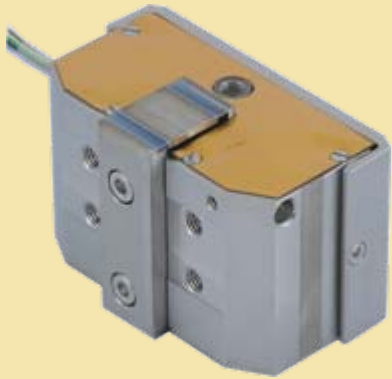


NEXLINE®

Linear Piezo Motor Actuator Combining
Long Travel, Picometer Resolution and
High Forces



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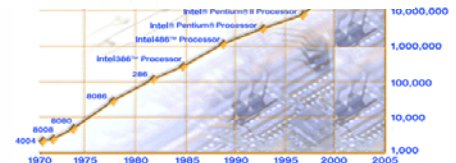
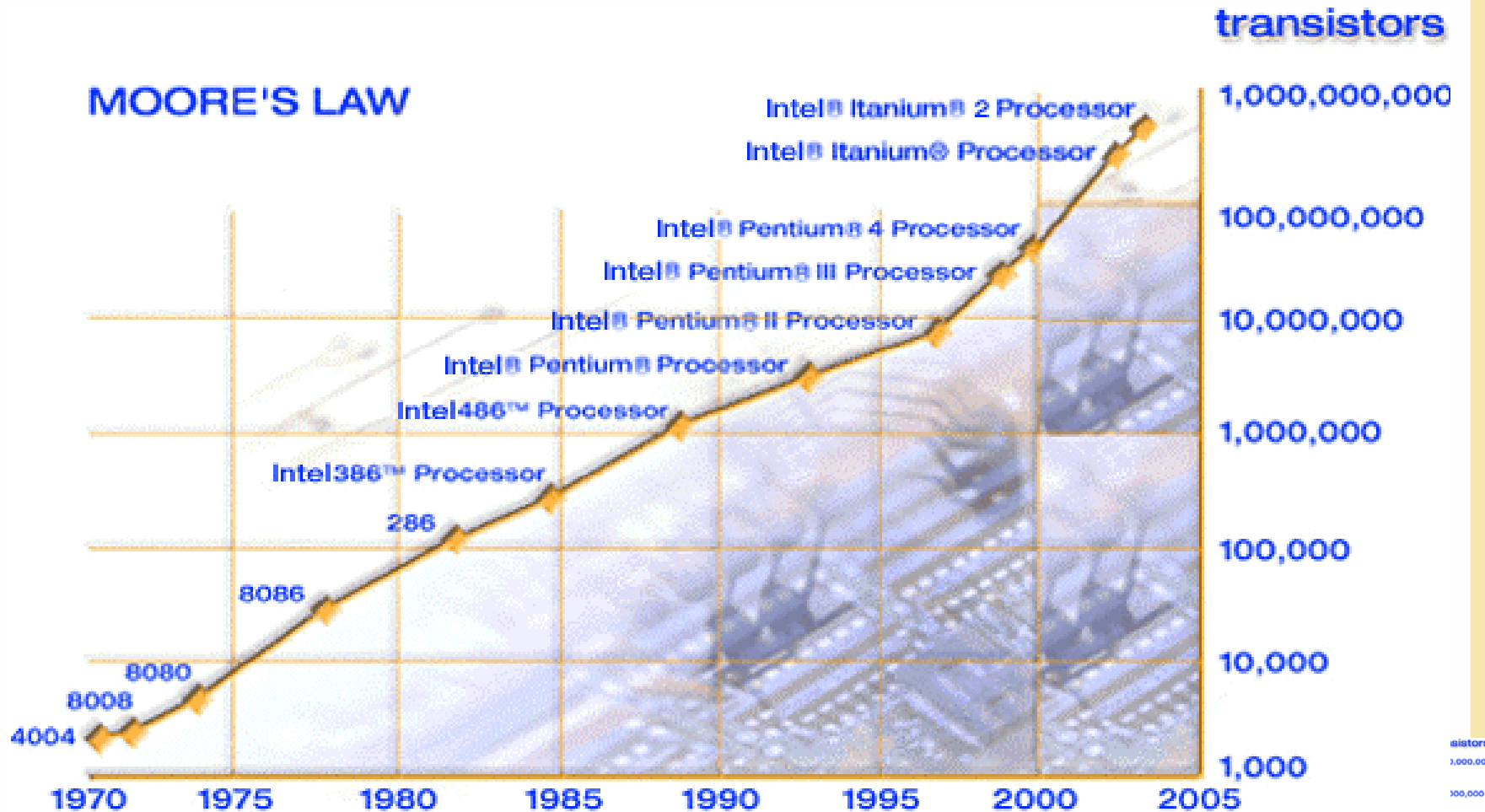
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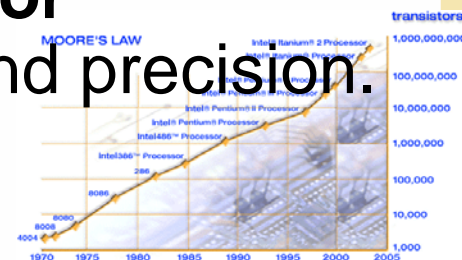
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The Problem: Moore's Law



