FETS Laserwire Emittance Scanner - Installation at Linac4

on behalf of
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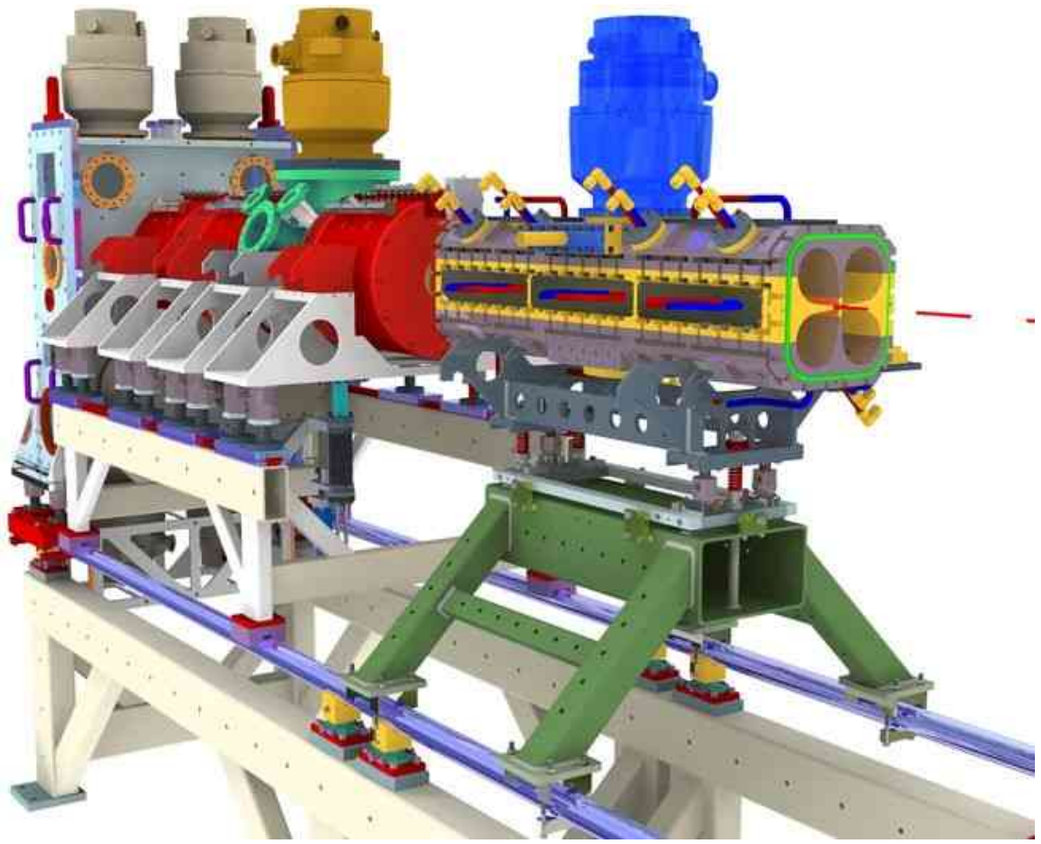
FETS Meeting, RAL
20/11/2013

Outline

- Laser tests at RHUL
- Installation at CERN
- Alignment
- Outlook



Summary of progress

- This month the laserwire system was delivered and installed at Linac4.

Main activities this month:

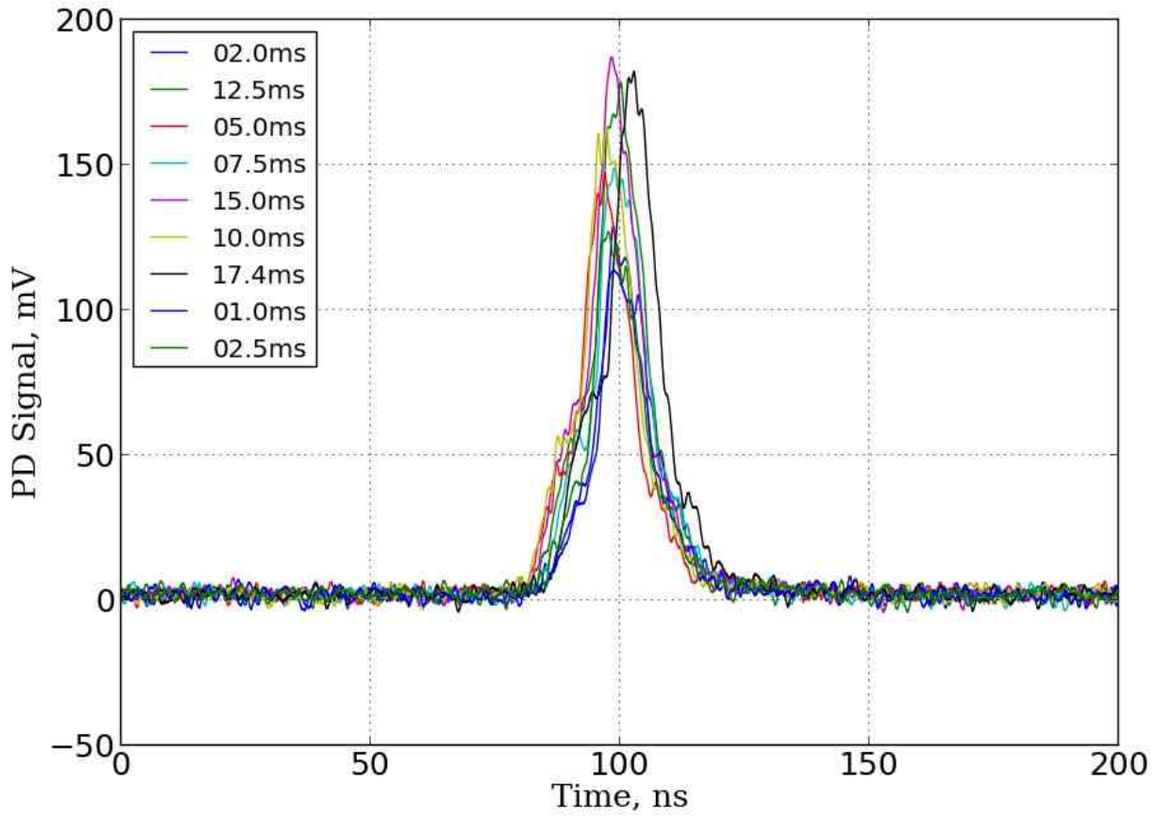
- Final tests of the laser system and beam delivery optics at RHUL prior to shipping.
- System delivered to CERN on 4th November 2013, follow by installation team at CERN for a week, 5th – 13th November:
  - Gary installed the PXI crate in Linac4 during previous week's BPM visit.
  - Joint installation by FETS team (Alessio, Konsantin, Stephen) working with CERN BE Dept (Thomas + Federico). On arrival at CERN:
  - Unpack and system check out
  - Pre-alignment of fibre coupling box.
  - Installation of laser, coupling and delivery box in Linac-4 + beam alignment.
- Interlock, control and DAQ:
  - Interlock installed and operation states verified.
  - Motorized stages and camera functional with PXI control: remote login enabled.

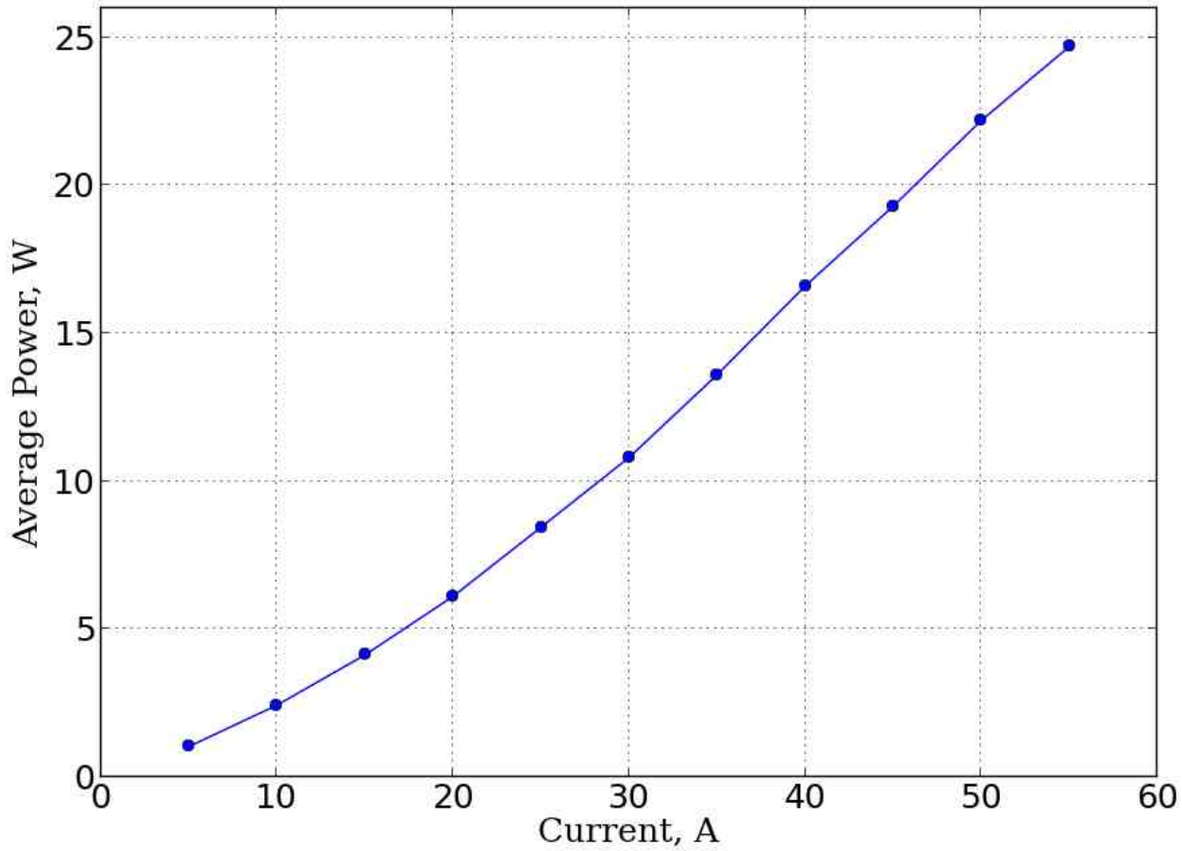
Laser test prior to shipping

- Tests on 20/11/2013 at RHUL
- Analysis by Konstantin Kruchinin

Laser 30 kHz, CW pumping

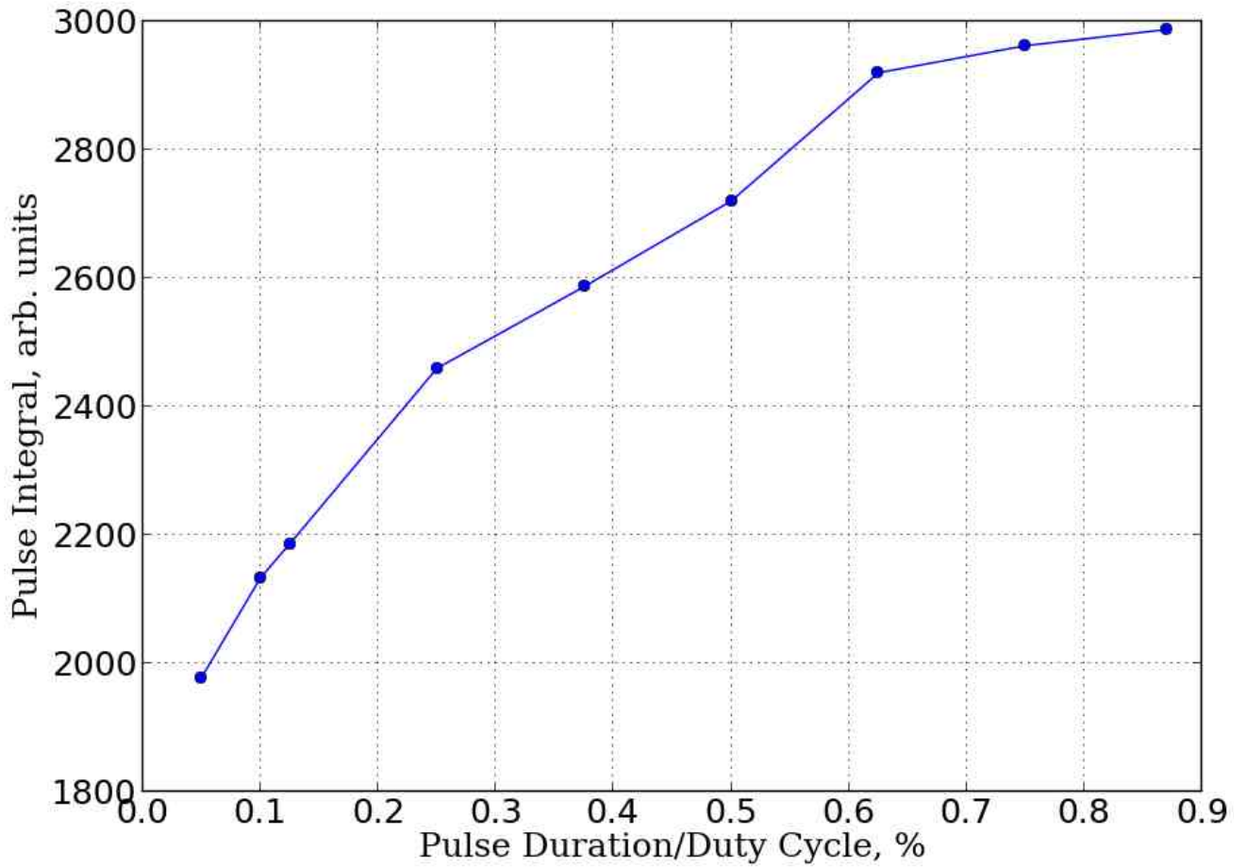
Duty Cycle 50 Hz (20 ms)

