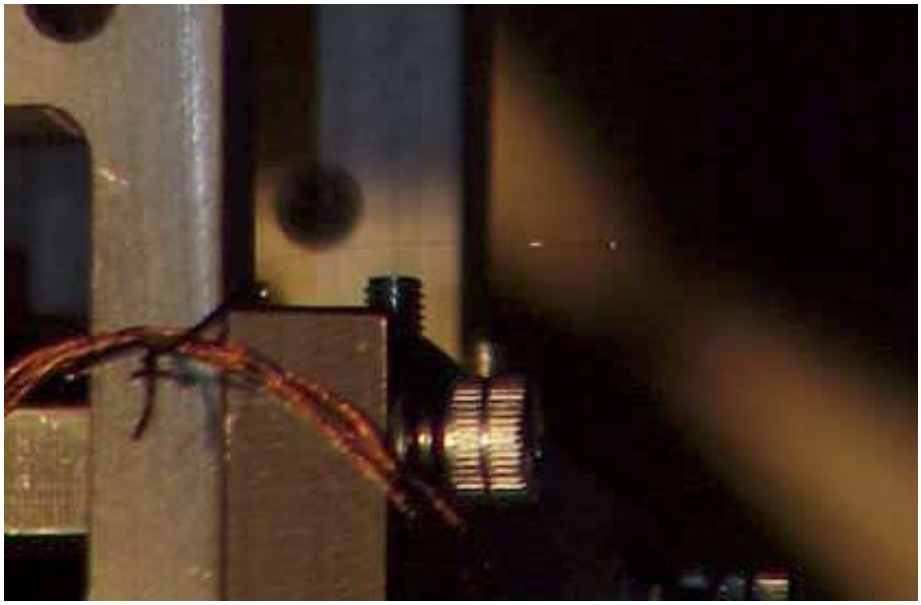
# ENVIRONMENTAL DISTURBANCES (INCLUDING S1 - STOPPERS)

