Grounding and Shielding
for the
CSC Sub-Detector

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Outline

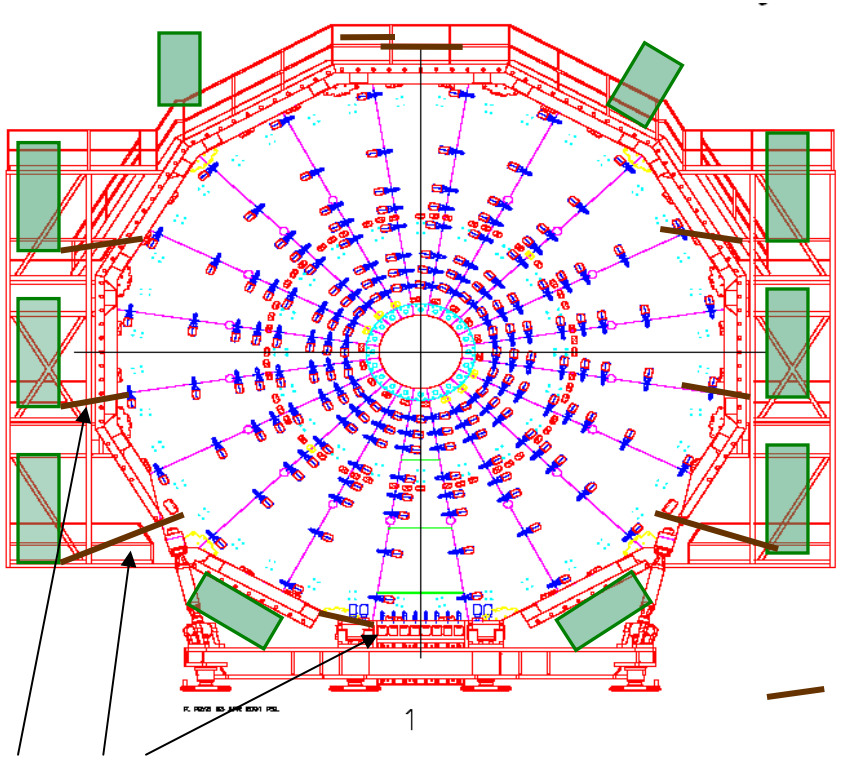
- Overview
- Detector Systems
  - HV
    - ME1/1 HV
    - All other HV
  - LV
  - Chambers (Signal)
- Summary

Overview

- Proper grounding and shielding of the CSC electronics is essential for proper operation
  - Earth or Safety Ground must be present for SAFE operation
  - Signal grounding must prevent and/or remove unwanted DC and AC noise from the system
  - Signal shielding must prevent AC noise through EM
- The common signal ground for the system is the steel of each disk
  - All grounds are connected to each disk and all disks are connected to the CMS wide ground

View of a Disk

- Each Rack is grounded to a special attachment point on the disk steel



Ground braid connected to grounding bar in rack at one side and to special point at the disk (DGT) at the other side.

Detector Systems

- HV
  - ME1/1 HV
  - All other HV
- LV
- Chambers

HV All Other

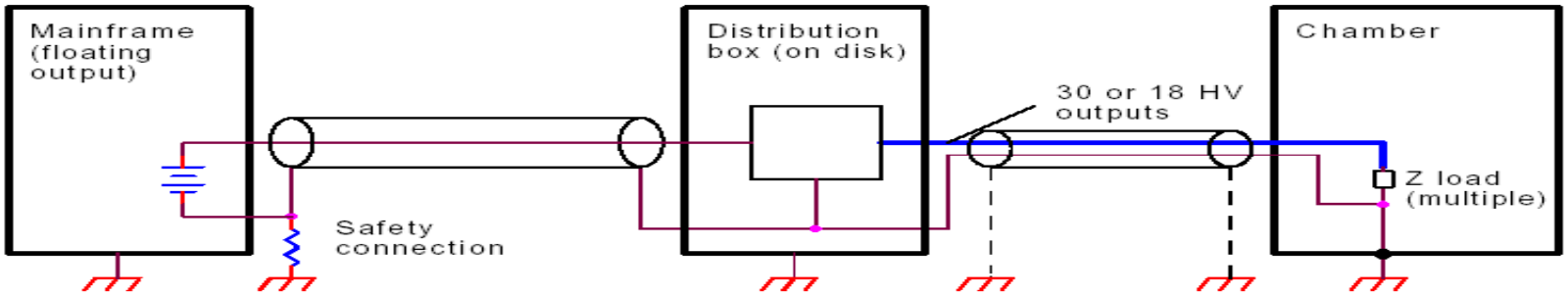
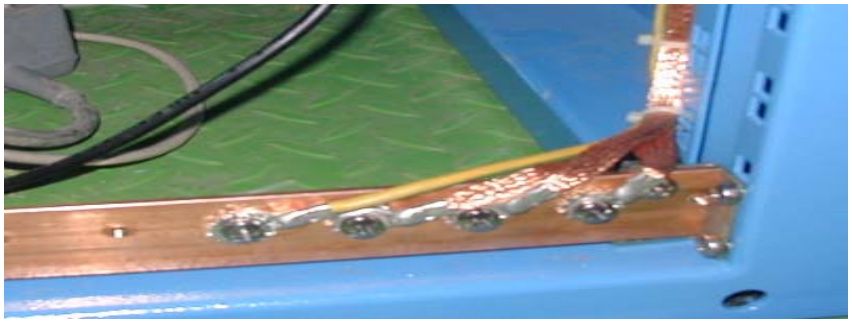


Figure 7. HV power distribution.

Grounding technique implemented at the HV rack

LV power supply grounding (top)
HV primary power supply grounding (bottom)

HV crates grounding point



Left and right sides of the rack grounding point

LV

- Use the Maraton LV system
- Route is OPFC ->
  - Maraton ->
    - pcrate or
    - JB -> CSC
- LV cables are shielded (supply + return)
  - Shield is connected to ground at load end
    - Have provision to connect at source or both
  - At pcrate can add (supply to return) filters

General Scheme for Signal Transmission

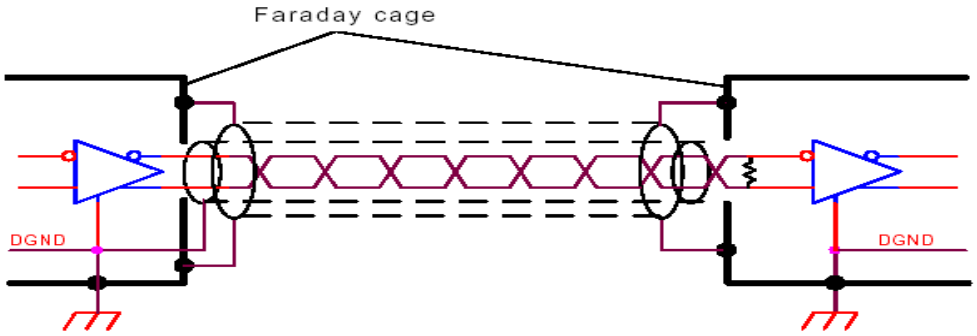
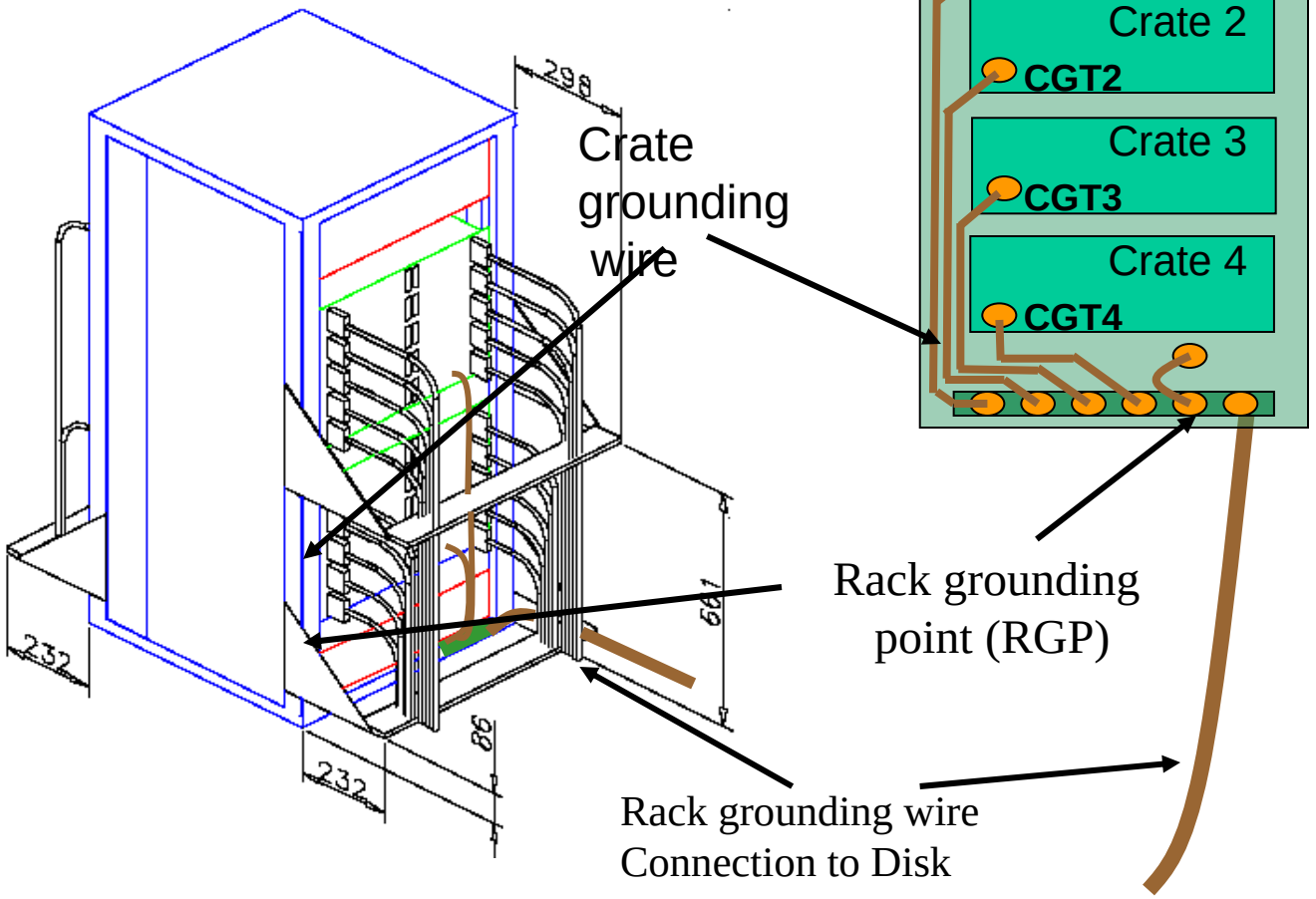