The Problem: Moore's Law

- Moore's Law compresses IC linewidths and feature-sizes.
- Nanopositioning mechanisms embedded in front-end production and metrology tools have difficulties keeping up; they must provide **10 to 1000x higher precision than feature size.**
- Vibrations, position errors, drift need to be controlled to <0.1 nm (~atom diameter).
- Conventional nanopositioning systems have **either** high accuracy and short travel **or** do not provide the required stability and precision.



Requirements from Semiconductor Industry for Next Generation Actuators

- Resolution <0.1 nm + travel of several mm
- Keep position stable to nanometer level for a long time
- Lifetime several years minimum
- Stiff with high resonant frequency for fast response and low vibrations
- Must work in Vacuum, Helium, Magnetic Fields

Requirements can only be met with solid state piezoceramic actuators!

But How?

Piezo Technology Before NEXLINE®:

Piezo = Mission-critical Technology

Deployed throughout semiconductor fabrication, packaging & test

- **Actuators**
 - High Force, Speed, Resolution
 - NEW: Ceramic Encapsulation (+Lifetime)
- **Flexure Positioners/Scanners**
 - <1 nm Resolution/Trajectory Accuracy
 - High-Speed Positioning and Scanning
- **Capacitive Position Feedback**
 - Sub-nm Resolution & Stability

Limitations (for some applications):

- Either small travel range
- **OR** low stiffness
- No position hold with power off



State-of-the-art PICMA® piezo actuators feature protective ceramic encapsulation



Low-profile, parallel-kinematics multi-axis nanopositioning stage for nanometrology

NEXLINE®: Solves the Problem

- **NEXLINE® Addresses the Drawbacks of Existing Nanopositioning Systems**
- **Unique Combination**
 - Long Travel (No Basic Limitation)
 - <0.1 Nanometer Resolution
 - High Bandwidth, High Force (to 500 N)
 - Very Compact & Stiff
 - Vacuum, Helium, UV compatible, Wide Temp. Range
 - Non-Magnetic Option (Electron Beam Compatible)
 - Auto Lock: nm-position hold @ 0V operating voltage:
No Leakage Currents => no wear => 10 Year Lifetime

