Cooling and System Integration Results

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2/9:35AM

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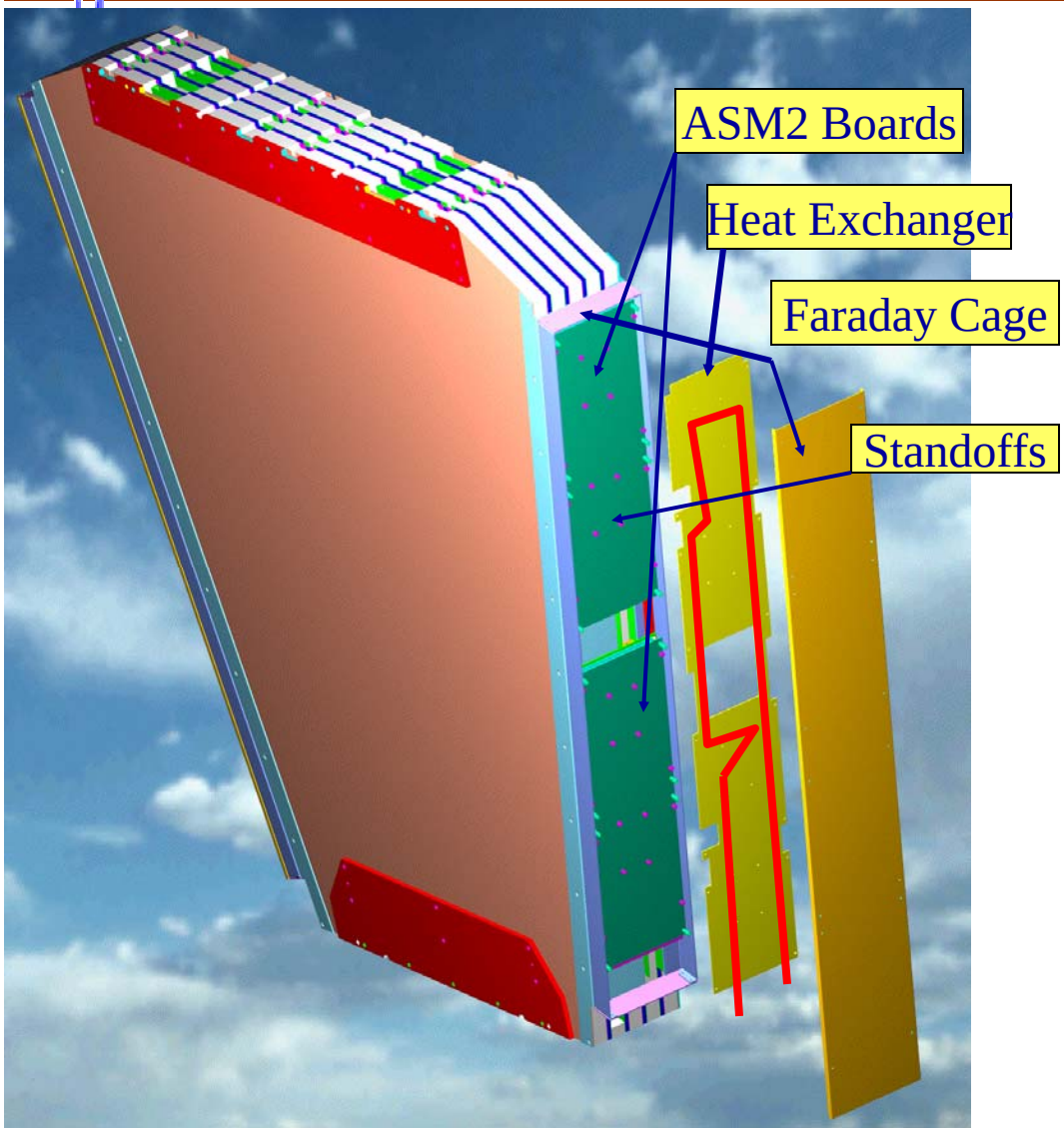
Cooling Overview and Production Plans

- Power dissipation ~300 W/Chamber
  - But… Confined in Faraday Cage in the narrow gap between the JD shielding disk and the EC Toroid
- Prototype FC with cooling has been demonstrated to work but choice of final heat exchanger is pending
- All tests done with a setup which complies with the ATLAS leakless system requirements (0.8 bar pressure, 17 ^{o}C temperature)
- Aim to have all components at T<30-40 ^{o}C on the surface

