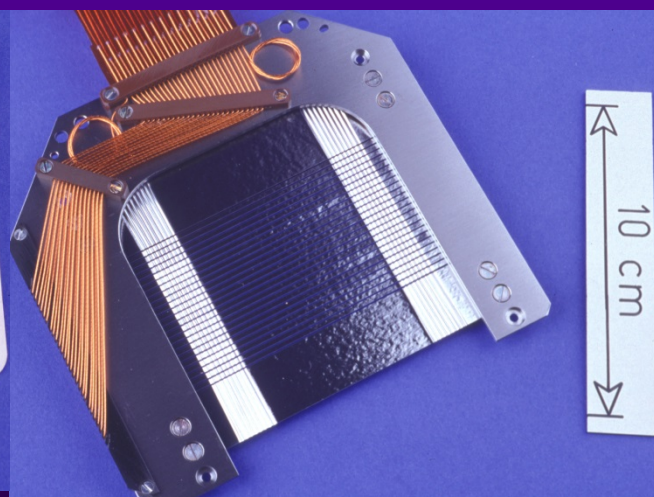
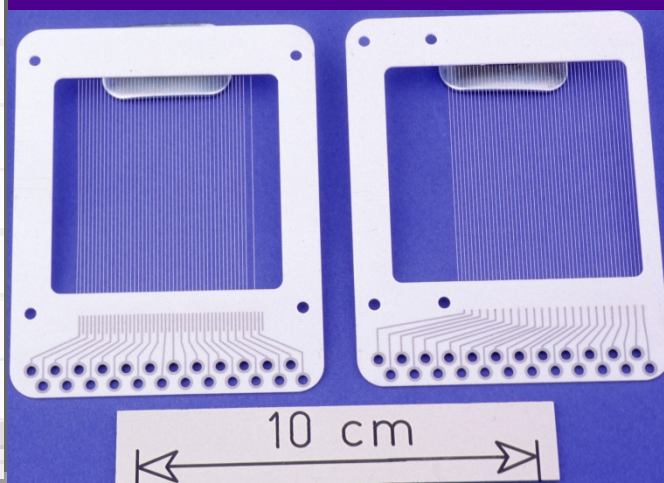
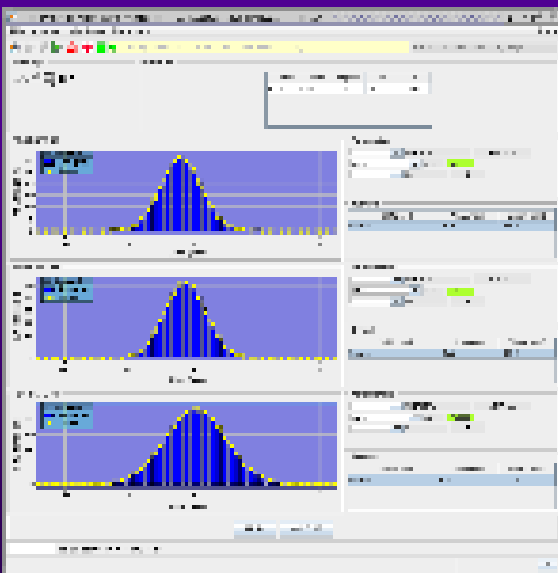
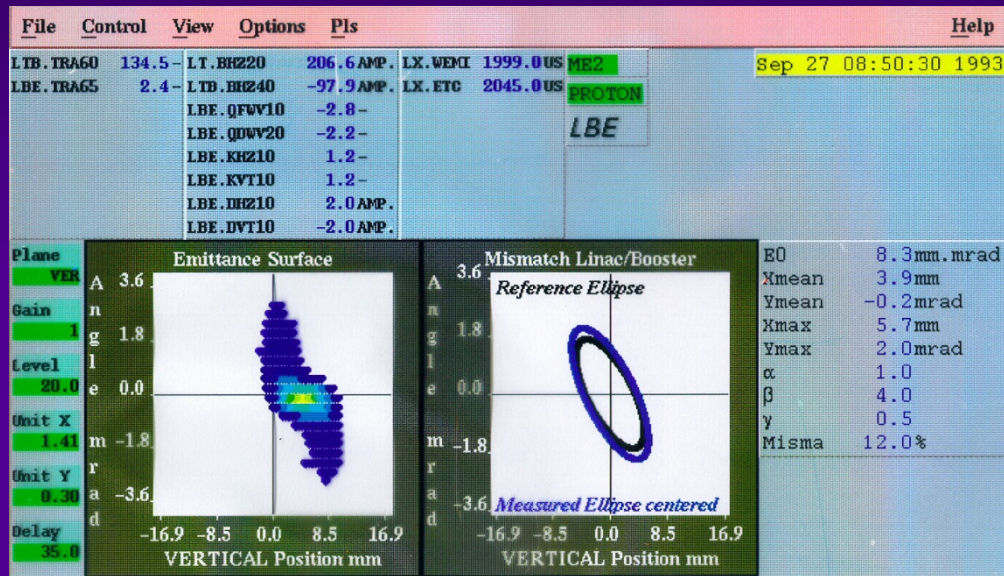
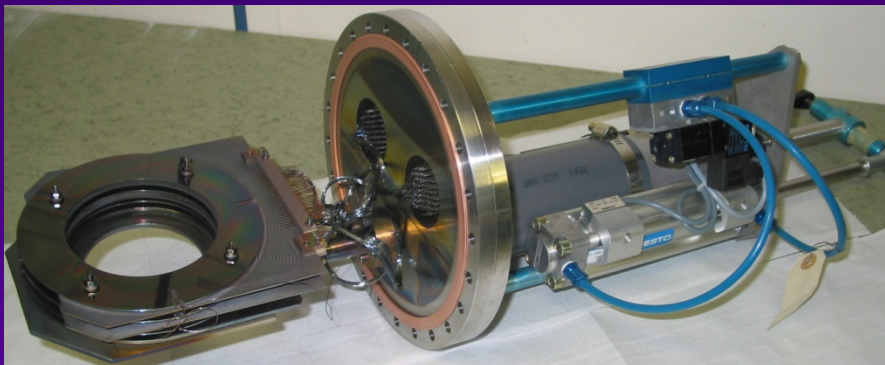


