

Magnetically coupled push-pulls for UHV

Nick Clark

Chief Scientist UHV Design Ltd

- Capabilities
- Magnetic push pull technical highlights
- Accelerator application case studies
- New Developments
- Magnetic push pull product range
- Q and A

In-House Key Facilities & Capabilities

Facilities



Engineering & Design



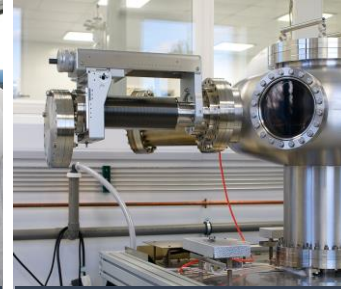
In-House Machining



Part Cleaning



Clean Room Assembly



Quality Assurance

Capabilities

- Technical Consultancy
- Product Customisation
- Product Design (CAD)
- Go-to-meeting customer support
- Product Innovation

- CNC Lathes
- CNC Mill/Turn Machines
- 3 & 5 Axis CNC Milling
- Rapid Prototyping
- Computer Aided Machining
- Trimos Measuring Equipment
- TIG Welding

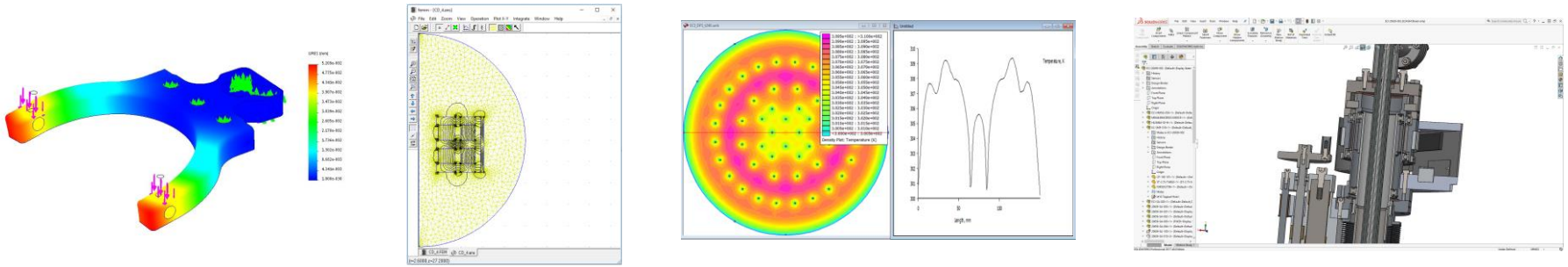
- Detergent clean
- Ultrasonic clean
- Oven dried
- Air tight packaging ready for assembly

- ISO 10,000 clean room
- Air lock part transfer
- Experienced assembly team
- Standard operating procedures
- 'Buddy checking'

- Dedicated test rigs
- ISO test procedures
- 'Buddy checking'
- Test sheet & certificate of conformity

In-House Key Facilities & Capabilities

- 8 Active Solidworks CAD seats/designers
- Thermal Modelling
- Magnetic Field modelling
- FEA
- More than 80 years experience in UHV industry within the design team
- Dedicated RnD Lab



Magnetic transfer arms -PowerProbes

Standard PowerProbe

Sliding PEEK bearing arrangement



- May introduce trace levels of organic material
- Pressure increase ~ 2 decades during translation

XPowerProbe

Metal rolling bearing arrangement

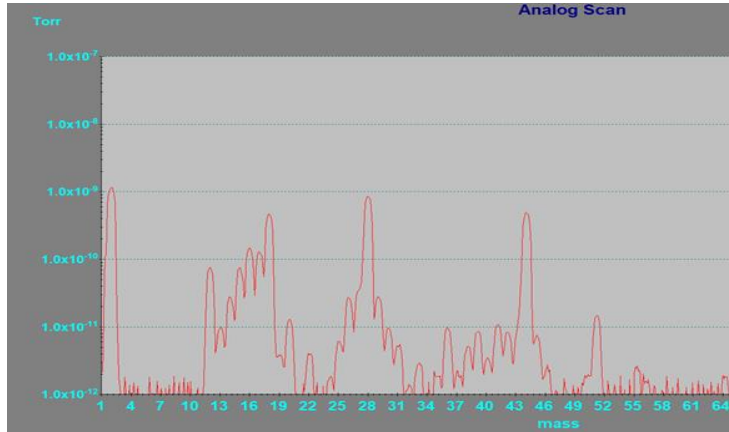


- **Ultra-clean operation**
- **Typically < 1 decade pressure increase during translation**
- **< 0.5 Linear friction of standard Power Probe**