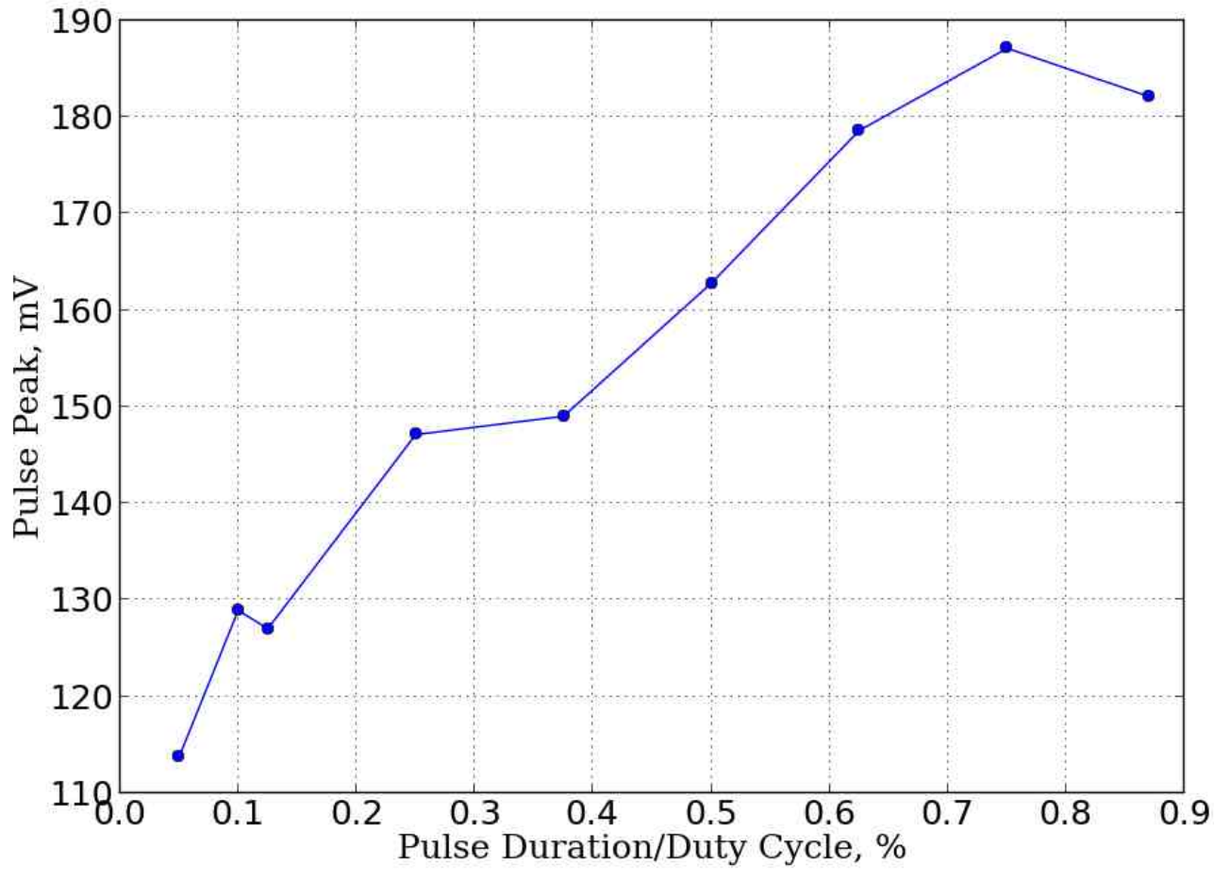




Laser test prior to shipping

- Analysis by Konstantin Kruchinin





Laser test prior to shipping

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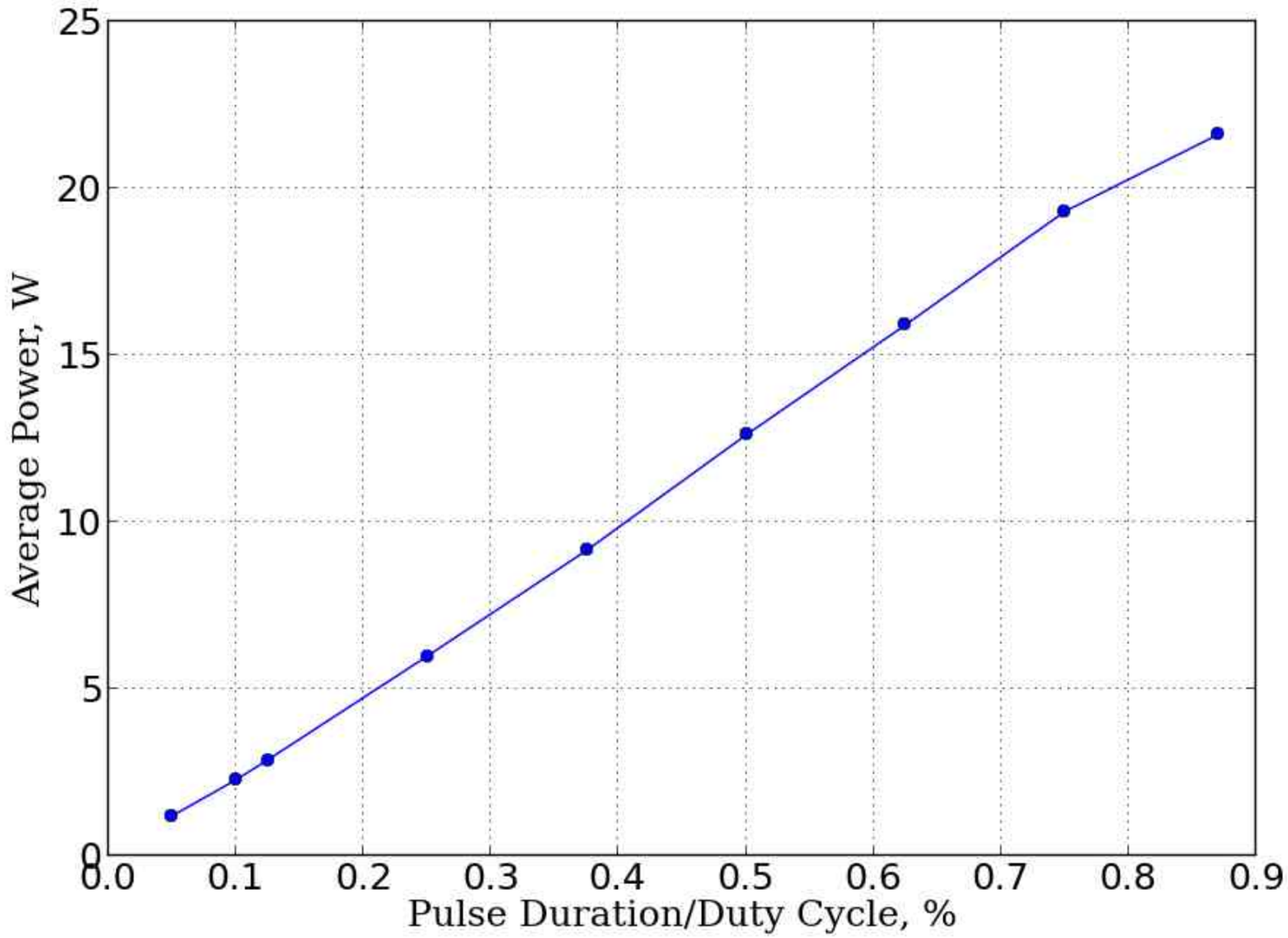
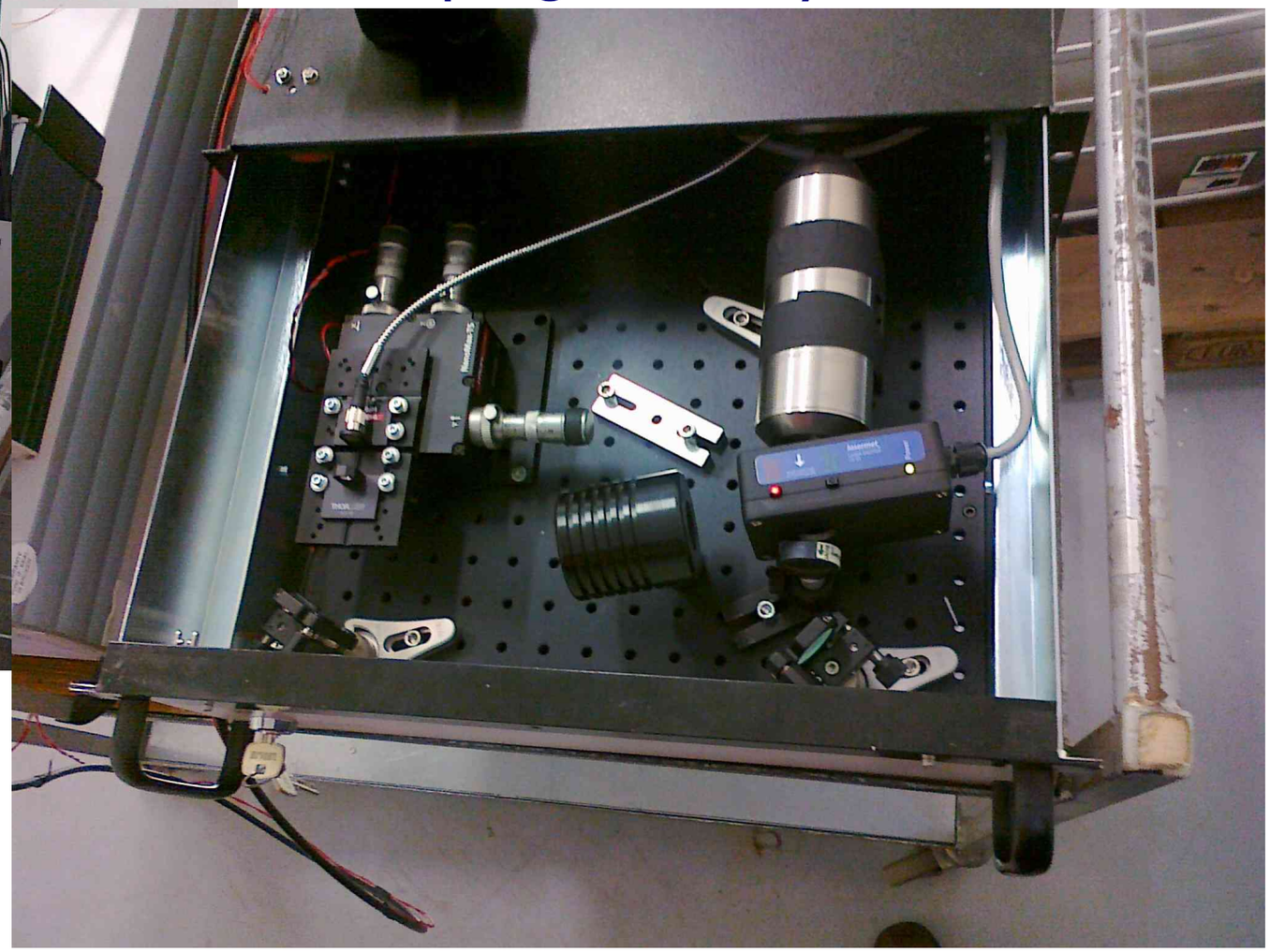


