MICE Cavity Instrumentation

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What's in there?

- Part I: Instrumentation List and Photos
- Part II: Non-Acoustic Instrumentation Signal Data
- Part III: Acoustic Instrumentation Signal Data

Part I

Instrumentation List
and Photos

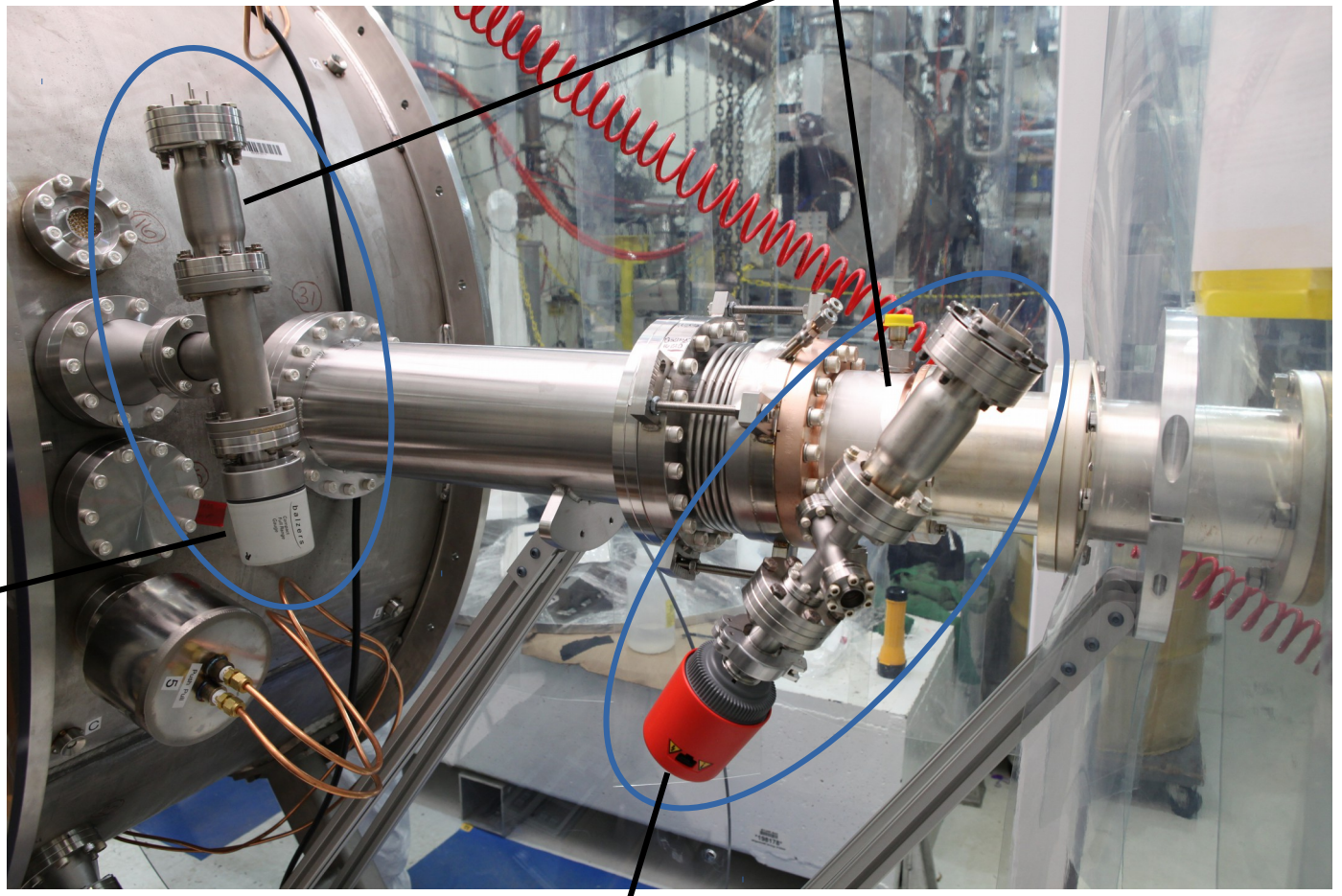
Cooling Water Lines

- Pressure
- Temperature
- Flow rate

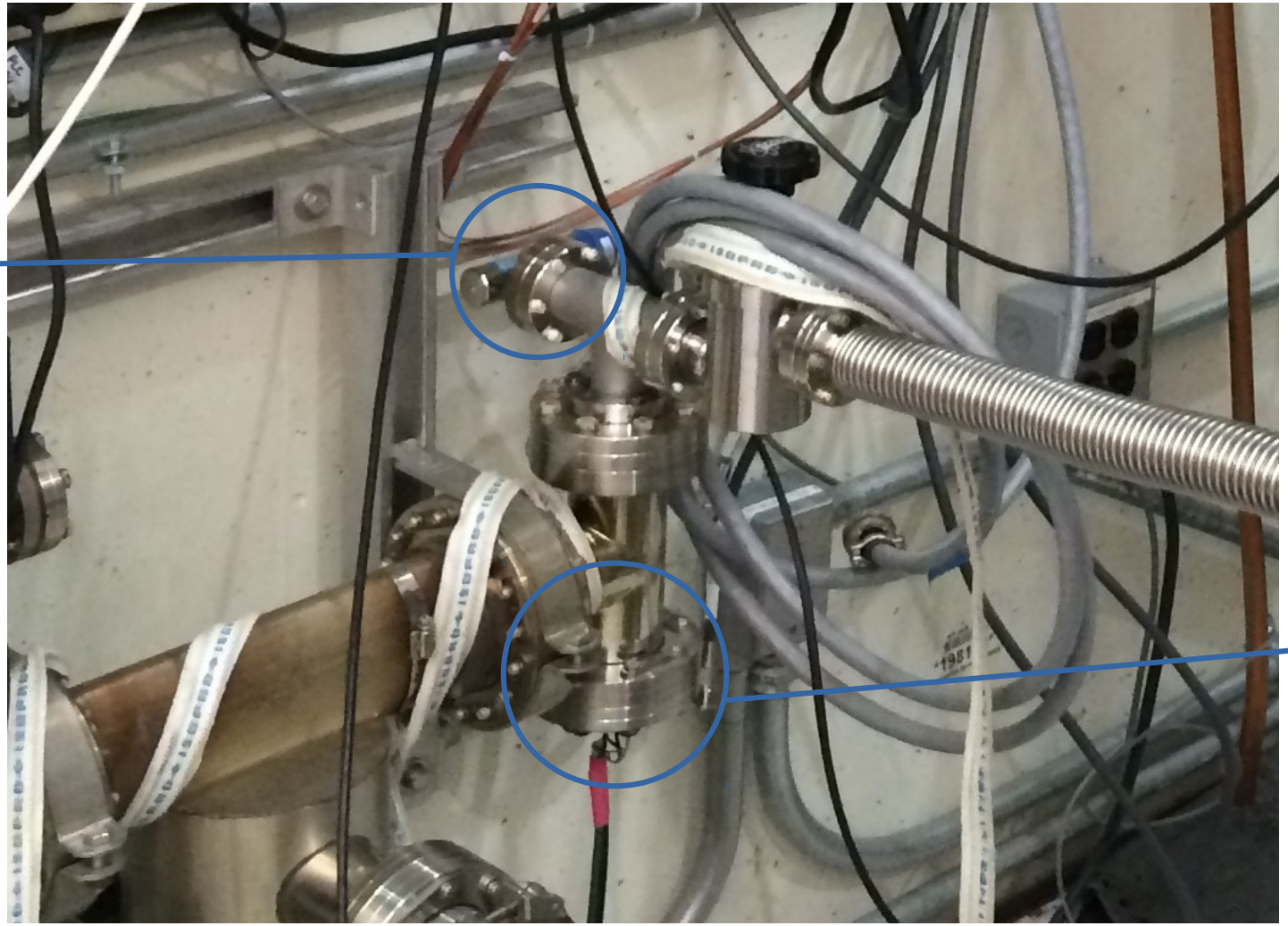
Vacuum

- Hot Cathode Gauge (HCG)
  - Cavity through top hat
  - Cavity at bottom port
  - Vacuum vessel
  - Left and Right RF couplers
  - Wall manifold
- Vessel Full Range Gauge (FRG)
- Left/Right Coupler Cold Cathode Gauges (CCG)
- Wall manifold Pirani gauge

