



# Status of the MICE Target(s)

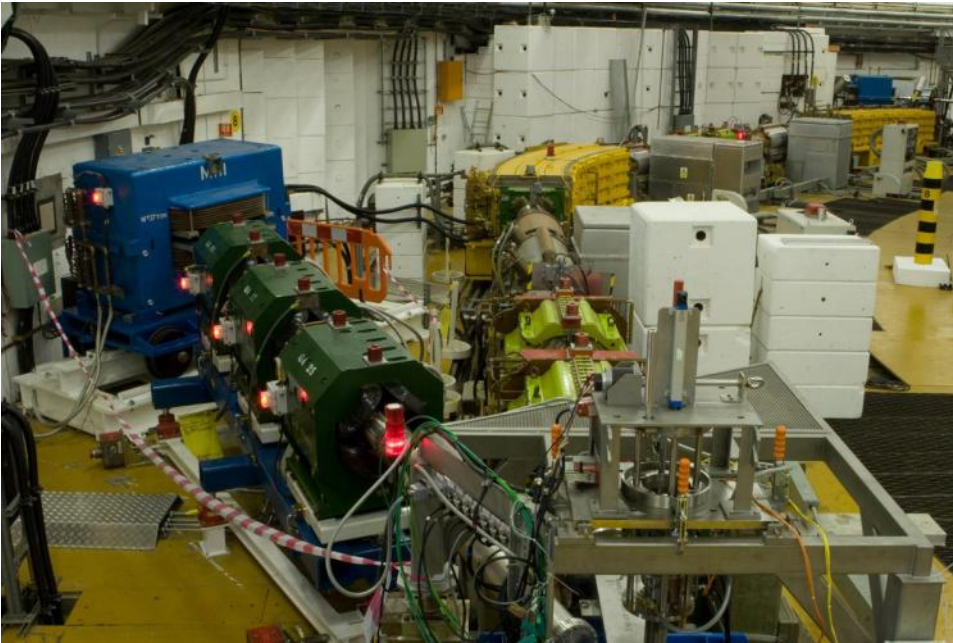
Paul Hodgson

The University of Sheffield

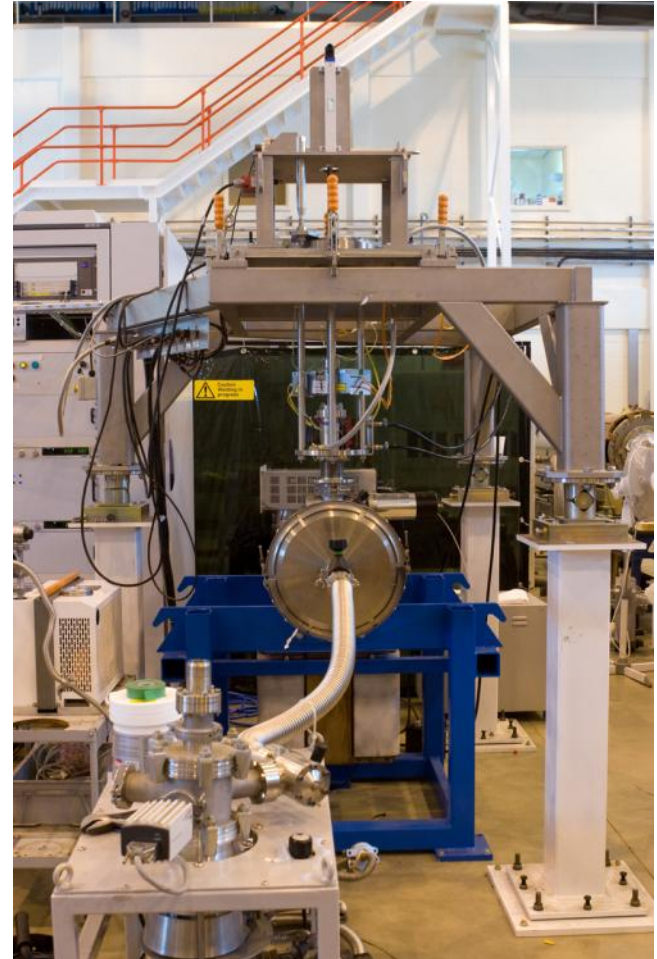
On Behalf of the Target Team

# The Two Target Systems

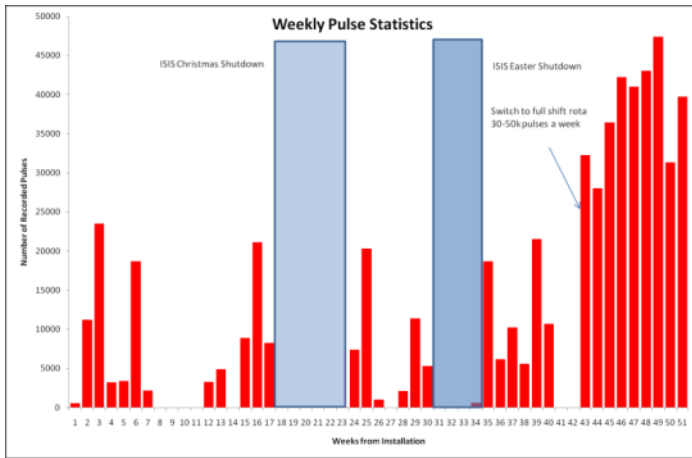
T1 installed in ISIS



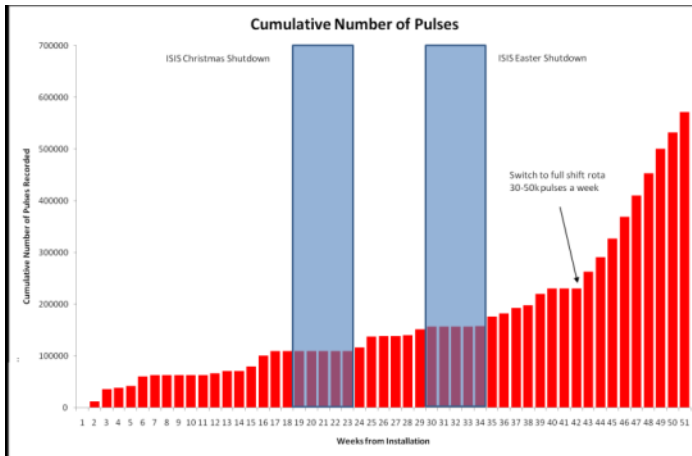
The T2 Test Rig in R78



# Pulse Statistics



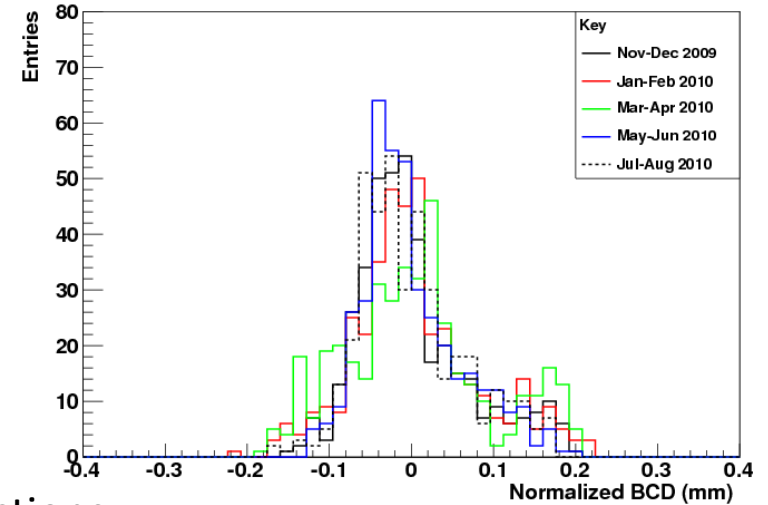
