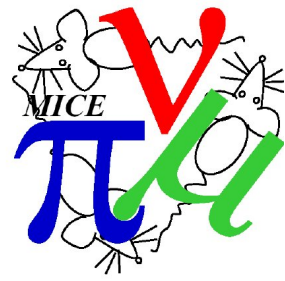


Detector Commissioning: Tracker

Melissa Uchida

26/6/14

Overview



- Status of Tracker installation
- Tracker Commissioning
 - US Tracker installation
 - US Tracker and SS in hall
 - DS plans
 - Lightguide Fibre QA
- In Hall commissioning Plan
 - Servicing
 - LED tests
- Step IV Readiness
- Data Runs
 - Commissioning and calibration

US Tracker Installation Progress

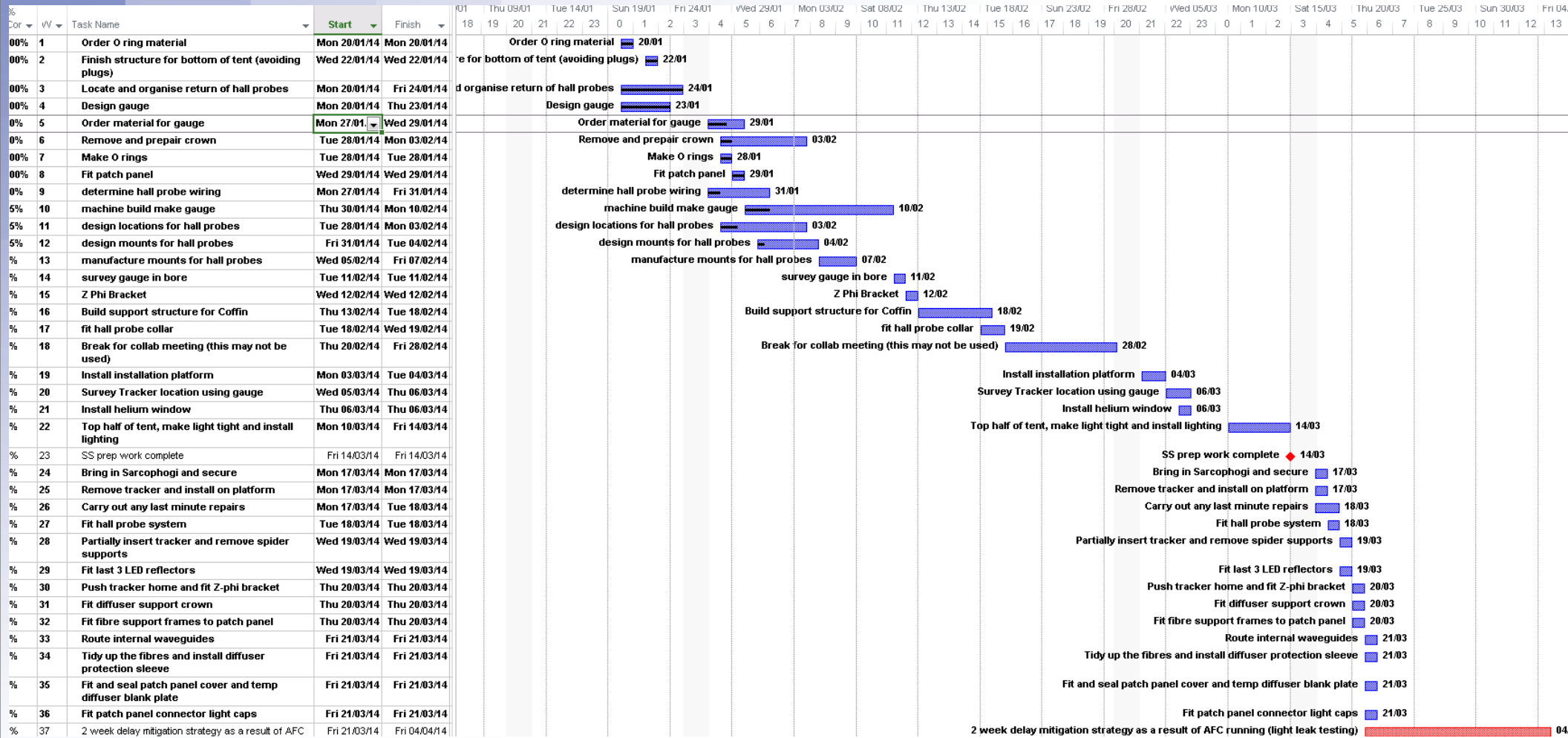
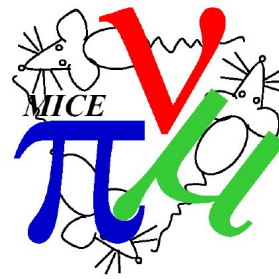