Coupler and Vessel Gauges



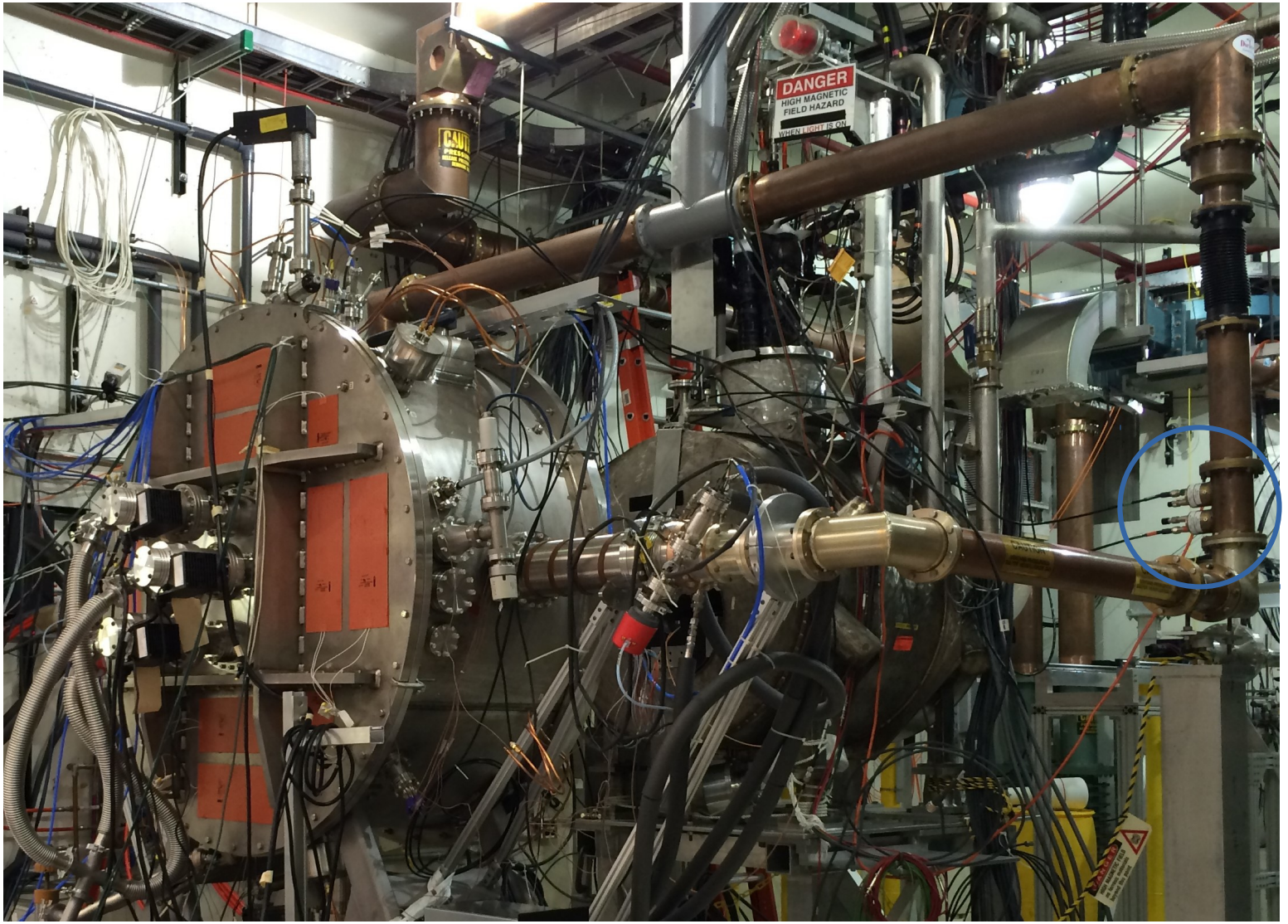
Wall Manifold Gauges



RF System

- Cavity field through top hat.
- Forward/Reflected power on couplers
- Coupler light through view port windows.
- Coupler electron current
- Coax air pressure
- Tuner Push/pull pressure

Coupler RF Pickups

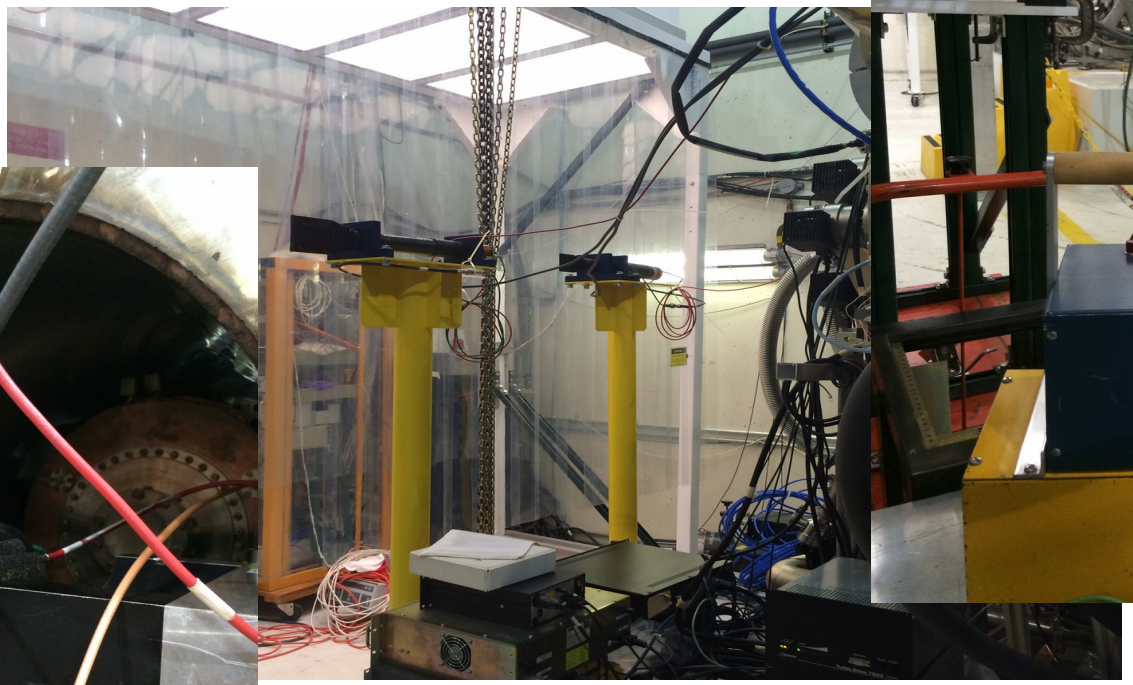


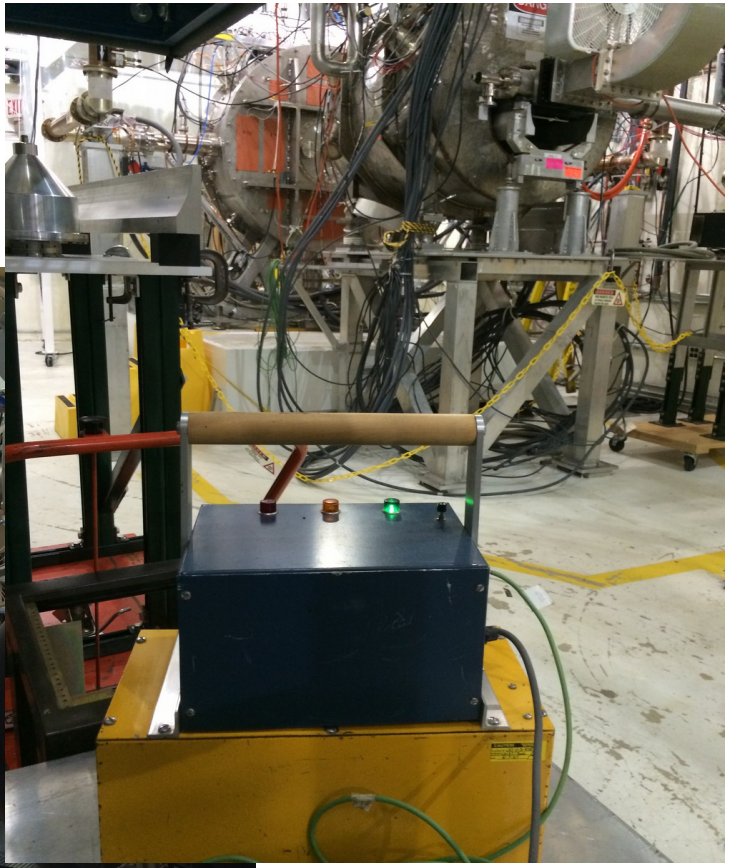
Radiation

- Breakdown light in cavity through top hat.
- Plastic scintillators + PMT (X-ray rate)
- NaI crystal scintillator + PMT (X-ray spectrum)
- “Chipmunk” ionization chamber detector (X-ray dose rate)

