California, Berkeley, Havard chose UCSD. While at CMRR, Havard will complete his master's thesis which involves a finite element program for numerical simulations of the flying characteristics of proximity recording sliders. He expects to complete his master's thesis by the end of April 1995. On his return to Norway, Harvard is considering pursuing his Ph.D., but may also do the first year of his graduate studies here at CMRR.

Marianne Fjelltveit

One of two Norwegian students currently studying at CMRR, **Marianne Fjelltveit** comes from the University of Bergen. After completing her master's thesis on "Syndrome decoding using table lookup—a fast decoding method for convolutional codes" Marianne continued on to the doctoral program.

Marianne expects to study at CMRR for approximately nine months under the supervision of Professor Jack Wolf. Her stay is funded by the Norwegian Research Council. Her studies are focused on the use of convolutional codes for a partial response channel.

After completing her Ph.D., Marianne hopes to work as a postdoctoral fellow in the United States.

Thomas Mittelholzer

After spending a year at CMRR, **Thomas Mittelholzer** is returning to the Swiss Federal Institute of Technology where he will resume his position as a research associate in the Signal and Information Processing Laboratory.

Here at CMRR, Thomas worked closely with Dan Soo of Metrum for six months, analyzing measurements taken from an experimental spin stand developed at Metrum to evaluate tapes. Five different types of particulate and metal evaporated tapes were studied. Arnon Friedmann, another student here at CMRR took the actual measurements and Thomas performed the analyses. With Thomas' return to Switzerland, Arnon will continue the measurements, using a spin stand modeled after the Metrum model.

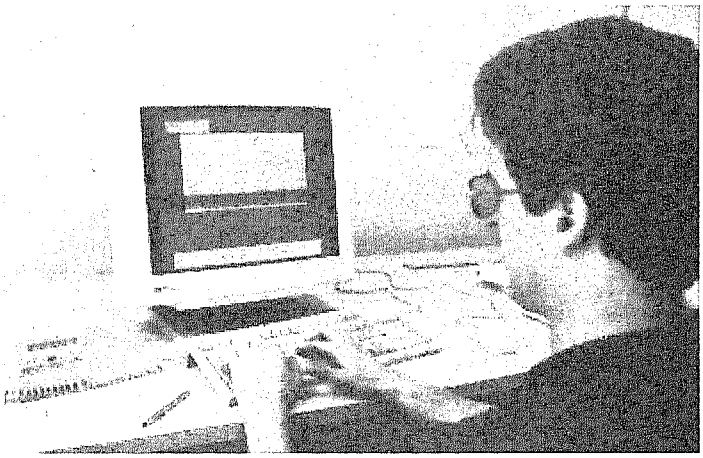
Thomas spent his last six months working on trellis coding for partial response channels. Together with Peter McEwen and Shrish Altekar, he constructed trellis codes without quasi catastrophic sequences.

Equipment Donations

CMRR has been very fortunate in receiving several gifts of equipment, specifically workstations and laboratory measuring equipment from Hewlett-Packard. These are being used in Professor Bertram's laboratory for micromagnetic studies of magnetoresistive heads and for analysis of domain noise in thin film heads.

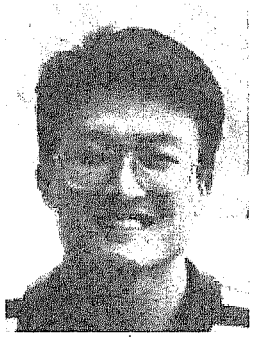
Having these local workstations helps alleviate pressure on our use of the San Diego Supercomputer Center for studies of magnetic media—both thin film disk and tape. The measurement equipment is being used in spectral analysis of noise and signals in magnetic recording.

The Center is grateful to Manoj Bhattacharyya of Hewlett-Packard Laboratories, Palo Alto, and Lou Witken, Project Manager of Hewlett-Packard's research grants program. They worked closely with Professor Bertram to identify his needs and then efficiently implement the projects.



New Graduate Students

Chris Platt



As an undergraduate physics student at the University of Arizona, Tucson, **Chris Platt** competed for and was successful in obtaining a place in the Science and Engineering Research Semester (SERS) program. Under this program, sponsored by the Department of Energy, students spend a semester at one of the six DOE national research laboratories. Chris went to the Argonne National Laboratory where he worked on HTC superconductivity.

This experience helped shape Chris' decision to choose Ami Berkowitz as his Ph.D. adviser here at UCSD. Currently he is working with Bob Beach, a postdoctoral fellow in the Berkowitz group, on giant magneto impedance in amorphous ferromagnetic wires. He is also involved in a joint project with Professor Berkowitz and Teresa Cheeks of the Electrical and Computer Engineering Department, involving metal evaporated tape.