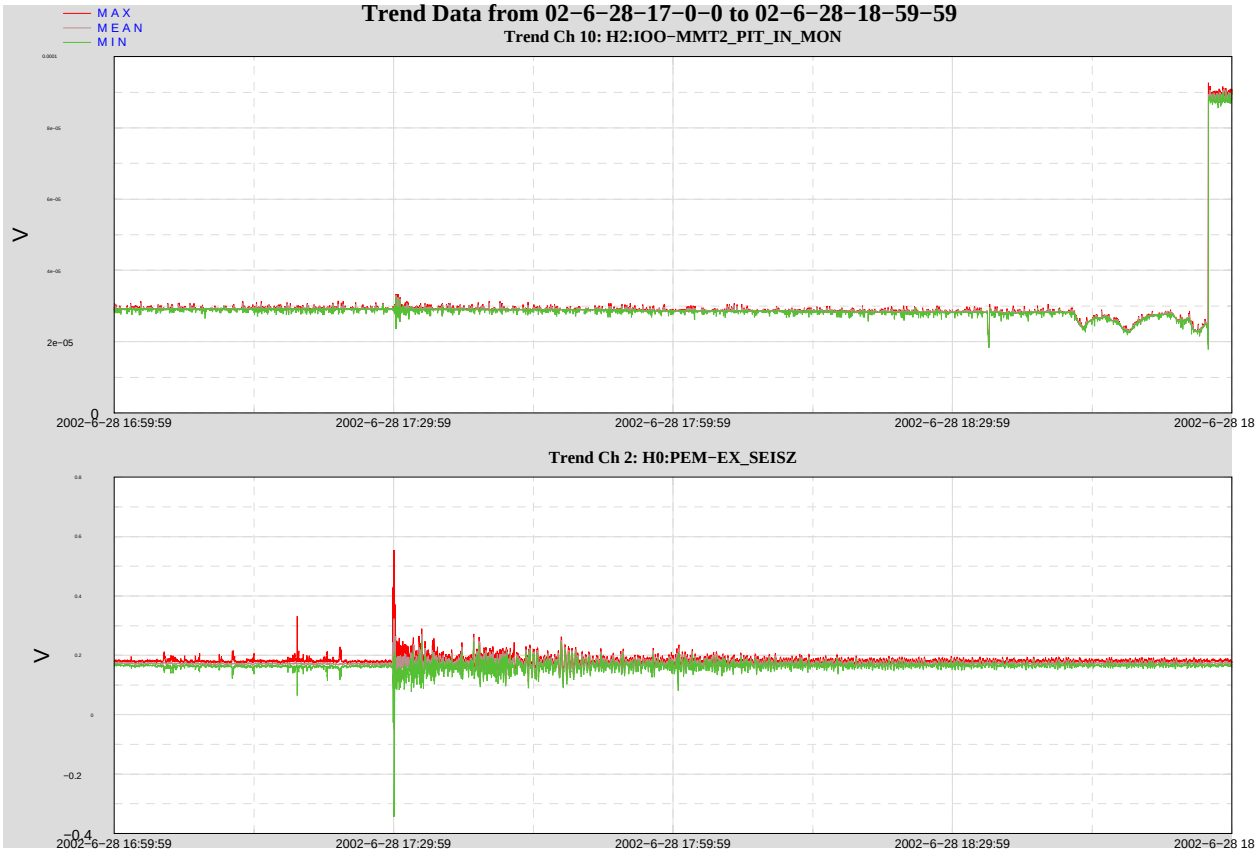


**Robert Schofield (Oregon)**

**E. D'Ambrosio (CIT), D. Cook (LHO), R. Drever (CIT), V. Sannibale (CIT), B. Bland (LHO)**

# Final Two Hours of MMT2 Suspension

## Top: MMT2 Pitch; Bottom: EX seismometer




**Quake** **Yaw Bias Drift** **Drop**

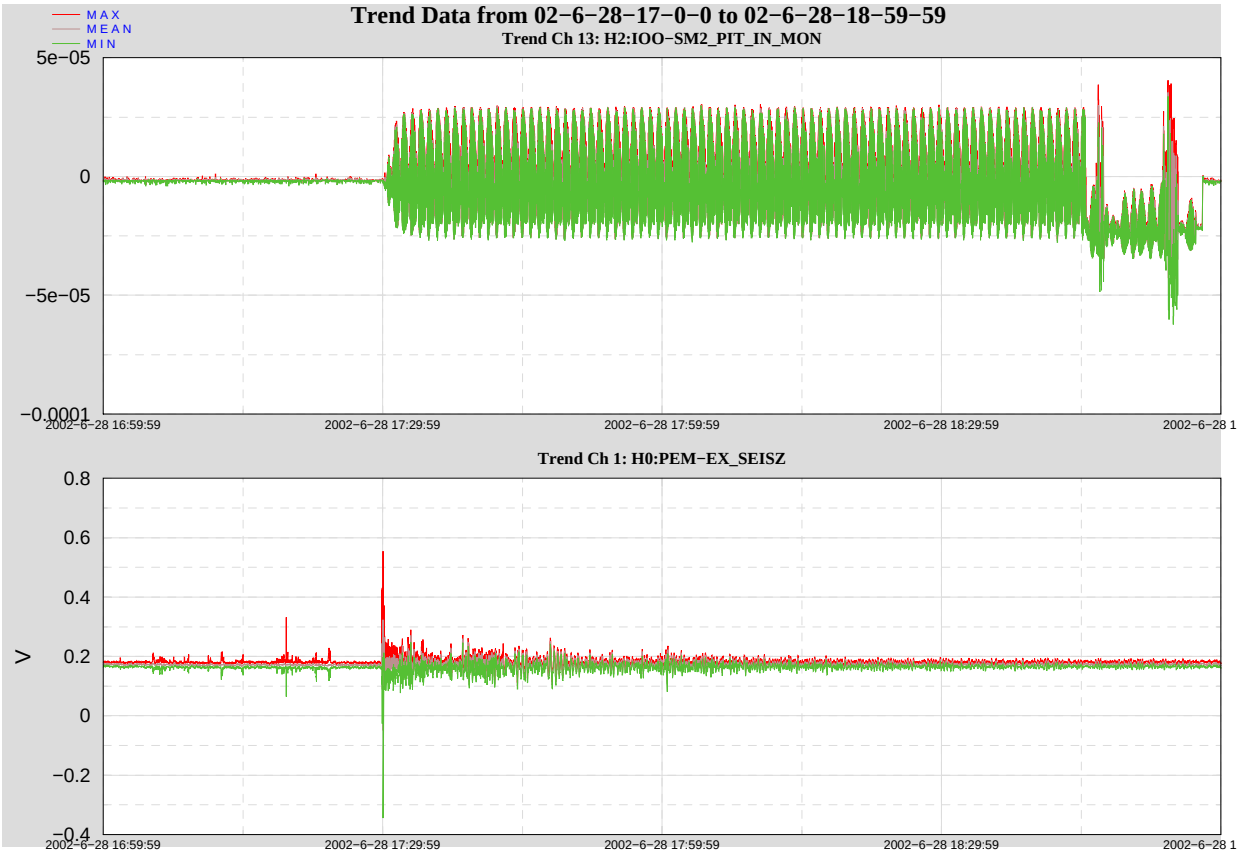
**Optic recovered from Russian-Chinese quake.**

