

# Concept of an in vacuum high resolution Monochromator for IXS experiments.



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At Petra III Beamline P01 a high resolution monochromator for energies down to 2,5 keV will be installed in March 2017.

### Motivation

Due to high absorption of 2.5 keV photons in air (more than 99,9% at 100mm) our high precision goniometers (three independent stages) for the high resolution monochromator will have to be put into high vacuum (1x10<sup>-7</sup>mbar). To our knowledge there is no vacuum compatible high precision goniometer at the market for this range of vacuum and for a load of 6kg.

### Description of the concept

A high interpolating Encoder with 1nm resolution in combination with a long piezo driven rod is chosen to cover an angular range of 40 degrees with a resolution of 10nrad. The maximal load of the high precision spindle ball bearing is 6kg. All components must be compatible with a clean vacuum of 1x10<sup>-7</sup>mbar.

Encoder  
Encoder wheel Ø 200mm 20µm scale  
Piezo driven rod  
Manual brake (for service)  
Counterweight  
Si Crystal

### High Resolution Monochromator

Vacuum Tank: on a separated support  
X-Y-Z-movers  
Bellows  
Granite

Dimensions:  
Height: 1,8m  
Width: 1,2m  
Depth: 1,4m

### High precision spindle ball bearing for 10<sup>-7</sup>mbar

Housing stainless steel Ø38mm Length 120mm  
Ball Cage bronze  
Balls stainless steel Ø3mm  
Shaft stainless steel Ø16mm/24mm  
Axial Bearings stainless steel

Concentric run-out: 5 microns  
Axial run-out: 5 microns  
Load: 6kg max.

Original design by Hans-Bernhard Peters from ZM1-DESY

### Scientific background

The very high resolution is needed to resolve very low energy excitations in materials. For example, phonon (atomic vibrations) energies are usually below 100meV. Also Magnetic excitations (magnons) are in this range of energy. We want to build highly efficient, high-resolution monochromators. This requires very good angular control of the monochromator crystals.

IXS research areas  
geophysics, catalysis, fuel cells, Li-ion batteries, correlated electron systems...

### Estimated costs

One HRM unit: (x-y-z-stages included)	35.000€
Tank+Granite	70.000€
Pumps, Bellows, Valves, Gauges, Feedthroughs	55.000€
Diagnostics (not shown)	10.000
<b>Total</b>	<b>240.000</b>

The Dynamics Beamline P01 is dedicated to Nuclear Resonant and Inelastic X-ray scattering experiments.

EH3 (NRS)  
EH2 (IXS/NRS)  
EH1 (NRS)  
OH2 (IXS)

### Two new 5m long Undulators (36mm period)

1st  
3rd  
5th  
7th  
9th  
11th  
13th  
15th