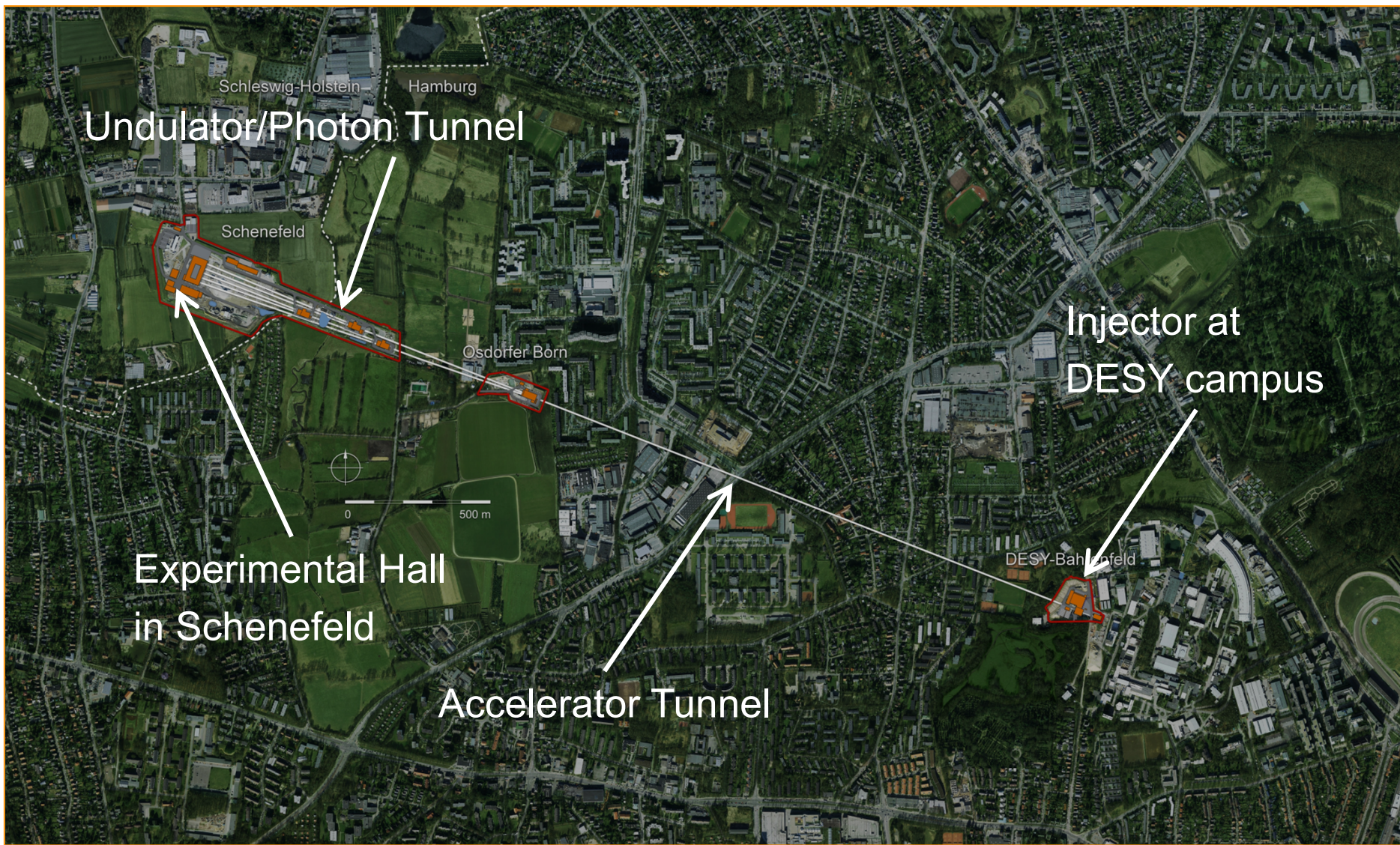
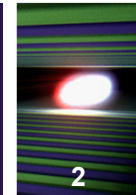


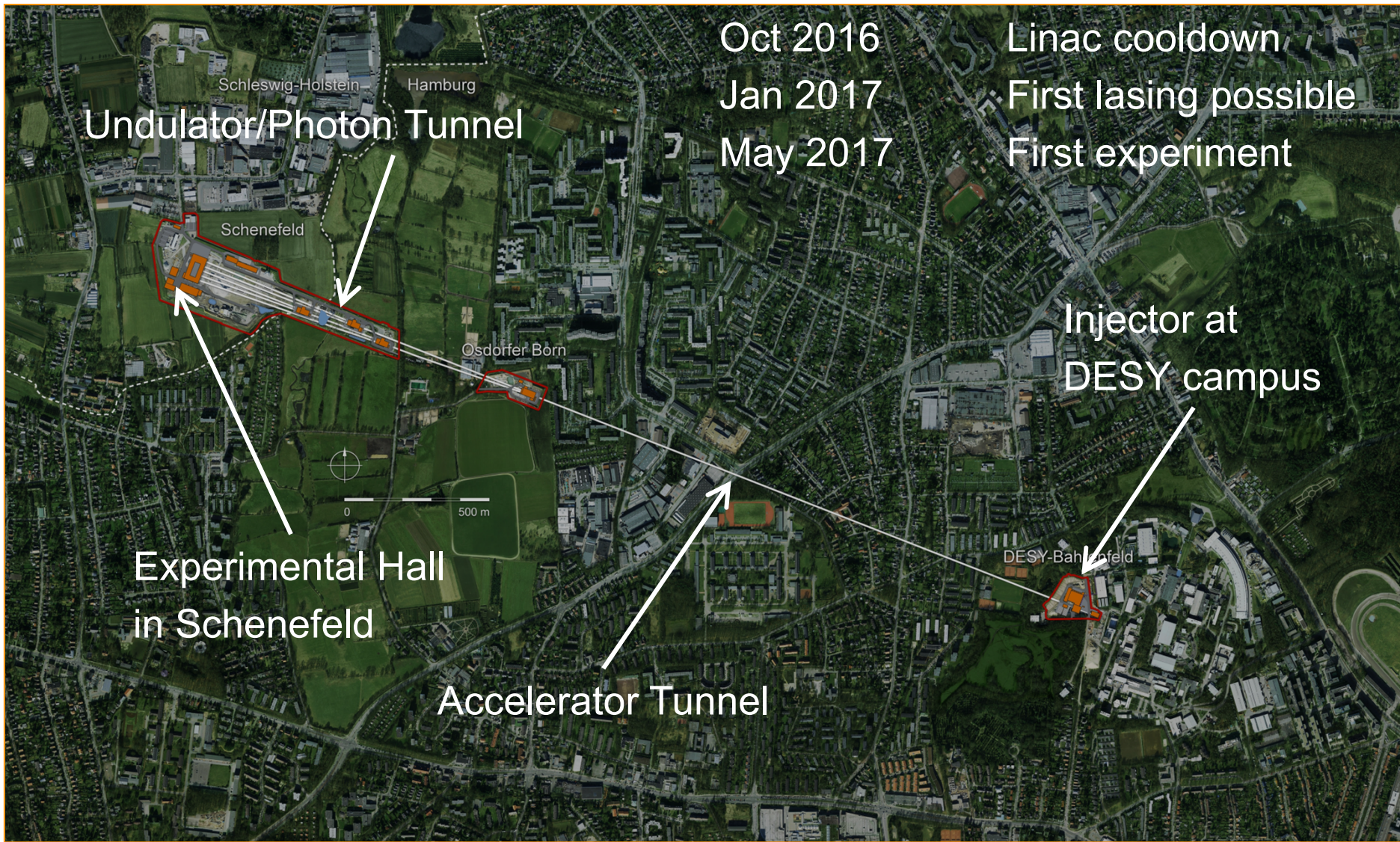
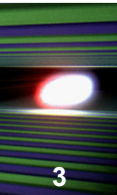