PowerProbes

Standard PowerProbe

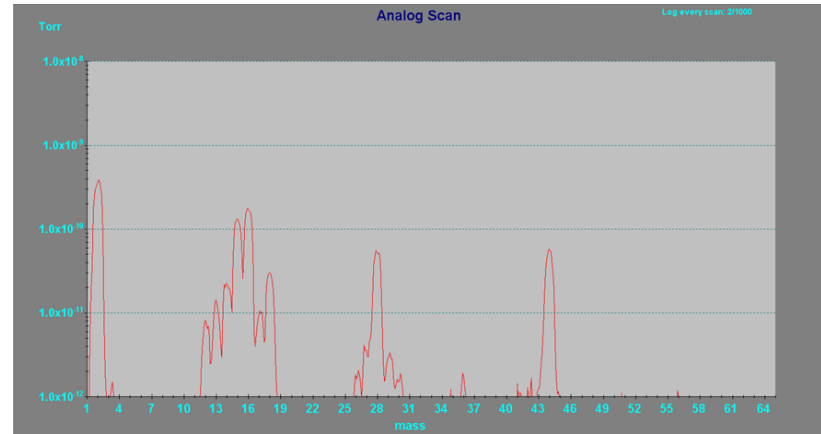
Sliding PEEK bearing arrangement



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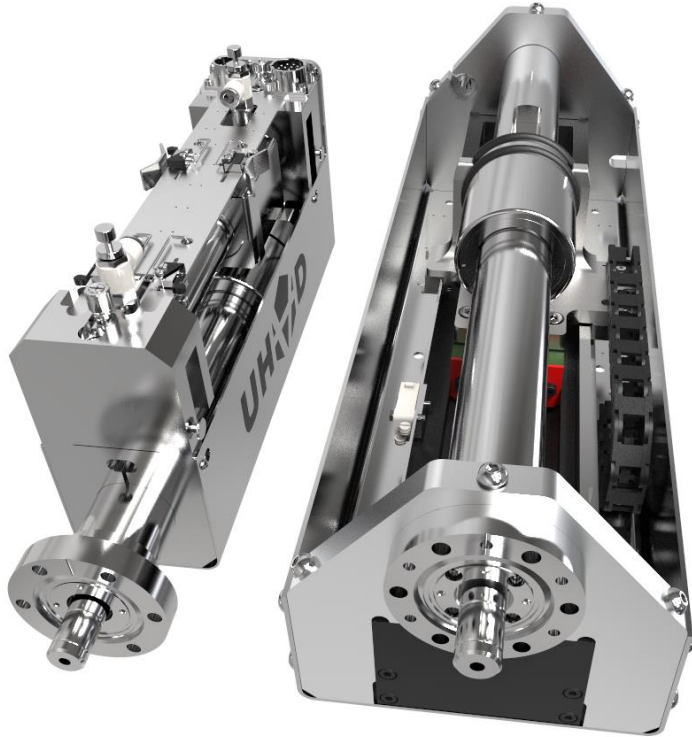
XPowerProbe

Metal rolling bearing arrangement



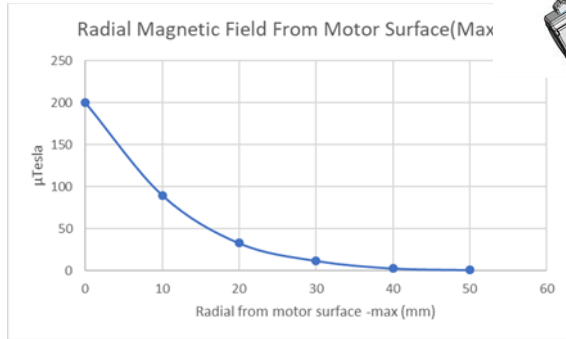
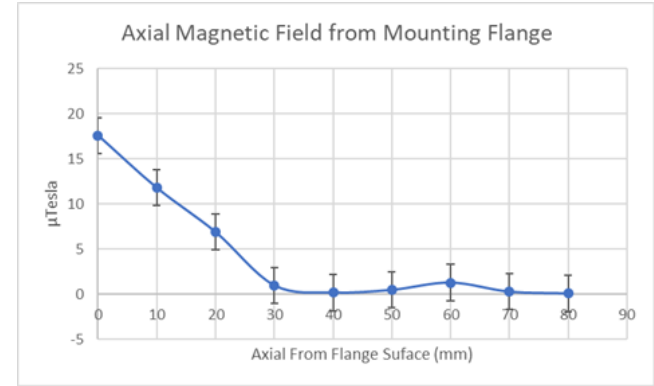
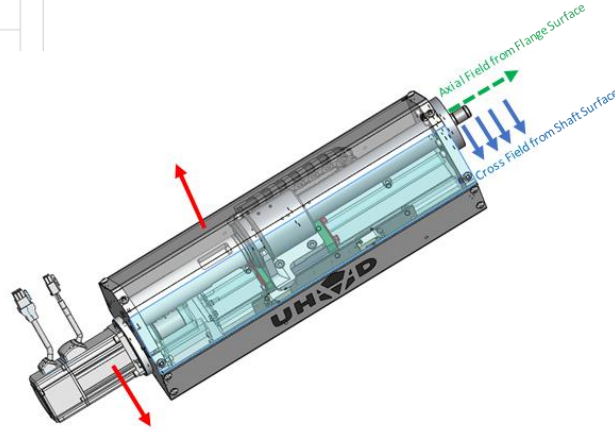
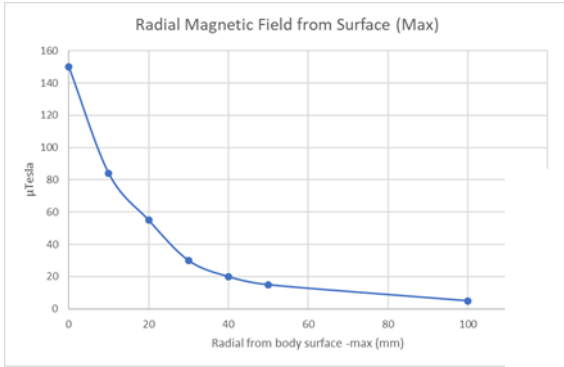
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Fast Magnetically coupled linear actuators

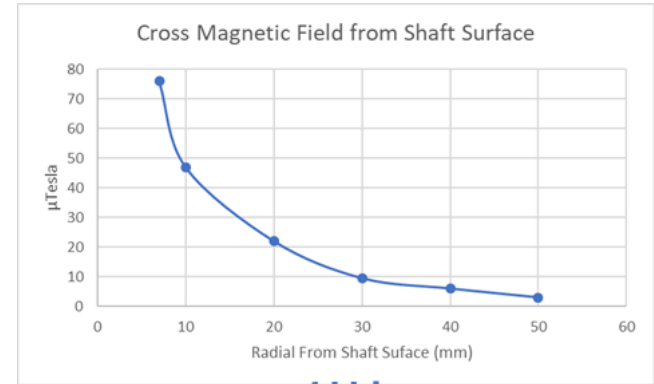


Pneumatic and ballscrew driven actuators for beamline diagnostic applications.