571k pulses in ISIS (620k total)



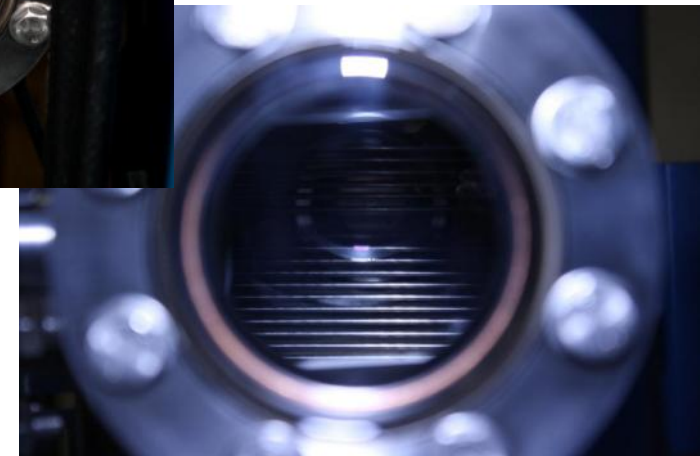
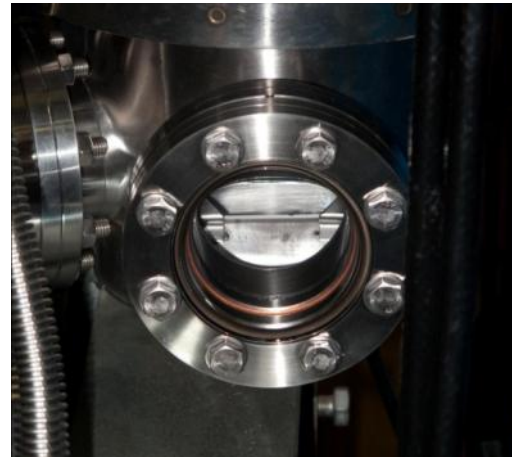
Decision made to continue using this target during 2011

# Calibration Plots

Target 1 BCD Calibrations Over Full Operation Period



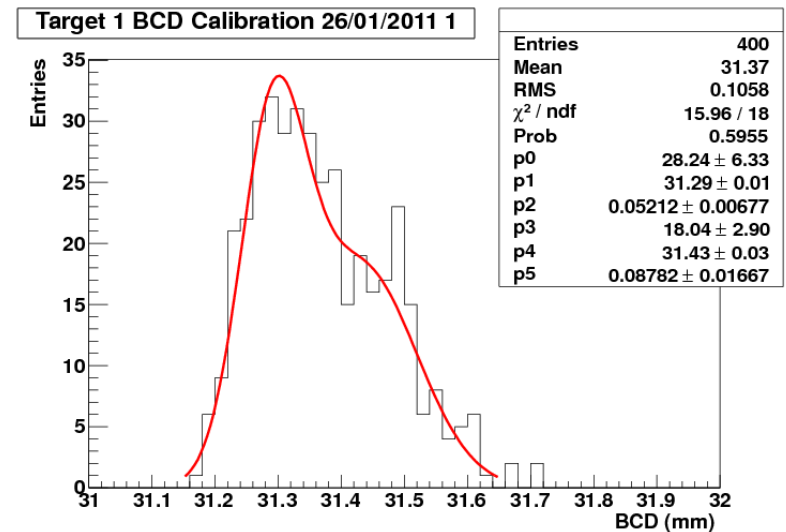
# Visual inspections



27<sup>th</sup> Aug 2010

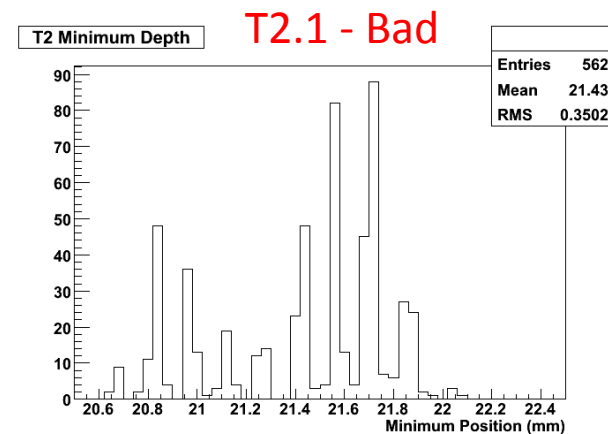
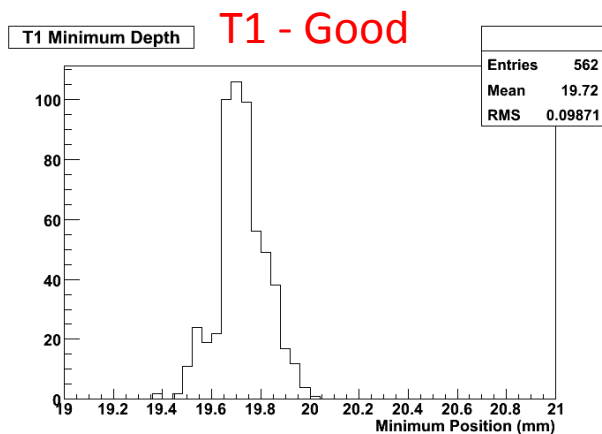
# T1 Re-Commissioning

