



US CMS Meeting, 19 Nov 99

Summary of Noise Studies at FNAL

S. Lusin

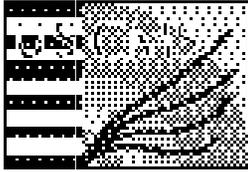
University of Wisconsin



Noise Studies @ Lab 7

Performed by:

- **Local participants:**
 - S. Medved, S. Dolinsky, N. Bondar, N. Terentyev
- **OSU:**
 - C. Rush, J. Gilmore, J. Gu



History

06 Oct 99

- P2” returned to FNAL

07 Oct 99 - 31 Oct 99

- Chamber commissioning and preliminary noise studies

01 Nov 99 - 03 Nov 99

- First OSU noise study

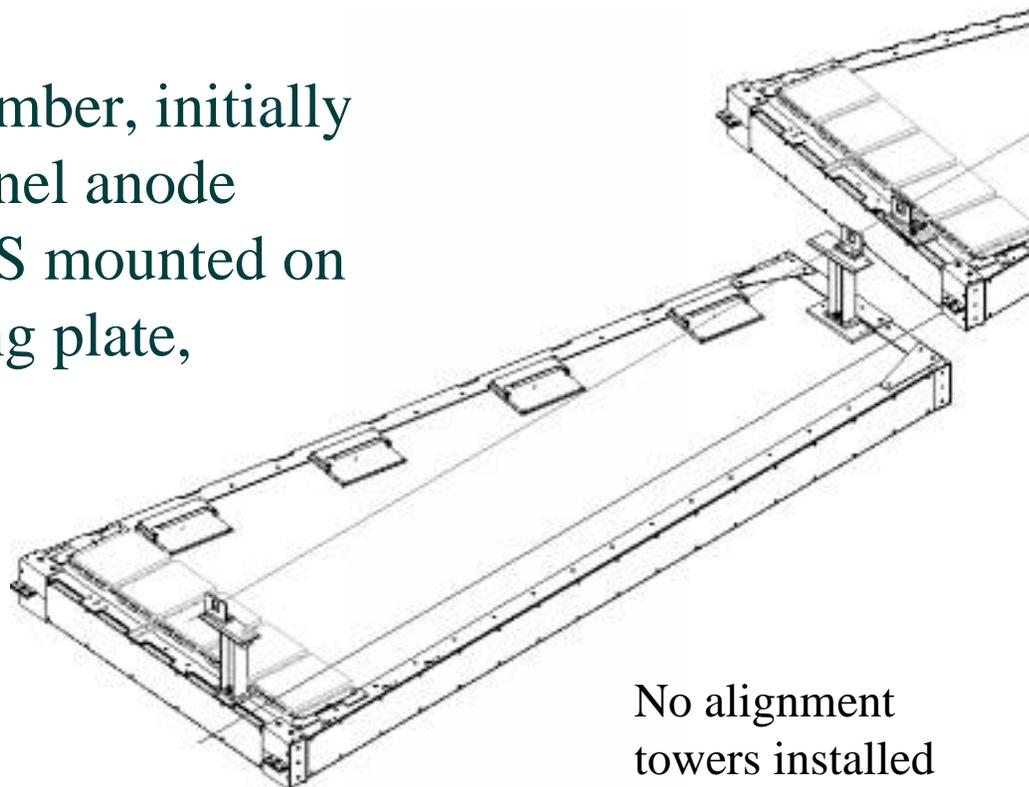
08 Nov 99 - 12 Nov 99

- Second visit from OSU, we are now beginning to understand the issues



Chamber configuration

ME 234/2 chamber, initially using 96-channel anode boards. CFEBs mounted on cathode cooling plate,

