

# Investigation of Acoustic Localization of rf Cavity Breakdown

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# Can we learn more about NLC rf cavity breakdown through acoustic signatures of breakdown events?

1. Who is participating
2. What we're doing
3. What we want/need

# Who is participating

At UIUC (“UC” = Urbana-Champaign):

George Gollin (professor, physics)

Mike Haney (engineer, runs HEP electronics group)

Bill O’Brien (professor, EE)

Joe Calvey (UIUC undergraduate physics major)

Michael Davidsaver (UIUC undergraduate physics major)

Rachel Hillmer (UIUC undergraduate physics major)

At SLAC:

Marc Ross

# Who is participating

Haney's PhD is in ultrasound imaging techniques

O'Brien's group pursues a broad range of acoustic sensing/imaging projects in biological, mechanical,... systems

Gollin is clueless, but enthusiastic.

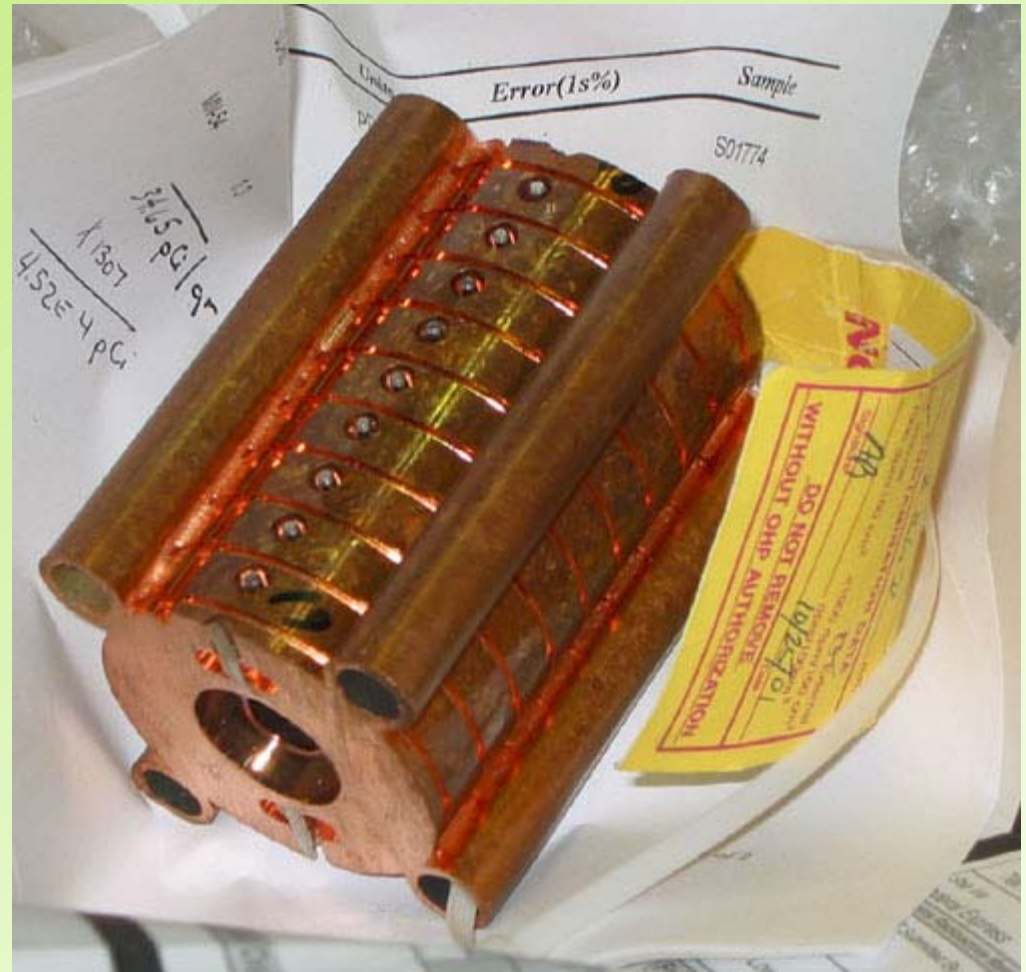
Ross is our contact at SLAC and participates in related work taking place there.

# What we're doing

Work is just starting in Gollin's lab.

Ross sent us a short piece of NLC and some engineering drawings specifying the geometry.

O'Brien has lent us a couple of 2.2 MHz transducers and associated circuitry.