**Also, nearby optic MC2 was steady during final motions of MMT2: any mechanical jolt would shake both**

# Quake Rings Up SM2

## Same time period as shown previously for MMT2 pitch

## Top: SM2 pitch; bottom: EX seismometer

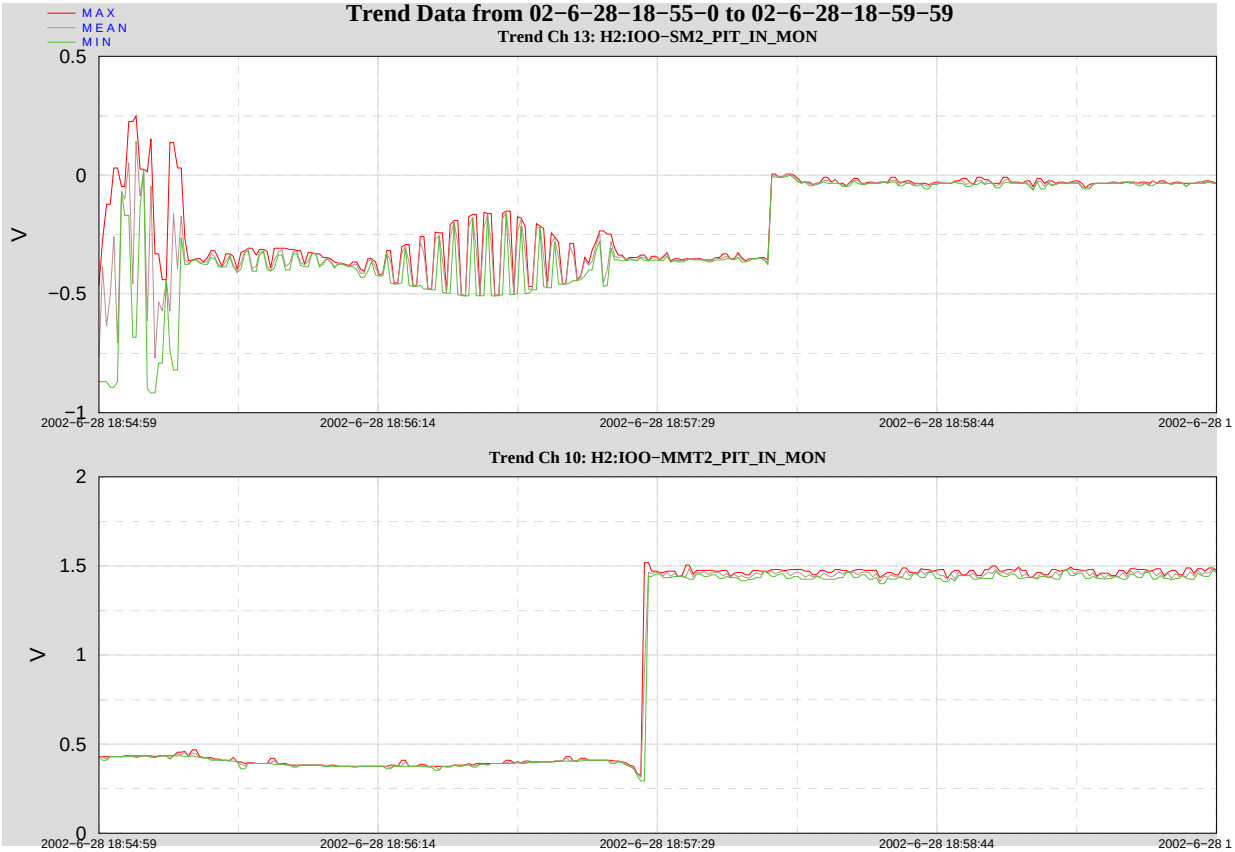



**Quake** **Josh Quiets**

# SM2 Pitch During Final Moments of MMT2

## 5 minute time span

## Top: SM2 pitch; bottom: MMT2 pitch



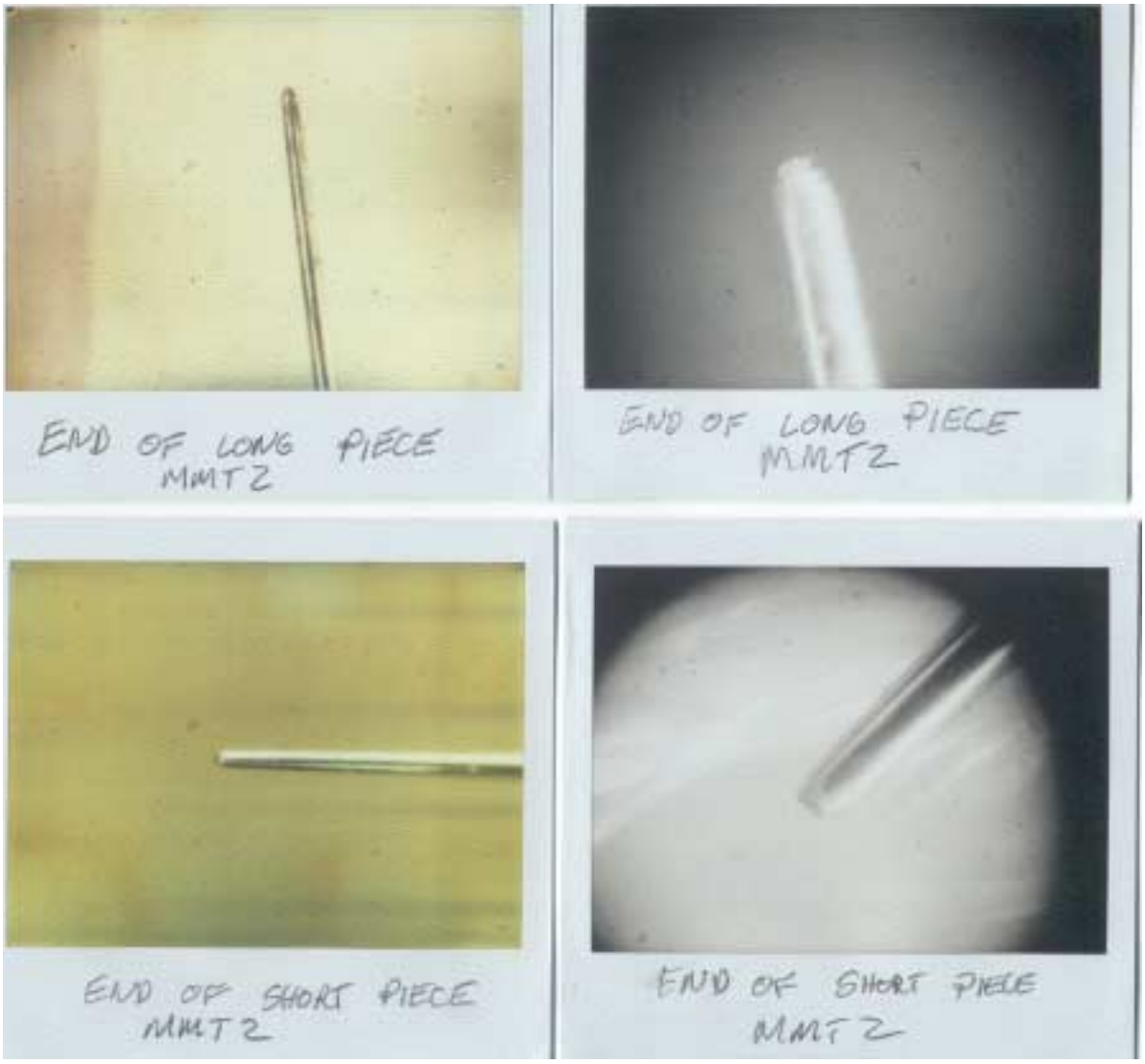

## Drop

- **SM2 stabilized about 5 seconds before MMT2 drop**
- **MMT2 pitch-drift accelerates seconds before drop**