Figure 3. Digital signal transmission.

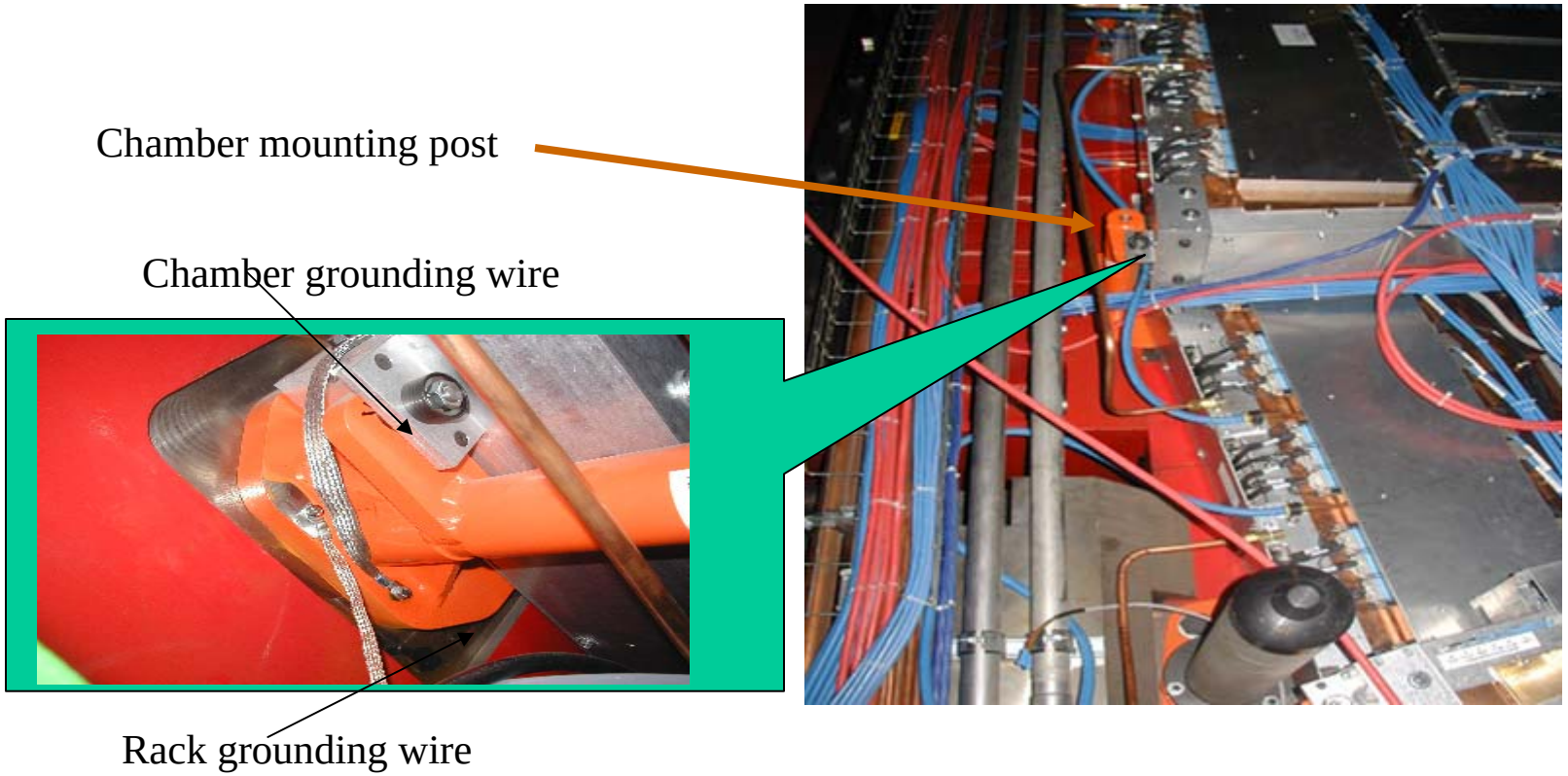
7. Rack Grounding Terminal (RGT). Rack grounding scheme.



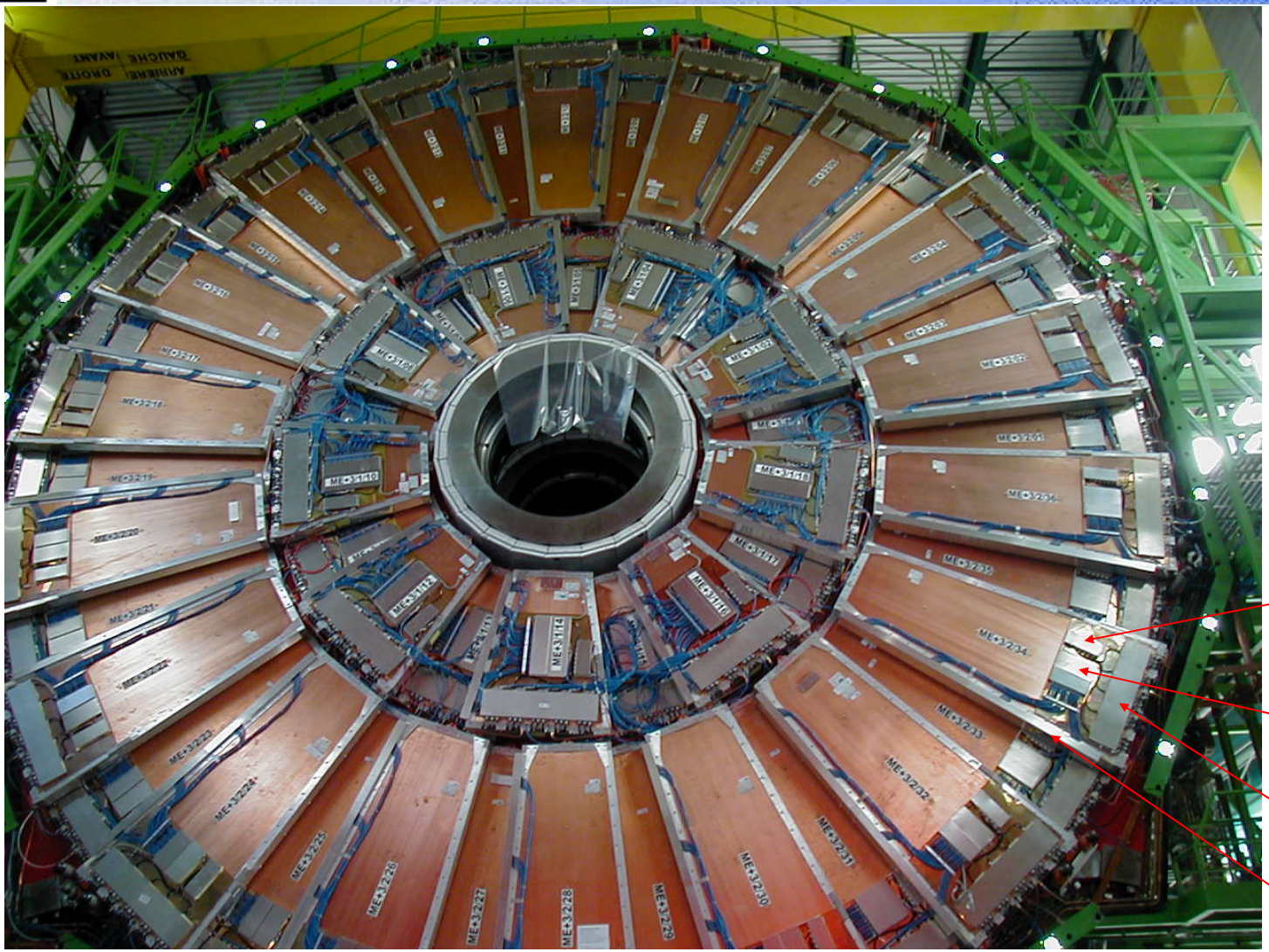
Crate grounding wire : Copper braid 10 mm^2 with O-ring terminals on both sides

Rack grounding point: Brass bar size 15x5 mm^2.