Soft X-Ray Monochromator at the European XFEL

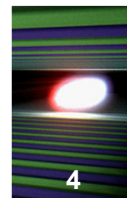
Daniele La Civita
European XFEL, X-ray Optics Group



European XFEL and milestones



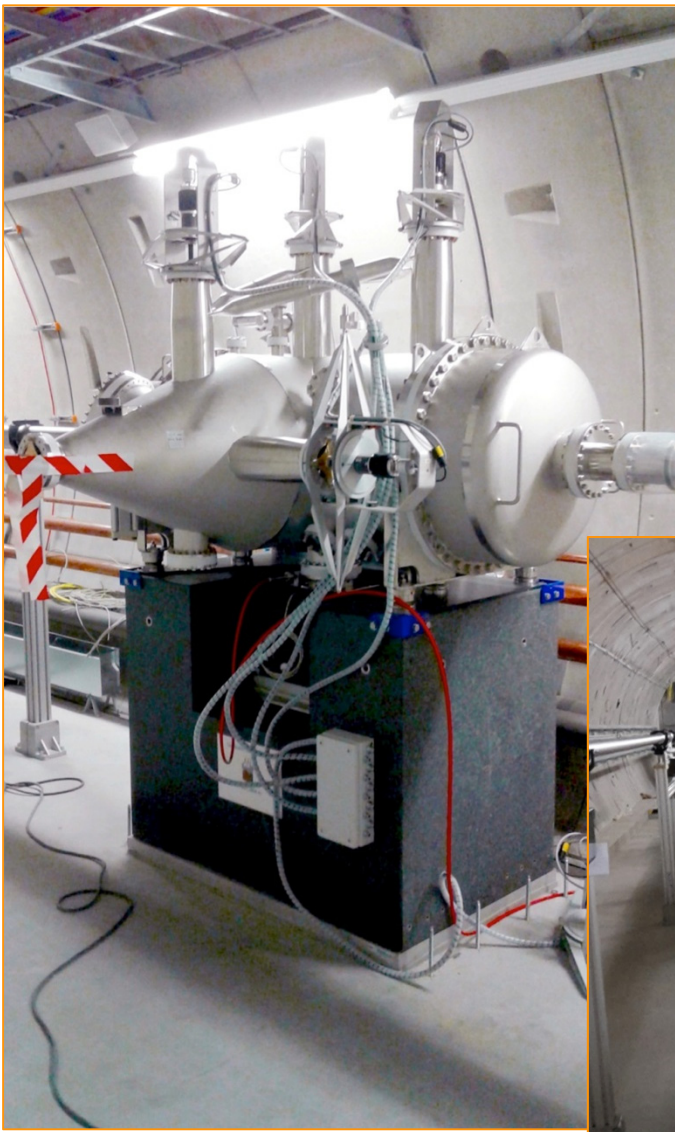
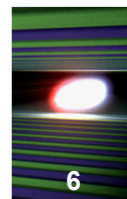
Progress on civil construction



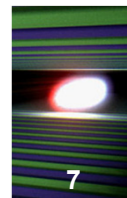
Progress on civil construction



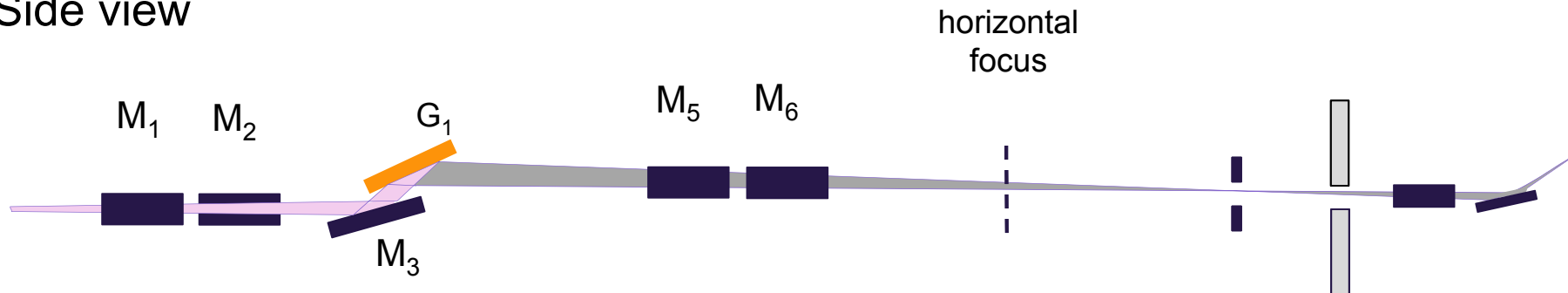
... and on the photon system installation