NEXLINE® Innovative Linear Actuators

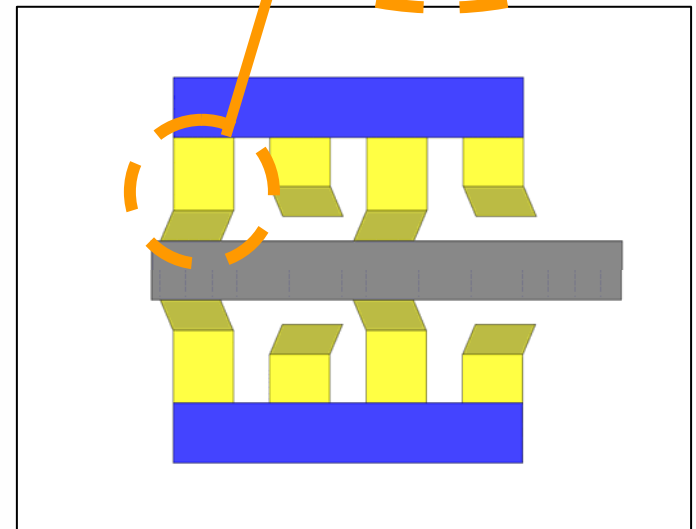
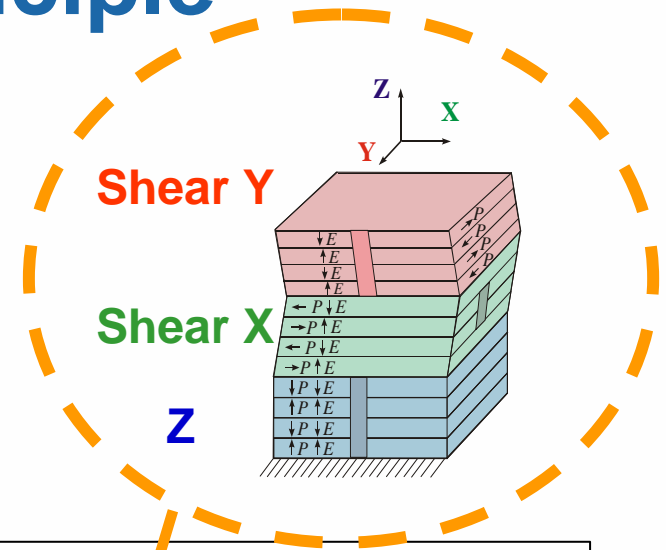
Piezoelectric Hybrid Drive

- **Flexible**
 - Geometry, Size, Force, Travel
- **Three Integration Levels**
 - OEM Motor, Actuator, Multi-Axis Stage
- **Applications:**
 - Nanofabrication
 - Lithography
 - Alignment and Nanopositioning
 - Metrology / Testing
 - Repair Systems



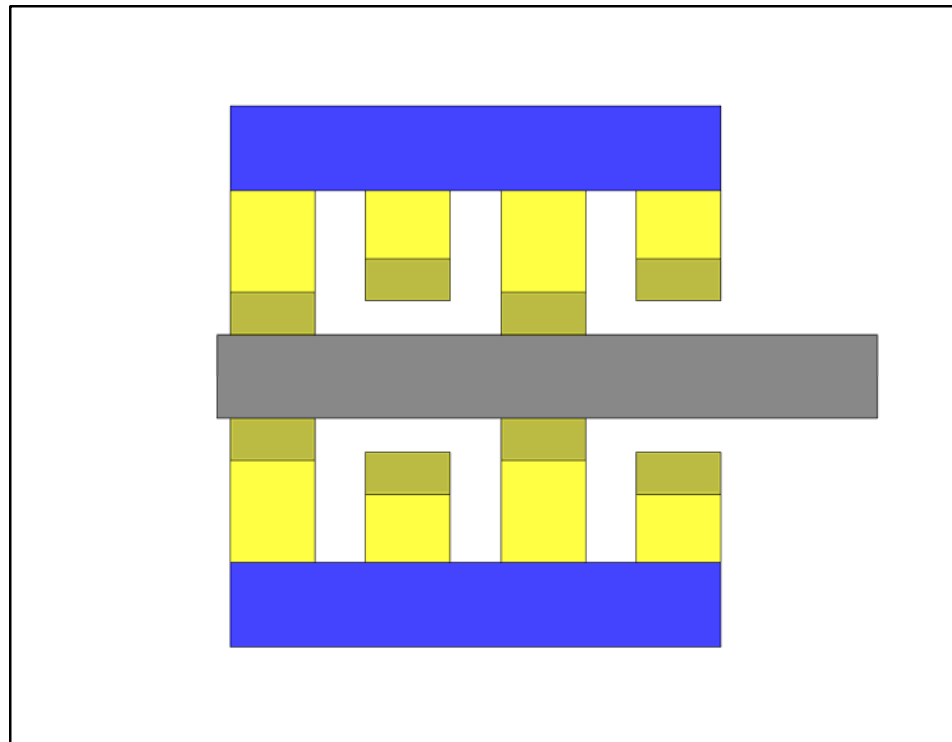
NEXLINE® Working Principle

- Combination of Shear and Linear Piezo Actuators
- Flexures for high guiding precision and zero friction
- **Smart Digital Controller** combines high resolution analog mode and long range step mode
- Compatible with different high resolution sensors