Arrival at CERN

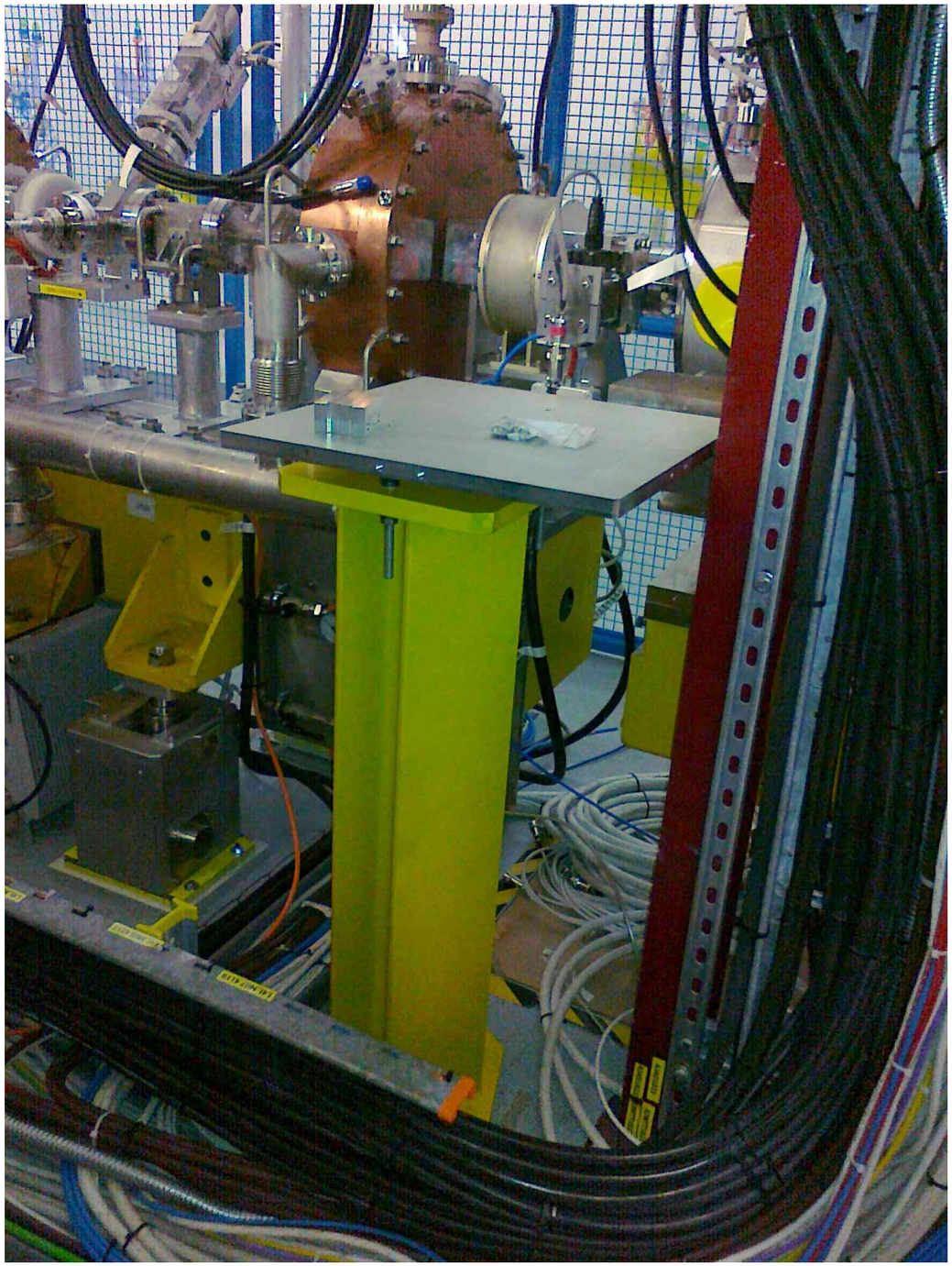
- Three packages arrived at CERN fairly unscathed:
- Metal box containing beam optics was punctured, though only into foam so contents were undamaged.

Laser check and fibre coupling

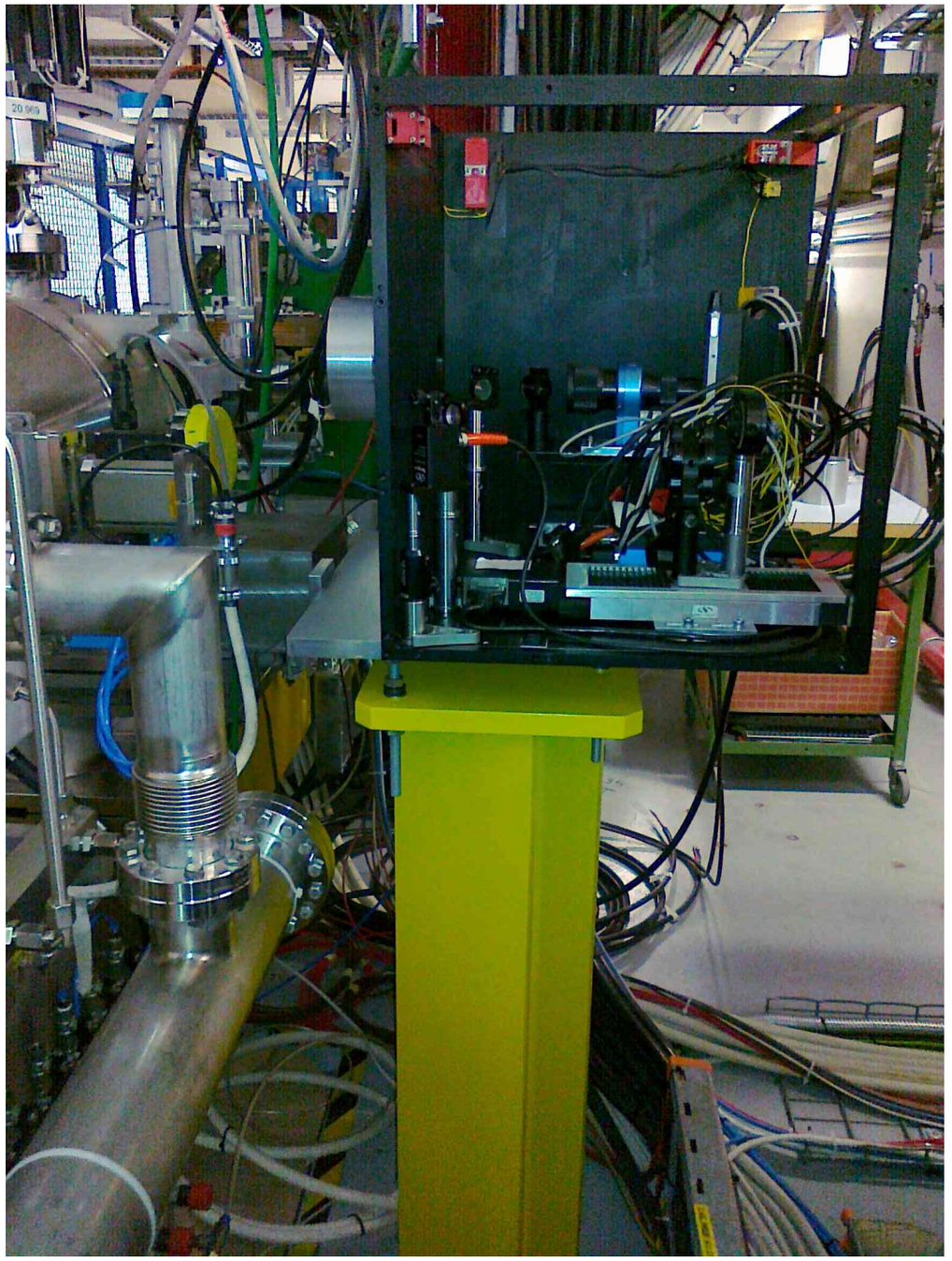
- Laser unpacked in enclosed radiation chicane which served as temporary laser room.
- Laser head installed in coupling box and realigned.
- Low power alignment of fibre, with coupling efficiency >70% achieved.



Support pillar problem:



- CERN were responsible for the pillar design and manufacture.



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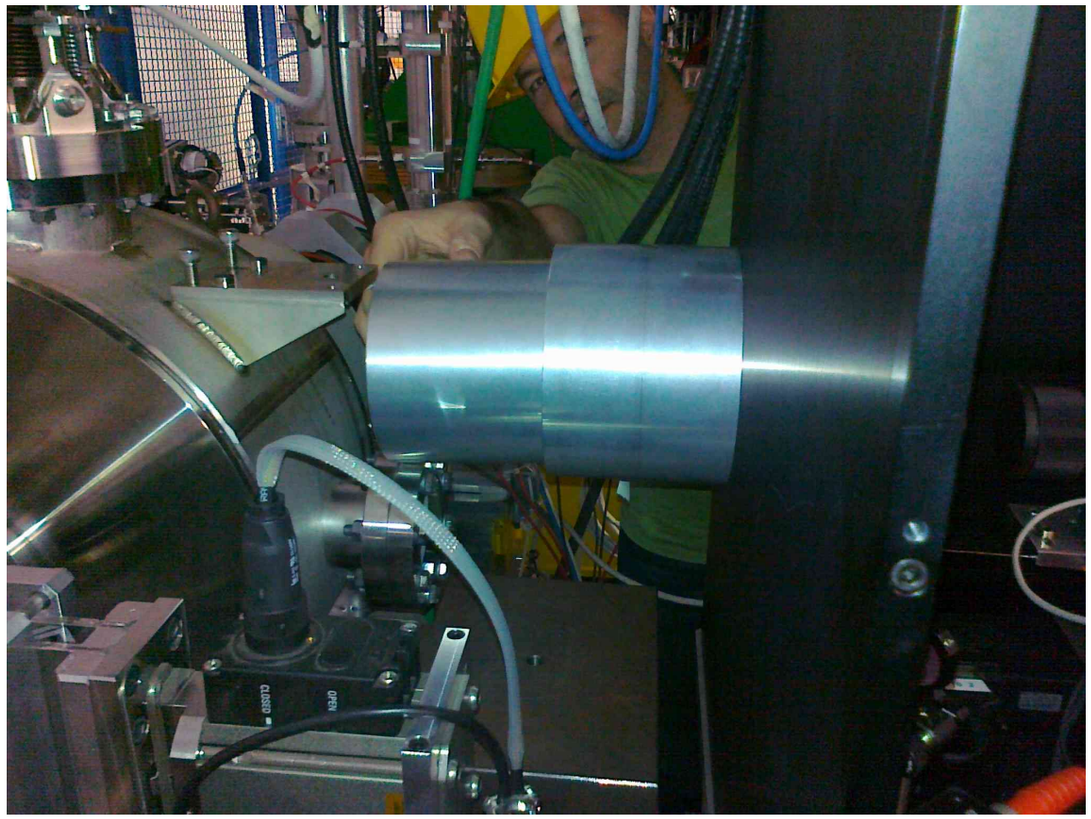
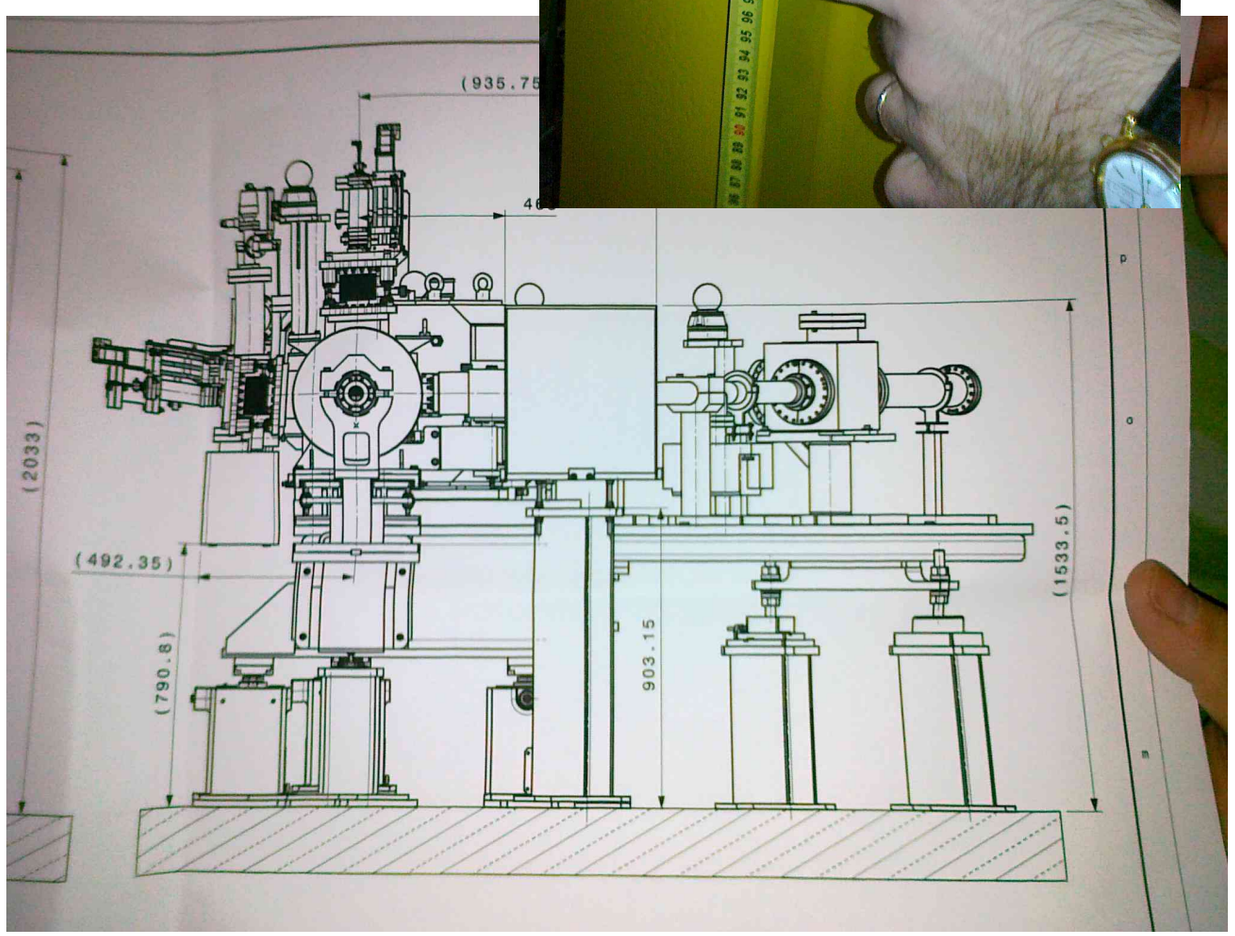
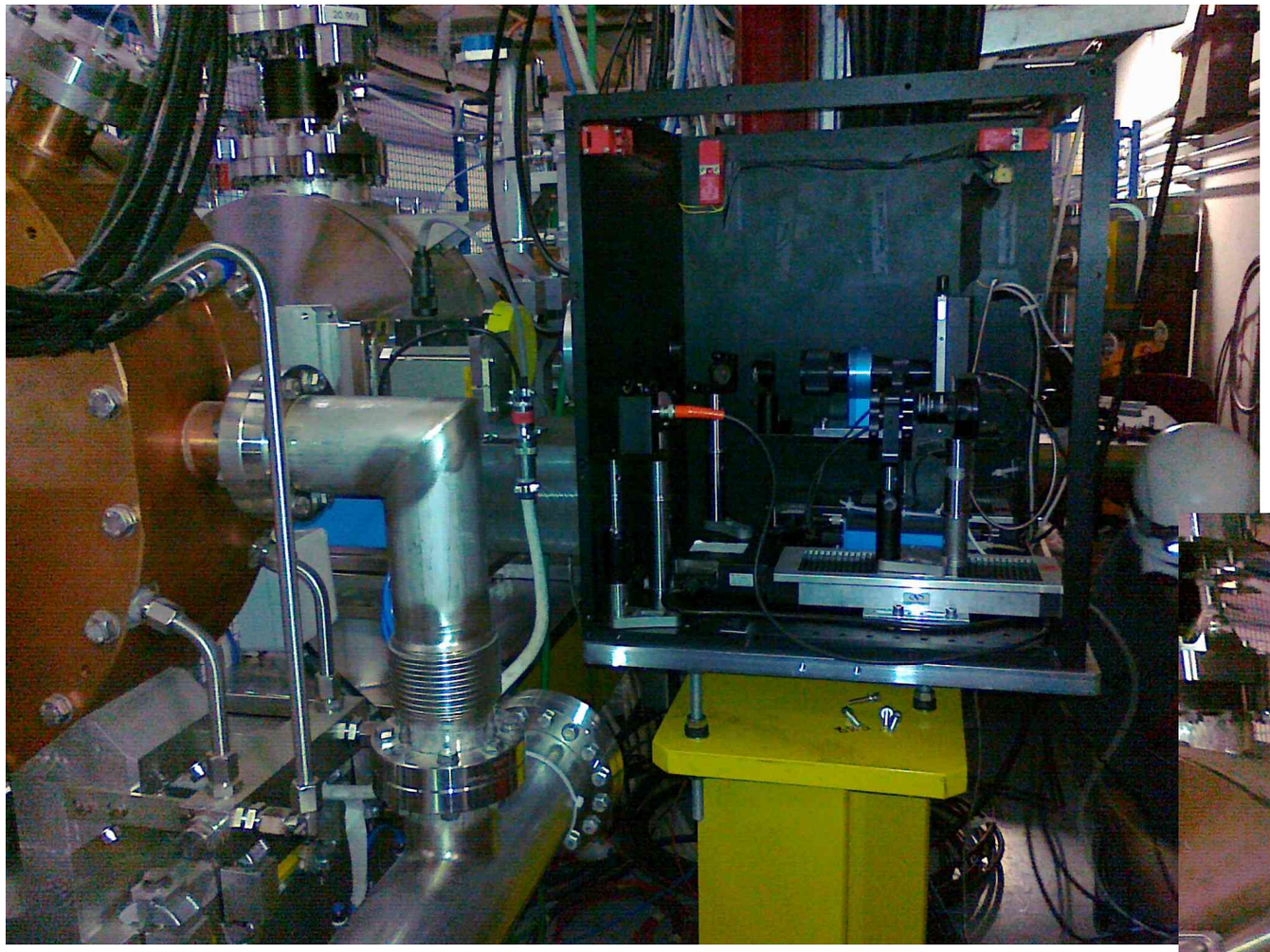