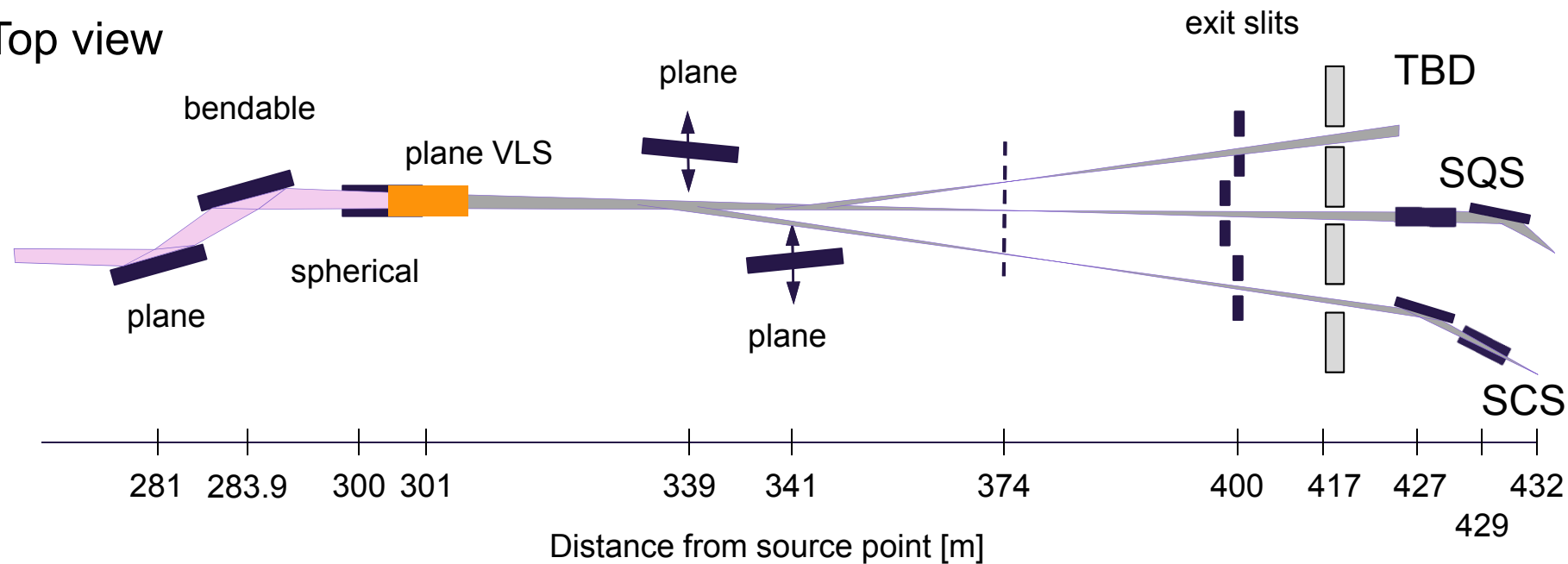
SASE3 optical layout



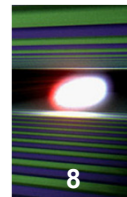
Side view



Top view

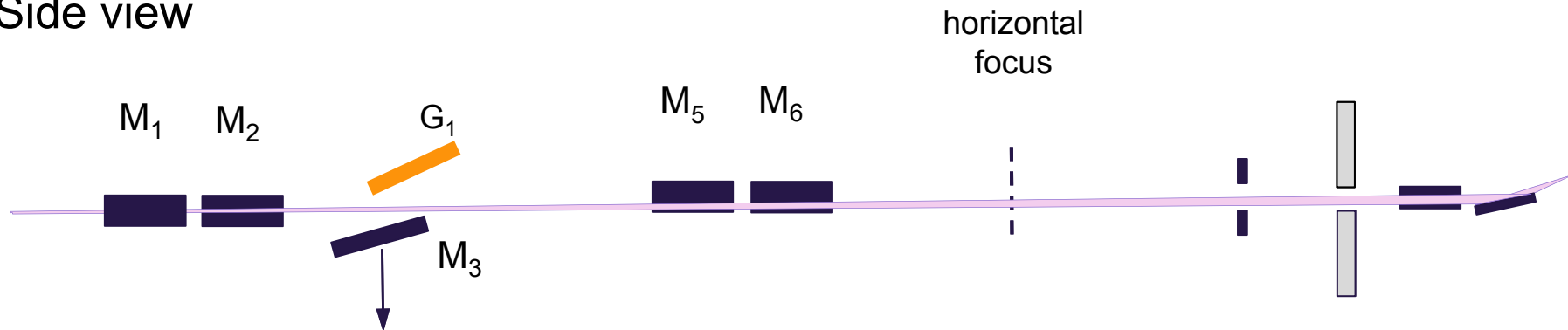


SASE3 optical layout

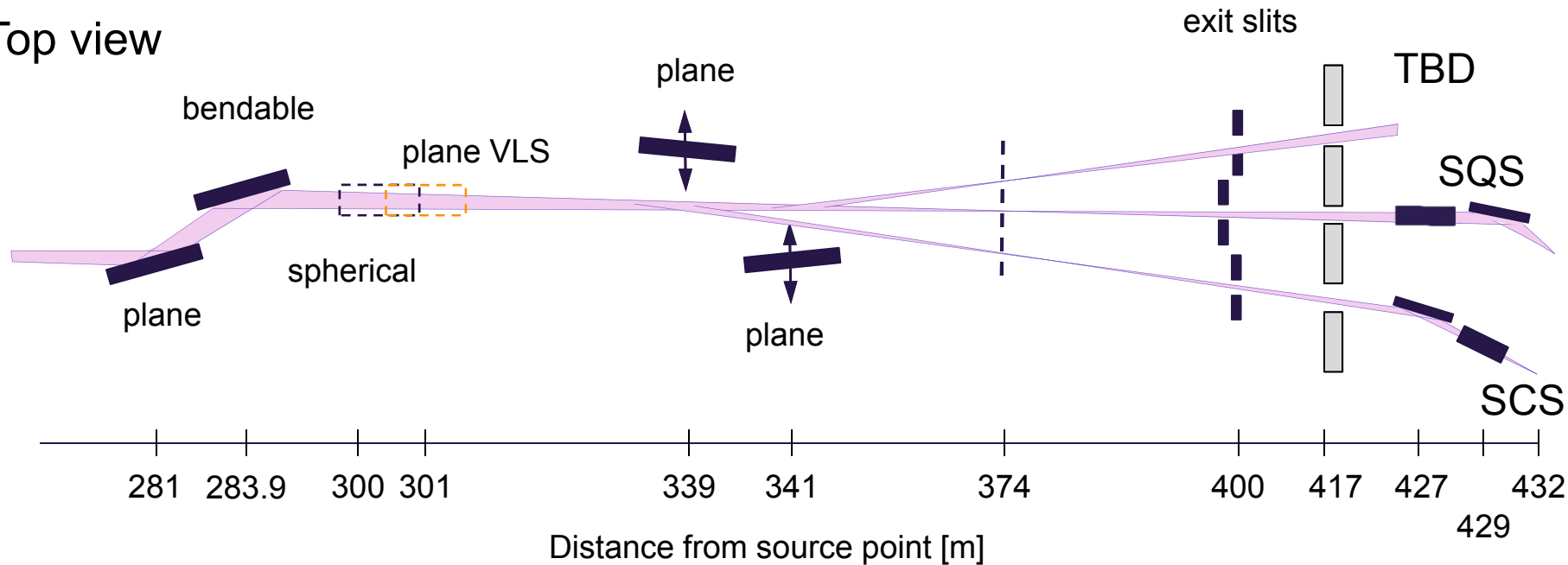


8

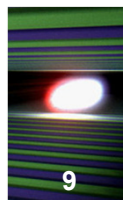
Side view



Top view

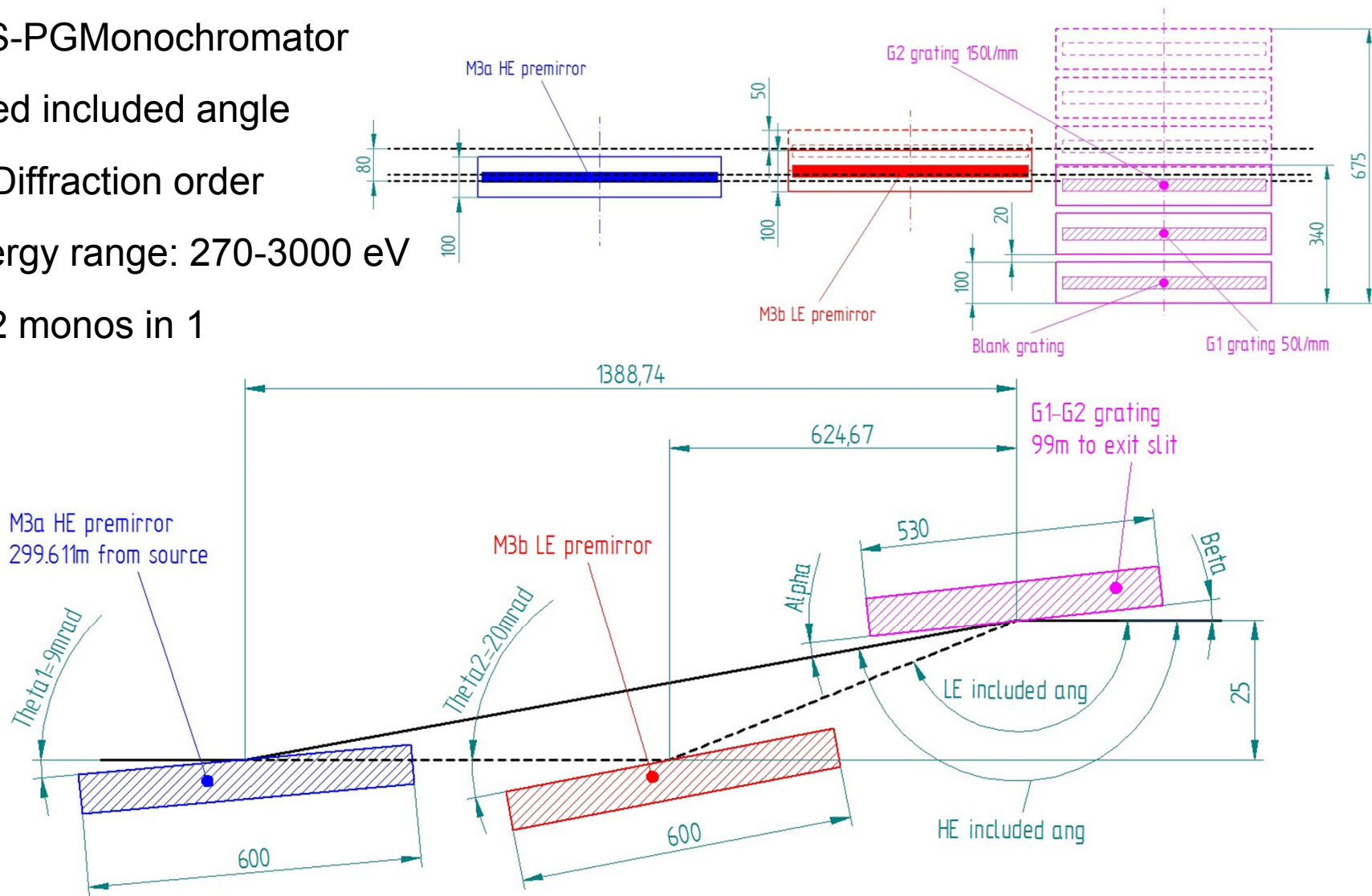


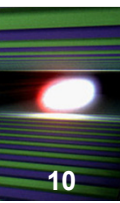