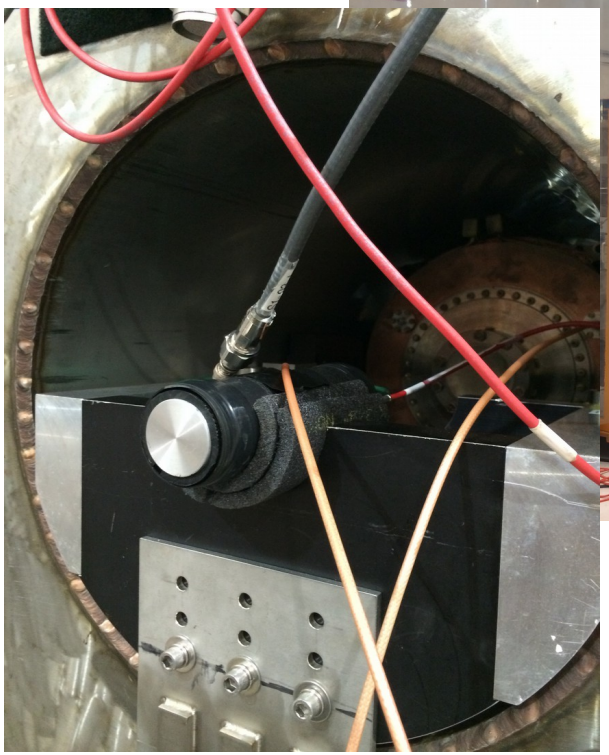
X-Ray Detectors

Plastic Scintillators





NaI Scintillator



“Chipmunk” Ionization Chamber Detector

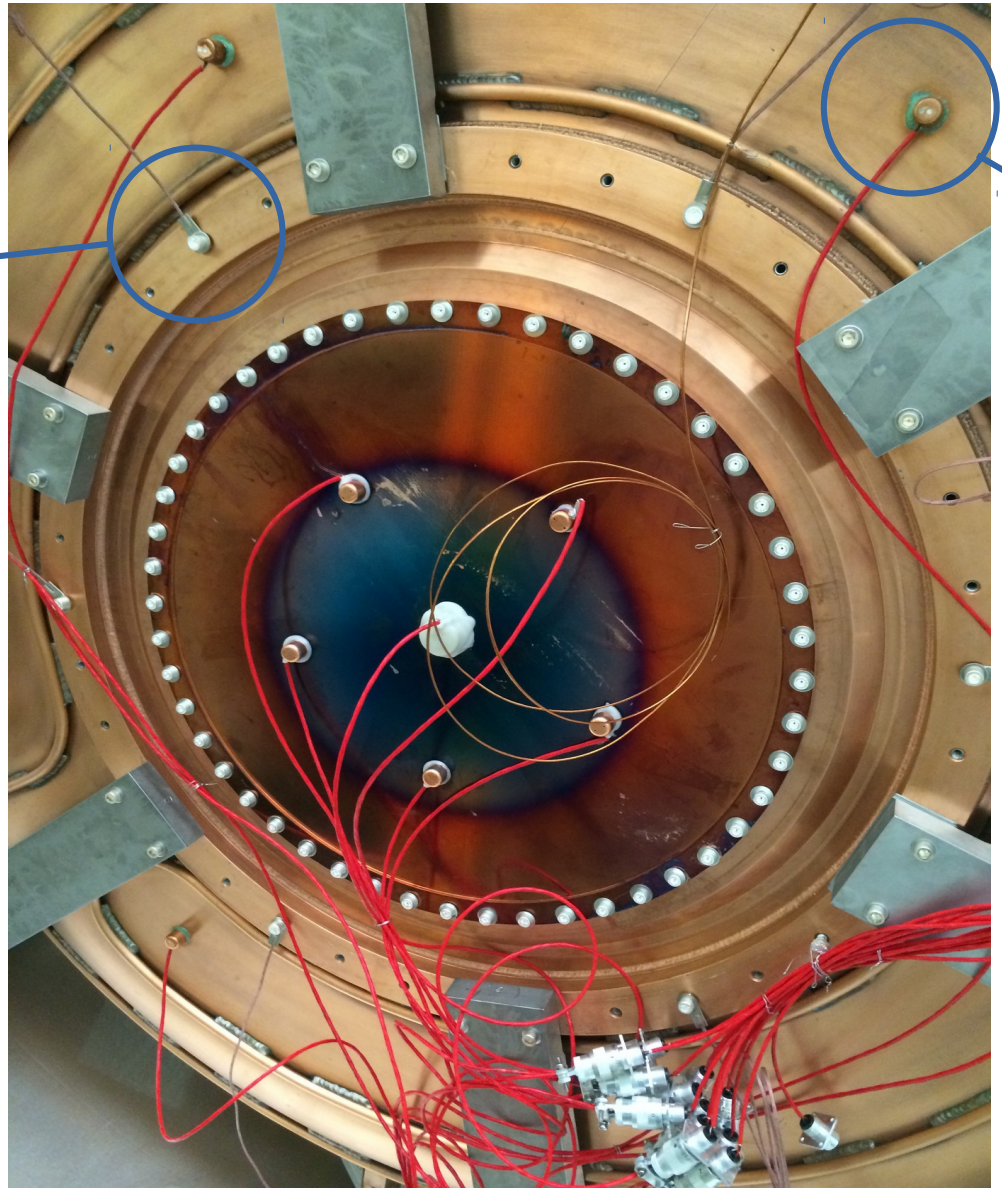
Temperature

- Thermocouples
  - 12 on cavity body
  - 1 on vessel cylinder
  - 2 on cover plates