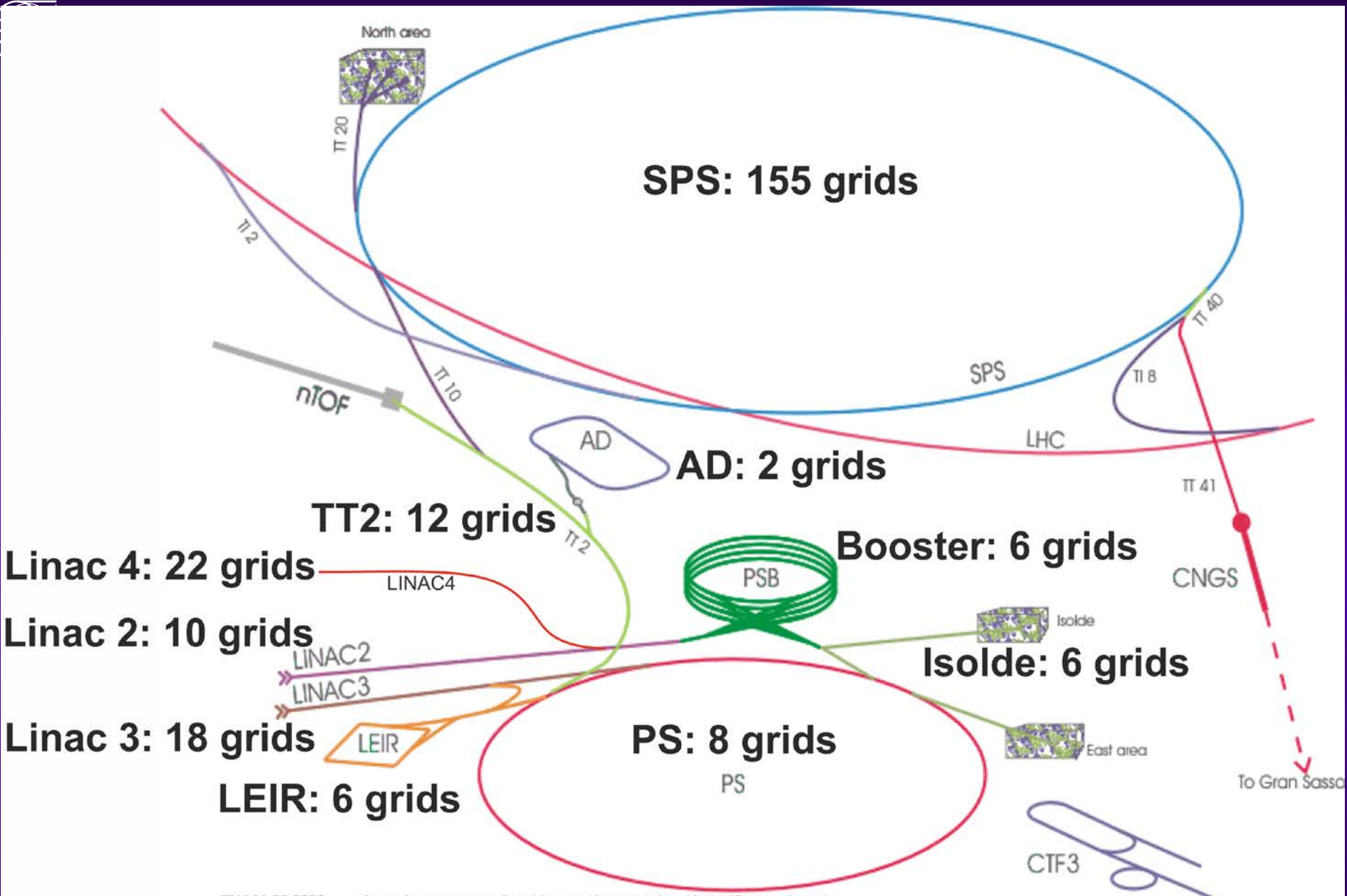
**BI-day 2014,**

**The SEM-grid renovation  
project**

**Michel Duraffourg**

# The SEMgrids (Secondary Emission Monitor)





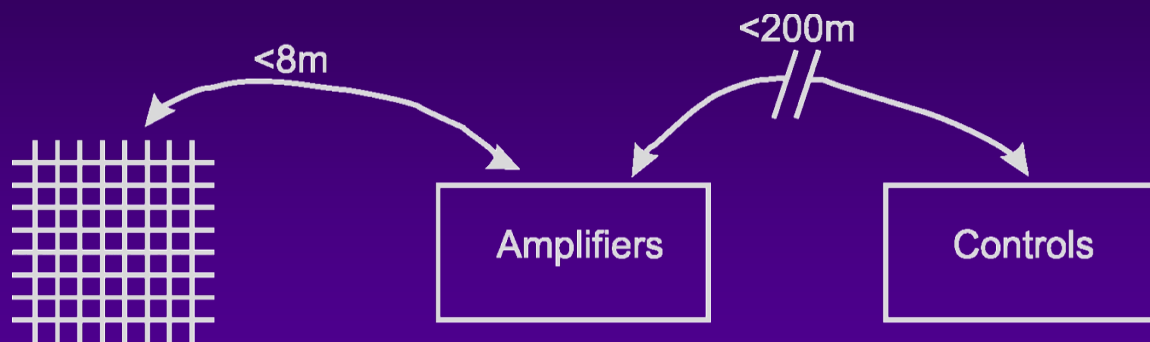
SDM 11.05.2005 - dimensions not proportional to machines real sizes / from AB\_complex.cdr

The electronic systems were renovated for 68 PS grids.

# Introduction

- ◆ Electronics of PS SEM-grids needed being replaced, too old and obsolete components.
- ◆ Common development for Linac 4 and PS-Complex
  - ◆ Linear Amplifiers for long beam pulses (Linacs),
  - ◆ Integrating Amplifiers for short beam pulses (circular machines, transfer lines).
