

Target:

— on behalf of the 'Target Team'.

Contents:

- **Target operation 2009 to 2010**
- **Beam loss and activation of ISIS**
- **Magnetic analysis and mapping**
- **Progress on mechanical assembly**
- **Electronics and DAQ**
- **Schedule**
- **Conclusions**

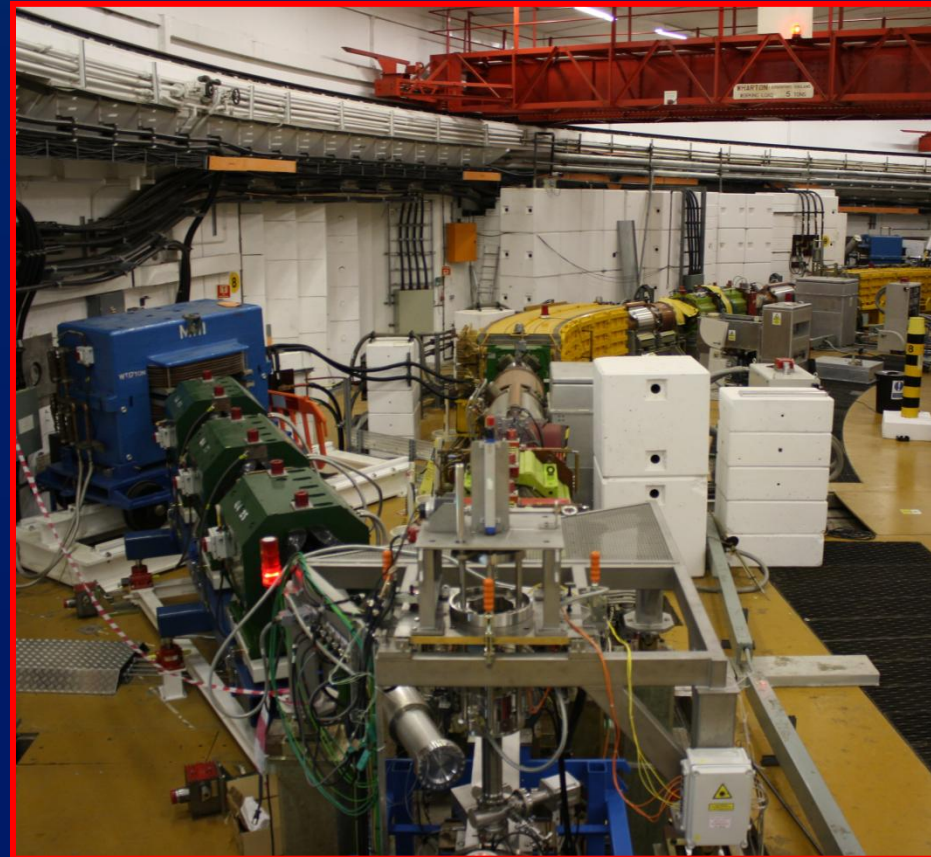
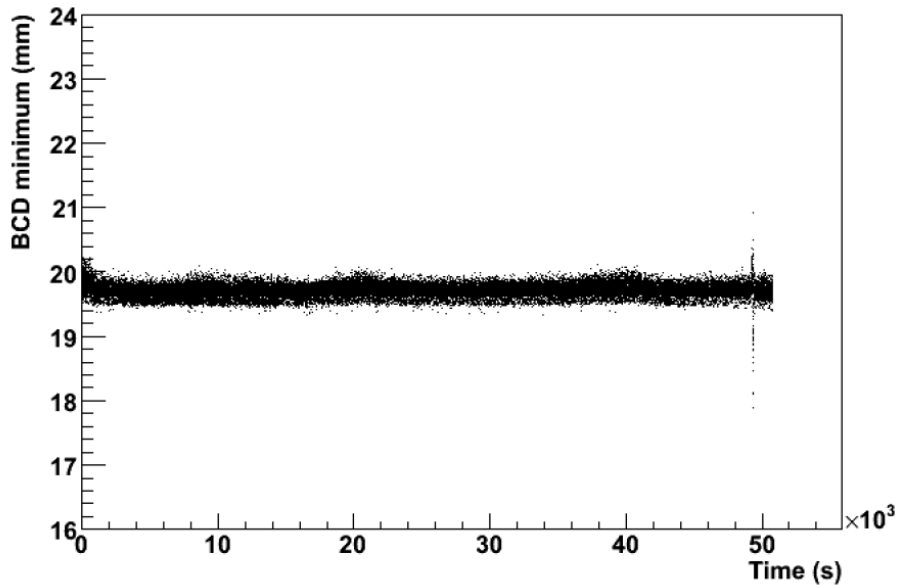
Target:

Operation 2009 to 2010

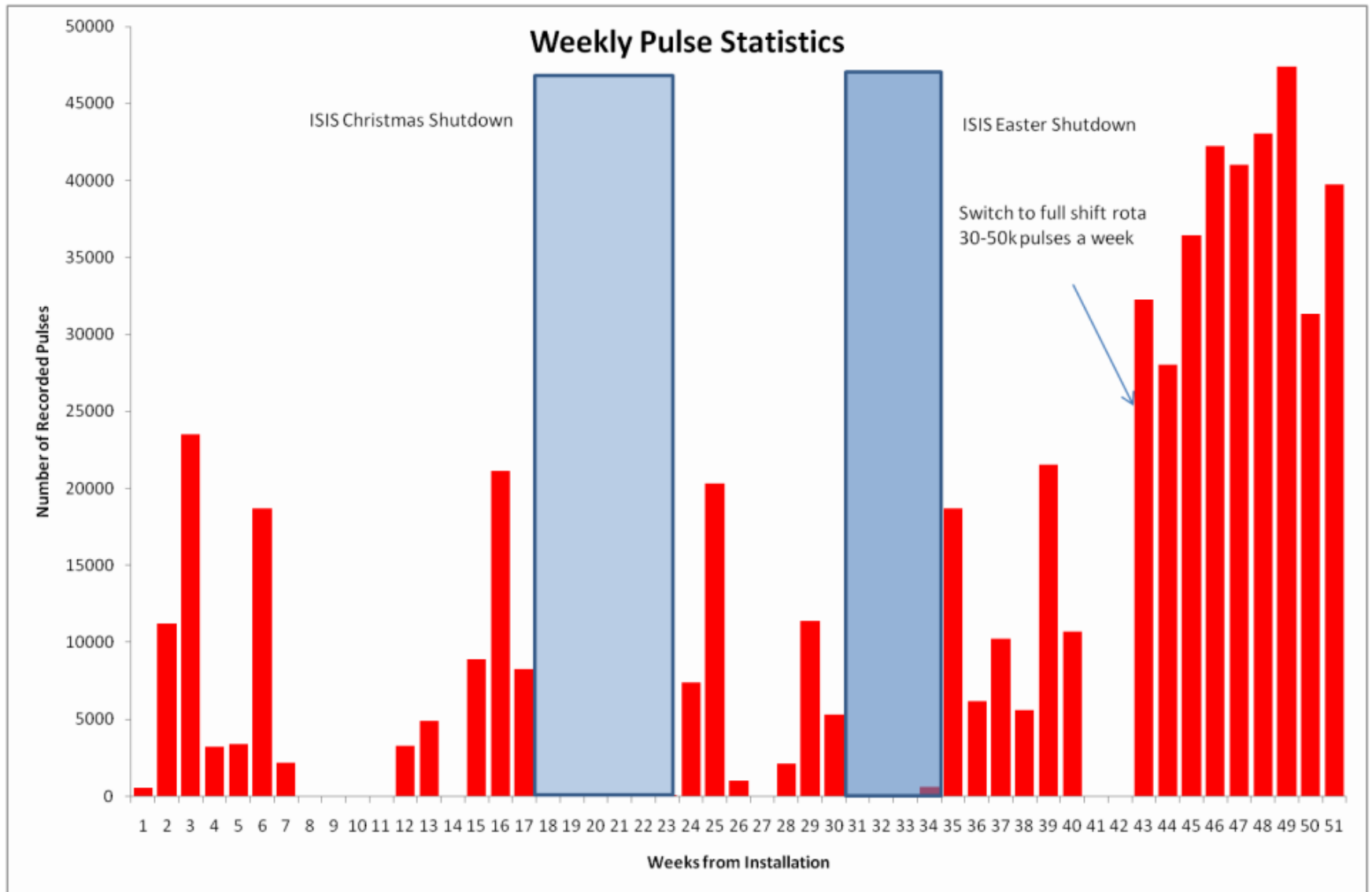
T1: target installed in ISIS:

- Installed in ISIS 25th August 2009:
 - Followed successful test in R78 – 50k good dips

