

R&D Portfolio -

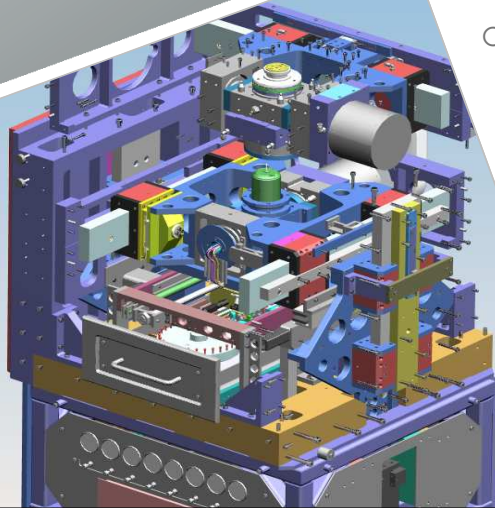
μ Four

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Concept design, development
& realisation of a compact
multi-process diamond
machining system

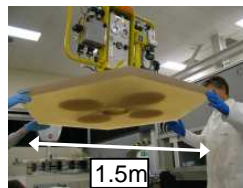
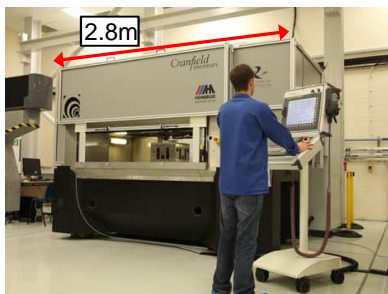
Paul Morantz



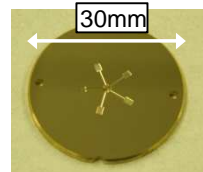
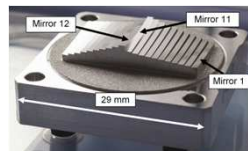
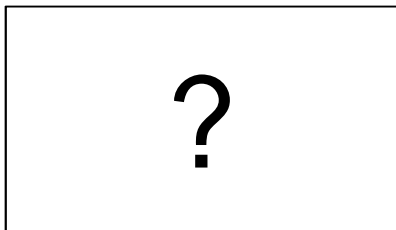
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Machine : component
(size ratio)

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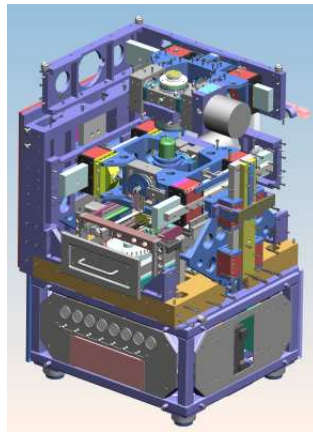
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Machine Development

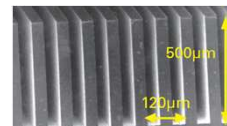
Engaged Suppliers:
3D Evolution
Heidenhain
Renishaw
Contour Fine Tooling
Hexagon Metrology UK
Professional Instruments
MCS motor
Aerotech



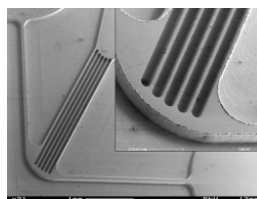
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Design Target

- Markets – mass production in:
 - watch components
 - inkjet printing components
 - IR and integrated optics
 - moulds
 - medical & microfluidic devices
 - optical components