8. **Disk Ground Terminals (DGT) and rack grounding.**



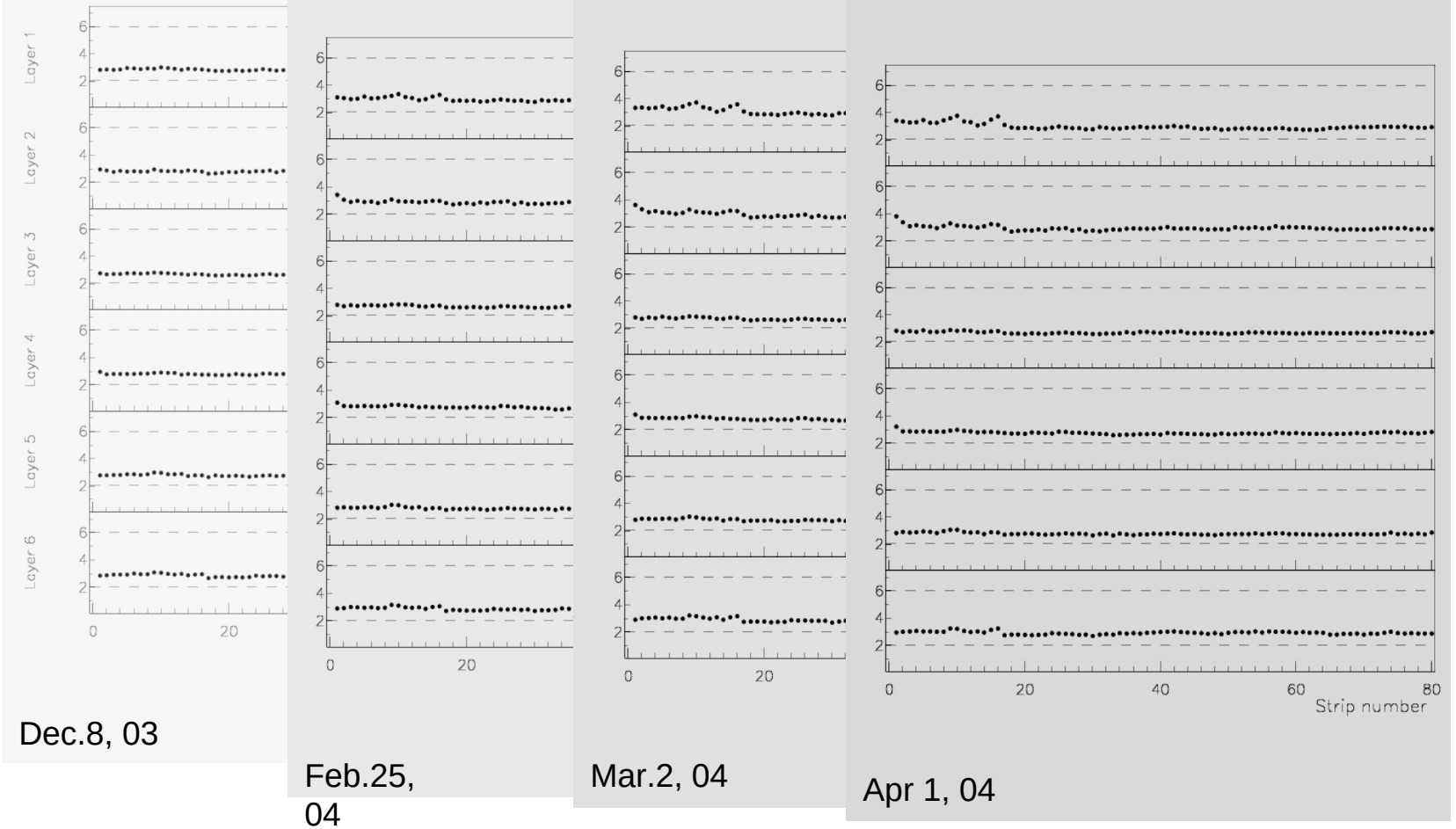
CSC's with electronics at SX5



Noise Found and Fixed

- As chambers were installed they were extensively tested on the disk
- We found two different kinds of noise
  - Aging Noise
    - Increased with time
    - Two solutions
      - Soldered jumpers
      - Gold screws
  - Pickup Noise
    - Effected specific parts of FEB under signal cable bundles
    - Metal covers