Monochromator conceptual design



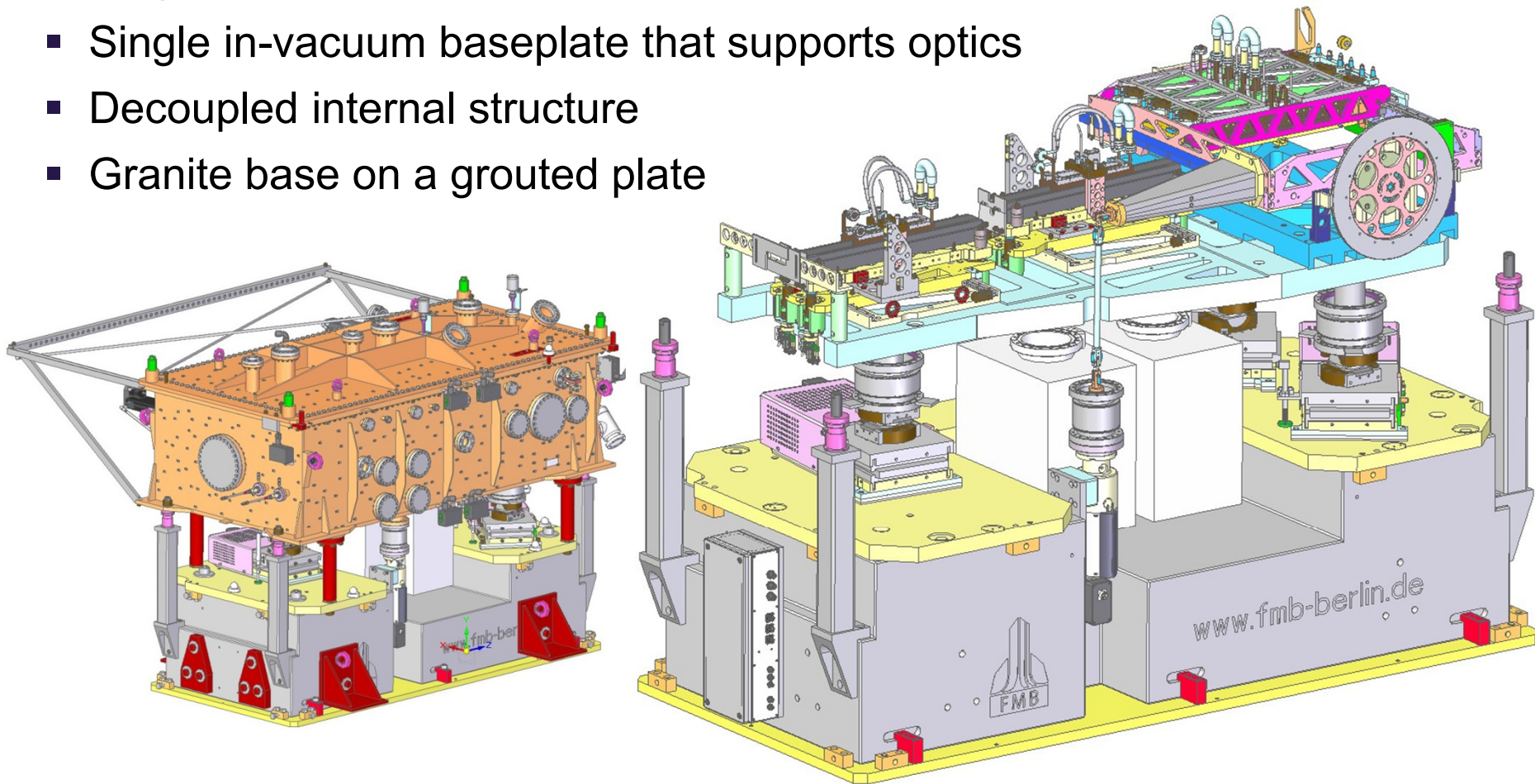
9

- VLS-PGMonochromator
- Fixed included angle
- 1st Diffraction order
- Energy range: 270-3000 eV
- ... 2 monos in 1





- Contract awarded to FMB Berlin
- Design concept based on:
 - Single in-vacuum baseplate that supports optics
 - Decoupled internal structure
 - Granite base on a grouted plate



