New DAQ for T-Maps on Superconducting Cavities

DESY Summer Student Program 2005

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The MHF-SL group

- technical group
- MHF: Machine High Frequency
- SL: Superconductivity

- Fabrication of cavities
- Preparing of cavities
- Testing
- Improvement in Cavity
 performance
- Operation

A 9 cell cavity





Problems with superconductivity

- Critical Temperature
- Critical H-Field
- Problems can cause a temperature rise
- Temperature rises can cause problems

- Impurities (material and surface)
- Field emission
- Multipacting
- Quench

Cavity fabrication

- Niobium plates
- Eddy scanning
- Deep drawing
- Hydroforming
- Spinning

Two-pass Electron beam welding:

- Iris
- Stiffening rings
- Equator

Cavity preparation

- 1) degreasing (US-cleaning + pure water rinsing)
- 2) electropolishing (electrolyt 1 x HF : 9 x H₂SO₄ ; horizontal set-up)
- **3) rinse with de-ionized high pressure water (chem area)**
- 4) rinse with (hot) ultrapure water, drying + packing (Henkel cleanroom)
- 5) transportation into DESY cleanroom

- 6) first high pressure water rinse + assembly of top flange
- 7) high pressure water rinse (> 2x)
- 8) assembly of antenna with vacuum connection, pumping + leak check
- **9) first vertical test** (optional: Tmapping
- **10) low temperature heat treatment between 100 C 140 C ("bake")**
- **11) second vertical test (optional: Tmapping)**

T-Maps

- Temperature
- 2D-Image
- 116 sensors (9 cells)
- 768 sensors (1 cell)
- Rotating / fixed sensors
- Multiplexing



DAQ System: Hardware

- DAQ-Board: National Instruments PCI board PCI-MI0-16XE-10
- Multiplexer System
- Terminal blocks
- Temperature sensors array



DAQ System: Software

- User interface done with LabView
- Interface needed between hardware and software
- Old solution: Linux 2.0 drivers provided by NI
- Problem: Linux 2.4 / 2.6 ?
- Comedi

Comedi

- Linux <u>control</u> and <u>measurement device interface</u>
- Suite of kernel drivers, tools and libraries for various data acquisition devices
- Easy installation
- DIO and AIO possible
- Triggered measurements
- Patch for communication with SCXI devices

Functions in Comedi

- Simple DIO / AIO
- Automatic unit conversion: comedi_to_phys
- Scan lists
- Instructions: Instruction lists, configuration
- Commands: triggered events, time intervals

Data acquisition sequence



Multiplexing with SCXI

- Registers to program over serial interface
- SLOTSELECT: Select slot
- HSCR: Options for programming and reset
- FIFO: Module number, # of scans
- CONF: Gain, Channel, Clock and Output control

Programming the acquisition Sequence



- SCANCLK problem
- Register writing not possible?
- Logic analyzer to observe signal
- Own routines for register write

Examples of T-maps







T-Map at 35 MV/m at 1.8K during quench **Δt_{max}=100mK**



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0.100