# What we're doing

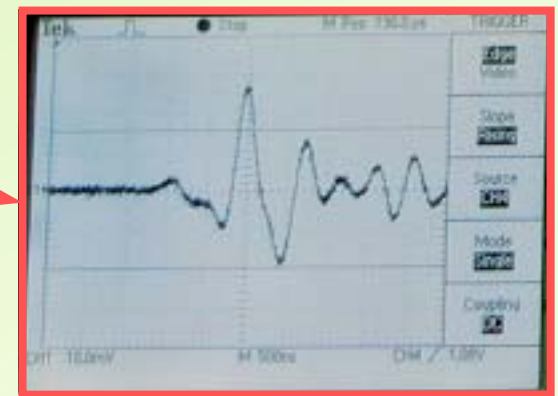
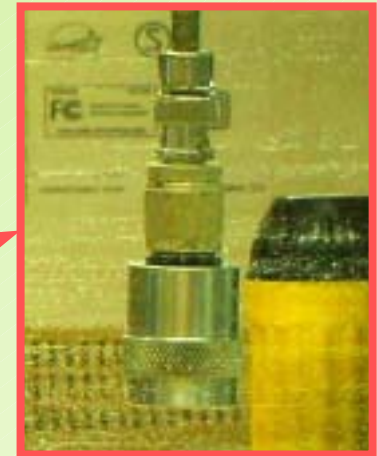
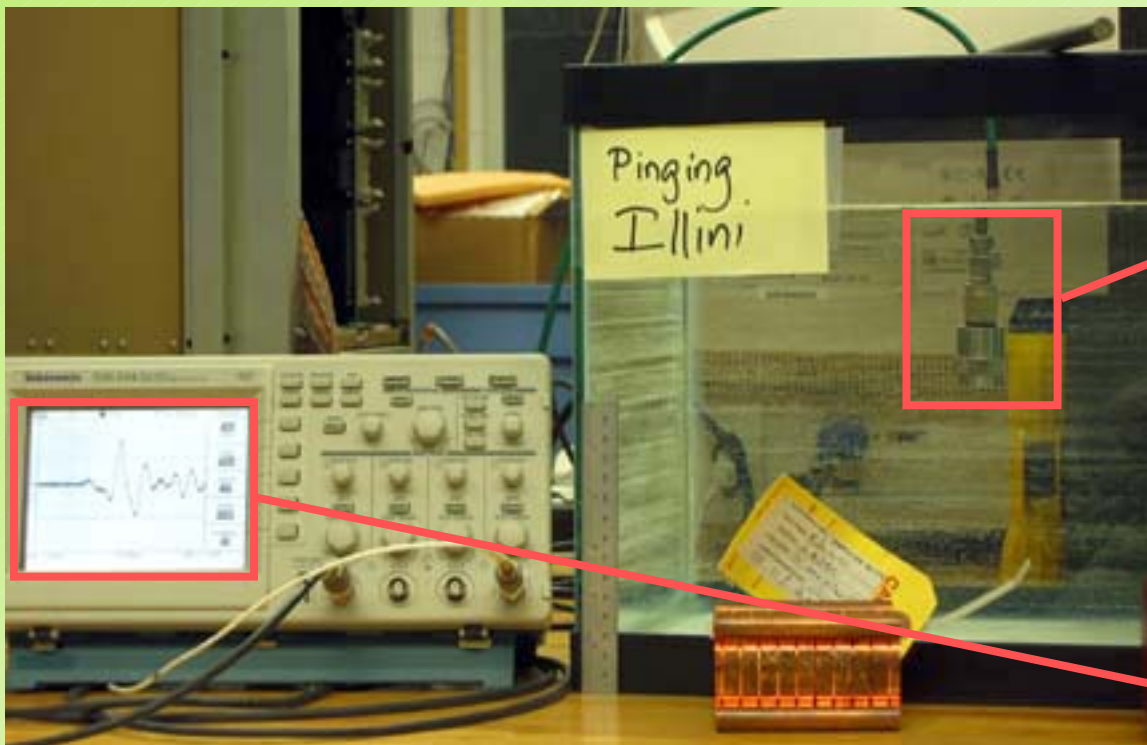
Initial investigations are entirely pedagogical: we need to understand the most basic of issues.

- How reproducible is pulse-to-pulse timing and amplitude information?
- How good is single-shot information (in comparison with multiple-pulse averages)?
- Is acoustic noise a concern?
- Can we successfully model the acoustic properties of objects and sensors?
- Can we make use of detailed pulse shape information or only some sort of time-integrated amplitude?



# What we're doing

Very first measurement: where's the bottom of a fish tank?



# What we're doing

## Surprises:

- Single-shot timing information looks very good: easy to locate individual peaks in echo pulse to  $\sim 10$  nsec.
- Pulse-to-pulse reproducibility is also very good.
- Noise is insignificant.

Perhaps detailed analysis of acoustic pulse shape (not just integrated amplitude) will be productive?

In water, 10 nsec  $\sim 15$   $\mu\text{m}$ ; in copper, 10 nsec  $\sim 50$   $\mu\text{m}$ . (Note: reflections or attenuation in NLC structures could make this impossible to achieve.)



# What we're doing

Fancier setup in the works:

- MATLAB for finite-element analysis and modeling of acoustic properties (installed, not yet used to model something simple)
- LABView DAQ will drive transducer pulser and 100 MHz dual channel PCI card digital scope (to be adapted from a system used to test CLEO III analog circuits)

Undergraduates will start working with us in January.

# What we want/need

Plain copper and heat-annealed copper dowels to check acoustic properties (*e.g.* frequency dependence of  $v_s$  and attenuation)

A limited amount of financial support from DOE:

- we need another PC to serve as the MATLAB engine
- small amount of PCI instrumentation for dedicated setup
- salary support for undergraduates

More time! (this is a university-based effort...)

So far this is great fun, BUT: DOE must begin to provide support for university-based LC work.