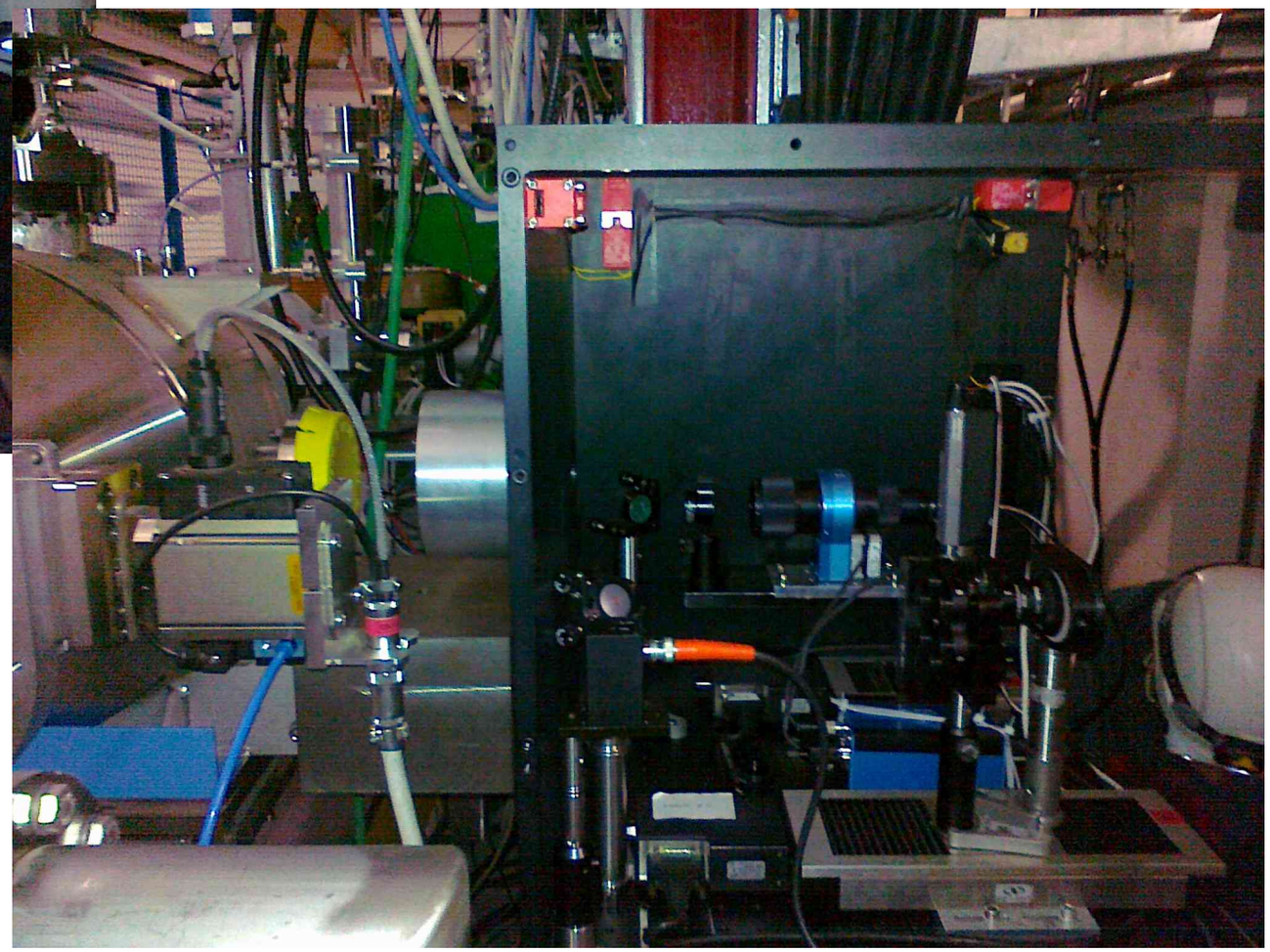


- Clear mismatch laser to window!
- Pillar was 15 cm taller than specified!!!
- CERN drawings were correct, but incorrectly manufactured in Denmark.
- CERN workshop provided rapid turnaround to chop and weld.