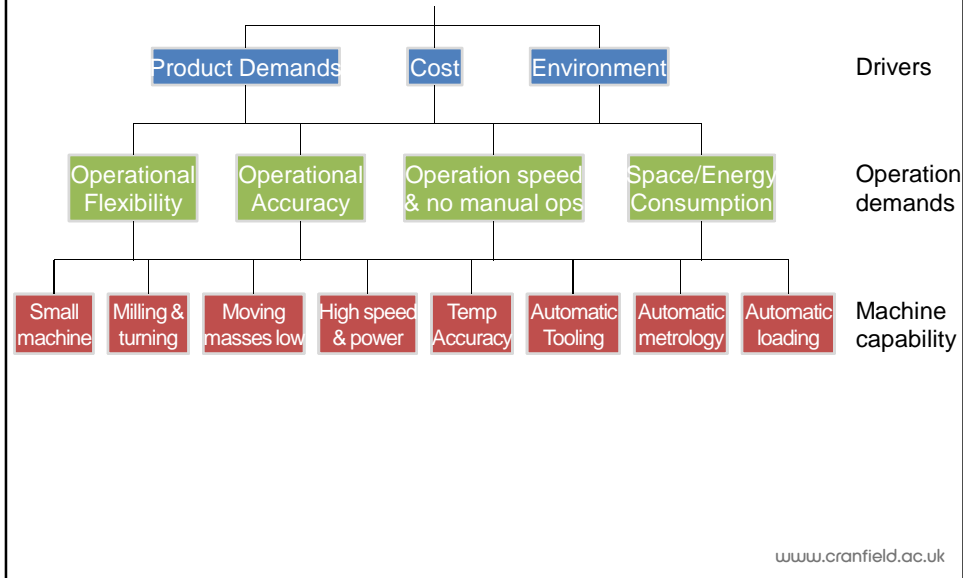


Picture refs: Akribos,
Rochester Precision
Optics, Fanuc, Sarix

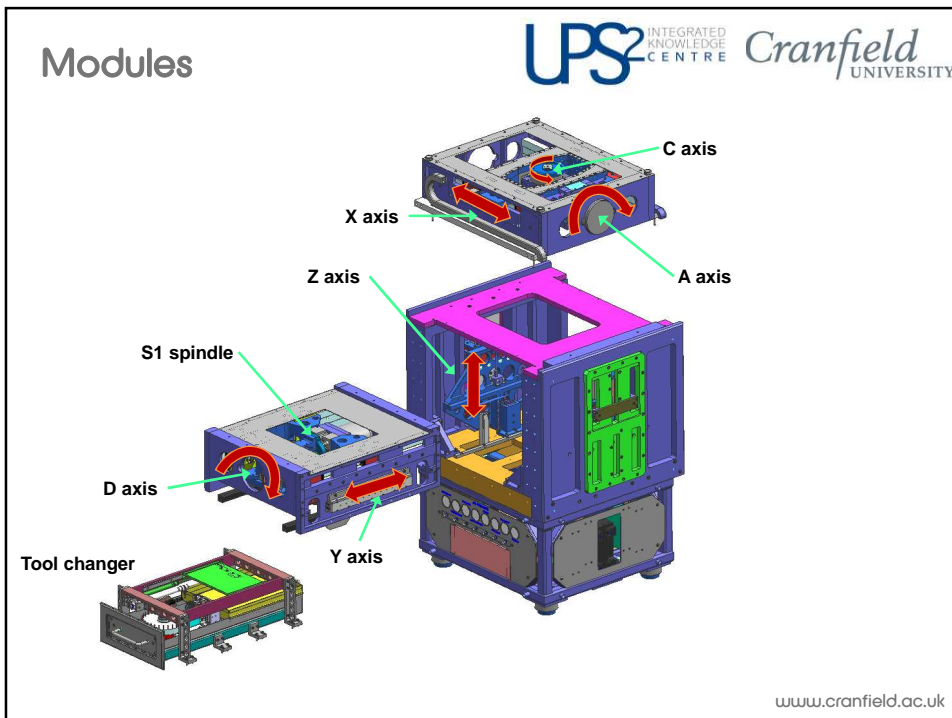


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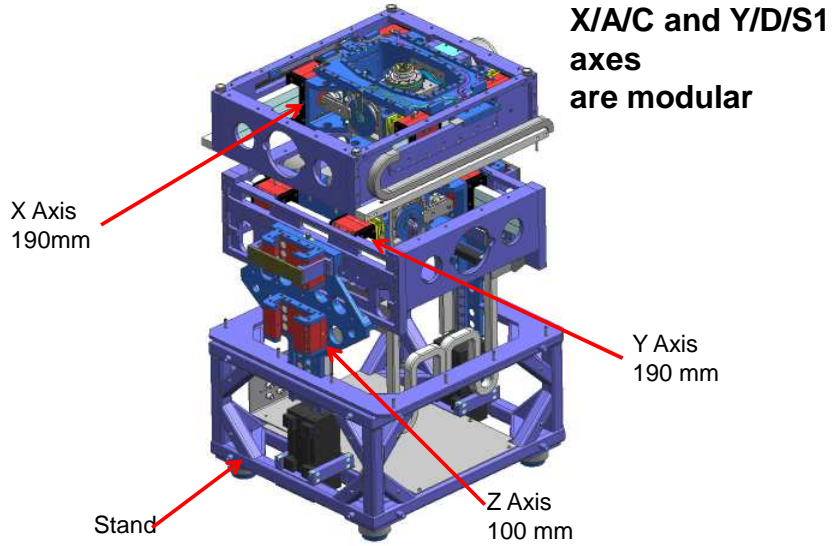
Small component manufacture - simplified requirements