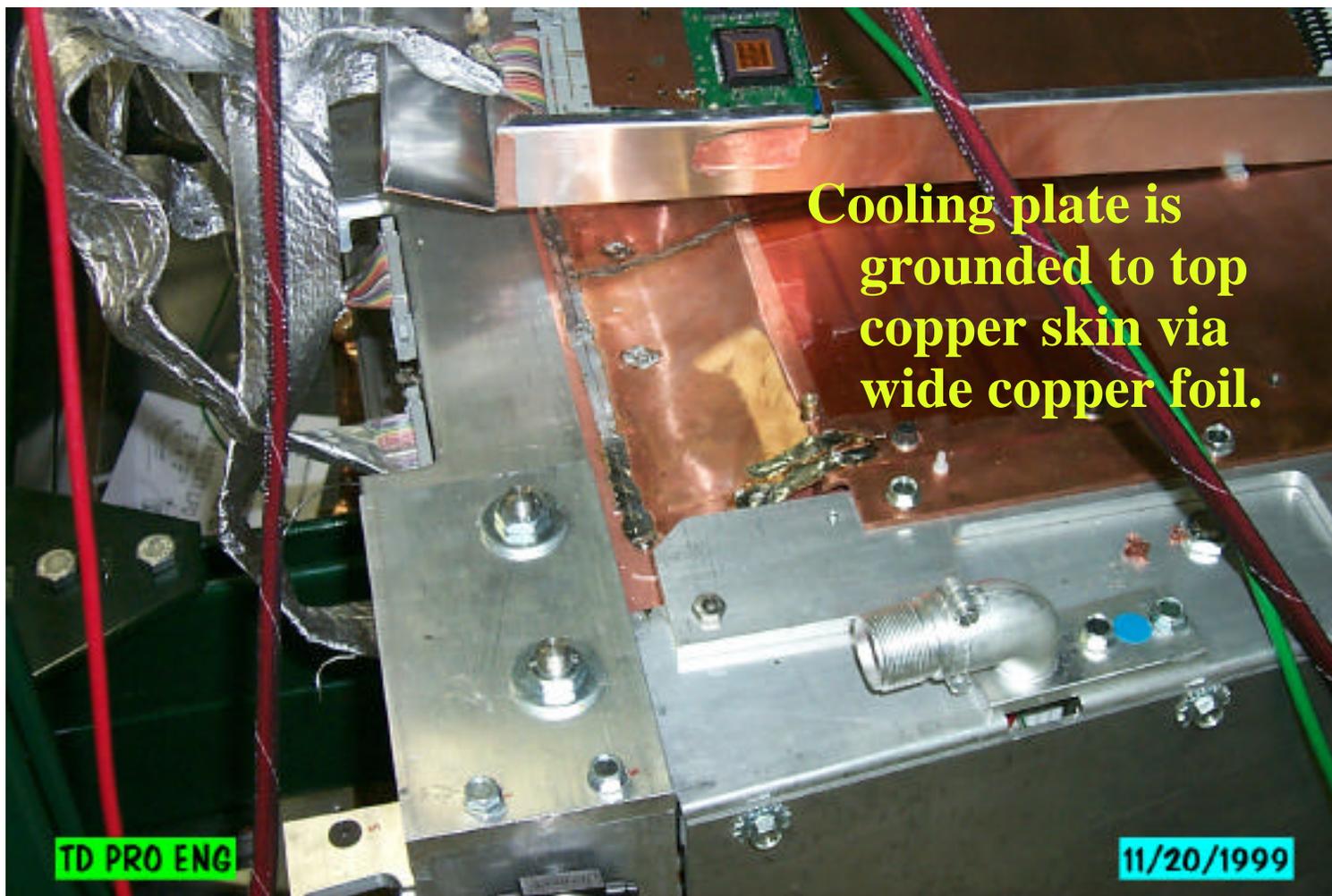


No alignment towers installed

But with significant modifications to grounding design ...

