ASTeC Report for CLIC-UK

Jim Clarke on behalf of all ASTeC & Technology Department staff contributing to CLIC-UK

STFC Daresbury Laboratory, UK

CERN-UK Review, 9th May 2012

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- WP1 – Crab Cavity
- WP2 – Drive Beam Quadrupoles

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WP1 – Crab Cavity

- Very little to report so far by ASTeC for this WP
- Project is being progressed by Lancaster – ASTeC to start contributing this year:
  - See talk by Ben Woolley later on overall project status
- ASTeC planning for FY12/13:
  - Optimise crab cavity damping solutions
  - Engineering design of ‘damped’ CC structure
  - Coordination and fabrication of CC structure and its verification

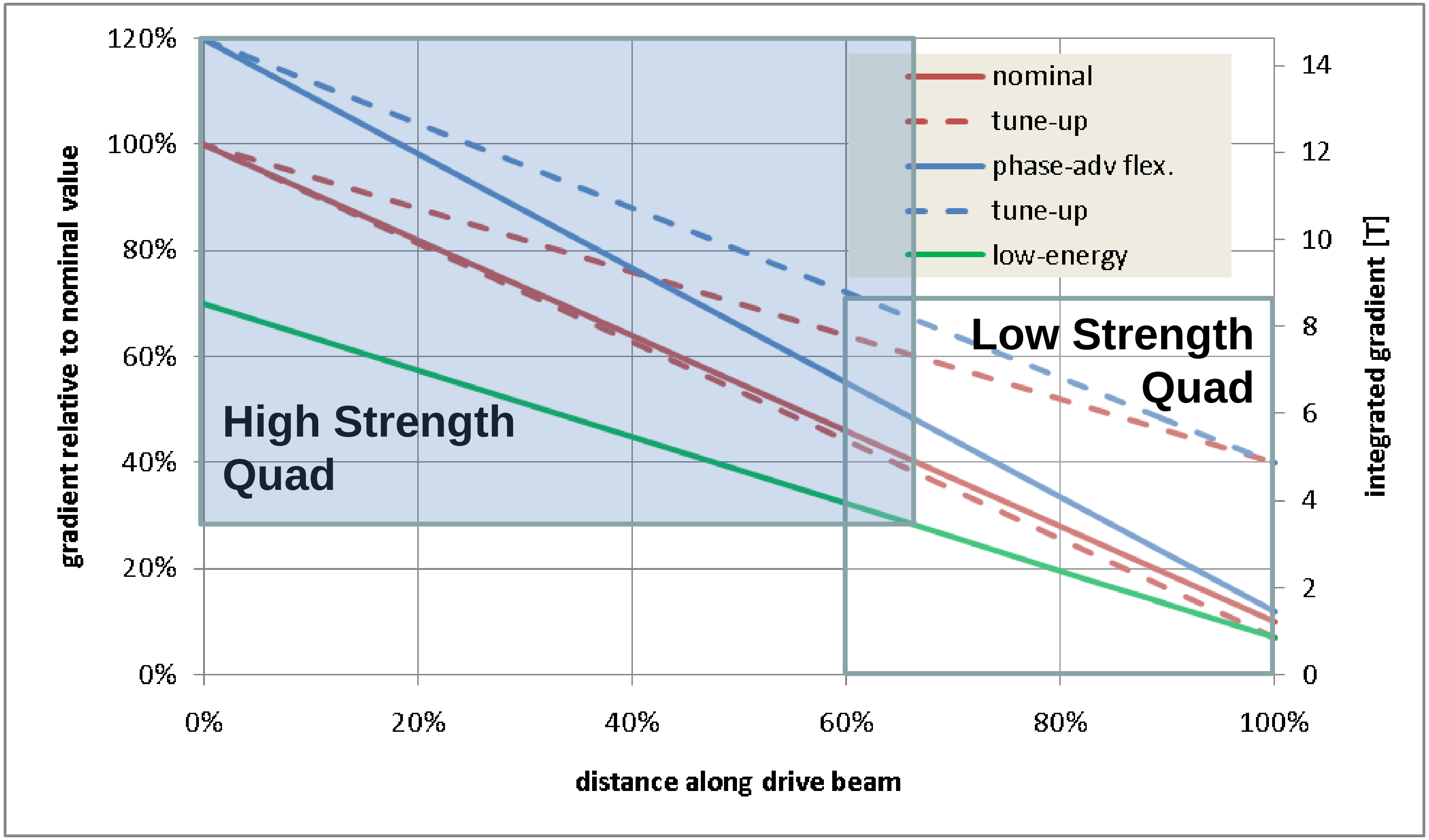
WP2 – Background

- The CLIC drive beam needs a quadrupole every meter (~42,000)
- The electromagnet option will consume ~400W per magnet
- Want to maintain heat load in tunnel to <150W/m
- ASTeC looking at permanent magnet options and also to assess new techniques for building ~50 quads/day (of any technology)

Specification

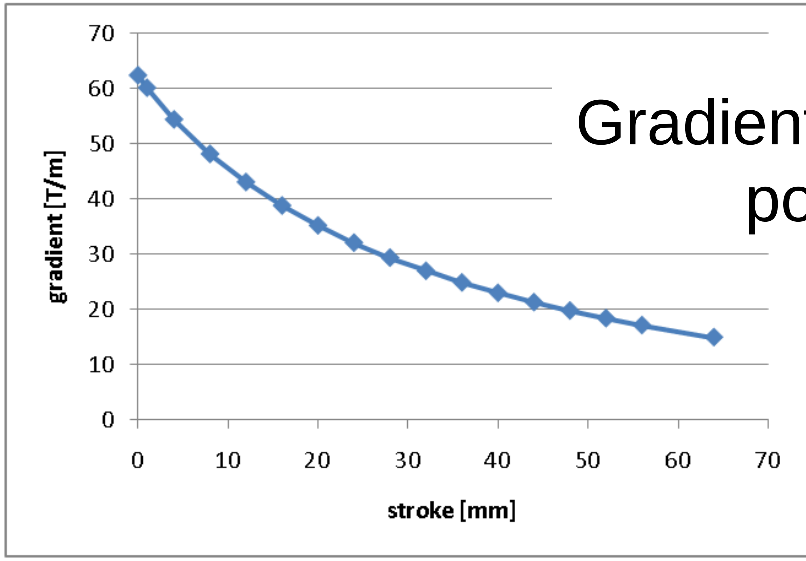
- Max Integrated gradient 14.6 T (120% setting)
- Inner radius of vac chamber 11.5 mm
- Outer radius of vac chamber 13.0 mm
- Field quality within ±0.1% over ±11.5 mm
- Max dimensions of magnet:
  - 391 x 391 x 270 mm (H x V x L)
- Need dipole correction also of 12 mTm (max) in both planes (not simultaneous)
- Large tuning range needed at every energy