as of CM38

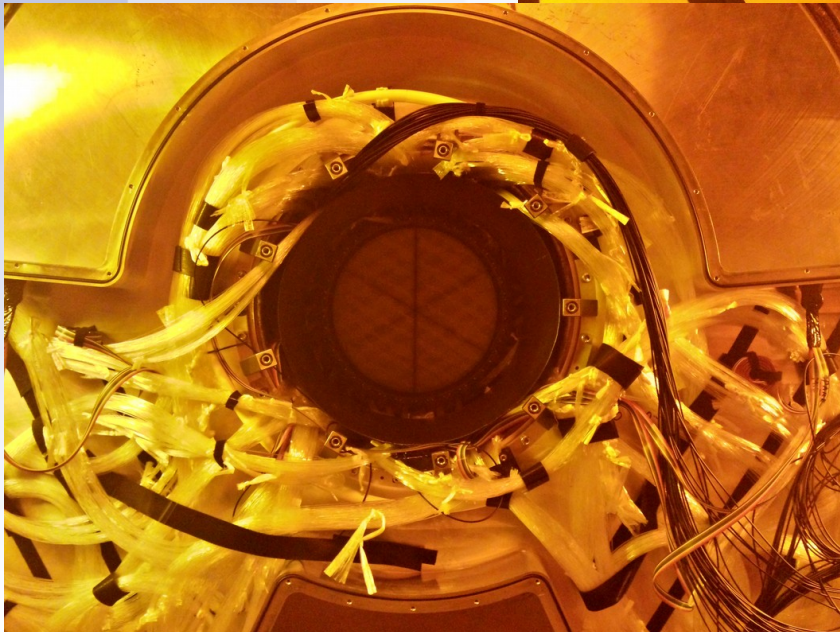
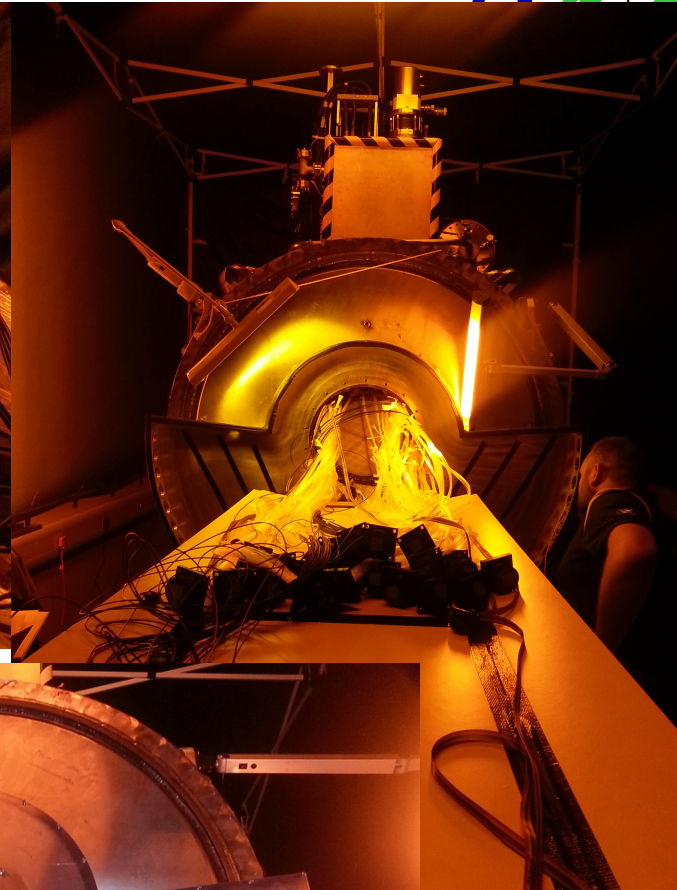
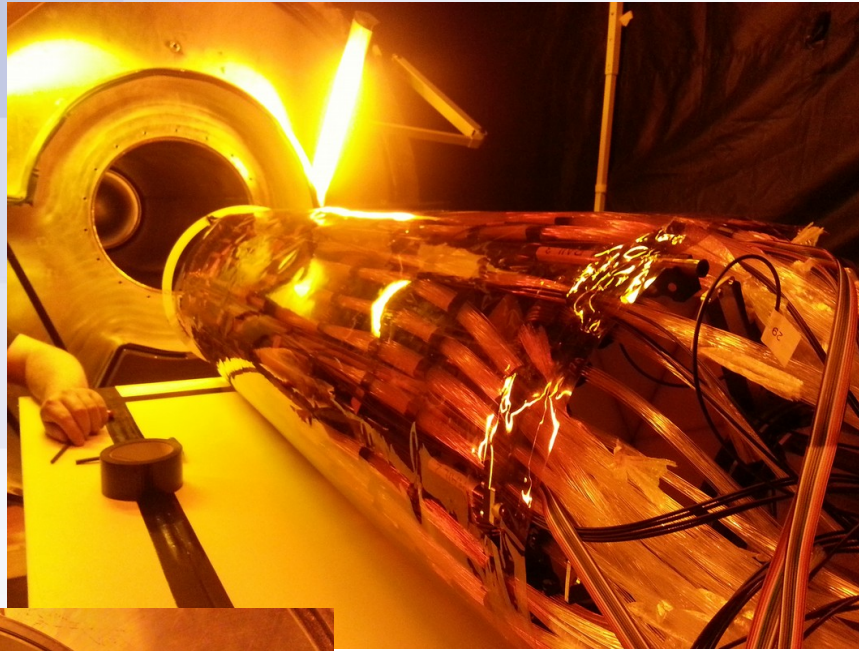


US Tracker Installation complete

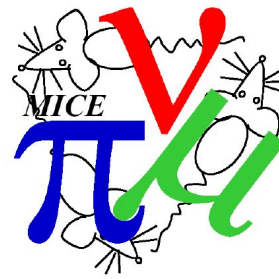
2 Weeks ahead of schedule!