- ◆ The Amplifiers need to be placed near the detectors, to be relatively safe with the radiation the electronics in the tunnels contains:
  - ◆ Only amplifiers,
  - ◆ No logic, no power supplies.

# Overview

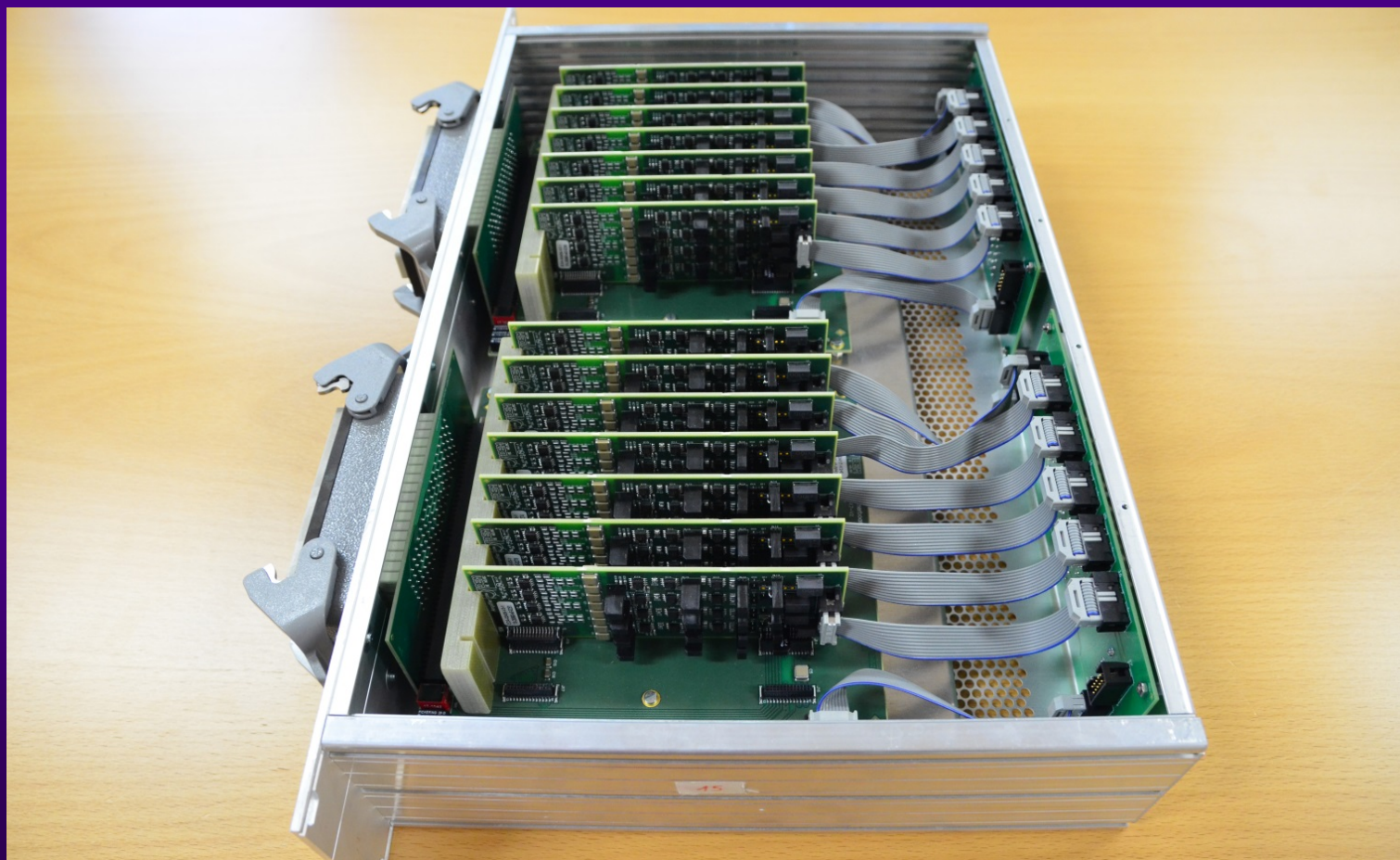


- ◆ Between Grid and Amplifier: two cables with twisted pairs with *individual* screening. The two cables will be mounted together in Harting 72-pin connectors.
- ◆ Between Amplifiers and Controls a single cable is proposed (CERN ND100) mounted with Harting 108-pin connectors.
- ◆ Power and I/O control are handled by the same cables, no additional cabling is foreseen.
- ◆ Bias  $\pm 120V$  directly onto measuring wires.
- ◆ Few cables allow rapid intervention on the box.