Tuneability

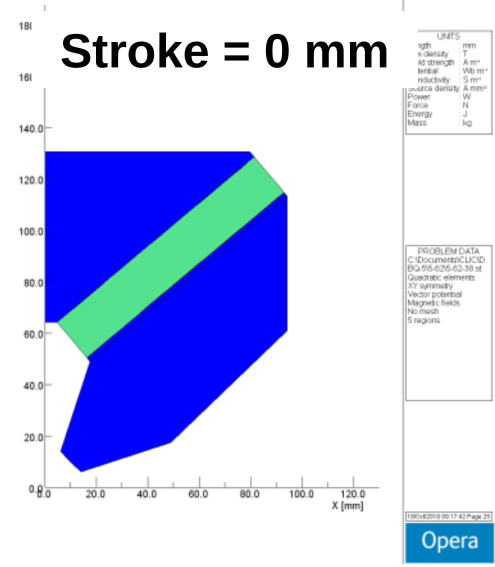


Low energy end more demanding in terms of adjustable range of magnet

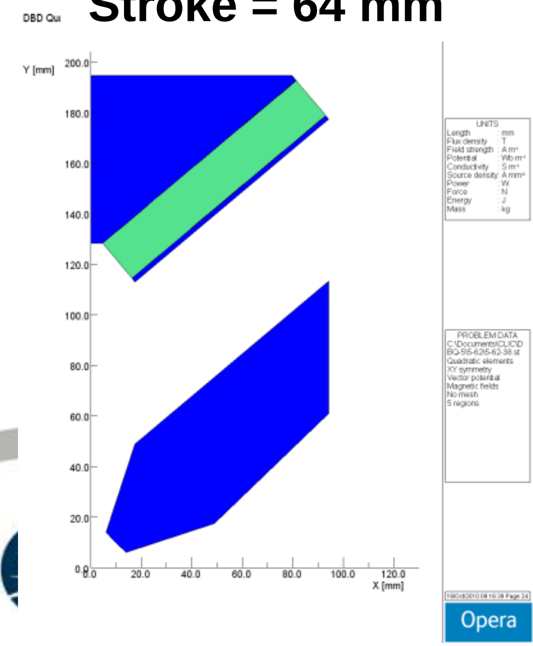
High Strength Quad Design

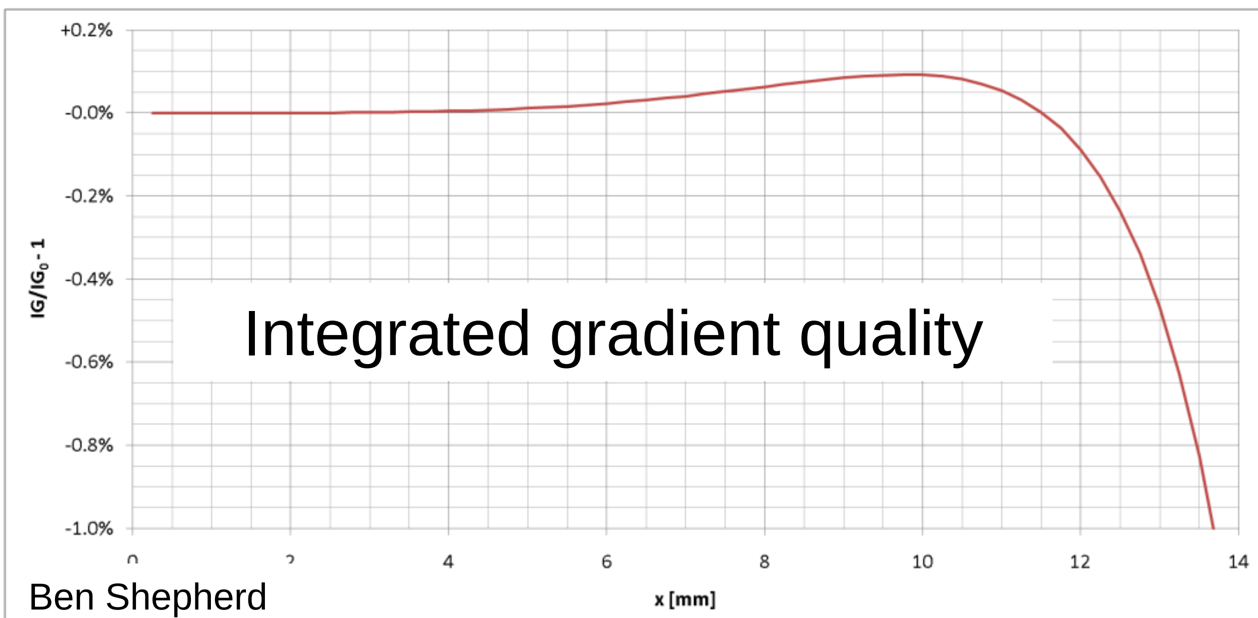


Stroke = 0 mm



Stroke = 64 mm



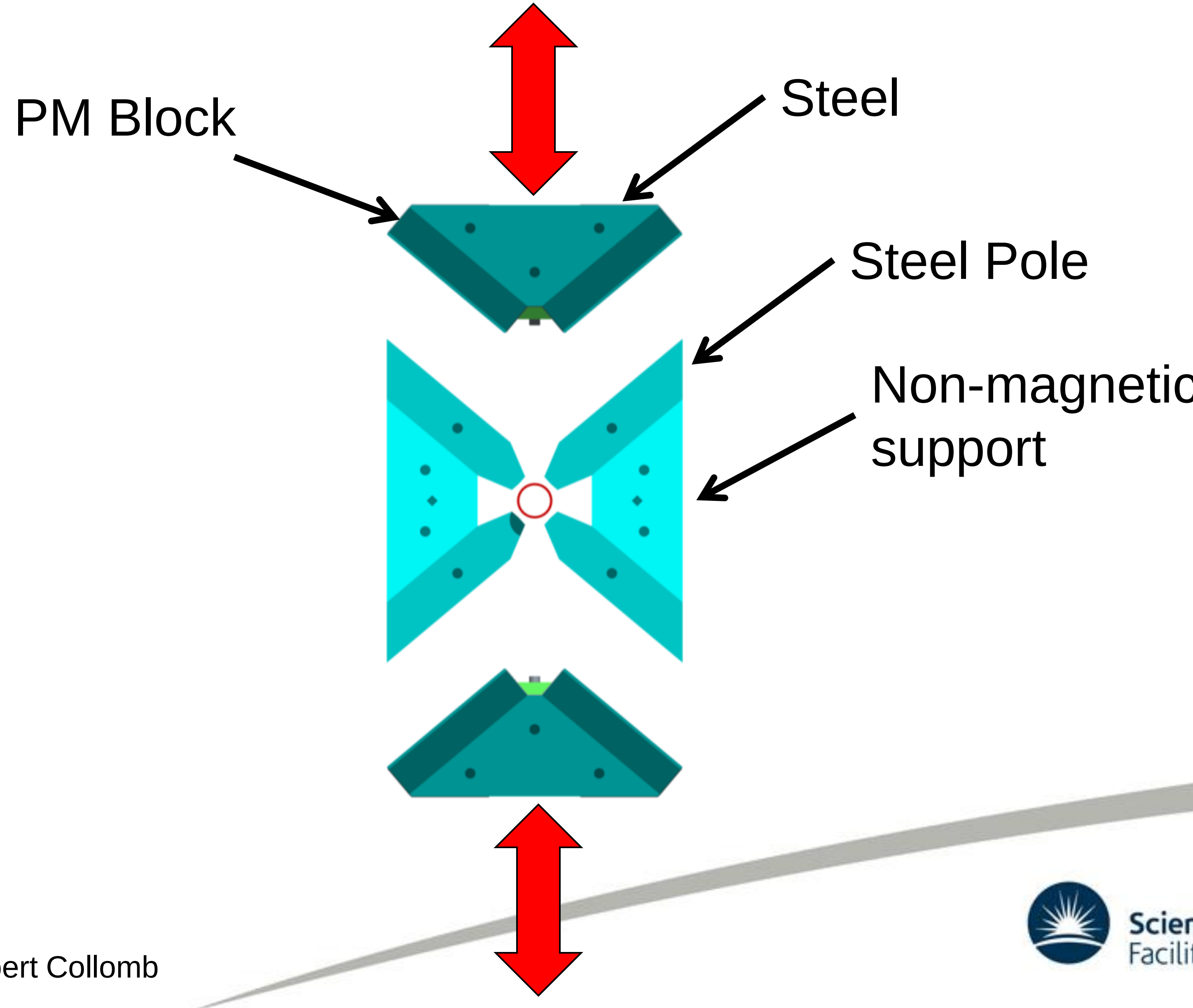


Ben Shepherd

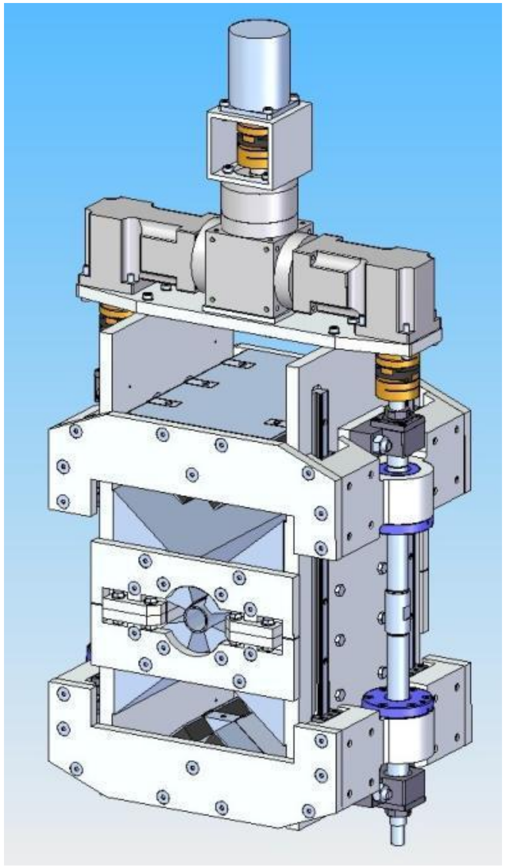
Parameters

Parameter	Value	
Inscribed radius	13.6 mm	
PM size	18 x 100 x 230mm	
PM angle	40°	
Magnet Pole Length	230 mm	
Maximum stroke	64 mm	
Integrated gradient	14.6 T (max)	4.4 T (min)
Relative to nominal	120%	30%
Good gradient region	±12.0 mm	