From CAD to reality

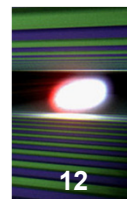


FMB Berlin



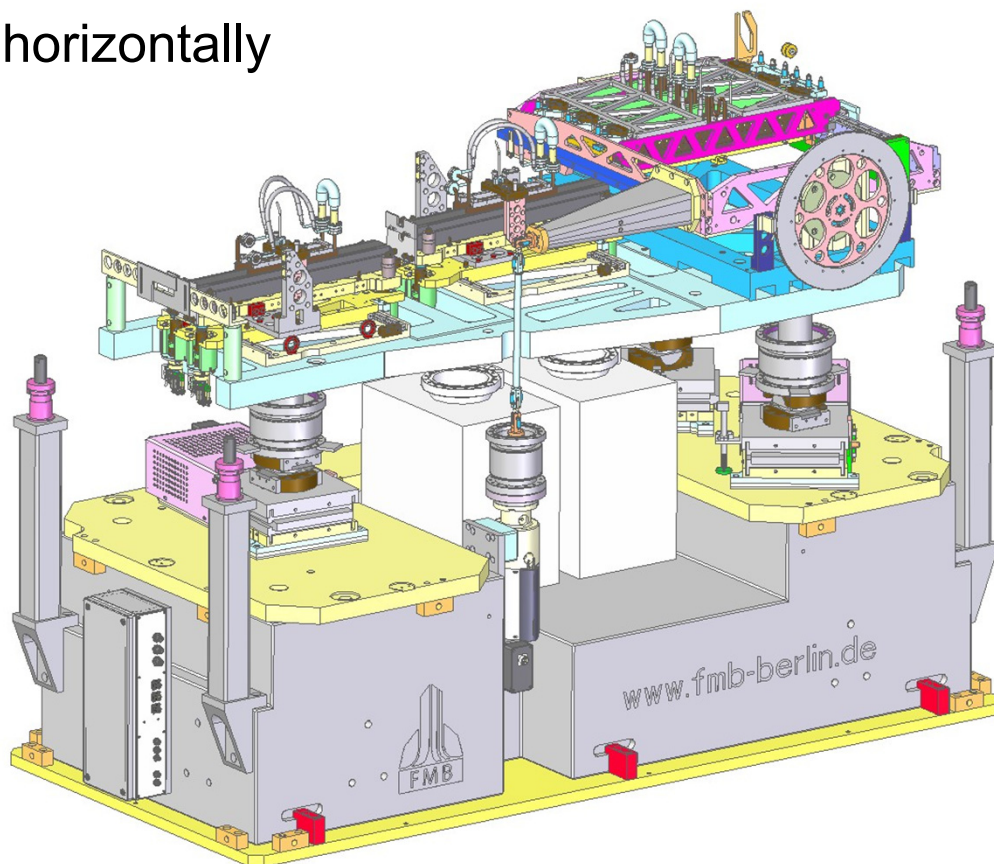
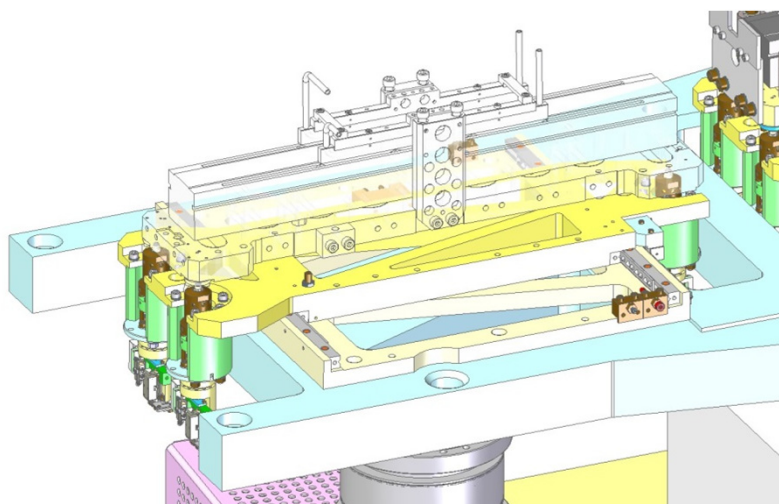
■ ISO class 5 cleanroom

Monochromator degrees of freedom



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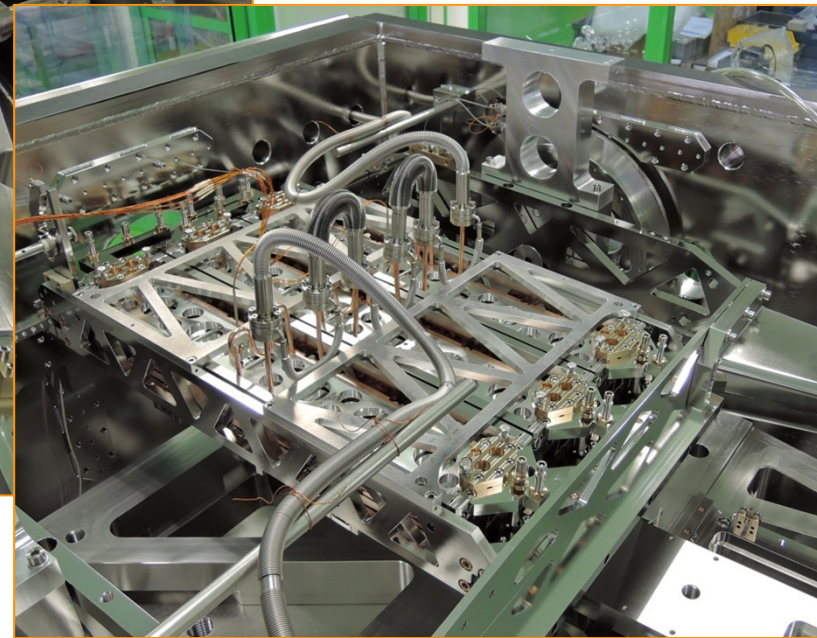