Modules

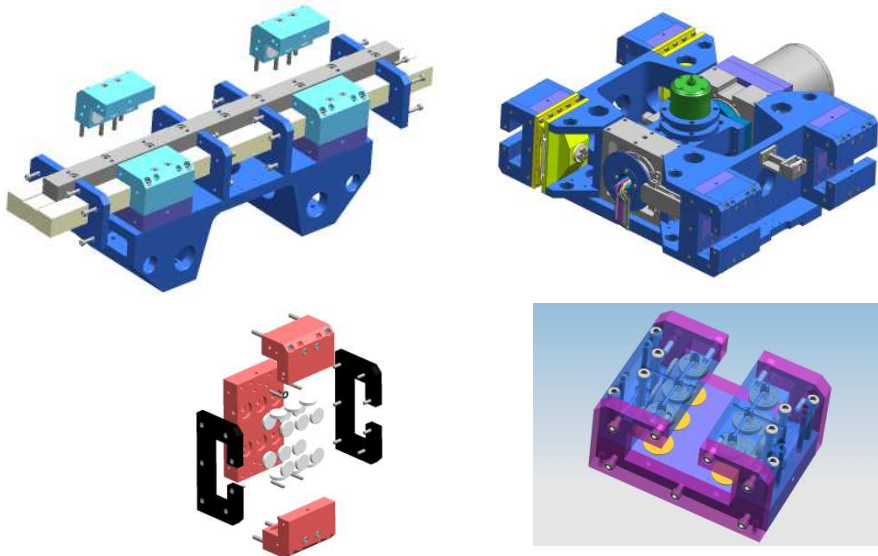


Modules



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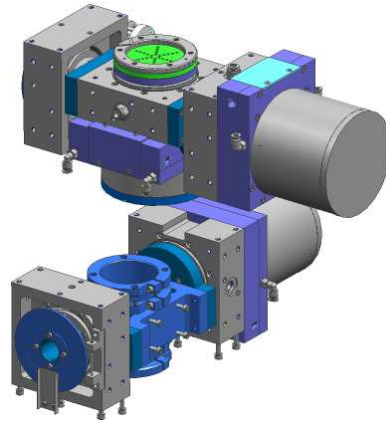
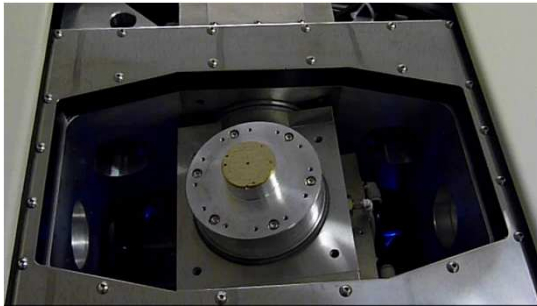
Air bearing linear guides