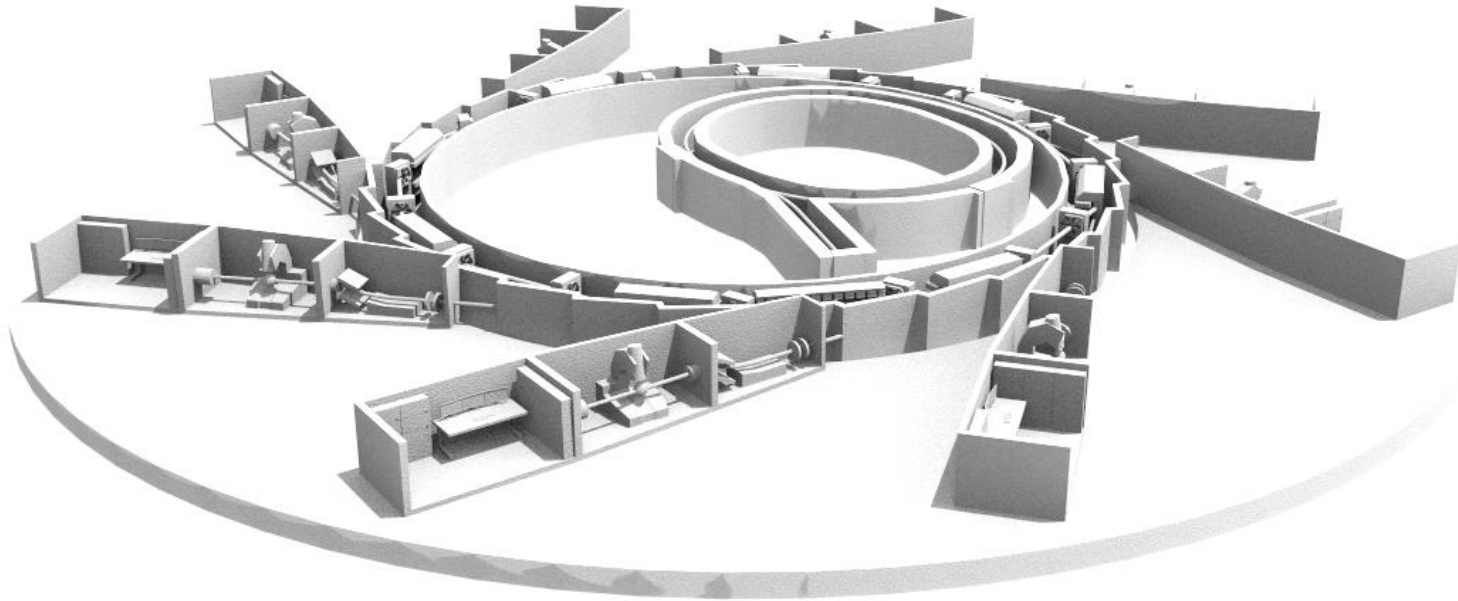
Fast Magnetically coupled linear actuators

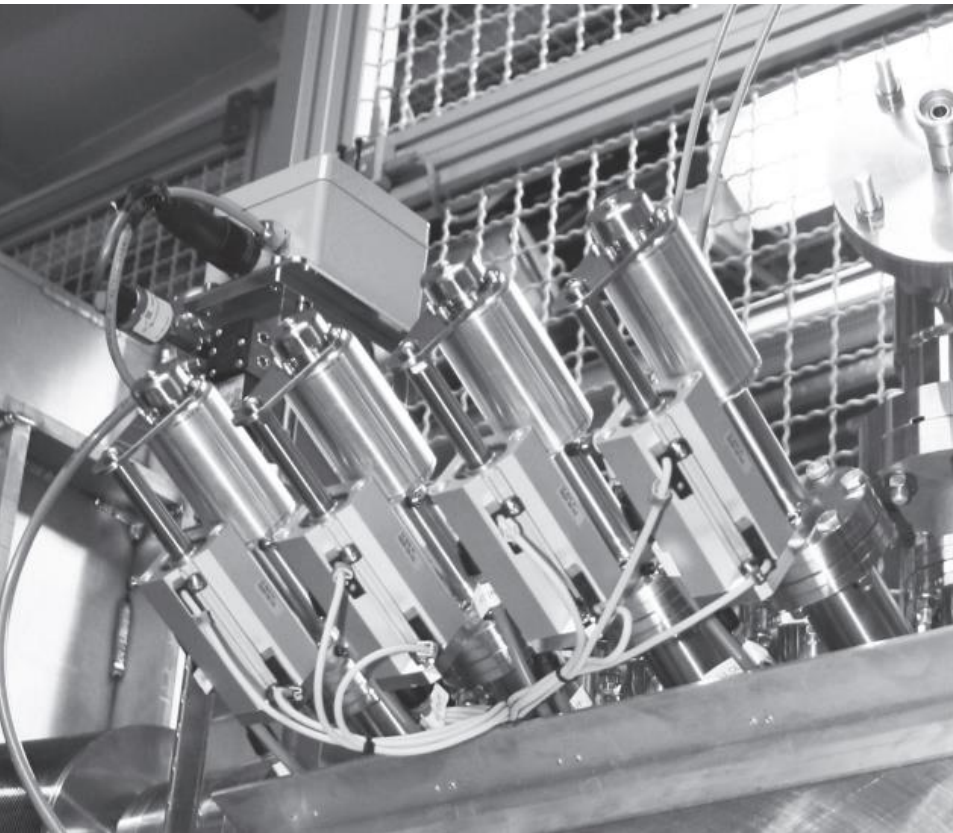


The magnetic field from the BAT drive reduces below the Earth's magnetic field by 30mm or less from any surface