**Not suggestive of sub-second wire melt.**

# Ends of Broken MMT2 Wire

**Top row: long piece; bottom row: short piece**

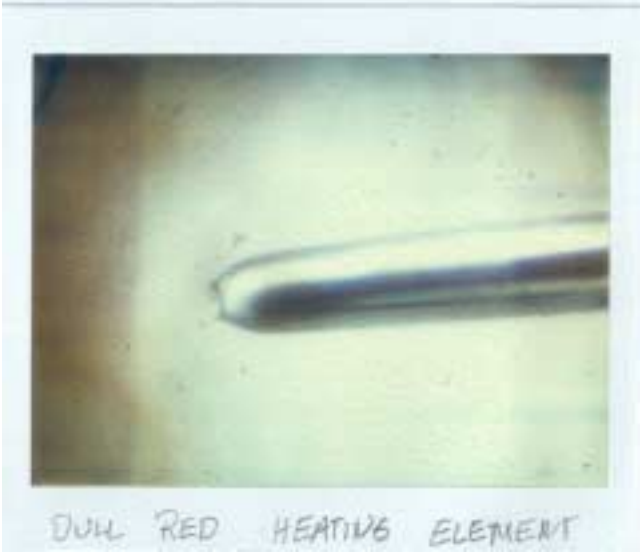


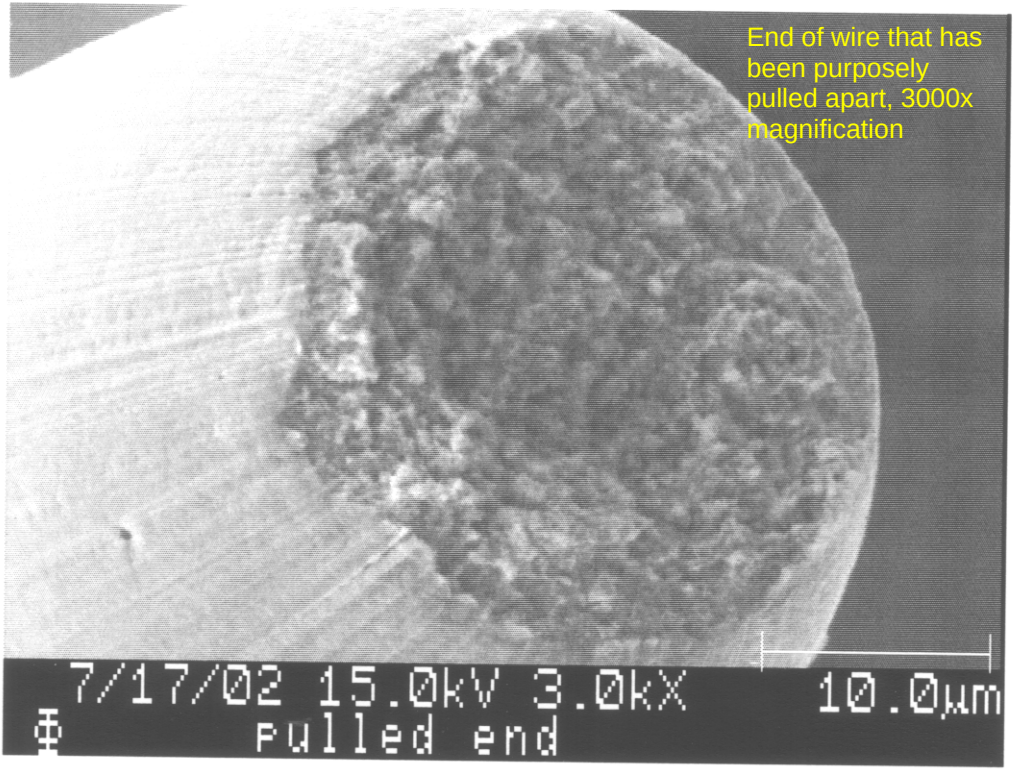

**Ends appear rounded; thin film colors near break.**

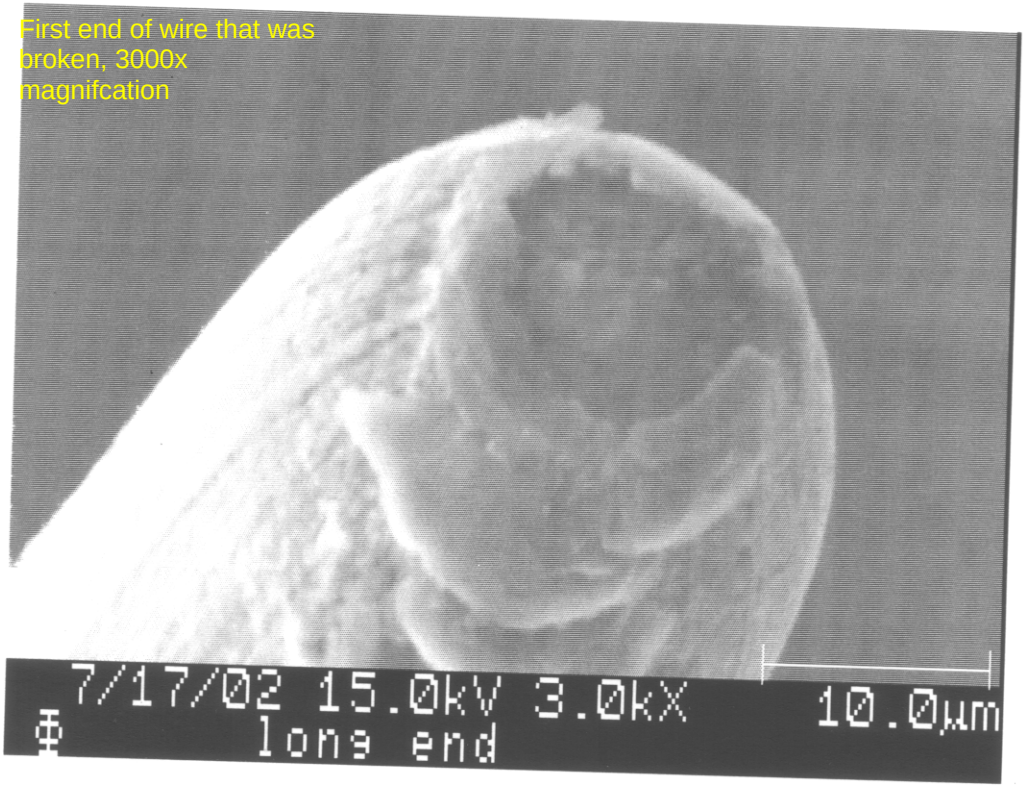
# Wires Broken Hot or Cold

**Broken at room temperature by increasing tension.**


**Broken by touching with dull-red stove heating element (170 gms tension)**

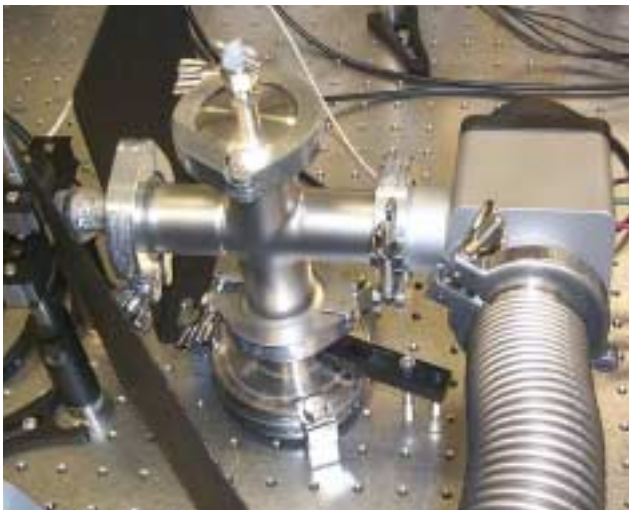


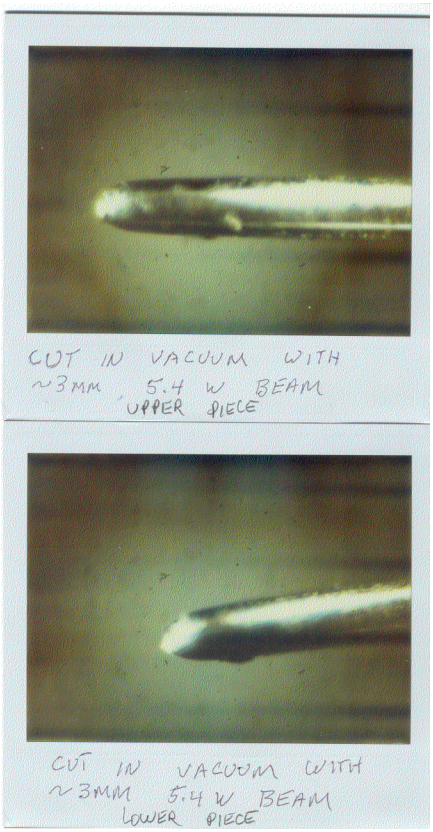

End of wire that has been purposely pulled apart, 3000x magnification
7/17/02 15.0kV 3.0kX
10.0µm
pulled end


First end of wire that was broken, 3000x magnifcation
7/17/02 15.0kV 3.0kX 10.0µm
long end

