

ESD

Demonstrations

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Outline

1. ESD and Magnetic Recording

- ◆ Past, Present and Future

2. Demonstration Technology

- ◆ Digital video

3. Demonstrations

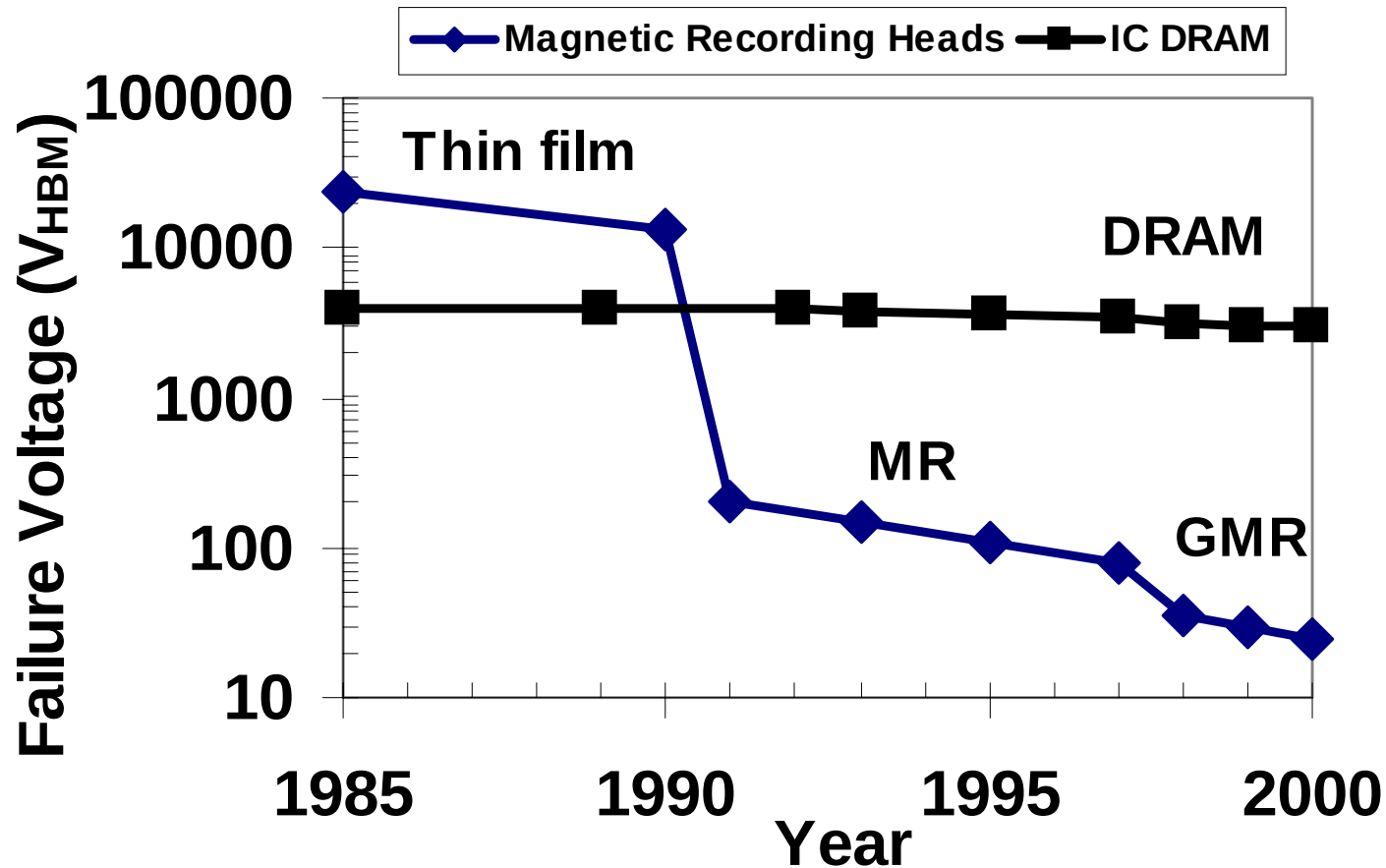
Tribocharging

Induction charging

Unbalanced ionizers

EMI

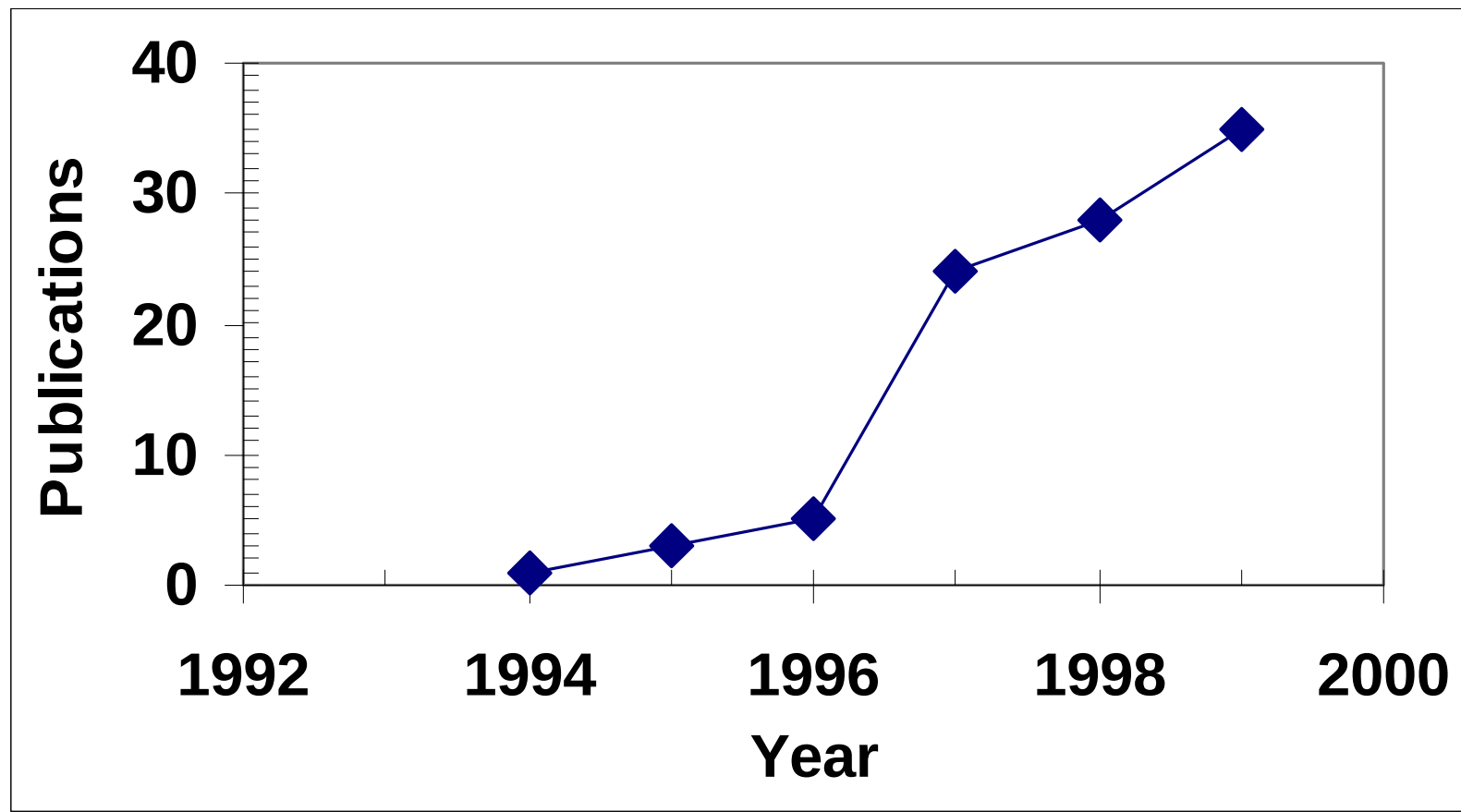
ESD Past, Present and Future