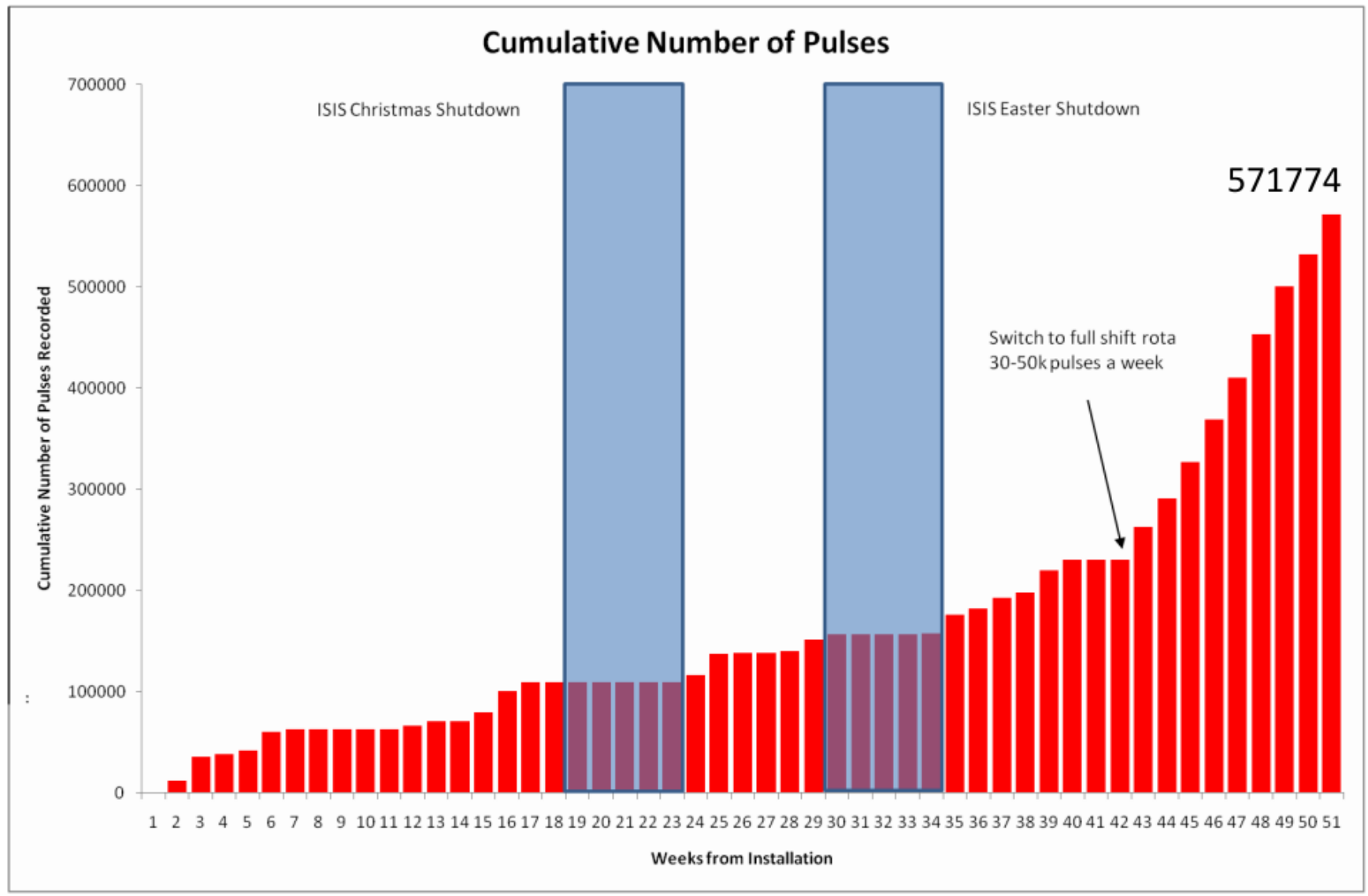
BCD vs Time for T1 Commissioning Run



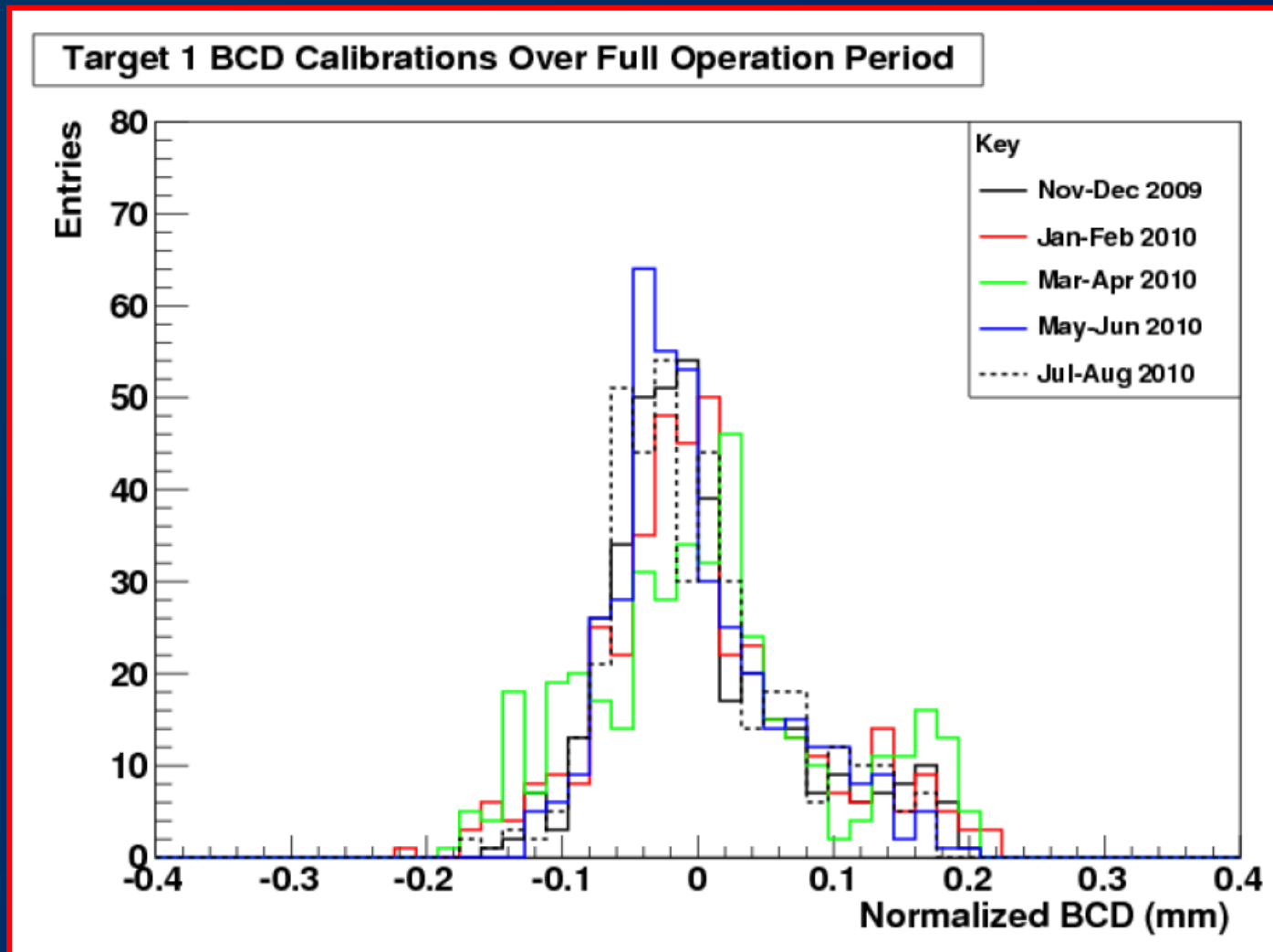
Pulse Statistics



Pulse Statistics



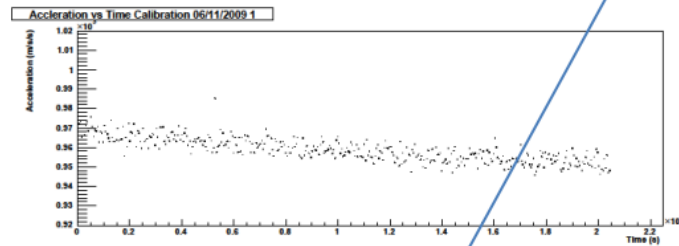
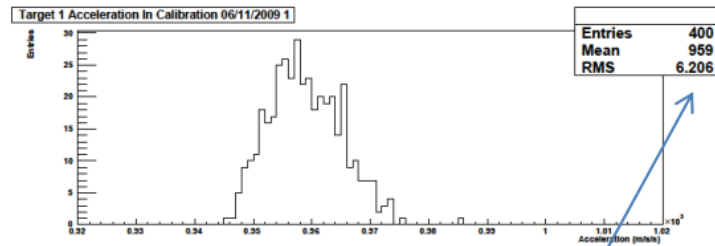
Target integrity test; history:



- No evidence of degradation over year's running

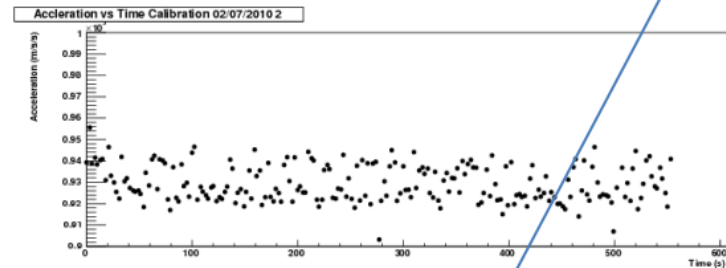
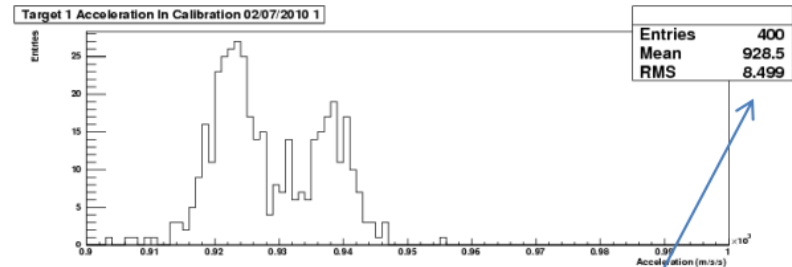
In more detail: acceleration:

6th November 2009



RMS 6.21

2nd July 2010

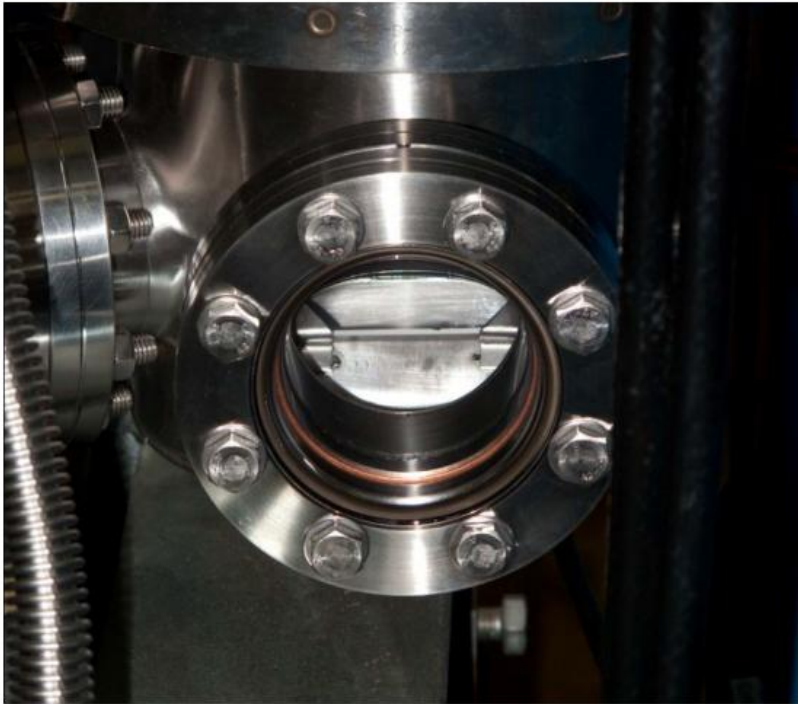


RMS 8.50

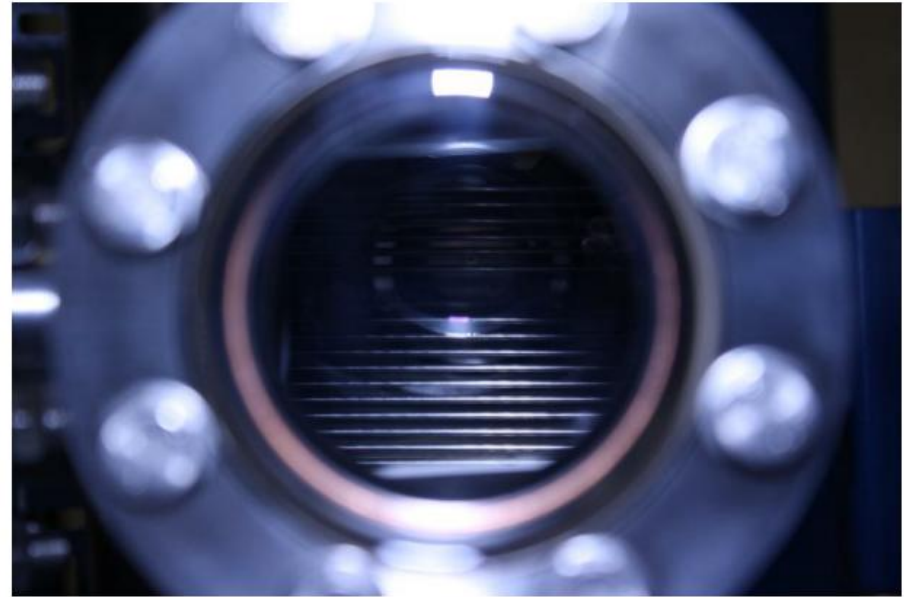
- Slight difference Nov09 to Jul10:
 - Do not believe behaviour indicates imminent issue

Visual inspection:

7th September 2009



27th August 2010



- No sign of dust or debris

Target in ISIS, conclusions:

- Total of more than 620k dips:
 - 571.8k in ISIS
- Excellent performance; routine data taking
- No evidence of wear either by direct inspection or through Paul Hodgson's analysis