# Laser Cut in Vacuum

**150 gm suspended from SOS wire in vacuum chamber with window**

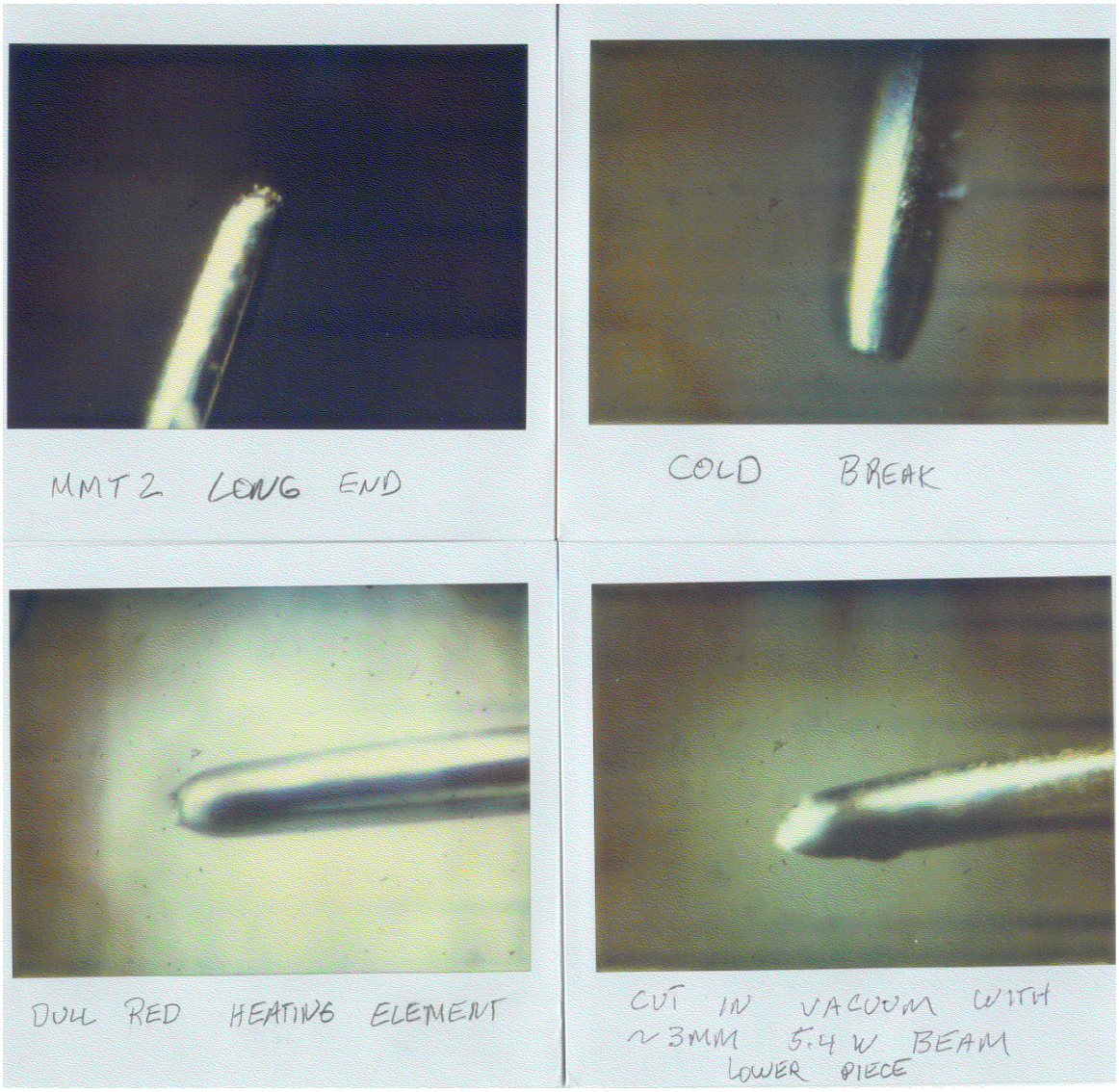





**5.4 W 3mm beam scanned across wire at about 1 cm/s**

# Summary Comparison

**MMT2** **Cold**




**Heating Element (not melted)** **Laser in Vacuum**

**MMT2 looks most like the warmed not melted wire, but not conclusive.**

# Some Lessons Learned

**1) Sliders can move beams onto suspension wires: limit sliders.**

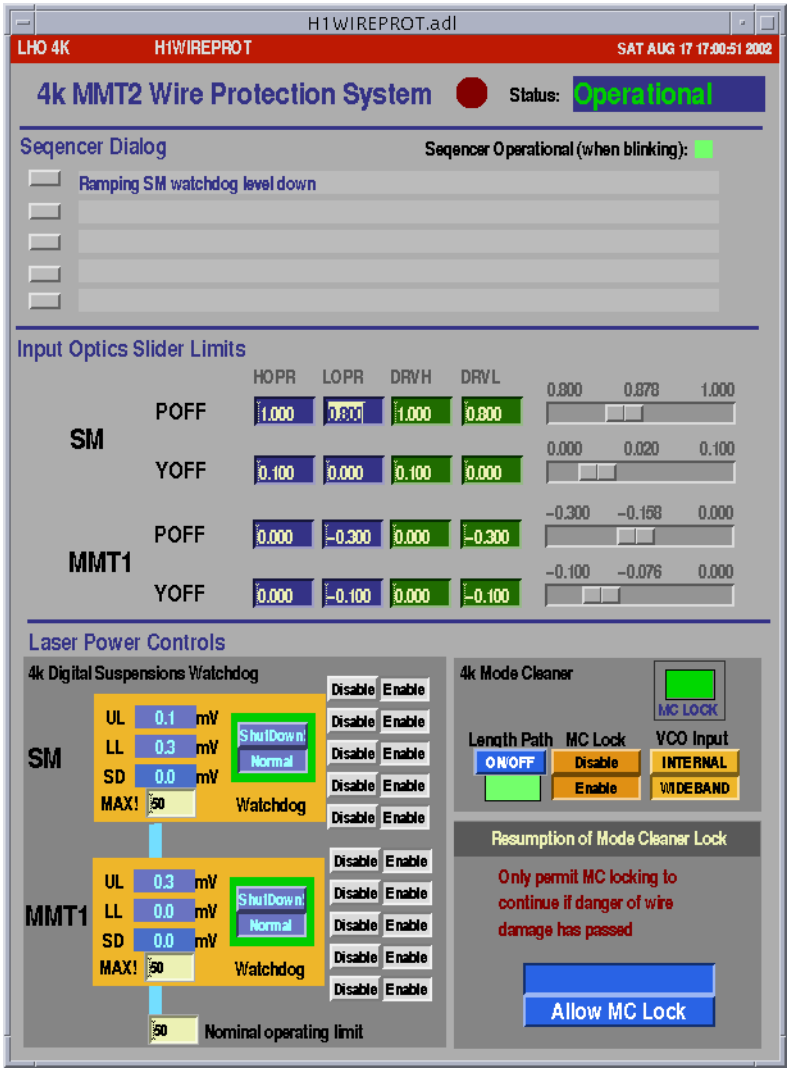
**2) Breaking a wire may take a long time: “watchdogs” could be very useful even if there is a delay in blocking the beam.**