Magnetoresistive recording head is much more ESD sensitive than IC DRAM devices

ESD Past, Present and Future

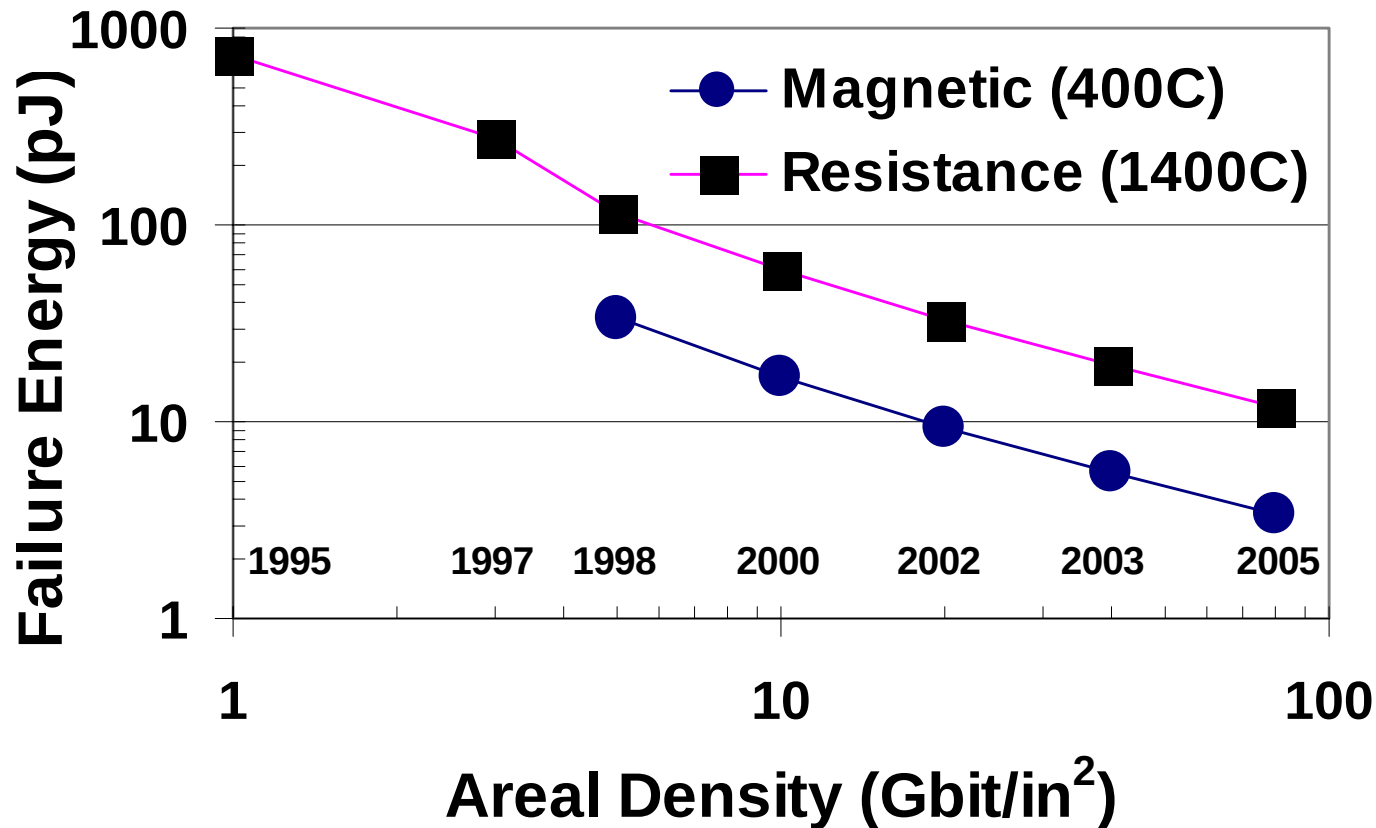
Number of magnetic recording and ESD-related papers vs. time



ESD Past, Present and Future

Sensor volume is scaled down as area density goes up
Failure energy $\sim$ volume

$$Q = \rho_m V C_V \Delta T$$



Demonstration Technology

- Multimedia Projector and laptop
 - Display PowerPoint; run any other application (SPICE)
- LabView + Analog-to-Digital Converter and DMM cards
 - Analog output: Monroe 284 NanoCoulombMeter and Trek 520
 - Display charge and voltage on laptop screen
- Digital video camera**
 - Show close-up of live demonstration
 - Pre-recorded digital video clips of ESD demos
 - Can't carry everything on long trip (e.g. scope)
 - full control of clip: **pause, slow motion, editing**