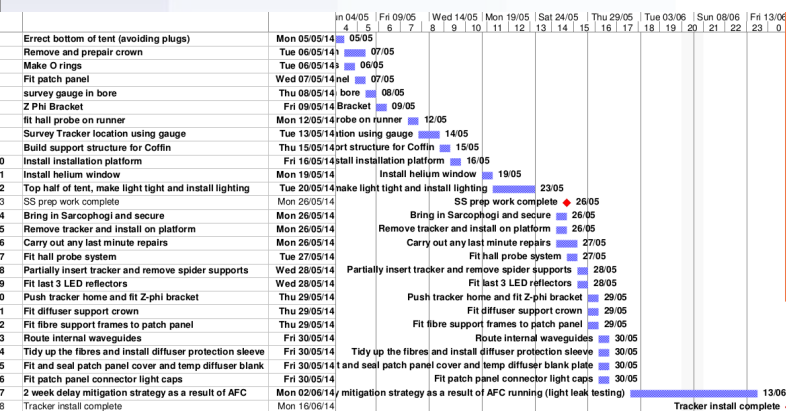
US Tracker installation



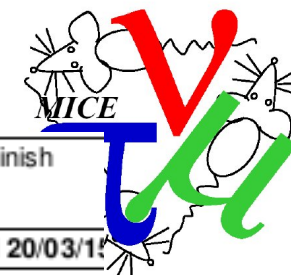
DS Tracker installation



- We have been working around the commissioning and mapping of the AFC in R9.
- Bore survey will be completed during the CM.
- Tent going up 30th June (will only take 1 day as only partially dismantled).
- Full installation begins 1st July.
- Installation will be completed by early July well ahead of the Tracker entering the critical path.

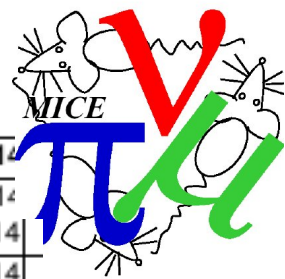


Tracker Commissioning Plan



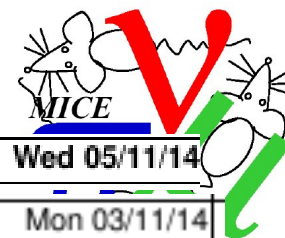
ID	% Complete	Task Name	Start	Finish
1	2%	Tracker Hall Integration	Thu 01/05/14	Fri 20/03/15
2	5%	Pre Installation work	Mon 12/05/14	Mon 03/11/14
3	0%	General Maintenance	Mon 12/05/14	Wed 14/05/14
4	0%	Gather all Tracker equipment in lab space and do stock check	Mon 12/05/14	Wed 14/05/14
5	0%	Get Electronics spares VME/NIM/Instruments?	Mon 12/05/14	Mon 12/05/14
6	6%	Cryostat related preparation	Mon 12/05/14	Tue 08/07/14
7	25%	Warwick QA of external waveguides	Mon 12/05/14	Fri 06/06/14
8	0%	Gather spares for making new external waveguides	Mon 12/05/14	Fri 23/05/14
9	0%	Quote/Book/Wait service with SHI cryogenics	Mon 12/05/14	Fri 06/06/14
10	0%	Get new aeroquip Helium lines - 8 x 10M extra plus union and Spares?	Mon 12/05/14	Mon 12/05/14
11	0%	Re-gas pressurise compressor with BIP Helium	Mon 12/05/14	Mon 12/05/14
12	0%	Mend broken manual pressure valve	Mon 12/05/14	Mon 12/05/14
13	0%	Service & clean CCG pressure sensors	Mon 12/05/14	Tue 13/05/14
14	0%	Service compressor - New Adsorber?	Mon 09/06/14	Tue 10/06/14
15	0%	Service cold heads	Mon 09/06/14	Tue 10/06/14
16	0%	Connect up new SL80 turbo pump to cryostat x4	Mon 12/05/14	Mon 12/05/14
17	0%	Mount & Connect TD400 turbo controller to Turbo x4	Tue 13/05/14	Tue 13/05/14
18	0%	Lab test of cryostat vac, cooling & electronics. Need He gas & Comp	Wed 11/06/14	Tue 08/07/14
19	0%	Electronics preparation	Mon 12/05/14	Tue 13/05/14
20	0%	Buy and connect up rack smoke detector?	Mon 12/05/14	Mon 12/05/14
21	0%	Buy another Vesda VLF250 or decide on single pipeline run?	Mon 12/05/14	Mon 12/05/14
22	0%	Run in 4 DAQ ISIS 1RF trigger cables from MLCR to Tracker rack	Mon 12/05/14	Mon 12/05/14
23	0%	Run in fibres between Tracker rack and Controls & DAQ computers	Mon 12/05/14	Mon 12/05/14
24	0%	Test AFE/It boards, upgrade firmware, check locator pins	Mon 12/05/14	Tue 13/05/14
25	0%	Services preparation	Mon 12/05/14	Mon 03/11/14
26	0%	Check Tracker rack & cryo positions and design for cryo stands	Mon 12/05/14	Mon 12/05/14
27	0%	Organise Mains distribution at Tracker rack positions	Tue 13/05/14	Wed 14/05/14
28	0%	Lay cable trays between rack and cryo position	Tue 13/05/14	Wed 14/05/14
29	0%	Arrange BIP grade Helium gas line to Tracker rack	Tue 13/05/14	Tue 13/05/14
30	0%	Global vac pipework in place end June 2014	Mon 30/06/14	Mon 30/06/14
31	0%	DL vac controls rack & software (NW corner) in place around Nov 2014	Mon 03/11/14	Mon 03/11/14