# Amplifier-boxes.

- ◆ Up to 2 x 32 channels per box.
- ◆ 2 Motherboards with daughter-boards carrying 4 amplifiers each.



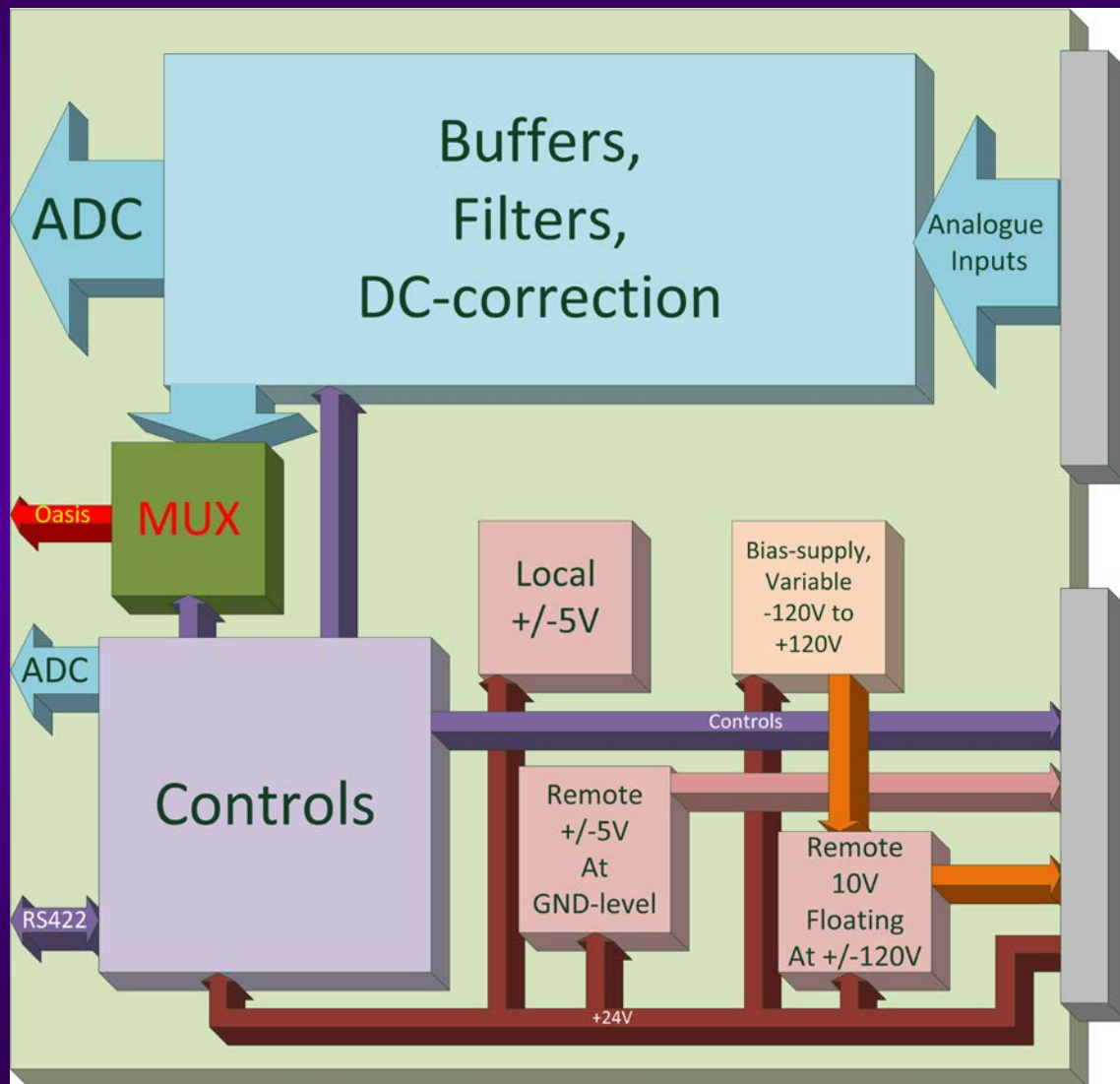
# Controls of grids.