MICE/ISIS target workshop

Conference Room G06, R66, RAL, 13:30 BST

Present: EO, CB, AD, DF, PH, GB, CR, JL, PS, SJ, KL, ABI (phone)

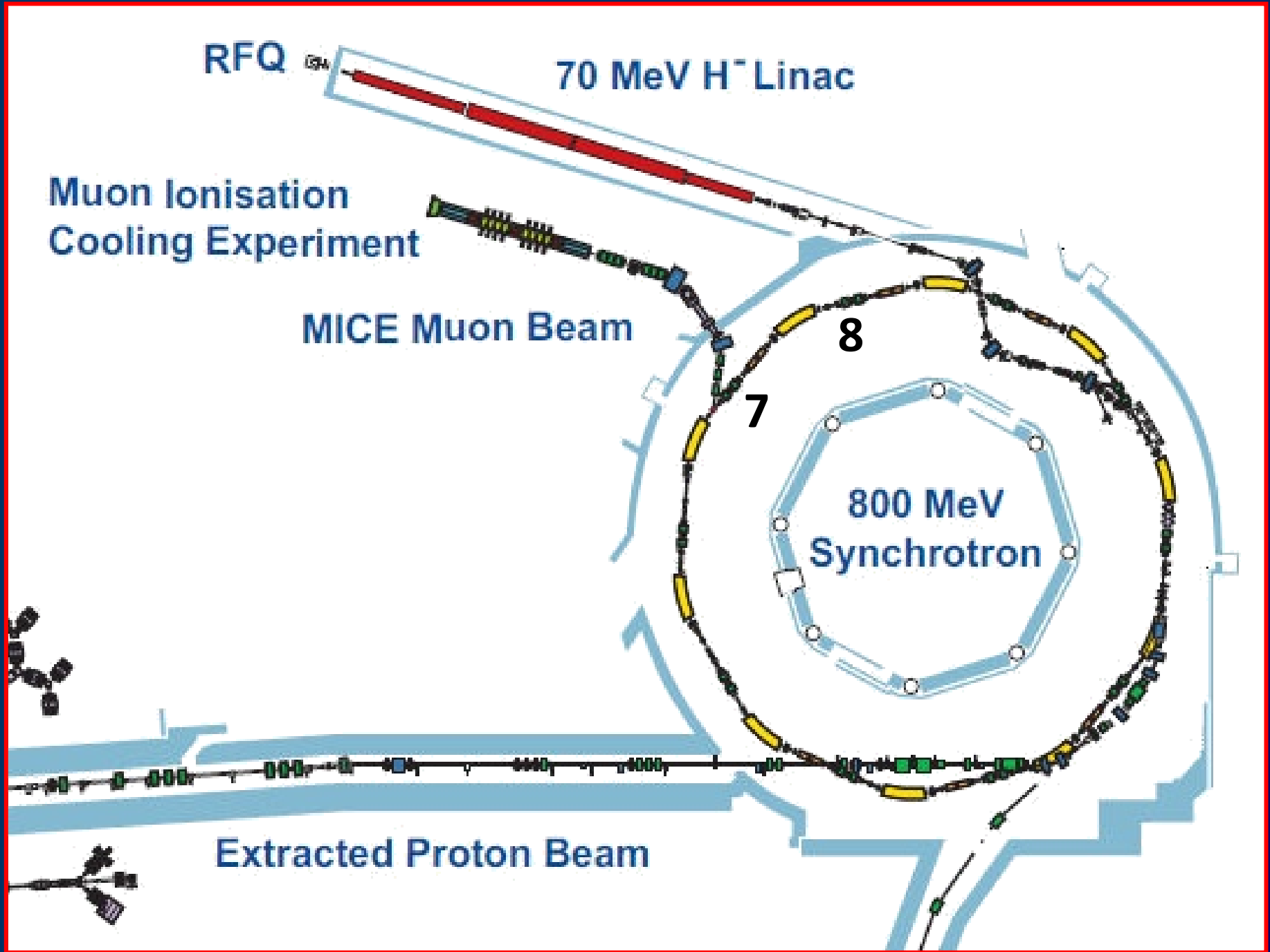
Principal agreements:

- ***Target presently installed on ISIS will not be removed during the present shut down.***
 - This decision was based on the following observations:
 - Present target is working well and at present there is no working (and acceptable) alternative;
 - Given the present understanding of the good quality of the Step I data, MICE does not expect to have a requirement for extended running in 2011.

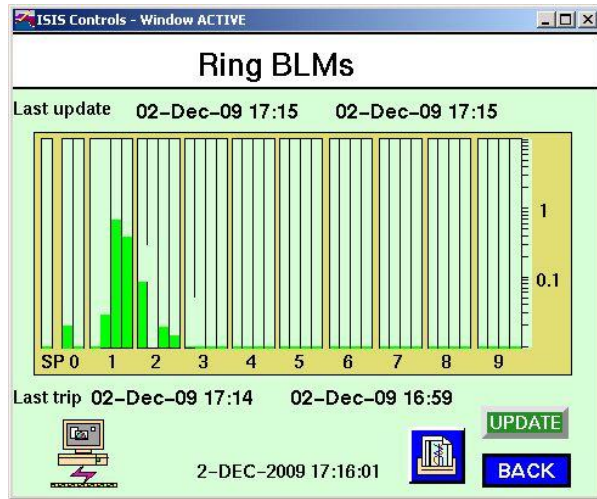
Clearly, if a requirement for extended MICE running emerges it will be necessary to review this decision and another MICE/ISIS target meeting will be needed.
 - The target team will continue to push toward a revised target on the timescale outlined. Once it has been demonstrated that the revised target is acceptable, the situation will be reviewed with a view to defining an early installation date.
- ***Target acceptance criterion:***
 - The revised target will be deemed acceptable for installation on ISIS when it has been demonstrated that dust production in a 'production running period' of 2M dips is negligible;
 - The production running period is taken to start after an appropriate 'running-in' period. Details of the running in period and the effective start of the production-running period will be defined based on the results of the planned soak test.
- ***Target BPS signal:***
 - A BPS signal will be generated using firmware in the target FPGA as presented by PS under item 5;
 - A future upgrade to include a modification to the target graticule will be considered in the future.

Target:

Beam loss and activation of ISIS



Pattern of loss around ISIS:



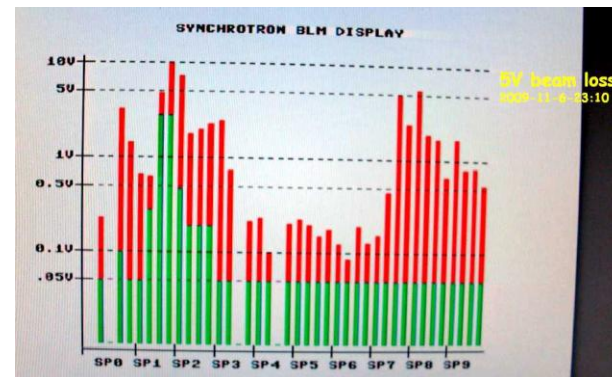
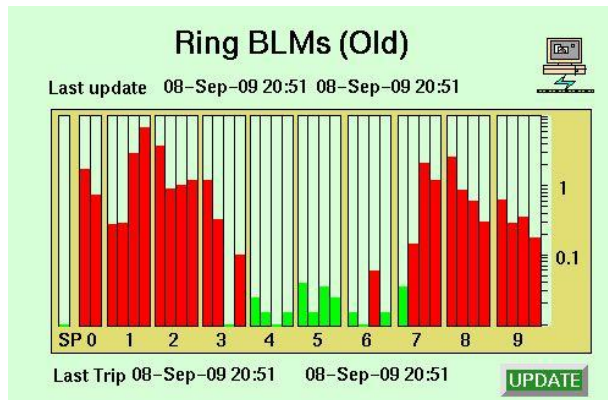
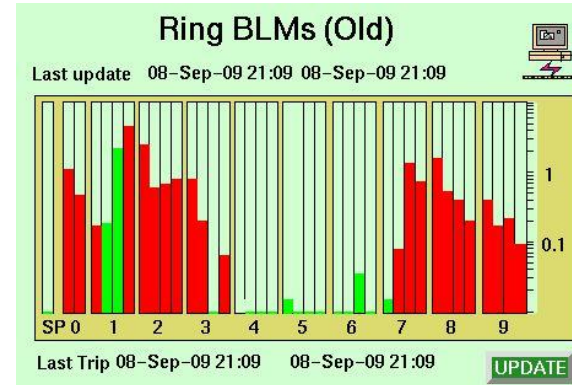
~0 V-ms

2.8 V-ms

R8BLM1 (V-ms)