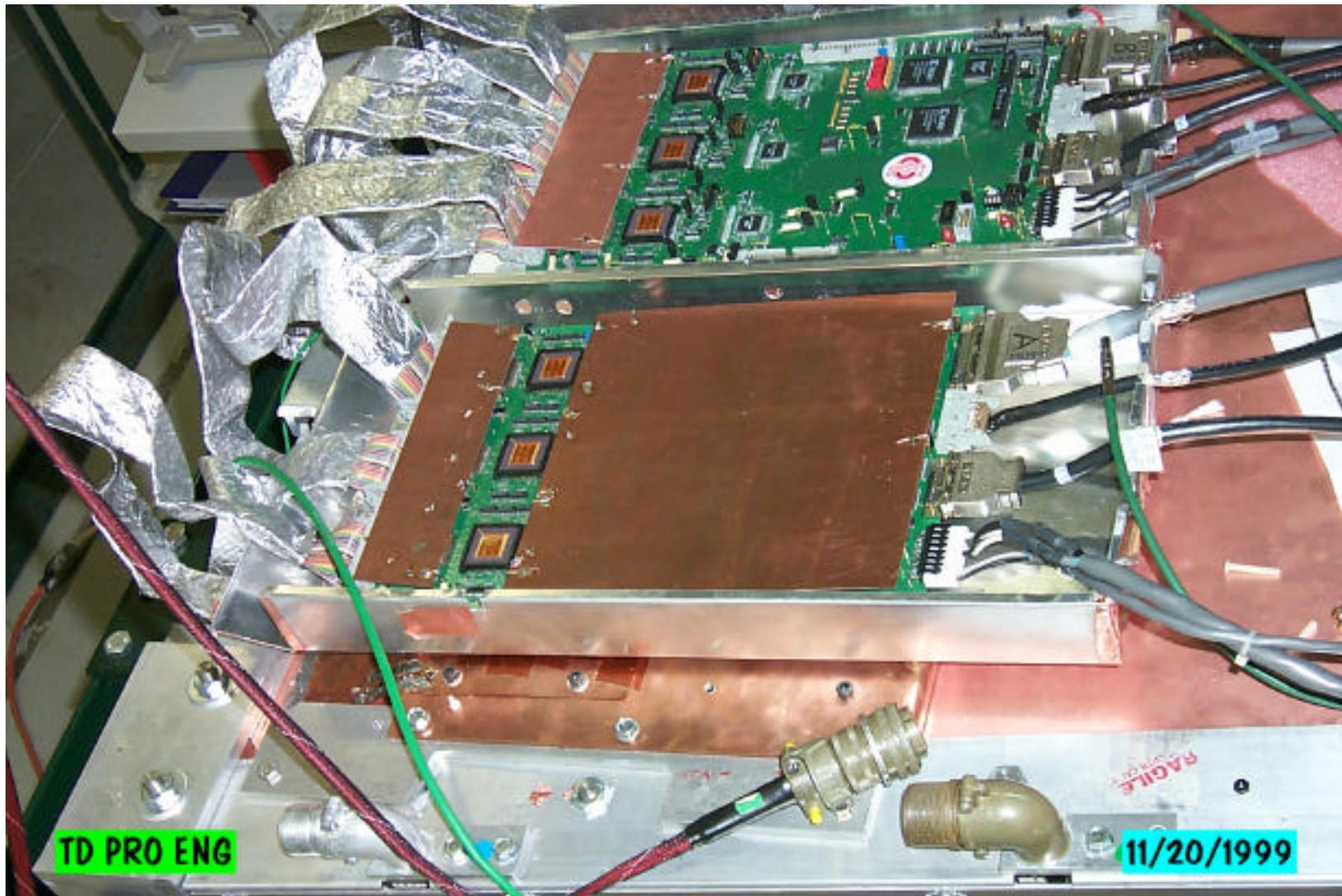


CHEB grounding



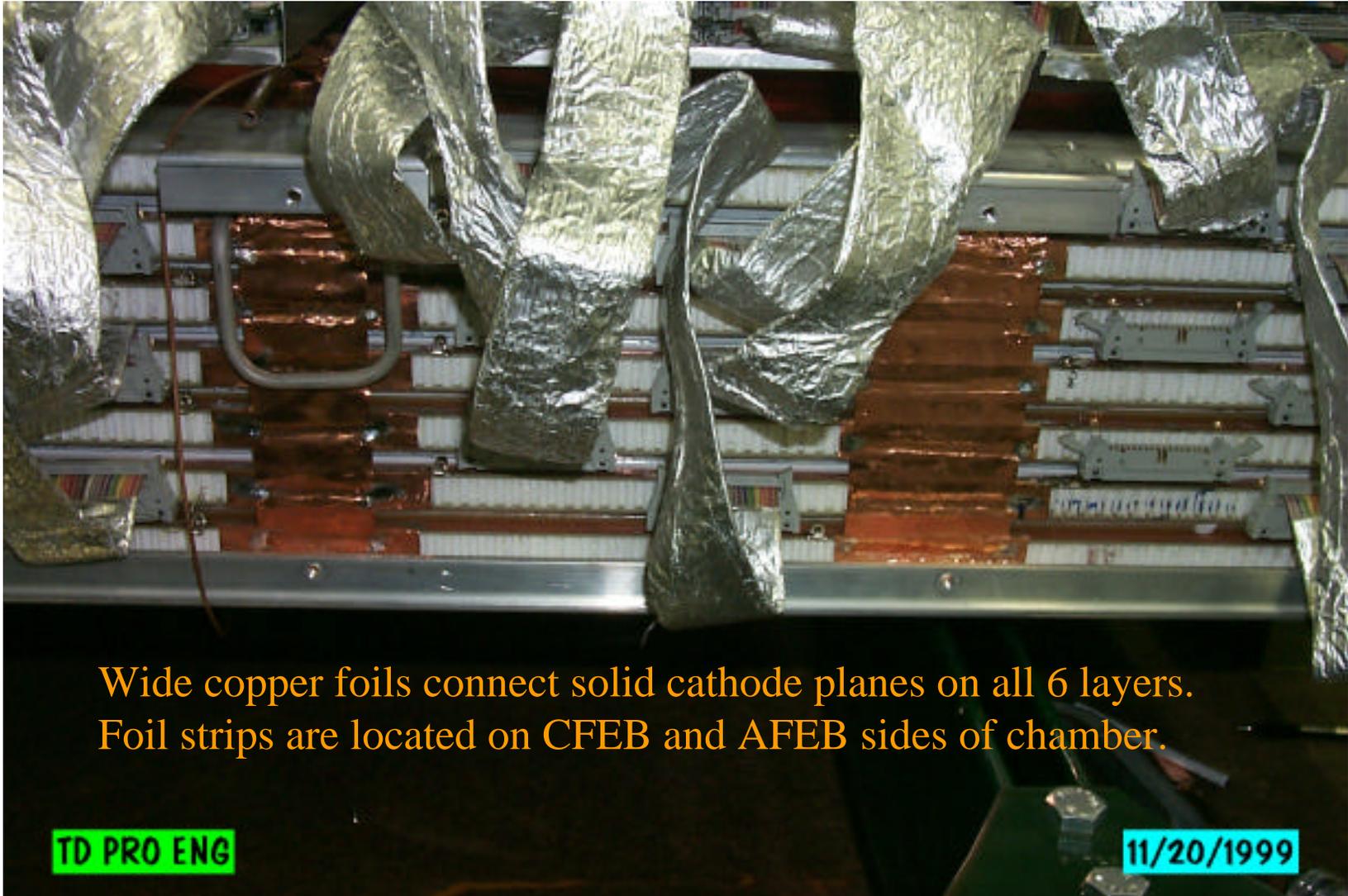


CFEB Shielding Modifications





Inter-Plane Grounding



Wide copper foils connect solid cathode planes on all 6 layers.
Foil strips are located on CFEB and AFEB sides of chamber.

TD PRO ENG

11/20/1999



Faraday Shield Test

Tried to simulate Faraday shield by cutting internal grounds to the top layer of chamber.

