Linac4 Drift Tube Linac

LIU Day 2014

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Linac4 DTL – RF Design

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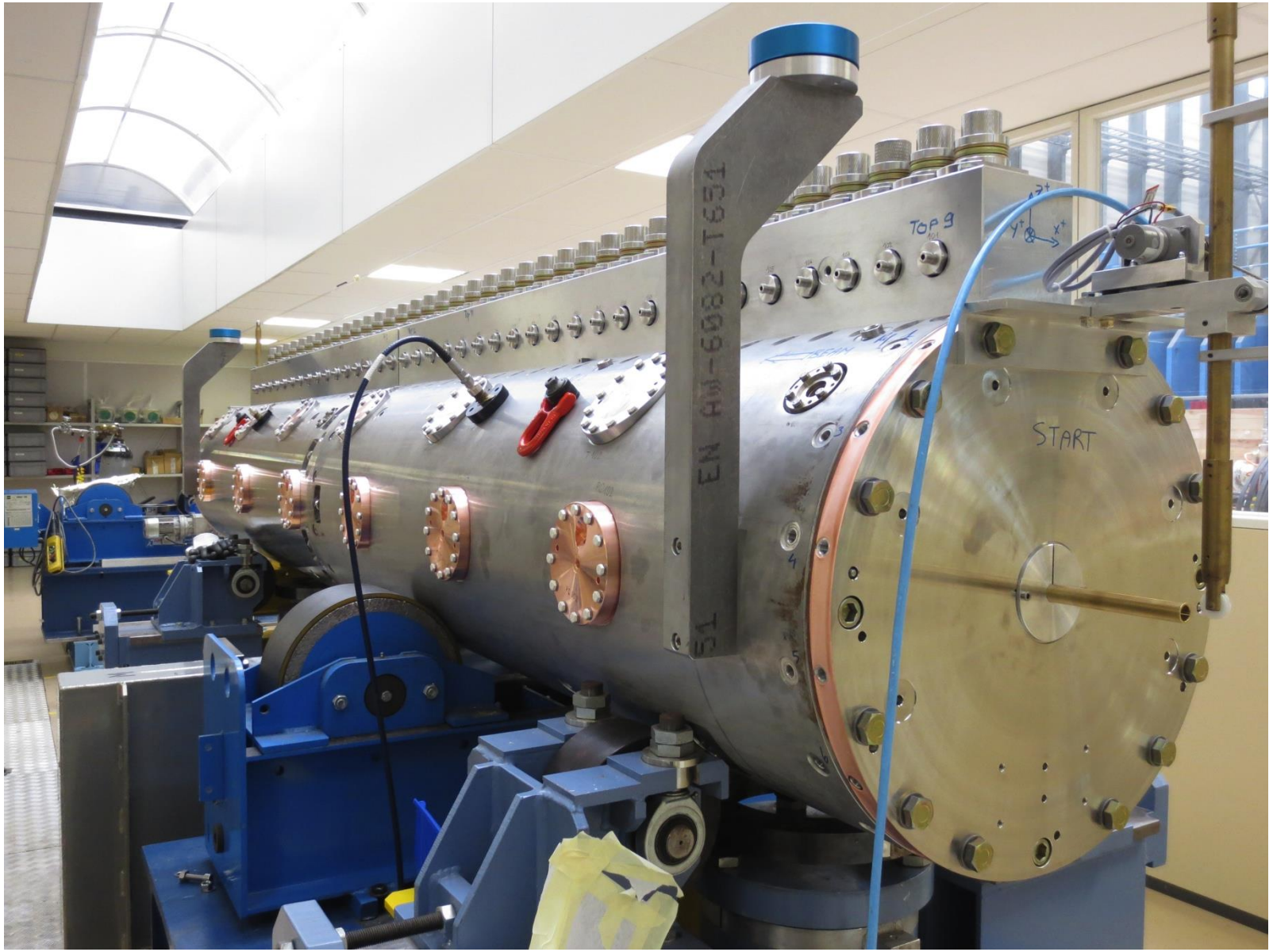
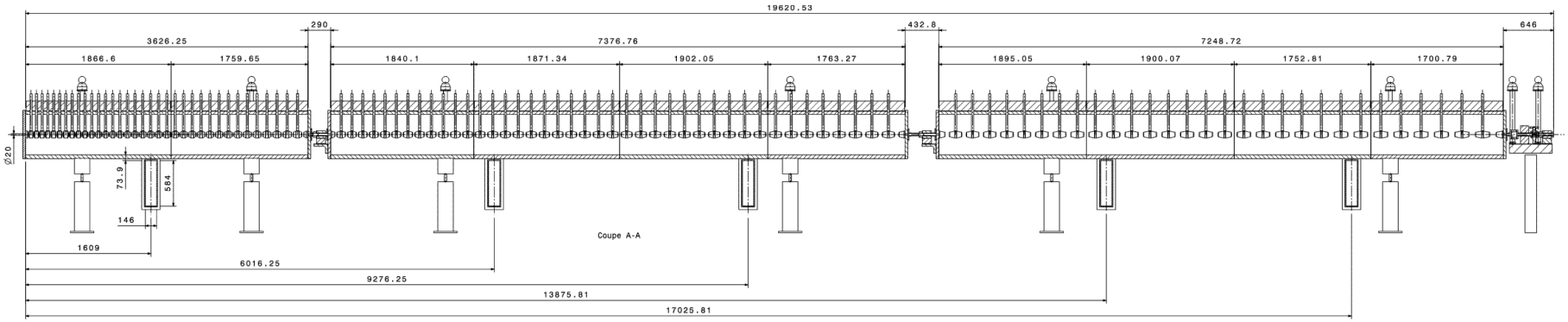
Linac4 Drift Tube Linac



