Horizontal Test Stands and CC2 Results

Andy Hocker

The need for HTS

- PRODUCTION NEED:
- After passing a vertical test, much cavity handling ensues
  - Welding to He vessel, installation of coupler/tuners…
- Until we perfect this process, best to make sure cavities survive it before they're buried in a CM
  - Figure of merit: E_{acc} and Q_0 within spec
- R&D NEED:
- Plenty of ideas on the table for ways to address cavity tuning, microphonics, Lorentz force detuning, high power RF processing…
- HTS serves as a bench where these ideas can be tested

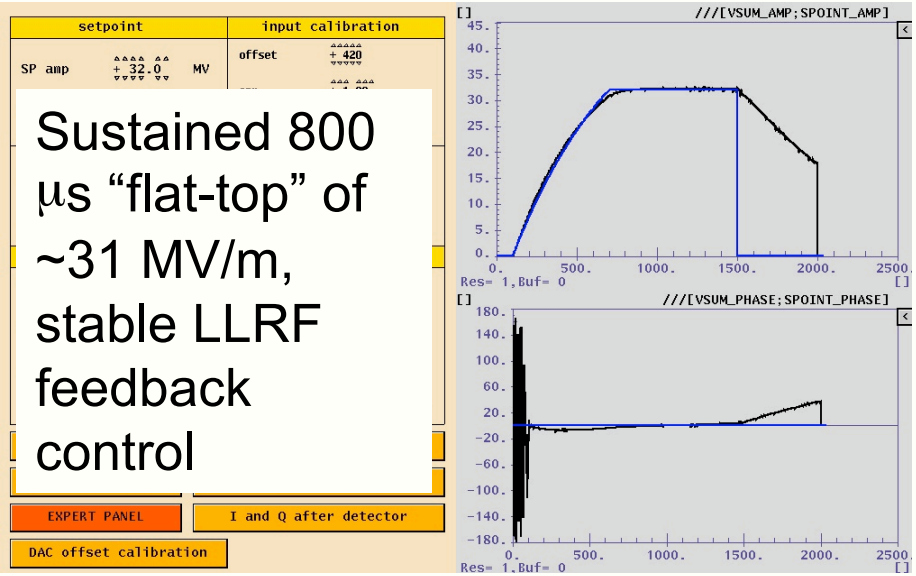
Components of HTS

- Shielding cave
- Vacuum vessel (a one-cavity cryomodule)
- 1.8 K cryogenic plant/distribution
- Clean vacuum systems for cavity/coupler
- High-power (at least ~300 kW) pulsed RF (klystron/modulator), LLRF control system
- Cavity diagnostics
  - X-ray detectors
  - Dark current detectors (Faraday cups)
  - Thermometry
- DAQ and controls system
- Much of this is already in place at Meson Detector Building (MDB)

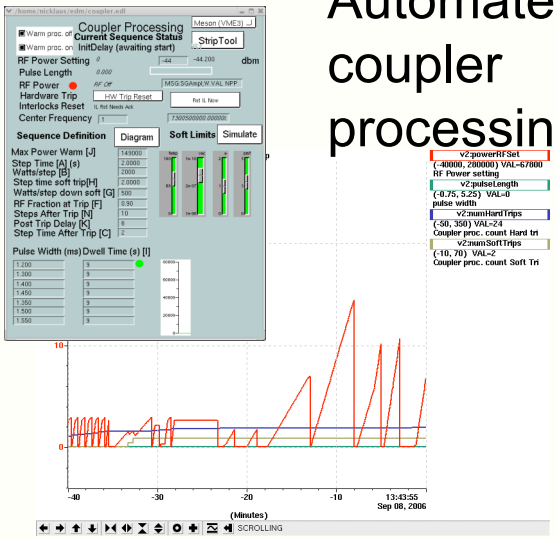
Capture Cavity 2

- Nine-cell TESLA cavity from DESY shipped to FNAL for A0PI energy upgrade
- Horizontal testing infrastructure built up at MDB to ensure that it survived the trip
  - …and with an eye toward HTS
- CC2 operations began in FY06, quite successful:
  - CC2 peak gradient: 31.3 MV/m (Q_0 ~ 1.5e10)
- Bodes well for HTS
  - Most of the RF and cryo infrastructure will be the same