Exploded view of FC and Cooling Plate



- ASM2 sandwiched between two cooling plates
- Only top plate has cooling loop
- Heat transfer from bottom via numerous standoffs
- Thermal pads connect chips to cooling plates
- Most power hungry chips (G-Link, voltage regulator) on top side

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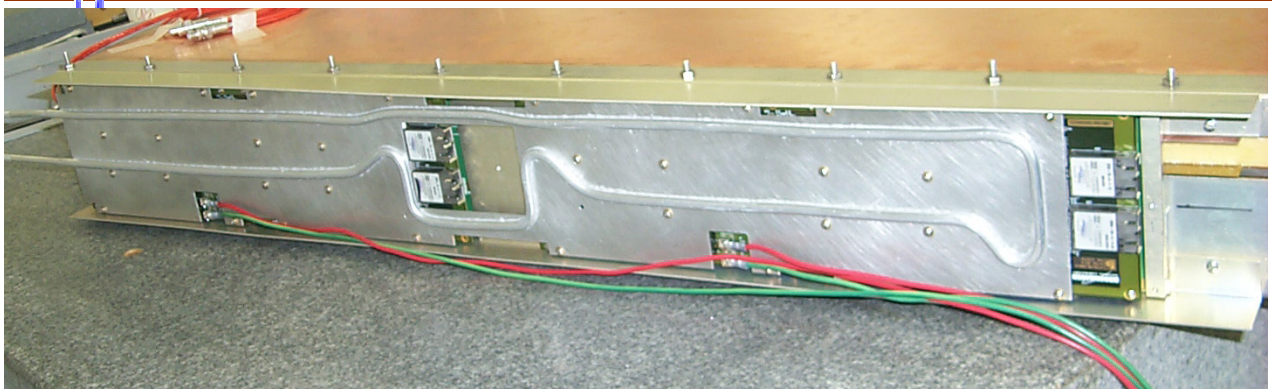
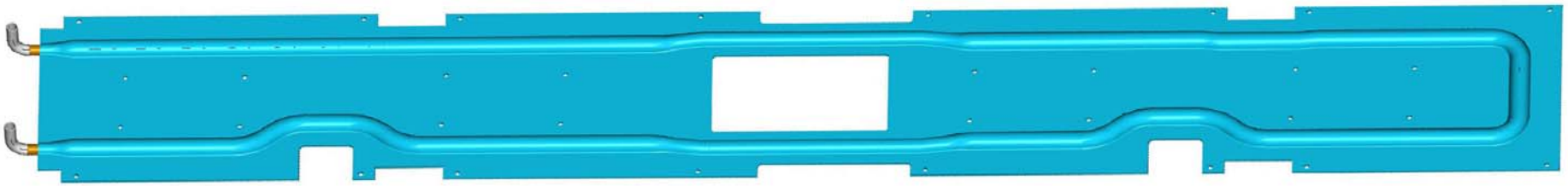
Production Plan



Original Heat Exchanger
(made of Aluminum)