- 26-01-2011 - T1 was re-commissioned
- Visual inspection
- Chiller unit in catacombs had failed
- Replaced with one from R78
- Vacuum valve opened
- Controls/Electronics tested
- Frame raised/lowered – new PPS system in place
- Target operated at calibration BCD for 400 pulses
- Everything looks fine
- Ready for operation in 2011



# T2.X Development History

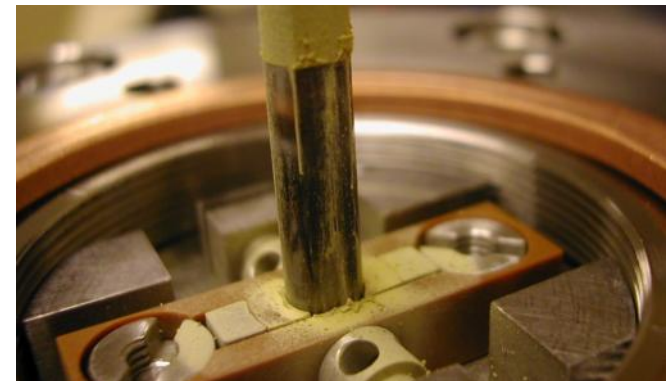
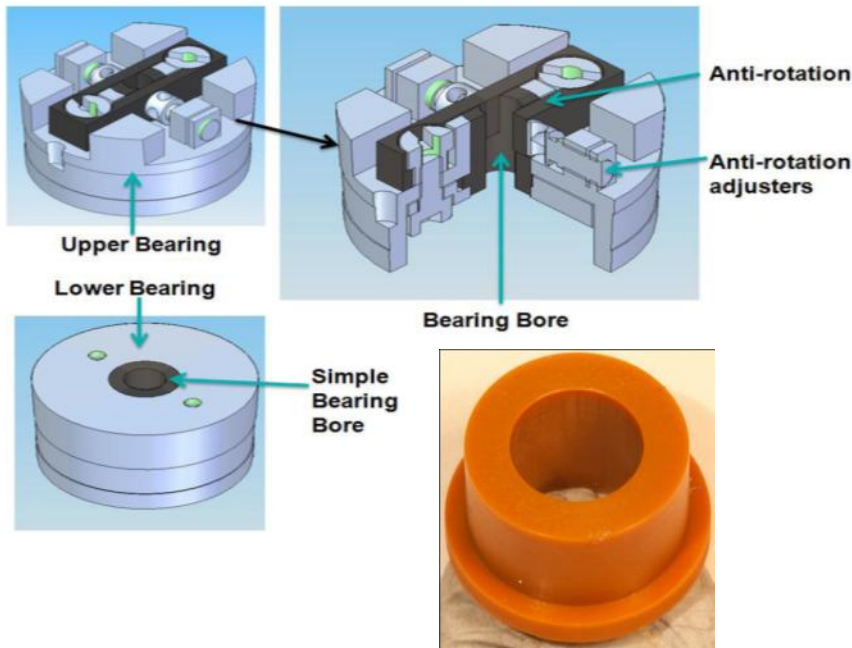
- 2.1 – DLC/DLC
  - After examining plots decided that the performance was unacceptable
  - Ended test after 1000 pulses



- 2.2 – DLC/DLC
  - Ran for 80k pulses and again saw poor performance
  - Decided that DLC/DLC was not the best material combination

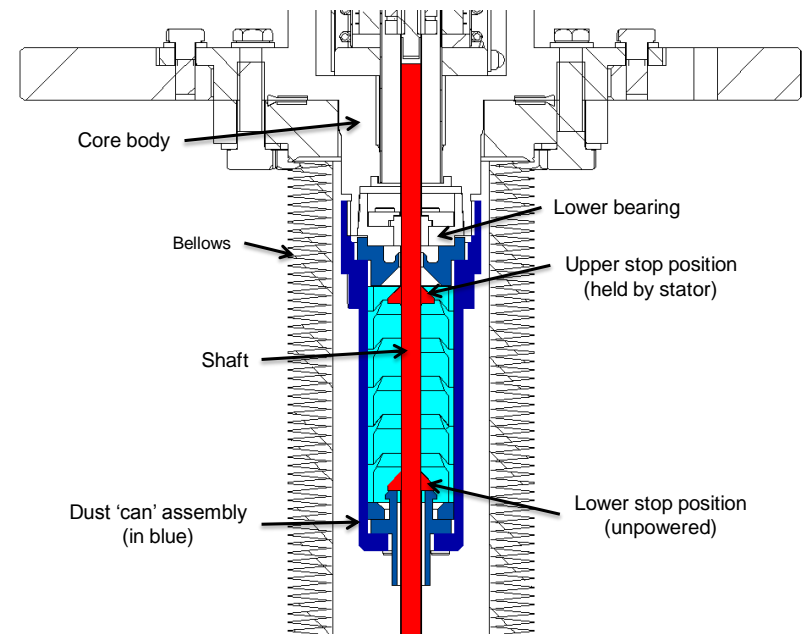
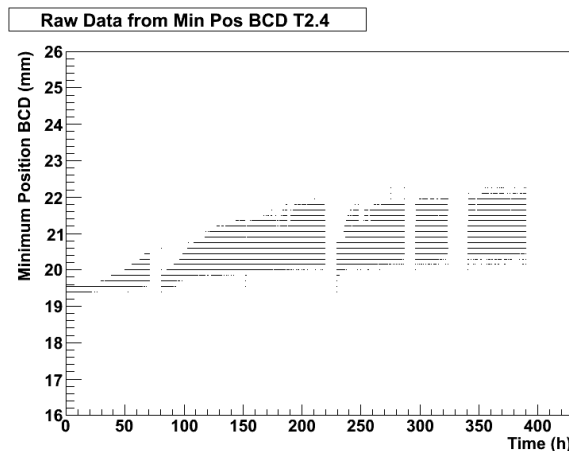
# T2.3 Performance

- 2.3 – DLC/Vespel tested early 2010
  - First try with the new Vespel (polyimide) bearings
  - Ran for 2.1 million pulses then stopped for inspection
  - Too much dust produced but otherwise encouraging
  - This was caused by poor finish on one side of DLC coated shaft
  - We had used a poorly finished shaft to allow rapid test while improved shafts were in production