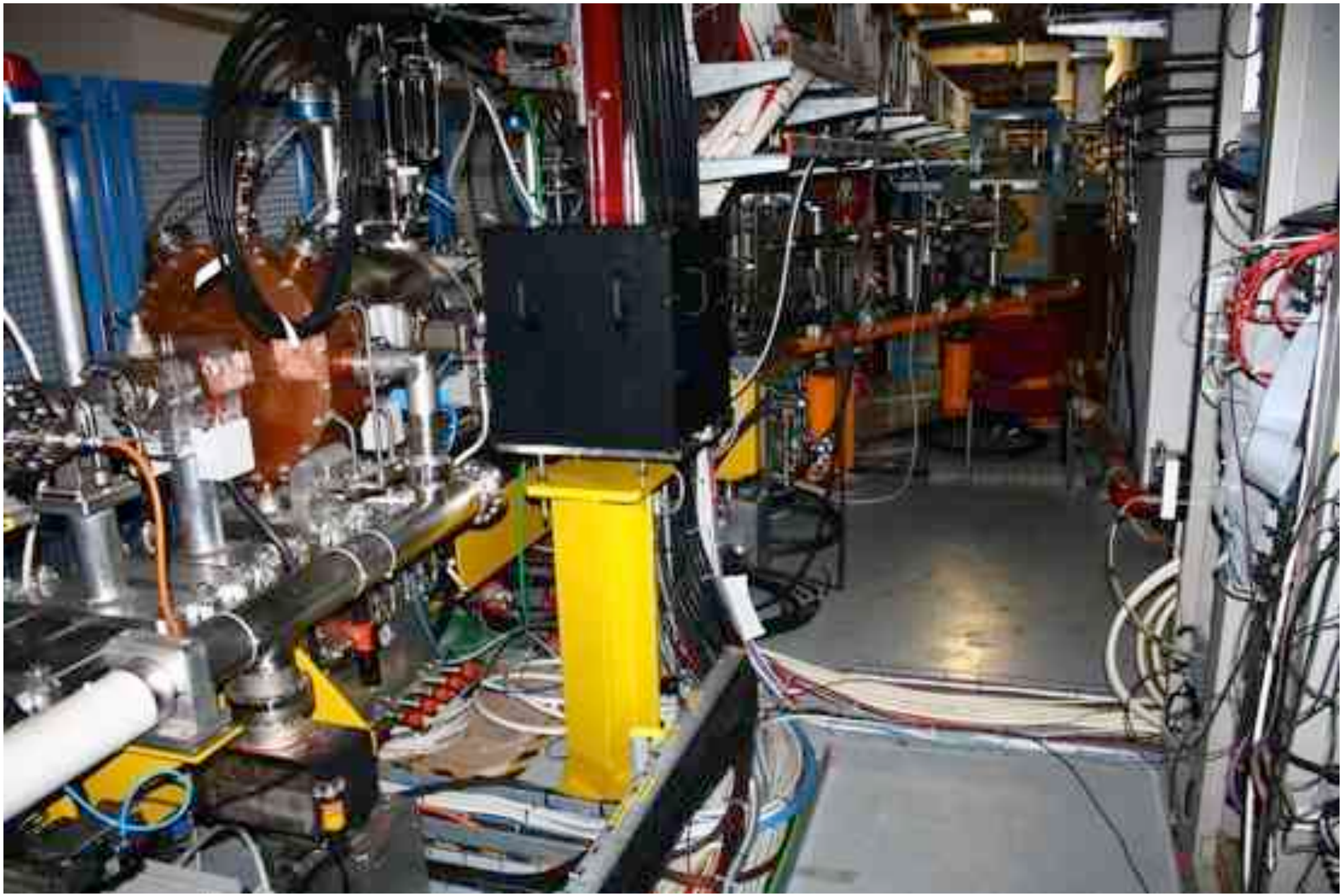
After pillar truncation



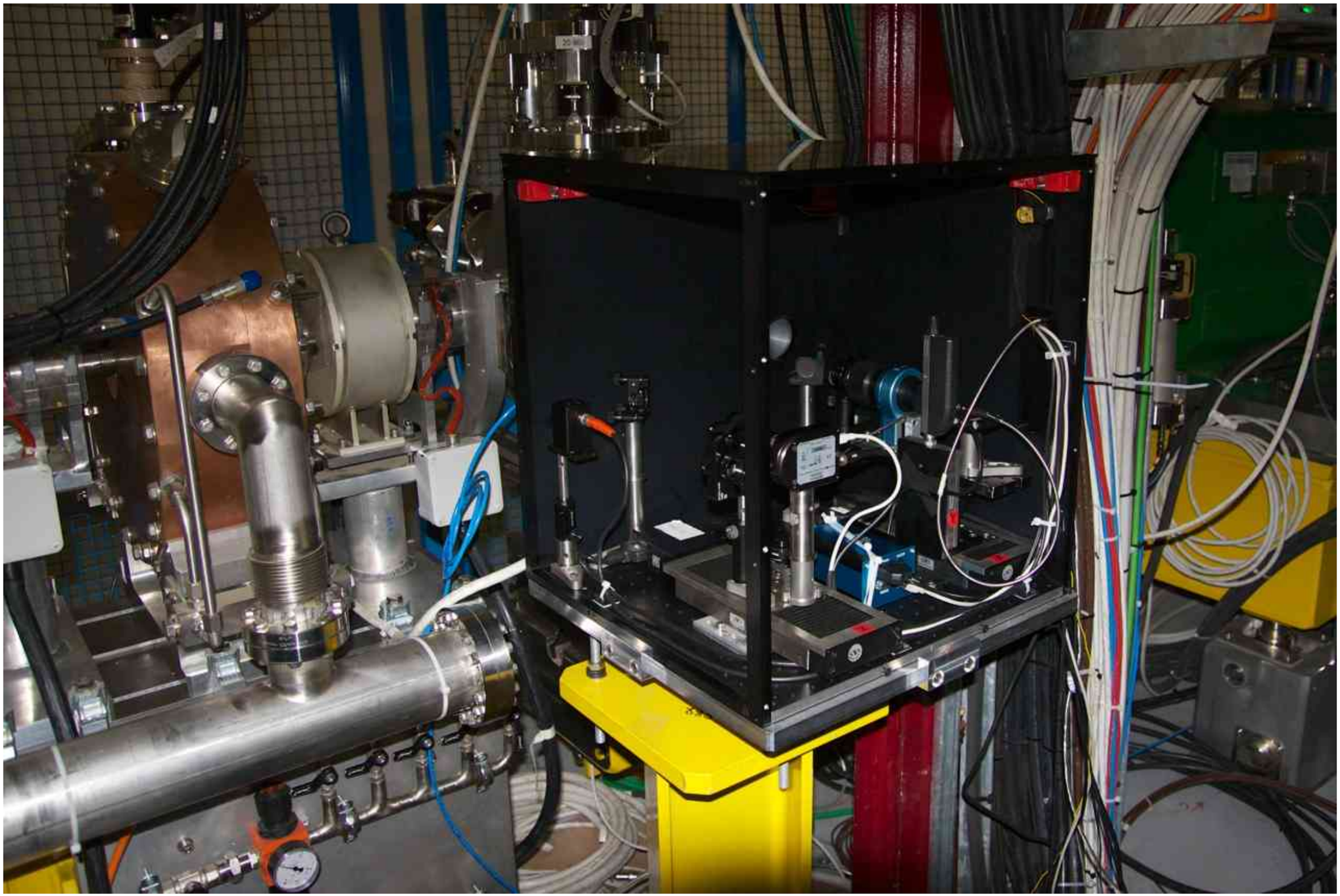
- A much better fit…
- Fine height adjustment and pitch / yaw levelling achieved with three support bolts.