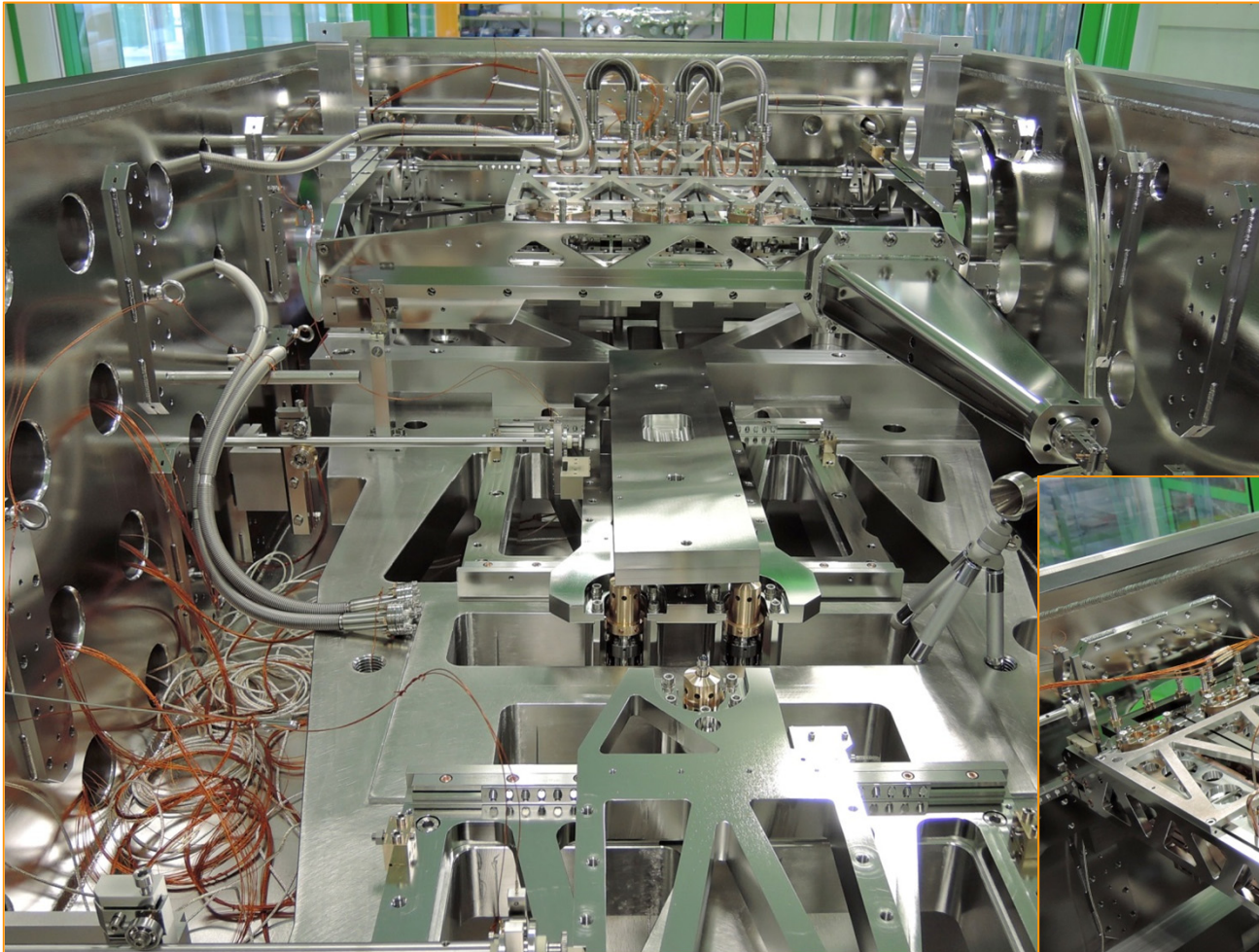
- The monochromator has 13 remotely controlled axes
 - Baseplate can tilt, roll and move vertically
 - Pre-mirrors can tilt, roll and move vertically and transversally
 - Grating can pitch and translate horizontally
- Stepper motor in air
- Piezoactuator in vacuum