Recent request by ATLAS
Responsible to switch to Cu

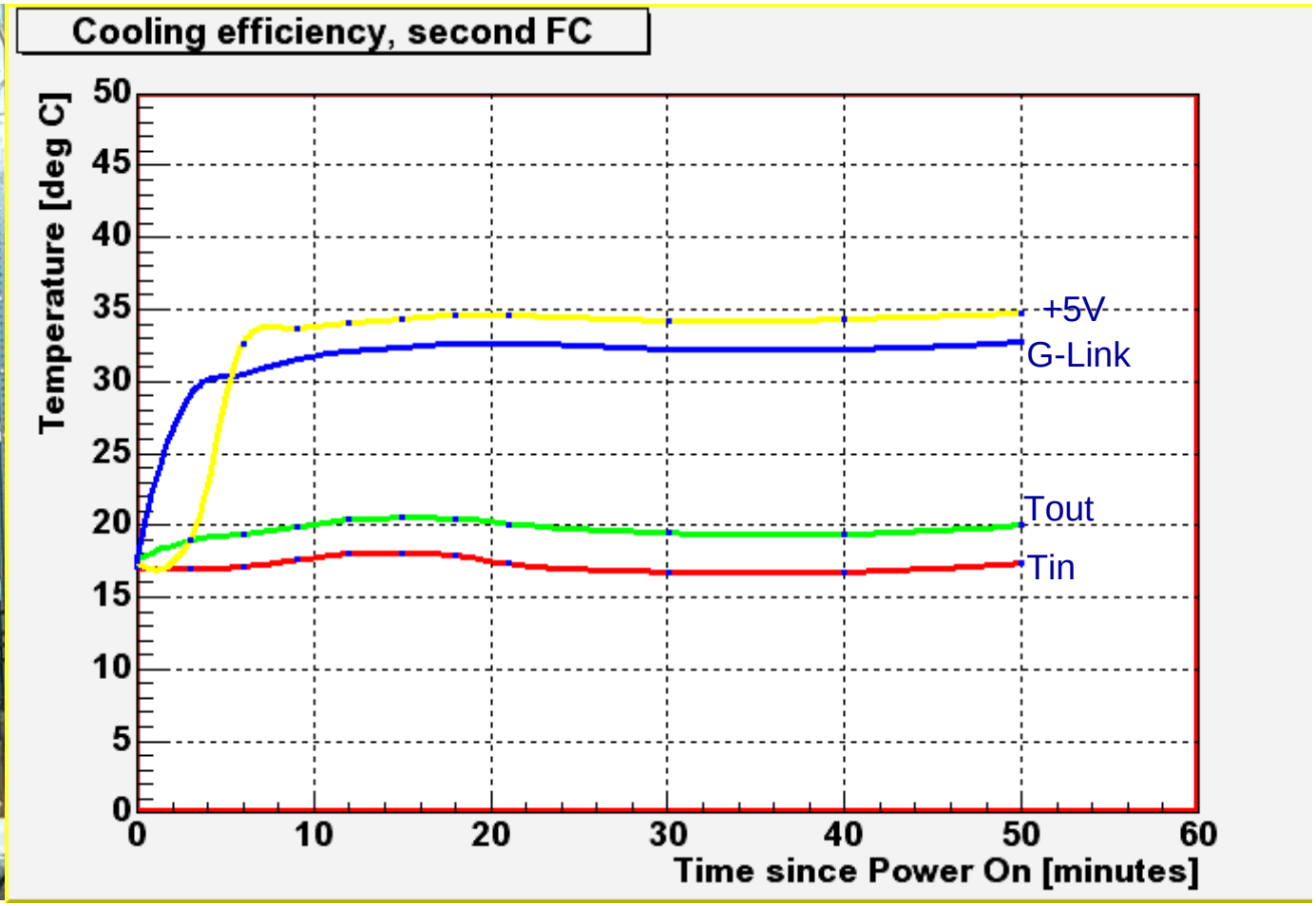
Also investigating option of roll-bonded plates with hydroformed cooling channels