- ◆ **VME-crates:**
  - ◆ **36-channel ADC's, (BI-PI design)**
    - ◆ Sampling at max. 250kHz,
    - ◆ Input Bandwidth ~200kHz.
  - ◆ **Serial RS422 Control cards, CO-standard.**
  - ◆ **Card for Timing.**
- ◆ **Up to 2 Interface chassis, each containing :**
  - ◆ **Up to 8 controller cards**
    - ◆ Limitation of 8 due to the size of the Harting connectors on the rear panel.
  - ◆ **24V power.**



# Grid controller cards.

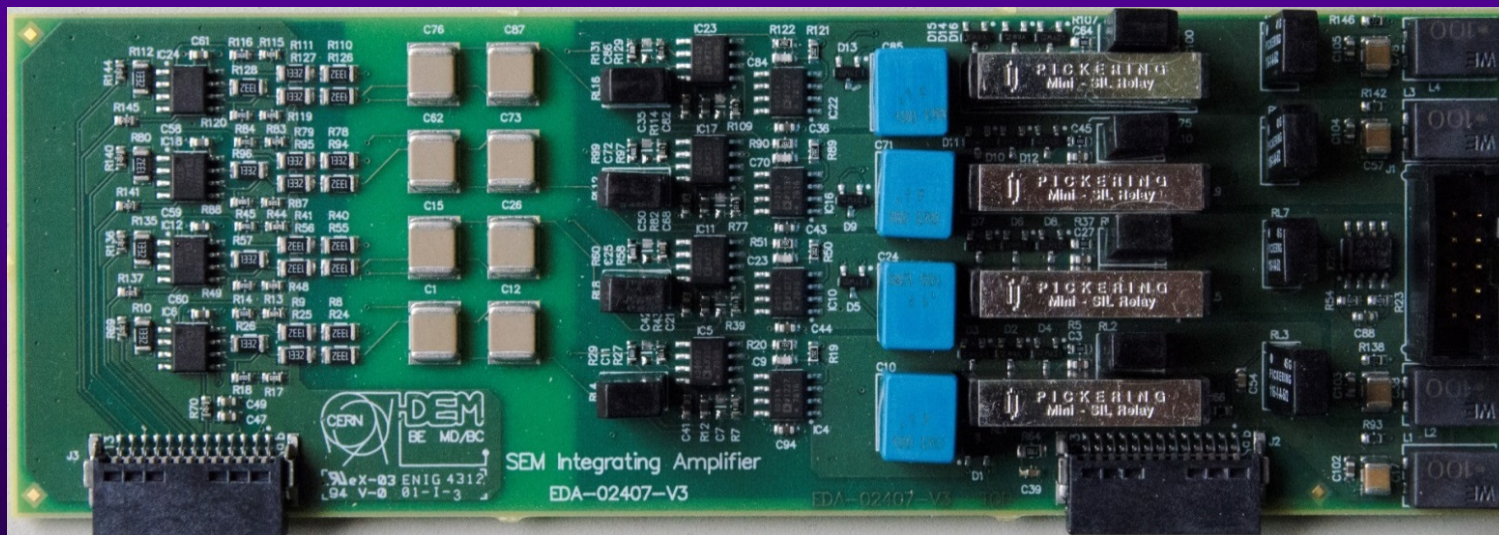
- ◆ Automatic offset-zeroing,
- ◆ Software controlled MUX: output to OASIS,
- ◆  $\pm 5V$  power for Amplifier output stages,
- ◆ Floating  $\pm 5V$  power at max.  $\pm 120V$  for Amplifier input stages (bias),
- ◆ Pneumatic Movement control,
- ◆ Control of relays for amplification setting and test-signals.
- ◆ Control by RS422.





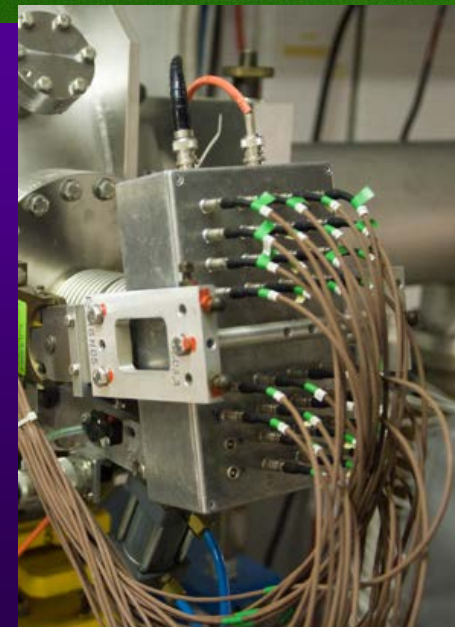
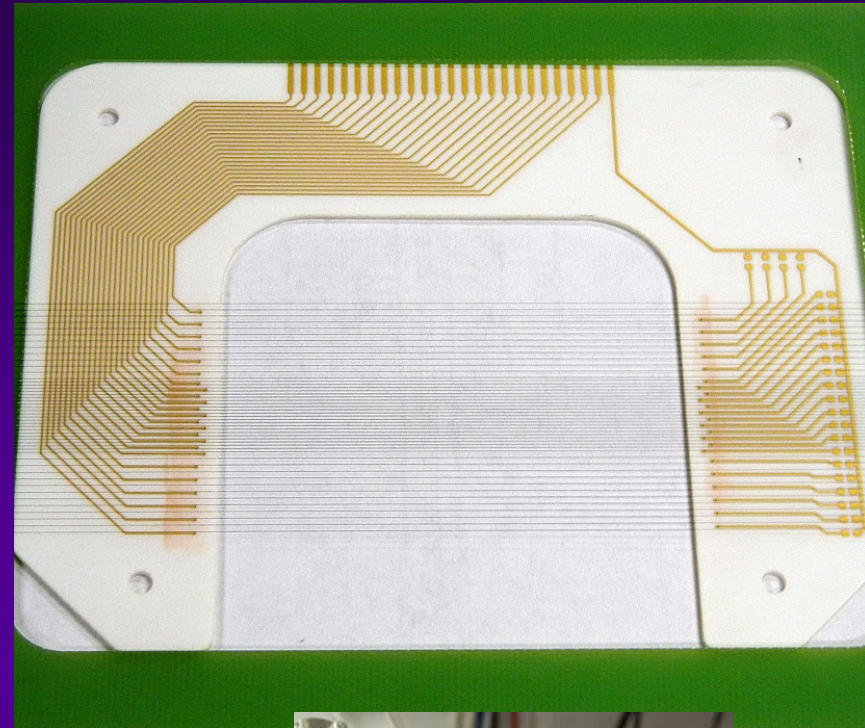
# Design Details (1).