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Rotary air bearings

150 Hz bandwidth

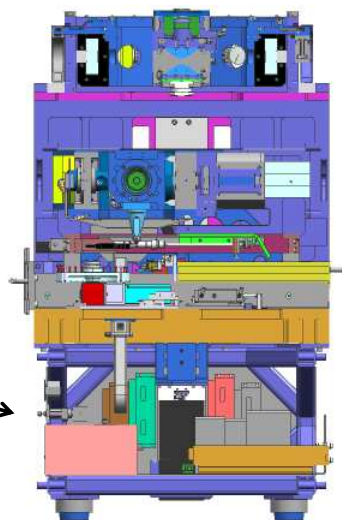


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Control Integration

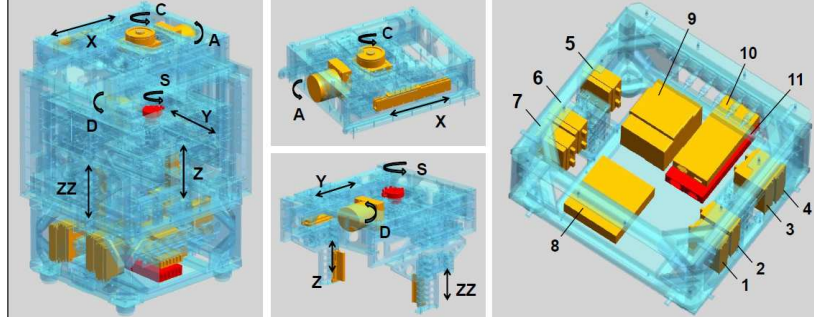
Control system in base stand

6 axes CNC
7 drive amplifiers
+ 1 for tool indexing
PLC
Power supplies
Optical tool setting
Pneumatics
Mass compensators

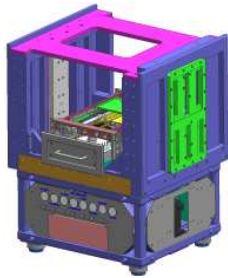


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Athermalisation

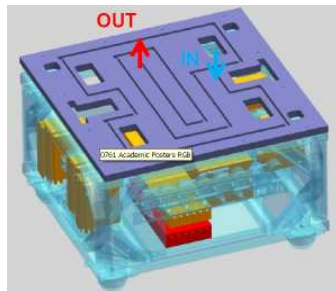


Thermal modeling of all heat sources



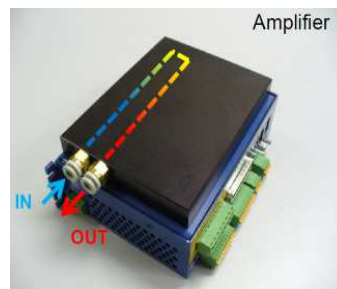
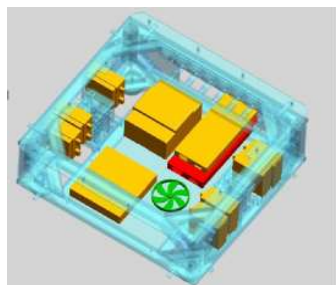
2 plane symmetry of structure and motion system

Athermalisation



Temperature control of the machine

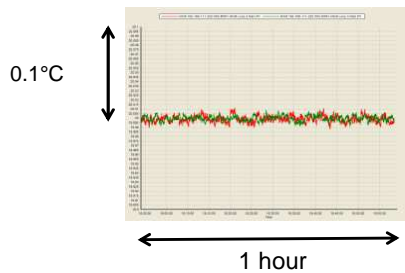
- 1) Water cooled heat shield
- 2) Direct water cooling of amplifiers
- 3) Air purge convection cooling



High performance temperature control

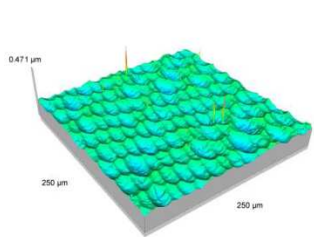
Ultra precision temperature control

- Sub milli-Kelvin resolution control
- Multiple channels
- Matched performance temperature sensors
- High response cooling technology
- Advanced fluid heater technology
- Remote heater and sensor positioning



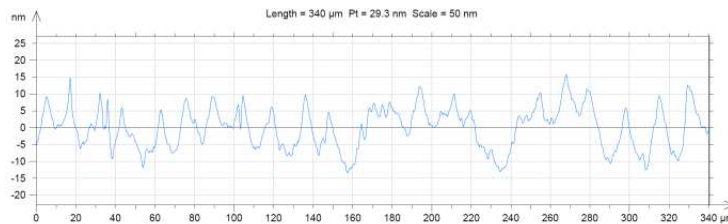
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Initial testing - diamond turning results



Test in brass (orange peel effect).