Matrix trailer

Triboelectric Charging

- Almost every serious ESD problem will have ***tribocharging*** as the root cause!
- When you rub two materials together, electrons or ions are transferred
 - one material acquires a - charge, the other is +
 - called triboelectric charging or tribocharging
- Triboelectric series *tends* to indicate the polarity and degree of charging

Positive +

Acetate

Glass

Quartz

Nylon

Wool

Silk

Aluminum

Polyester

Paper

Cotton

Steel

Ni, Cu, Ag

Zinc

Rubber

Acrylic

Foam

Vinyl (PVC)

Mylar

Teflon

Negative -

Measuring Charge and Voltage

Charge: NanoCoulombMeter

- Faraday Cup for insulators and conductors
- direct contact probe for conductors only
 - Monroe 284 Portable, straightforward



Faraday cup
for insulators

Voltage

- Noncontact electrostatic voltmeter
- Trek 520



Contact probe
for conductors

Teflon

Triboelectric Video Clips

Teflon

Acrylic

Induced potential on floating 20 pF metal plate

Latex glove

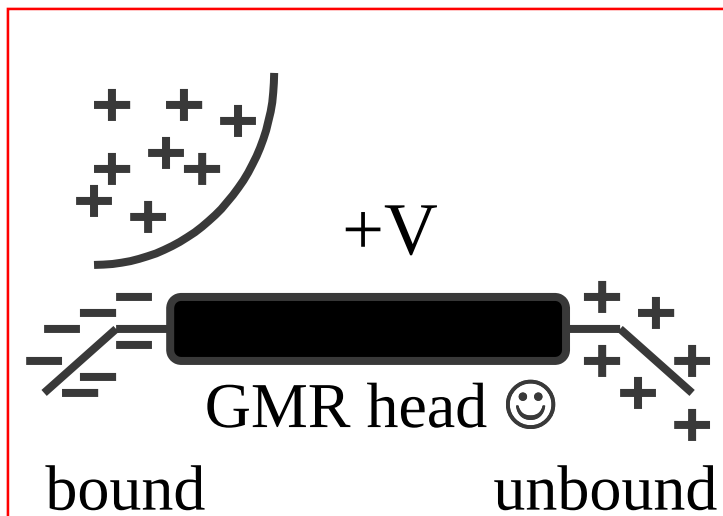
Pulling foam tape on metal plate

Magnifying glass

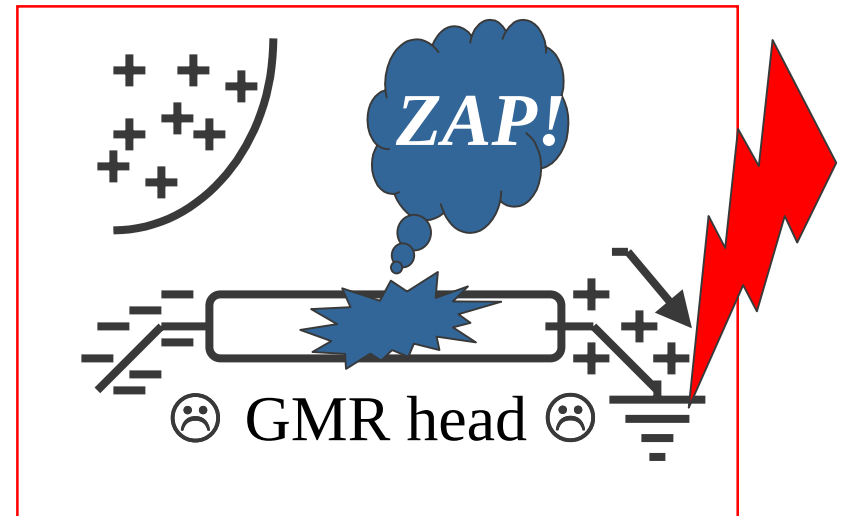
Dust off (live)

Induction Charging and ESD

- Uncharged GMR head near a charged source
- Charge in GMR head is polarized and has a potential V
- “Egg” is raised high
- No damage yet (unless field is very strong)