NEXLINE® Working Principle

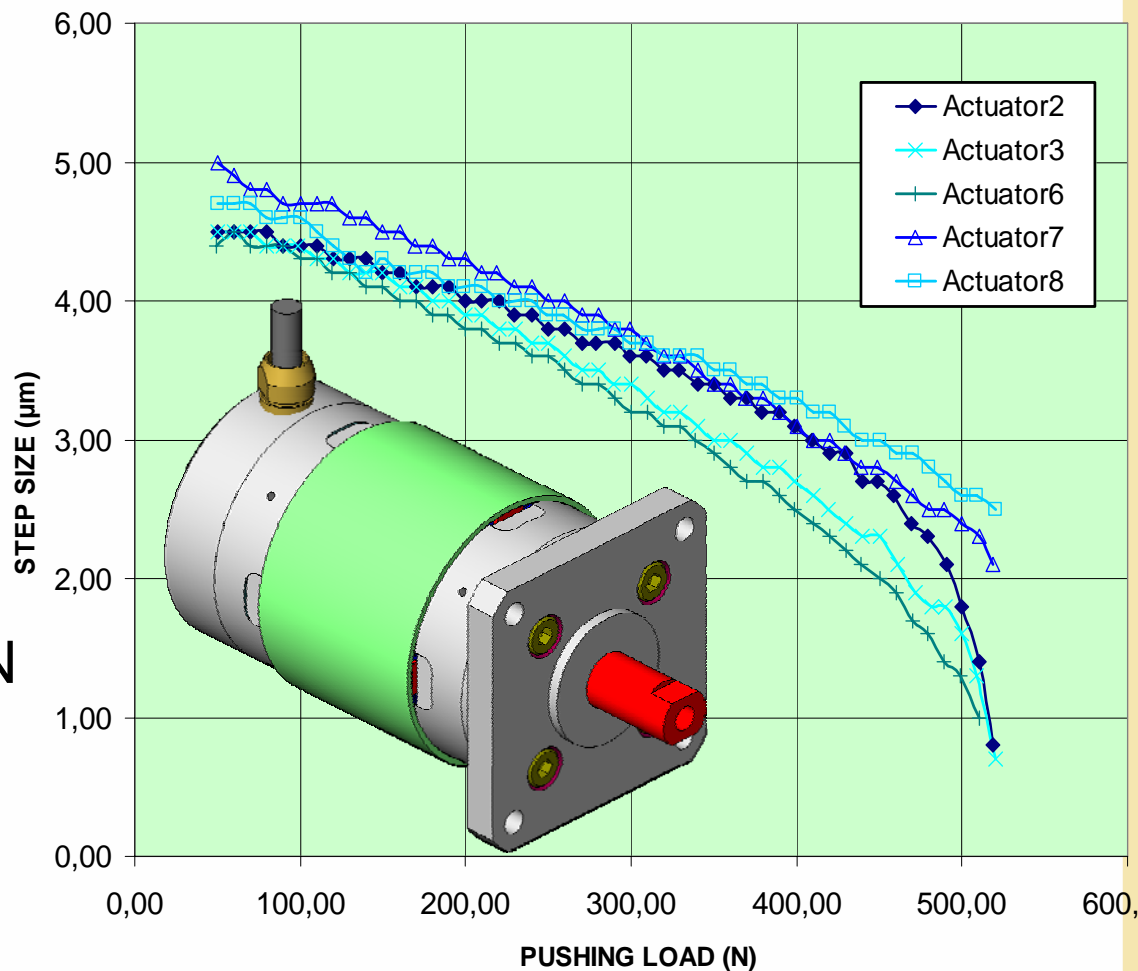
- analog
- step
- mixed
- const. speed



NEXLINE® – Actuator Characteristics

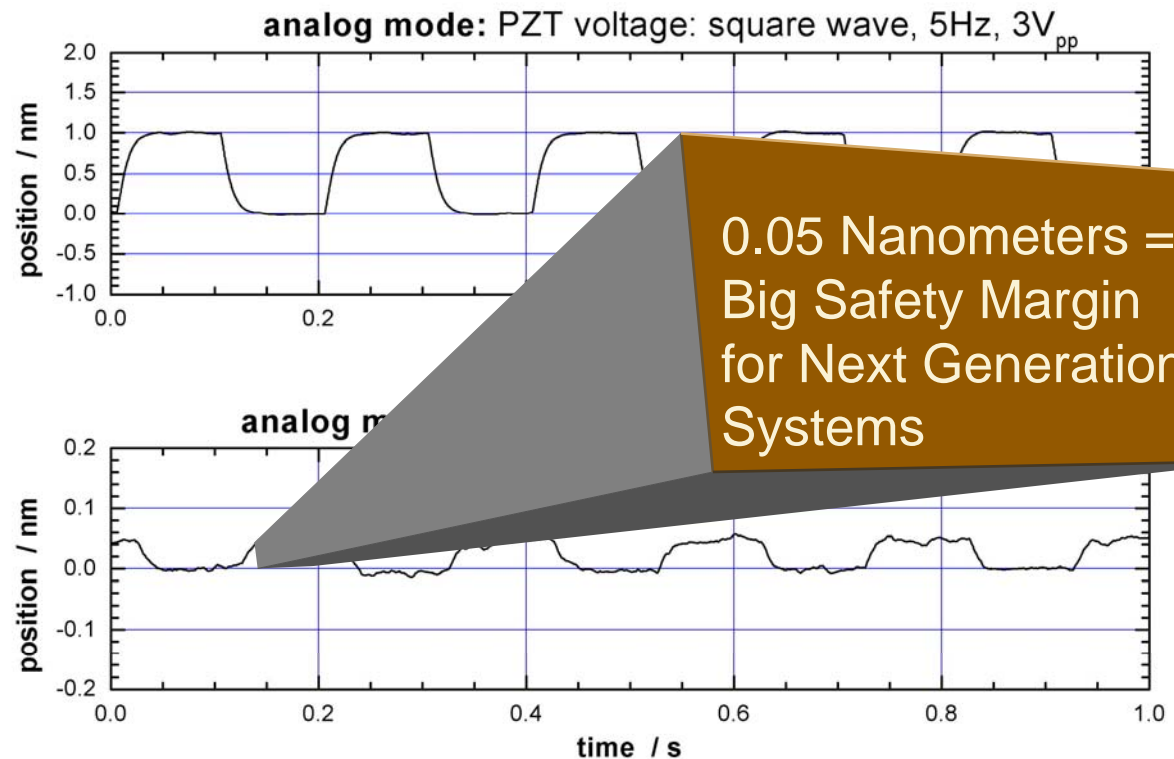
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- **Stroke:** 20 mm
- **Continuous Analog Mode:**
Resolution < 0.05 nm
Range: to 4 μm
- **Step Mode:**
Step size: 5nm - 8μm
- **Blocking force:** >500N
- **Slipping force:** >600N



NEXLINE® – Actuator Characteristics

- A) Long range step mode
- B) **<0.05 nm** steps in analog mode



Value for Semiconductor Industry

- NEXLINE® helps to increase resolution of steppers or scanners
- Improves the precision of projection systems by correcting errors caused by vibrations, mechanical or thermal problems or other deficiencies
- Was specifically developed for the semiconductor industry and combines high resolution, compact design, high force, stiffness and lifetime

