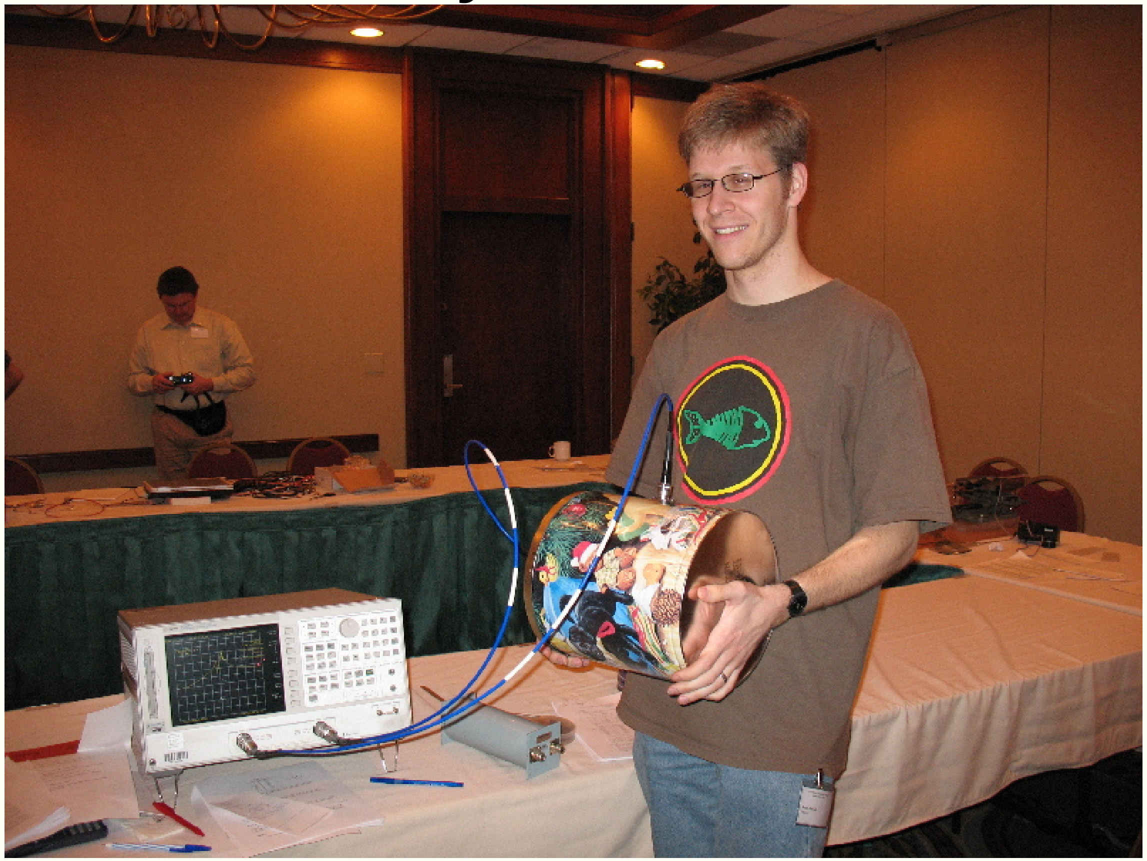
Horizontal Test Stands and CC2 Results

Andy Hocker



Testing an alternative ILC cavity design at USPAS (Q_0=2.23E+02)

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**

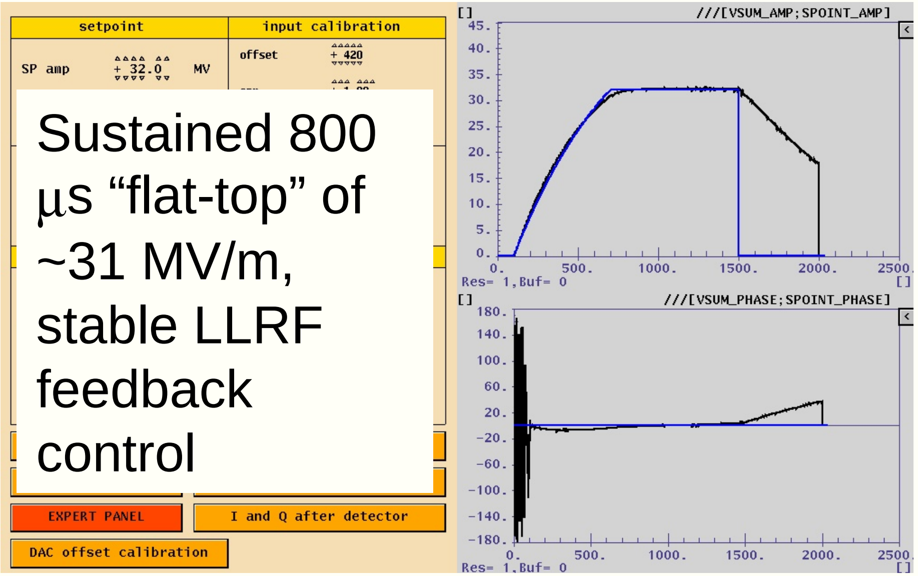
Components of HTS

- 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)