Tracker Commissioning Plan



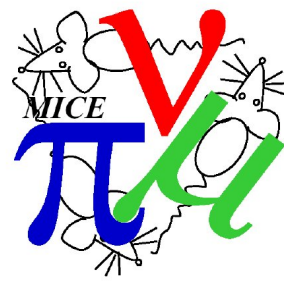
32		0%	Make LED Calibration boxes	Mon 12/05/14	Mon 19/05/14
33		0%	Construct 2nd LED box (Drill box,pot fibres & PCB and Solder)	Mon 12/05/14	Tue 13/05/14
34		0%	Polish 2 sets (Qty20) of LED fibres in small connectors	Mon 12/05/14	Mon 12/05/14
35		0%	Pot & Polish 2x10 sets of LED fibres in PP connectors	Tue 13/05/14	Tue 13/05/14
36		0%	Cable up LED box in hall (VME,ethernet,fibres)	Wed 14/05/14	Wed 14/05/14
37		0%	LED box hardware & software debug (as not used before!)	Thu 15/05/14	Fri 16/05/14
38		0%	Run LED calibration with PMT?	Mon 19/05/14	Mon 19/05/14
39		0%	Upstream SpecSol offline activities in hall	Thu 01/05/14	Thu 15/05/14
40		0%	Plan Offline LED Calibration test with PMT?	Mon 12/05/14	Mon 12/05/14
41	✓	100%	Upstream SpecSol placed in Offline position in hall	Mon 05/05/14	Mon 05/05/14
42		0%	Carry out Offline LED calibration test?	Tue 20/05/14	Mon 26/05/14
43		0%	Trial connect and reform south side external waveguides?	Mon 05/05/14	Mon 05/05/14
44		0%	Compressors in hall	Mon 01/09/14	Mon 20/10/14
45	☰	0%	3 phase mains connections at compressor positions in place?	Mon 01/09/14	Mon 01/09/14
46	☰	0%	Chilled water piping & flowmeters at compressor postions in place?	Mon 01/09/14	Mon 01/09/14
47	☰	0%	Framework in place for stack of two compressors	Mon 01/09/14	Mon 01/09/14
48		0%	Move compressors to hall and place in position	Mon 01/09/14	Mon 01/09/14
49	☰	0%	Connect chilled water & mains	Tue 02/09/14	Wed 03/09/14
50		0%	Run Helium lines (30M) from compressors to cryostat (S & N seperately?)	Thu 04/09/14	Wed 15/10/14
51		0%	Run electrical line (30M) from compressors to cryostat (S & N seperately?)	Thu 04/09/14	Thu 04/09/14
52		0%	Connect compressors to DL interface box	Tue 02/09/14	Tue 02/09/14
53		0%	Leak test system (S & N seperately)	Thu 16/10/14	Mon 20/10/14
54		0%	DL Tracker cryostat interface box (Interlocks)	Mon 12/05/14	Tue 04/11/14
55		0%	DL Tracker cryostat interface box in place in RR2?	Mon 12/05/14	Mon 12/05/14
56		0%	Connect up smoke detector sensing pipework	Fri 24/10/14	Mon 27/10/14
57		0%	Comission Vesda smoke detector in situ	Tue 28/10/14	Wed 29/10/14
58		0%	Get Vesda system officially commissioned & accreditation test	Thu 30/10/14	Fri 31/10/14
59		0%	Connect Vesda system alarm relay to DL interface box	Mon 03/11/14	Mon 03/11/14
60		0%	Connect 115V transformer to Lid Heater box	Thu 23/10/14	Thu 23/10/14
61		0%	Connect up Lid Heater outputs to DL interface box	Fri 24/10/14	Fri 24/10/14
62		0%	Connect up Oxford ITC503 to RS232 via Ethernet to DL interface box	Tue 04/11/14	Tue 04/11/14
63		0%	Connect Wiener (AFE) mains supply to DL interface box	Fri 24/10/14	Fri 24/10/14
64		0%	Use Wiener mains interlock TTL signal?	Mon 12/05/14	Mon 12/05/14
65		0%	Connect phone dialler?	Mon 12/05/14	Mon 12/05/14
66		0%	Tracker racks in hall (require both for N or S operation)	Mon 03/11/14	Wed 05/11/14