Magnetically coupled push-pulls for UHV Accelerator Application Case Studies

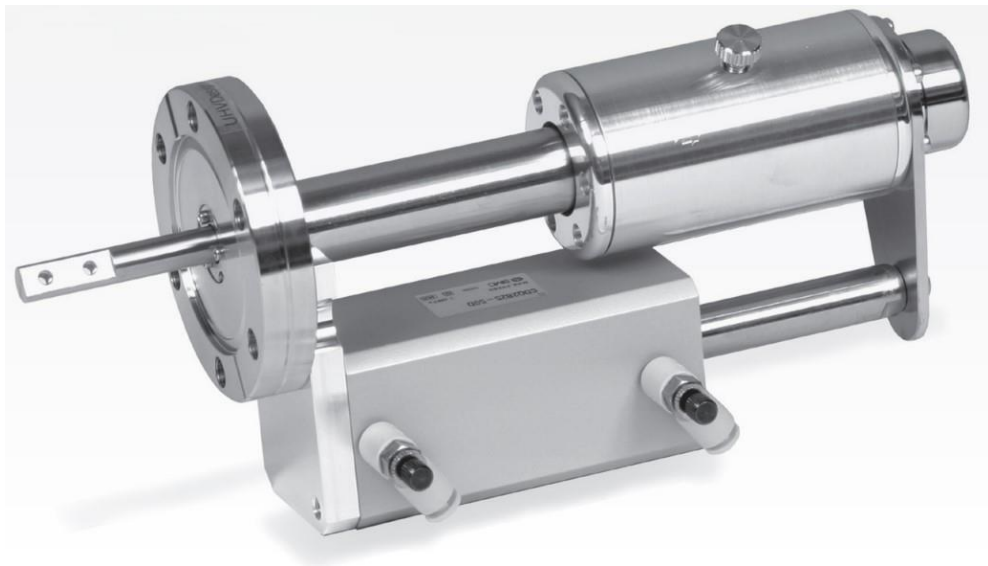




CASE STUDY

Magnetic Push-Pull for X-Ray Beam
Line dynamic beam intensity control
Diamond Light I07

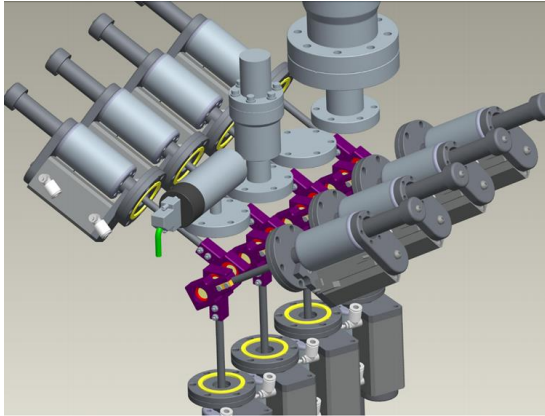
Magnetic Push-Pull for Beam Attenuation



APPLICATION

- Diamond Hard (undulator) X-Ray line I07. (Ambient and UHV Diffraction).
- Requirement to insert foil-filters of different thickness into the beam
- Dynamic beam intensity regulation via down beam sensor

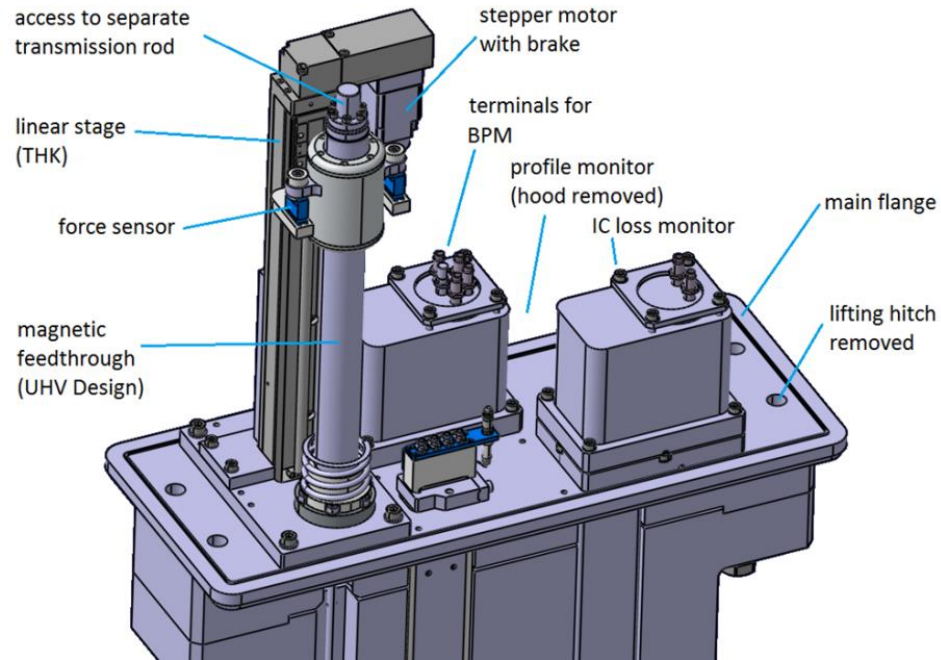
Magnetic Push-Pull for Beam Attenuation



Key Design Features

- Ultra-clean design
- Pneumatic Operation
- Outstanding reliability
- Anti-rotation control