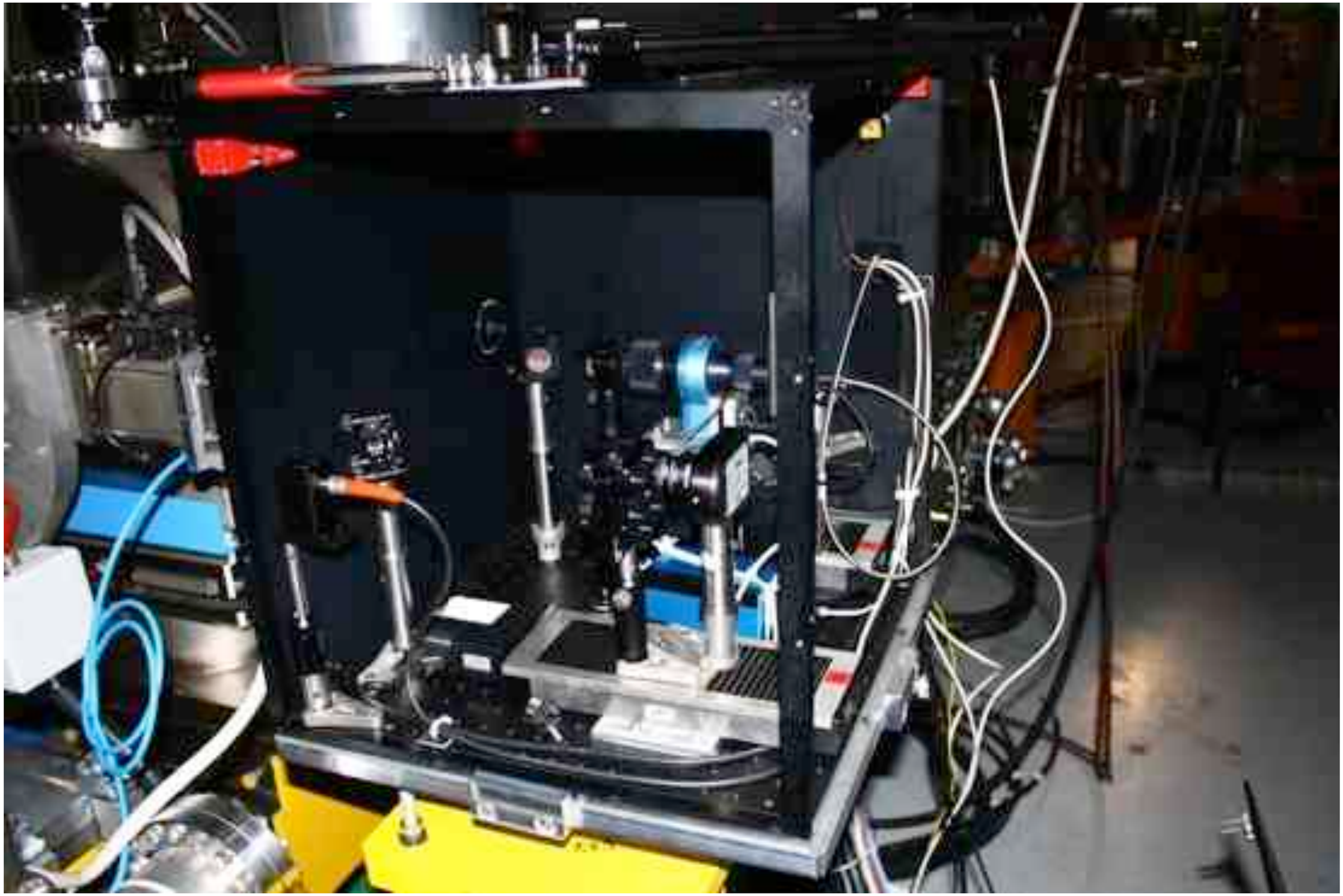
Lasewire enclosure in Linac4



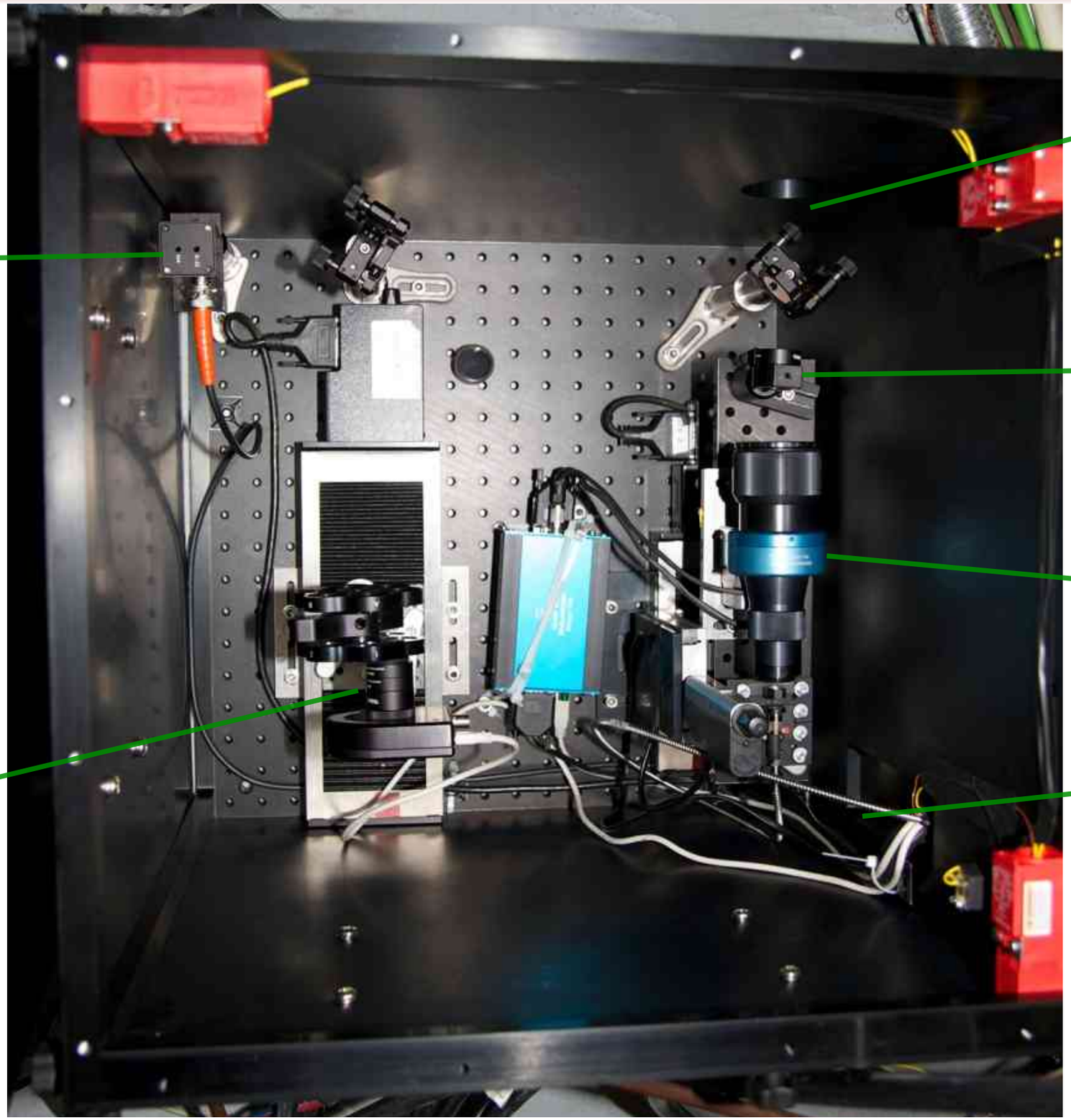
With safety panels removed



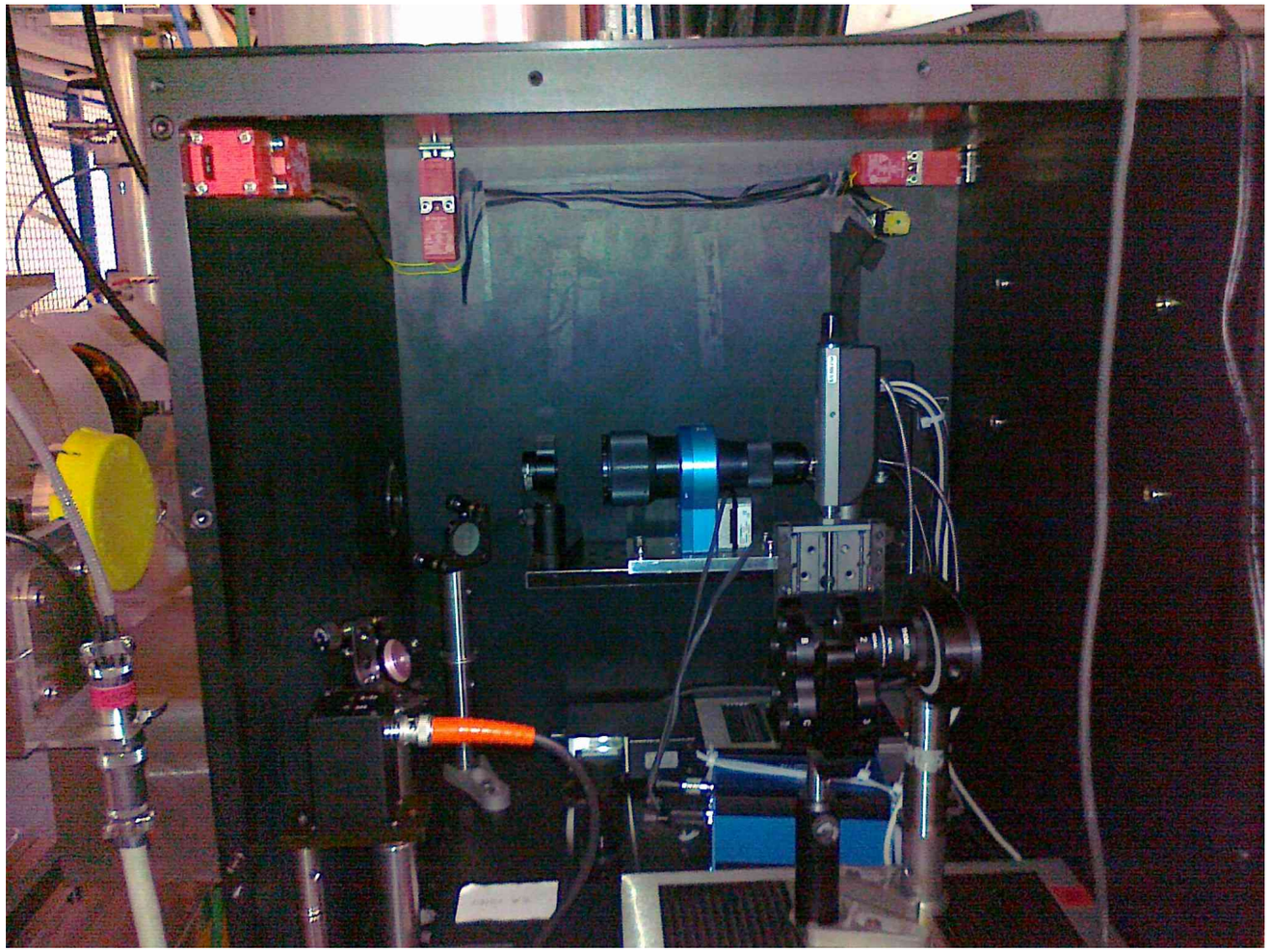
With safety panels removed

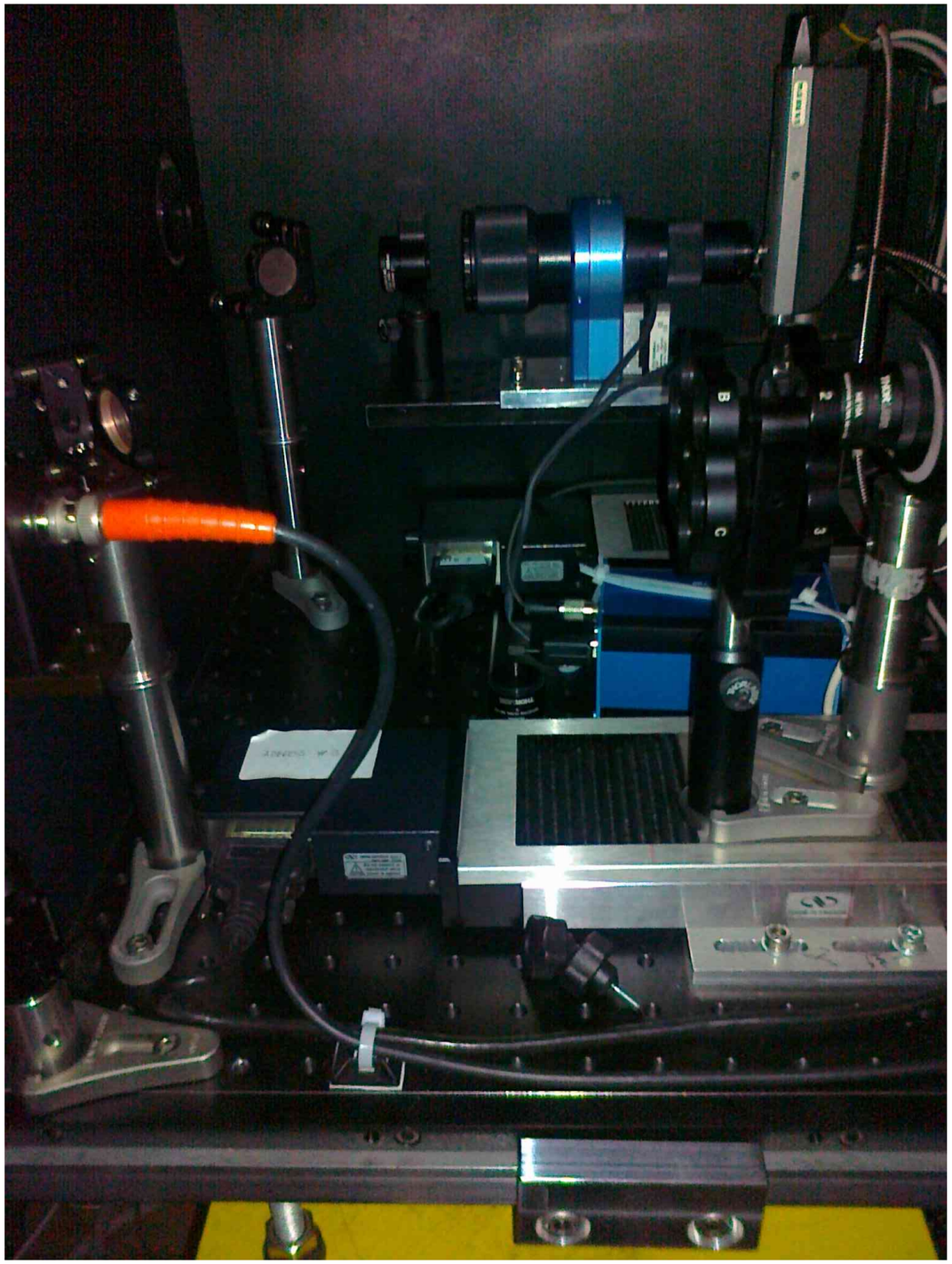


Overview

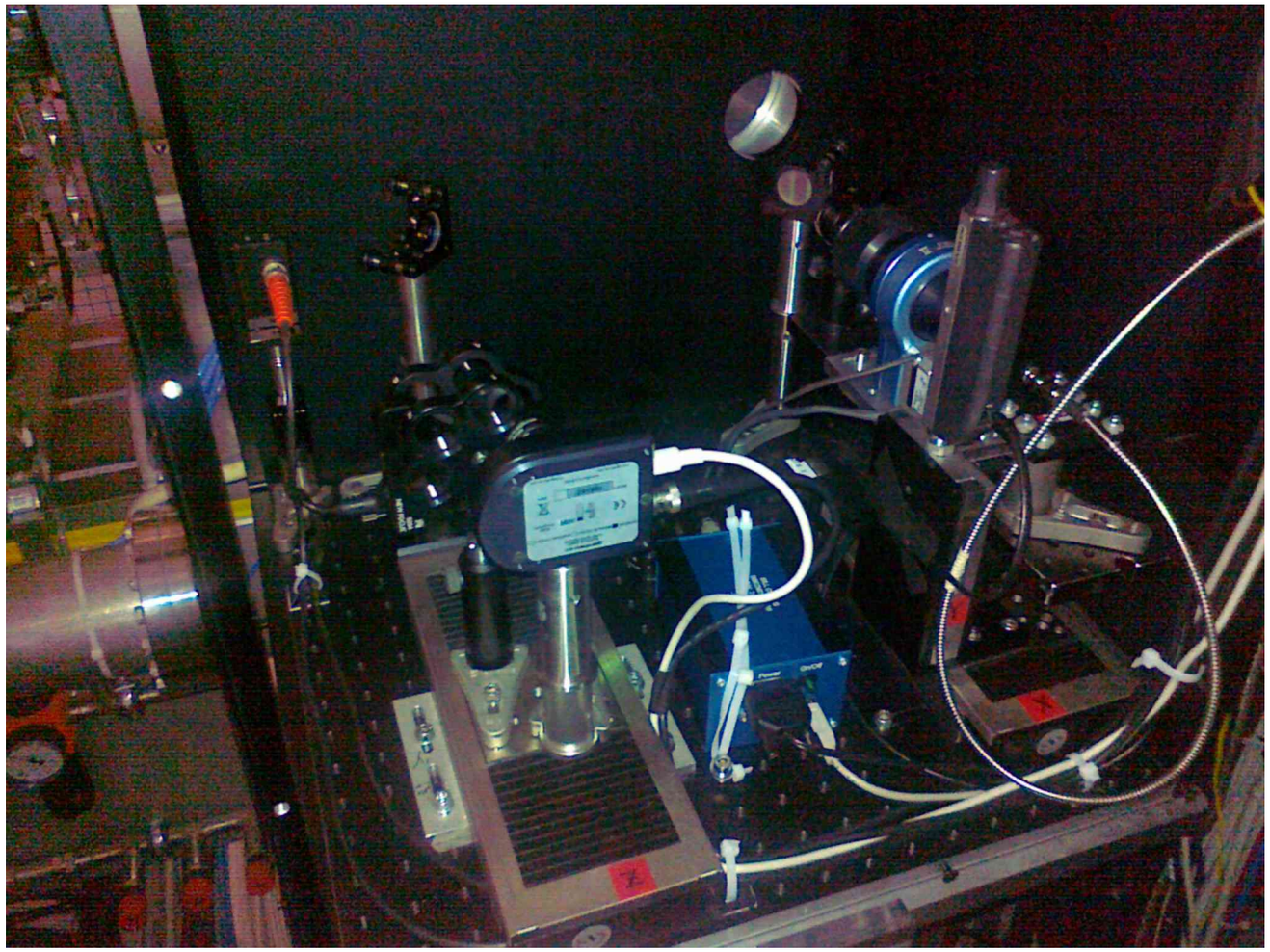

Fast photodiode
Port to accelerator vacuum chamber
Focussing lens
Beam expander on motion stages, X and Y
Filter wheel and camera on Z translation stage
Fibre input / services