**3) Warming, short of melting, can cause breakage and, short of breaking, may cause alignment drift.**

**NEW PROTECTION:**

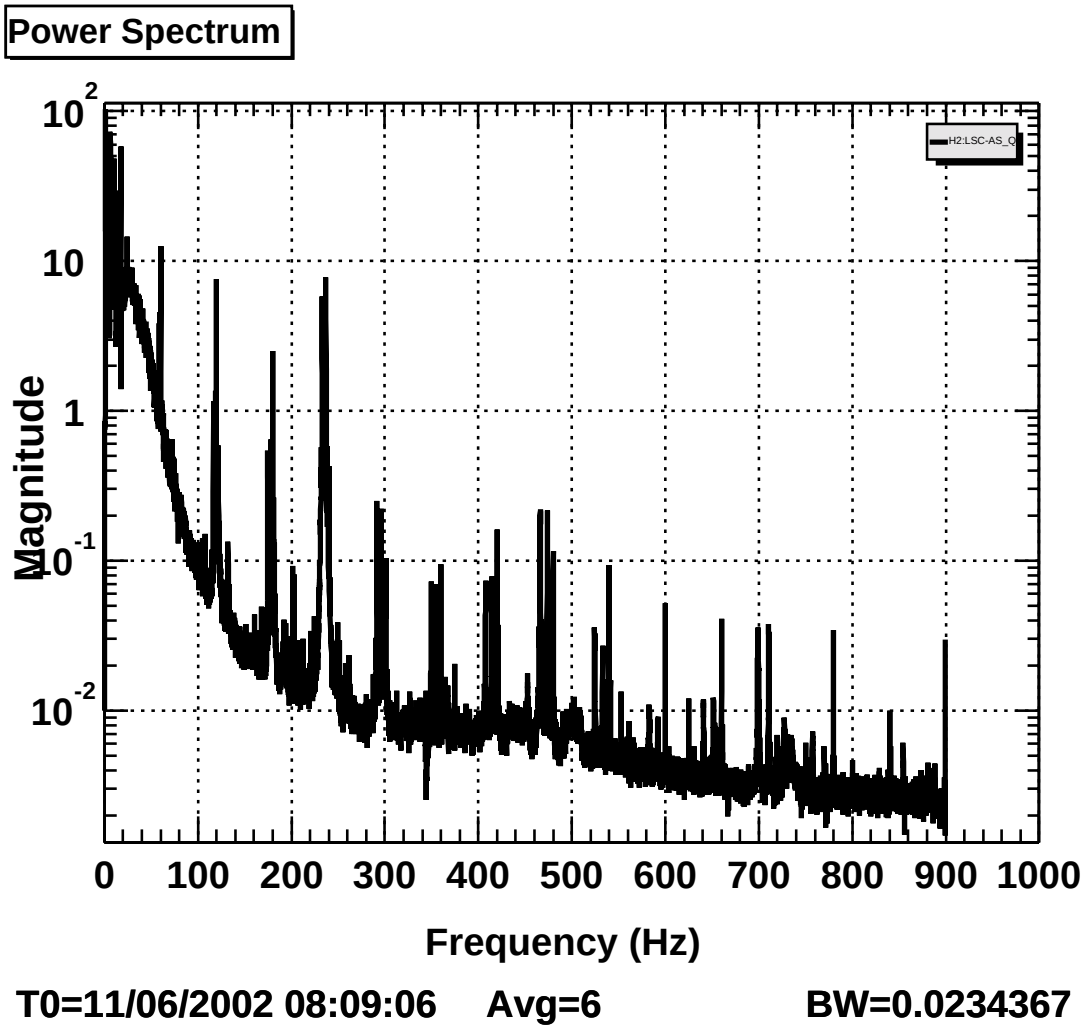
**H2: baffles on MC2 and MMT2‘**
**H1: SM and MMT1 Sliders limited and protected by watchdogs**