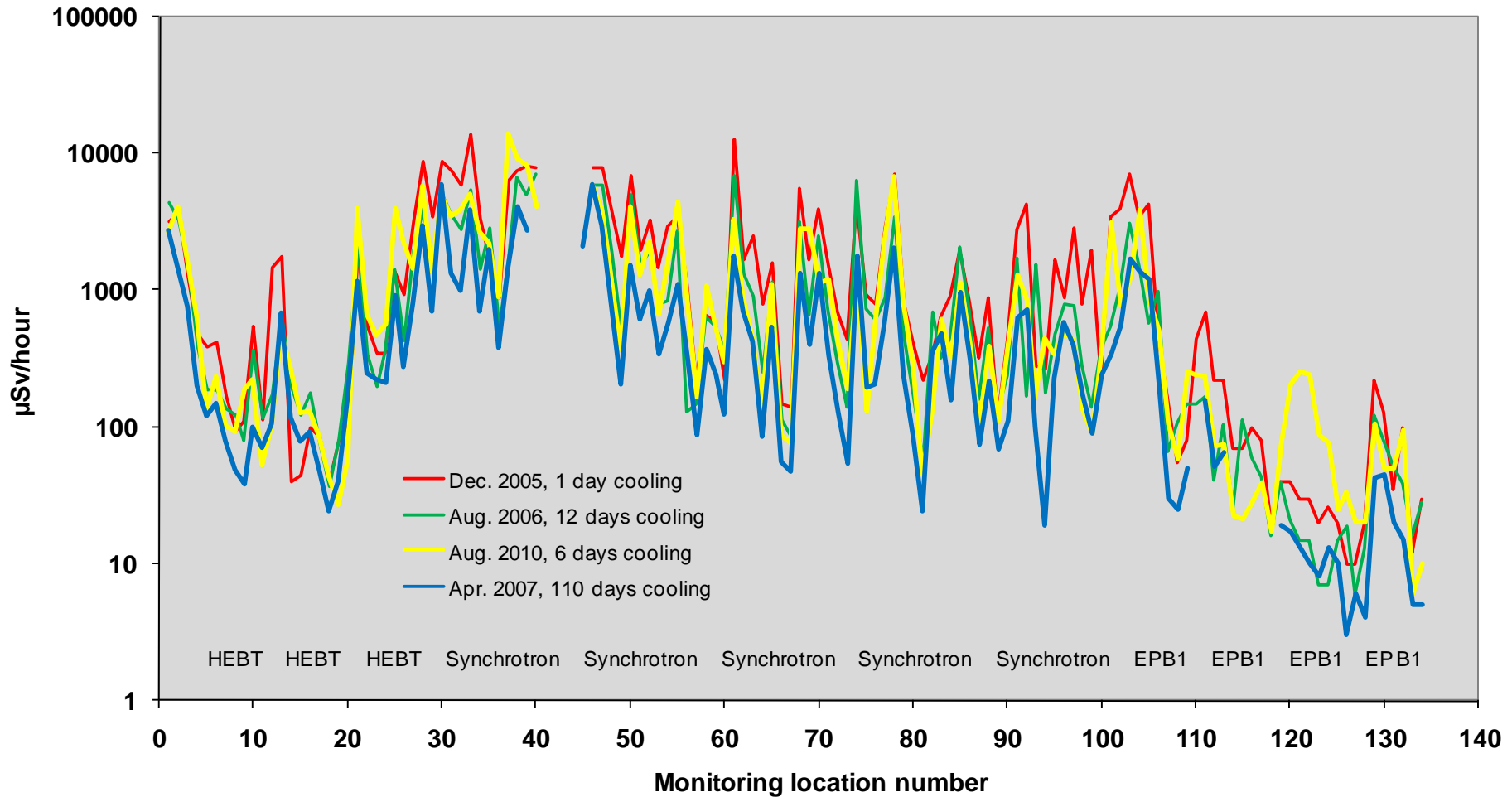
1.6 V-ms

5 V-ms



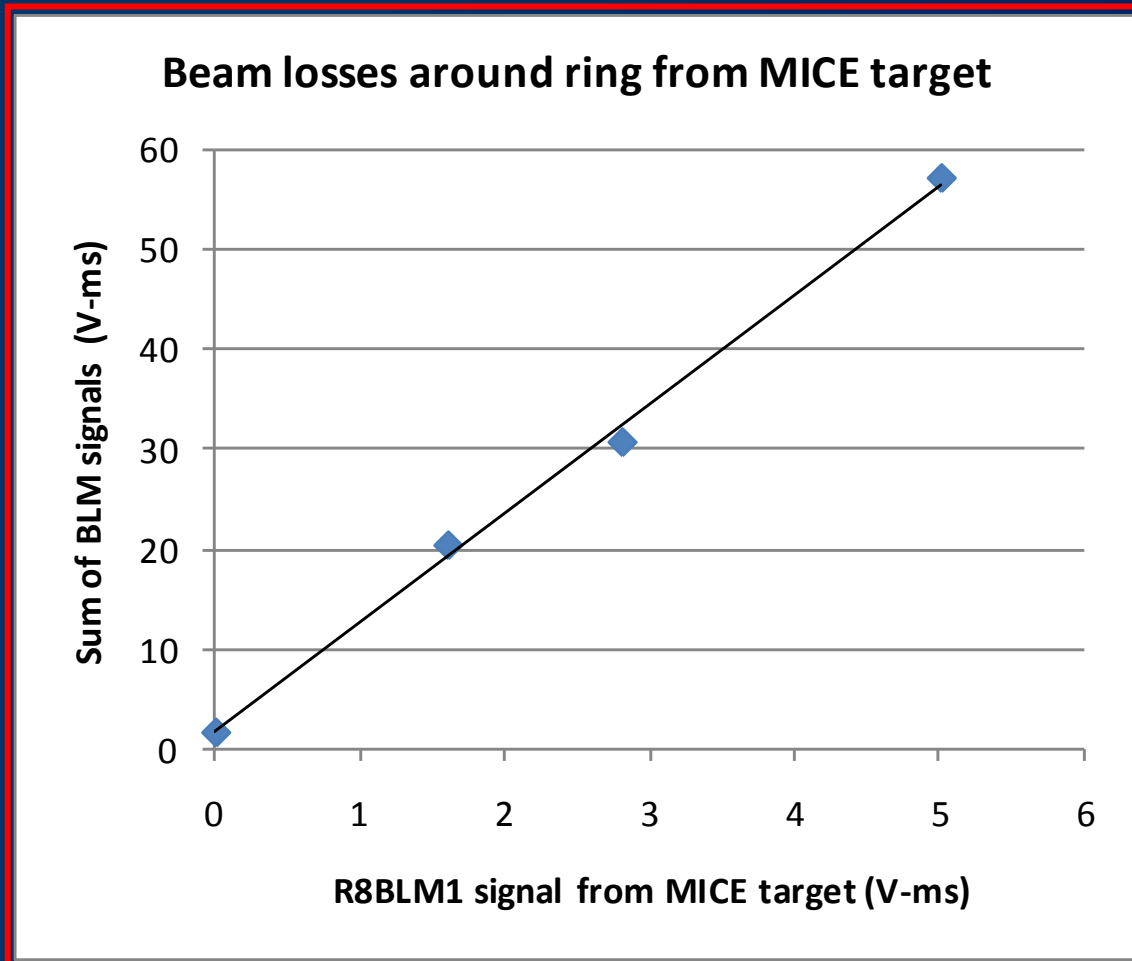
- MICE target induces beam loss around ISIS

Induced activity contact dose rates



- No evidence (yet) of increased dose due to MICE running

Total loss versus loss close to MICE target:



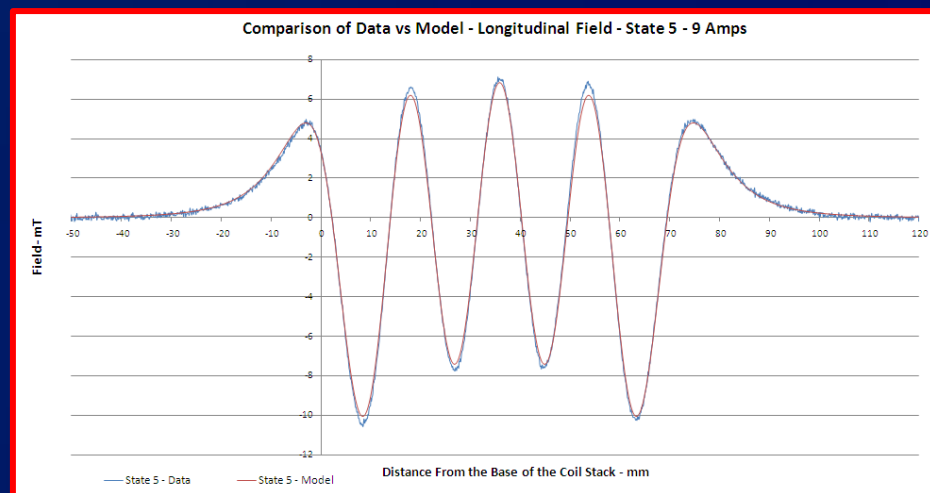
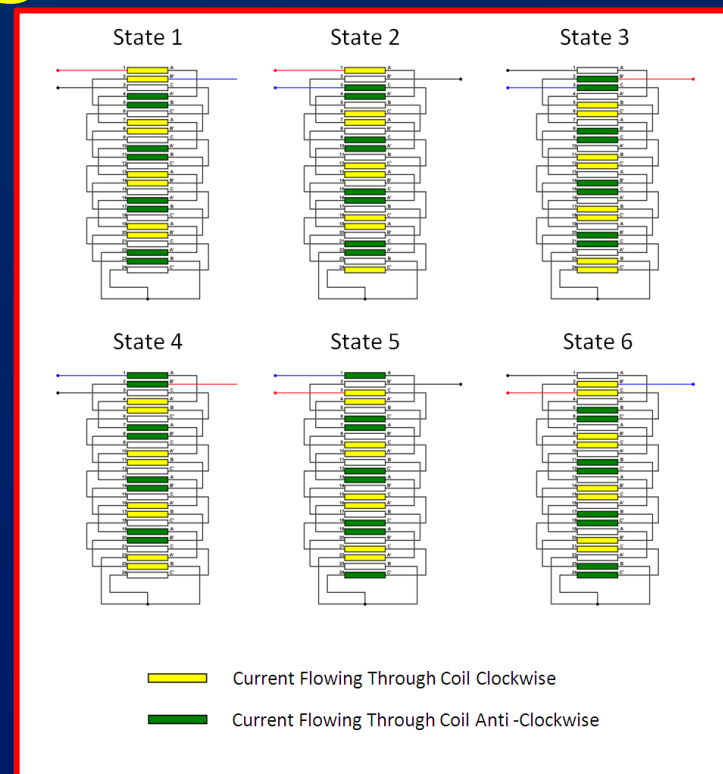
- Extrapolation of total loss to:
 - 5 V·ms @ 1 Hz implies 69% increase of total loss over loss when MICE target is not running
- Such an increase is not acceptable to ISIS.
- Mitigations:
 - Beam bump (Dean Adams);
 - Increased acceleration
 - Revised target geometry or material
- Implies an ongoing programme of:
 - Beam-loss vs particle rate measurement and simulation
 - Development of target system and mechanics

Target:

Magnetic analysis and mapping

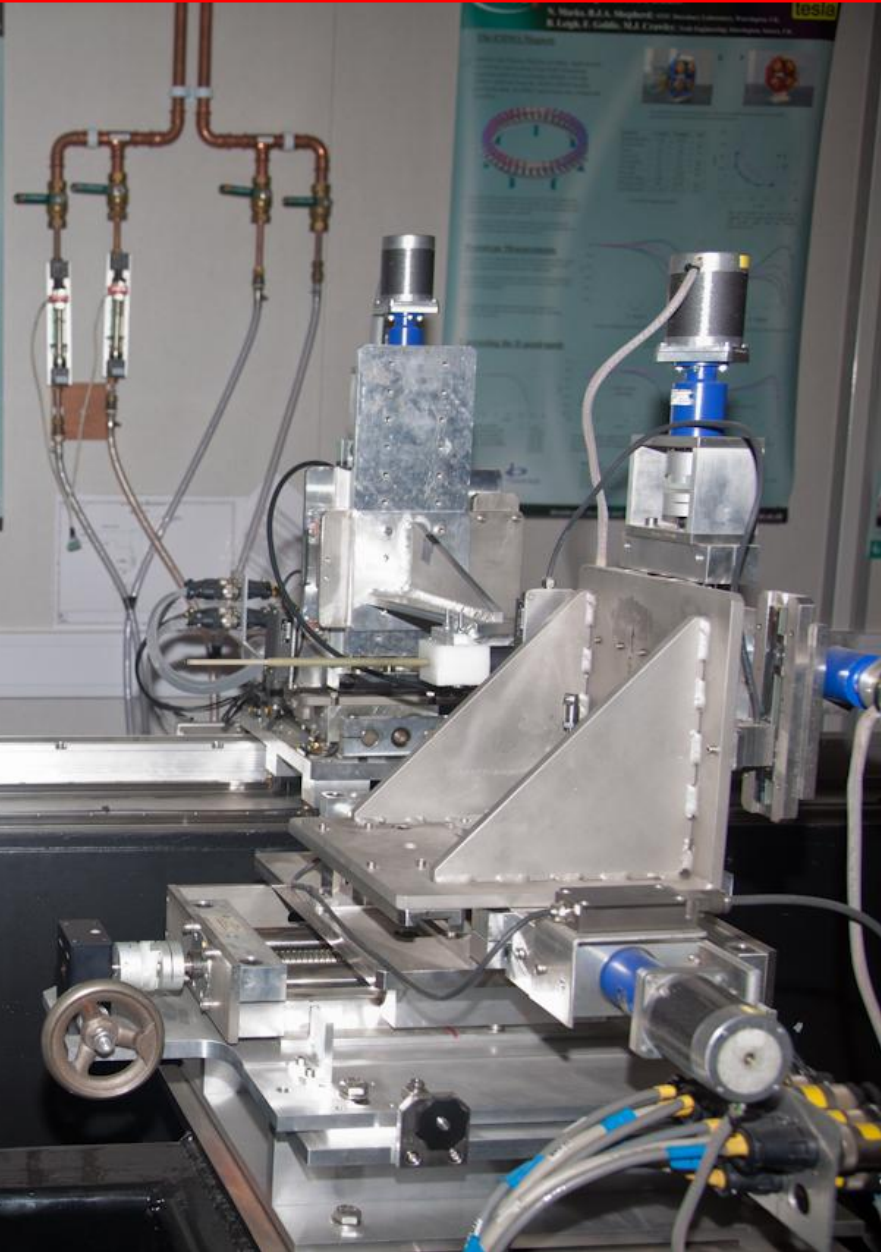
Magnetic investigation of T2 stator:

- Status at CM27:
 - Measurement of T2 stator by E. Longi using Diamond magnetic measurement rig indicated offset of magnetic axis from position of mechanical axis
- Delay in repeating measurement owing to Diamond shutdown work
- Mitigation:
 - Develop own magnetic QA rig:
 - Partially set up in R9
 - Will complete, presently on hold
 - Repeat magnetic measurements at DL using light-source magnetic measurement rig there:
 - Ben Shepherd is making the measurements for us



P. Smith,
G. Barber

Magnetic measurement set up in DL:

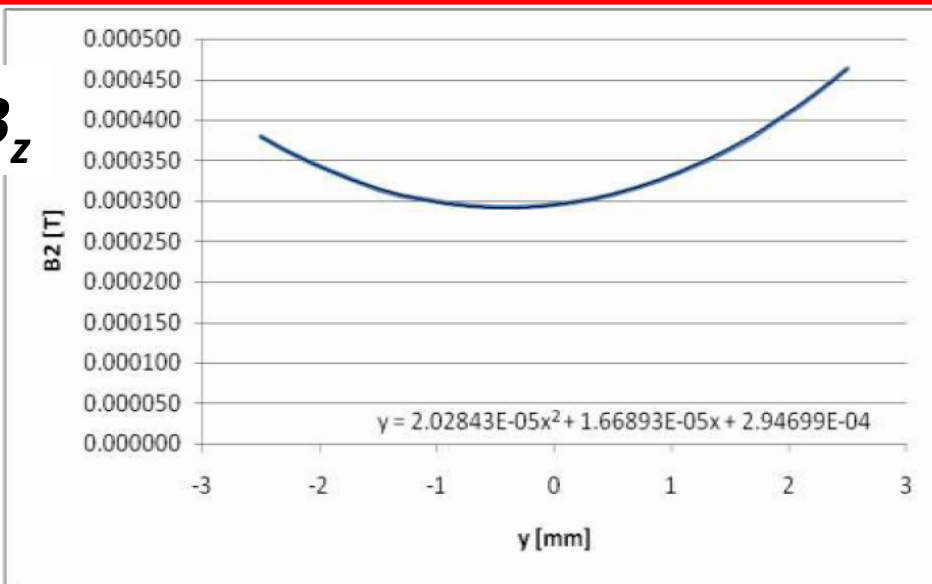
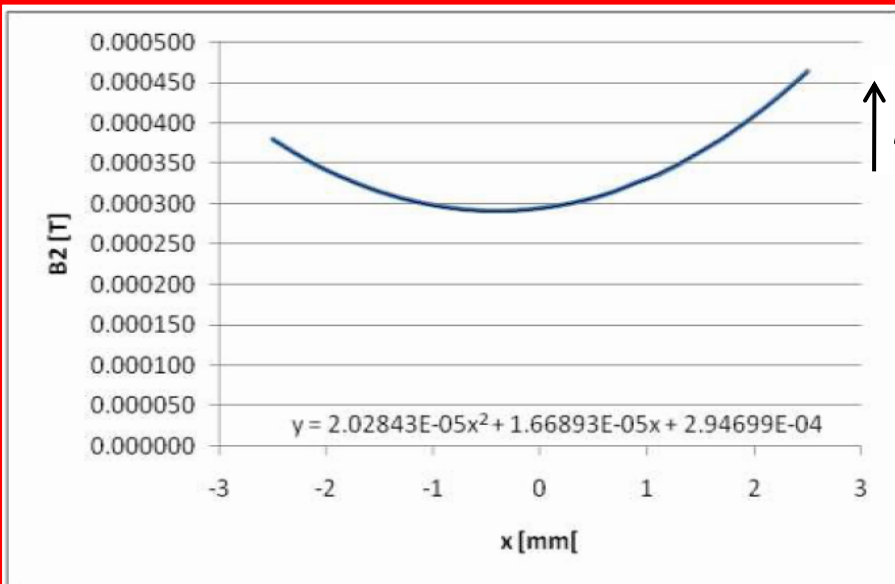
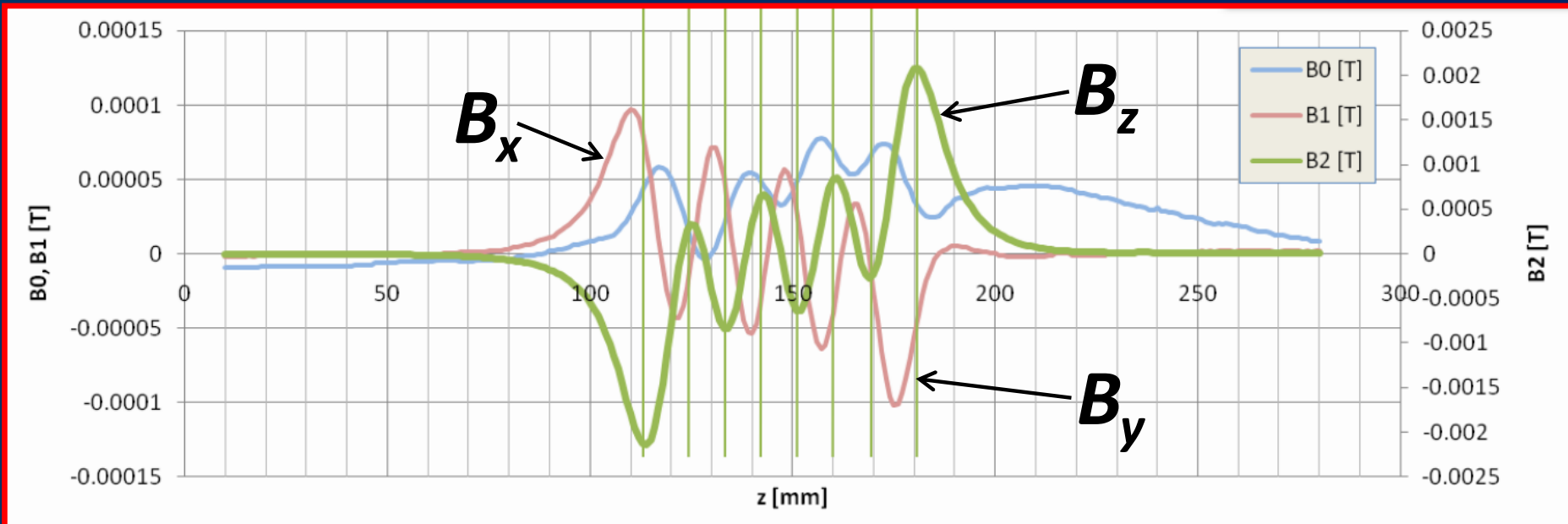


Alignment and set up:

- Optical survey telescope used with custom bearing inserts to align mechanical axis of stator to axis of linear stage:
 - Alignment good to $\sim 100 \mu\text{m}$ over 1.8 m
 - Total length of stator 180 mm
 - Alignment therefore good to $10 \mu\text{m}$ over stator
- Map magnetic field in coordinate system with z axis aligned with mechanical axis
 - Will give accurate measurement of offset of magnetic axis

Only one phase so far

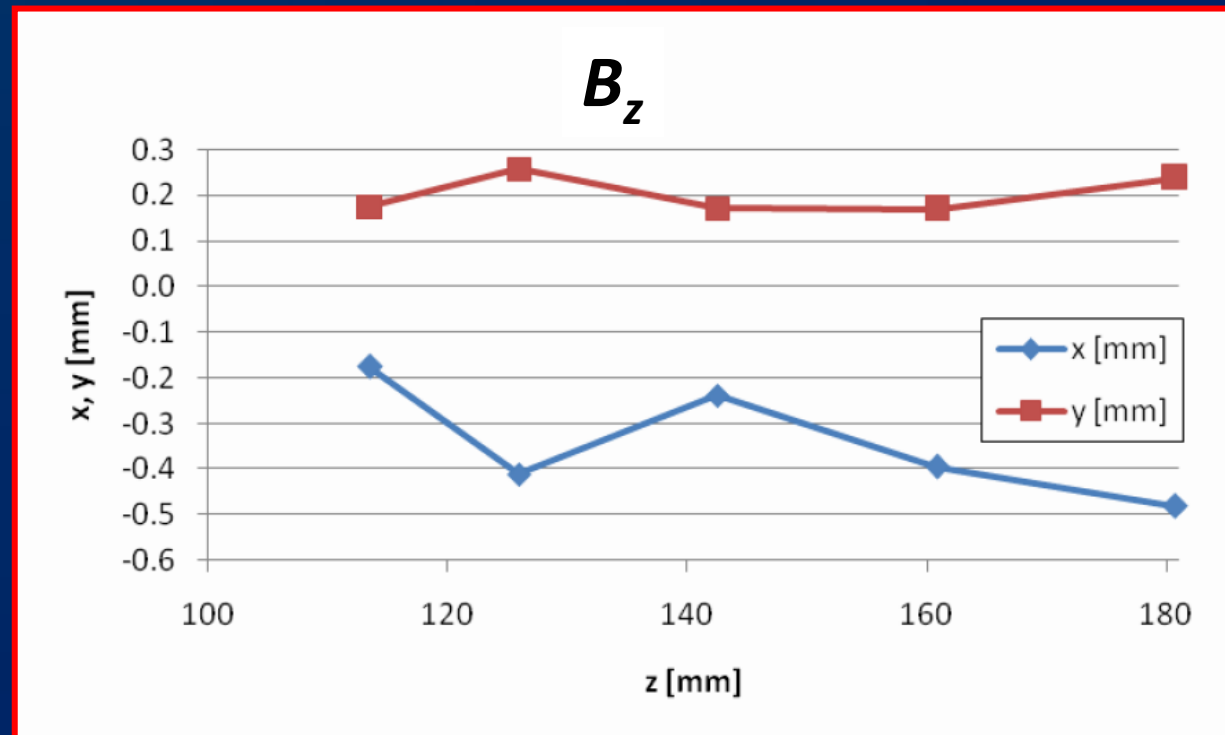
Results of first scan:



First estimation of magnetic axis:

Possible inconsistency of minimum of B_x and B_y with that of B_z under investigation

Measurements at DL appear to show more variability with position along stator axis. Under investigation



• Next steps:

– Consistency checks:

- Repeat measurements with stator rotated by 180°
- B_z minimum consistent between all three phases?
- Minimum of B_x and B_y consistent with minimum B_z ?
- Re-check mechanical axis

Planning for magnetic measurement and refit:

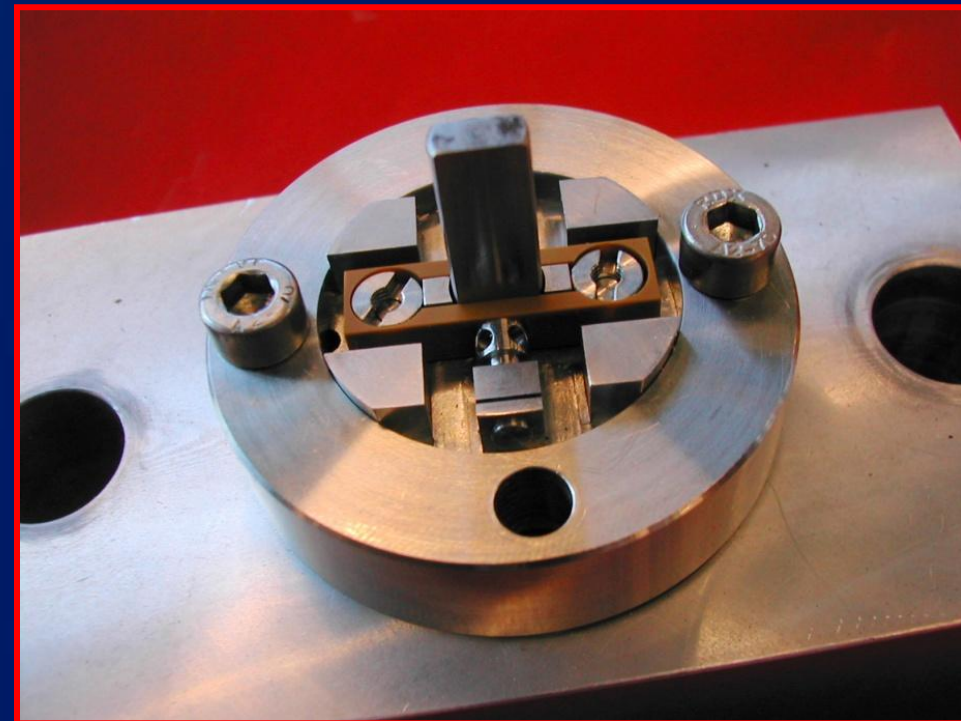
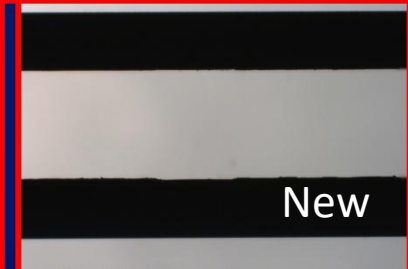
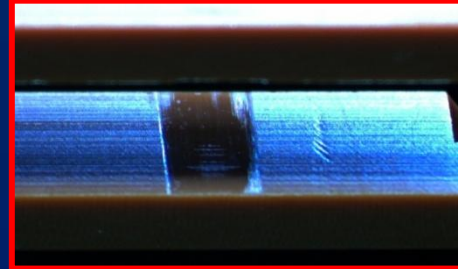
- This week (i.e. in parallel with CM28) complete magnetic measurements;
 - And document
- Meeting planned for 11Oct10 to review measurements and decide where to position bearings:
 - Risk:
 - If there were to be a large variability in the position of the magnetic axis along 'z' – might be hard to define position
- Decision on position will allow re-assembly of T2:
 - Estimated time: ~2 weeks
- Also developing plans for:
 - Measurement of individual coils and permanent magnets
 - Purchase of more permanent magnets
 - Consider larger diameter to increase force (i.e. acceleration)
 - Design of new coils
 - Better control of relative position of magnetic and mechanical axis

Target:

Progress on mechanical aspects

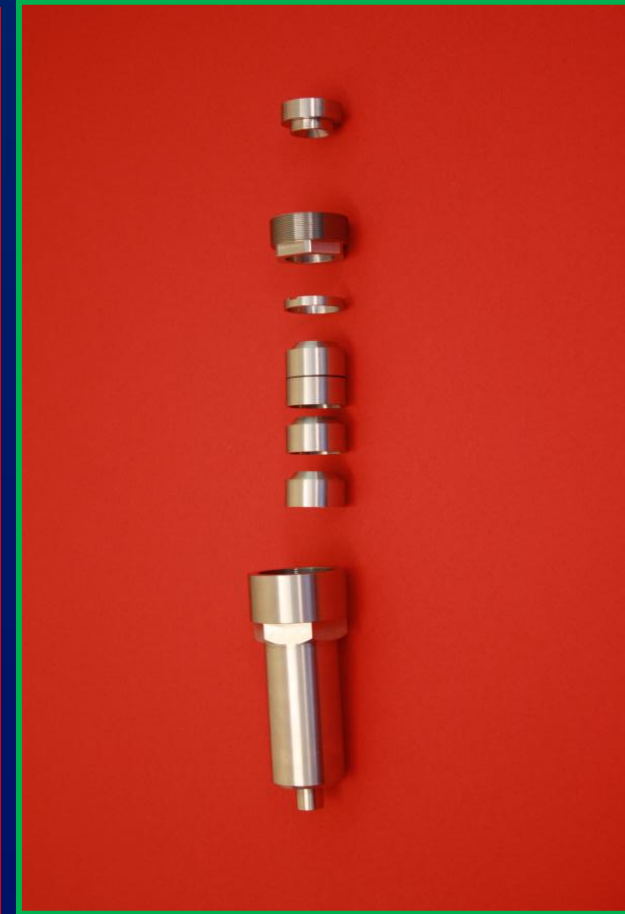
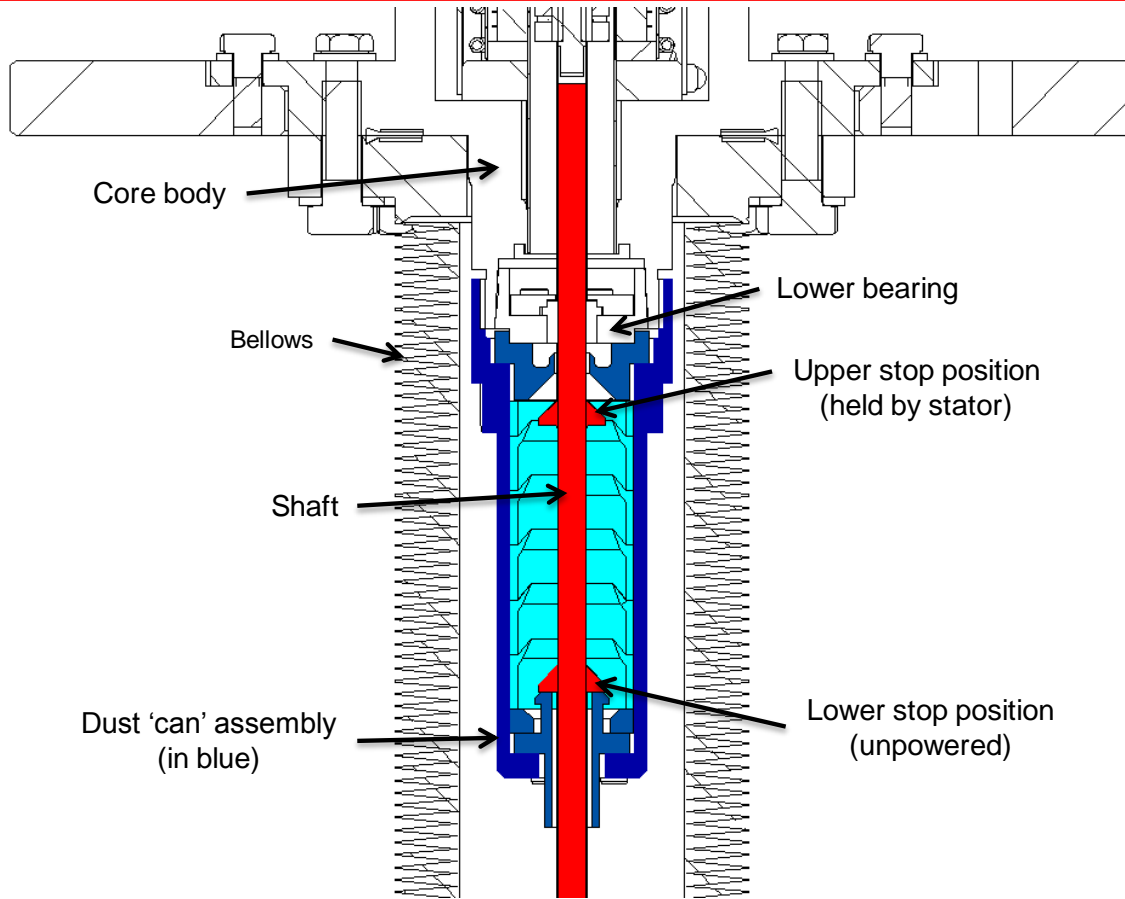
Mechanical progress: dust:

- Reducing dust at source:
 - Polish both flats at top of shaft and round lower shaft
 - Burnishing surfaces to size:
 - Burnishing tests of round and flat Vespel bearing surfaces carried out:
 - Wear induced with burnishing tools too slow
 - Option of accelerated wear (stone) risks contamination
 - Therefore have specified a 'running-in period'
 - Length to be determined empirically



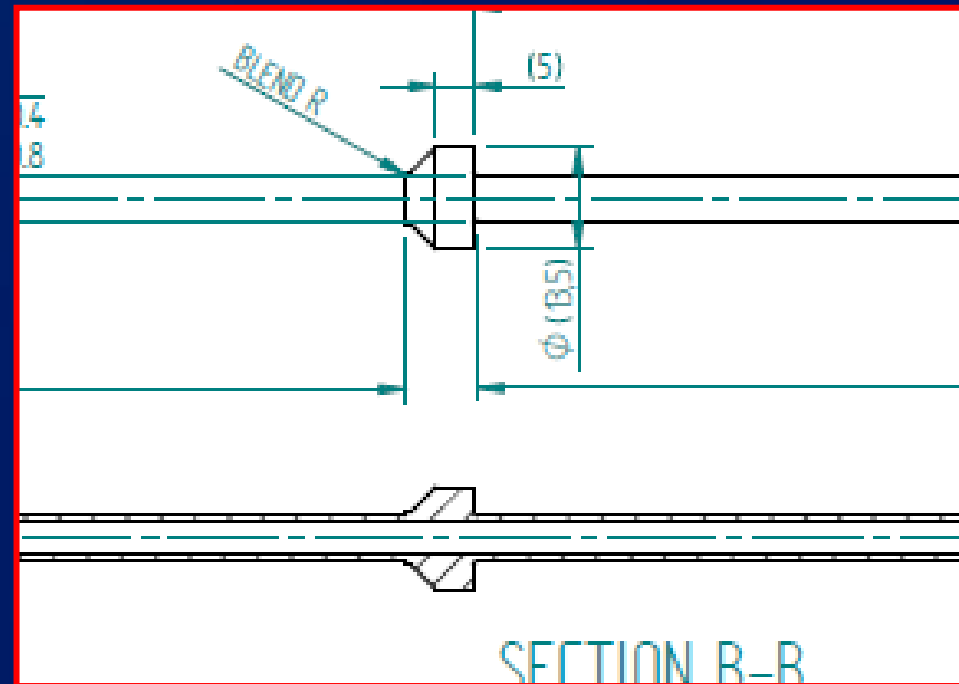
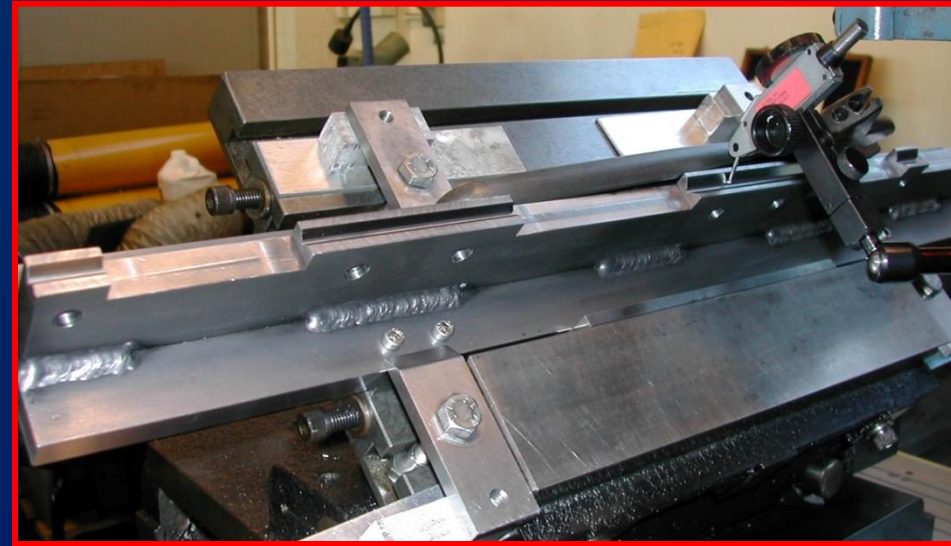
Mechanical progress: dust:

- Dust management: 'dust catcher':



Mechanical progress:

- Shaft manufacture:
 - Stress relief, annealing, straightening jig manufactured;
 - Lower stop now integrated on shaft;
 - EDM drilled + wire eroded bore in 330mm long Ti
 - Rough machined lower shaft, next steps:
 - Heat treat & re-inspect (distorted?)
 - EDM & wire cut bore
 - Final machine & polish
 - More costly but more robust & accurate + less risk



Target:

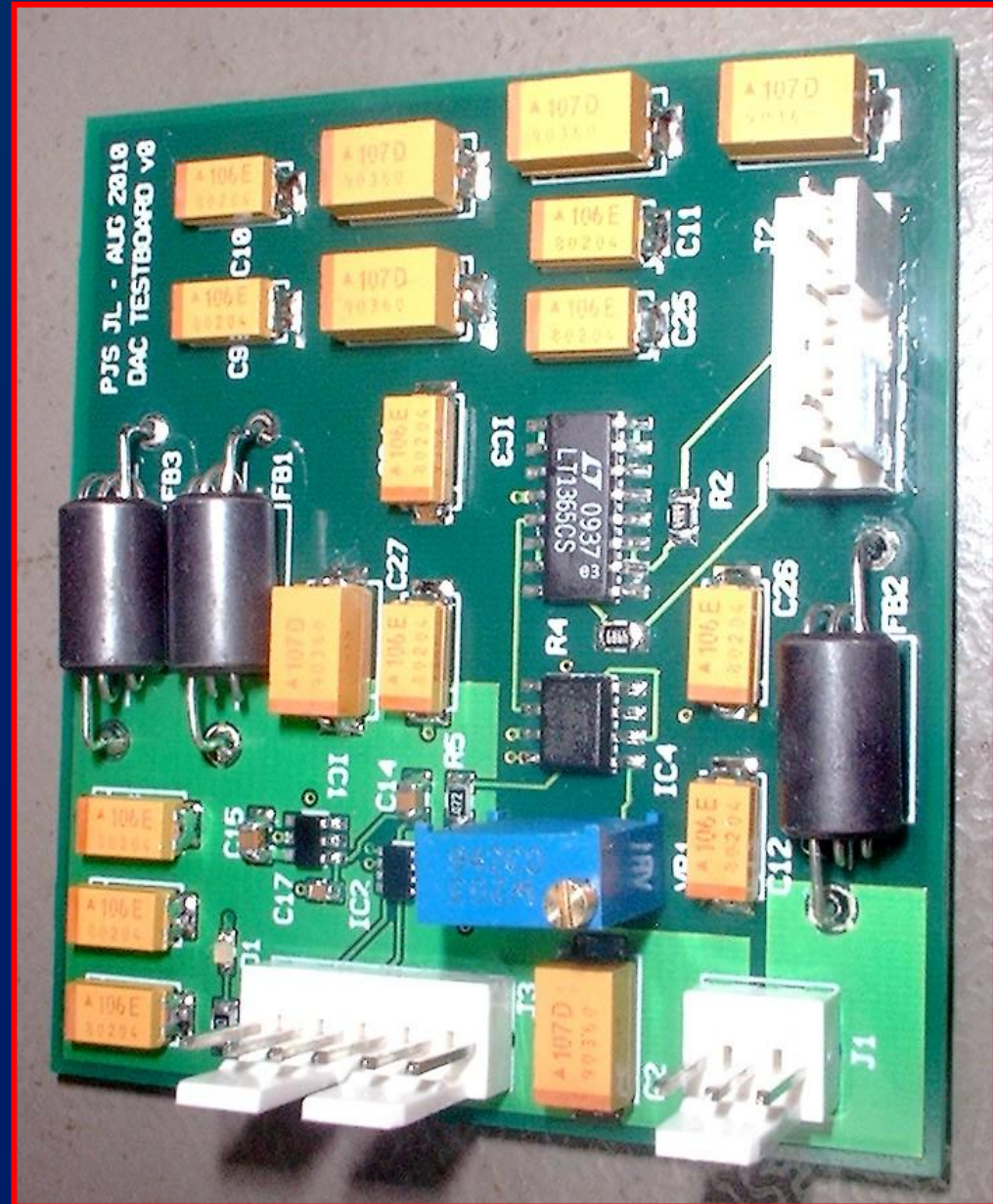
Electronics and DAQ:

- **Phase 1 Upgrade – Target Controller [complete]:**
 - This controller was not soak tested in R78 as planned due to delay in obtaining magnetic measurements. The phase 1 target controller has temporarily been taken back to Sheffield to obtain some running data on an older target.
 - We are using this opportunity to do some soak testing of the controller.
- **Phase 2 Upgrade - Electronics**
 - The purpose of the Phase 2 electronics is to integrate much of the peripheral target electronics onto PCB's and to add some low level functionality that will enable the system to be more easily managed by an expert (no additional user functions)
 - Phase 2 has, until recently, progressed to plan. The recent additional requirement to provide ISIS with a firmware BPS (Beam Protection Signal) on the new controller has slightly delayed the phase 2 timetable.
 - A revised timetable sees the phase 2 work to be completed by May 2011 (Originally March 2011)

- **Phase 2 electronics will consist of 3 PCBs:**
 - 1. Daughter Card A: Optical Amplifiers + DAC**
 - 2. Daughter Card B: Drivers + Interlocks**
 - 3. Power Supply**
- **Currently implementing 1 & 3**

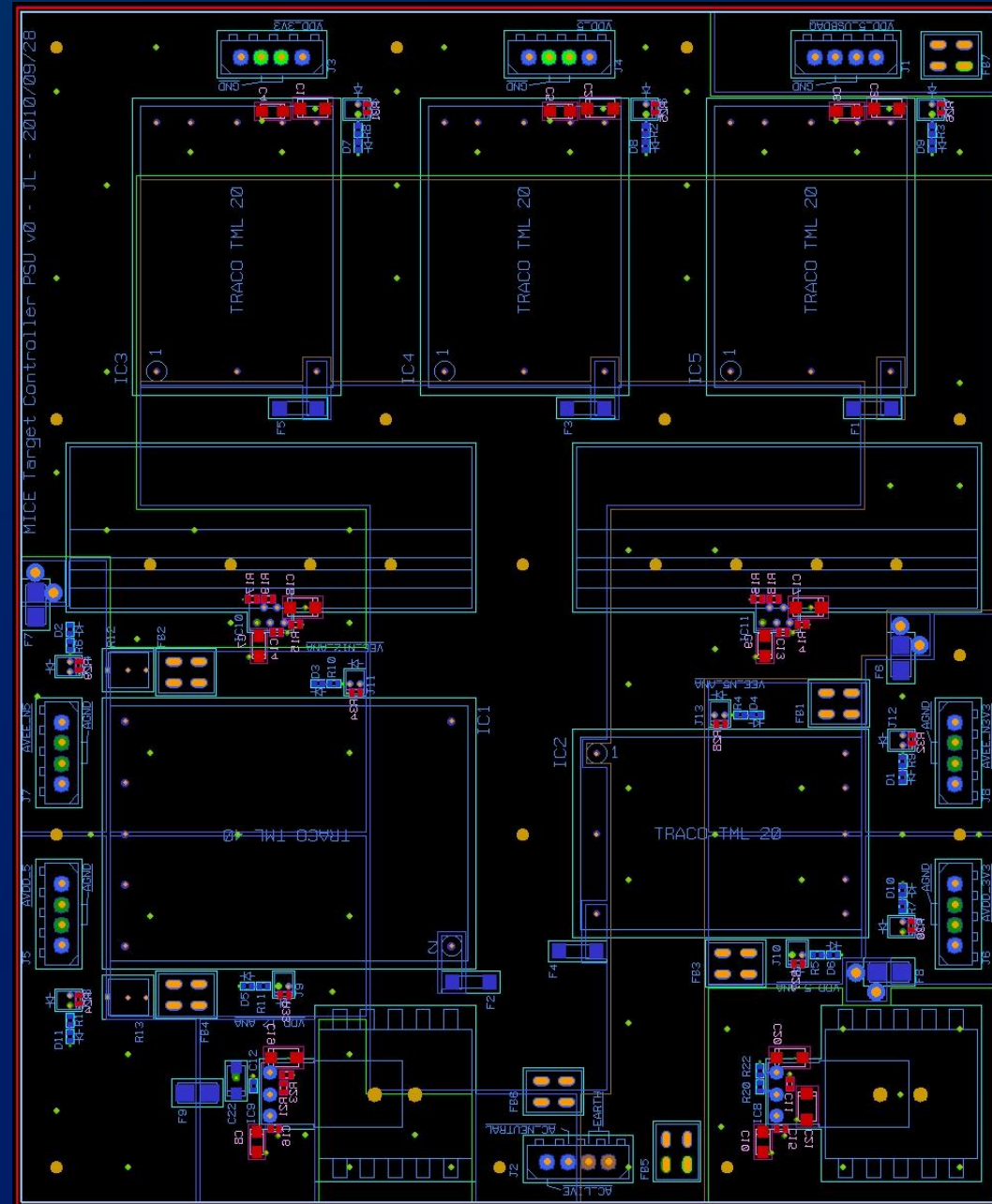
Daughter card A: Optical Amplifiers+DAQ:

- Single channel Optical Amplifier test circuit has been designed
 - Will be prototyped on Veroboard before integration with final system
- DAC test board has been produced
 - Successfully demonstrated FPGA control via SPI interface



Power Supply:

- PCB layout complete
- Provides:
 - Digital:
 - 2 x 5V (4A each)
 - 3.3V (4.5A)
 - Analogue (low noise):
 - +/- 5V (1A each)
 - +/- 3.3V (1A each)
- Will be sent for manufacture within 1-2 weeks



For Yagmur ...