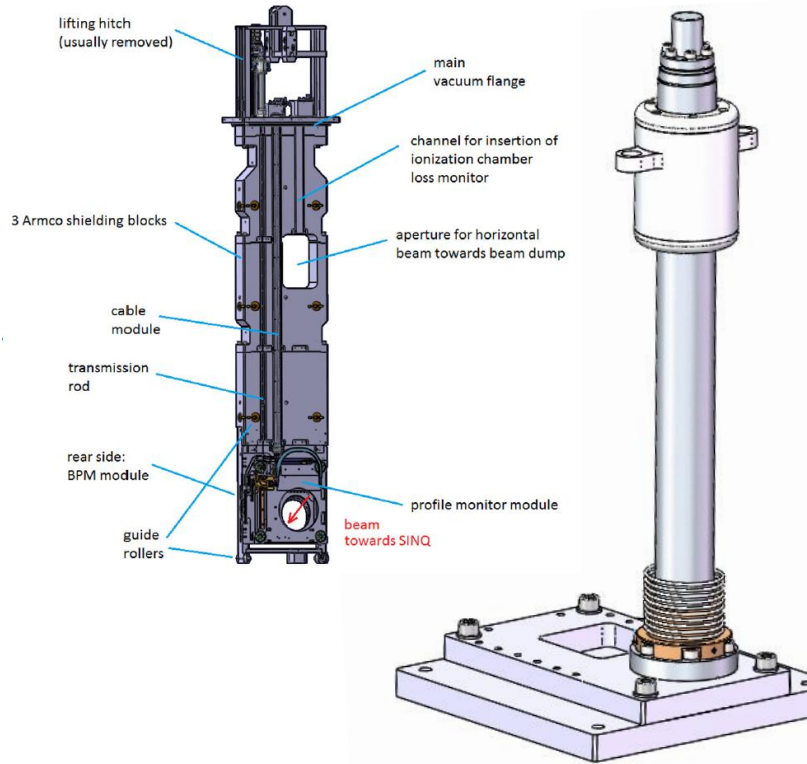


CASE STUDY

Profile Monitor High Intensity Proton Accelerator (HIPA)
Paul Scherrer Institute

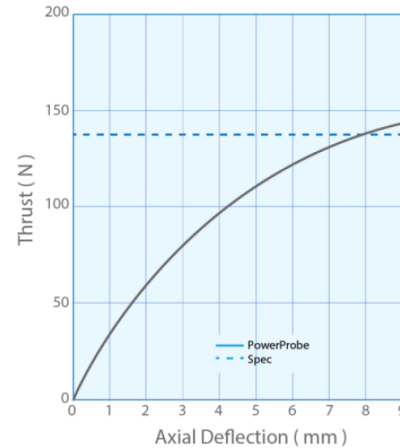
R Doelling "Progress of profile measurement refurbishment activities at HIPA" IBIC 2020

Profile Monitor Push Pull



Key Design Features

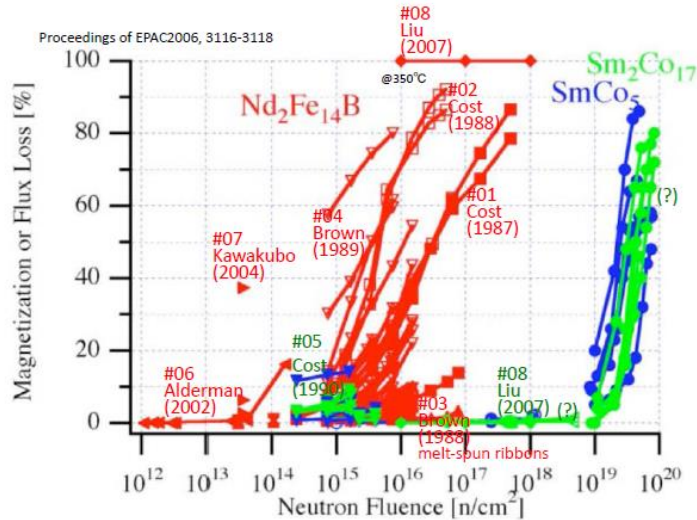
- NdFeB “Neo” magnets
- Customer integrated fail safe features



Standard breakaway = 140N

Revised design + “Neo” = 350N +

Profile Monitor Push Pull



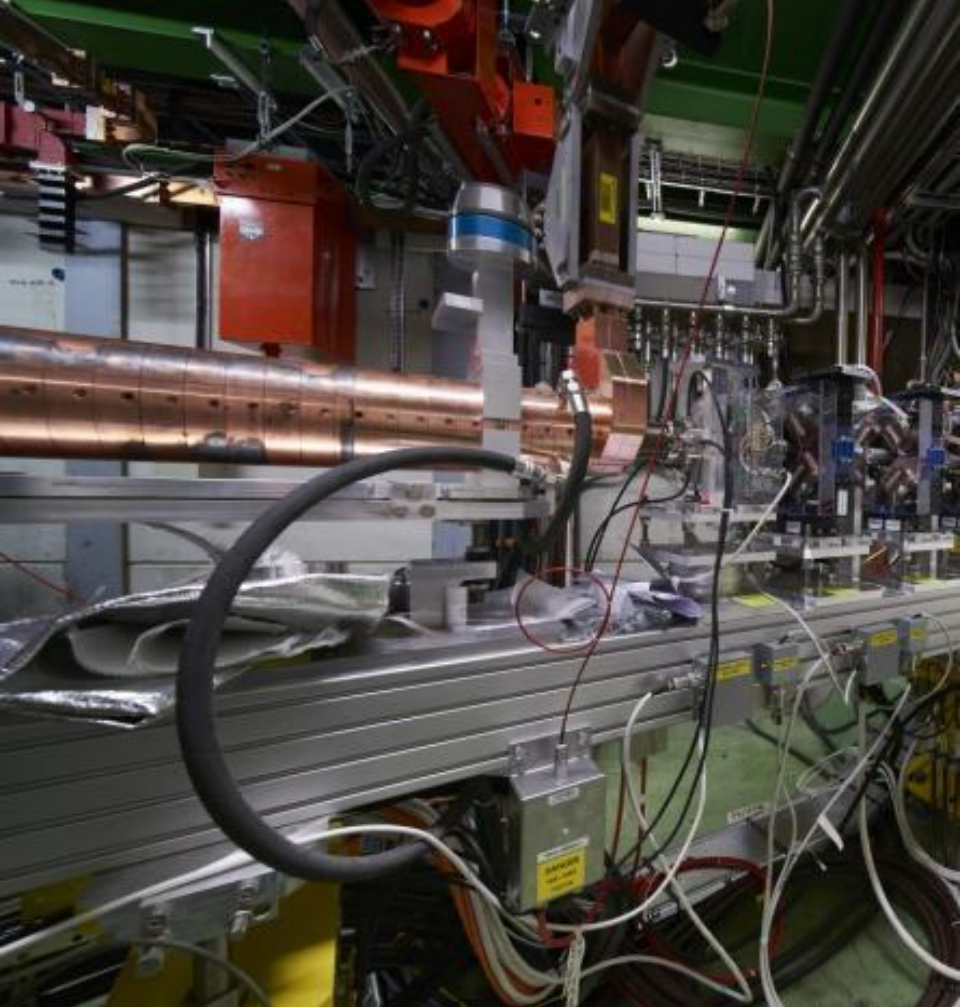
Why “Neos” ?