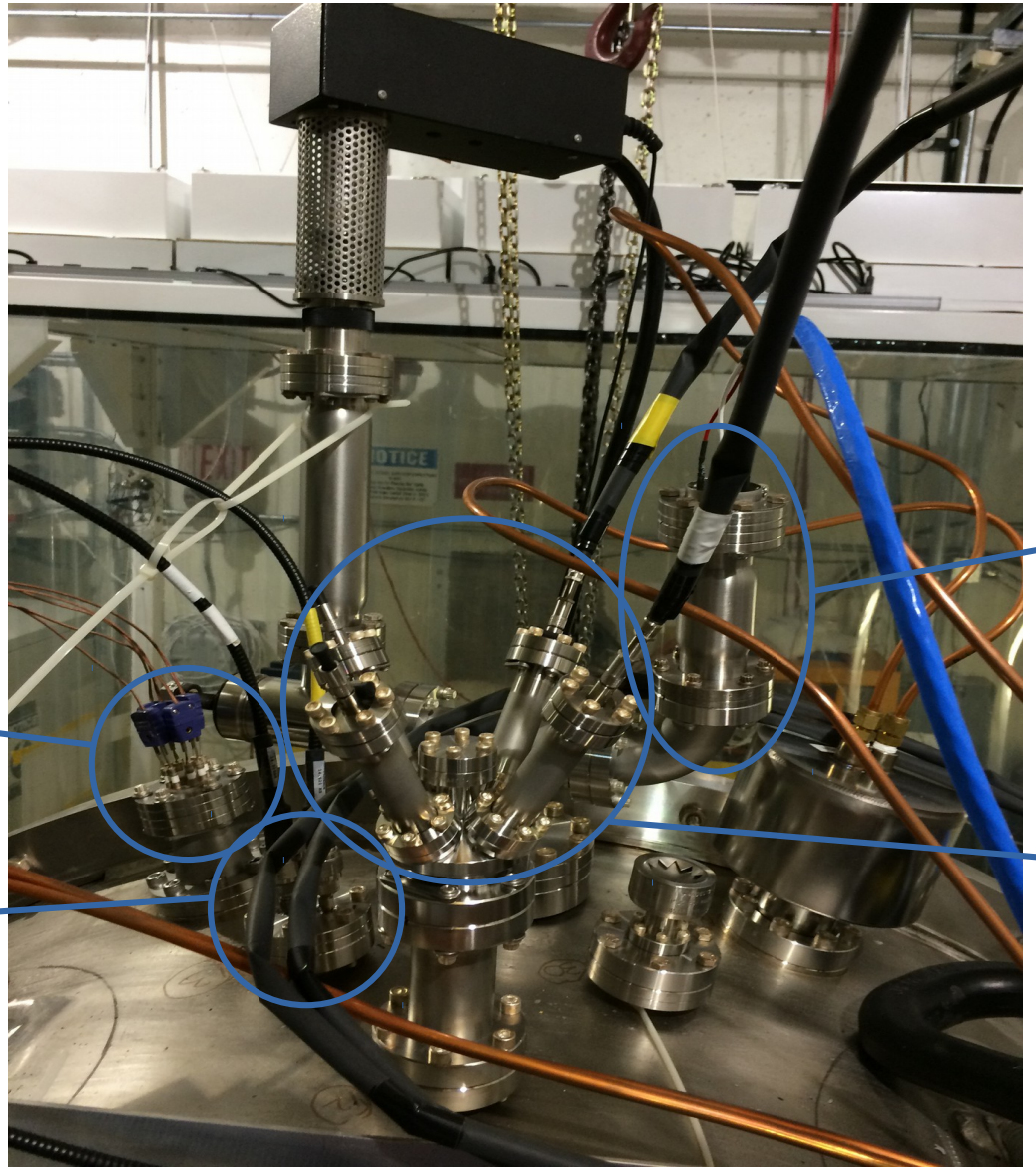
Acoustics

- 24 piezo microphones on cavity body
  - For localization of breakdown.