Linac4 DTL Design

DTL design parameters:

- DTL from **3 – 50 MeV** with 3 cavities and 1 LEP and 2 new klystrons
- Klystron output power at cavity port **1 MW** (Tank1) and **2 MW** (Tank2&3)
- Accelerating field at ~**3.2 MV/m**
- Peak electric field of **1.6 Kilpatrick** lowered to 1.2 Kilp. over the first cells
- **PMQ**s in **vacuum**
- Self supporting steel cylinders of **50 mm** thickness
- Maximum segment length of **2 m**

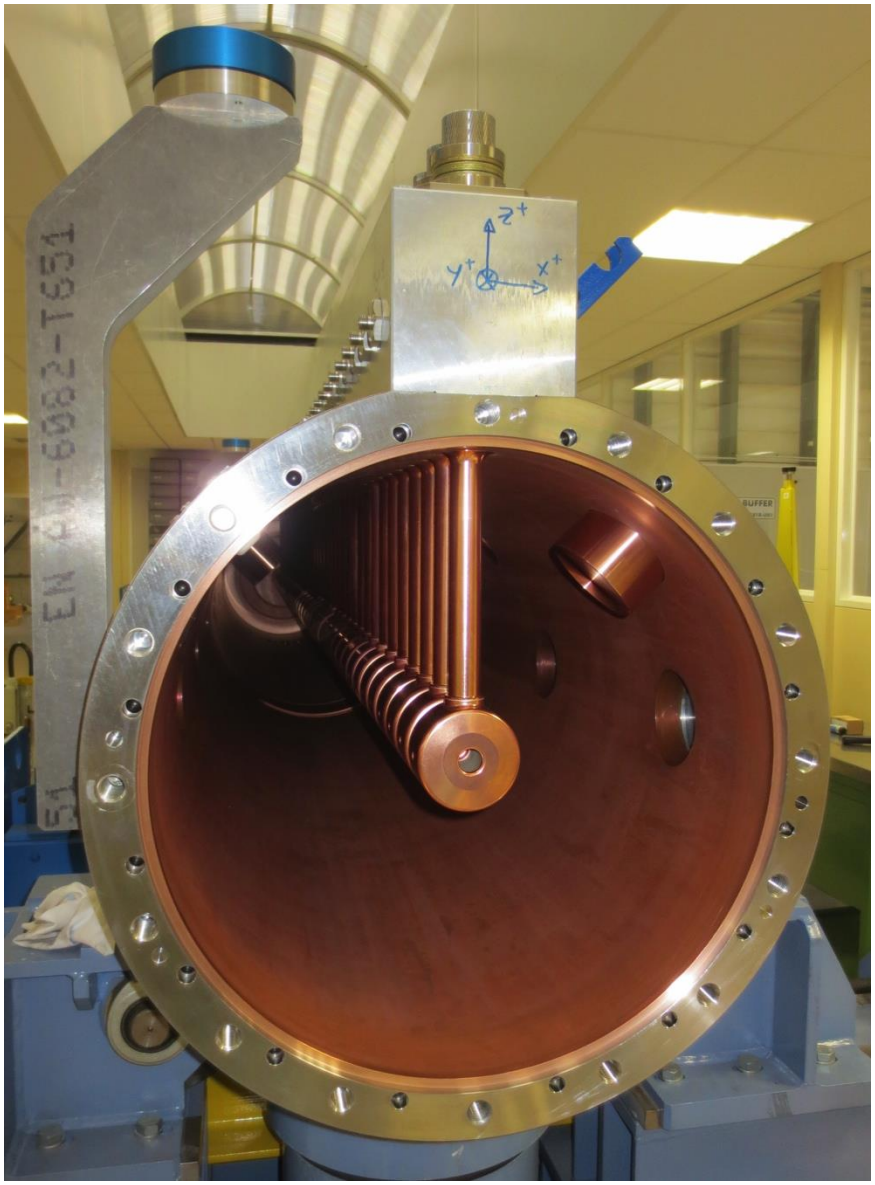


Production design:

- RF design compatible with mechanical realization

Parameter \ Cavity	1	2	3
Cells per cavity	39	42	30
Accelerating field	3.1 MV/m	3.3 MV/m	3.3 MV/m
Maximum surface field	1.5 Kilp.	1.4 Kilp.	1.45 Kilp.
Synchronous phase	-35 to -24 deg	-24 deg	-24 deg
RF peak power per cavity	1.00 MW	2.03 MW	1.98 MW
Quadrupole length	45 mm	80 mm	80 mm
Flat Size	11 mm	7 mm	5 mm
Number of sections	2	4	4
Length per cavity	3.8958 m	7.3406 m	7.2508 m
Beam output power	11.88 MeV	31.45 MeV	50.14 MeV