Practical evidence that Neutron activation is much lower for Neos than SmCo.

**RADIATION DAMAGE TO PERMANENT MAGNET MATERIALS:
A SURVEY OF EXPERIMENTAL RESULTS**

Ben Shepherd
ASTeC, STFC Daresbury Laboratory, Warrington, UK



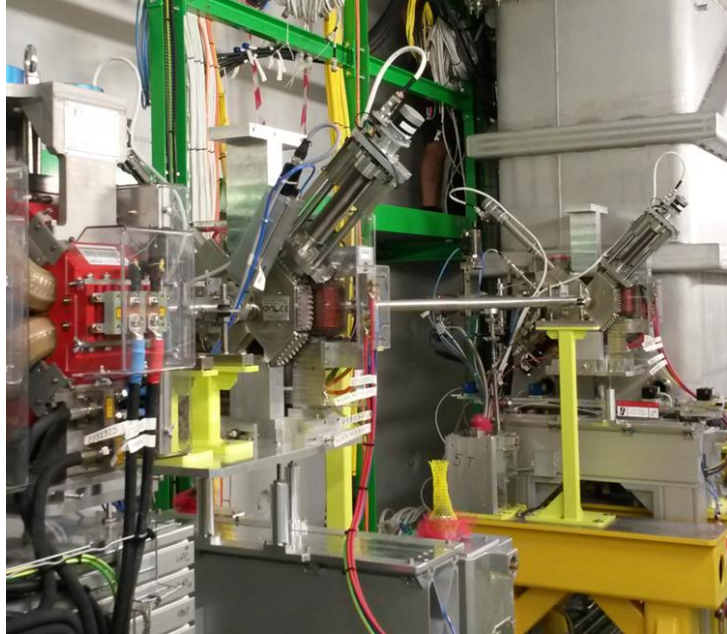


CASE STUDY

Bellows-free Linear Drive for critical
beamline applications

CERN

Bellows-free Drive for Beam Profile Application



Application

- CERN - beam profile diagnostic.
- Insertable screen
- Replace existing bellows design

Bellows-free Drive for Beamline Applications

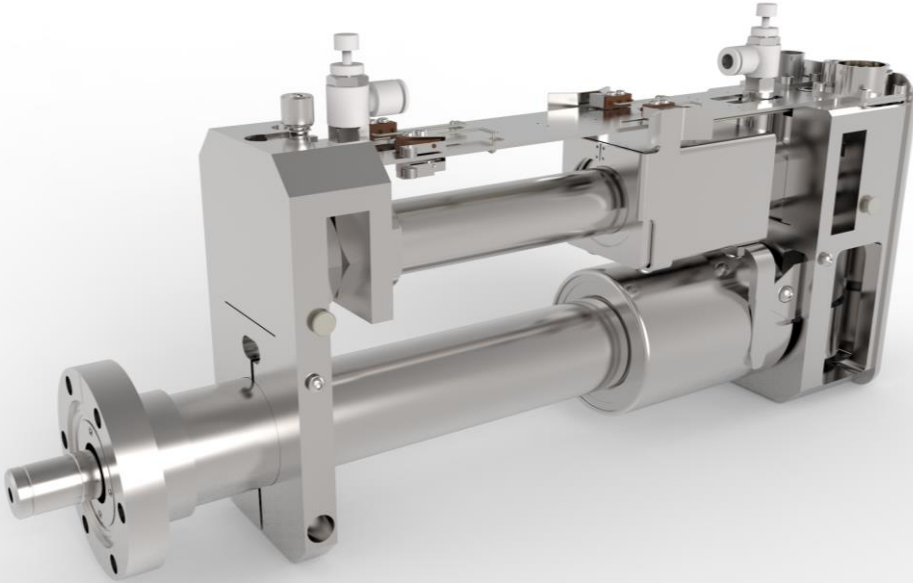


Prototype Assembly - CERN

Design

- Ultra-clean design
- Fail-safe operation
- Outstanding reliability
- Bellows-free

Bellows-free Drive for Beamline Applications



- All metal in vacuum
- Silicon Nitride Rolling bearings
- Extensive testing
- Cartridge based system for easy maintenance

New Developments – Ballscrew Actuated Translator - BAT



Key FEATURES

- 90N axial coupling
- 100mm linear stroke
- Speed up to 1m/s
- Acceleration up to 20m/s^2
- Repeatability ???