Cavity Body Instrumentation



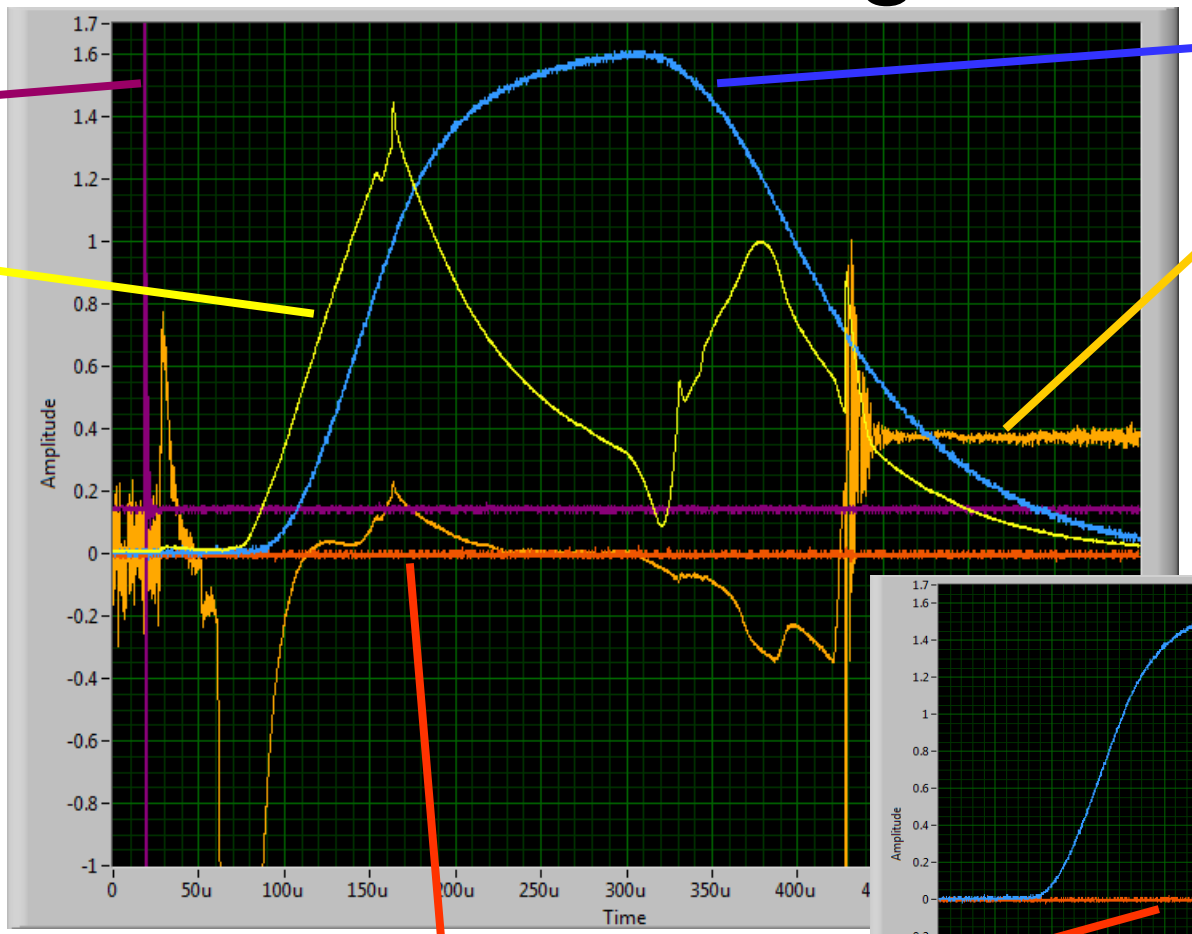
Various Vessel Feed-Throughs

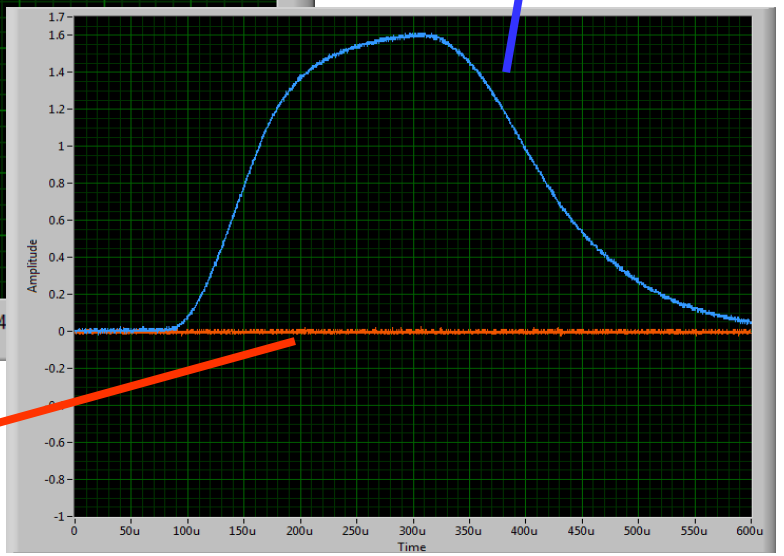


Part II

Non-Acoustic Instrumentation
Signal Data

Normal RF Pulse Control Signals





Trigger

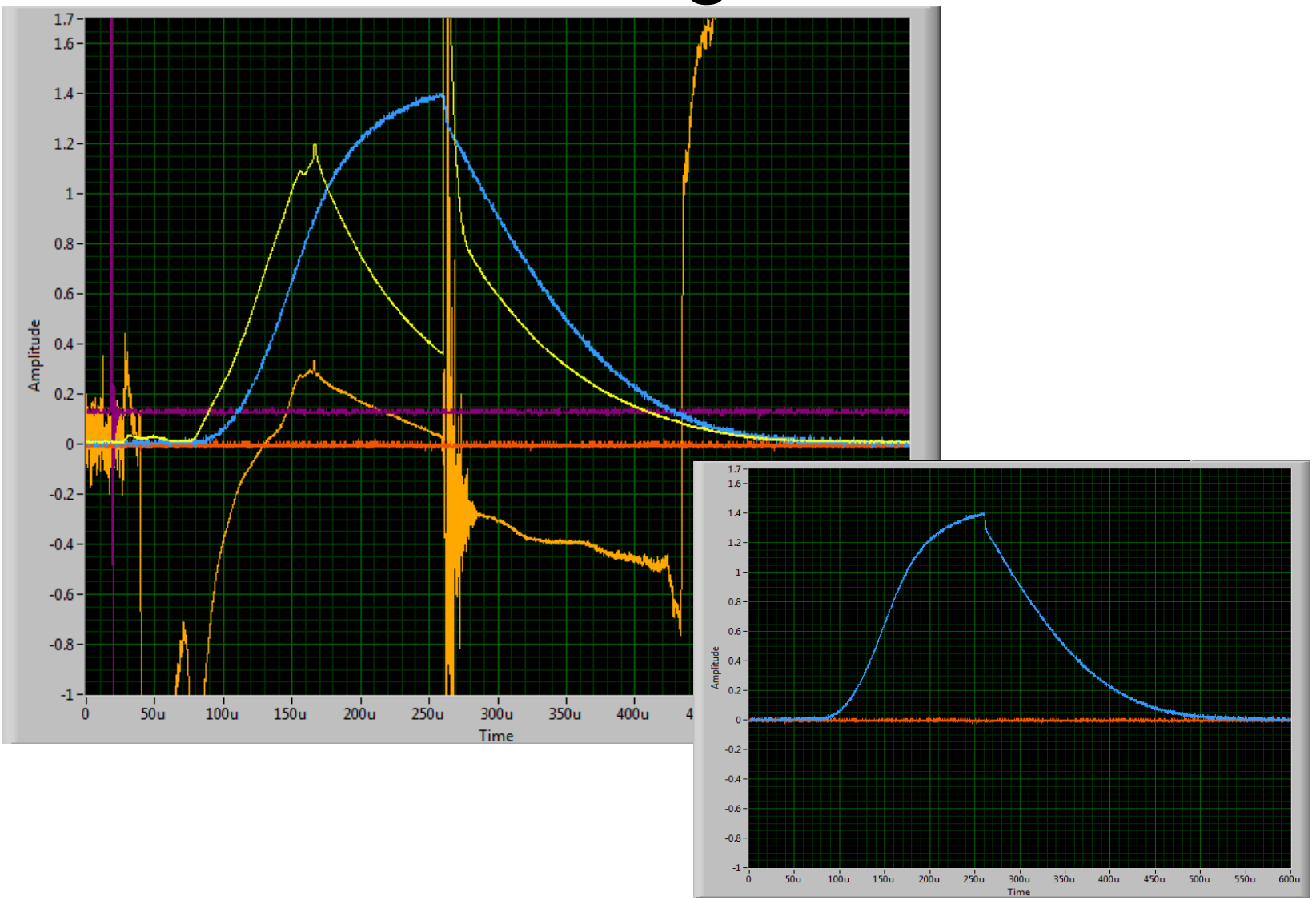