Linac4 DTL– Mechanical Design



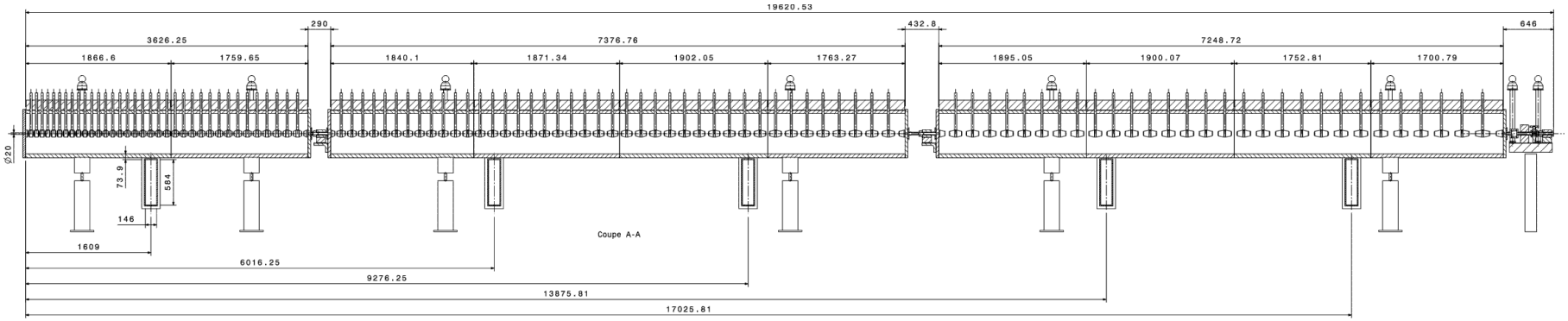
Linac4 Drift Tube Linac Mechanical Design:

Make it as straightforward as possible:

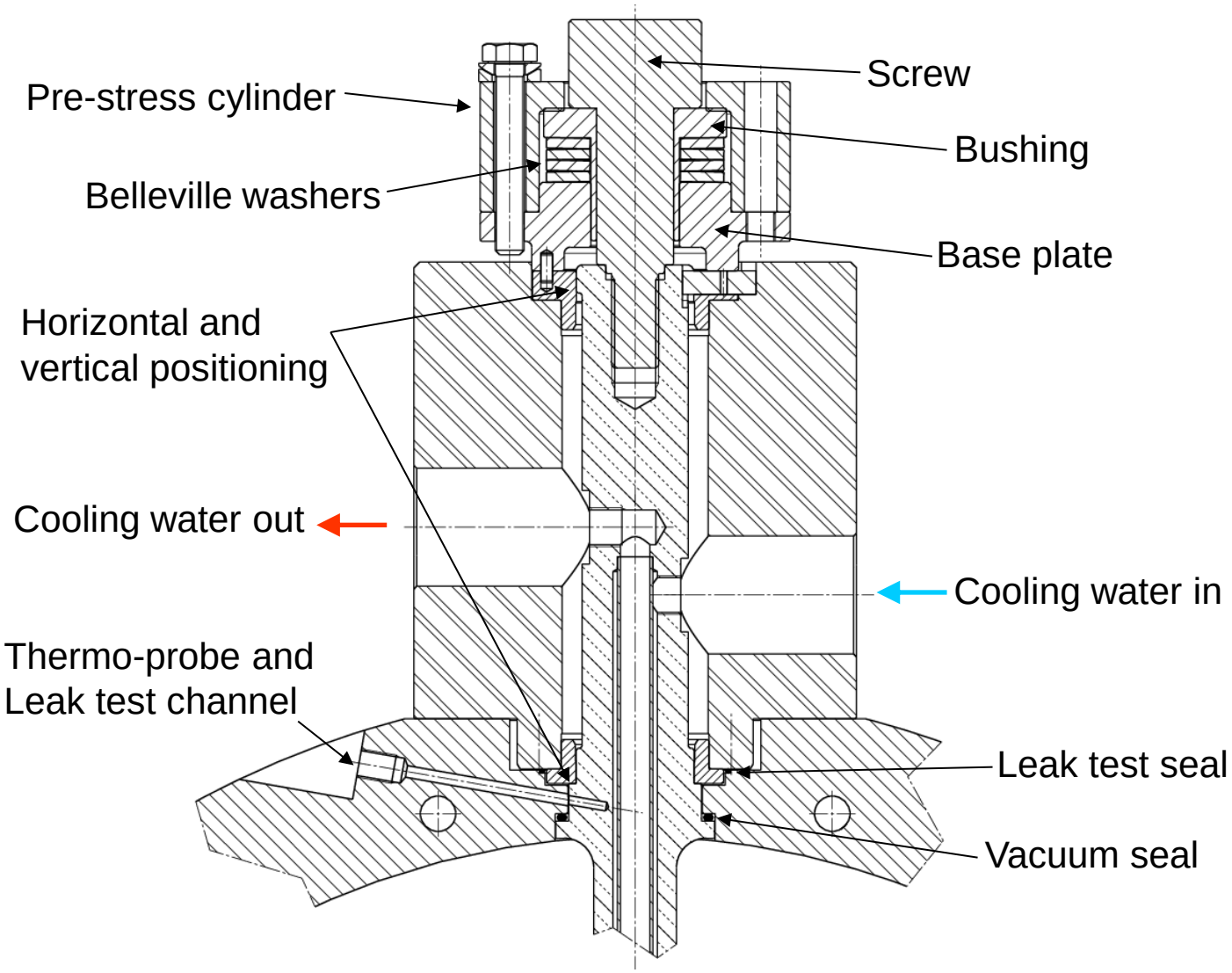
- Mechanical Design without position adjustment of Drift Tubes
- Single Helicoflex gaskets for vacuum and RF sealing
- Coaxial water cooling in Drift Tubes
- No wires in Drift Tubes: PMQs, no instrumentation, thermal probes at top
- Rigid steel support structure, w/o welds (almost), soft Aluminium girders