“Aging” Noise



Dec.8, 03

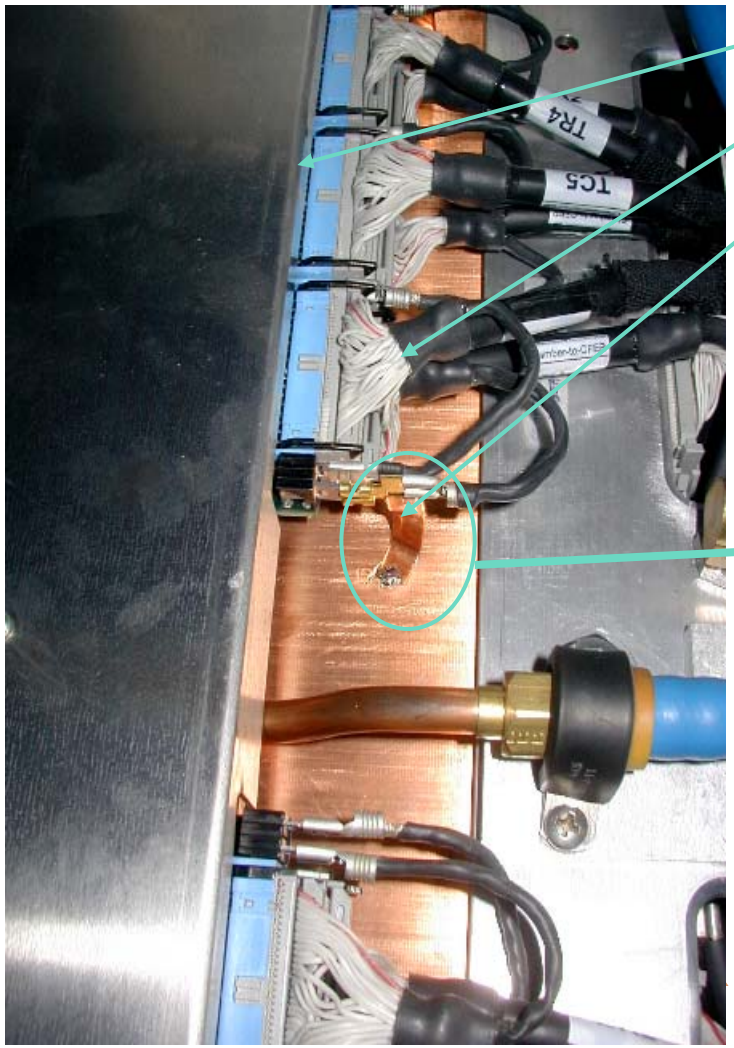
Feb.25, 04

Mar.2, 04

Apr 1, 04

- Grounding Problem

“Aging” noise solution: jumpers

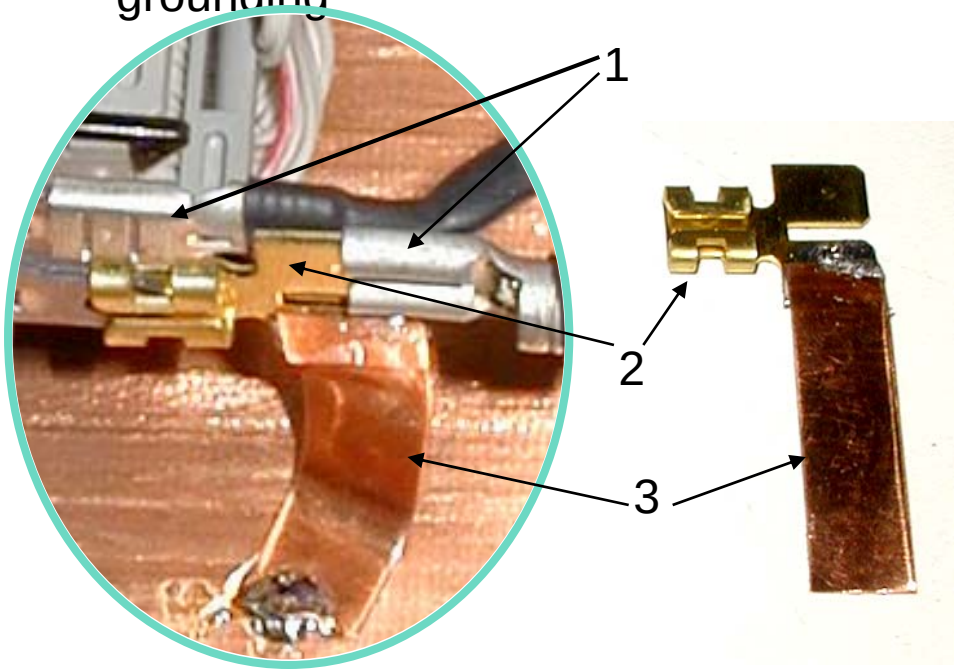


CFEB Input side

CFEB Input cables

CFEB Input cables grounding connection

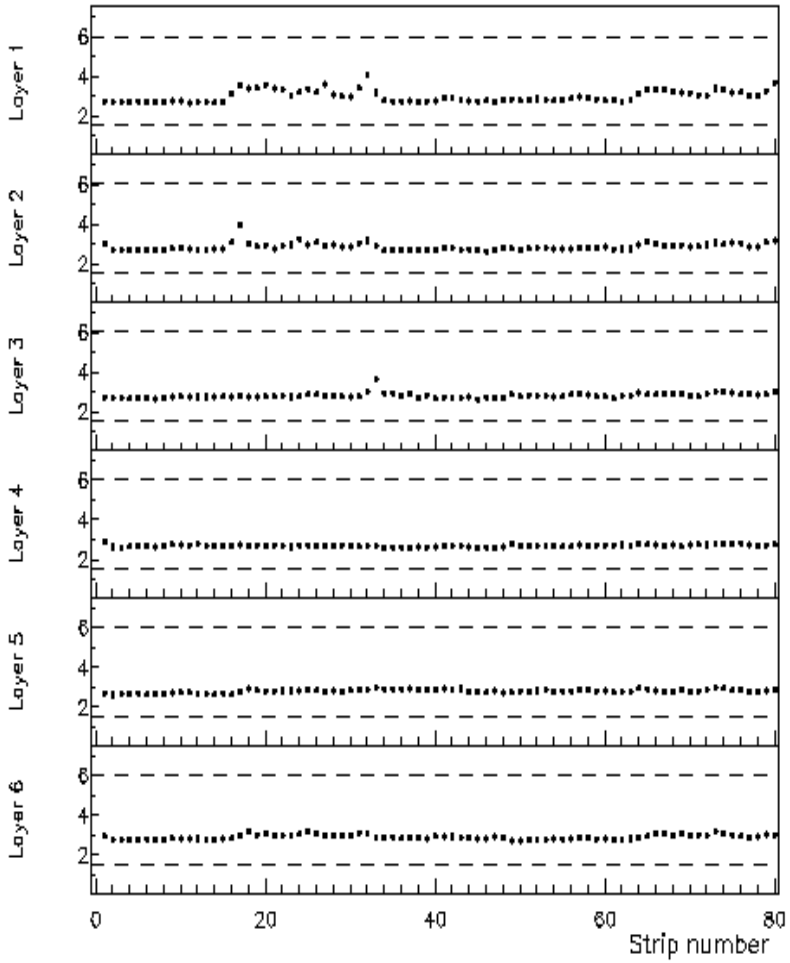
Additional CFEB grounding

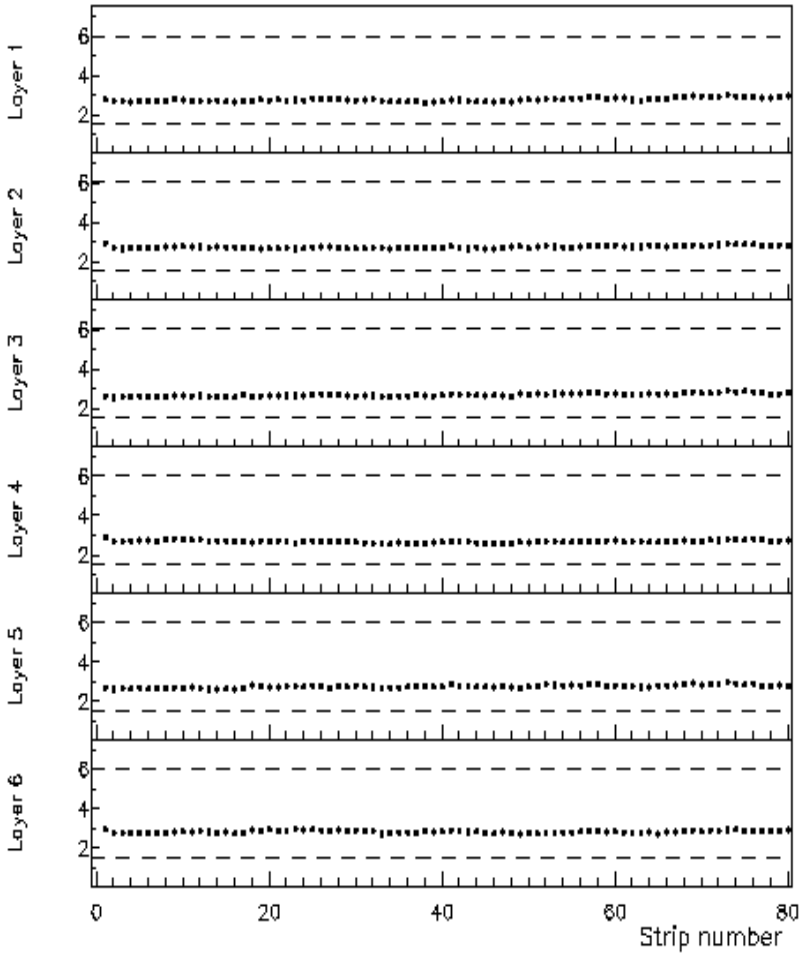


1. Cable grounding disconnect
2. Disconnect Adapter, Panduit D-250A-M;
3. Copper foil

“Aging” noise solution test

Original noise | Chamber ME-2/2/09 | **With jumpers**

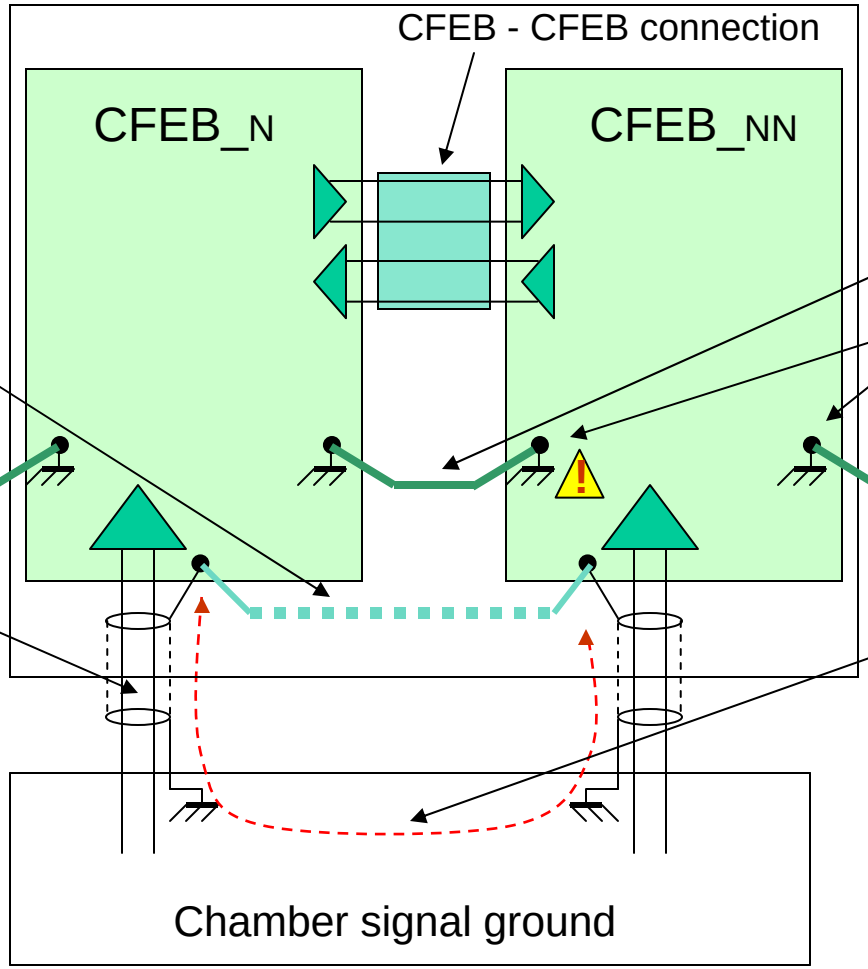




ME234.2.063
Test 15
CFEB Noise test
CFEB Noise
/data/csczdata/cscdataz003759.dat

Aging Noise

1. Internal pickup



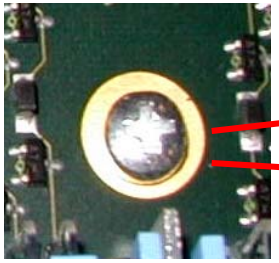
When the contact is lost because of corrupted screws some unbalanced current will go through the chamber signal ground.