Left Coupler Reflected

Probe Voltage

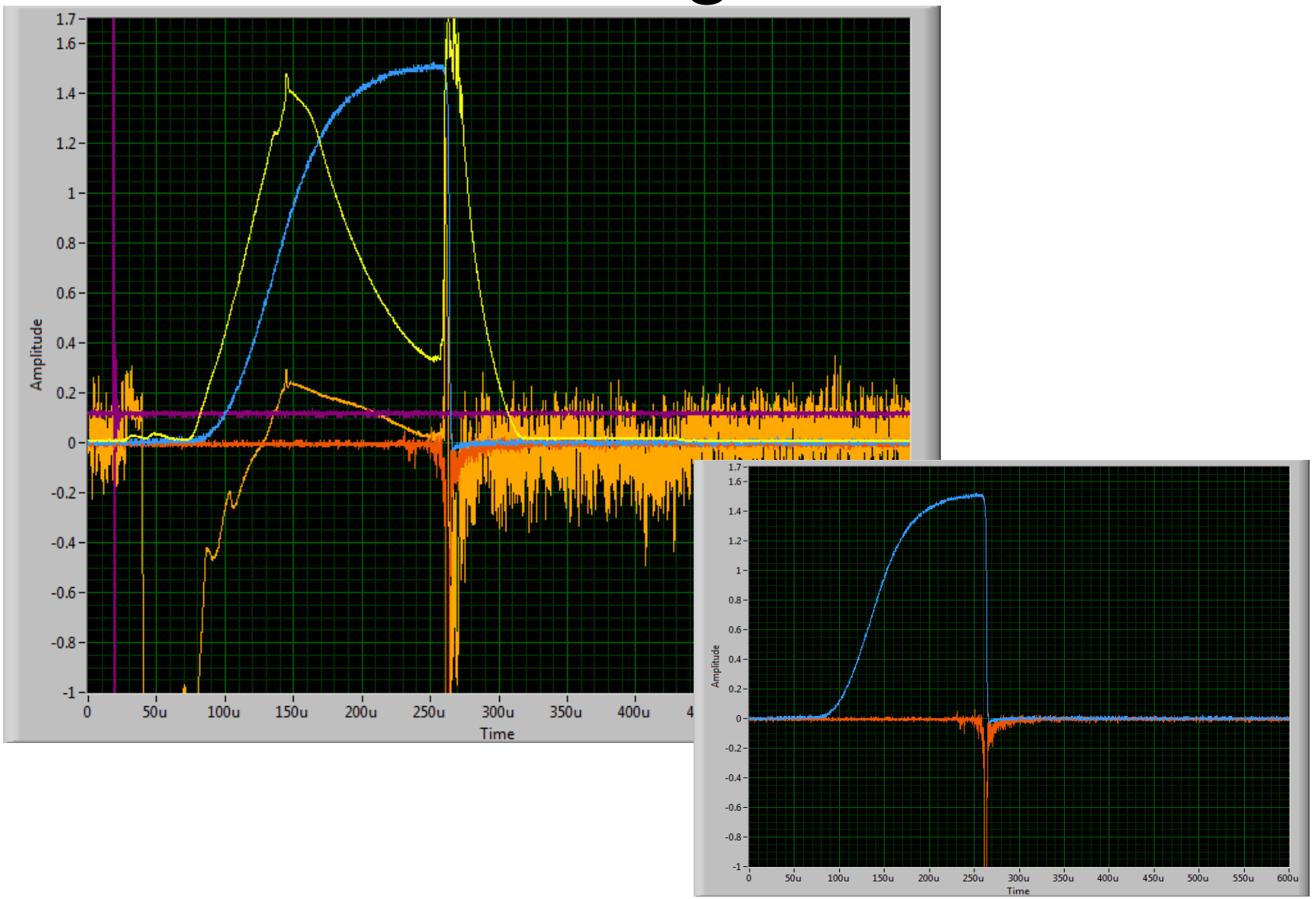
Phase

Cavity Light

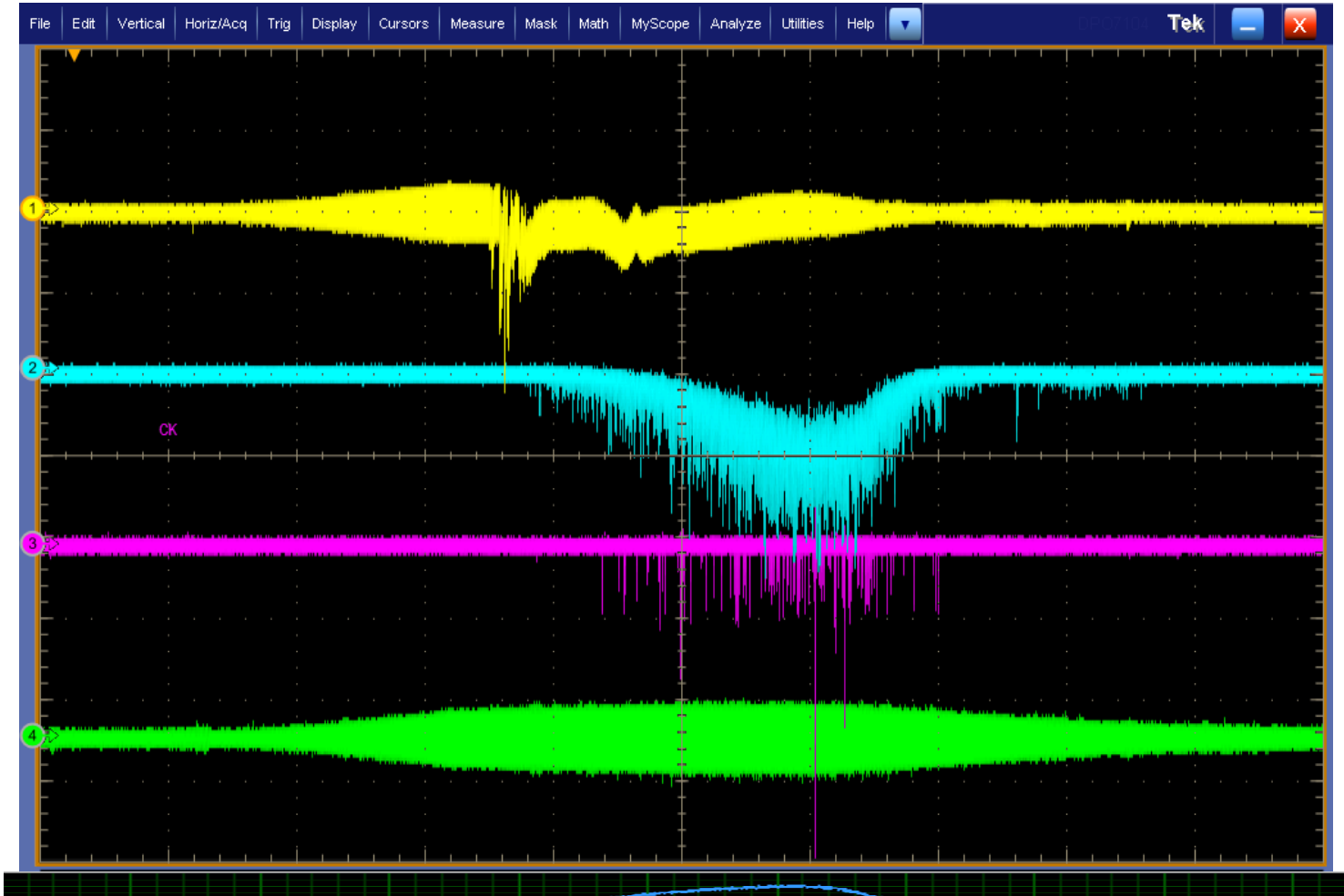
Modulator Trip (False Spark) Control Signals



Cavity Breakdown Control Signals



Normal RF Pulse Radiation



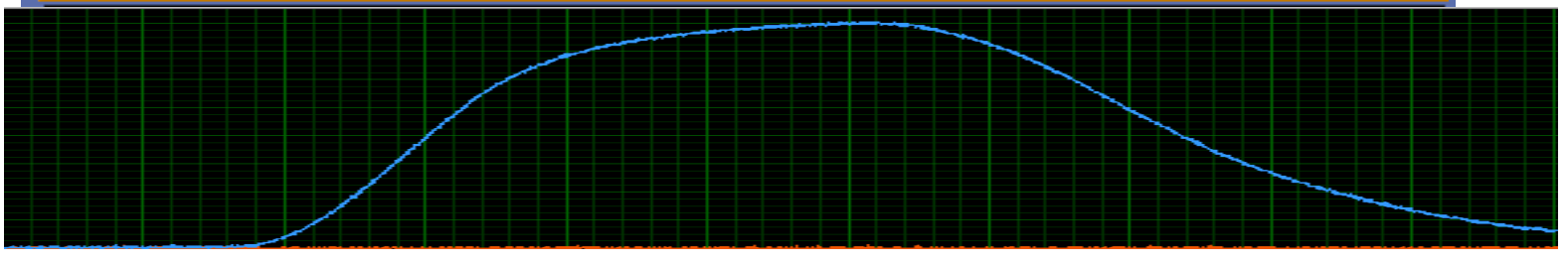