Consequence:

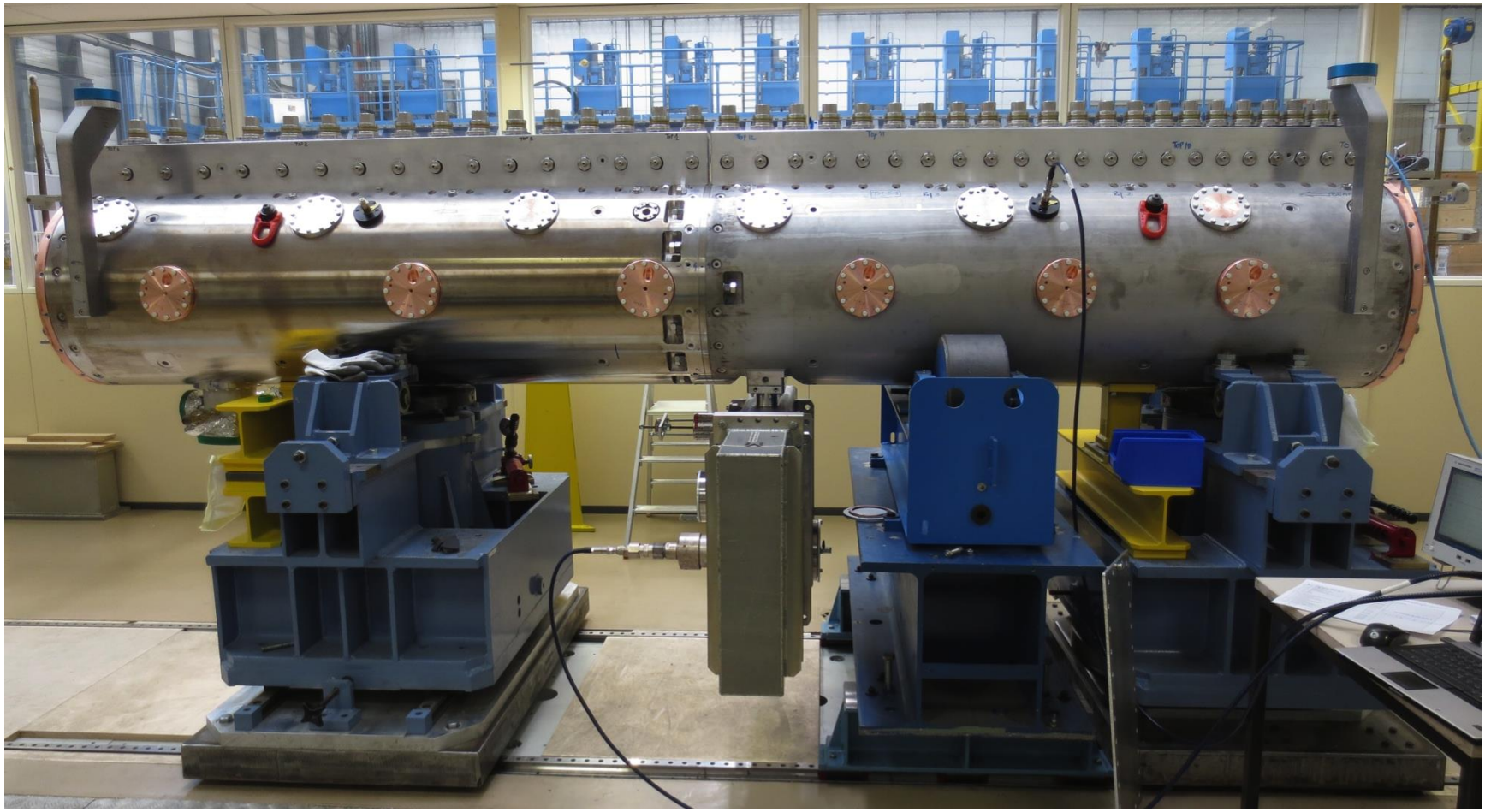
- Precision Machining required, and tight Quality Control



“Adjust and Assemble”