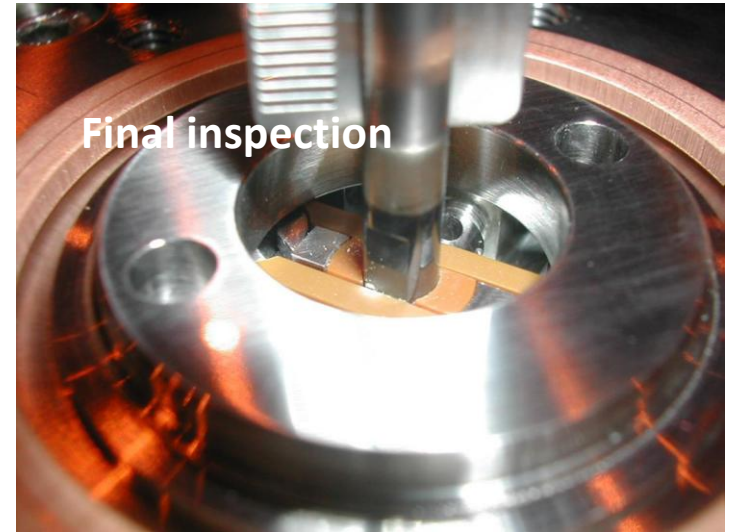
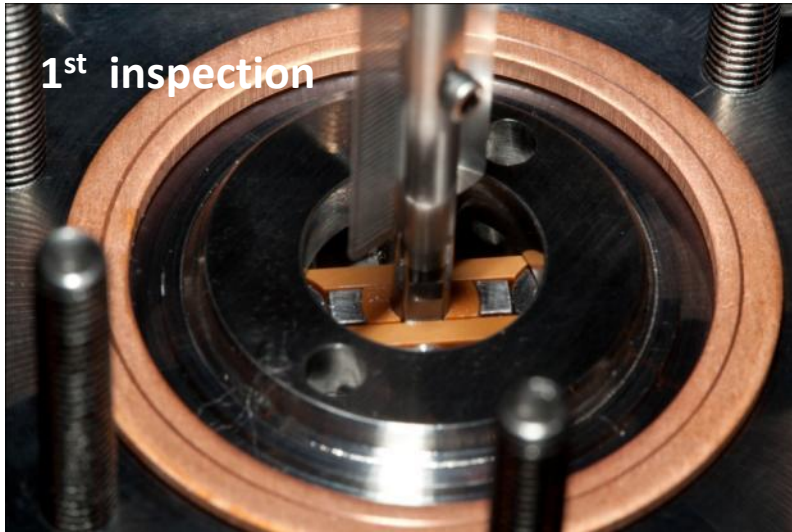


# T2.4 Performance

- T2.4 DLC/Vespel – Installed Nov 2010
- Improved surface finishes on shaft and bearings
- Dust Catcher added below bottom bearing
- Ran target for ~1 million pulses
- Inspect weekly (500k)
- Using the new FPGA controller
- Digital data