NaI Crystal

Plastic Scintillator Paddle

Cavity Light

Fiber 1

Fiber 2



Probe Voltage

Modulator Trip (False Spark) Radiation

NaI Crystal

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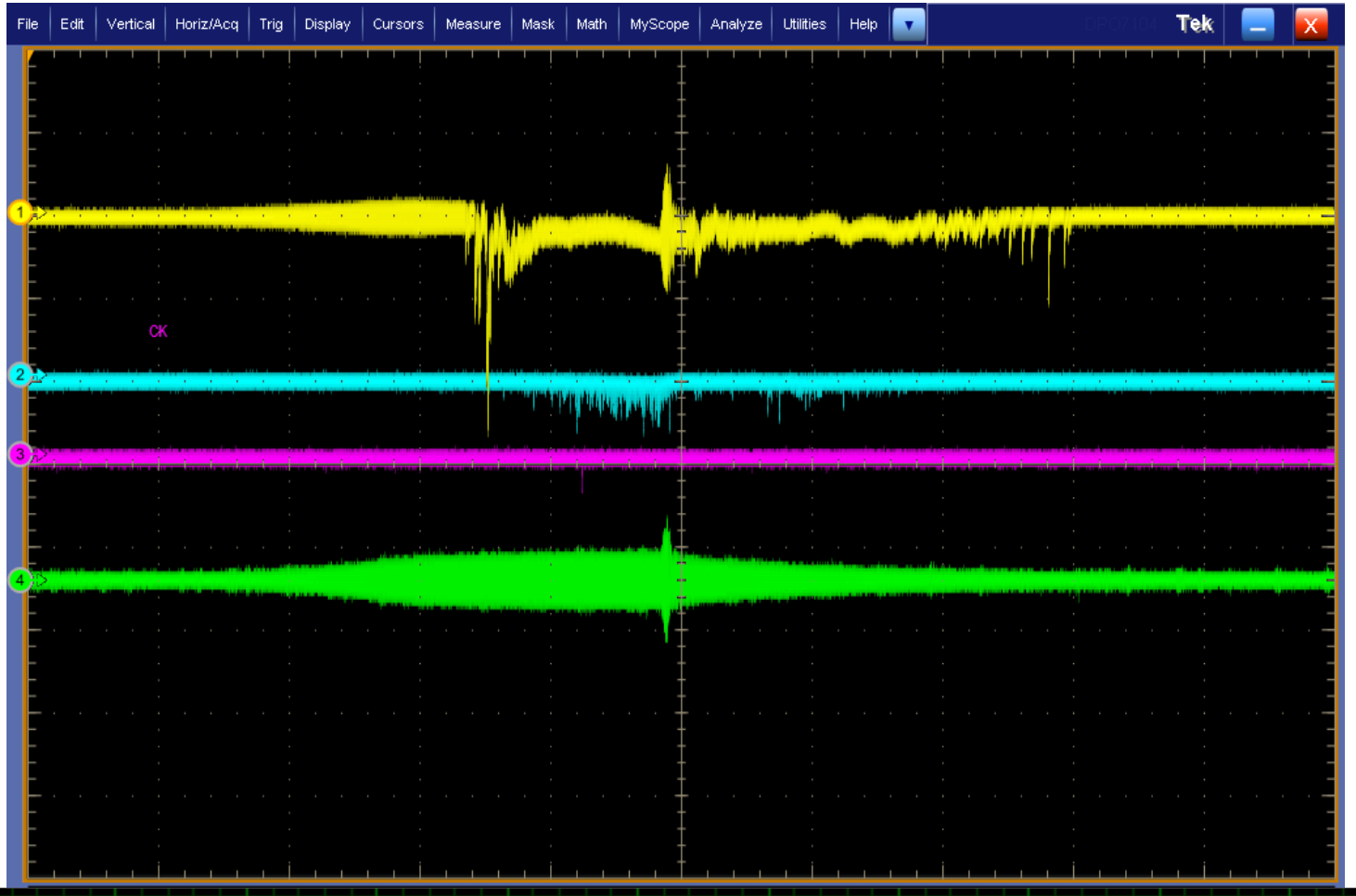
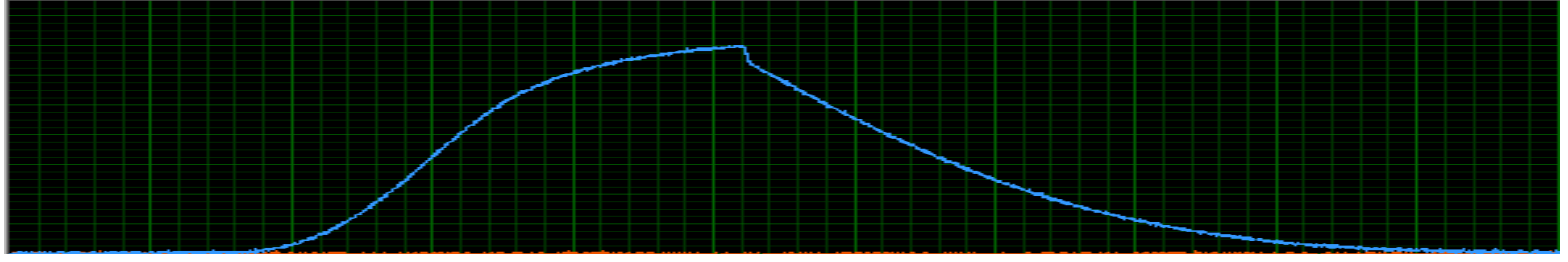
Cavity Light