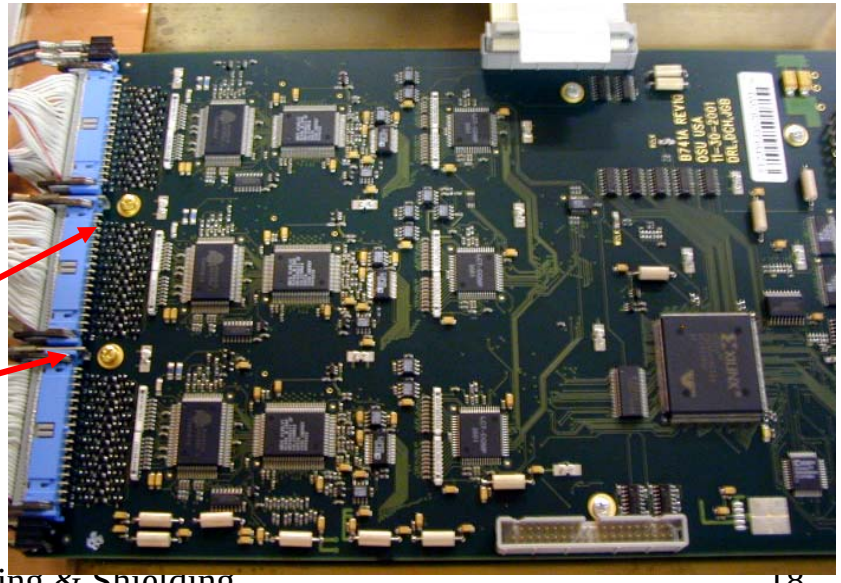
The best way to fix this problem – restore the contact.

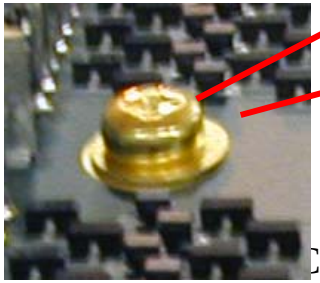
Solution was to replace screws with gold plated ones for permanent contact.