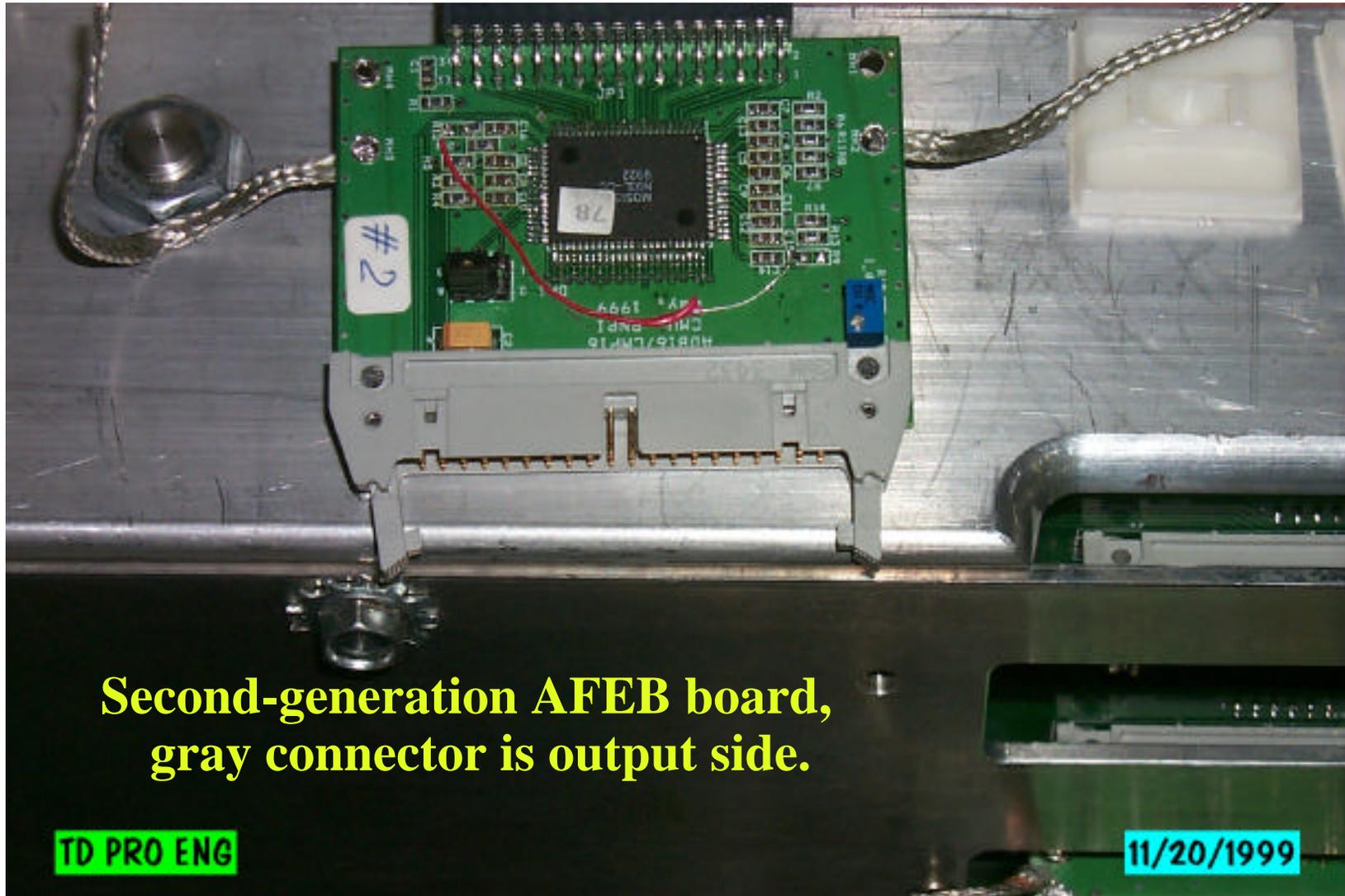
- Planned to test noise immunity of remaining 5 layers against current design
- Unfortunately, signal cables to CFEB were still connected to all 6 layers.
- Top layer was still connected to front end ground via signal cable

Injected 5v @ 15 MHz current into top of chamber through 200 Ohm resistor

- Detected 0.5 ADC counts on some channels
- Did not detect this noise in original configuration