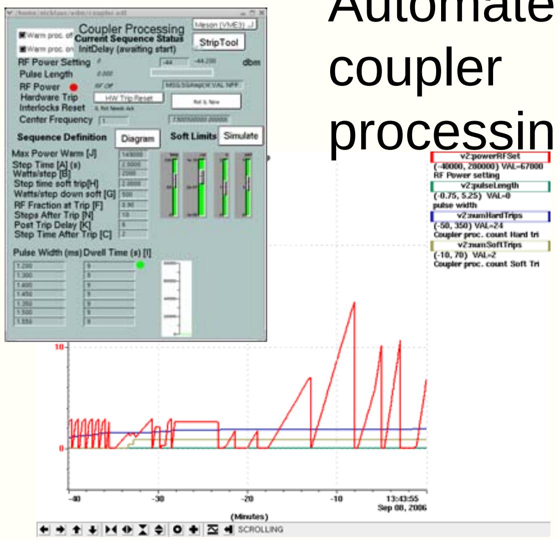
Capture Cavity 2

- 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

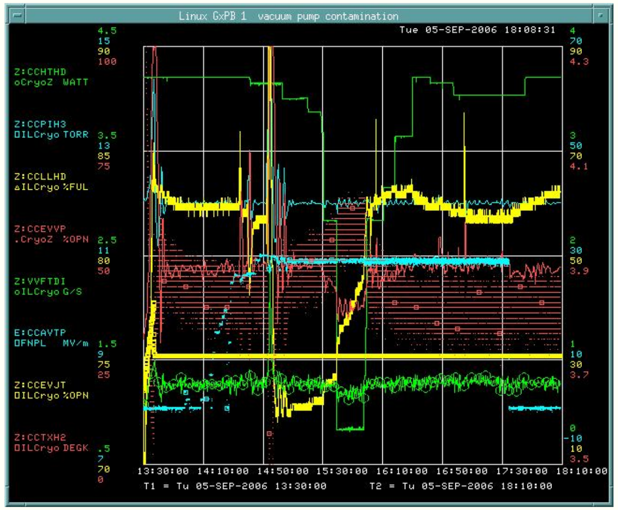
Other CC2 results



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

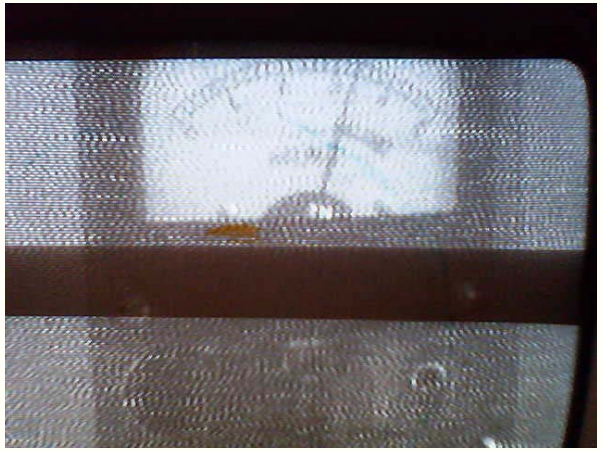


Automated coupler processing



Dynamic heat load studies (Q_0=1.5e10)

X-rays observed at full gradient



HTS work in FY06

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

- **Cryostat installation in MDB underway, commissioning to follow**

Needed HTS Capacity

Program	FY07	FY08	FY09	FY10	Capacity Needed/yr by FY10
Horizontal Testing	Fermilab-6	Fermilab-24	Fermilab-24	Fermilab-72	72

- **HTS testing cycle is ~2 wks/cavity**
  - **At peak performance, 1 HTS = 24 cavities/yr**
- **Proposal for "HTS2" --- a second cryostat long enough to house two cavities**
  - **Increase throughput with minimal incremental cost**
  - **Some unique R&D opportunities (cavity+magnet, driving multiple cavities w/ one RF source)**
  - **Requires new RF/cryo distribution, clean vacuum systems, instrumentation, controls**

Factorizing HTS and ILC

- **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

Expenditure Description	M&S (K$)	SWF (K$)	Total including Indirect (K$)
Infrastructure Improvements	45	33.75	96.63
Horizontal Test Cryostat	200	337.50	675.06
Cryogenic System (distribution Only)	50	202.50	323.48
RF System and Distribution	600	168.75	920.03
LLRF	75	67.50	175.79
Controls & Data Acquisition	100	67.50	204.91
Vacuum System	60	67.50	158.31
Shielding Caves	50	44.55	116.60
Safety Interlock System	10	33.75	55.86
Other Utilities	30	33.75	79.16
Total of Horizontal Test Stand	1220	1057.05	2805.82

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