“Aging” noise, adding gold screws

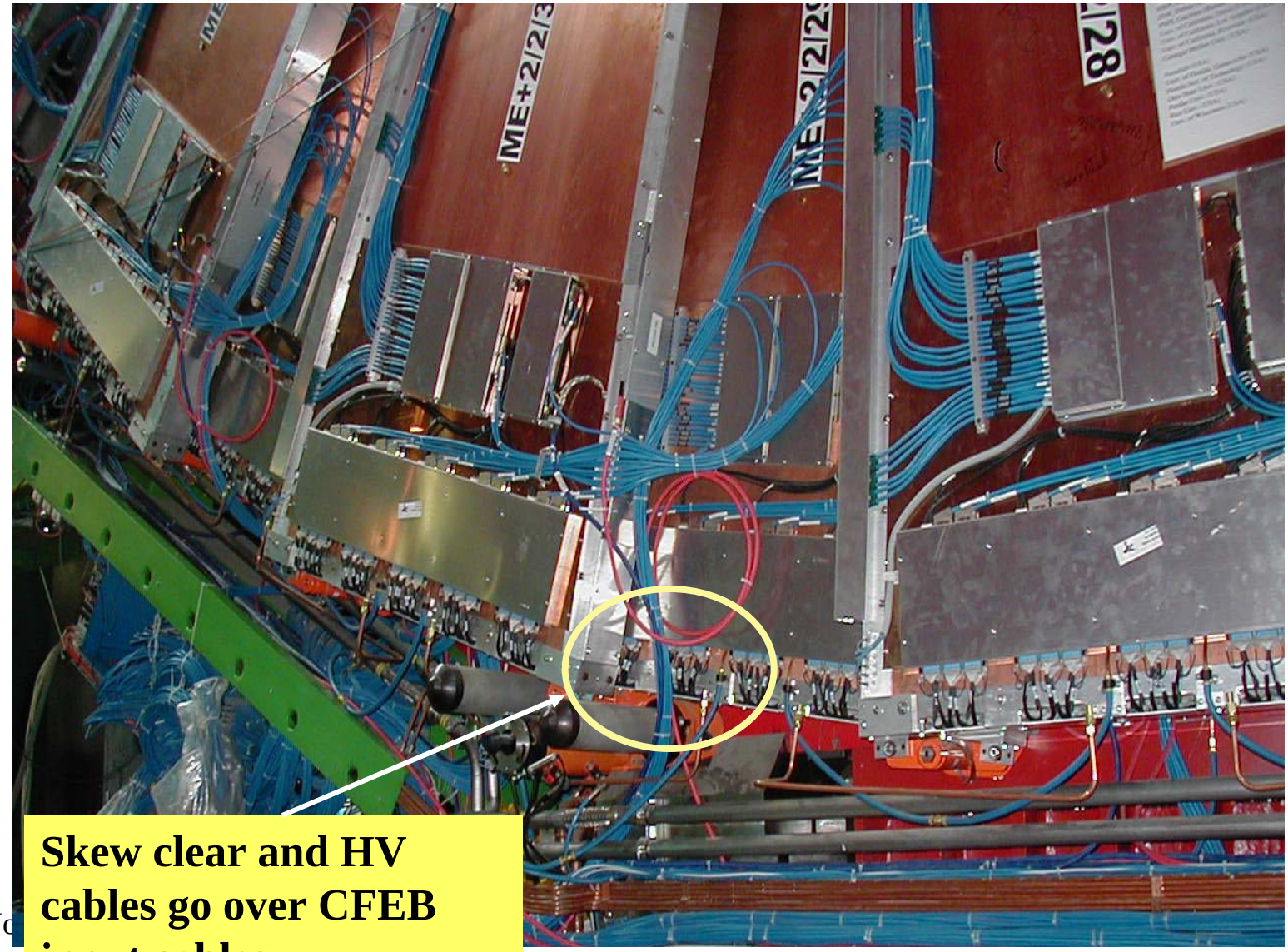
- Gold Plated screws







Electromagnetic Pickup Noise

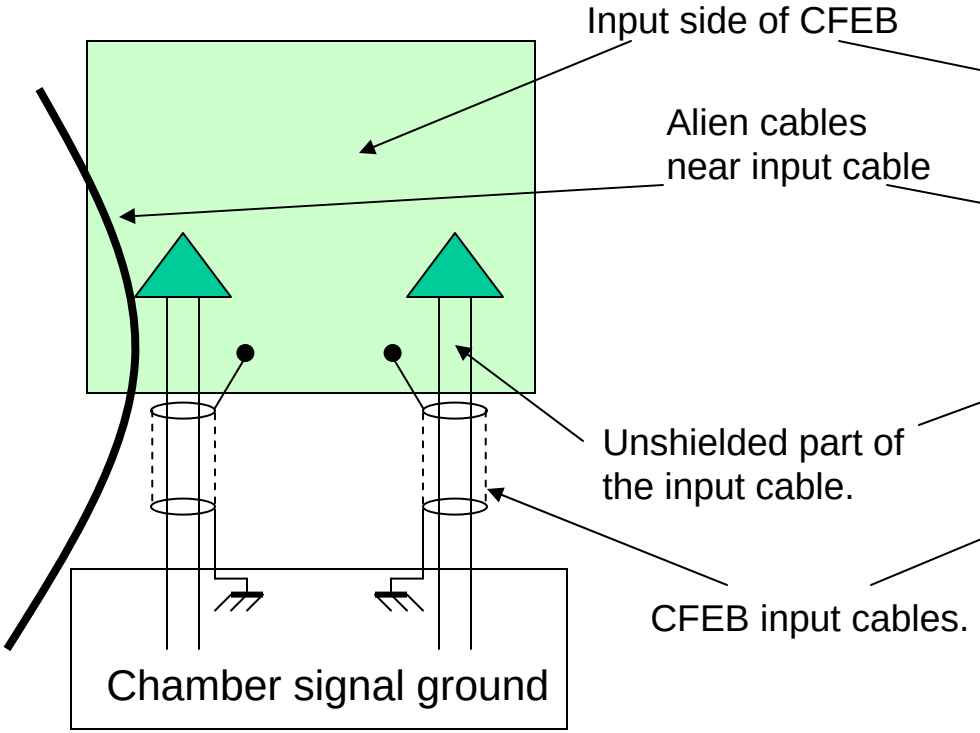


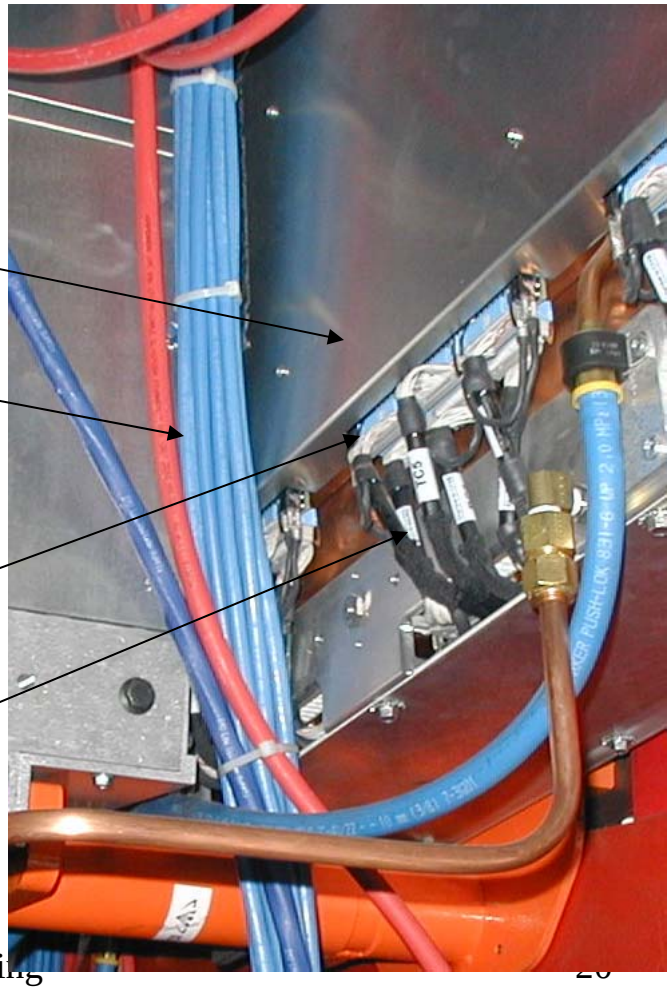
Noise sources

There are 2 noise sources:

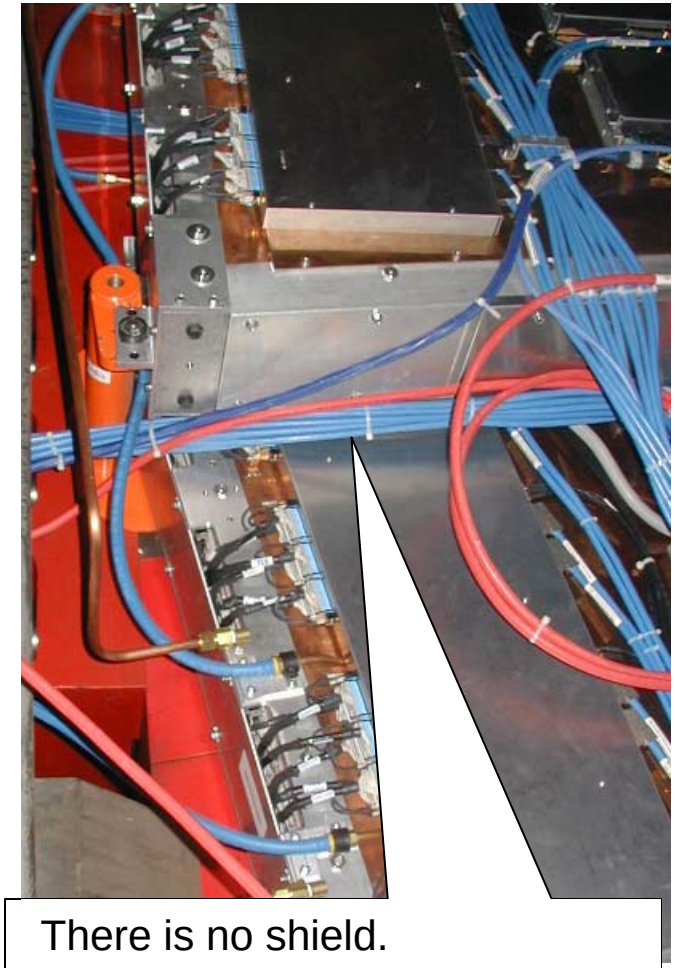
2. External pickup

Outer shield of the alien signal cable works as an antenna and may retransmit disturbances to the CFEB input cable located nearby. The value of measured noise is a function of the noise source power and disk location relatively the noise transmitter.

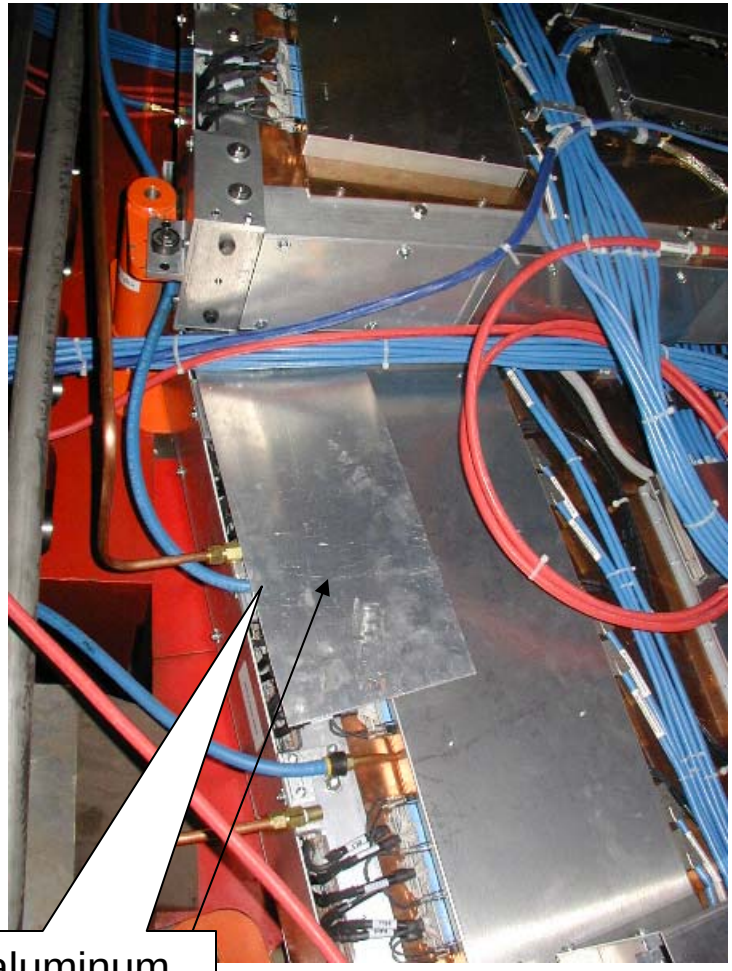




External pickup noise
shielding



There is no shield.
To reduce pickup noise the cable bundle was moved out of the input cables