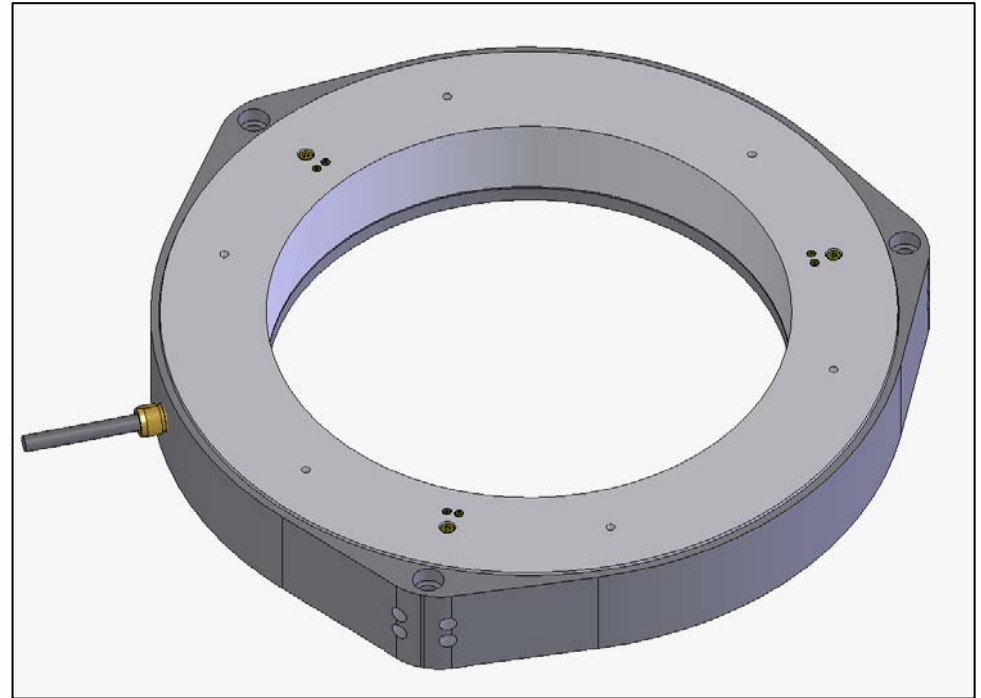


NEXLINE® Systems: What's next?

- NEXLINE® can be Integrated in Complex Multi-axis Positioning Systems
- Applications:
 - Wafer Chuck: Z/Tip/Tilt Stages
 - Positioning systems for nanoimprint lithography
 - Nanometrology systems

High Load Z-Tip/Tilt Wafer Stage

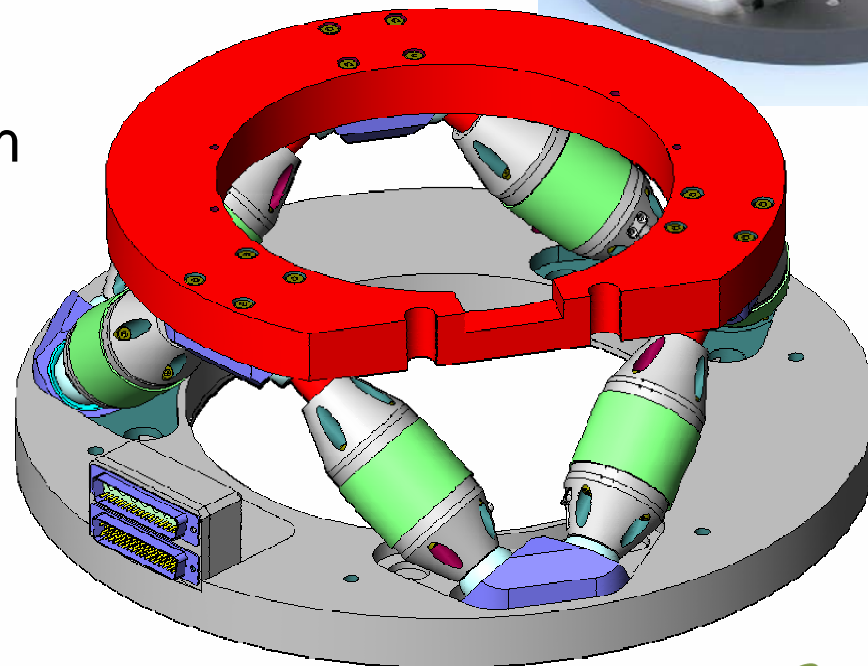
- Z-stroke: 1.3 mm
- Tip/Tilt: +/- 4mrad
- Max. Load >50 kg
- Closed loop with internal incremental sensor



Nonmagnetic 6-DOF Hexapod

Low Profile, Six-Axis Nanopositioning System

- 8" Aperture
- Load 50kg
- Low Profile: 140mm
- Translation XYZ: 10mm
- Rotation all axes: 6 °



NEXLINE® Technology Summary

- Increases performance of production and metrology tools
- Proven, novel technology
- Has been successfully used in semiconductor applications
- Addresses challenges of emerging lithographies (e.g., EUV, immersion, nanoimprint)
- Overcomes limitations of classical nanopositioning systems
- Very flexible: from OEM-actuators to 6 DOF systems