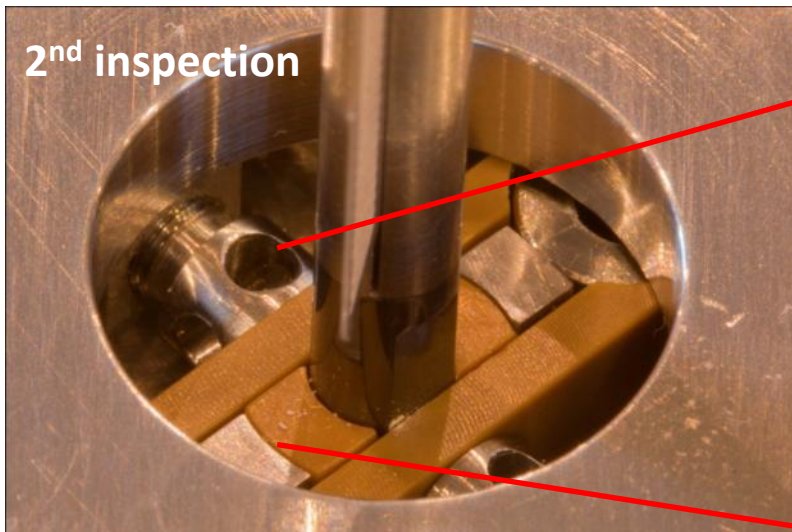


# T2.4 Performance



Wear on one corner

Shaft appears to be rotated in bearing

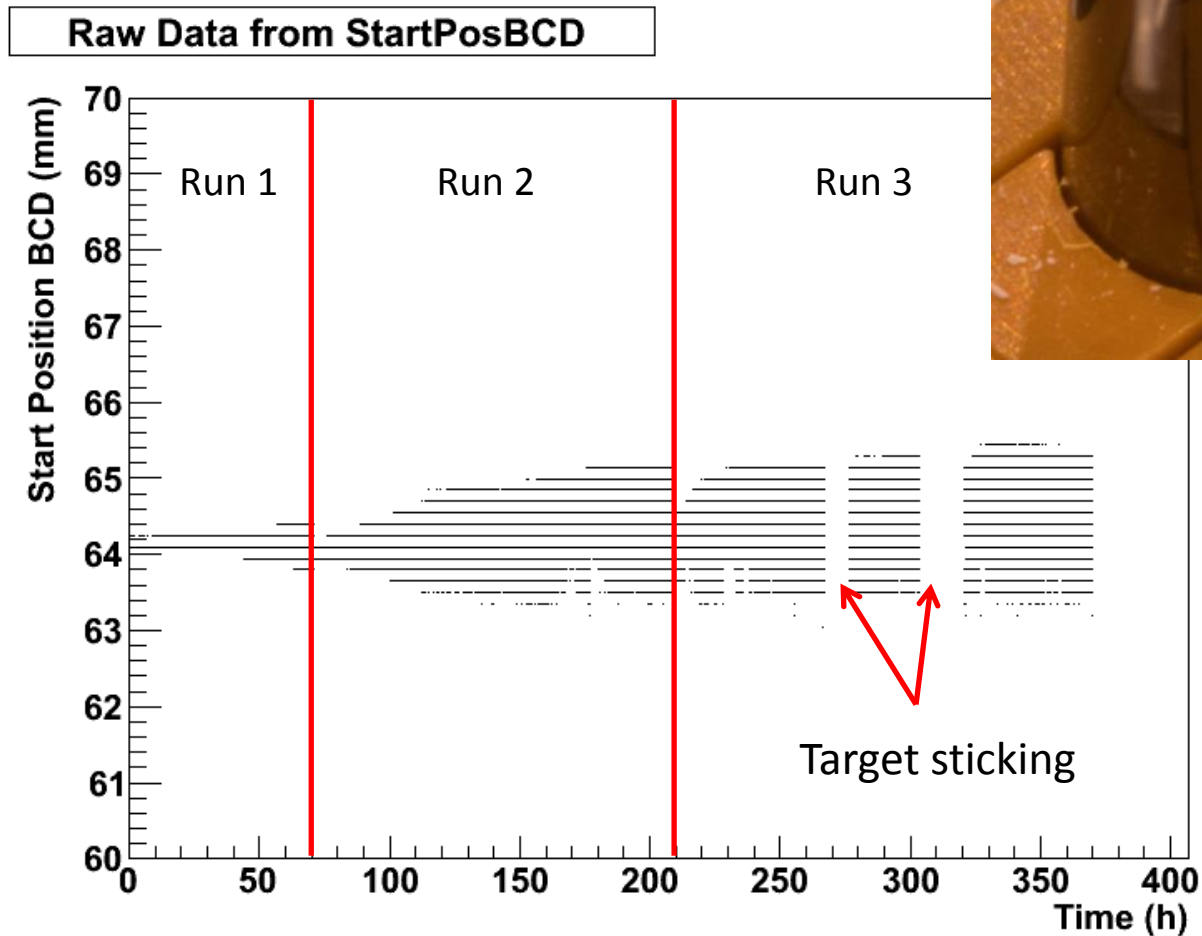


**Very little dust seen**



# T2.4 Performance

Digital data – exact position from controller



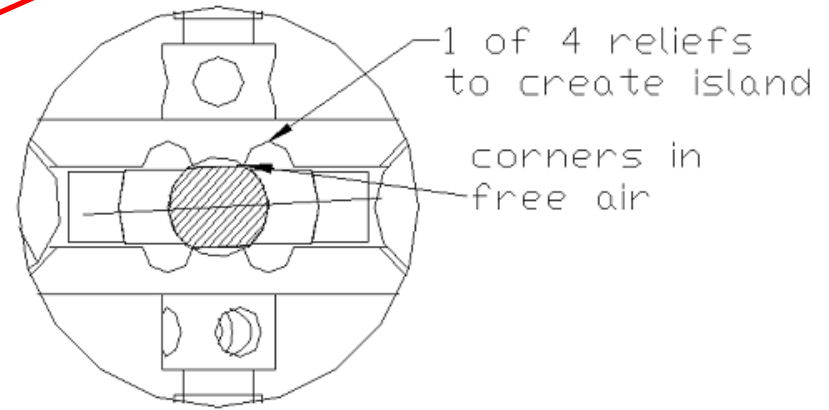
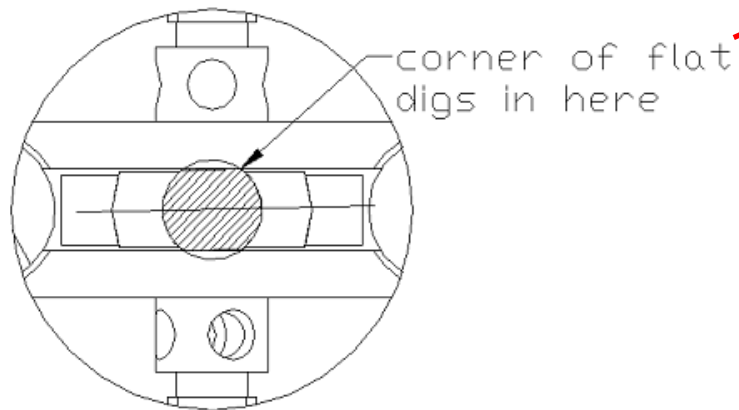
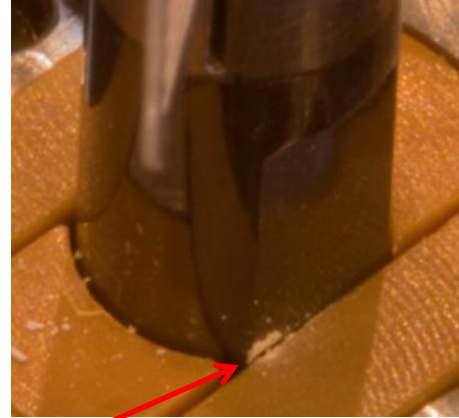
Target became “stuck” several times (8) during run

# T2.4 Performance

- The shaft was operated for approx. 1 million pulses.
- There was very little dust production.
- What material was produced was contained within the stator and the dust catcher.
- There was very little evidence of wear on the VESPEL bearings.
- The target became “stuck” in **capture position** several times.
- The sticking occurred at the top of the target trajectory.
- Bearings modified to mitigate against this.