Yun Zhang

Yun Zhang has chosen to work with Professor H. Neal Bertram as her adviser for her Ph.D. in Physics. She will perform experimental and theoretical studies of erasure in high coercivity thin film media while here at CMRR.

She received her bachelor's degree in physics from Tsinghua University and her master's degree from Peking University. These are two of the top three universities in China. Her master's thesis on surface physics looked at the atomic and electronic structure of the metal/semiconductor interface.

Peter McEwen

Peter McEwen received his undergraduate degree in electrical engineering from MIT in 1986. From there he joined Digital Equipment Corporation in Shrewsbury, Massachusetts where he worked on magnetic recording head development. In 1989, as a participant in DEC's corporate Graduate Engineering Education Program (GEEP), Peter returned to school to complete a master's degree in Electrical Engineering at Carnegie Mellon University, specializing in signal processing for magnetic recording. While there he co-authored an IEEE Transactions on Magnetics paper entitled "Evaluation of Magnetic Recording Detection Schemes for Thin Film Media."

On his return to DEC, Peter worked in a variety of areas relating to advanced development for magnetic recording heads, including researching the impact of advanced signal processing on head performance and design. He was also able to share his expertise with other DEC employees by teaching seminars in digital signal processing for magnetic recording for DEC's storage systems group.

Peter joined CMRR in September 1993 to undertake his Ph.D. He is working with Professor Jack Wolf as his adviser. His research is concerned with signal detectors and trellis codes. He has two papers accepted for Intermag '95. Details can be found in the article in this issue, which lists the papers submitted to Intermag '95.

Gene Sandler

Gene Sandler completed his bachelor of arts in physics and applied mathematics at the University of California, Berkeley in 1991. From there he came to UCSD to begin his Ph.D. in theoretical plasma physics with Professor Dan Dubin. In the fall quarter 1994, Gene decided to switch to a more applied field and chose to work with Professor H. Neal Bertram in magnetic recording physics. Gene will be studying domain wall dynamics and Barkhausen noise in inductive thin film heads.

New PostDoc Students

Ashok Machcha

Dr. Ashok Machcha accepted a postdoctoral position with Professor Frank Talke in August 1994. He is working on the mechanics and tribology of the head disk interface and is studying the contact recording approach of Censtor. Other areas of interest include optical interferometry and micromechanical systems.

Ashok recently completed his Ph.D. in applied mechanics/engineering sciences here at UCSD with Professor Nemat-Nasser as his adviser. His thesis topic, "Dynamic Response of Materials at High Loading Rates—A Study on Ceramics and Elasto-Hydrodynamic (EHD) Lubricants," formed the basis of a talk which he presented at a CMRR seminar on November 8, 1994. A videotape of this talk is available for loan to members of CMRR's corporate sponsors by contacting Jan Neumann (619) 534-6199.

Prior to his arrival at UCSD in 1988, Ashok worked for four years as a development engineer at the Corporate Research and Development Center for Bharat Heavy Electricals Ltd., Hyderabad, a company which manufactures power plant equipment. He received his bachelor of technology in mechanical engineering at the Regional Engineering College, Warangal, India, in December 1983.

Hae-Sung Kwon

Dr. Hae-Sung Kwon from Yonsei University in Seoul, Korea, joined Professor Talke's group as a visiting scholar/postdoctoral fellow in April 1994. Hae-Sung's thesis was concerned with the numerical analysis of the helical scan head/tape interface, using finite element analysis to simulate the detection of the tape under the moving head. Since coming to CMRR, Hae-Sung's work has focused on improving the numerical models of the helical scan head/tape interface. In particular, he is working on a model that includes contact phenomena and air bearing pressure effects at the head/tape interface in a helical scanner.

Rodrigo Arias

Rodrigo Arias, having completed his bachelor's and master's degrees in physics from the University of Chile, came to UCSD in 1987. He completed his master of science degree in Physics in 1988, then returned to his native Chile from 1988 to 1990. Rodrigo studied Industrial Engineering and has satisfied all requirements for a bachelor of arts.

Returning to UCSD in 1990, Rodrigo undertook his doctorate in physics under the advisement of Professor Harry Suhl. His thesis topic was "Magnetic Susceptibility in the Coexistence Regime of Ferromagnets." During the academic year 1992-93 Rodrigo held a General Atomic fellowship.

Upon completion of his Ph.D., Rodrigo accepted a one year post doctoral position with Professor H. Neal Bertram, beginning in October 1994. He will study temporal thermal effects—superparamagnetism, in high density disk and tape media.