Tracker Commissioning Plan



66		0%	Tracker racks in hall (require both for N or S operation)	Mon 03/11/14	Wed 05/11/14
67		0%	Place tracker rack in position in hall	Mon 03/11/14	Mon 03/11/14
68		0%	Arrange Helium gas line from Tracker rack to cryo	Tue 04/11/14	Tue 04/11/14
69		0%	Ship back David Adey kit from the US	Mon 03/11/14	Mon 03/11/14
70		0%	Populate VME crates with modules	Tue 04/11/14	Tue 04/11/14
71		0%	Connect fibre between Tracker rack and controls computer	Wed 05/11/14	Wed 05/11/14
72		0%	Connect fibre between Tracker rack and MLCR based DAQ computer	Wed 05/11/14	Wed 05/11/14
73		0%	Connect 1553 cables from VME module to AFE backplane	Wed 05/11/14	Wed 05/11/14
74		0%	South side cryostats install	Mon 30/06/14	Thu 06/11/14
75		0%	South side PRY in place by Mid Oct 2014	Mon 20/10/14	Mon 20/10/14
76		0%	Cryostat stands - South side in place	Mon 20/10/14	Tue 21/10/14
77		0%	Move South side cryostats to hall and place in position	Wed 22/10/14	Thu 23/10/14
78		0%	Connect up CCG to MKS gauge in Tracker rack	Thu 06/11/14	Thu 06/11/14
79		0%	Connect up Cold head Electrical & Helium lines with new washers	Fri 24/10/14	Fri 24/10/14
80		0%	Connect temperature sensors to Oxford ITC503 in Tracker rack	Thu 06/11/14	Thu 06/11/14
81		0%	Mount 4 x AFE IIT PCB's	Fri 24/10/14	Fri 24/10/14
82		0%	Connect mains power to Wiener AFE PSU	Fri 24/10/14	Fri 24/10/14
83		0%	Cryostat Vacuum system	Mon 30/06/14	Tue 04/11/14
84		0%	Connect TD400 Turbo controller to DL vac rack	Mon 03/11/14	Mon 03/11/14
85		0%	Mount & Connect 24V for turbo controller at cryostat or DL vac rack	Tue 04/11/14	Tue 04/11/14
86		0%	Connect up MKS937 pressure gauge controller trip relay to DL vac rack	Tue 04/11/14	Tue 04/11/14
87		0%	Connect Pneumatic fail safe pressure valve behind turbo?	Mon 30/06/14	Mon 30/06/14
88		0%	Connect Pneumatic fail safe through to valve island and onto DL vac rack	Mon 03/11/14	Mon 03/11/14
89		0%	Connect Roughing/Backing line to fail safe valve	Tue 04/11/14	Tue 04/11/14
90		0%	South side External Waveguides connect	Mon 12/05/14	Wed 29/10/14
91		0%	Upstream spectrometer solenoid in place on cooling channel?	Mon 12/05/14	Mon 12/05/14
92		0%	Make dark working environment	Mon 12/05/14	Tue 13/05/14
93		0%	Reform and connect external waveguides to fit from PP to Cryostat	Fri 24/10/14	Tue 28/10/14
94		0%	Errect trellis to support external waveguides	Wed 29/10/14	Wed 29/10/14