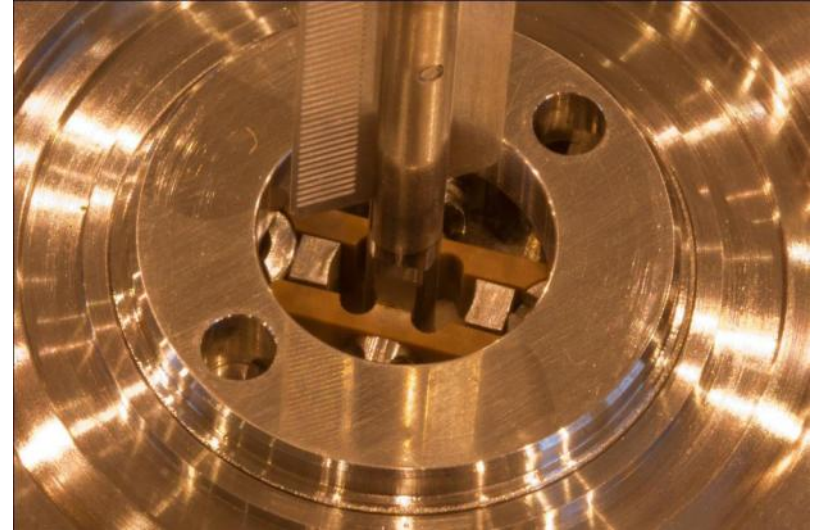
# T2.5 Performance

- 2.5 – DLC/Vespel
- Top Bearing Modified



v

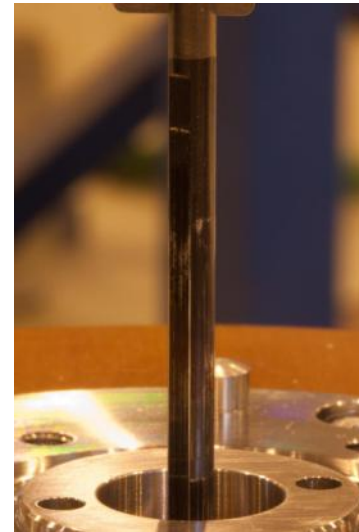
# T2.5 Performance



800 hours of running

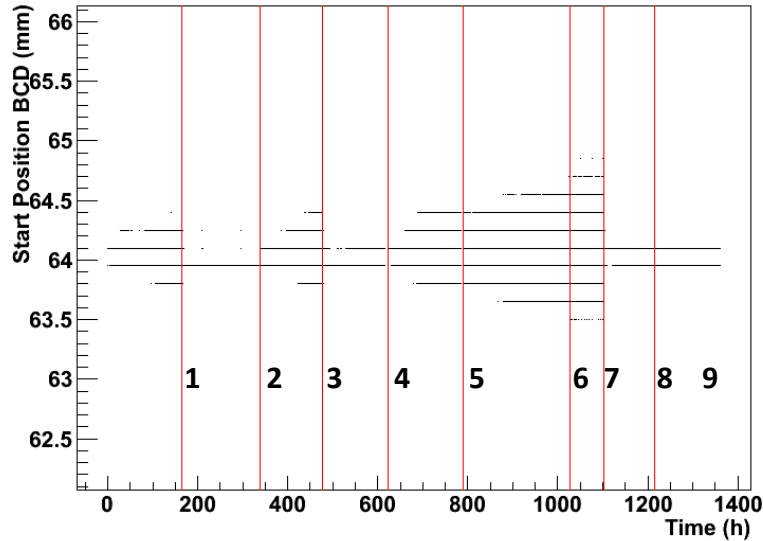


2.3 million pulses



# T2.5 – DLC/Vespel – 4.0 million pulses

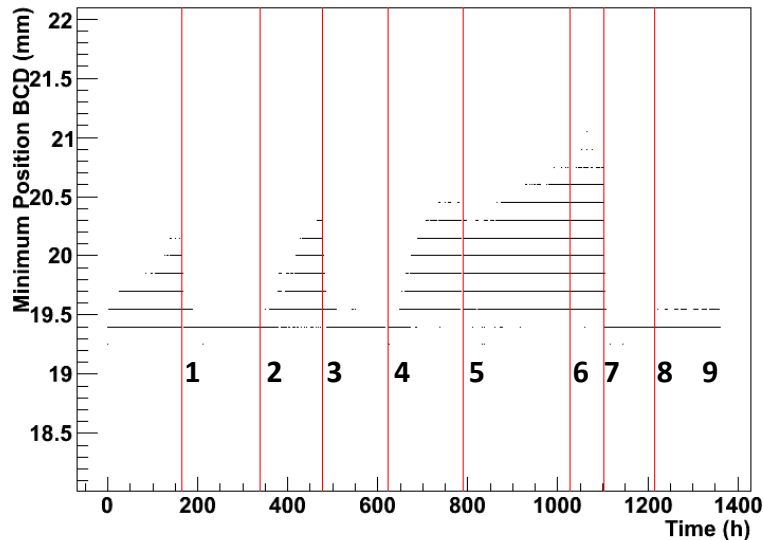
Raw Data from Start Pos BCD



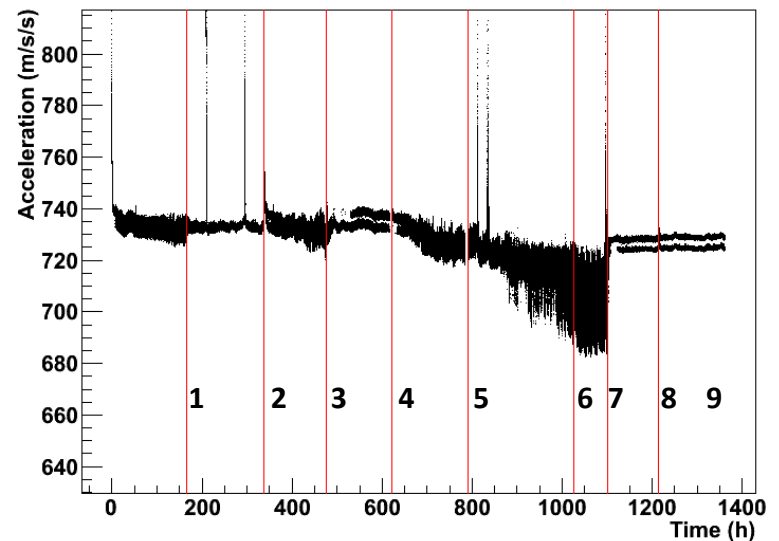
Stop Time | Actuations | Description

Stop Time	Actuations	Description
1 - 164	490960	Inspection 1 (14/12/2010)
2 - 338	512865	Pause for Christmas, Inspection 2 (5/1/2011)
3 - 476	412043	Inspection 3 (11/01/2011)
4 - 621	414325	Inspection 4 (18/01/2011)
5 - 790	482527	Inspection 5 (26/01/2011)
6 - 1026	701662	Test Pause in running park for 1hr. (attempt reset)
7 - 1101	219747	Inspection 6 (17/02/2011)(CM29)
8 - 1214	334982	Pause, DAQ pc full
9 - 1361	436588	Final Stop (no line, end of data)