Either design of heat exchanger compatible with Faraday Cage

Production of the two can proceed independently

Test of the Cooling System



Test was performed with both Al and Cu Heat Exchangers
Efficiency 80 – 85 %

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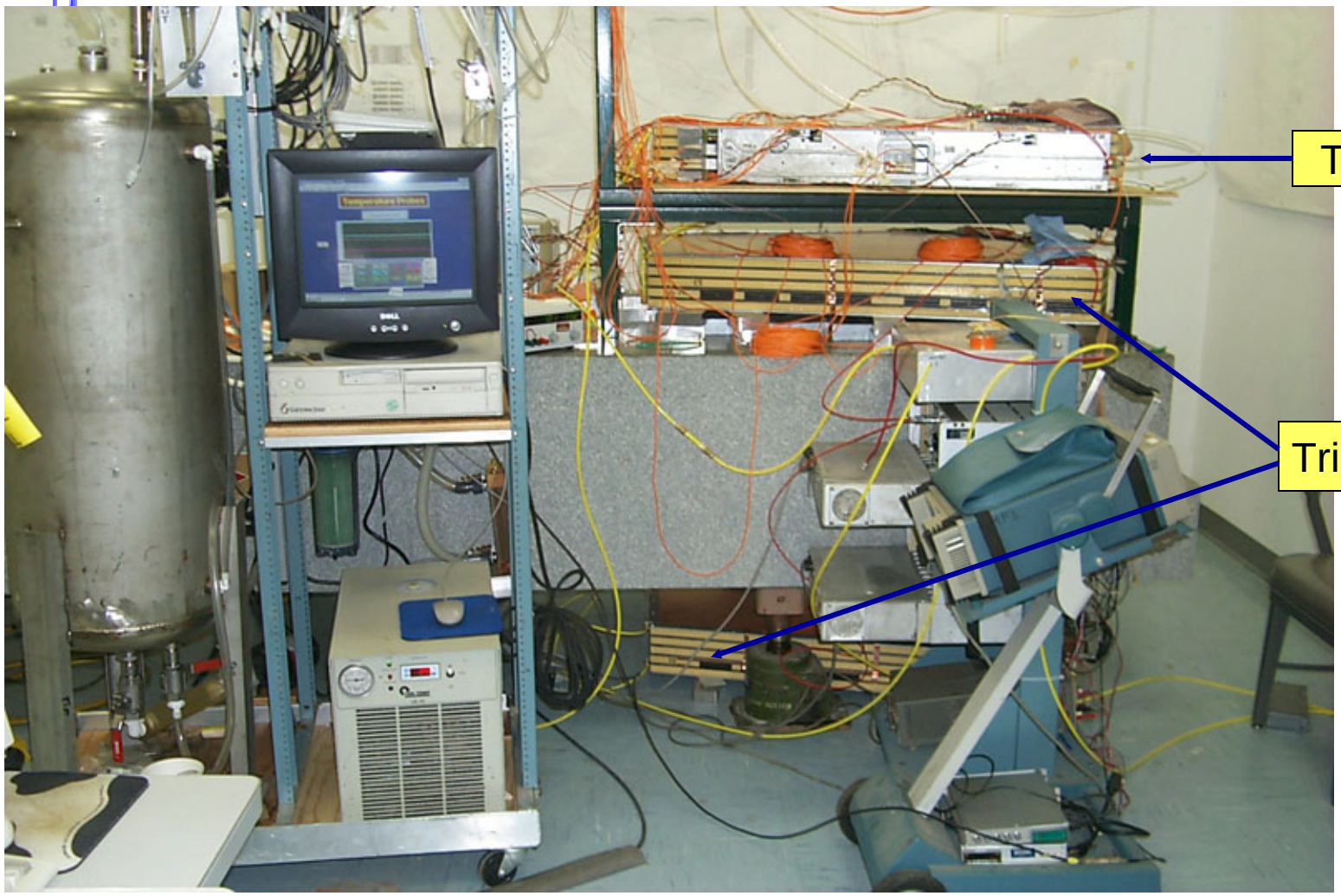
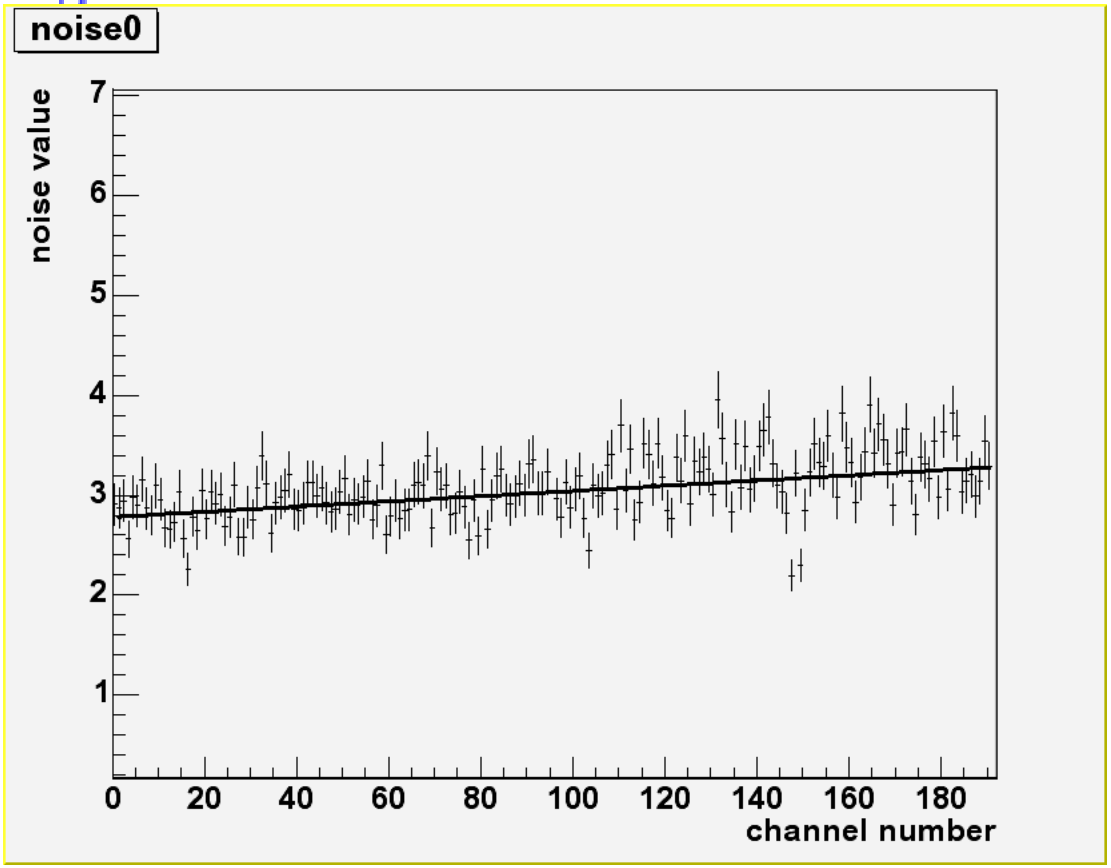
System Integration Test