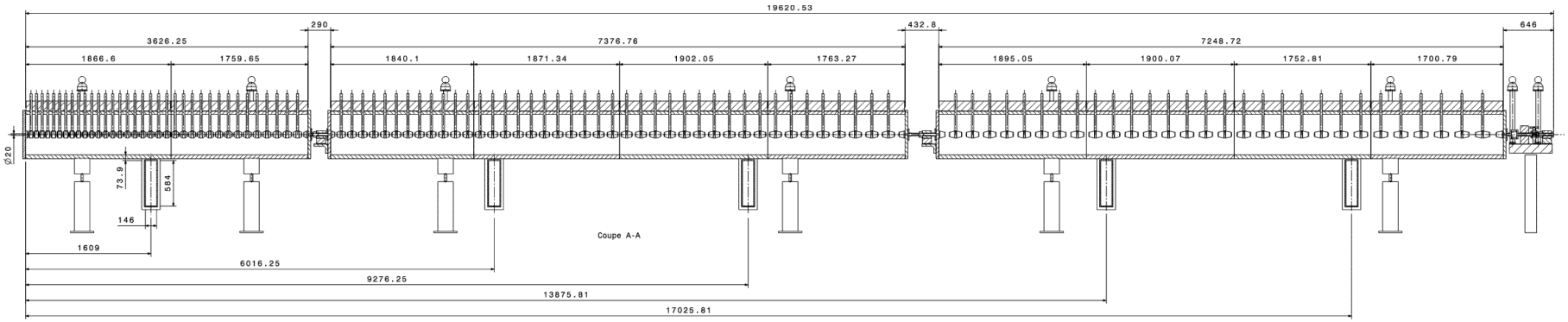


Linac4 DTL Manufacturing



Linac4 Drift Tube Linac Manufacturing:

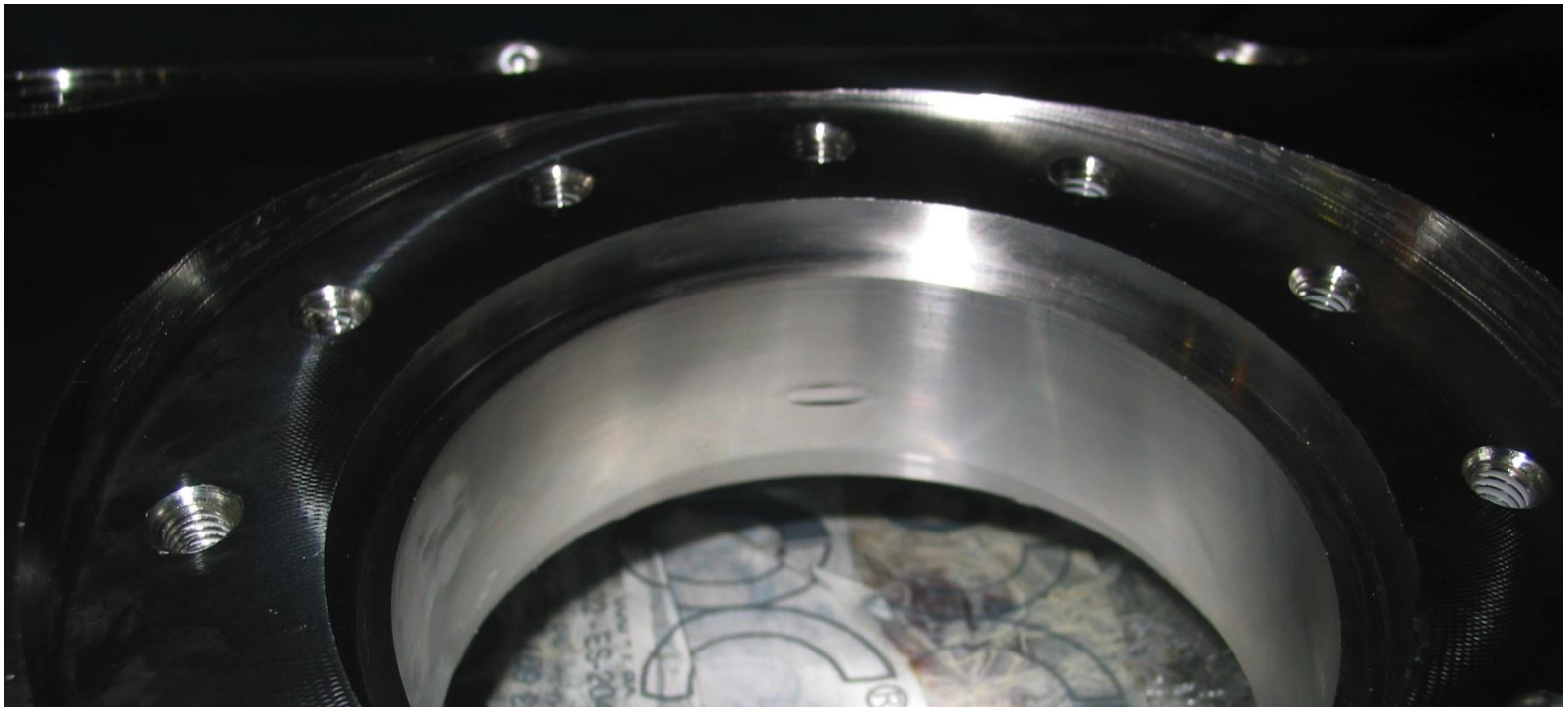
- Girder manufacturing at CADINOX, Veenstra Glazenborg & CERN
- Retendering to Mancisidor and GoiAlde, Spain → Completed June 2013
- Drift tube component machining, DMP, Spain → Completed January 2013
- Drift tube assembly, CERN → Completed November 2013
- Tank manufacturing at CADINOX, Spain → Completed February 2014
- Tank plating, CERN → 5 Segments Completed, 1 Ongoing, 4 Waiting
- Tank assembly, CERN → Tank1 Completed, Tank3 Ongoing