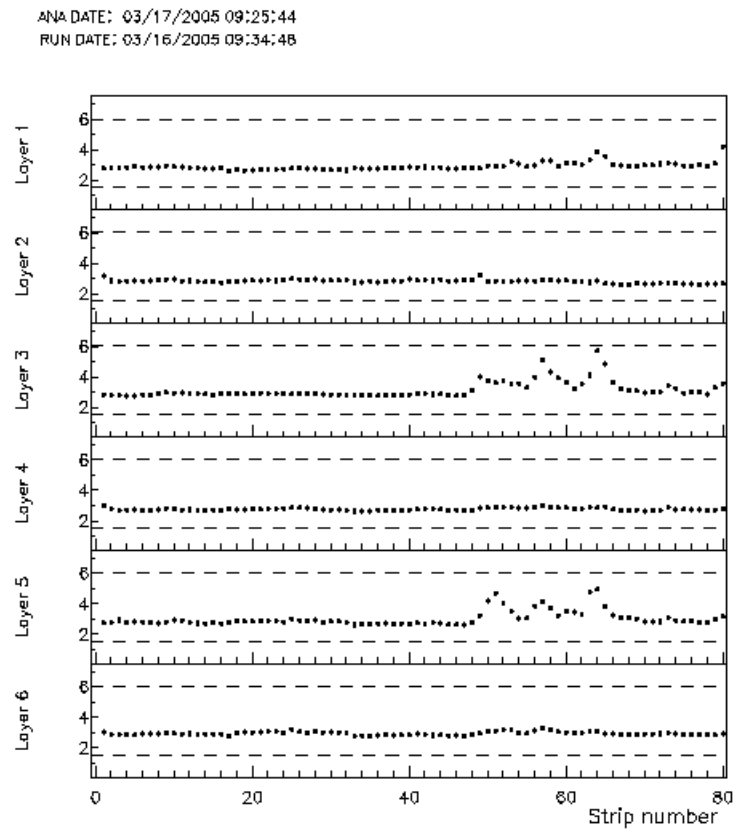


Piece of aluminum used as a shield

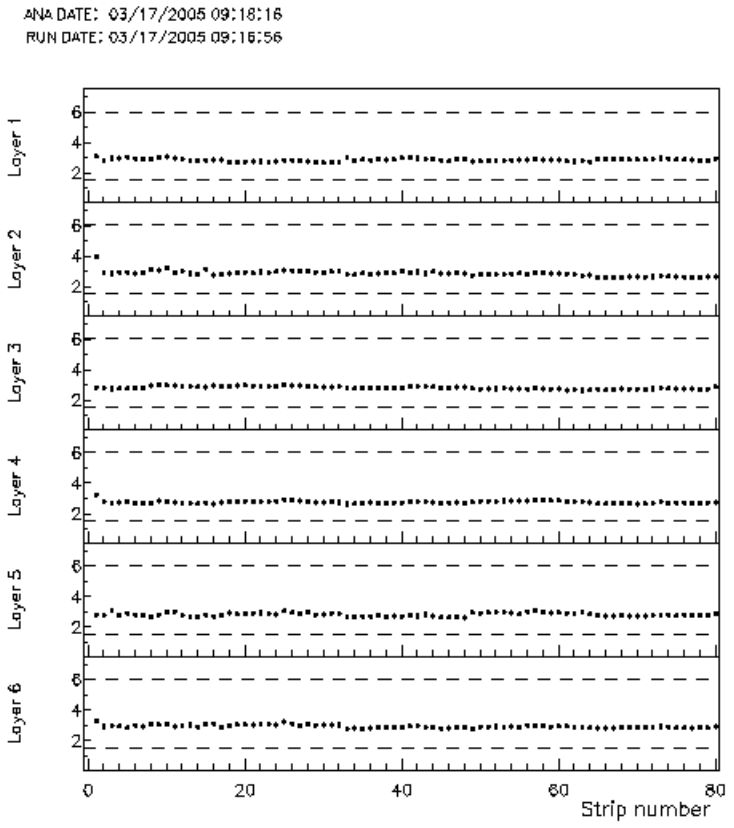
External pickup noise
proposed shield

Shielding effect

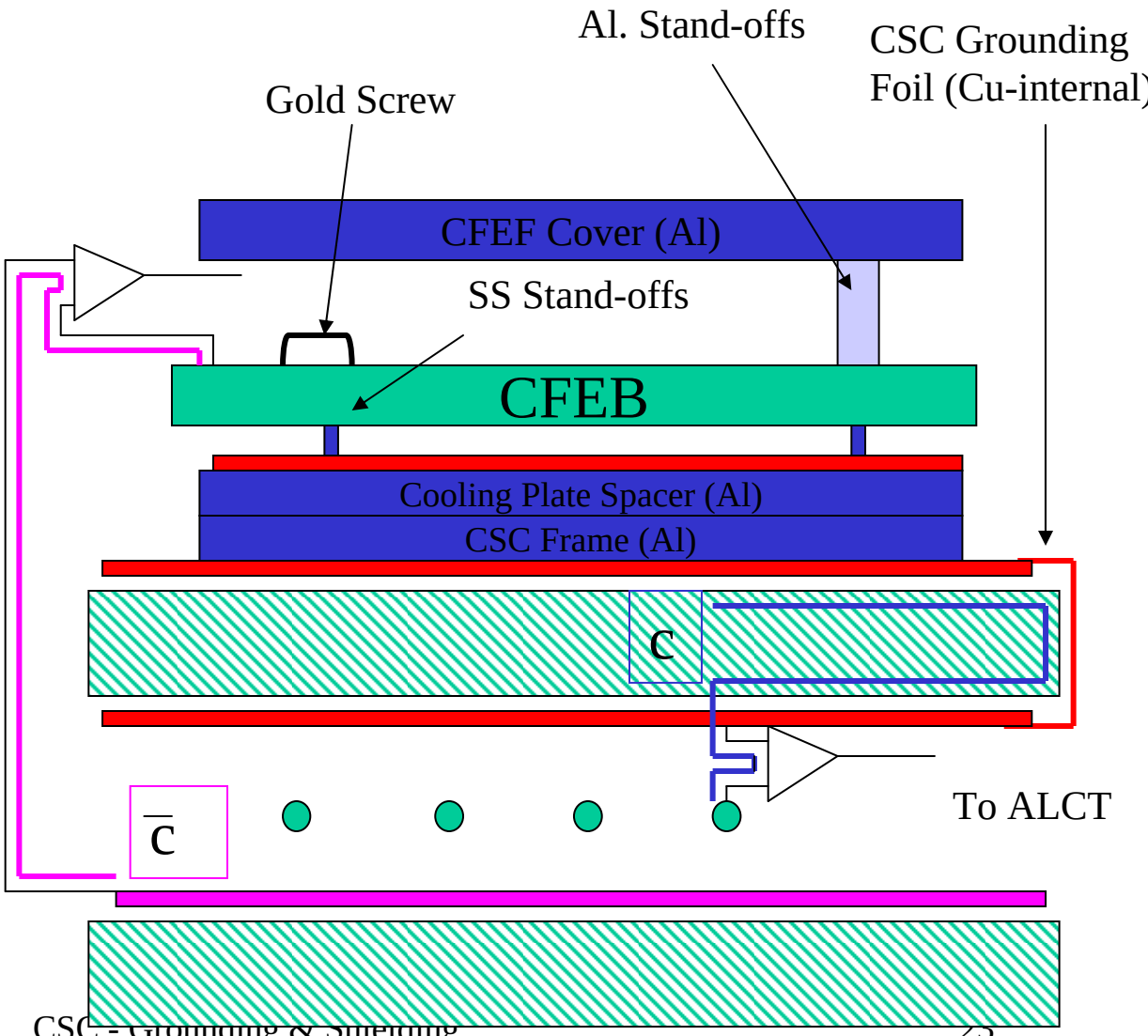
Noise before shielding



Noise on shielded chamber

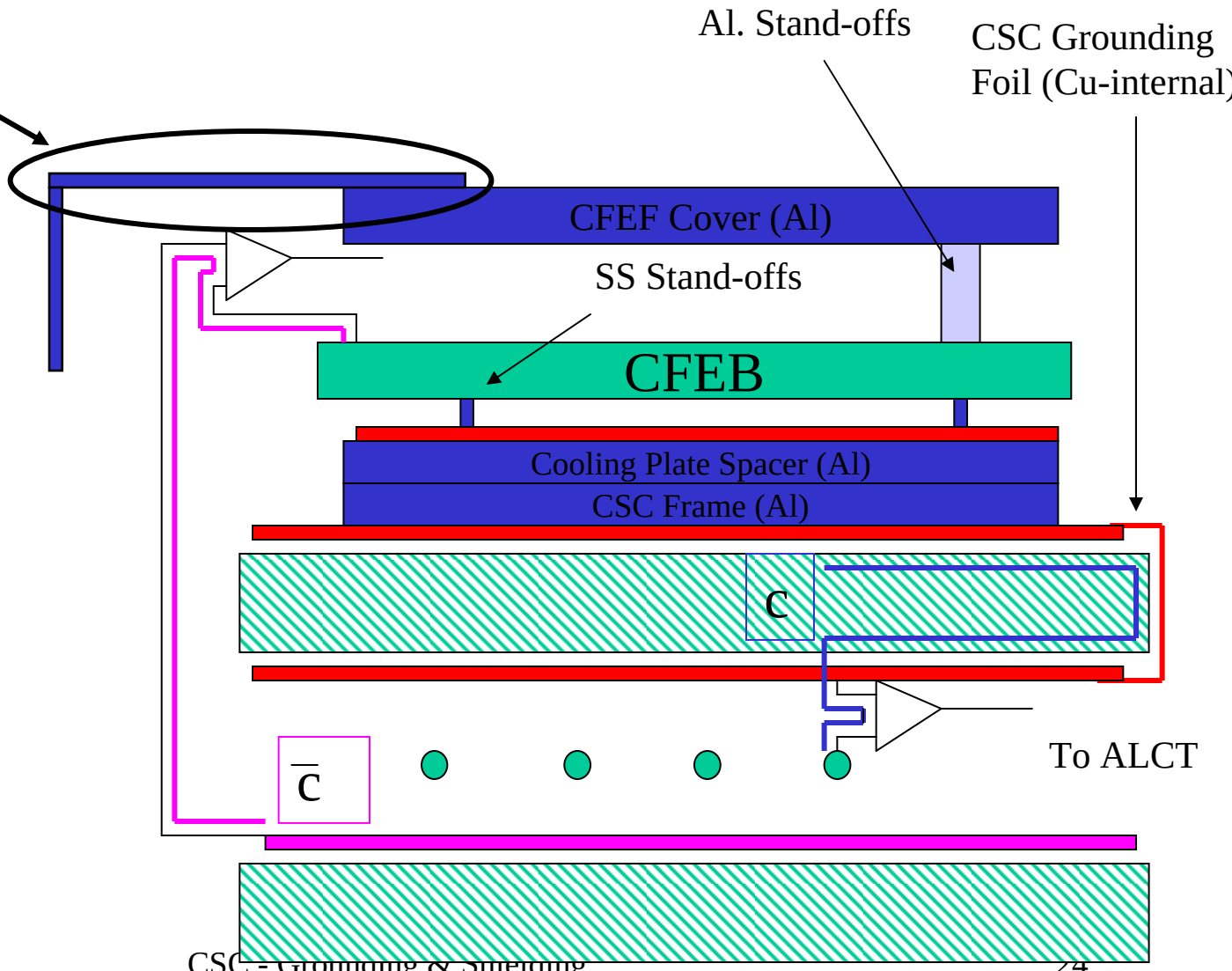


Grounding Changes



Grounding Changes

- Provide an RF cover with conductive mech. connections (copper or alodyned Al.) and ground it to the BG.