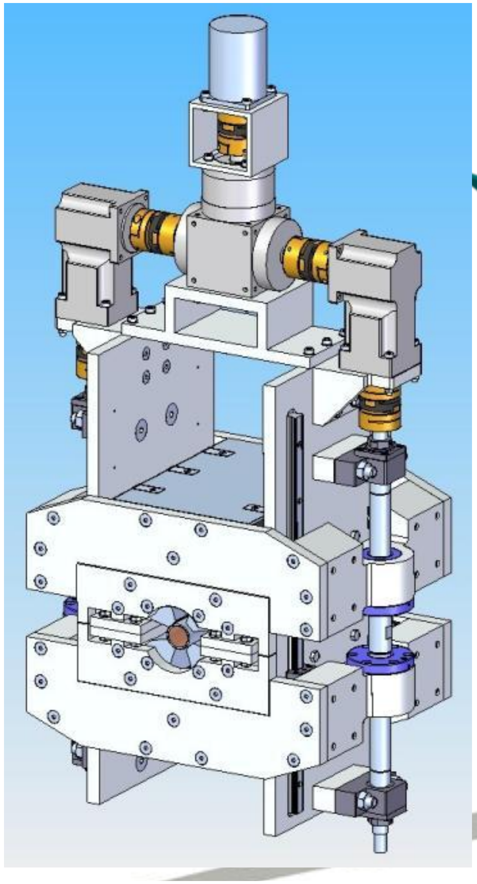
Basic Engineering Concept



Engineering

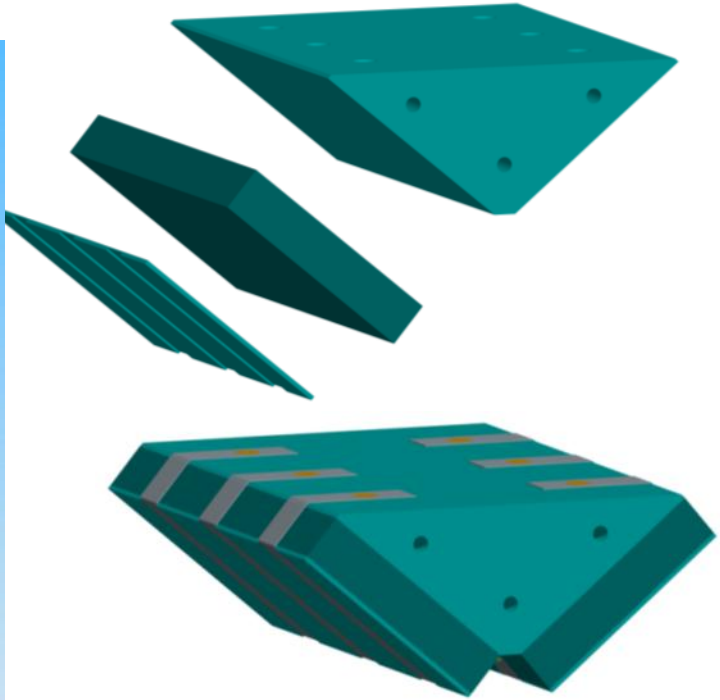


Fully Open



Fully Closed

PM Block secured to steel yoke



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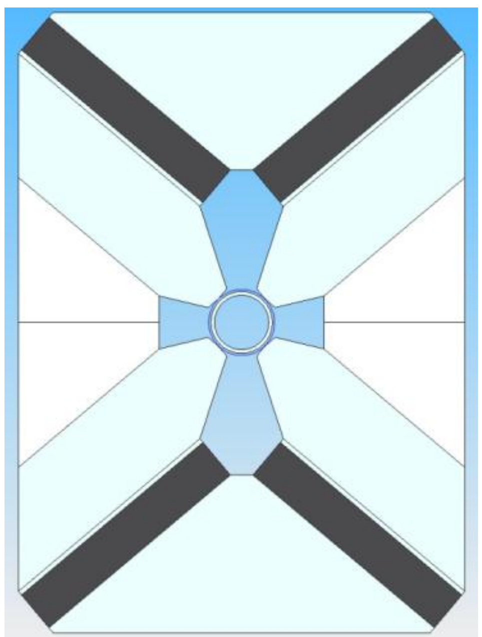
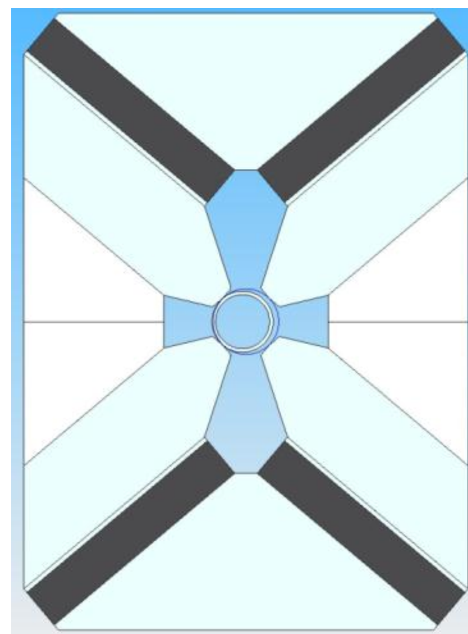
Dipole Correction

- Require 12 mTm in either x or y
- Most easily achieved by moving magnet by up to 0.8 mm – current design makes allowance for this