Tank Manufacturing

Tank manufacturing:

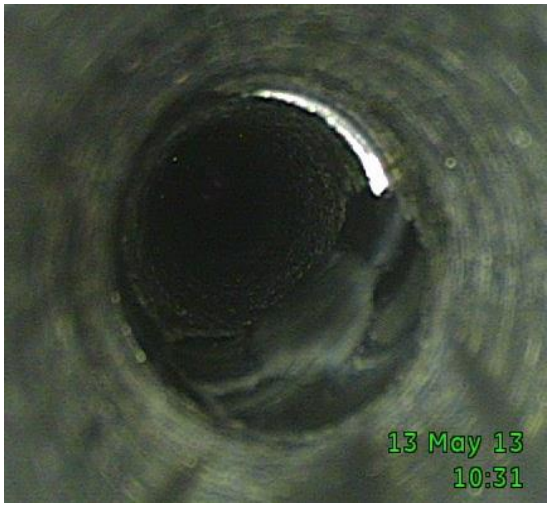
- Order started November 2010
- Manufacturing of 1 pre-series segment T1S1 completed October 2011
  - Pre-series segment fully in specification
- Machining error on deep drilled cooling channels found March 2012



Cooling channel repair

Crash program:

- Definition of analysis procedure by ultrasound
- Analysis of all segments: 9 segments out of tolerances, 2 to be repaired
- Definition of repair with inserts
- Successful test on sample pieces at manufacturer
- Ordering of dedicated machining tool
- Machining of defined channel opening
- Failed repair on tank segments at manufacturer
- Remachining of defined channel opening



- Successful repair at CERN – T3S3 sent back, T1S2 at CERN (May 2013)

Other issues:

- Other leaks (water to air) plugged
- Re-machining of segments out of tolerances
- Non-connected cooling channel

Linac4 DTL Tank Status

Tank status:

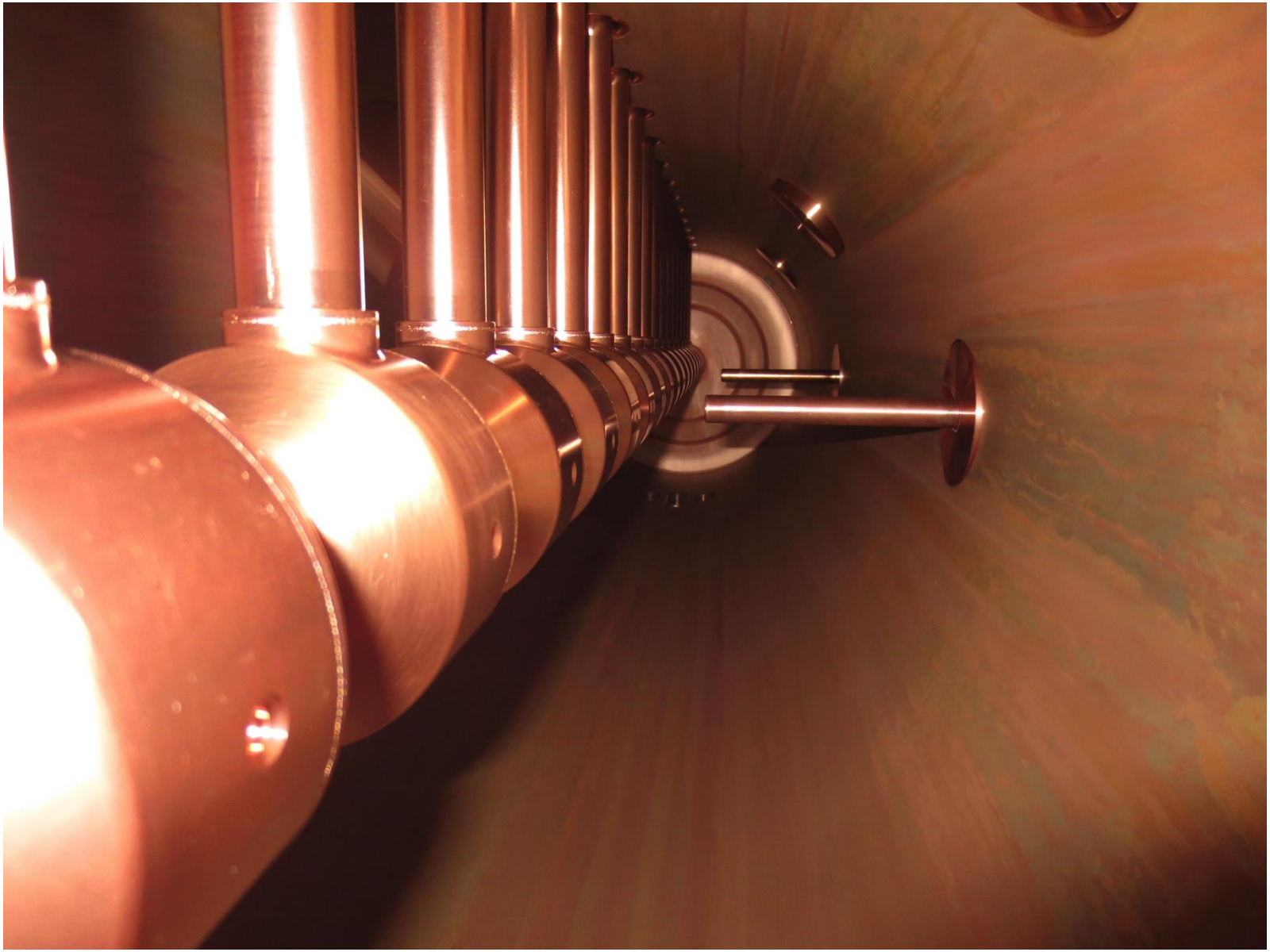
- T1S1 & T1S2 assembled and joined as Tank1 – in completion
- T3S1, T3S2 & T3S4 assembled
- T3S3 under copper plating
- T2S1-S4 at CERN