From CAD to reality



FMB Berlin



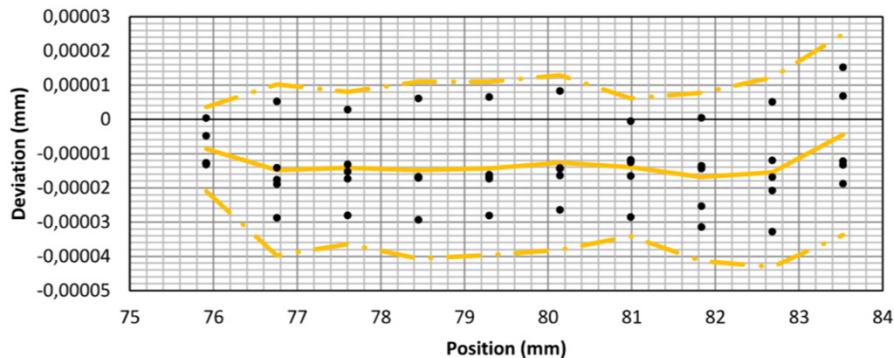
Pre-mirror actuators – PiezoMotors Uppsala AB

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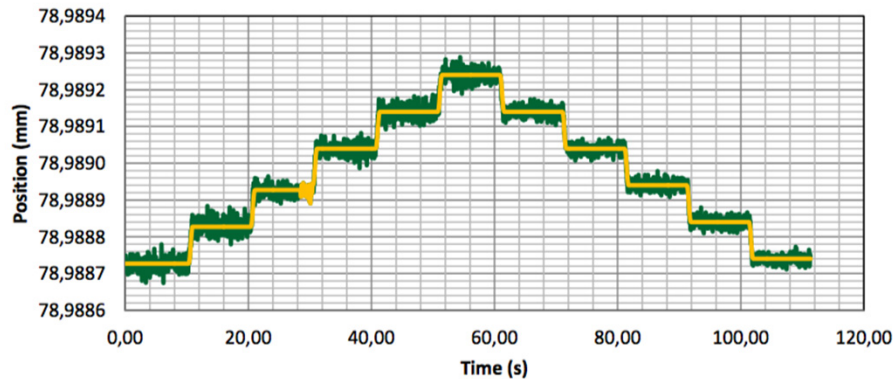