UPCOMING INTERMAG PAPERS

The following papers have been submitted to Intermag '95 for the meeting to be held April 15–21 in San Antonio, Texas:

Magneto-impedance Effect in NiFe Plated Wire
R. S. Beach, C. L. Platt, A. E. Berkowitz

Linear Signal Analysis of Shielded AMR and Spin Valve Heads
H. Neal Bertram

Micromagnetic and Experimental Studies of CoPtCr Bicrystal Thin Film Media
Qingzhi Peng, H. Neal Bertram, Mary Doerner, Steve Lambert, Mohammed Mirzamaani,
Nina Fussing, and David Margulies

Effect of Interface Dispersion of Hysteresis in Hard Magnet Pinned MR Elements
Eric Champion and H. Neal Bertram

Modeling and Analysis of Overwrite on Thick Particulate Media
Dan Wei, Arnon Friedmann, H. Neal Bertram, and Richard H. Dee

Experimental Study of Single Ferromagnetic Cylinders
Marcos Lederman, Robert O'Barr and Sheldon Schultz

Comparison of Flying Characteristics Between Negative Pressure Airbearing Slider
and Tri-Pad Slider Design Based on Finite Element Simulations
Havard Stenberg, Michael H. Wahl, and Frank E. Talke

Tribological Behavior of Tri-Pad and Two-Rail Sliders
Sai S. Varanasi, Frank E. Talke, Cary Chee, Shashi Agrawal, and Ramesh Yadava

Investigation of Slider Take-Off Velocity for Proximity Recording
Thomas C. McMillan, Robin C. Swain, and Frank E. Talke

Non-Quasicatastrophic Trellis Codes for the Dicode Channel
Thomas Mittleholzer, Peter McEwen, Shrish Altekar, and Jack K. Wolf

All pass Forward Equalizer For DFE
Peter McEwen and John G. Kenney

New Staff Member
Marcia Levitt

Marcia Levitt is the newest addition to the CMRR staff, joining us 1 October 1994. Marcia has been a UCSD employee since 1987 and came to CMRR from the Center for Molecular Genetics. She is secretary for Professors Ami Berkowitz and Frank Talke's research groups and has already proven herself to be a valuable asset. In her off hours, Marcia loves to cook and try new recipes (which is always welcome at CMRR). Other interests include playing with her cats, Tootsie and Katya, puttering in her garden and taking walks on the beach with her husband, Don. Marcia says that the only difficulty she has encountered at CMRR so far is that the CMRR building is an exact mirror image of the CMG building, where she used to work, and she keeps getting turned around.

CALENDAR

Future Conferences 1995

This section includes forthcoming conferences, meetings, symposia, special courses, etc., of interest to the recording industry.

Apr. 17–21 Materials Research Society, spring meeting, San Francisco, Calif.
For info: Materials Research Socety, Suite 327, 9800 McKnight Rd., Pittsburgh, Pa.
For info: (412) 367-3003; Fax: (412) 367-4373

Apr. 18–21 International Conference on Magnetics, (Intermag '95), San Antonio, Tex.
For info: Diane Suiters, Courtesy Associates, Washington, D.C.,
(202) 639-5088; Fax: (202) 347-6109

Apr. 24–27 Comdex Spring Meeting, Atlanta, Ga.
For info: The Interface Group, (617) 449-6600

Apr. 25–26 Workshop "Tape Media II—The Ultimate Limits," University of Alabama, Tuscaloosa, Ala.
For info: Prof. Doyle/Prof. Fujiwara, (205) 348-2507; Fax: (205) 348-2346; email: dsnow@risc.ua.edu

May 11 IDEMA Quarterly Dinner Meeting, San Jose, Calif.
Speaker: Barbara Grant, VP, IBM
For info: IDEMA, (408) 720-9352

June 18–21 International Conference on Communication, (ICC '95), Seattle, Wash.
For info: Michael Lupton, U. S. West Communication, 1005 17th St., Denver, CO

June 20–21 THIC (Tape Head Interface Committee) meeting, Denver, Colo.
For info: Jim Miller, Metrum,
(303) 773-4633; Fax: (303) 773-4909

July 10–14 TMRC '95. (The Magnetic Recording Conference), Pittsburgh, Pa.
Carnegie Mellon University
For info: Mark Kryder, CMU, (412) 268-3513

July 17–19 6th International Conference on Magnetic Recording Media (MRM), Oxford, U.K.
For info: The Institute of Physics, London, 44 71 235 6111; Fax: 44 71 823 1051; email: IOPCONF@ULCC.AC.UK

Sept. 4–8 European Magnetic Materials and Applications Conference (EMMA '95) Wien, Austria
For info: +43 1 586 31 91;
Fax or email: emma95@email.tuwien.ac.at

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