Current tasks:

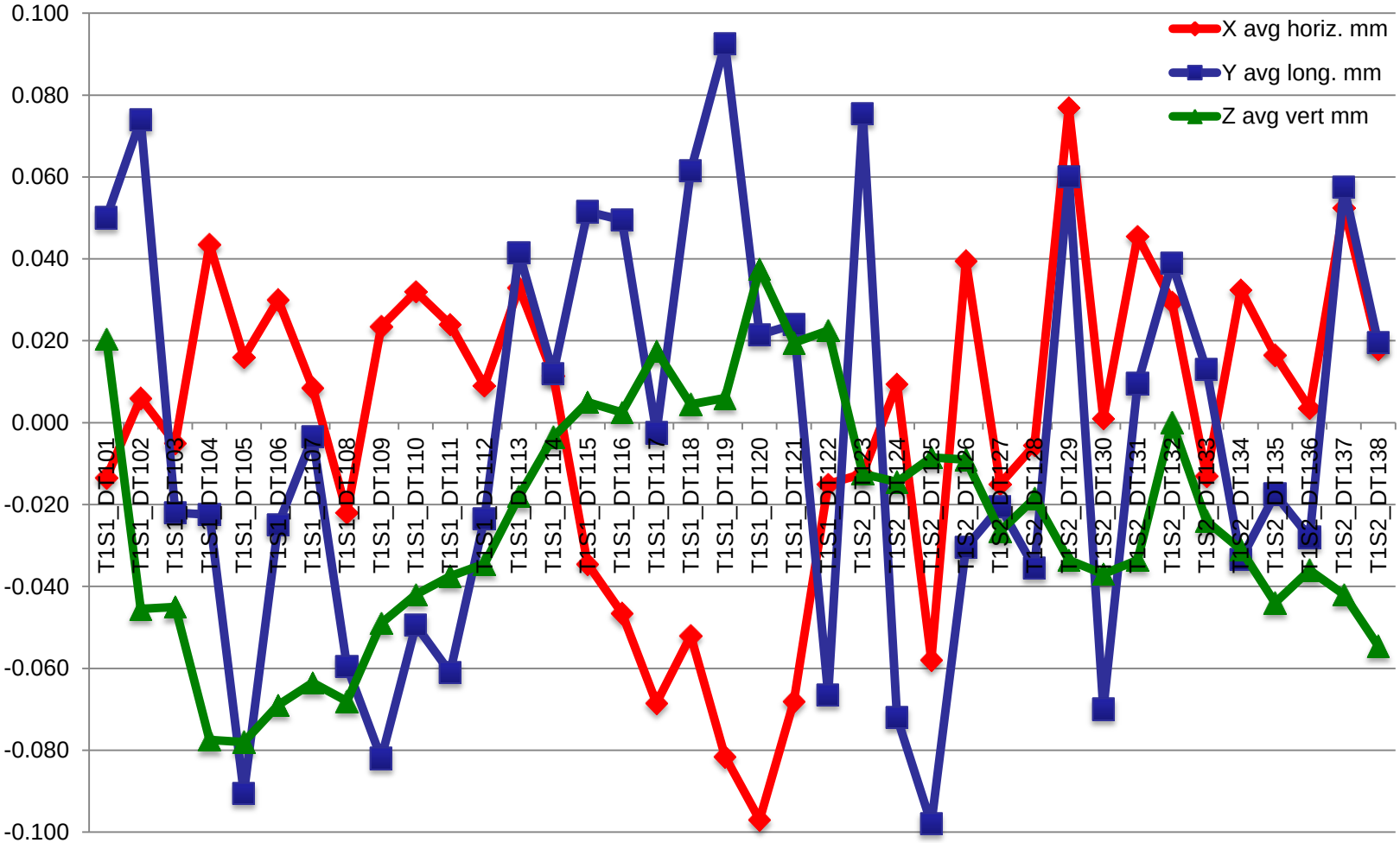
- Verifications and completion of Tank1
- Copper plating of remaining segments in competition with LS1
- Assembly of segments of Tank3