# Dave Barker's Wire Protector



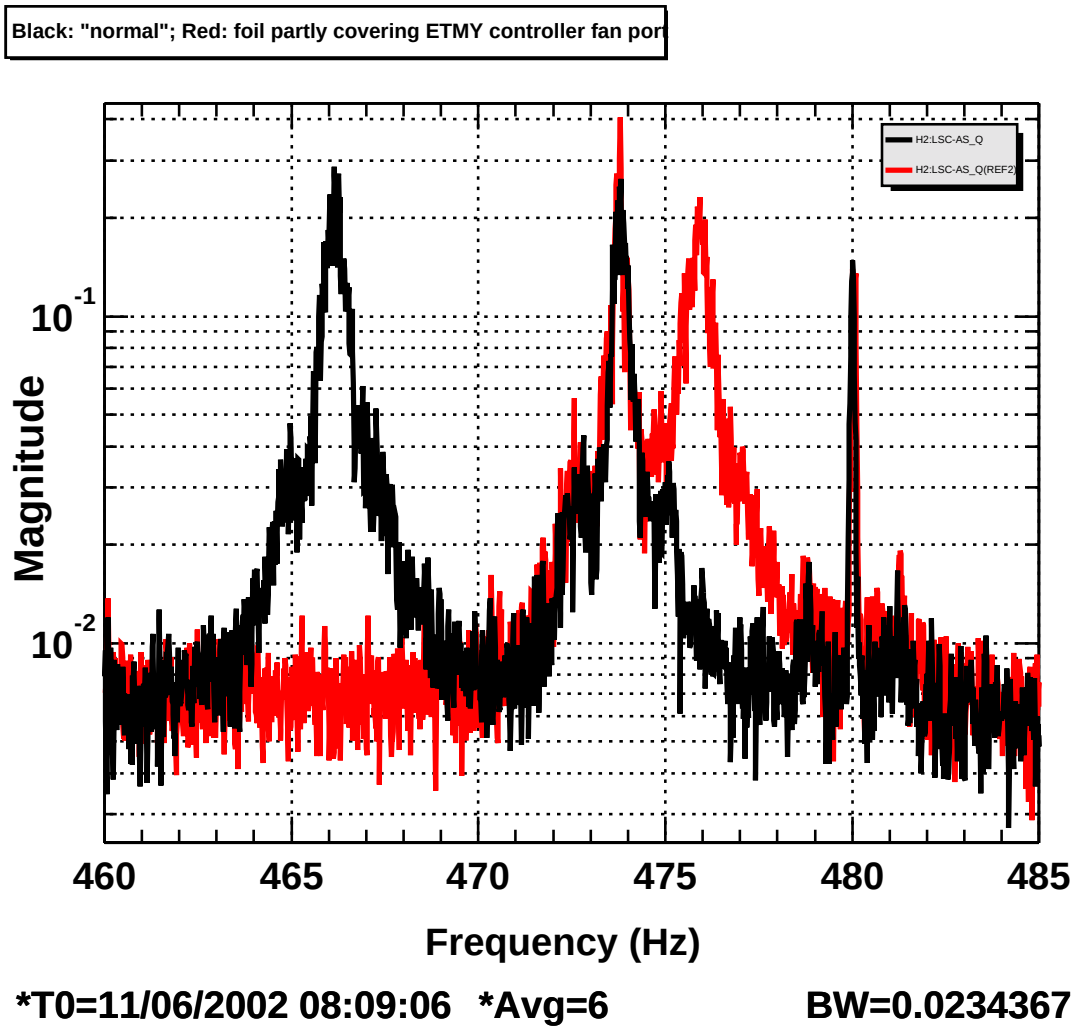
# Fans That Show Up on the GW Channel

# A Forest of Peaks in AS_Q



# Peaks Movable

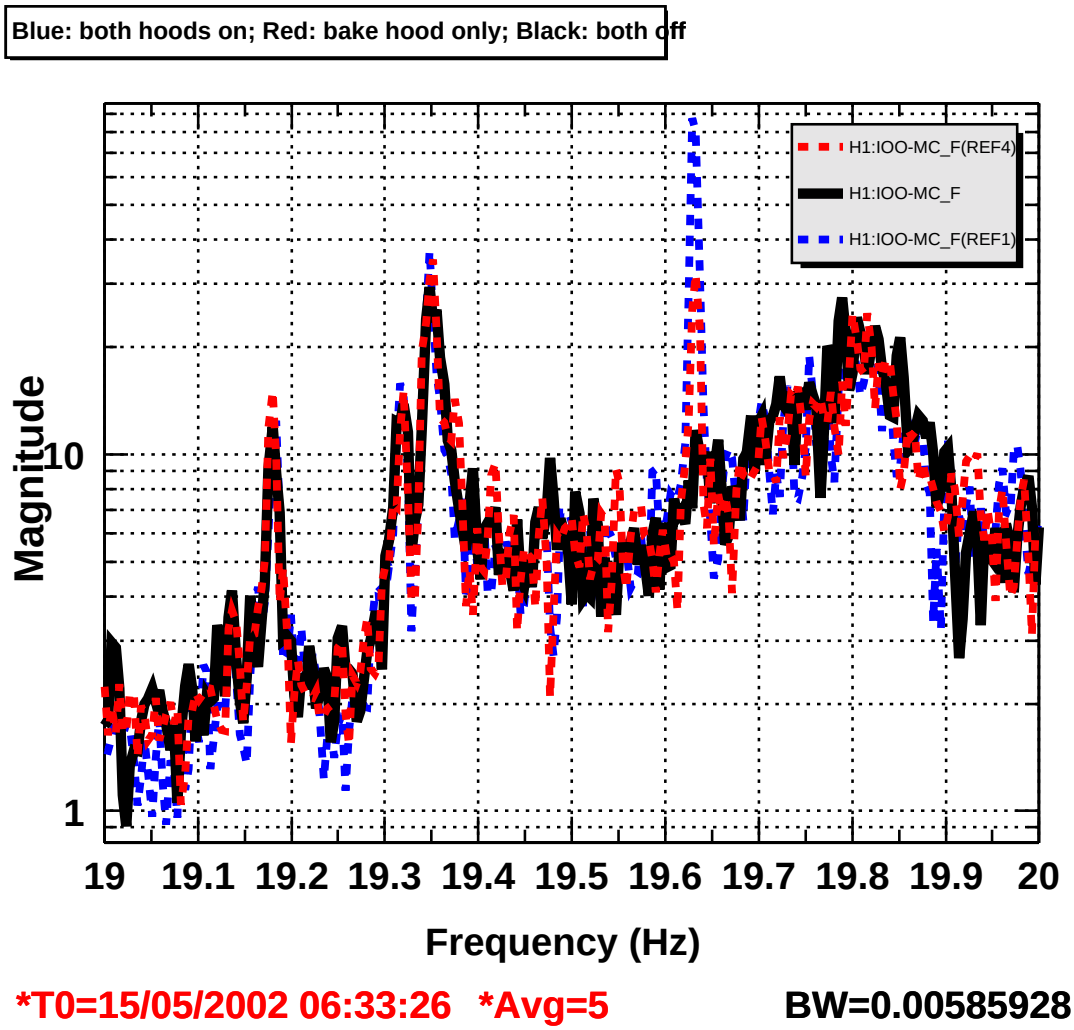
## by partially covering fan port of test mass controller with foil




**Separate fan power supply removed peaks - fans probably caused power supply ripple**

# Hood Fans Responsible for 19.6 Hz Peak

## “mimicked” small optic bounce mode

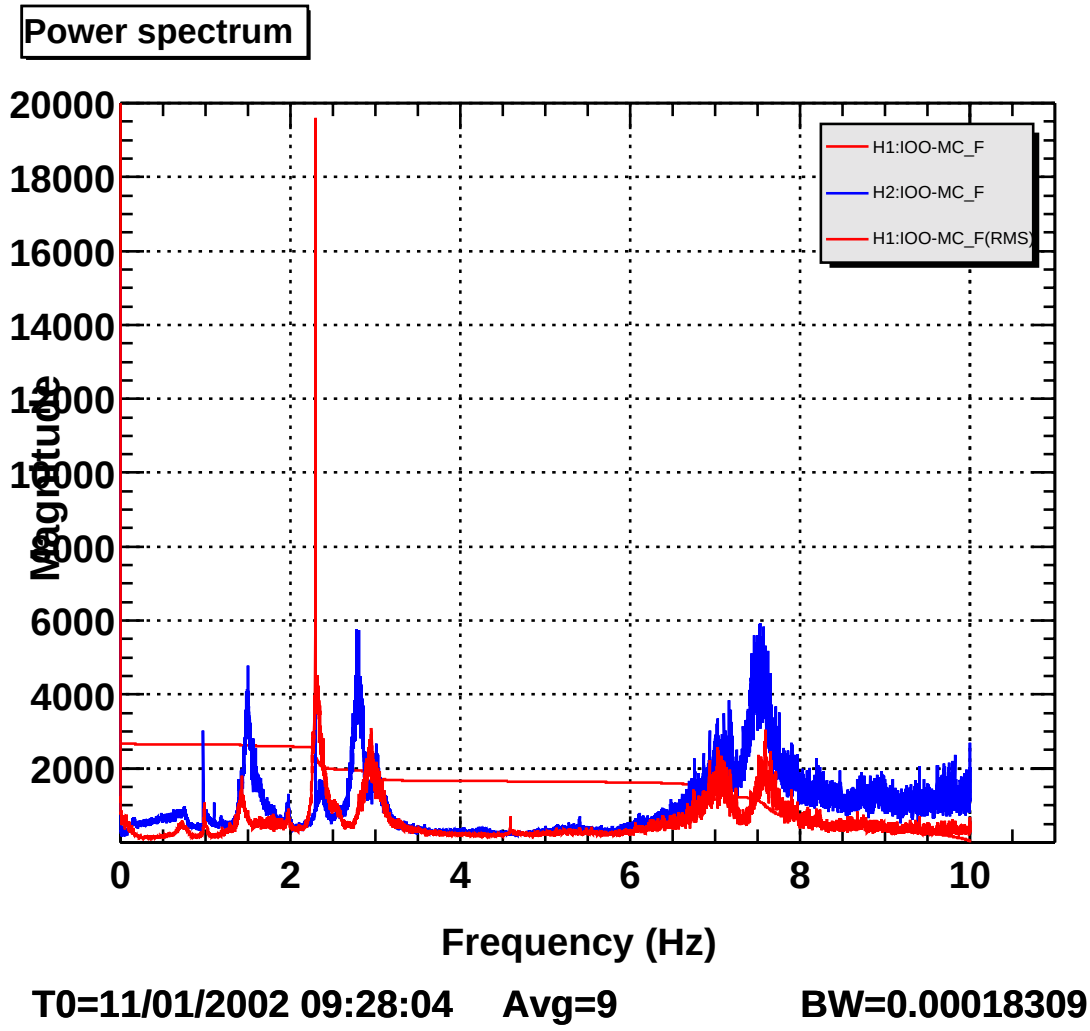


# Hood Fans Responsible for 19.6 Hz Peak

## One of the two culprits:

## The solution:

# Peak at 2.295 Hz responsible for about 20% of RMS in 4k mode cleaner control




**Effect since reduced by resonant gain stage, but still responsible for several percent of RMS of HAM2 coils.**

# Cooling Tower Fans at ENW Nuclear Reactor

**Mobile seismometer suggested cooling towers.**

**Motor monitors and gear-teeth ratios allowed calculation of frequency for each of 36 fans: nearly all fell within our peak.**