BAT drive on test RnD Lab UHV Design

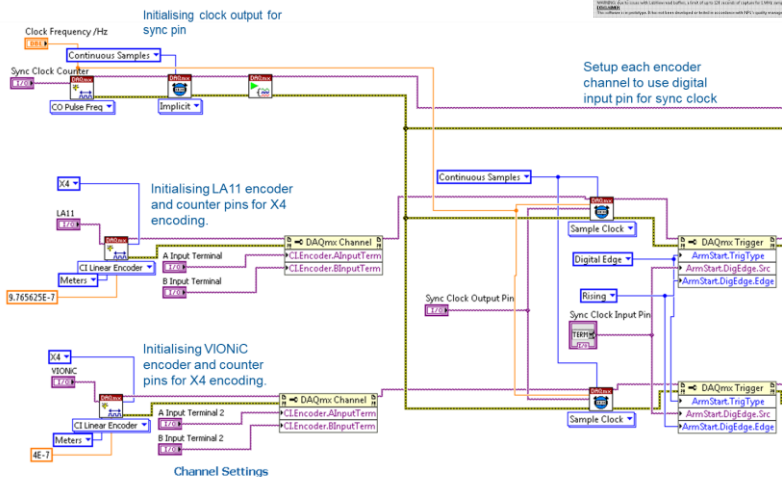
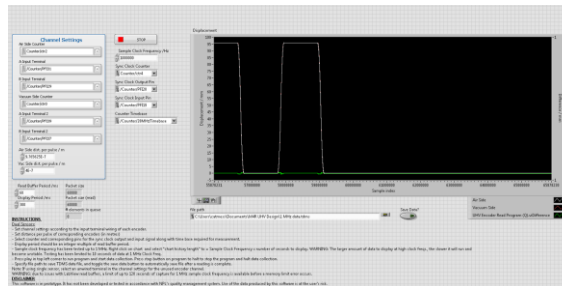
Vionic(Renishaw)

- Max Speed: 12 m/s at 0.5 μm
- Max Speed for 0.1 μm resolution: 3.24 m/s
- Acceleration: 500 m/s^2
- Minimum digital clock required to read at 0.1 μm resolution at 1 m/s speed: 20 MHz

High speed data system

- National Instruments PCI 6602 counter card to count encoder pulses
- SCB-68 breakout box
- 15 pin D-SUB screw terminal connections and back shells:

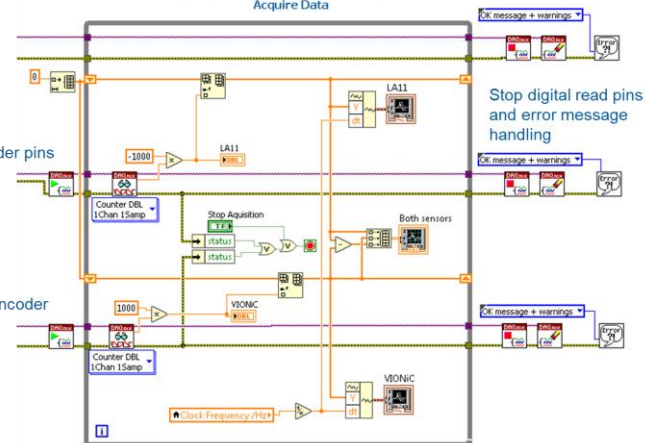
Software Overview - LABVIEW



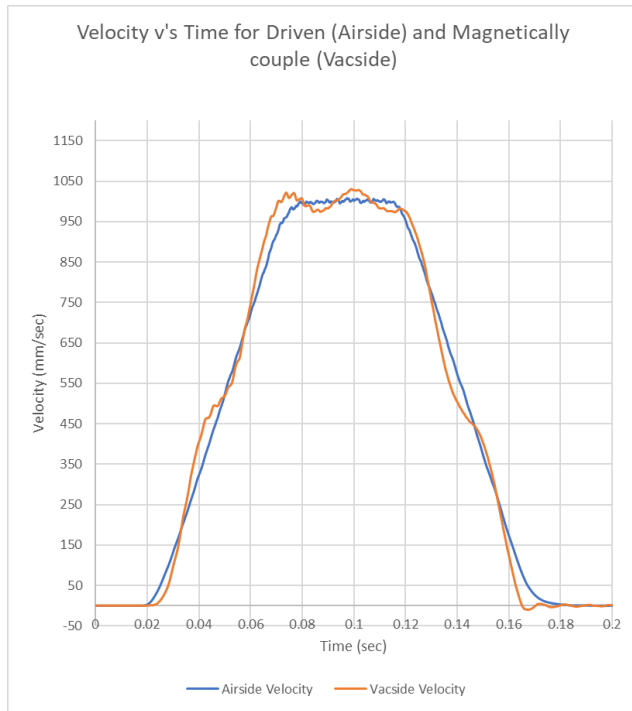
While loop: reads each encoder and converts data to mm and displays as a number and graph
Acquire Data