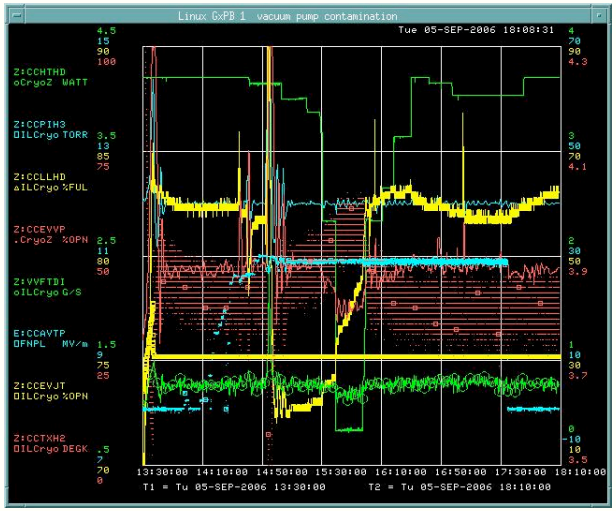
Other CC2 results



Sustained 800 μs "flat-top" of ~31 MV/m, stable LLRF feedback control

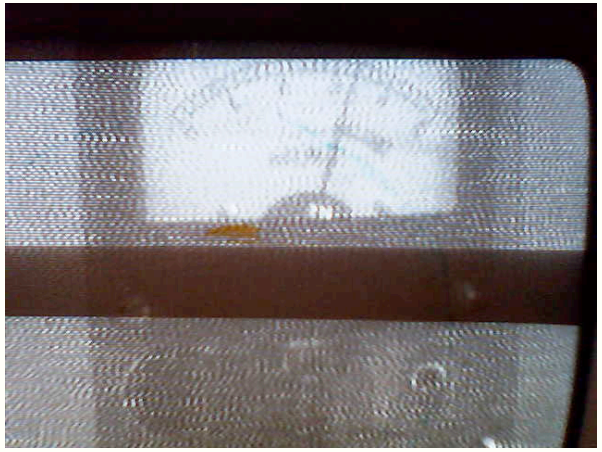


Automated coupler processing



Dynamic heat load studies (Q_0=1.5e10)

X-rays observed at full gradient



HTS work in FY06

Fermilab

- New cave and cryogenic transfer lines in MDB
- New cryostat for easy cavity installation/removal

- Cryostat installation in MDB underway, commissioning to follow

Future of HTS

- HTS testing cycle is ~2 wks/cavity
- ILC needs will eventually demand higher throughput
- A second cryostat (clone of first) could be housed in existing cave --- would need additional
  - cryo transfer lines (plant capacity sufficient)
  - RF distribution
  - vacuum systems
  - instrumentation
- Even better: a two-cavity cryostat
  - Yet more throughput with minimal incremental cost
  - Could be run as a mini-CM, with RF system upgrades

Factorizing HTS and ILC

Fermilab

- Except for the 1.3 GHz RF system, HTS is not very ILC-specific
- A 1.8 K fridge with ports for RF, vacuum, and instrumentation
- Example: FY07 will see HTS testing 3.9 GHz SCRF cavities for DESY's VUV-FEL
  - Modified a few cavity/coupler support structures
  - Bought a 3.9 GHz klystron and some waveguide
  - Downconverter for LLRF system
  - That's about it!
- The use of HTS for R&D on cavity "accessories" (couplers, tuners, etc.) has wide applicability

Cost

	M&S	SWF
HTS1		
Cryo	330K	1.3 FTE
HLRF	50K	1.0 FTE
LLRF	21K	1.5 FTE
Controls	30K	0.5 FTE
Test infra	36K	1.3 FTE
HTS2		
Cryostat	250K	2.0 FTE
Cryo	280K	2.5 FTE
RF	140K	1.0 FTE
Vacuum	60K	0.5 FTE
Test infra	23K	1.3 FTE
Total	**1220K**	**1055K**

Conclusions

- HTS plays a key role in developing high-performance ILC cryomodules
- Provides Fermilab with unique opportunity for studying SCRF cavities and their accoutrements under high-power pulsed RF
- Infrastructure at MDB already highly developed
- Capture Cavity 2 program a successful demonstration of laboratory's horizontal testing capabilities