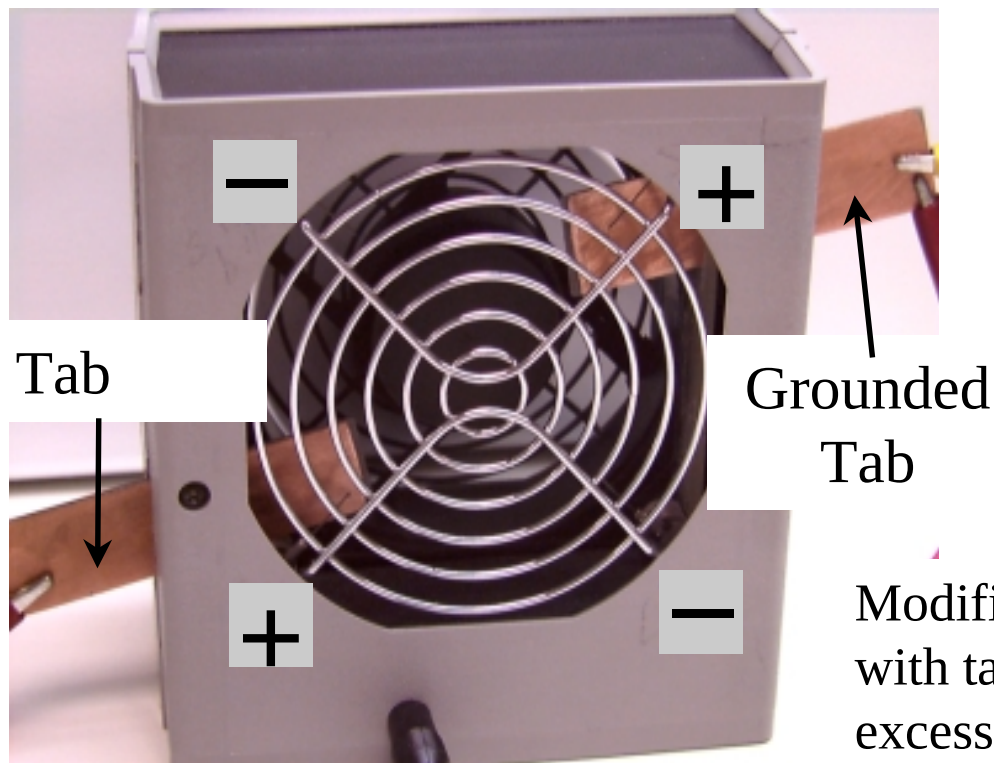


- Ground one GMR input terminal: metal contact
- Current transient as $V \rightarrow 0$
- “Egg is dropped: splat!
- *No direct contact between charged object and GMR head*



Unbalanced Ionizer Demo

- Ionizer modified with movable grounded, metal tabs
- Tabs intercept charged air ions
- Position of tabs controls degree of imbalance

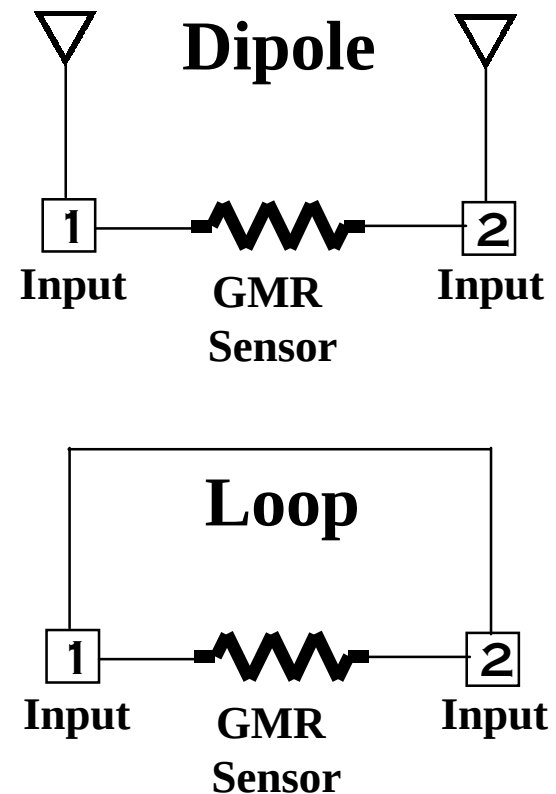


•Measure voltage on a floating 20 pF metal plate using Trek 520 and electrical ionizer with metal tabs in various positions