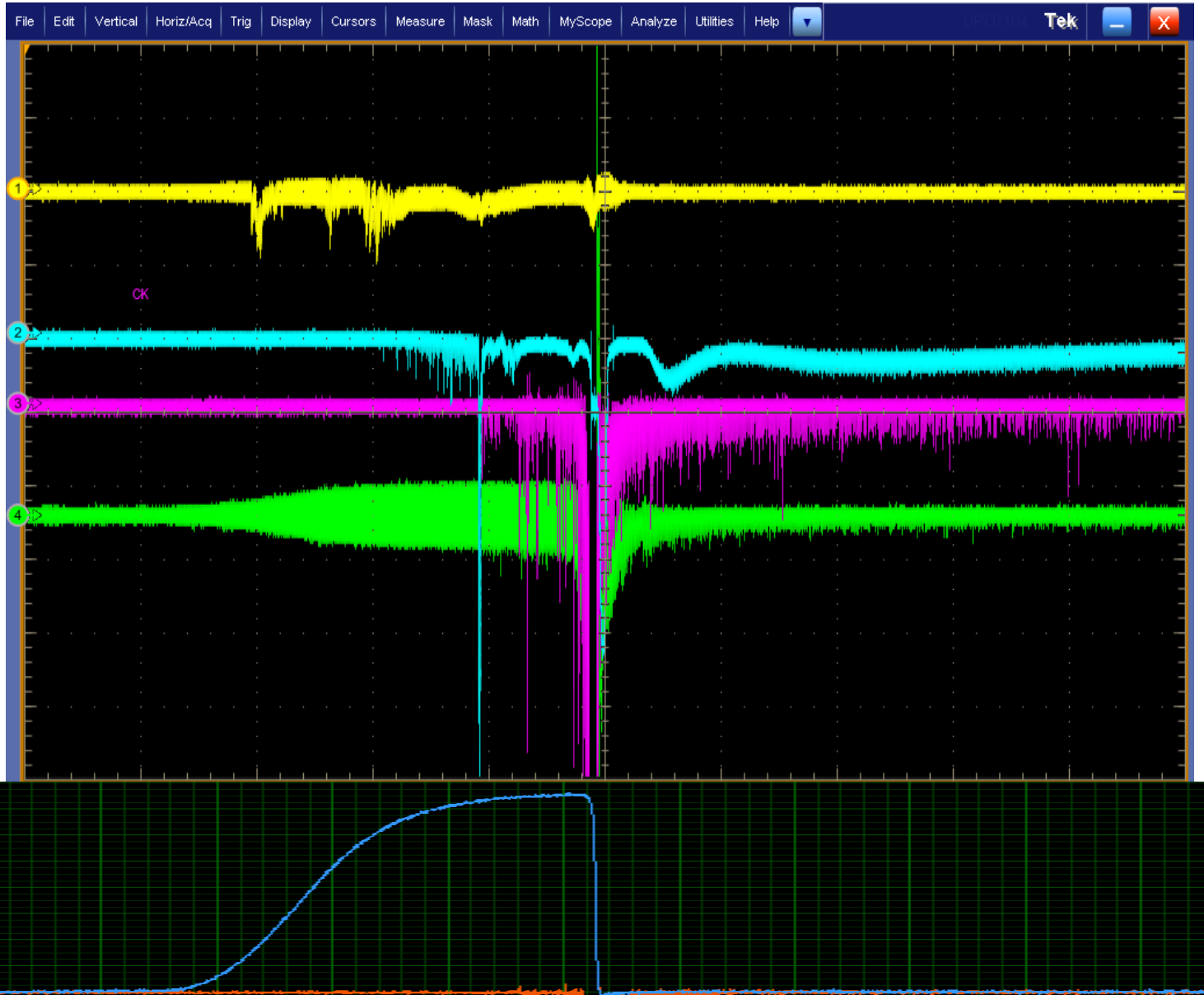
Fiber 1

Fiber 2

Probe Voltage



Cavity Breakdown Radiation



NaI Crystal

Plastic Scintillator Paddle

Cavity Light

Fiber 1

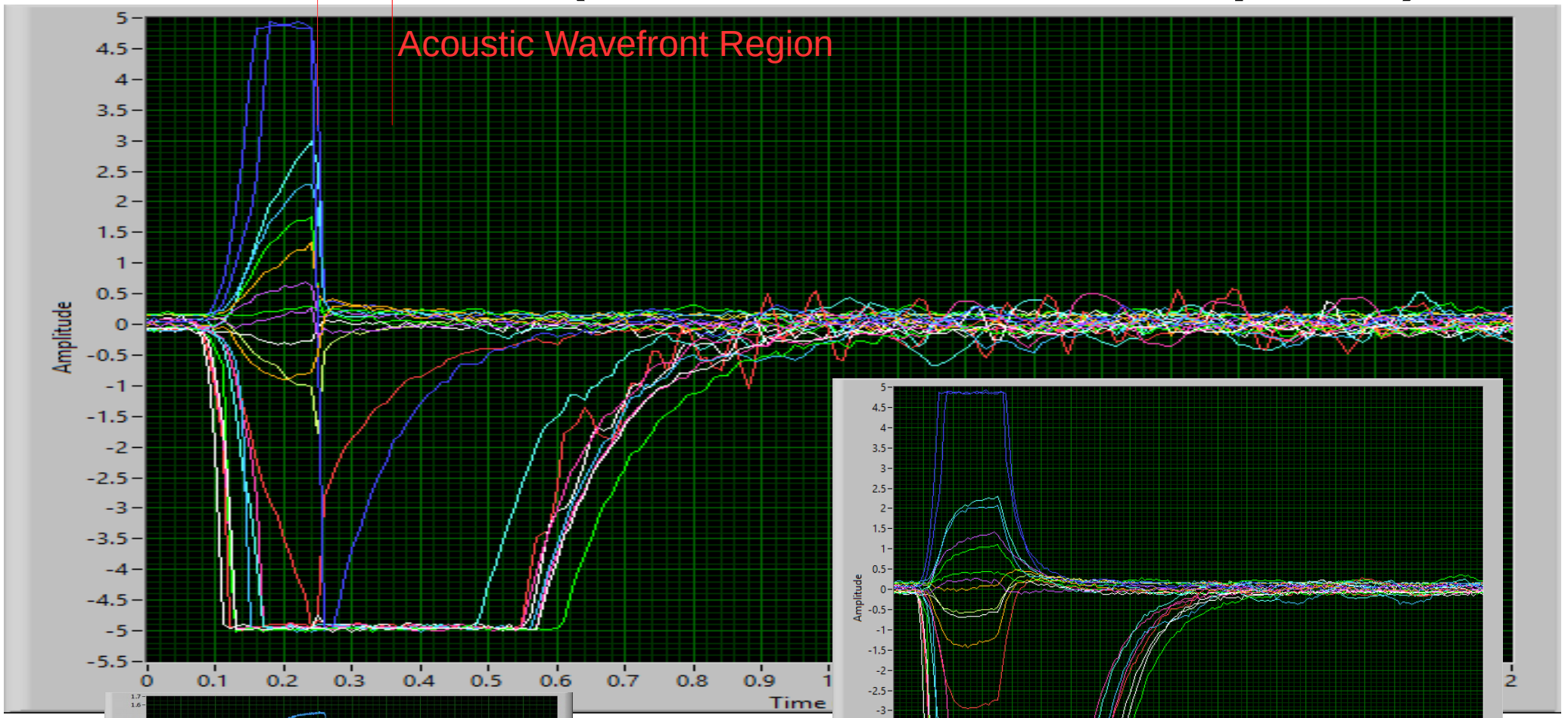
Fiber 2

Probe Voltage

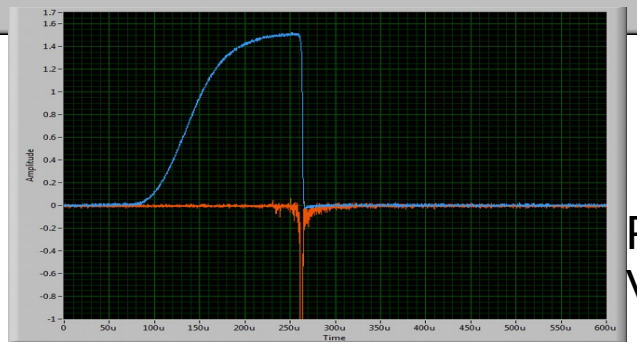
Part III

Acoustic Signal Data

Cavity Breakdown Acoustics (RF Hammer + Spark)



Normal RF Pulse

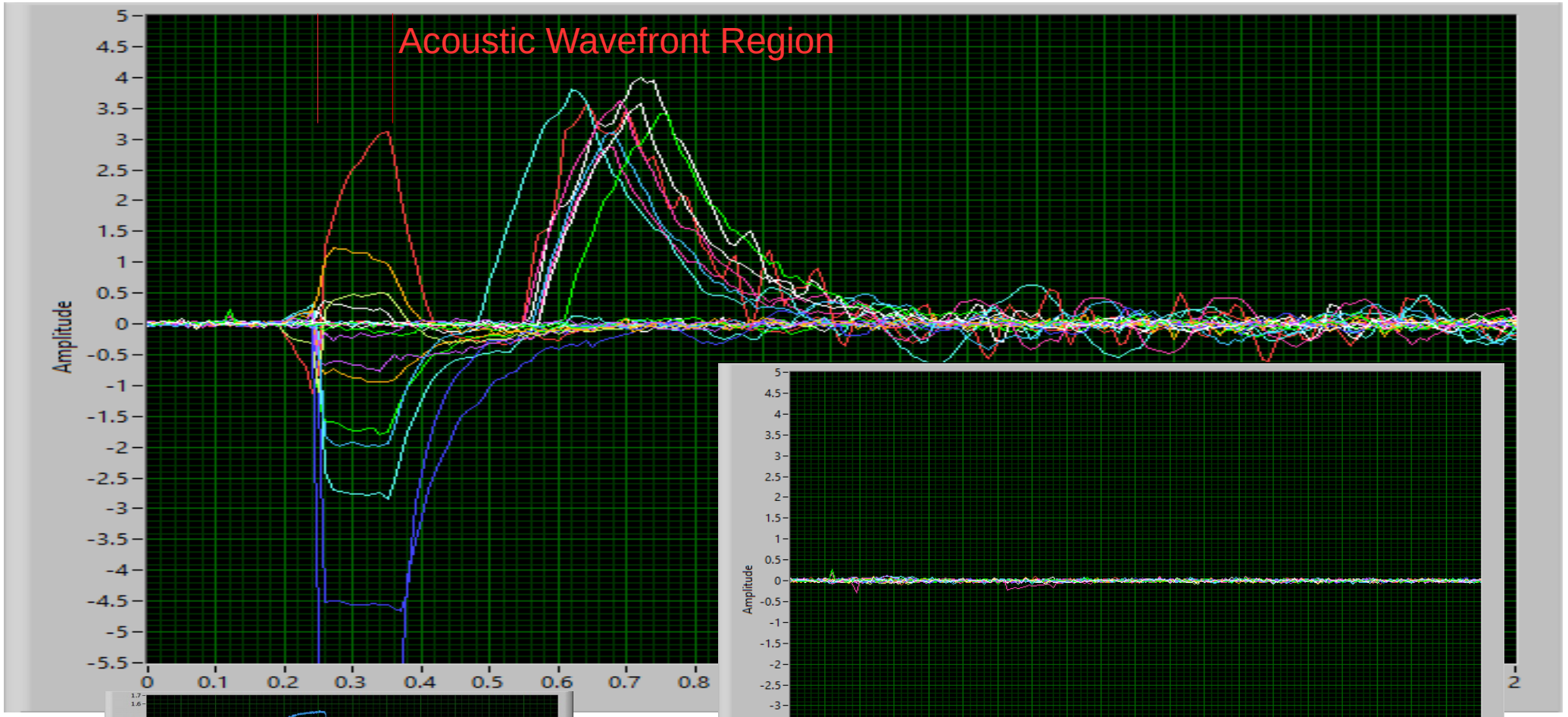


Probe Voltage

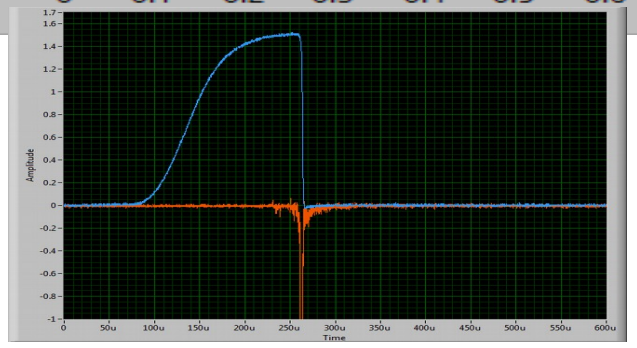
RF Hammer Subtraction

- RF Hammer
  - Normal force on inner cavity walls due to the RF pulse
- Subtraction
  - Compute a rolling average of normal RF pulse signals
  - Subtract from spark signal
- Very effective on HPRF cavity signals, but...
  - HPRF acoustic wavefront is after the end of the RF pulse
    - 10x shorter RF pulse
  - HPRF spark dwarfed RF hammer (opposite case)

Cavity Breakdown Acoustics (Minus RF Hammer)



Normal RF Pulse



Probe Voltage

Making Sense of the Acoustics

- Larger energy capacity should mean louder sparks
  - Verify end-to-end functionality of mics and DAQ
- Test whether large noise is acoustic
  - Leave unadhered microphones in vacuum vessel
- More experience needed
  - Microphones going on the modular cavity soon
  - Will instrument the HPRF cavity again as well