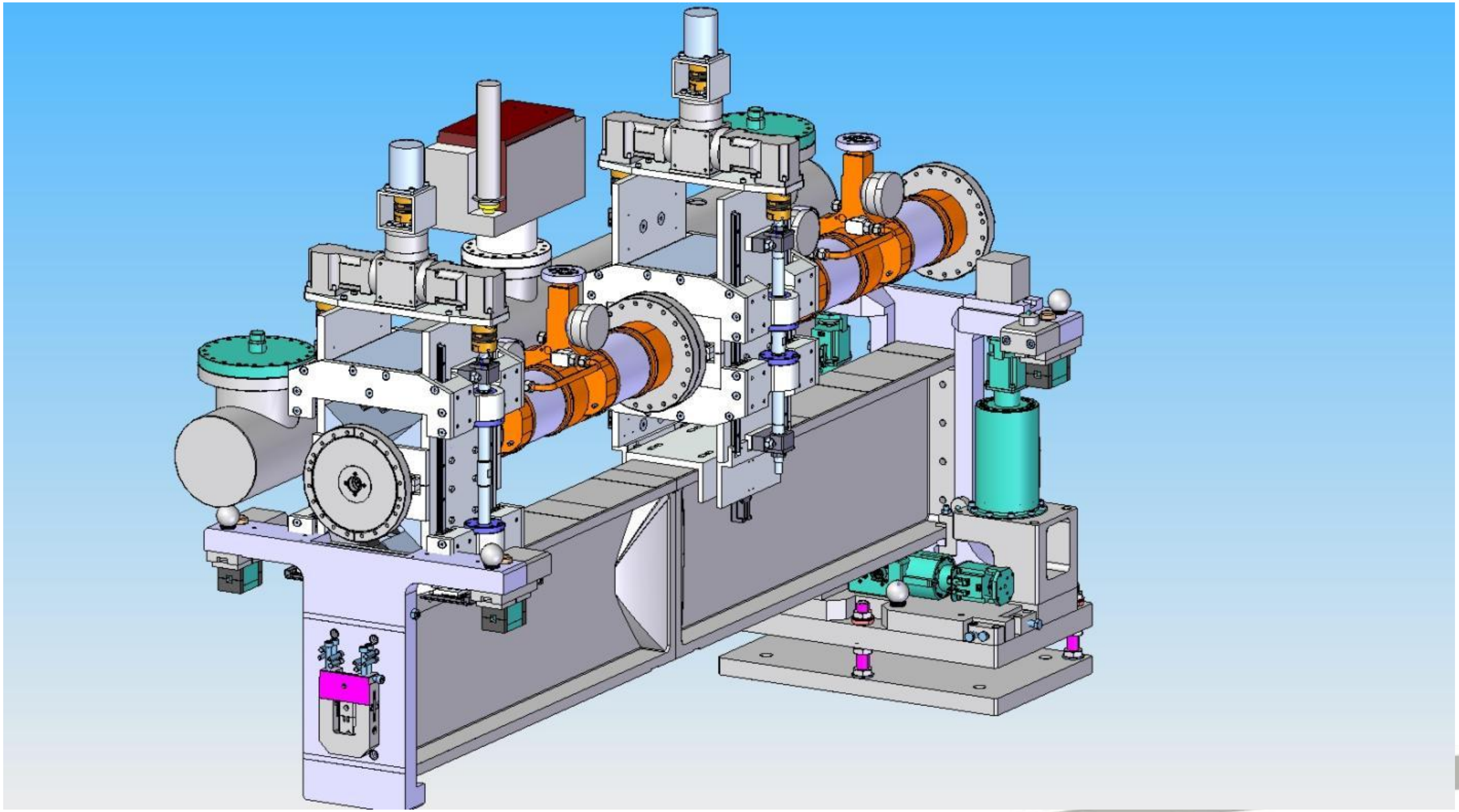
Magnet on axis





Magnet moved to the right

PM Quads in CLIC



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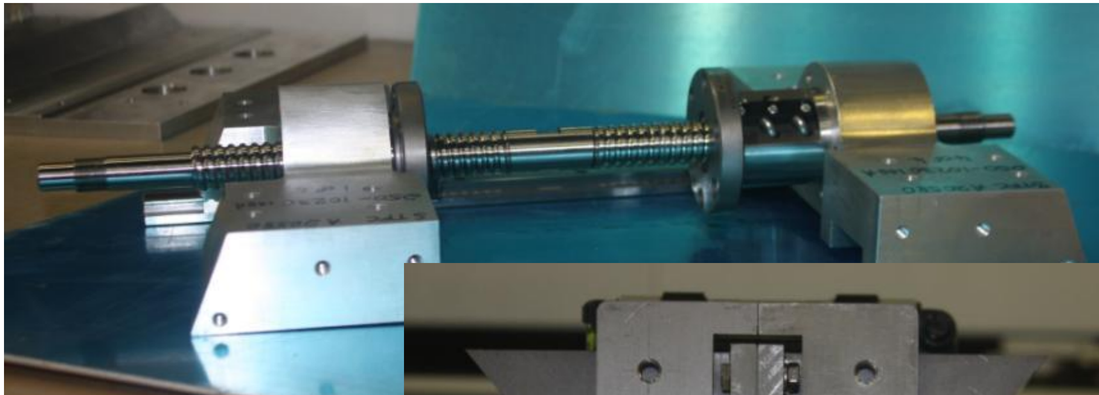