Start LA11 encoder pins

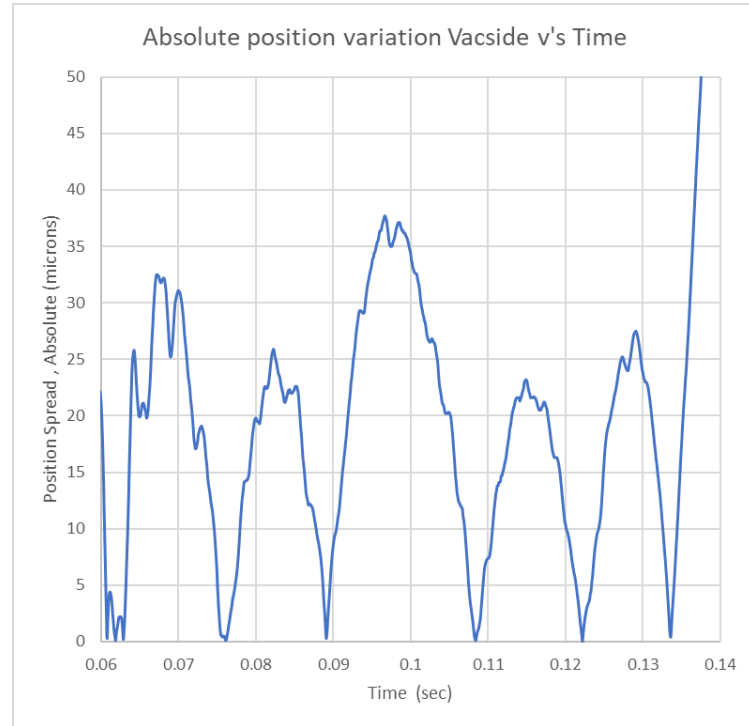
Start VIONIC encoder pins



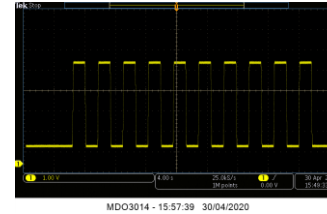
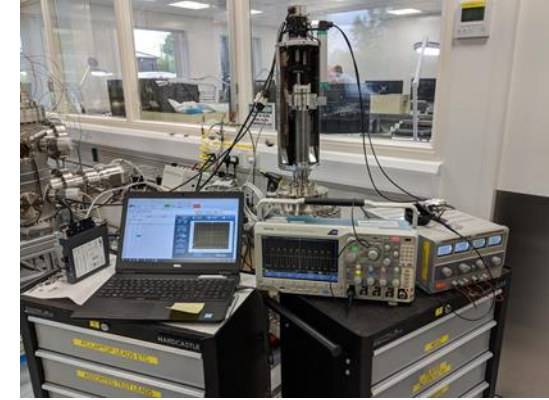
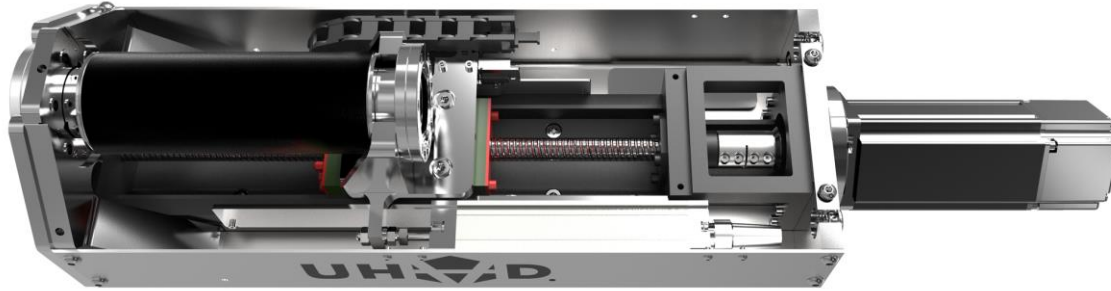
BAT Drive - Performance



Velocity v's time Airside and Vacsider (from encoder readings) single cycle



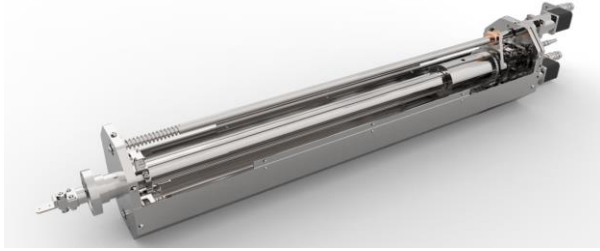
Absolute positional variation over 5 cycles during ~1m/sec phase



1. 0 – 25mm: 0 – 1m/s acceleration
2. 25 – 75mm: 1m/s constant speed
3. 75 – 100mm: deceleration to full stop

Tektronix MDO 3014, 100MHz-2.5G/s sample rate, digital storage oscilloscope
Gefran LT-M-0130-S Linear Transducer 130mm stroke 60 V
MASTECH DC PSU HY3003D-2 DC, 2 x30V
Applied Motion SC2B3-Q-AE servo driver

Magnetic Push Pull Devices - Overview



Transfer Devices – Power Probes -PP

- 1 to 3 Axis
- Motorisation
- Deep UHV low out gas versions



Push Pulls – MPP(RL)

- Rotary and Linear
- Guided and unguided

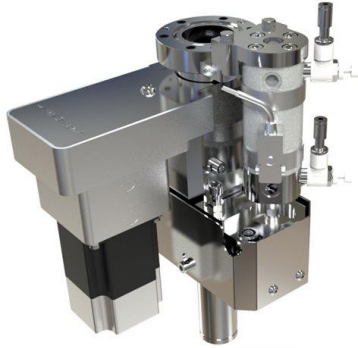


Fast Magnetically coupled linear actuators

Primarily for Beam Diagnostics

- Pneumatic, fail safe
- Servo-Ball screw, high speed
- All metal (vacuum side)

Magnetic Push Pull Devices - Overview



Combined linear and rotate– Magilift

- Up to 60rpm
- Up to 25mm linear
- 140N Linear
- 9Nm Torque



Magnetically coupled,

- Linear up to 350mm travel
- Tilt +/- 22°
- Secondary “trigger” motion
- All metal/ceramic deep UHV version

- Extensive facilities and design resources
- A comprehensive range of magnetic push pulls
- Able to work with customers on bespoke applications
- Advancing our products and technologies

Acknowledgements

Thanks to

Ben Shepard, STFC-Daresbury UK
Dr Martin Burt, Diamond Light UK
Dr Rudolf Doelling, PSI Switzerland
James Shepard, NPL UK
Dr Ben Hughes, NPL UK
Toby Miller, LLNL, USA



FOR MORE INFORMATION

www.uhvdesign.com

- | Configure
- | Preview
- | Download

Click here to learn how to use the product configuration tool

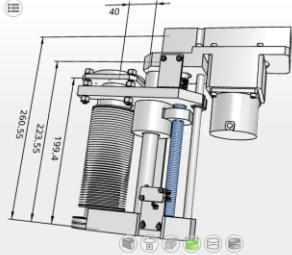
Available products: 1

LSMT38-100-SS-DLA

ORDERING	LSMT38-100-SS-DLA	
Order Number	LSMT38-100-SS-DLA	
SR	LSMT	
Flange size	CF38	
Flange position	0	mm
Q	100	
LB	Digital Scale	
AO	Side-mounted stepper motor	
MO	none	mm
FT		
W	6.3	kg

CFD by email
PDF datasheet
Request for quotation

Preview for LSMT38-100-SS-DLA_01



Contact us ...sales@uhvdesign.com



Thank
You

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Nick Clark
Chief Scientist UHV Design Ltd