- Fully Instrumented Production Chamber
  - Functional System Unit, 960 channels, 3% of entire system
- Goals of Test
  - Demonstrate system including ASM1,ASM2,ROD
  - Verify that noise at desired levels
  - Demonstrate immunity of front ends to digital activity
  - Demonstrate immunity of front ends to SCA simultaneous R/W
  - Demonstrate acquisition at 100 kHz trigger rate
  - Electromagnetic Compatibility
  - Data taking with Operational Chamber (Cosmic Rays)

Cosmic Ray Stand



Noise Performance



Typical distribution of RMS noise for 192 channels of an ASM2

3ADC counts = ~0.5 fC
Slope consistent with increased capacitance of strips(~30e/pF)

Expected signal ~60 fC

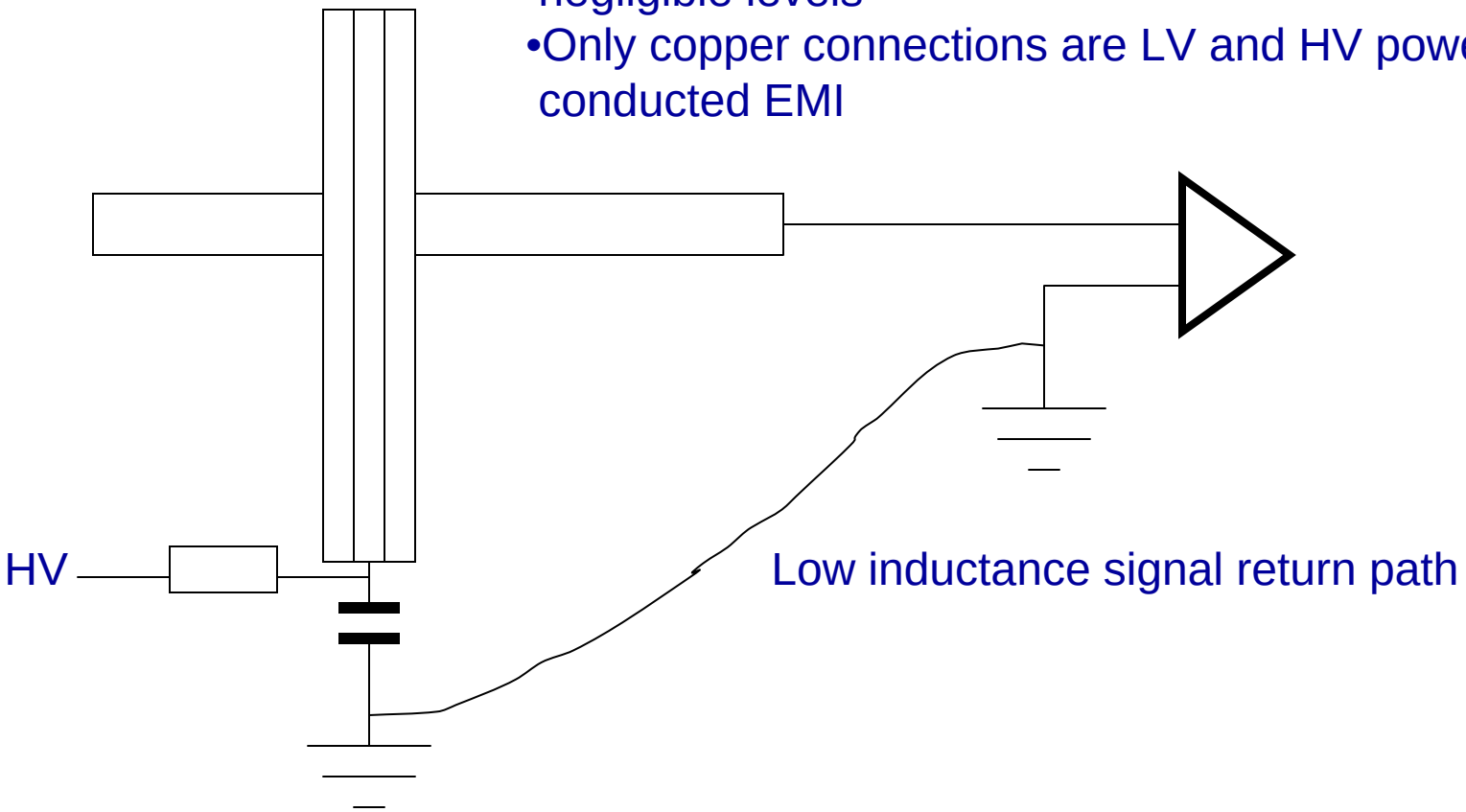
Signal to noise ratio determines precision of the charge interpolation