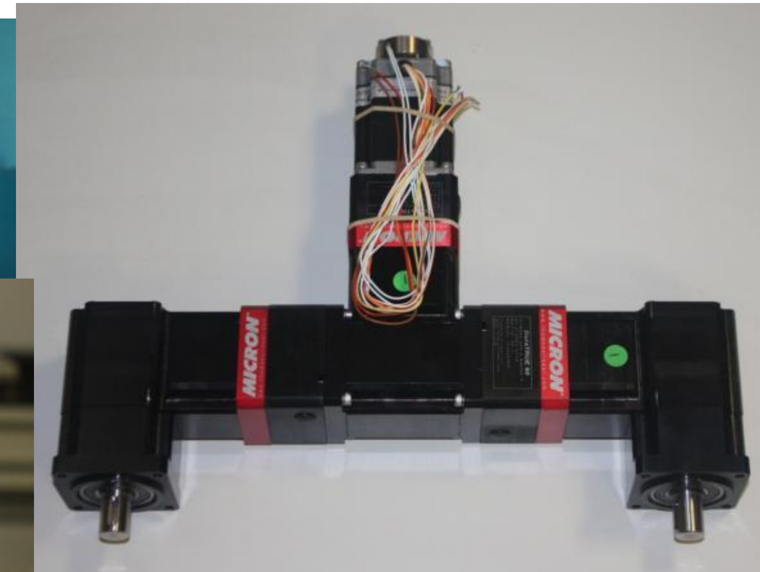
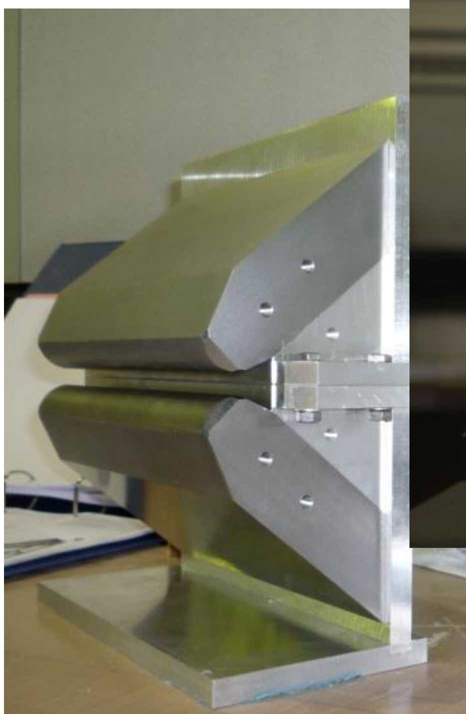
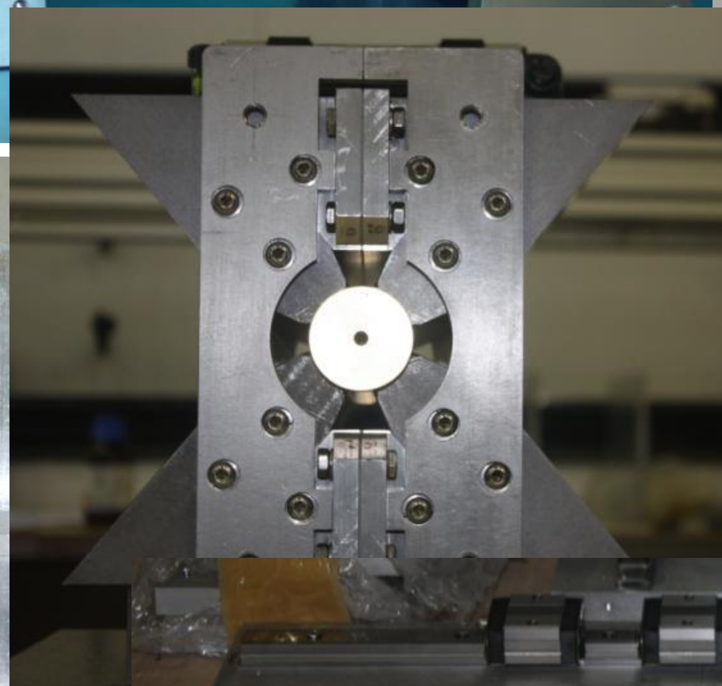
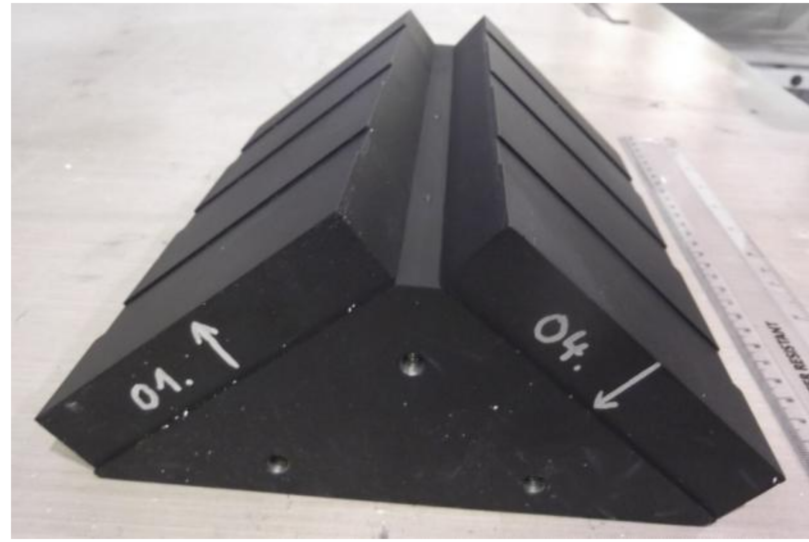
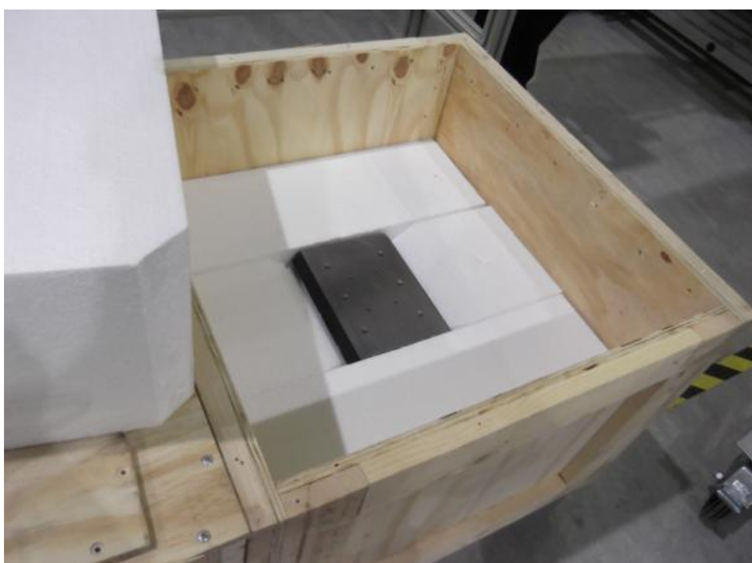
Prototype Components