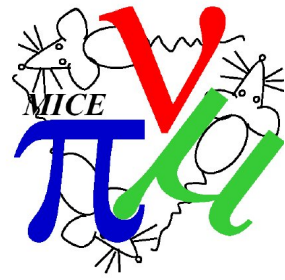
Tracker Commissioning Plan



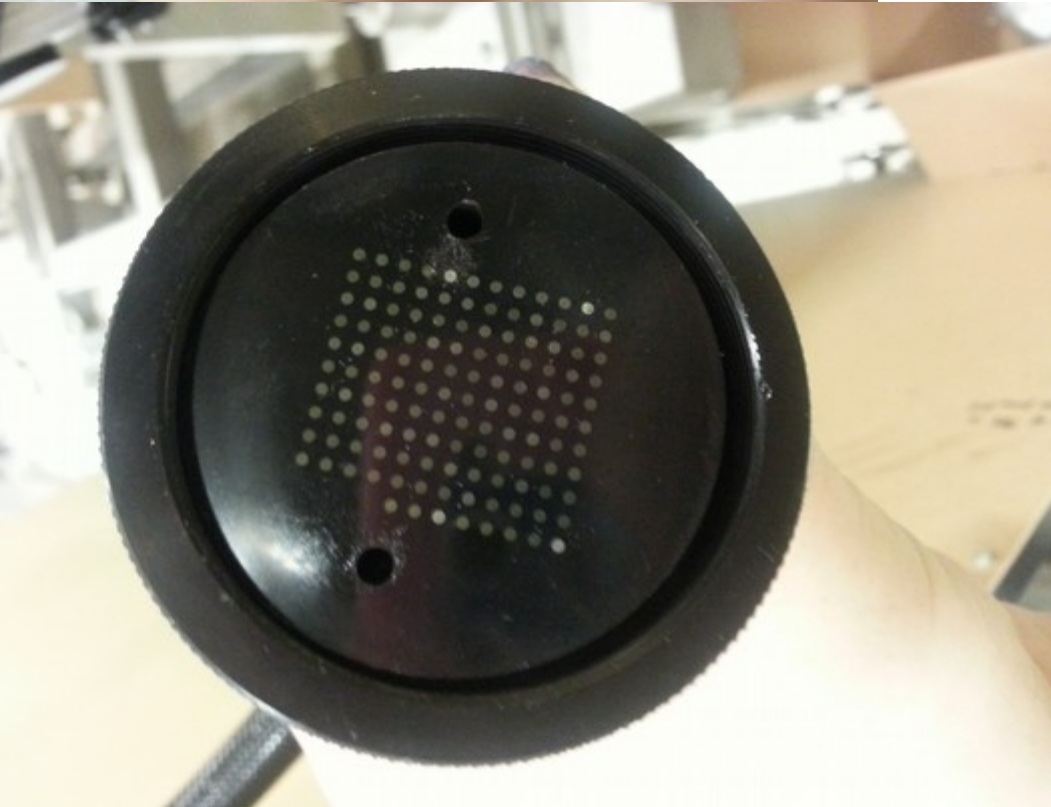
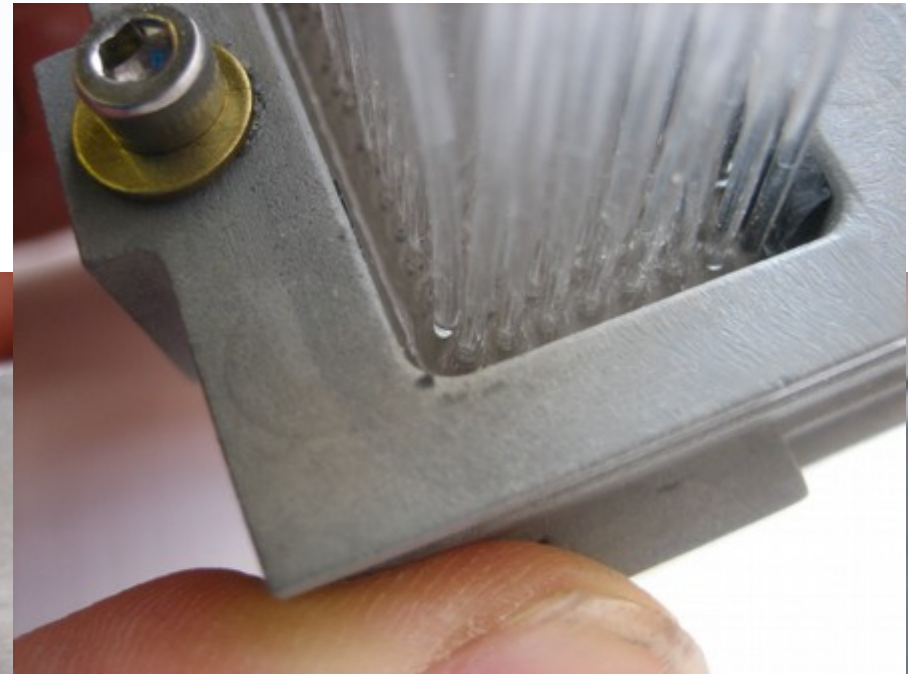
95		0%	North side cryostats install	Mon 30/06/14	Thu 05/03/15
96		0%	North side PRY in place by Feb 2015	Fri 27/02/15	Fri 27/02/15
97		0%	Cryostat stands - North side in place	Fri 27/02/15	Mon 02/03/15
98		0%	Move North side cryostats to hall and place in position	Tue 03/03/15	Wed 04/03/15
99		0%	Connect up CCG to MKS gauge in Tracker rack	Thu 05/03/15	Thu 05/03/15
100		0%	Connect up Cold head Electrical & Helium lines with new washers	Thu 05/03/15	Thu 05/03/15
101		0%	Connect temperature sensors to Oxford ITC503 in Tracker rack	Thu 05/03/15	Thu 05/03/15
102		0%	Mount 4 x AFEIIT PCB's	Thu 05/03/15	Thu 05/03/15
103		0%	Connect mains power to Wiener AFE PSU	Thu 05/03/15	Thu 05/03/15
104		0%	Cryostat Vacuum system	Mon 30/06/14	Tue 04/11/14
105		0%	Connect TD400 Turbo controller to DL vac rack	Mon 03/11/14	Mon 03/11/14
106		0%	Mount & Connect 24V for turbo controller at cryostat or DL vac rack	Tue 04/11/14	Tue 04/11/14
107		0%	Connect up MKS937 pressure gauge controller trip relay to DL vac rack	Tue 04/11/14	Tue 04/11/14
108		0%	Connect Pneumatic fail safe pressure valve behind turbo?	Mon 30/06/14	Mon 30/06/14
109		0%	Connect Pneumatic fail safe to valve island and DL vac rack	Mon 03/11/14	Mon 03/11/14
110		0%	Connect Roughing/Backing line to fail safe valve	Tue 04/11/14	Tue 04/11/14
111		0%	North side External Waveguides connect	Thu 13/11/14	Tue 10/03/15
112		0%	Downstream spectrometer solenoid in place on cooling channel?	Thu 13/11/14	Thu 13/11/14
113		0%	Make dark working environment	Thu 13/11/14	Thu 13/11/14
114		0%	Reform and connect external waveguides to fit from PP to Cryostat	Thu 05/03/15	Mon 09/03/15
115		0%	Errect trellis to support external waveguides	Tue 10/03/15	Tue 10/03/15
116		0%	Pre-beam Comissioning	Thu 06/11/14	Fri 20/03/15
117		0%	South side operations	Thu 06/11/14	Wed 26/11/14
118		0%	Test AFE slow controls (Adey)	Thu 06/11/14	Mon 10/11/14
119		0%	Test Tracker safety interlocks	Fri 07/11/14	Mon 10/11/14
120		0%	Cool down procedure	Tue 11/11/14	Fri 14/11/14
121		0%	LED Calibration & other	Mon 17/11/14	Mon 24/11/14
122		0%	Initial ISIS RF timing with TOF mimic?	Tue 25/11/14	Wed 26/11/14
123		0%	North side operations	Fri 06/03/15	Fri 20/03/15
124		0%	Test AFE slow controls (Adey)	Fri 06/03/15	Fri 06/03/15
125		0%	Test Tracker safety interlocks	Fri 06/03/15	Fri 06/03/15
126		0%	Cool down procedure	Mon 09/03/15	Thu 12/03/15
127		0%	(Full) LED Calibration & other	Fri 13/03/15	Fri 20/03/15
128		0%	Step IV beam commissioning starts : ISIS cycle starts 17th March	Tue 17/03/15	Tue 17/03/15