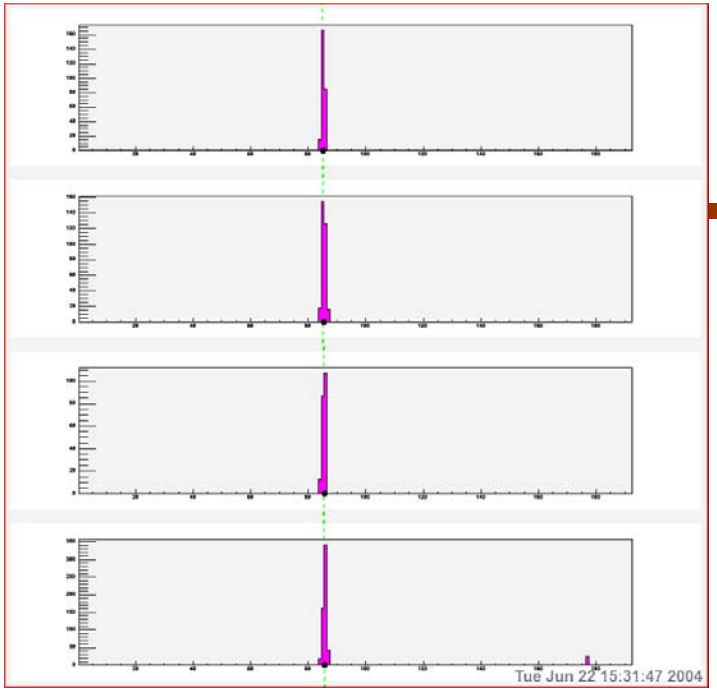
Design goal s/noise ~100

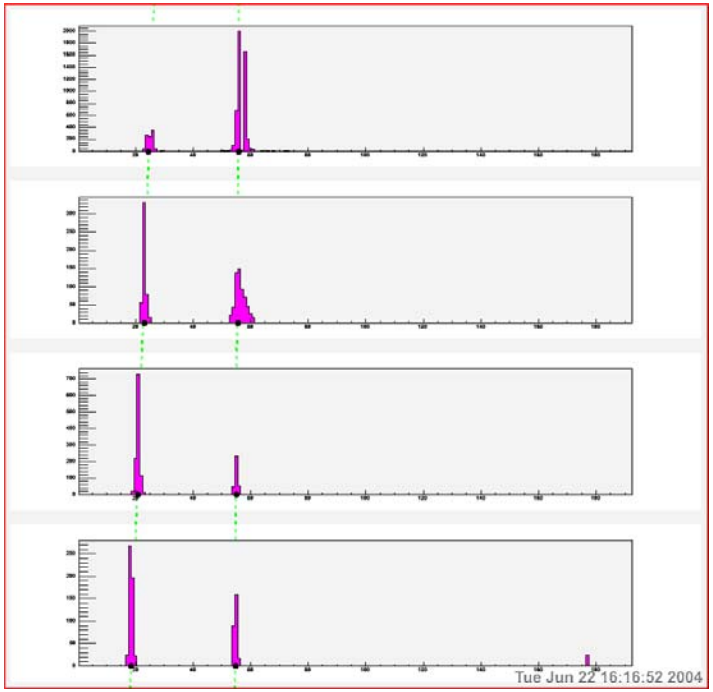
Noise remains constant as trigger rate increases and the system simultaneously reads and writes the SCAs