Beam aligned to vacuum flange

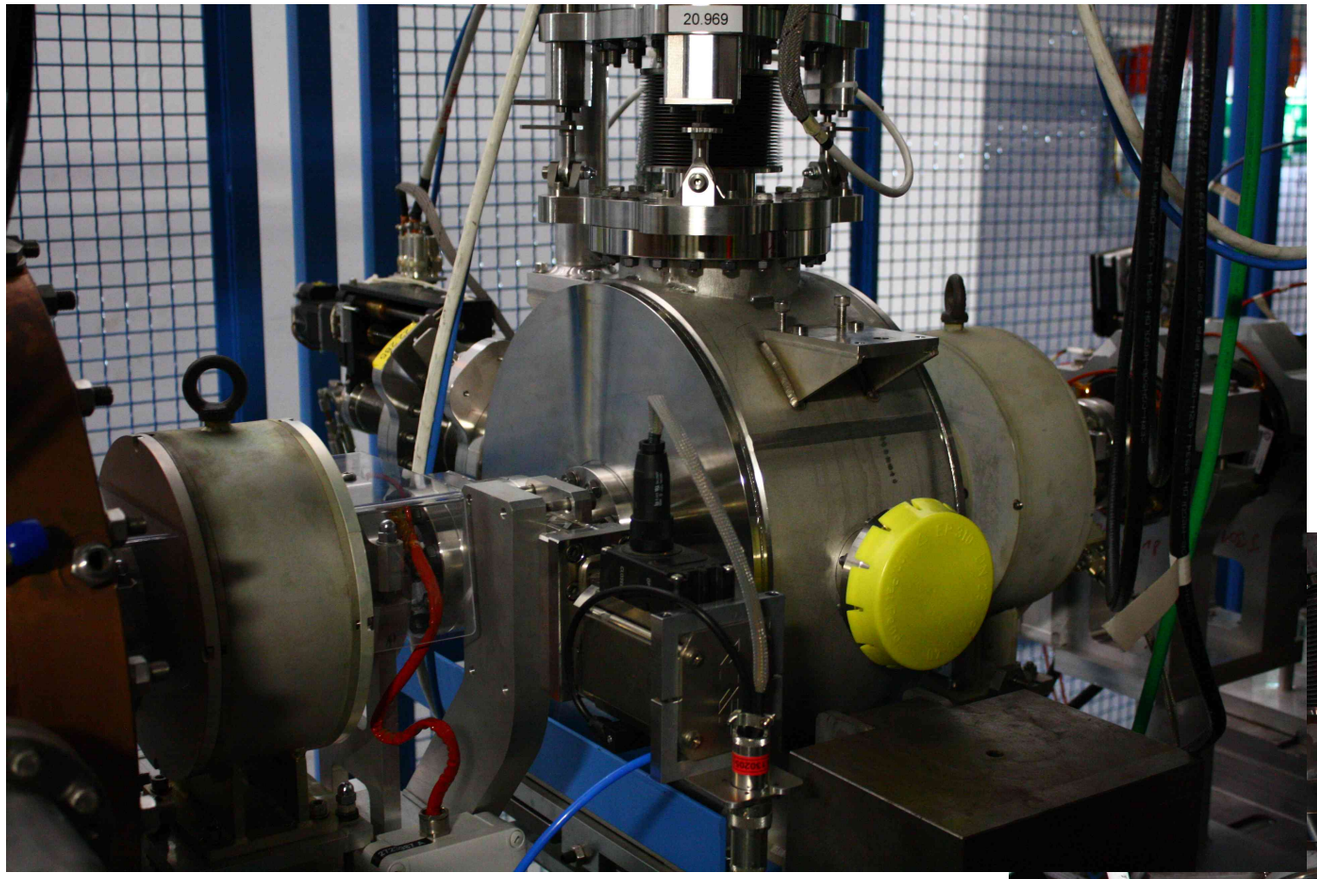


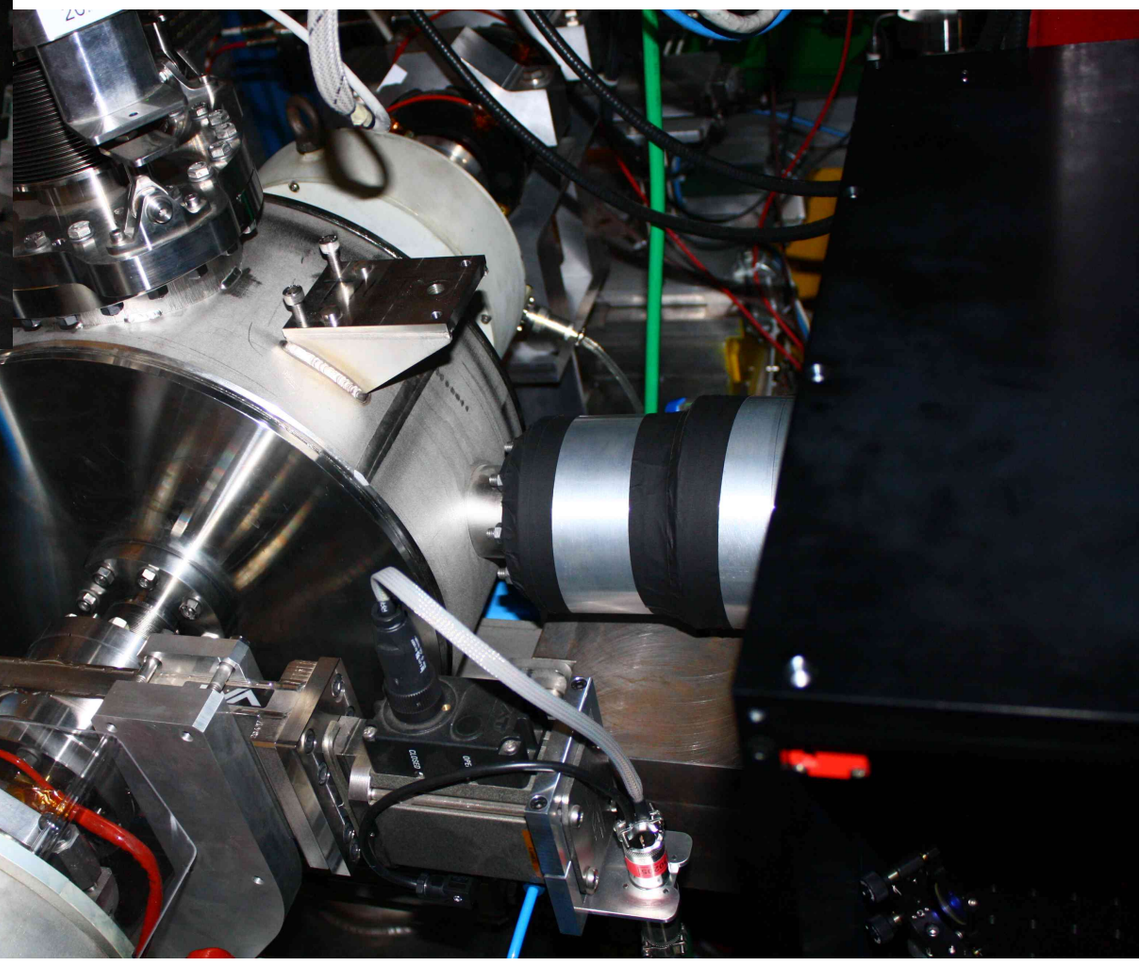


Beam aligned to vacuum flange



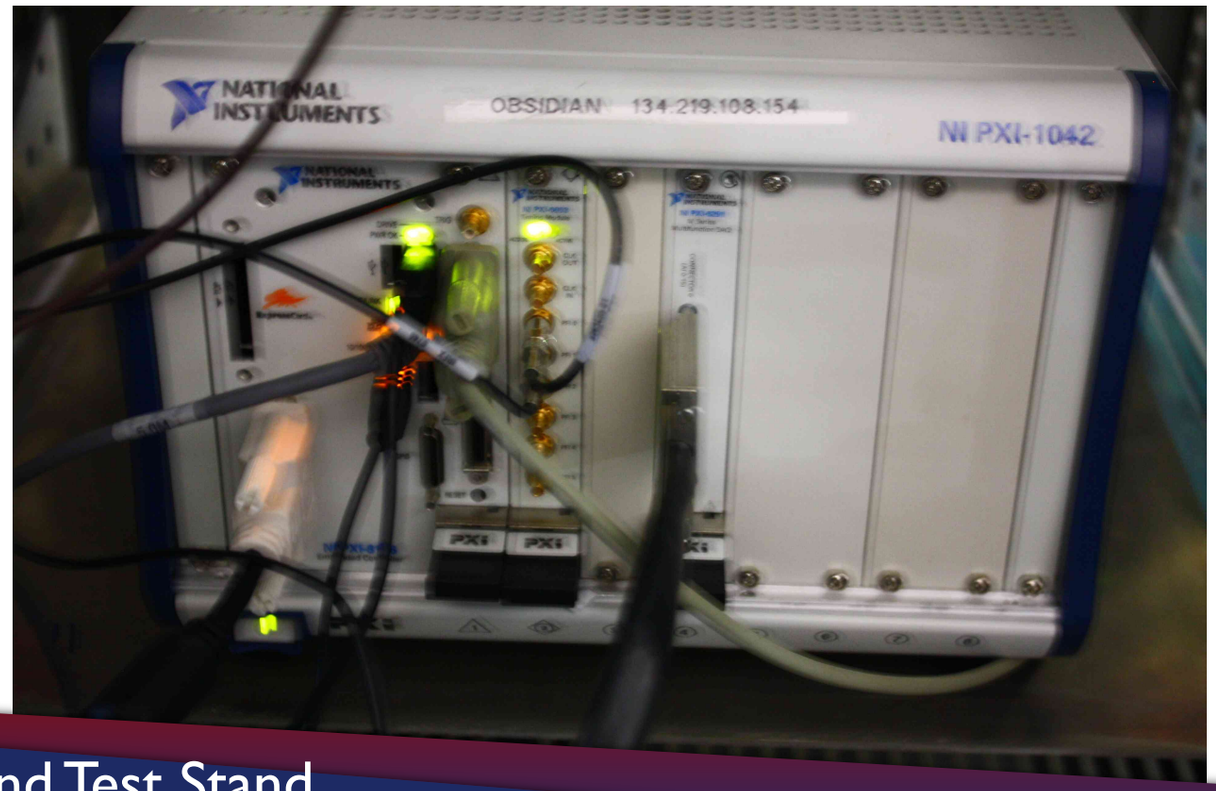
Protective tube covers vacuum flange



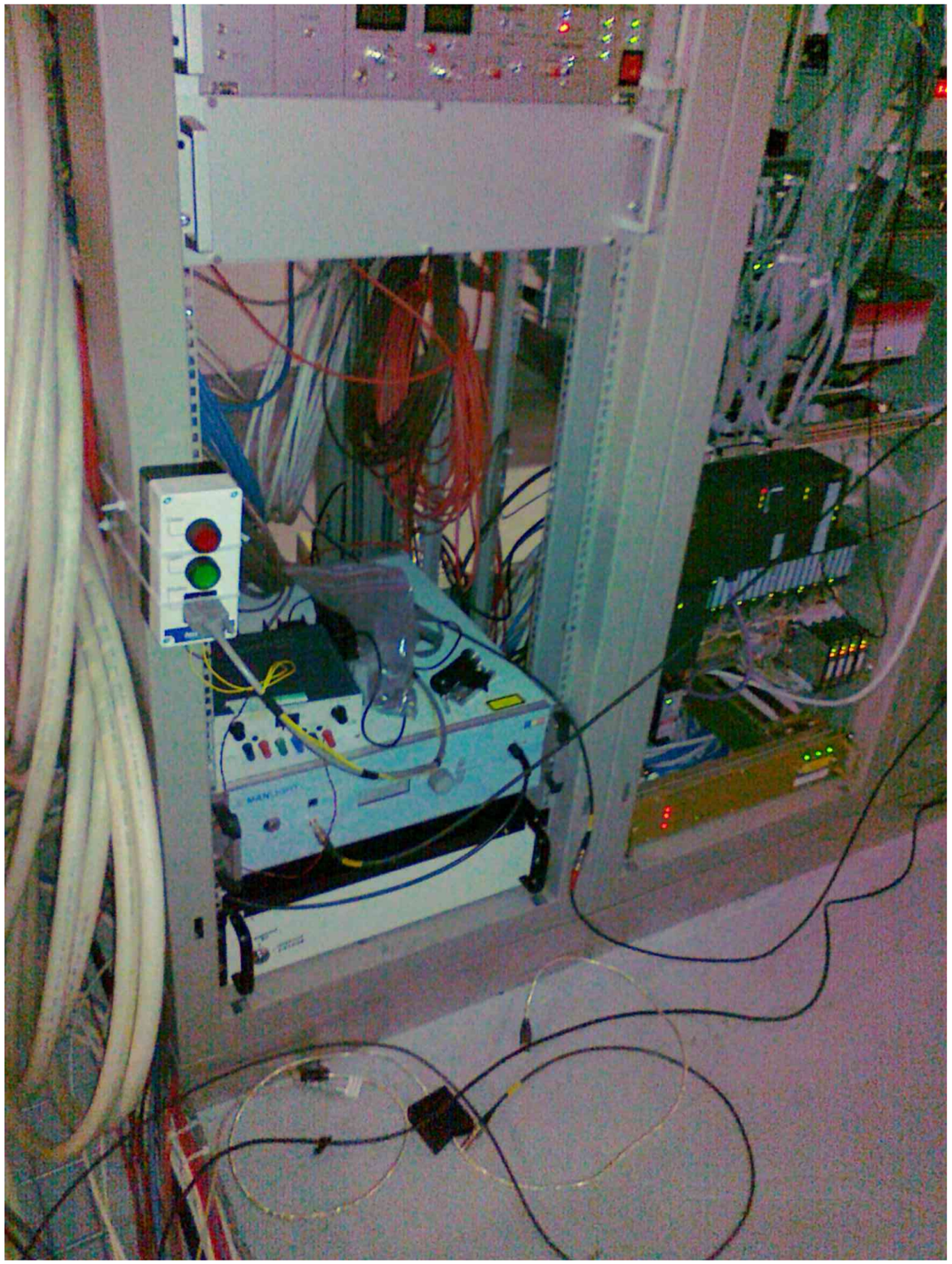


LeCroy scope and PXI crate

- PXI and LeCroy scope on CERN technical network, with remote control enabled.
- Camera software installed on PXI crate.
- LabView software tested in situ and correctly controls motion stages.
- Beam expander power supply found to be faulty (under voltage) – will be replaced by Sill Optics.
- Currently set to required magnification by hand.