Modified ionizer shown with tabs set to produce excess negative charge

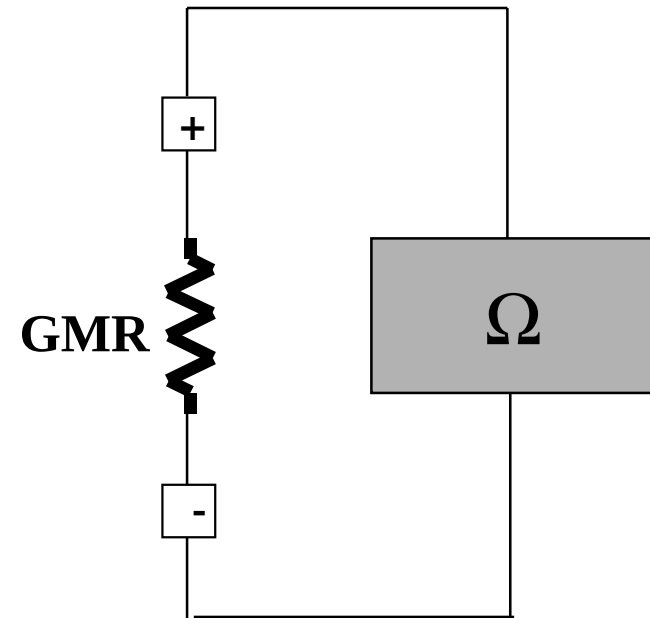
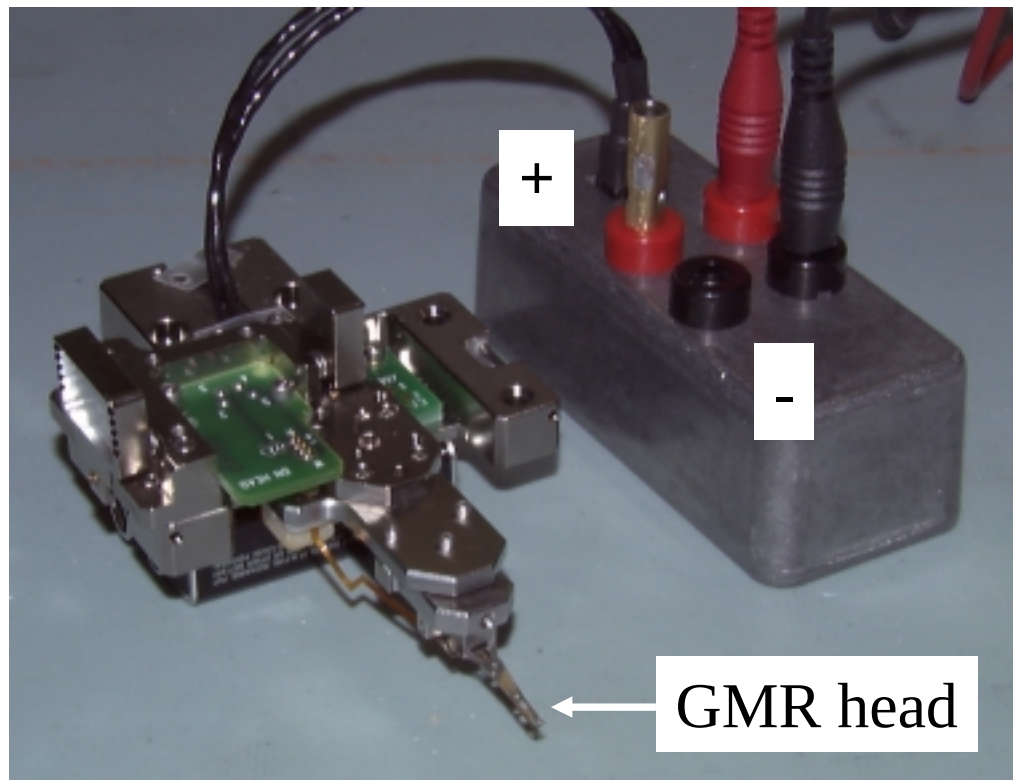
EMI concern with GMR heads