Raw Data from Min Pos BCD



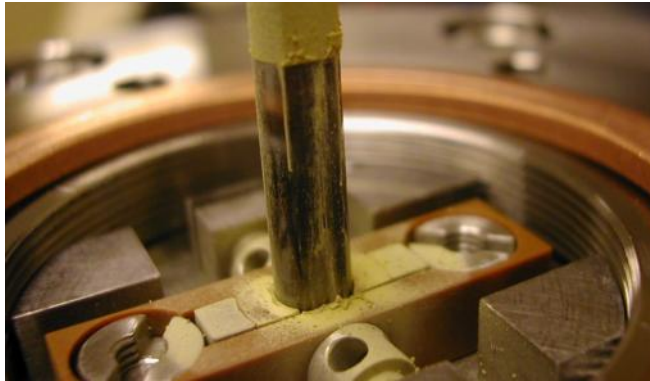
Acceleration to SP1



# T2.5 Performance

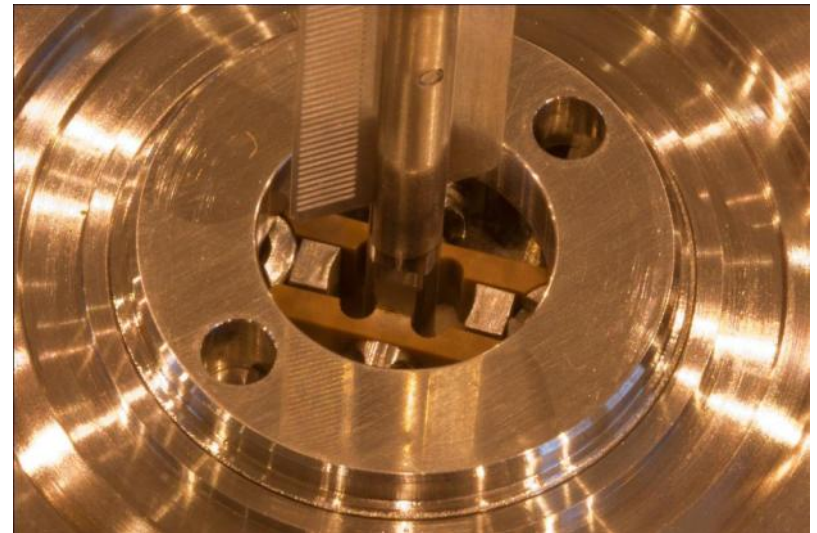
Comparison between T2.3 and T2.5

T2.3



2.1 million pulses

T2.5



2.3 million pulses

A major improvement

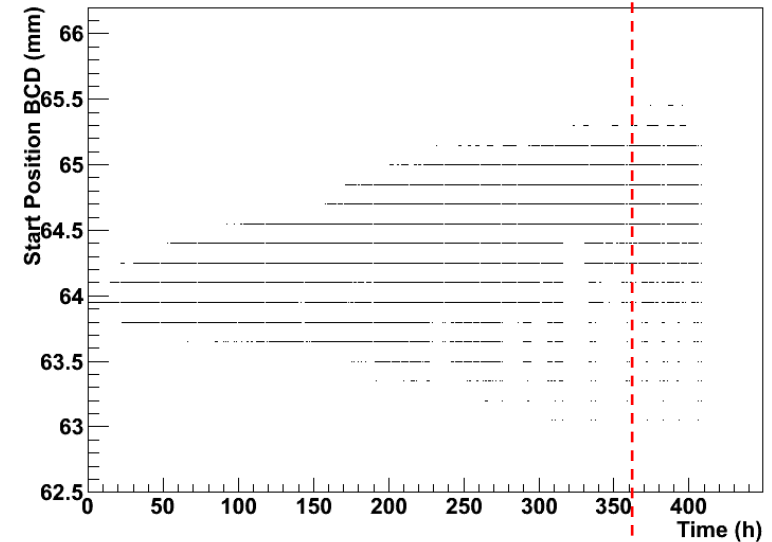
Remember that stator 2 would not pass new QA

## T2.6 – DLC/Vespel – 1.14 million pulses

- Nominally identical to T2.5
- Clearances around bearings changed
- Changed inspection routine
- No weekly inspections
- 1 hour stop every day
- Several capture sticks occurred, +370 h