Roughness:
3nm Ra
(~ 6 nm Sa)



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330,000+ rpm air bearing spindle for micro-machining

Upto 350,000 rpm shaft speed - higher productivity and better surface finish on components (<10 nm)

Lightweight ceramic shaft - allows faster movement of machine tool axes for higher productivity, and fixed axial tool position due to minimal shaft thermal growth

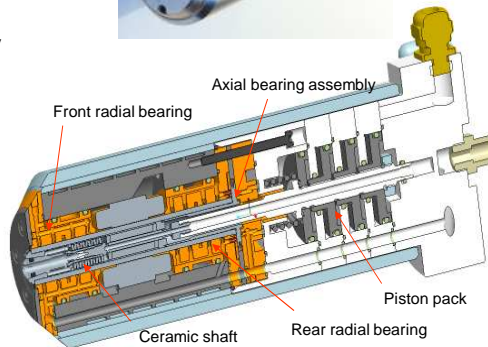


High efficiency permanent magnet DC motor - faster acceleration for improved productivity and reduced thermal impact on machine tool accuracy

New low voltage motor - valuable reduction in amplifier size and dissipation for inclusion in base



WESTWIND[®]



Initial testing - diamond milling results

Parameters calculated on the profile SWATCH MILLED STAR -00002
Extracted profile

* Parameters calculated on the full length of the profile.
* A microroughness filtering is used, with a ratio of 1:0.5 μm .

Roughness Parameters, Gaussian filter, 80 μm

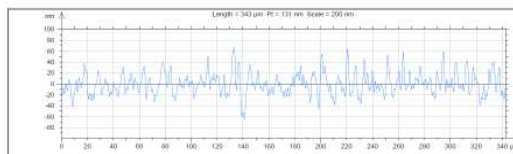
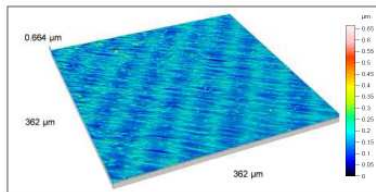
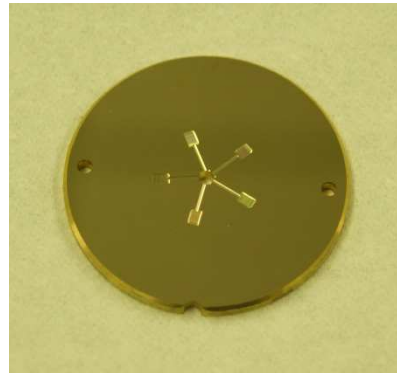
Rms: - 19.3 nm
Rms: Root-Mean-Square (RMS) Deviation of the roughness profile.
Rt: - 129 nm
Rt: Total Height of roughness profile.

Roughness Parameters, Gaussian filter, 25 μm

Ra: - 13.7 nm
Ra: Arithmetic Mean Deviation of the roughness profile.

Roughness Parameters, Gaussian filter, 102 μm

Rz: - 130 nm
Rz: Maximum Height of roughness profile.