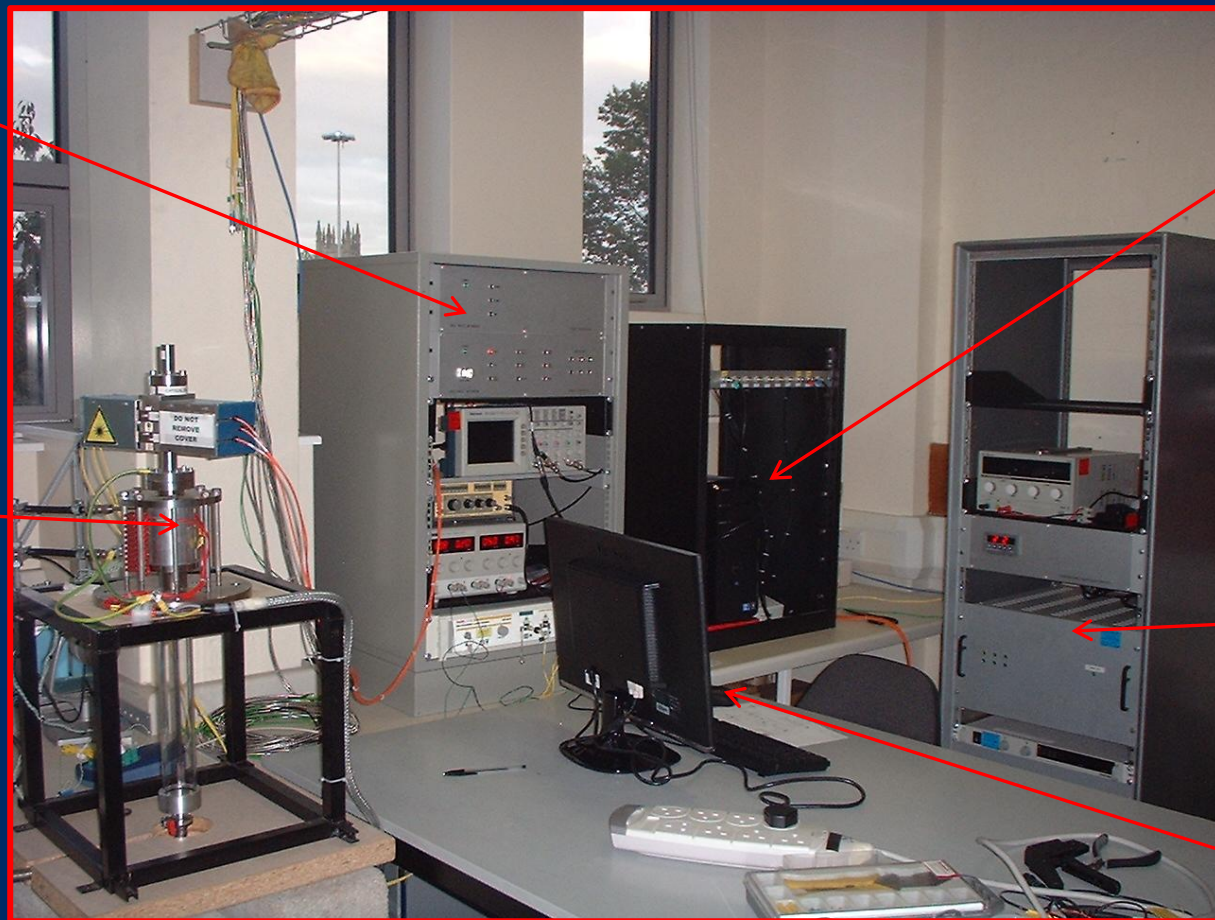


... It could be worse!

- **Target BPS mtg between MICE target electronics experts and ISIS BPS experts, 04Aug10 concluded that:**
 - **MICE target system will generate BPS signal from firmware in Phase I controller upgrade;**
 - **Target bad signal generated from:**
 - Beam-centre distance out of tolerance;
 - Start time or duration of dip out of tolerance;
 - Start position and BPS hold position out of tolerance;
- **BPS upgrade is now included in the target DAQ/controls schedule:**
 - **Specification document drafted;**
 - **First steps in development of firmware taken**

New Target
Controller

Target
(Older
design)



DAQ &
Target
Control PC
and DAQ
electronics

Target PSU
And Temp
Monitoring

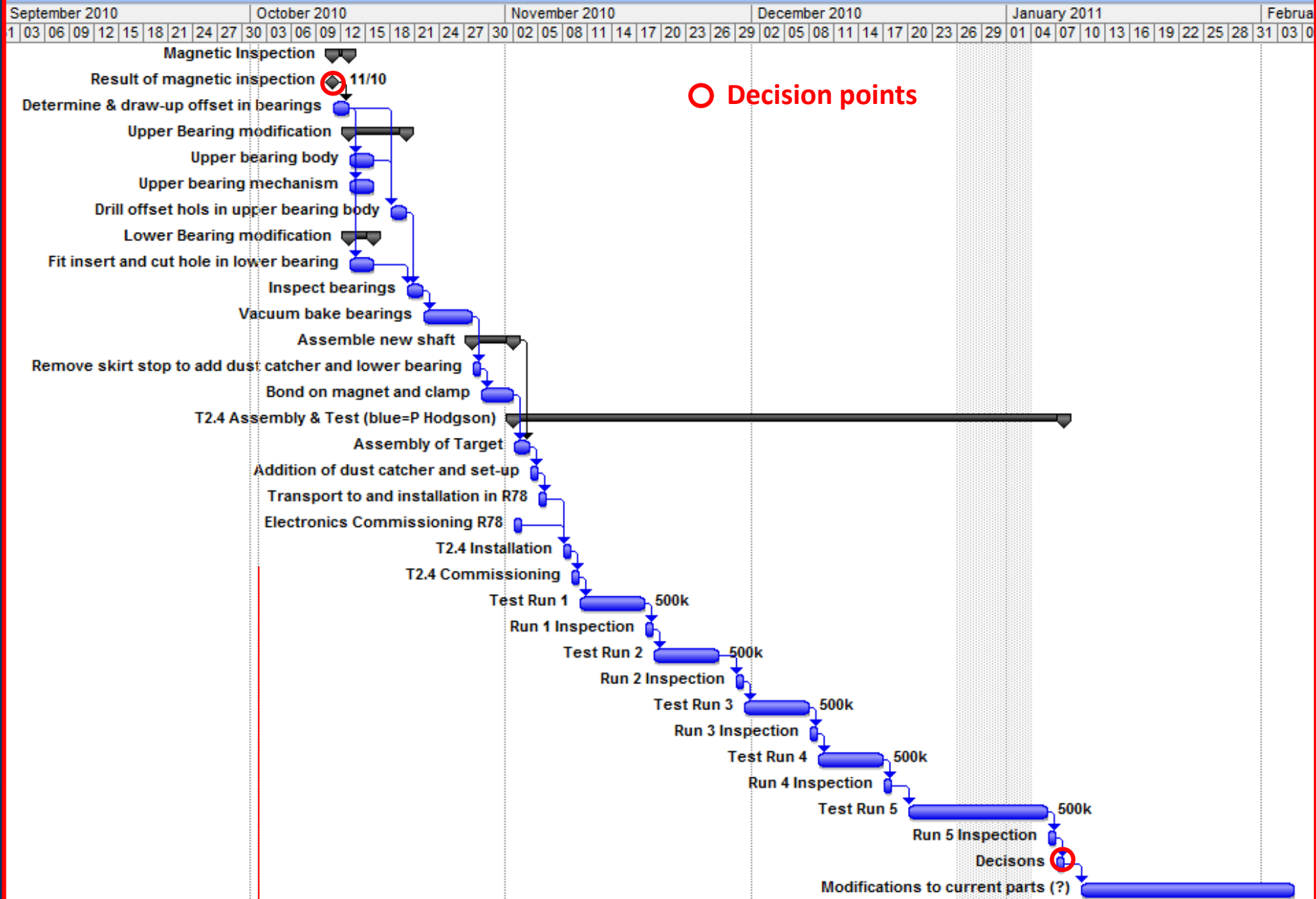
Target User
Interface!

Target Setup at Sheffield for a soak test of the new target controller and to generate some data for the BPS implementation

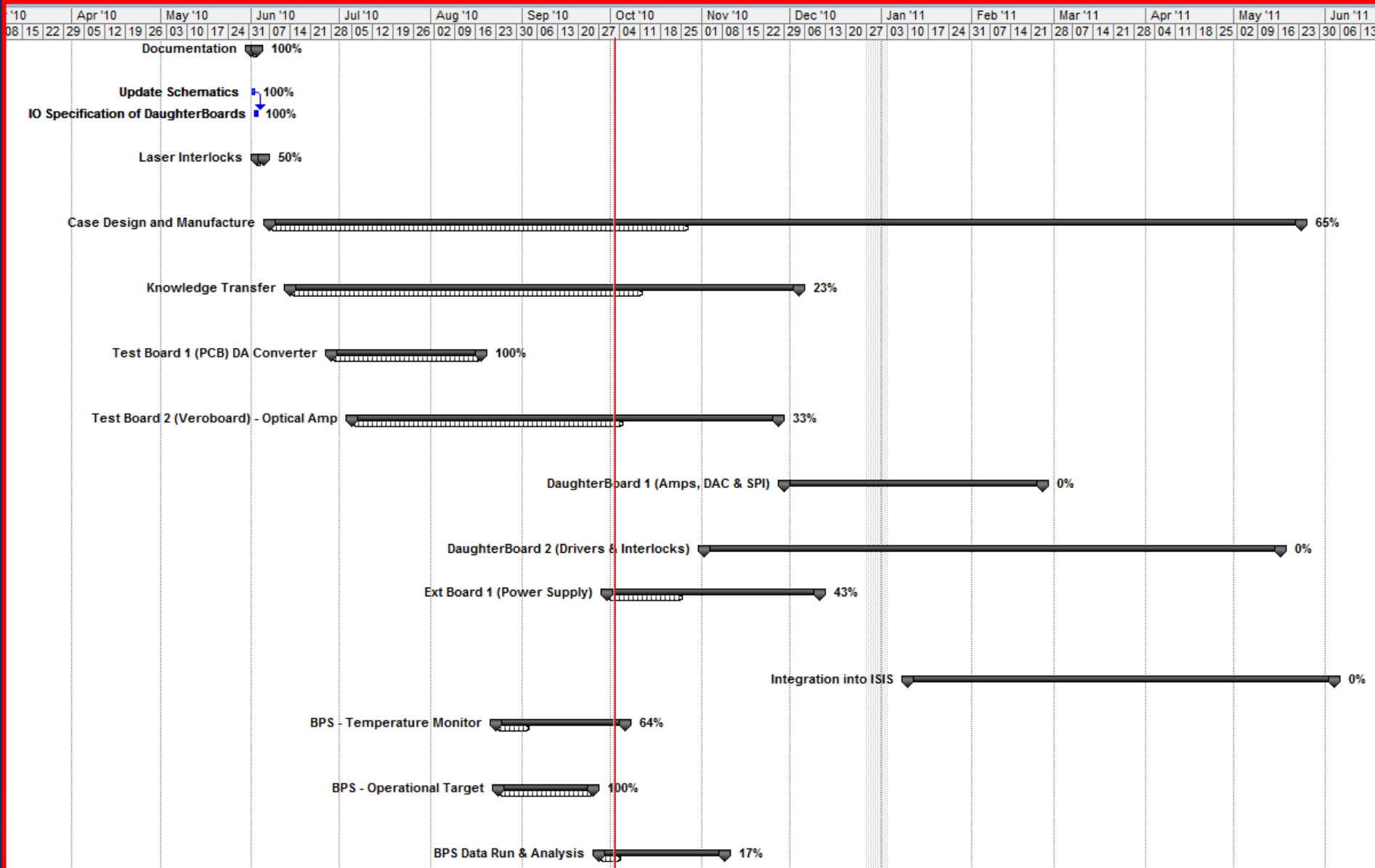
Target:

Schedule:

T2: re-assembly and test:



DAQ and control:



Target:

Conclusions:

Conclusions:

- Frustrating period following initial success in measuring magnetic properties of T2 stator
- Believe that we're back on track now:
 - Magnetic measurements taking place in DL now;
 - Review/decision point 11Oct10 for drilling of new bearings;
 - If positive, expect T2 under soak test ~end October
- DAQ/control upgrade going well:
 - Additional work added to plan to implement BPS
- With reliable target in our hands, will move to define ongoing development plan