16-channel Anode Board



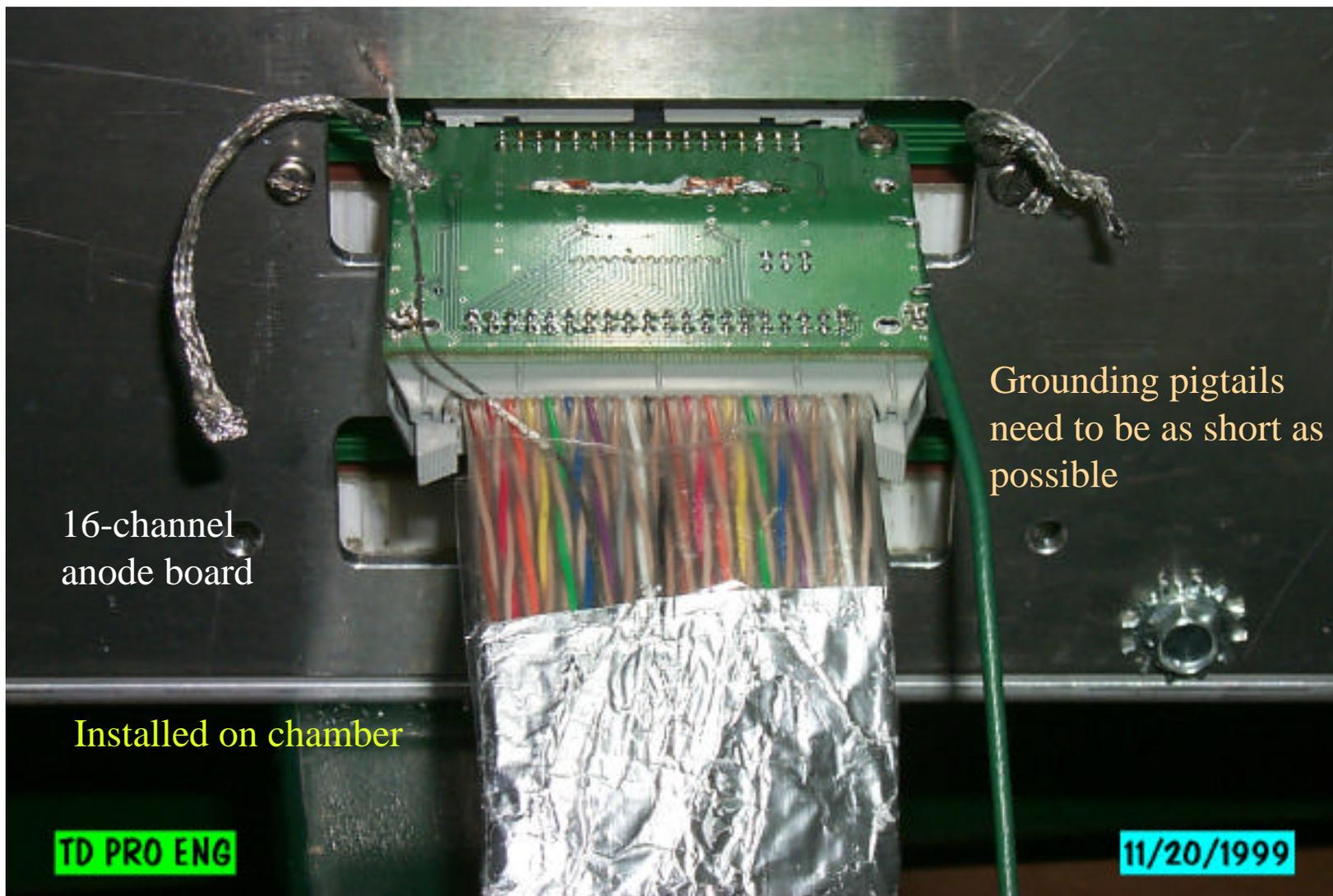
**Second-generation AFEB board,
gray connector is output side.**

TD PRO ENG

11/20/1999



Anode Board Grounding



16-channel
anode board

Installed on chamber

TD PRO ENG

11/20/1999

Grounding pigtails
need to be as short as
possible



Conclusions

- Major source of noise is digital noise generated on CFEB board, apparently harmonics of 40 MHz clock
- Emphasis should be placed on solving the digital noise problem at the source, i.e. to prevent propagation off the CFEB.
- Faraday shield test was not ideal, but demonstrated significant noise immunity with respect to external sources
- Faraday shield on top of chamber may not be necessary
- CFEB input cables must have ground shield with low inductance (short, wide, thick). This compromises Faraday shield, but protects front end from digital noise



Recommendations

- **CFEB cables**
 - Cables should be kept short, need solid ground connection between chamber & amplifier
 - Round shielded cable will work, do not need twisted pair
 - Flat cable will also work, need solid ground shield
- **Al boxes**
 - Design of Al box that is integral to CFEB is under investigation
- **Amplifier end of CFEB must be grounded to box**
- **On-board shielding on CFEB is somewhat helpful**
 - Commercial sources of PC-mount shield boxes are being investigated
- **Faraday shield test will be repeated using Al skin over frame**
- **Need further anode board noise testing once we get real anode cables**