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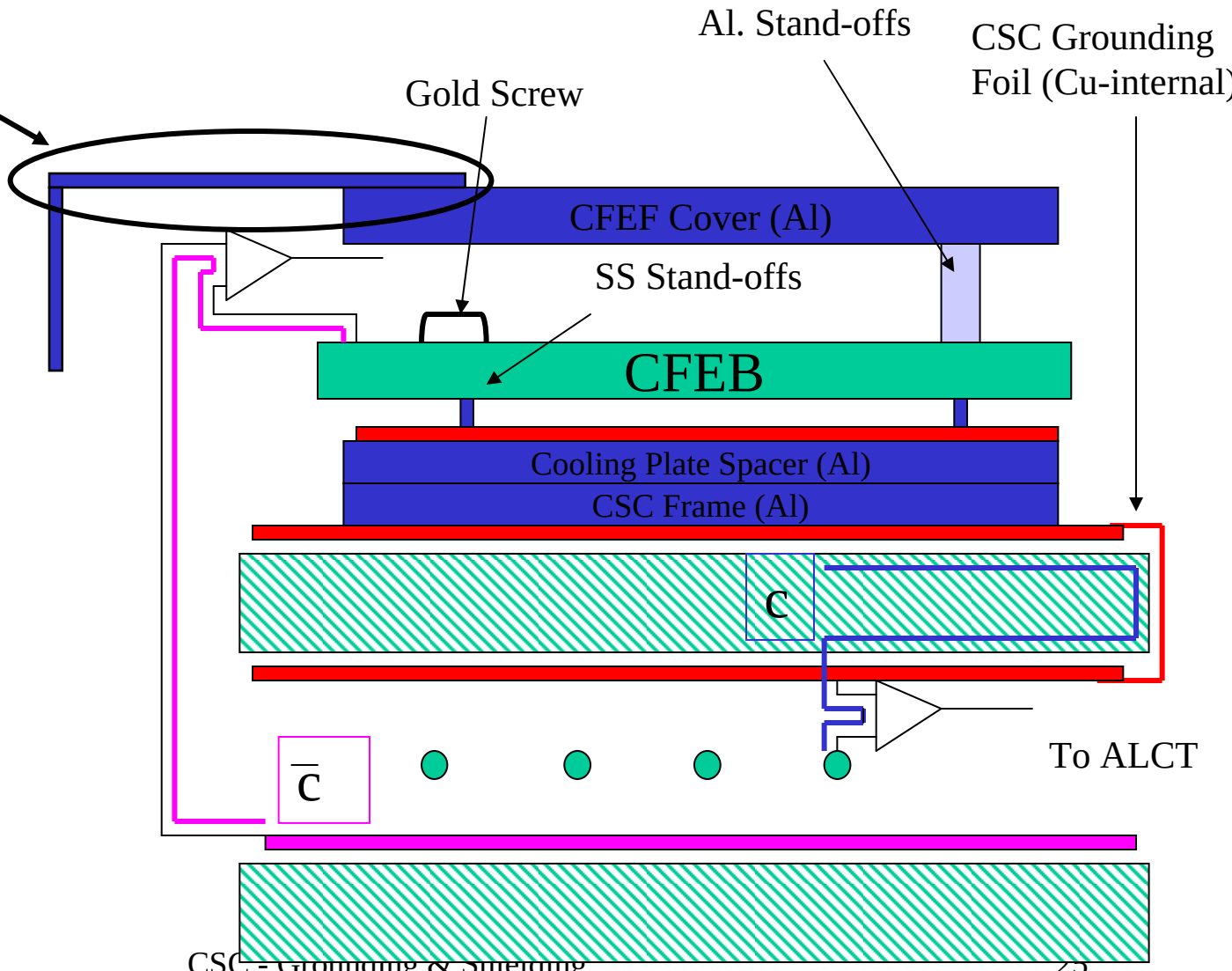
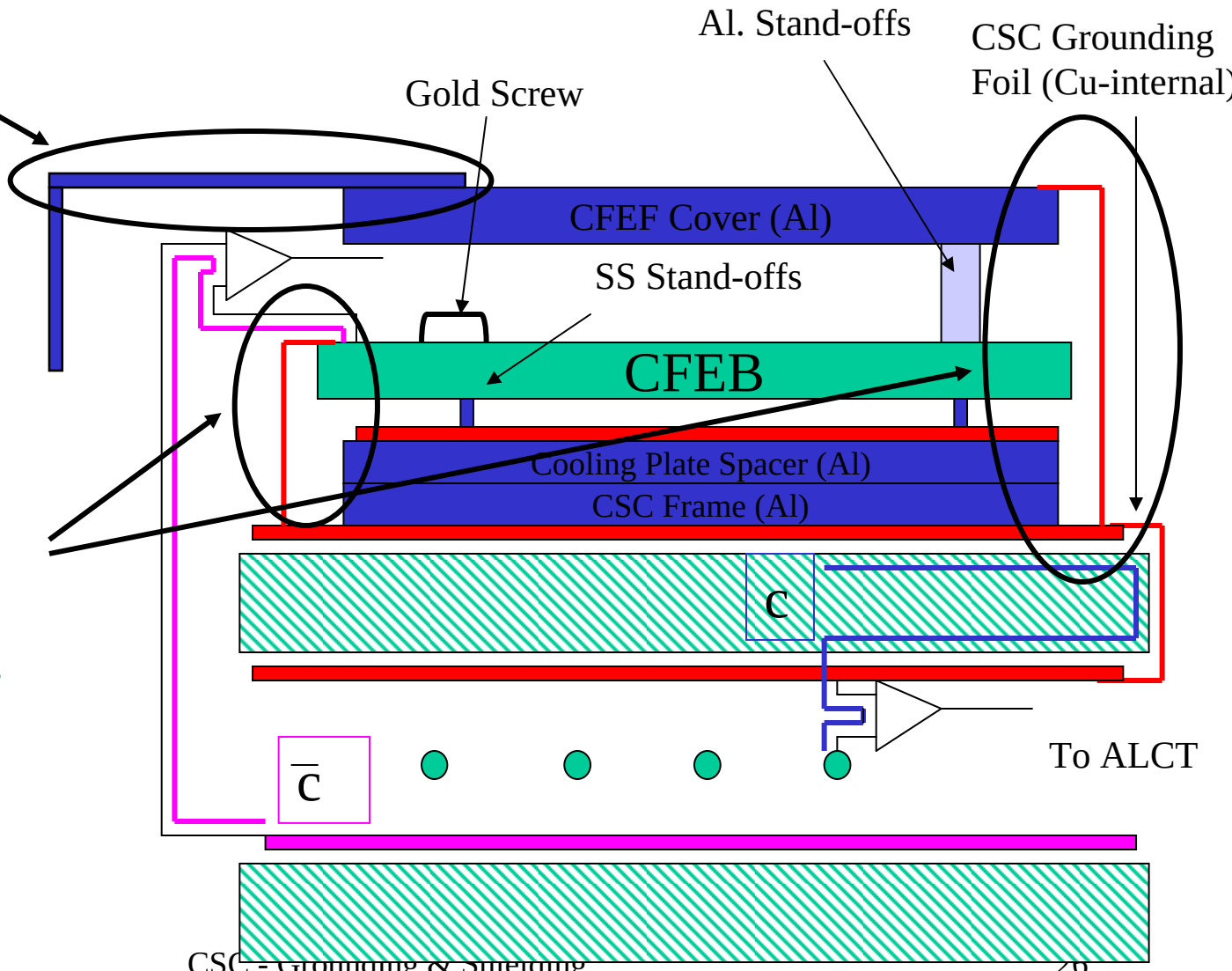


Grounding Changes

- Provide an RF cover with conductive mech. connections (copper or alodyned Al.) and ground it to the BG.
- Ground through a path of minimal impedance (copper, soldering, etc.) the ground of the CFEB.



Summary

- CSC has worked to build good grounding and shielding into their systems
- In installation and test noise was found at the chambers and corrected
- Have provided options for problems found in final system
- Are beginning to run final system

- Extra
- Slides