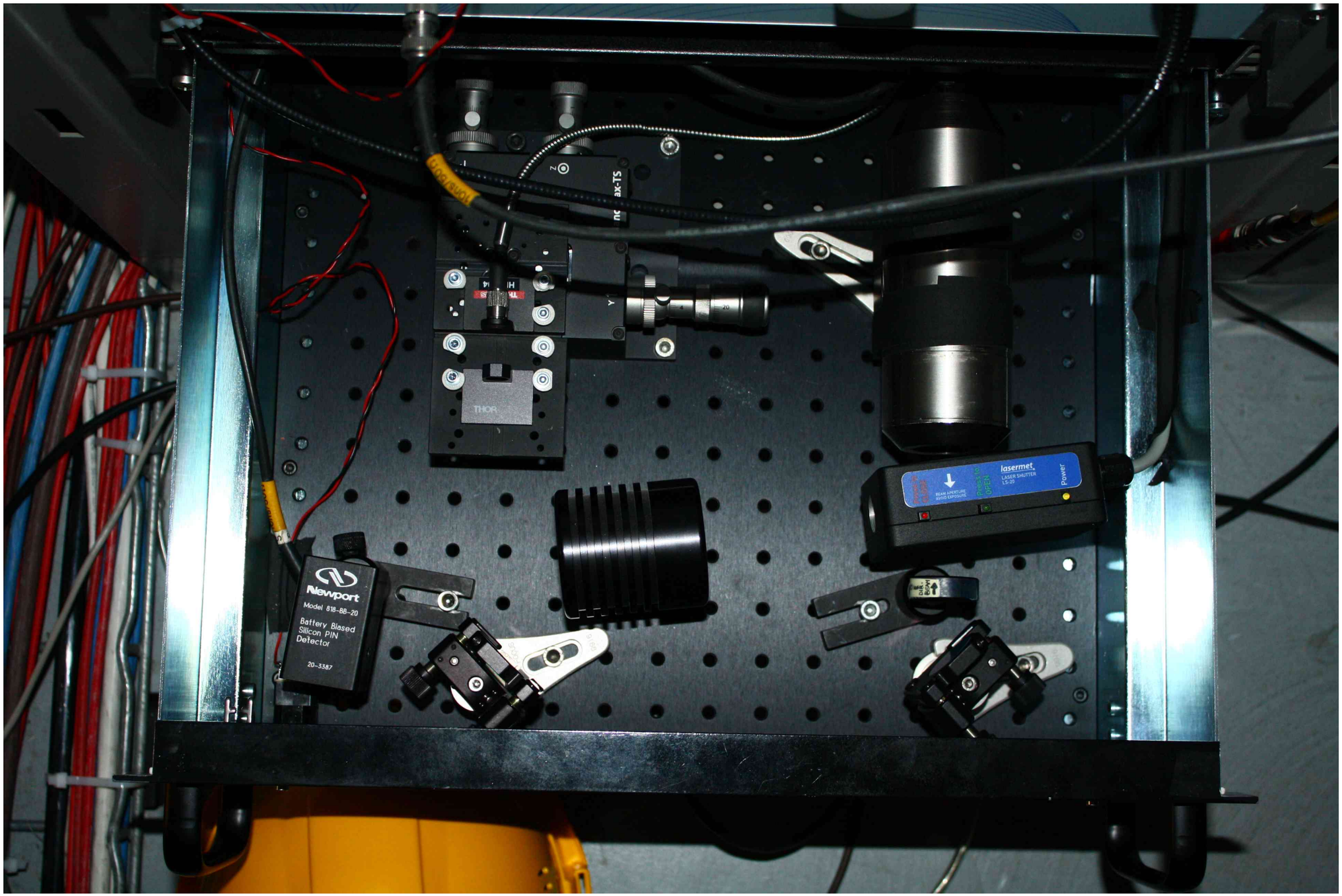


Laser, coupling and interlock



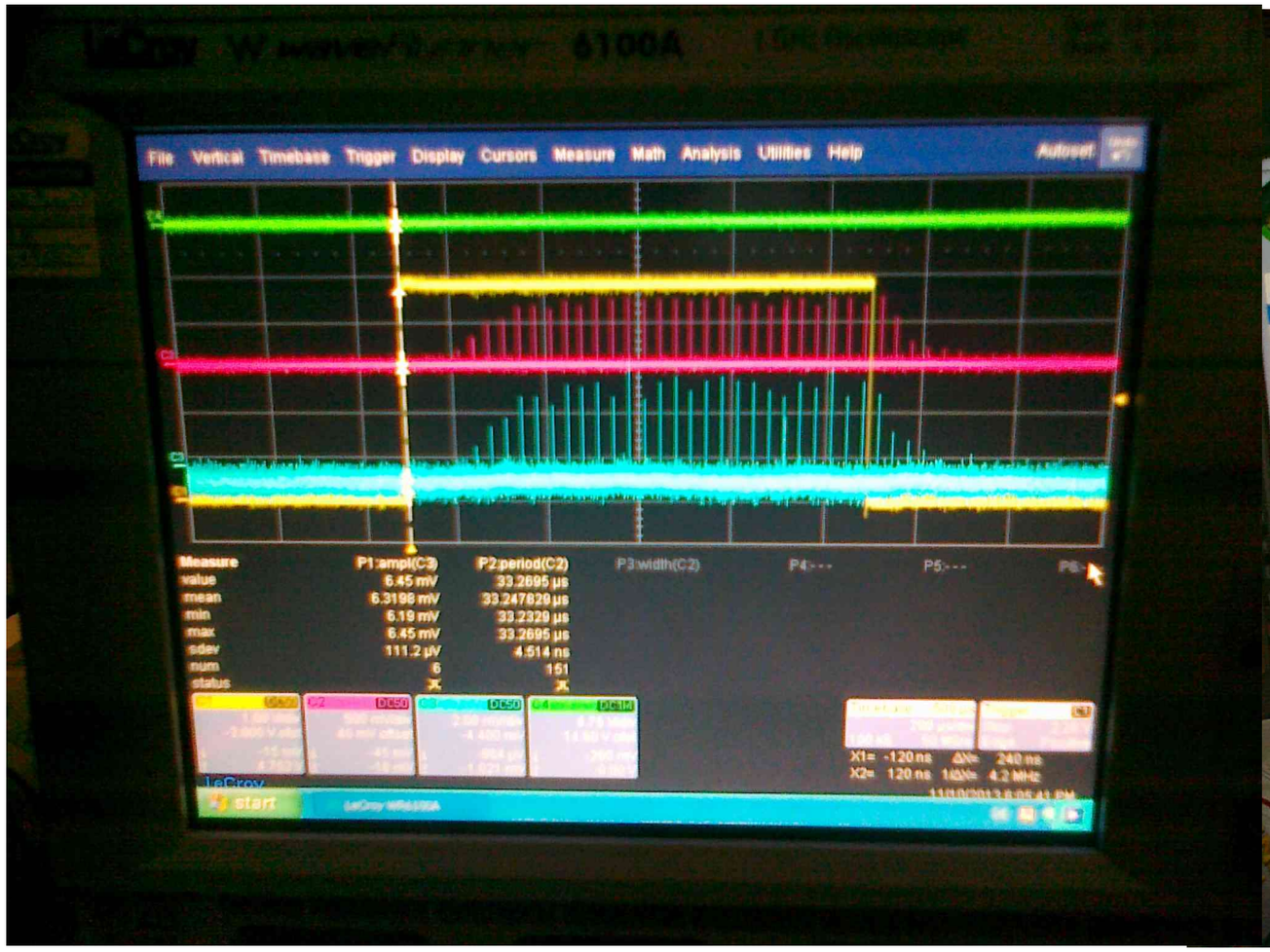
- Interlock installed with push buttons to open laser shutter.
- Openning a panel on the delivery box breaks the interloc and blocks the laser beam (or if the coupling box is opened, triggers the rear laser interlock).
- Override keys are present on coupling box and delivery box to enable access during alignment with goggles.

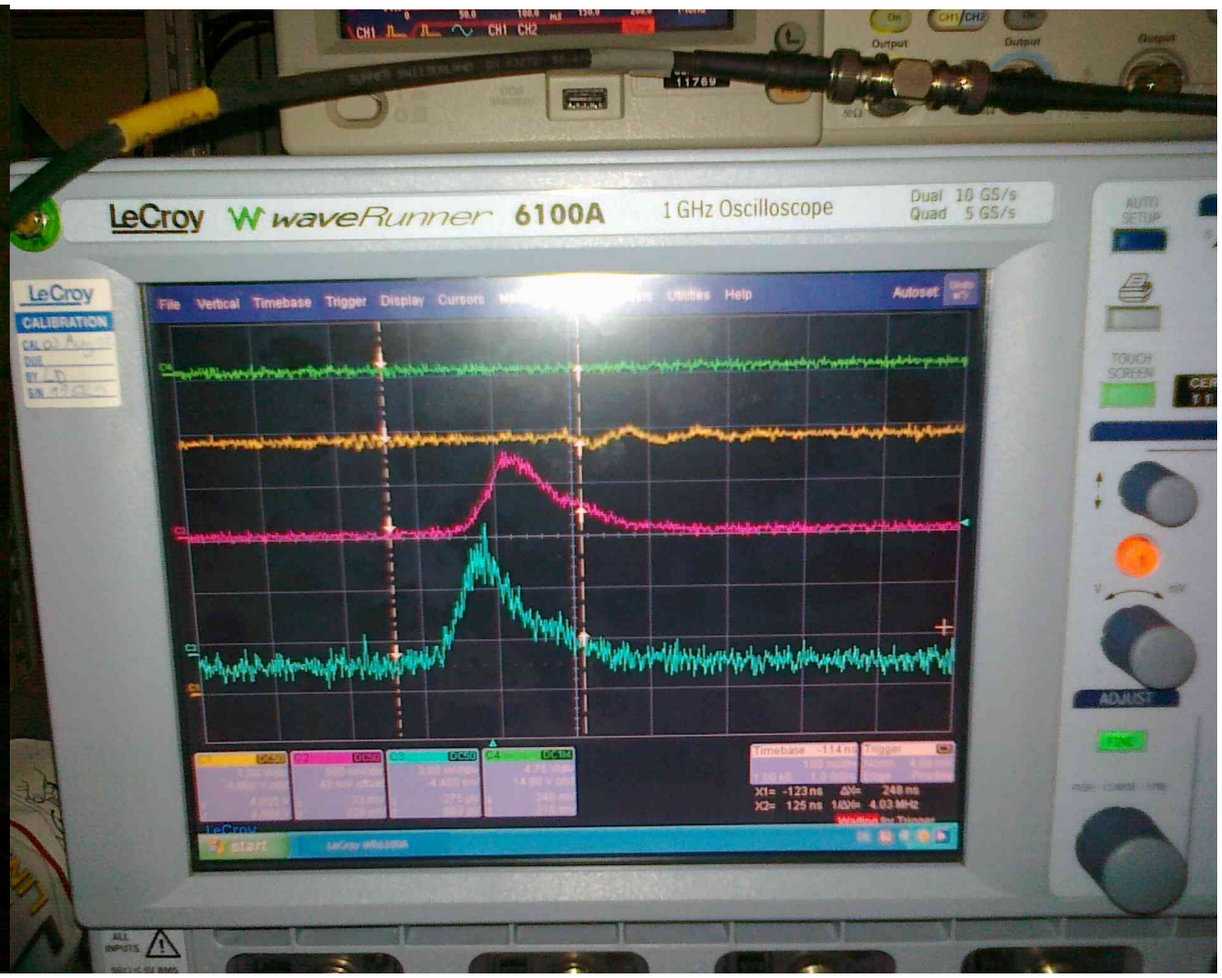
Coupling box optics



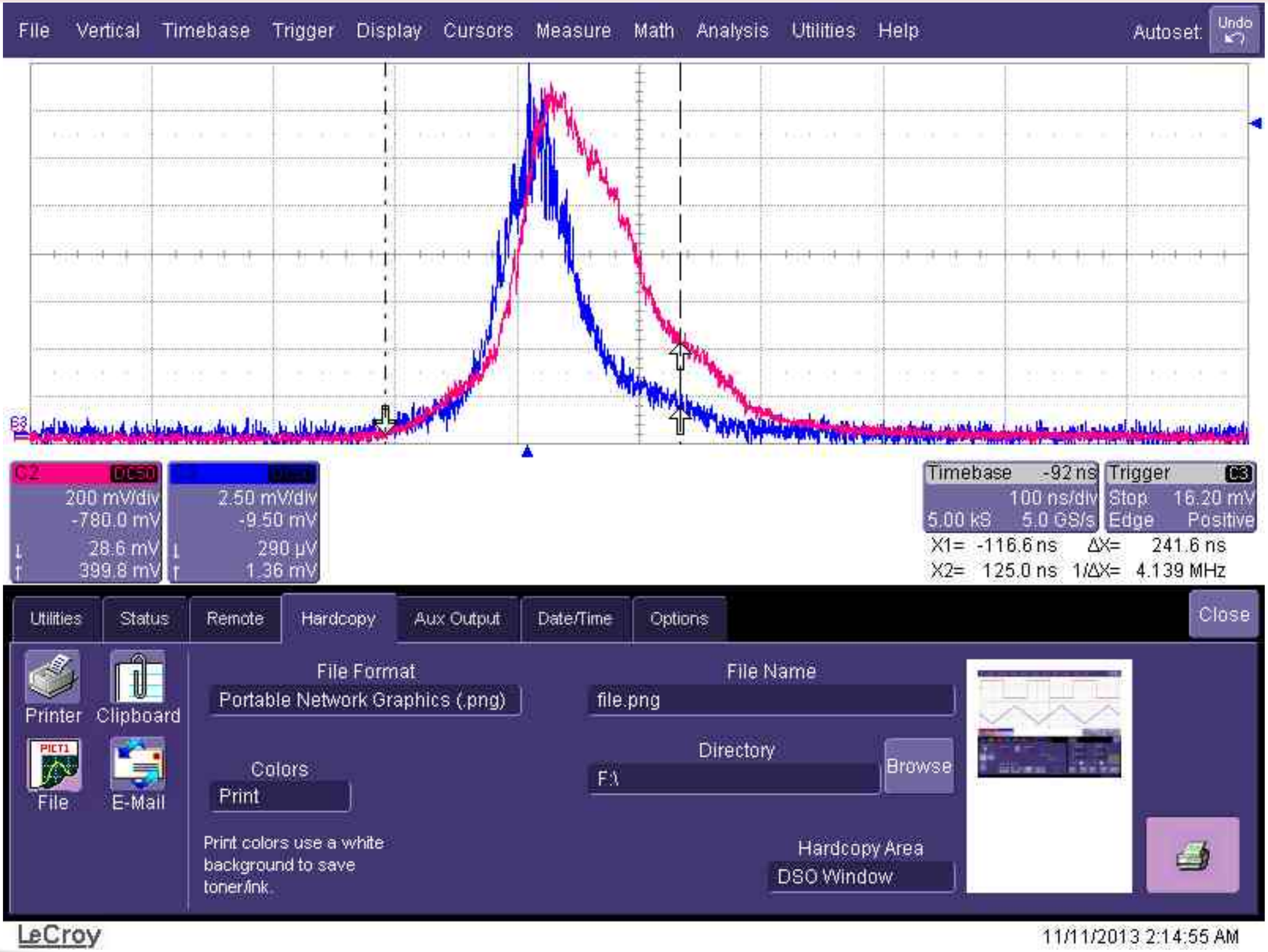
Amplified pulses

- Two fast photodiodes are installed in the coupling box and the beam delivery box, so that the pulse signal before and after the fibre can be measured.
- The photodiode in the coupling box is essential for synchronizing the PXI, especially when the beam expander stage is positioned to deliver the laser to the vacuum chamber (deliver box photodiode not illuminated).
- Pulse shape measured before and after fibre:





Amplified pulses



Outlook

- CERN has asked Gary to visit once more in the coming weeks to configure the software, now that the hardware is fully installed.
- The 3 MeV beam was very recently been obtained after the RFQ.
- Beam tests now arrives at the SEM grid – CERN are current working on beam stability.
- Next step is for CERN to install the diamond detector (5 strip detector) and power the spectrometer magnet.
- Thereafter, first tests with the FETS/Linac4 laserwire system are eagerly awaited.

Outlook