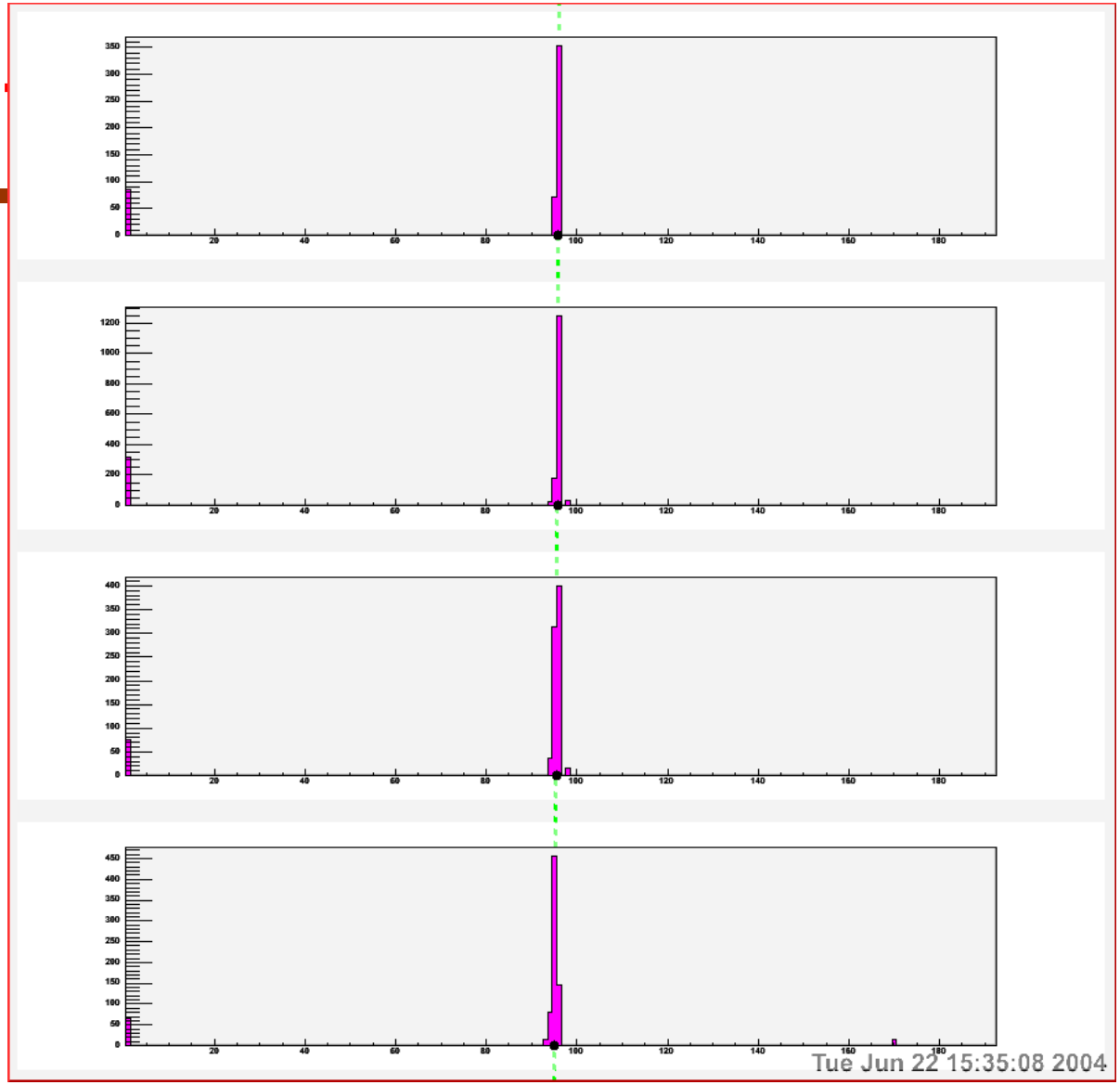
EMI Immunity

- System operated in Strong radiated EMI environment
- Low inductance ground connections reduce interference to negligible levels
- Only copper connections are LV and HV power minimize conducted EMI