- ◆ Linear Amplifiers:
  - ◆ Input ranges:  $1\mu\text{A}$  to  $10\text{mA}$ ,
  - ◆ The calculated input-related noise-level is  $\sim 2\text{nA rms}$  at  $1\text{MHz BW}$ .
  - ◆ Overall BW is defined by the cable-length between grid and electronics,  $8\text{m}$  cable results in  $500\text{kHz}$ .
- ◆ Integrating Amplifiers:
  - ◆ Depending on the input sensitivity the input will be
    - ◆ An active integrator with most sensitive input range  $2,5\text{pC}$ ,
      - ◆ Theoretical noise should be  $5\text{fC rms}$ , but environmental noise appears to be much higher.
    - ◆ Or a passive integrator with maximum input range of  $250\text{nC}$ .



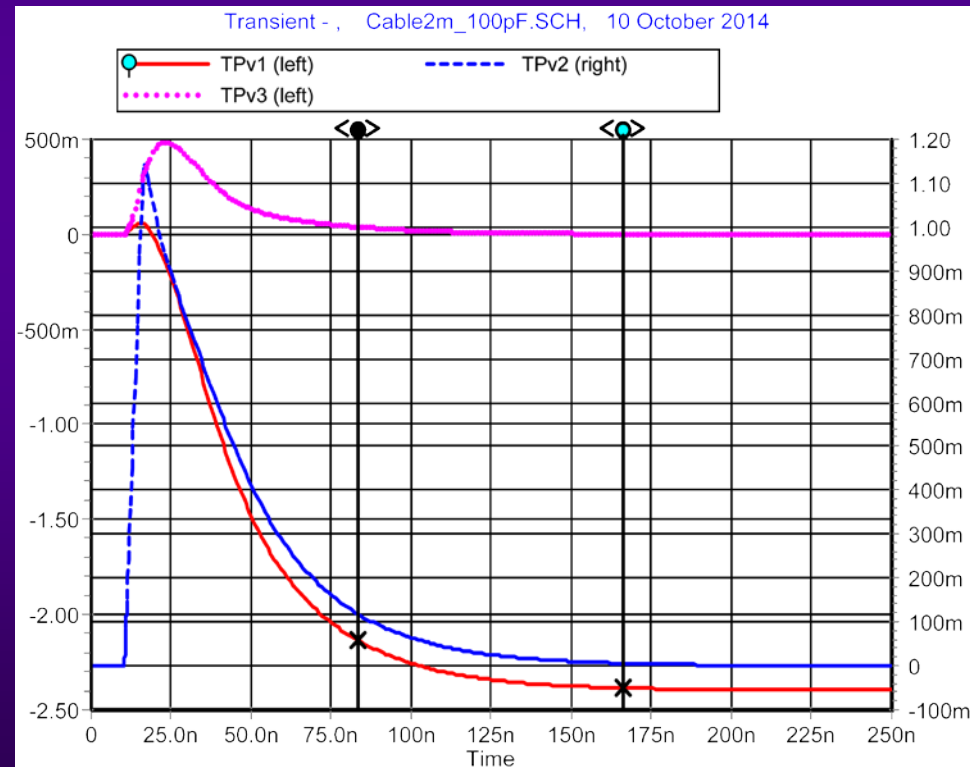
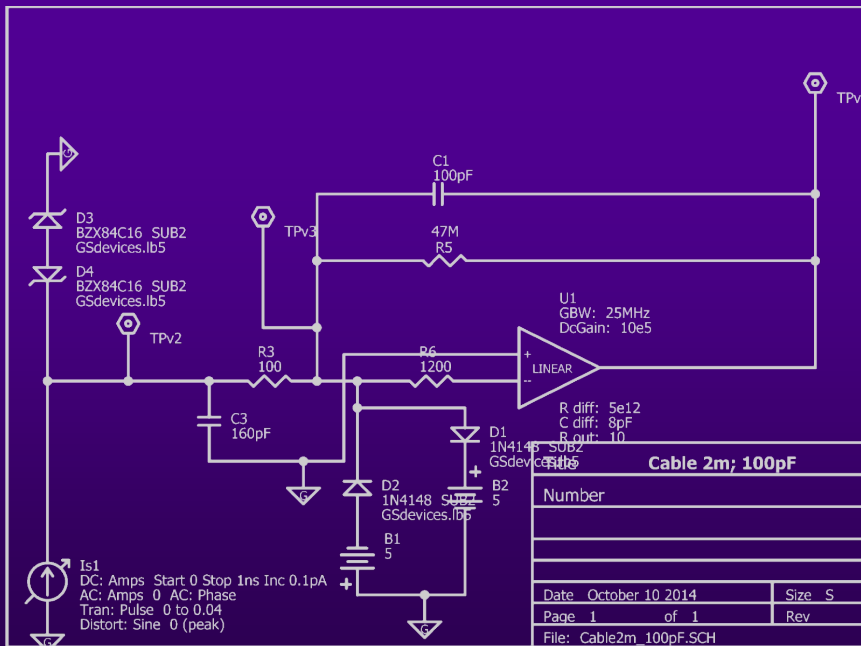
# Design Details (2).