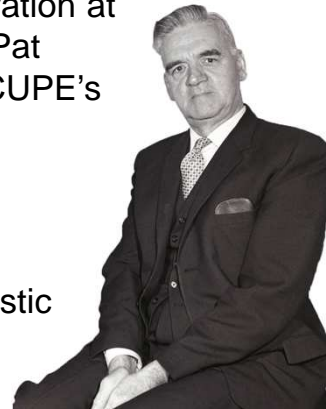


Introducing

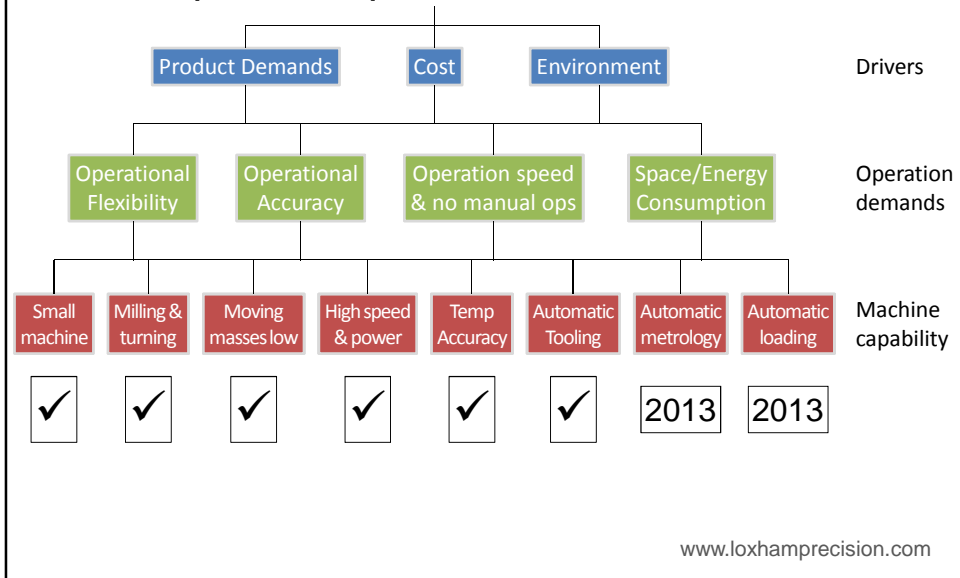
LOXHÅM
PRECISION

Loxham Heritage

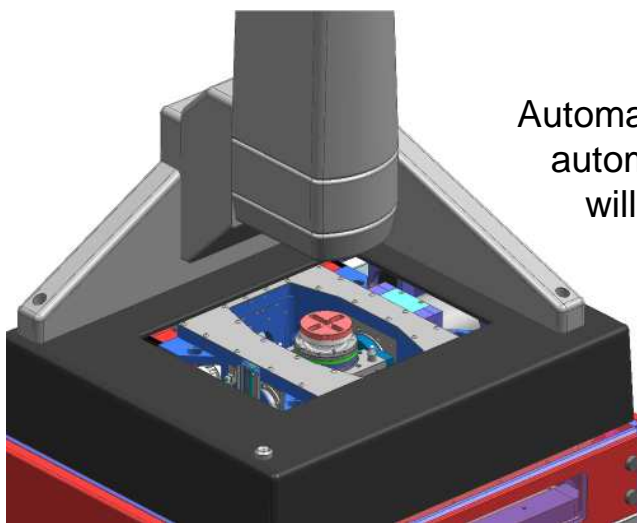
- A new spin-out from precision engineering at Cranfield, initially building from a UPS² IKC activity
- Building on half a century's innovation at Cranfield, inspired by Professor Pat McKeown, dating back through CUPE's formation in 1968
- Named for CUPE's founder Professor John Loxham, international pioneer of deterministic engineering



Small component manufacture - simplified requirements



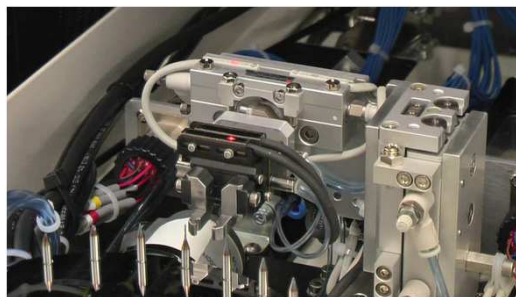
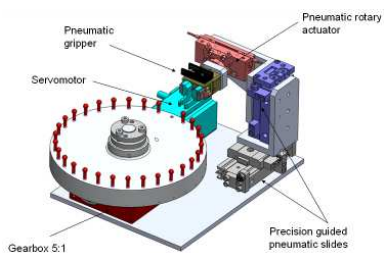
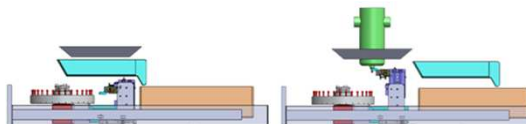
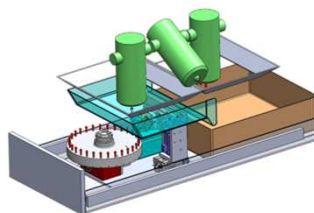
In-situ Metrology system



Automatic loading and automatic metrology will be progressed through 2013

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Automation



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μ 4 at euspen's 12th International Conference in Stockholm



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