- ◆ ESD causes radiated electromagnetic fields that can induce current in a nearby wire
- ◆ GMR heads can be damaged by current
- ◆ **GMR heads with wires attached can be damaged by the current induced by the radiated fields from a remote ESD event, an electrical fast transient (EFT), motor or relay.**
- ◆ Generally need long wires (> 6 inches)



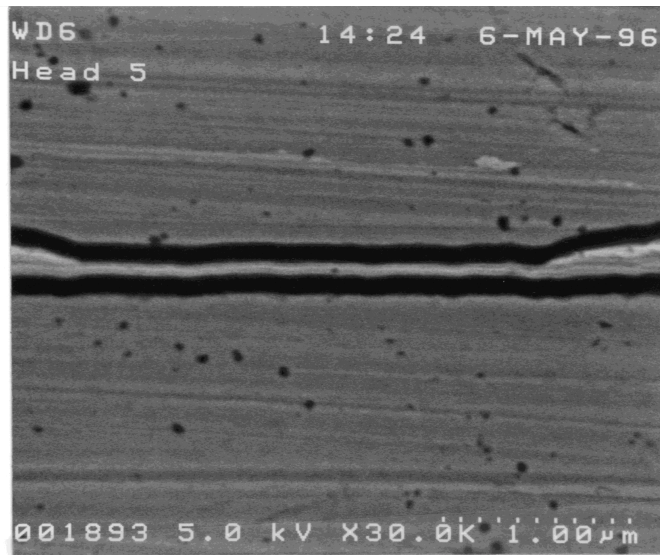
GMR head demonstration

- Laptop with ohm meter (PCMCIA card)
- Fixture to hold and make electrical contact to GMR head
- Allows measurement of head resistance during ESD and EMI

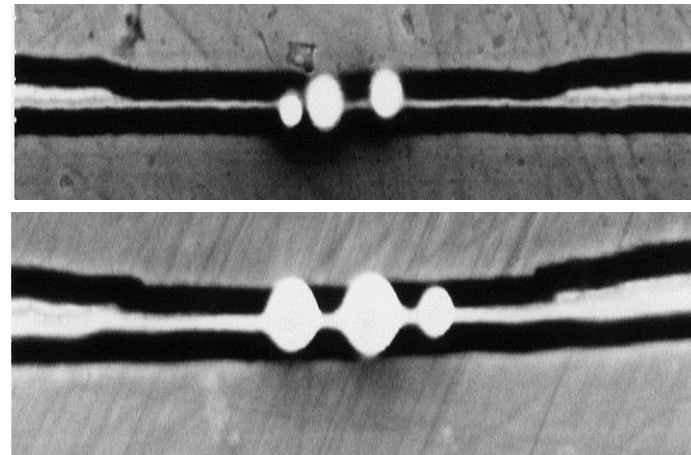


Don't lose your HEAD over ESD!

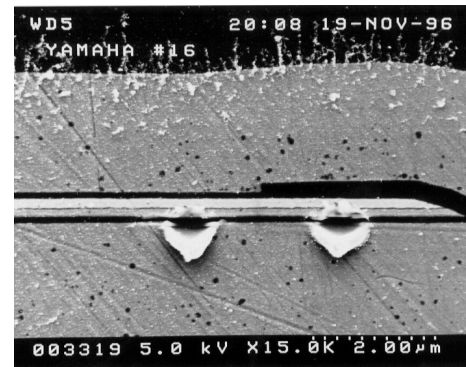
This is your GMR head....



This is your GMR head
after ESD or EMI....



Any questions?



IDEMA ESD Education

Overview of ESD in magnetic recording

- Many hands-on ESD demos with class participation
- New digital video clips of other ESD demos
- Developed and taught by Al Wallash (www.wallash.com)

When and Where

- Wednesday, February 15, 2000: 8:00am-12:00
- IDEMA headquarters in Santa Clara, CA
- Register to reserve your seat
 - » http://www.idema.org/edu/edu_c_esd.html

Conclusions

Aids to effective ESD demonstrations

- Laptop with data acquisition can display charge, voltage and resistance
- Advances in digital video technology can be used to enhance ESD education
 - camera helps all to see demos on table
 - pre-recorded digital video clips are efficient and can be edited and played back with precise control