- ◆ Both Amplifier types:
  - ◆ Isolated input-stage: Bias of up to  $\pm 120V$  on measuring wires.
  - ◆ The design foresees to use test-resistances:
    - ◆ At the grid in the vacuum-chamber,
    - ◆ Outside the vacuum-chamber at the cable-connection,
    - ◆ At the amplifier-inputs.
  
- ◆ Specific for old PS Grid Hardware:
  - ◆ In many places the original cabling was kept.
    - ◆ Lemo-00 connections, original cables in very good shape.
    - ◆ Changing these cables would have required major modifications on the SEM-grid hardware or replace the hardware.
  - ◆ **Not possible to have test-resistors!**



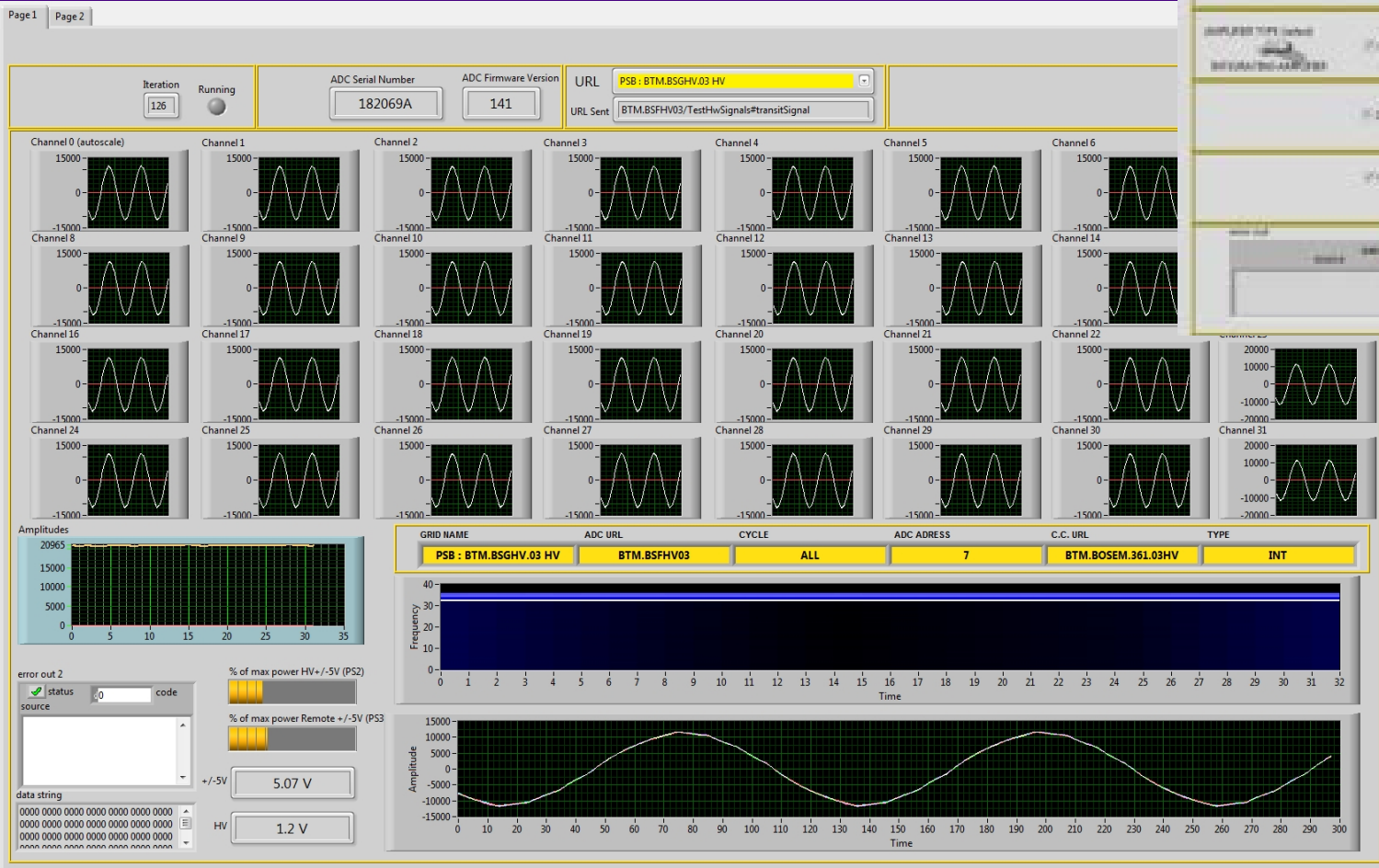
# Spice was used for development

## Integrating Amplifier Design Details



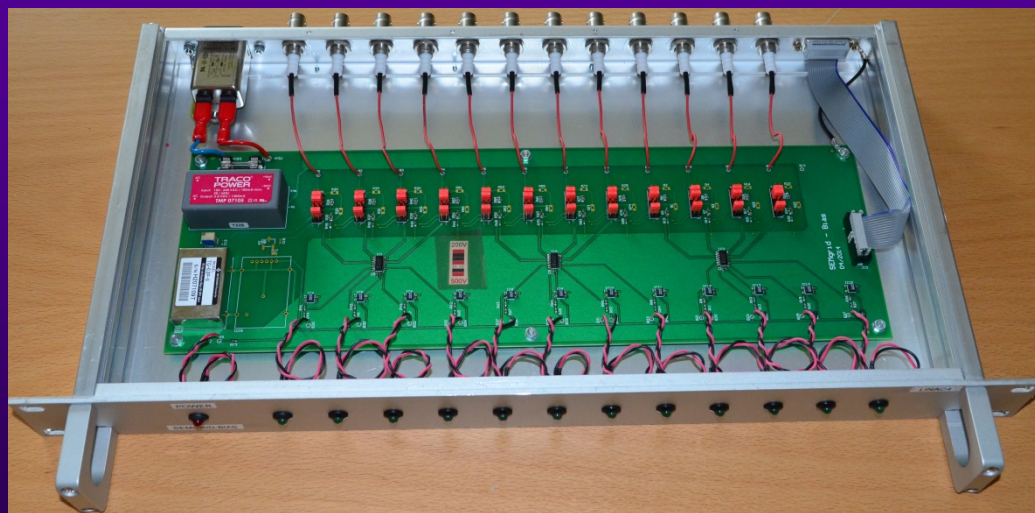
# Tests.

- ◆ Labview programs have been developed for testing using Fesa class.
- ◆ 150 ADC's programmed and tested,
- ◆ More than 200 Amplifier cards tested.



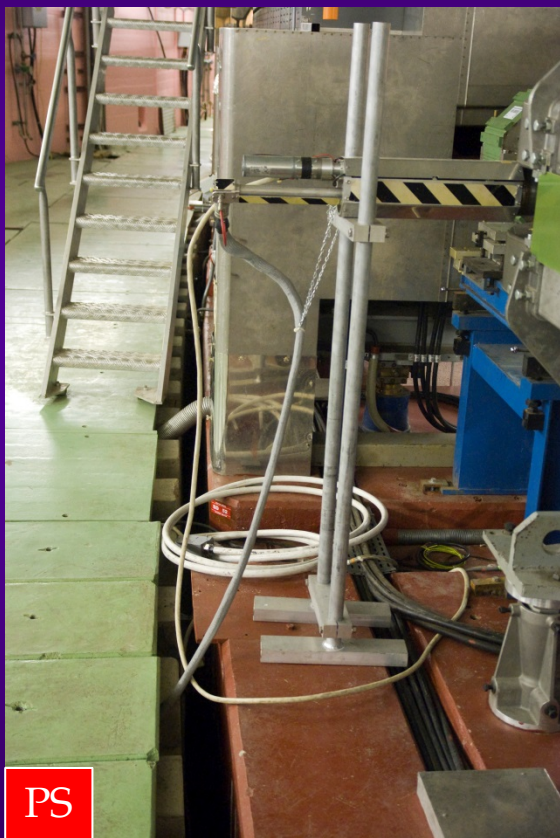
# Other modifications to the installations.

- ◆ PLC's for In/Out control and angle control have been installed or upgraded
  - ◆ In/Out with Interlocks,