- Manufacturing of wave-guide couplers & movable tuners

Linac4 DTL Tank1 Results

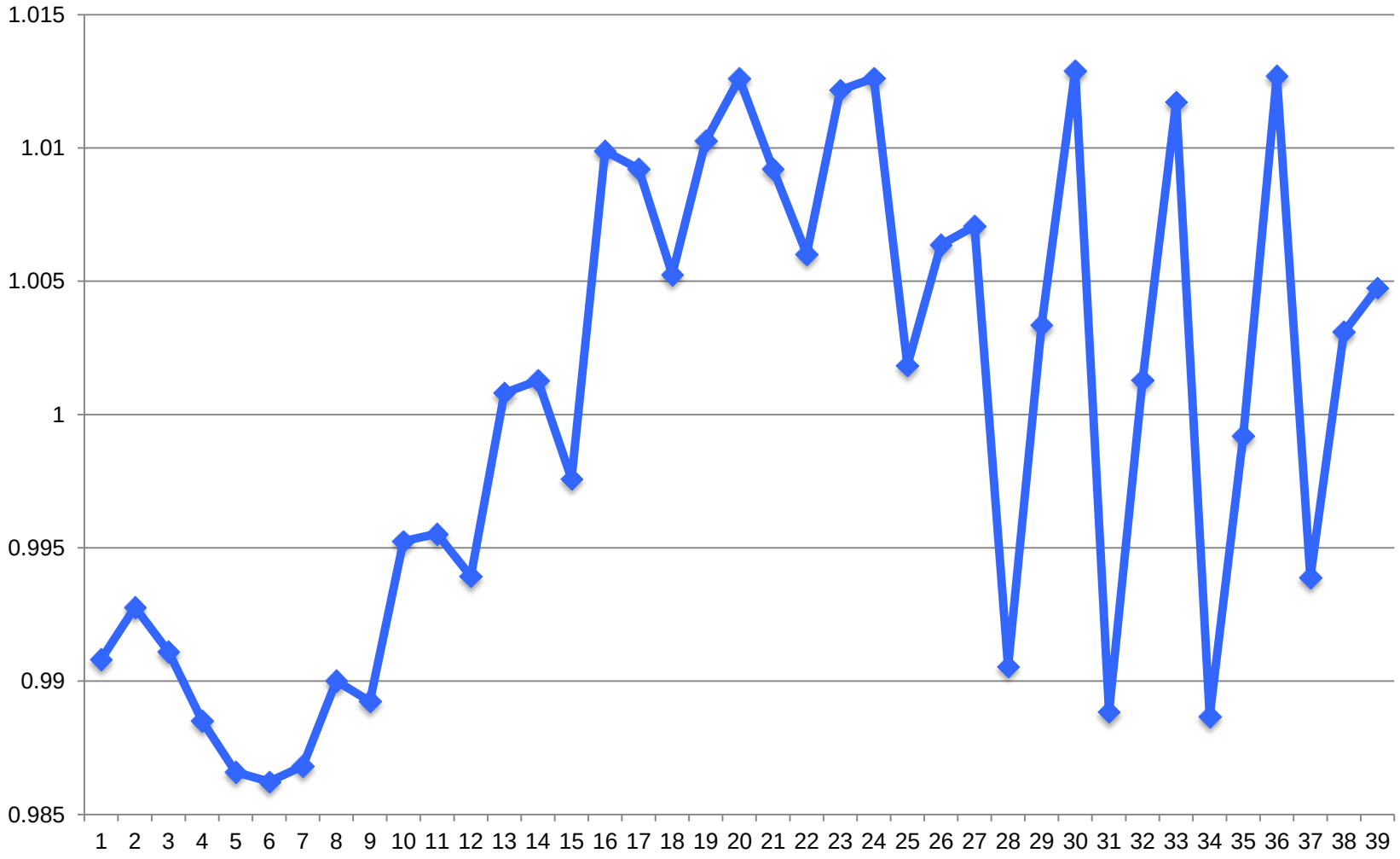


Quadrupole positioning: Horizontal / Longitudinal / Vertical



Linac4 DTL Tank1 Results

Tuning: E0 variation within +/- 1.35%



Linac4 Drift Tube Linac – Conclusions

Conclusions:

- The Linac4 Drift Tube Linac is a **prototype**
- Manufacturing requires tight **quality control**
- Considerable quality **issues** have been **overcome**
- Almost all major **components** have been **completed**
- Last manufacturing stages are in **competition with LS1**
- The Drift Tube Linac is a **puzzle of a thousand pieces**
- Final assembly is **on its way**