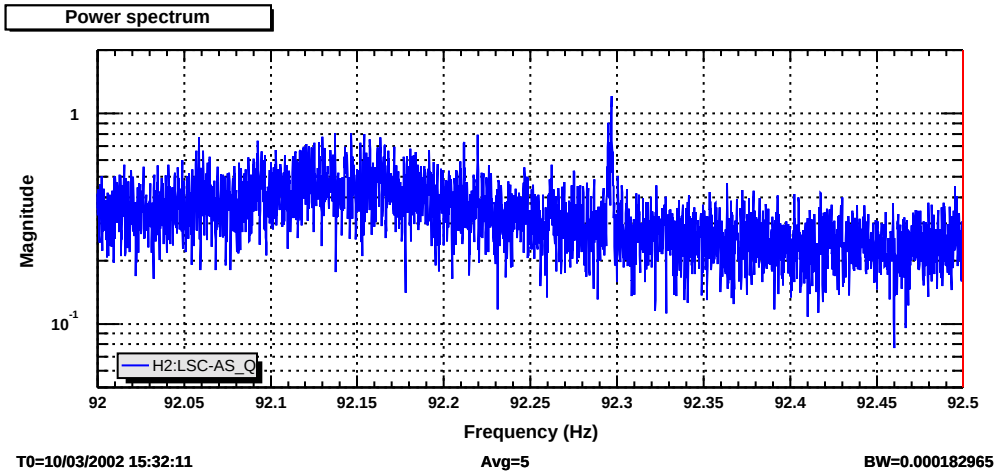
**Inside the giant swamp-cooler;**

**motor shaft, gearbox and 30 ft. diameter blade.**

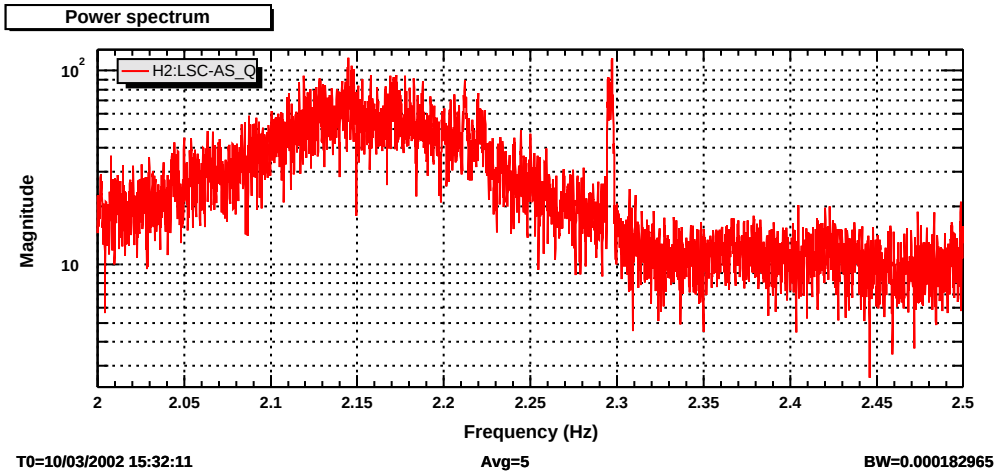
# Upconversion of Cooling Tower Fan Peak

## sideband on 90 Hz injected peak

## The peak at 92.295 Hz



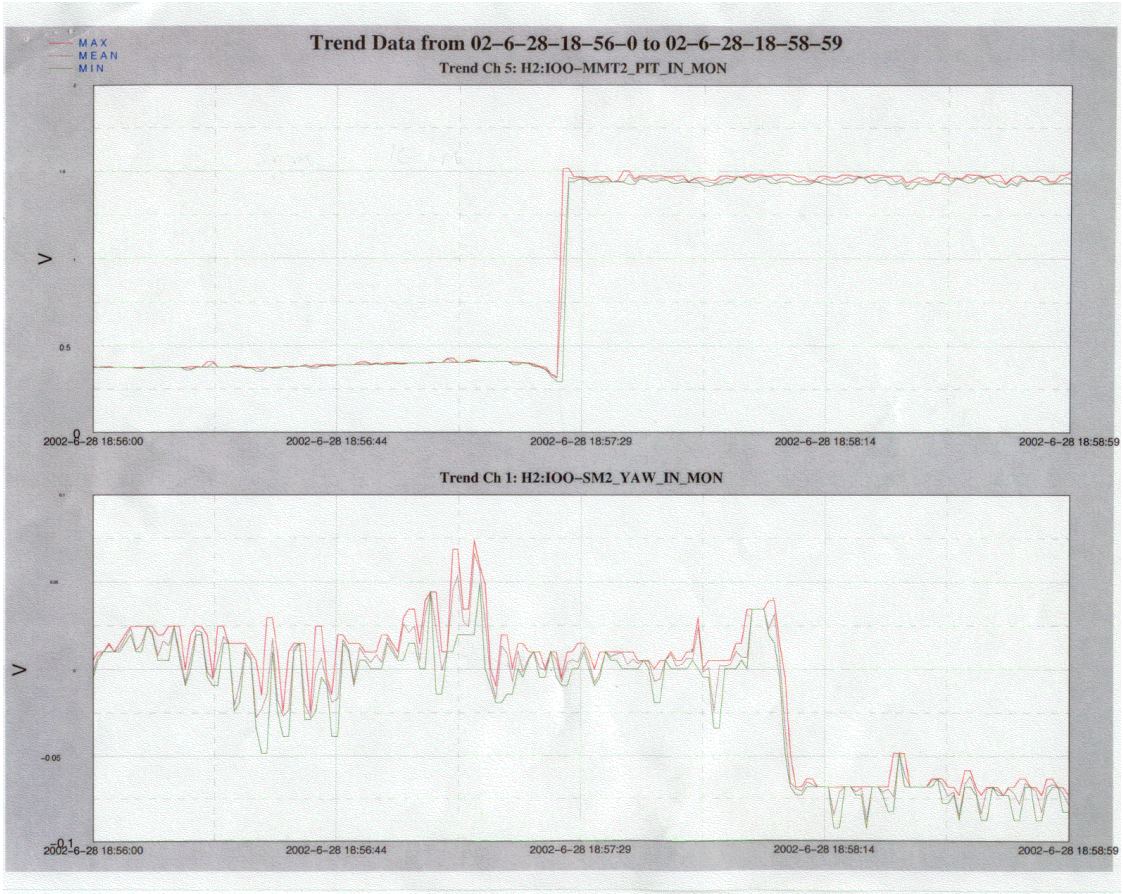

## The peak at 2.295 Hz



# Bonus slide: SM2 Yaw During Final Moments of MMT2

## 5 minute time span

**Top: MMT2 pitch; bottom: SM2 yaw**




**Drop**

**Yaw appears to be offset far enough to put beam on or near wires. Motion just before drop may be a few beam diameters**