  - ◆ Electrical In/Out Movements,
  - ◆ Stepper Motor Controls for variable Angle.
- ◆ Power Supplies for polarisation have been renewed.

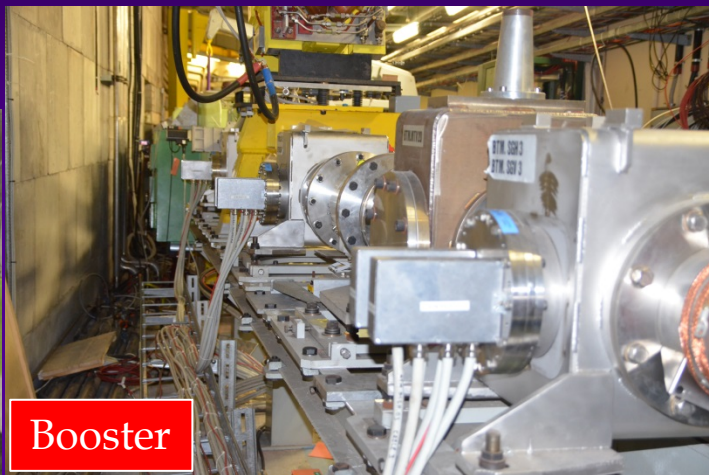


Linac3

# Installation Examples.



PS



Booster



TT2



Booster

# Conclusions and remarks.

- ◆ **Though the PM –section was a bit stressed to install a totally new system with little possibilities for testing beforehand it looks like the equipment is working. Time will learn whether it will fulfil the wishes of the users and how long it will resist in radiated areas.**
- ◆ **This system could also be used for other machines by using different Amplifiers. It is foreseen to make very sensitive (slow) amplifiers for Isolde.**

# Acknowledgements

- ◆ **Thanks to all people that participated to this renovation.**
  - ◆ **Jean Tassan-Viol**
  - ◆ **Gerrit Jan Focker**
  - ◆ **David Michel Sellez**
  - ◆ **Section SW**
  - ◆ **Section ML**
- ◆ **Thanks to Joao de Carvalho Saraiva from the R2E Team finding the best spots for installation in the tunnels.**
- ◆ **MANY THANKS TO ANA FOR HER GREAT CONTRIBUTIONS AND (moral) SUPPORT !!!**