Lightguide Fibre QA

The Lightguides

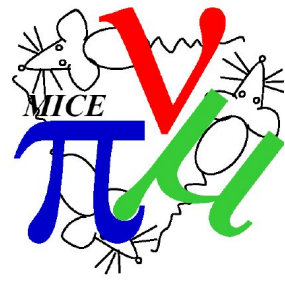


- All fibres transmit light
- ~3/128 show signs of damage
- Effect likely due to cracks
- Extent of impact on light yield unknown – Purpose of QA

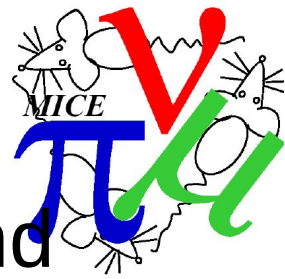


Lightguide Fibre QA

The Scanner

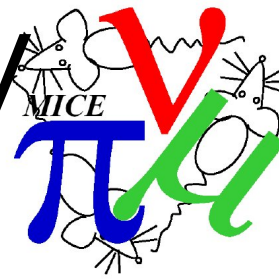


Lightguide Fibre QA



- We have a scanner that is well understood and ready to be adapted.
- Connector pieces to allow us to use this scanner (including calibration) have been designed.
- Connector piece is now manufactured.
- Fibre QA does not impact tracker installation or commissioning.
- In case any major problems are discovered (at any point) we have a plan in place for production of spare lightguides.

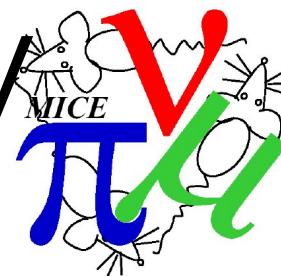
Tracker Considerations for Step IV



- Measurement Capabilities.
- Backgrounds.
- Misalignments of optical elements is one of the largest sources of systematic errors. Minimise!
 - Tracker station offsets
 - Misalignment between the two Trackers.
- Magnetic field homogeneity.
- Differences in efficiency/errors etc. between the two trackers?
- Reconstruction efficiency.
- Online Plots.
- Step IV_0 Analysis possibilities.
- Attenuation length in fibres.

- Understood
- In progress
- Not yet considered

Tracker Considerations for Step IV



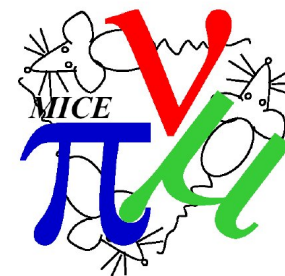
- Measurement Capabilities.
- Backgrounds.
- Misalignment
- Sources
- Tracker
- Misalignment
- Magnet
- Different
- Recoil
- Online
- Step
- Attention

There are talks on many of these aspects at cm39, please see specific talks for details.

Documentation on Tracker wiki.

The important thing to take from this now is that we have considered hardware and software readiness for tracker data taking and analysis. All such necessary works are either scheduled or under way.

ers?