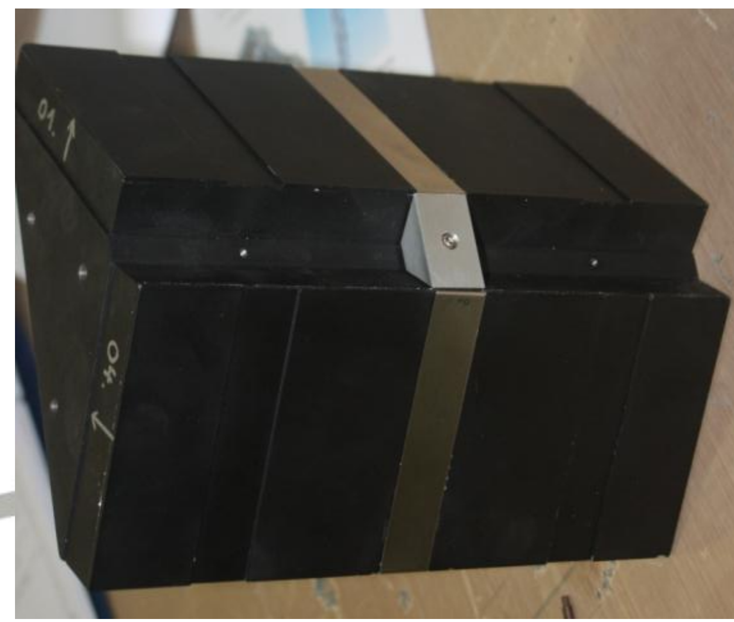



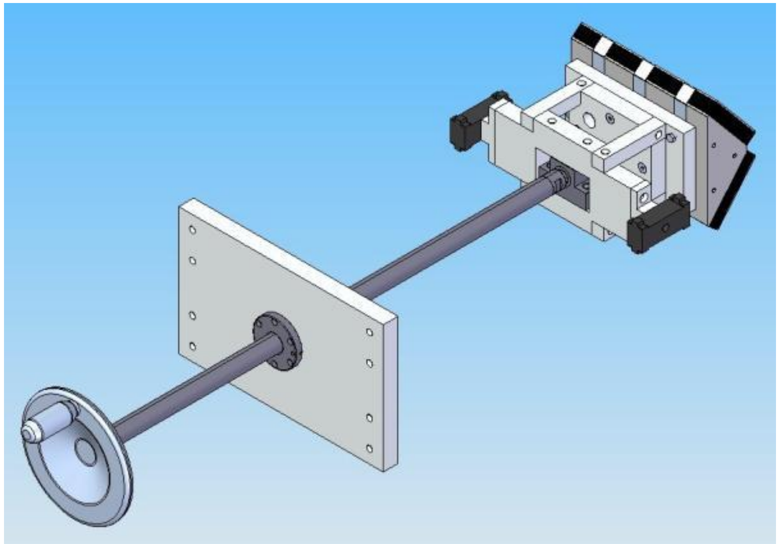

Permanent Magnets

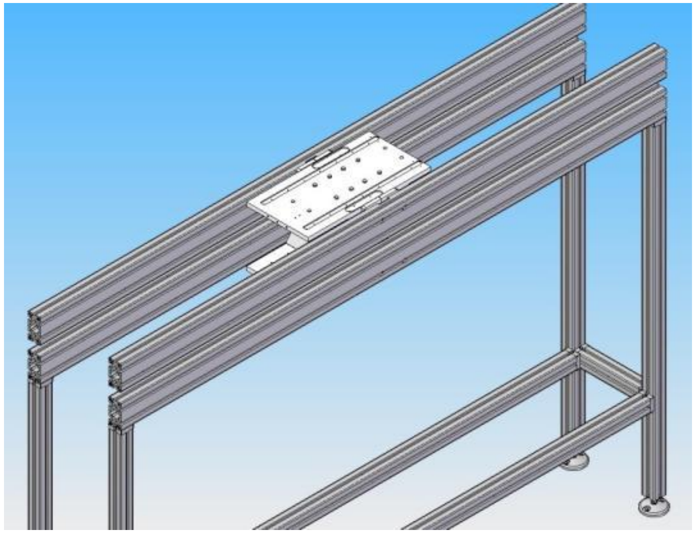




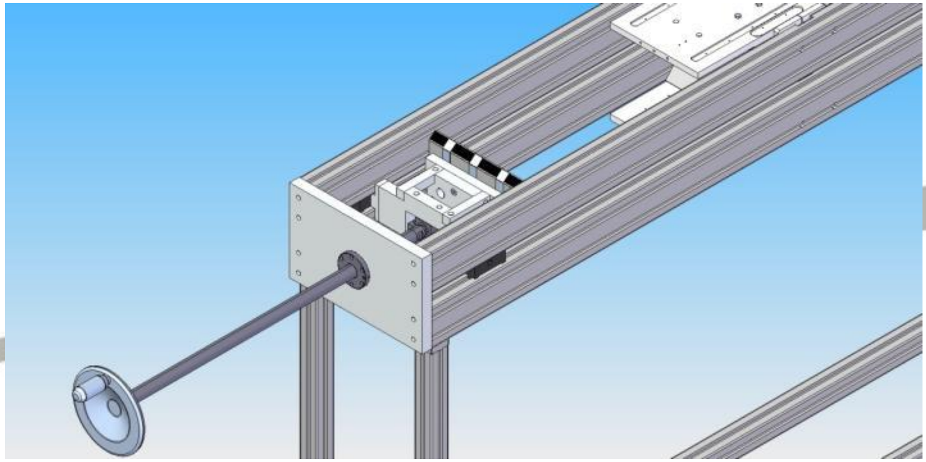


High Strength Prototype Assembly Fixture and Test Stand





Fixture essential for safe assembly, also allows for initial magnetic testing without rails, leadscrews etc – can then directly measure influence of these magnetic components