Sample reconstructed Cosmic Ray Tracks

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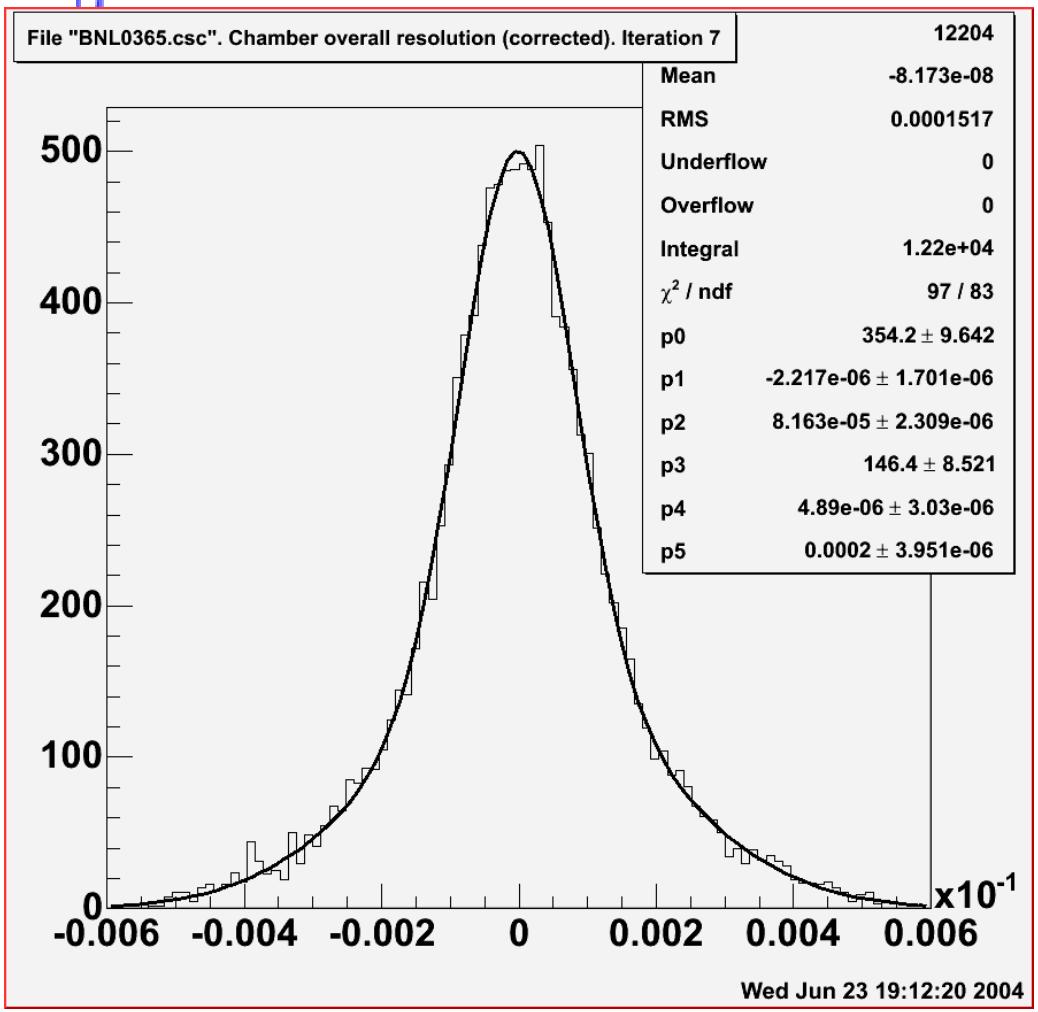
Spatial Resolution



- Average resolution of all 4 planes ~80 microns
- Tails due to multiple scattering and delta rays
- Calibration constants have NOT been applied yet
- Resolution is expected to be ~60 microns
- ATLAS requirement is 80 microns

Conclusions

- System has been running flawlessly since Day One of integrating ASM1, ASM2, ROD
- Meets or exceeds ATLAS requirements
- Noise levels close to expected values
- Immunity to Digital Activity
- Immunity to radiated EMI
- Immunity to SCA simultaneous Read/Write