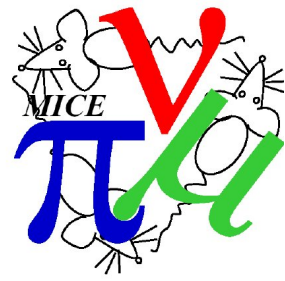


Tracker commissioning Data runs

- Readout commissioning – no beam, random, cosmic and LED triggering to iron out VME based trigger logic – **2 days**
- Calibration – no beam runs with LED varying bias, discriminator and TDCs (latter two not Step 4 essential) – **4 days (bias) + 4 days (discriminators) + 4 days (timing) = 12 days**
- Timing commissioning – starting with LED and moving to beam to ensure integration and veto period align with arrival of particles – **5 days**
- Alignment checks – no field straight tracks to reconstruct actual alignment of tracker in reference frame – **5 days**

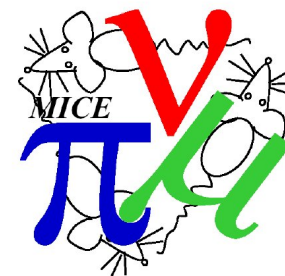
TOTAL: 24 days

Conclusions



- Tracker installation of US SS completed ahead of schedule.
- US SS and Tracker 2 installed in MICE hall.
- DS SS arrived May 2014.
- DS SS and Tracker 1 installation working around AFC and due to be completed in early July 2014.
- Hall installation and detector commissioning schedule competed and we are already working through it.
- Step IV readiness plan understood for some time.
- Alignment and commissioning run plans are now top of our agenda.
- Software in good shape and improving all the time.

Efficiencies



Reconstruction (SW)

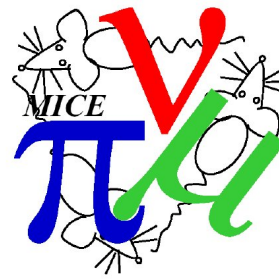
Currently at 99.5% work is well under way to improve this see Adam Dobbs' talk in Software session

Hardware

Differences in efficiency/errors etc. between the two trackers

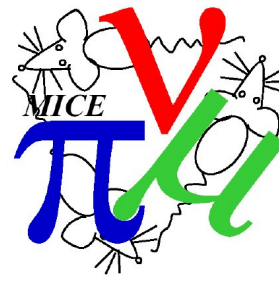
- Particle Response
 - Time integrated charge (RF) → when running.
- Light yield
 - Variation in light transmission between fibres <10%.
- How alike is their detection, interpretation, electronics readout, noise...

Misalignments



- a) Rotational offsets between tracker stations ←
In progress
- b) Non-parallel tracker stations (pitch)
 - maximum possible offset shown to have negligible effect. ← In progress
- c) X-Y offsets in trackers stations ← Completed
by E. Santos.
- d) Misalignment between the two Trackers ← see
Tracker plenary talk

Magnetic Field Homogeneity



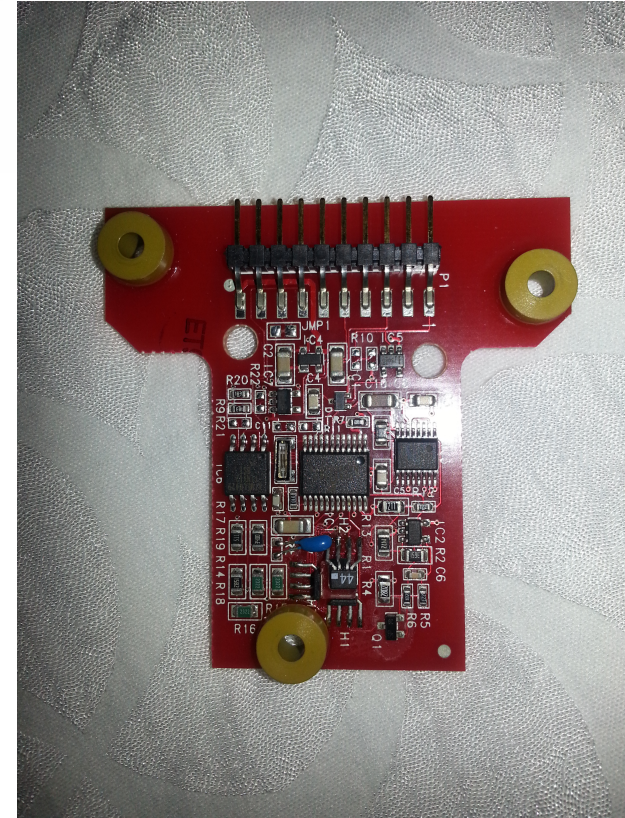
Inside solenoids

SS data analysis under way by
V. Blackmore.

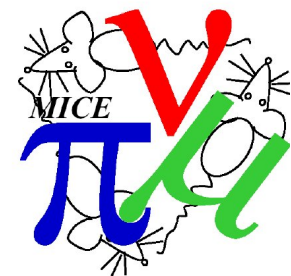
Inside trackers

Hall probes inside trackers.

- We have 4 probes per tracker.
- Mounts and locations designed and manufactured ready to install.



Hall Probe Positions



Existing hall probe positions



New positions