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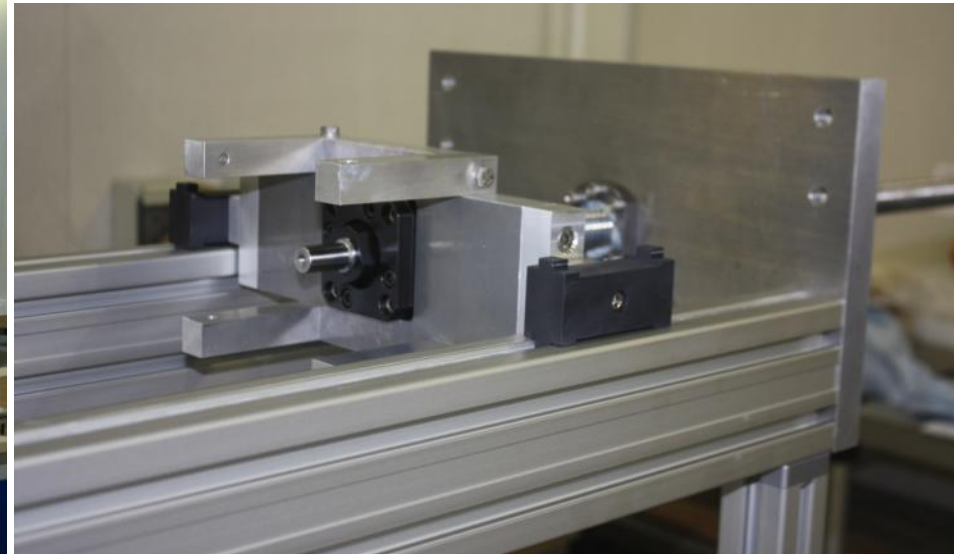
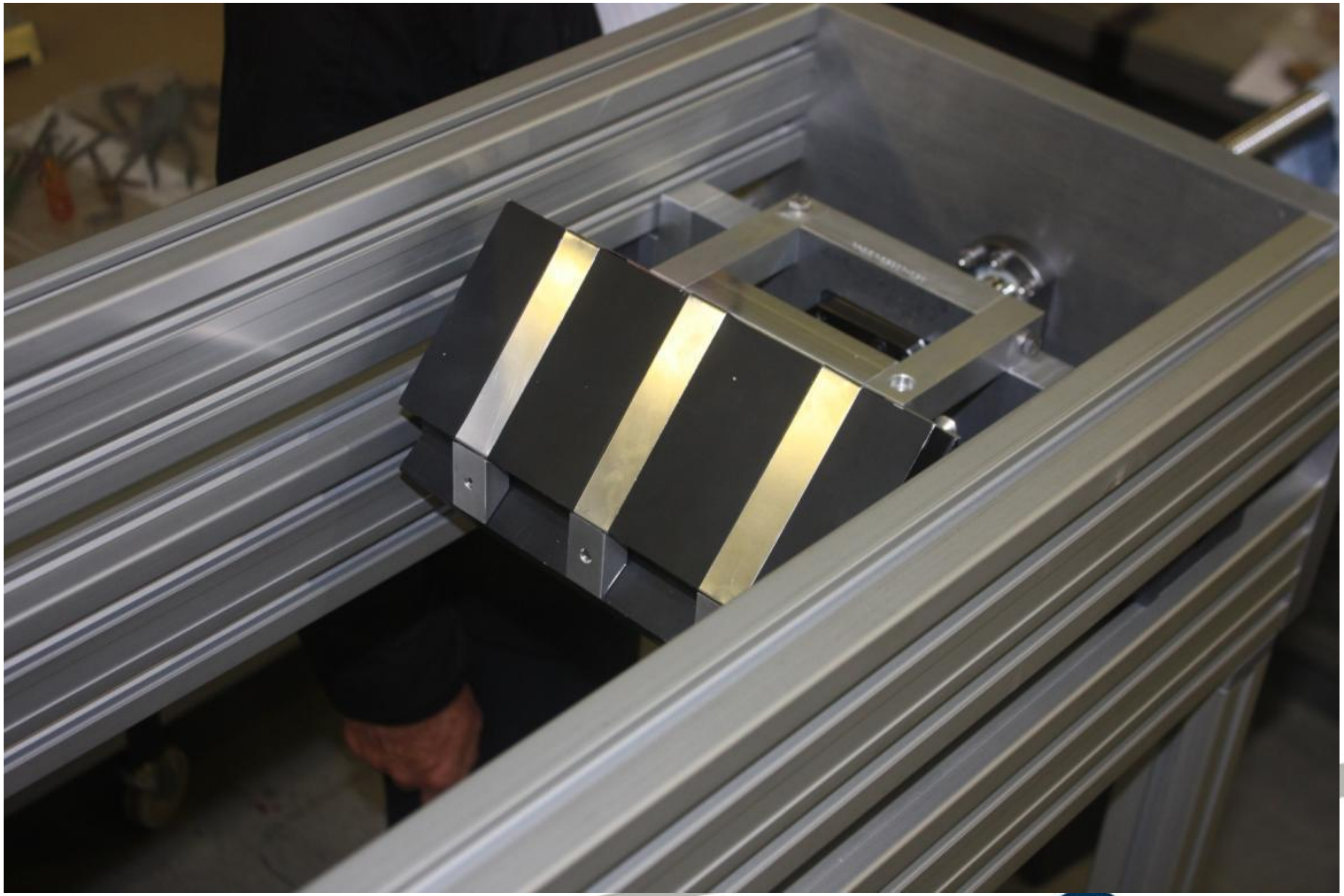
High Strength Prototype
Assembly Fixture and Test Stand



High Strength Prototype Assembly Fixture and Test Stand



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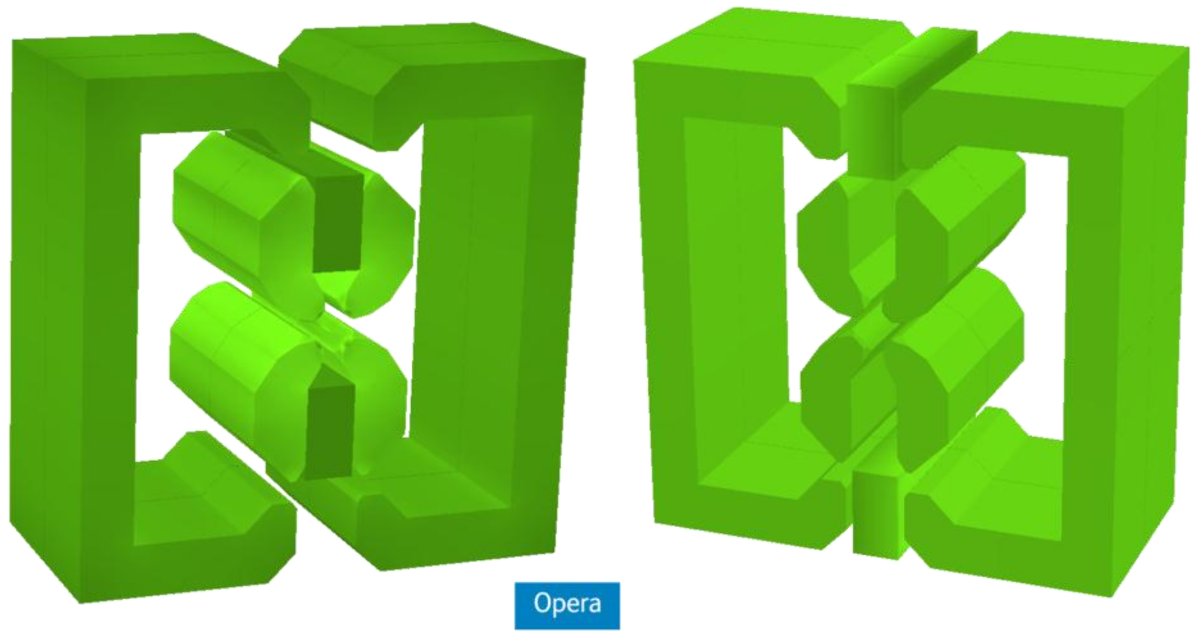
High Strength Prototype Schedule

- Magnet measurements without rails, leadscrews etc starts this week
- Add rails, leadscrews etc to make standalone magnet with full motion control system – complete mid June
- Mechanical and electrical testing for 2 weeks
- Magnet testing of standalone prototype – July
- Ship to CERN – end July
- Visit CERN to discuss magnet tests – 13 or 14 Sept
- CERN magnet tests for comparison with ASTeC tests to then follow