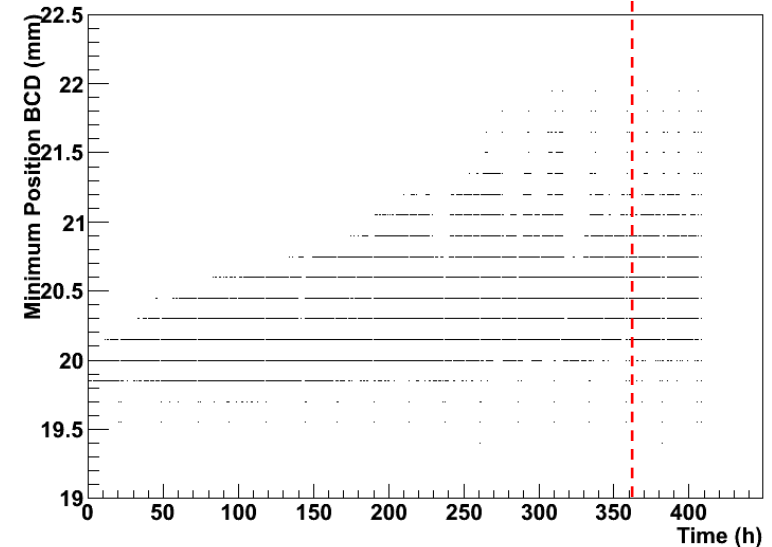
Raw Data from StartPosBCD

15/16

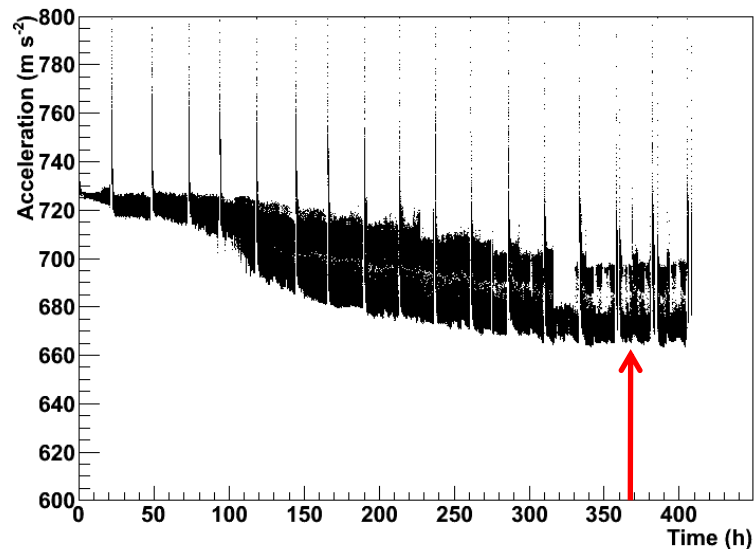


Raw Data from Min Pos BCD

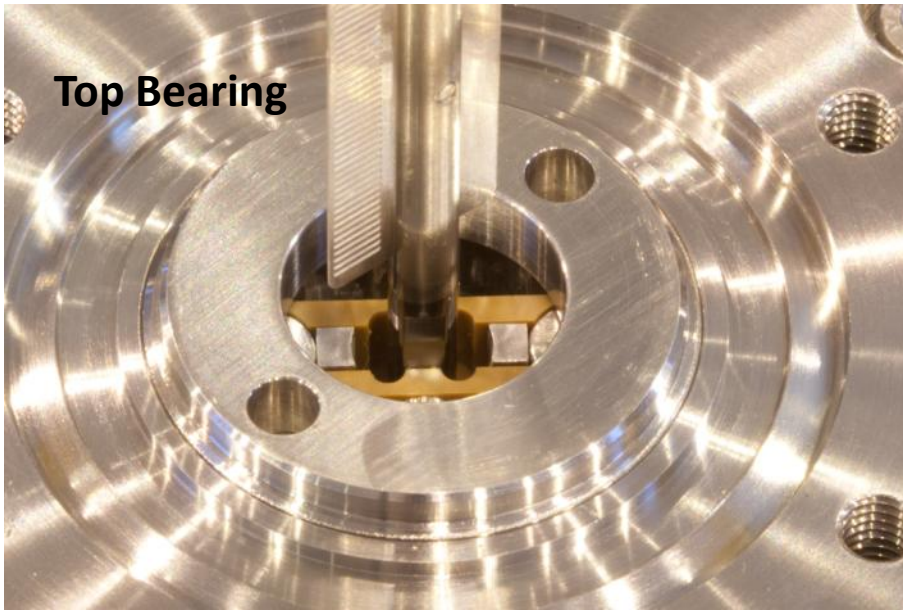
15/16



Acceleration to SP1



## T2.6 Inspection



Very small amount of material visible

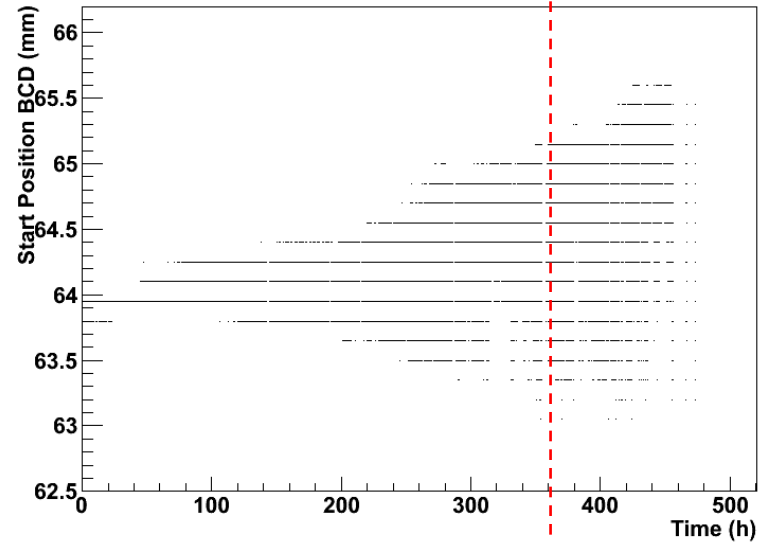


## T2.7 – DLC/Vespel – 1.28 million pulses

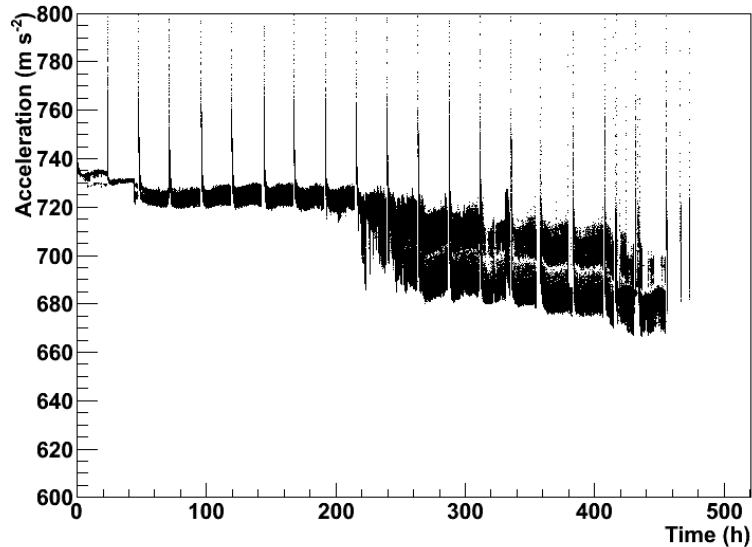
Clearances increased around bearings  
Daily pauses as for T2.6  
Again several capture sticks seen  
These began at 360 h

Raw Data from StartPosBCD

15/16

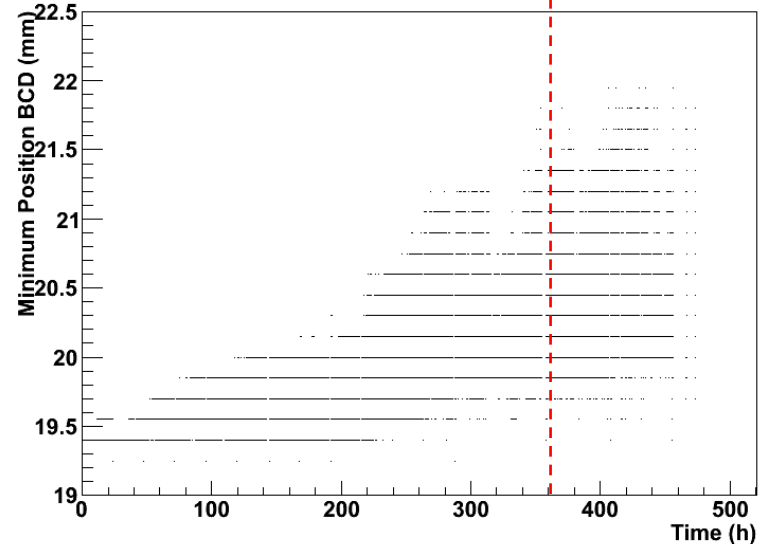


Acceleration to SP1



Raw Data from Min Pos BCD

15/16



# Summary of T2.X development

Target #	Design	Pulses (k)	Comment	Outcome
2.1	DLC/DLC	1	Old bearing design.	✘
2.2	DLC/DLC	80	Old bearing design.	✘
2.3	DLC/VESPEL	2100	New Bearings but poorly finished shaft.	✘
2.4	DLC/VESPEL	1000	Improved shaft, minimal dust.	✓
2.5	DLC/VESPEL	4000	Improved shaft minimal dust. Weekly inspections. Bearing cut-outs. No sticking observed.	✓
2.6	DLC/VESPEL	1100	Realistic run profile, minimal dust. Some sticking observed.	✓
2.7	DLC/VESPEL	1300	Increased clearances. Sticking still occurs.	✓

# T2.X Performance

- ISIS schedule 2011

User run cycle	Target	Start	End	Weeks
2011/1	TS1 & TS2	10-May-11	09-Jun-11	4
2011/2	TS1 & TS2	05-Jul-11	04-Aug-11	4
2011/3	TS1 & TS2	04-Oct-11	03-Nov-11	4
2011/4	TS1 & TS2	22-Nov-11	22-Dec-11	4

- In 4 weeks target would use:
  - 200 k pulses. Best last year
  - 4/500 k , if we ran at faster rate
  - 1 million assuming maximum effort, 7 days a week etc.

# Conclusion

- Have a working target in Synchrotron
- Comprehensive target development program
- New Stator design (T3) ready later in year
- Bearing test program using T2 underway
- T2.4 onwards showing minimal dust production
- Aiming for 1.5 – 2.0 million pulses without sticking
- May test other materials if required.