Low Strength Quadrupole

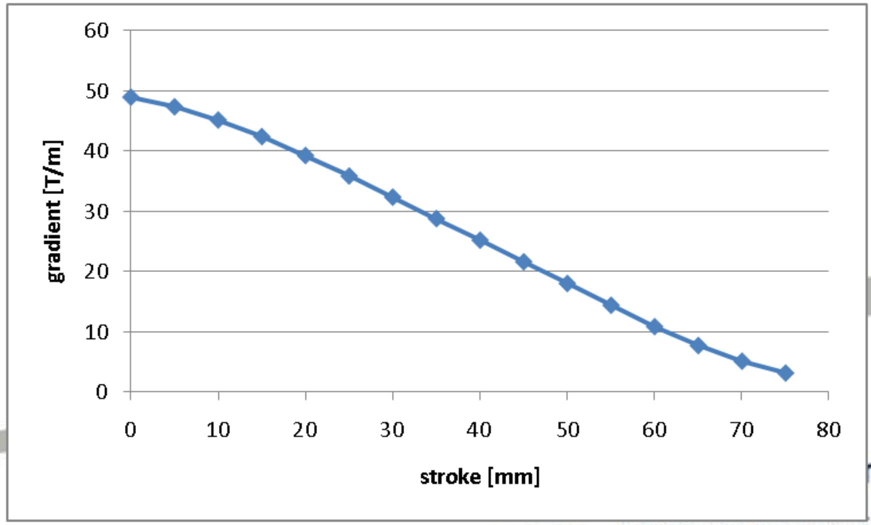
Specification:

Less demanding magnetic strength but much wider tuning range



Design solution:

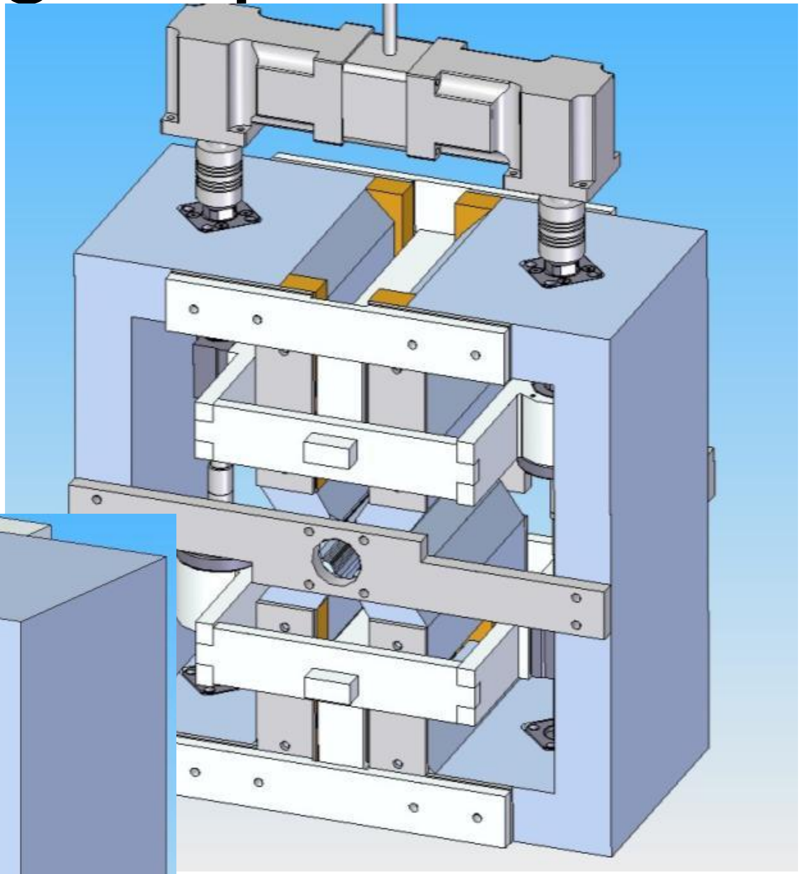
Simple vertical movement with low forces, surrounding outer yoke to short circuit flux and reduce gradient quickly

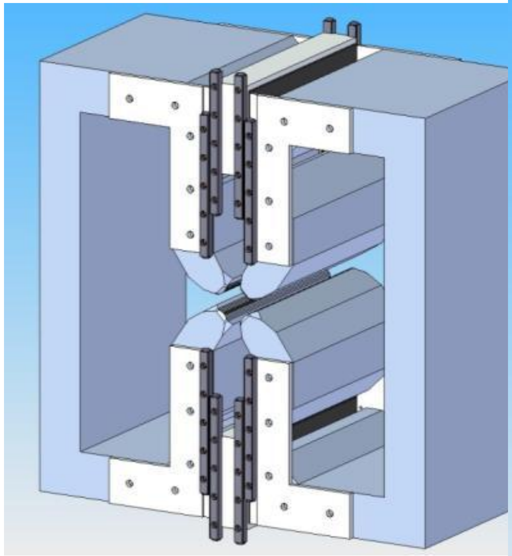


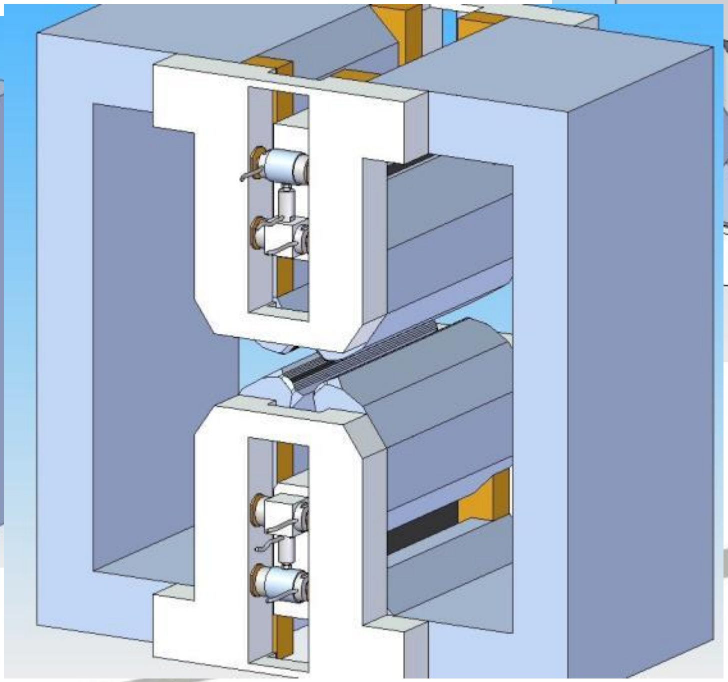
Mechanical Design Options

Mechanical engineering looks feasible

Need to select motion system and then detail up







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Low Strength Prototype Schedule

- Select mechanical design option – July 12
- Detailed engineering design – Oct 12
- Prototype construction – Mar 13
- Magnetic Measurements by ASTeC and CERN – Sept 13

- Note – agreed deliverables are prototype by 30/9/13 and report by 31/3/14

Summary

- Crab cavity work yet to really start at ASTeC – no cause for concern
- PM quadrupoles well under way
  - First measurements of high strength quad this week
  - Low strength quad ahead of target
  - Study of how to manufacture in such high numbers to follow after low strength quad

Thanks

- Special thanks to Ben Shepherd, Norbert Collomb and Peter McIntosh for providing the material for the slides

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