- nm-level resolution and repeatability
- UHV and particle free compatible

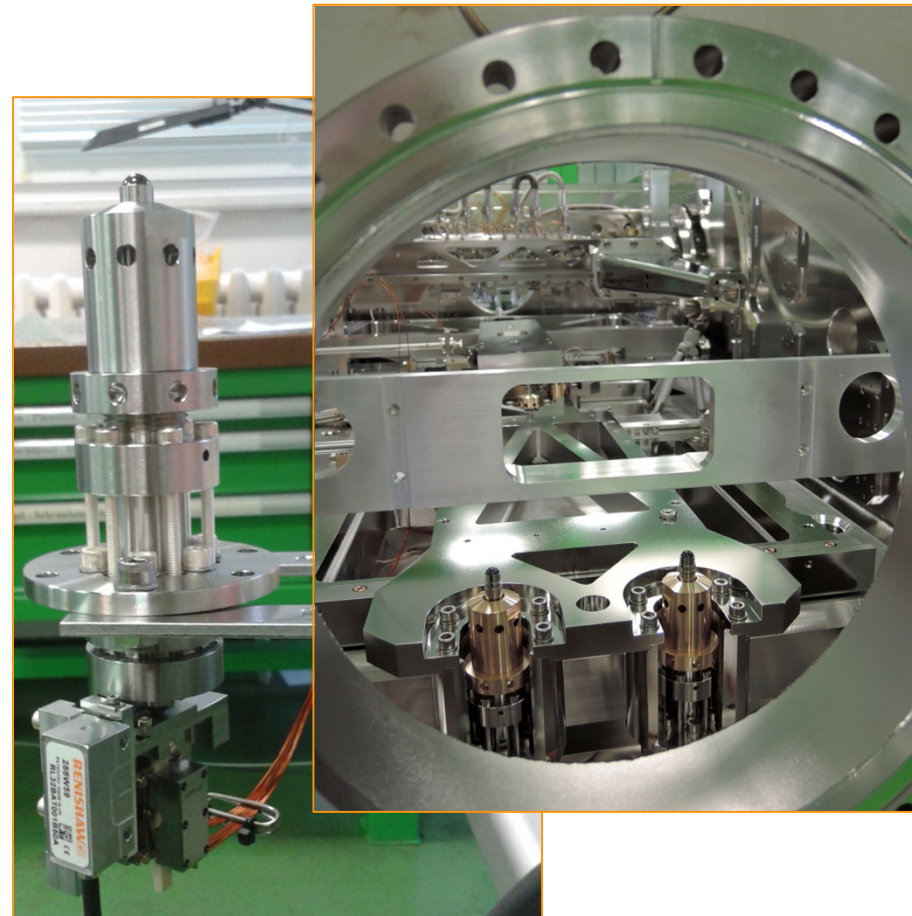
Unidirectional Accuracy ↑ (Renishaw Resolute)



Resolution (Renishaw Resolute)

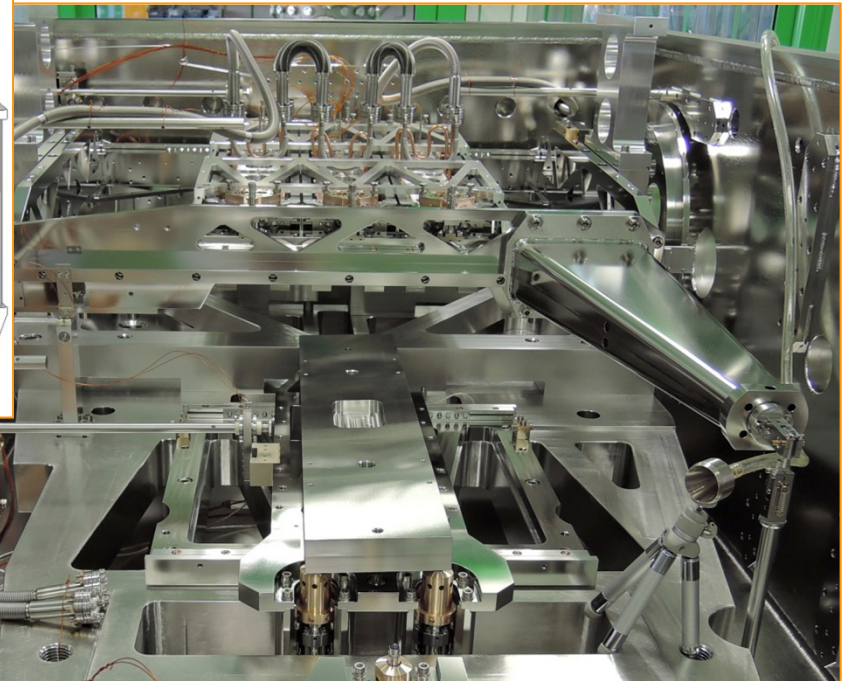
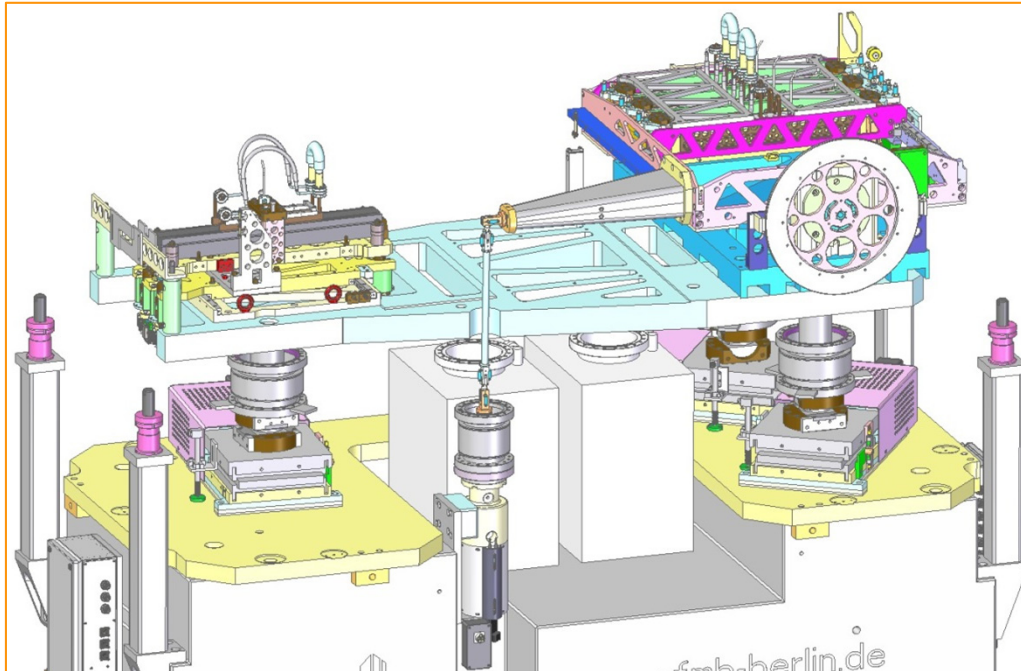


— Actual Position Renishaw Resolute — Commanded Position



Grating pitch control

- Very challenging (better than 50nrad rms) specification for the angular resolution of the grating pitch

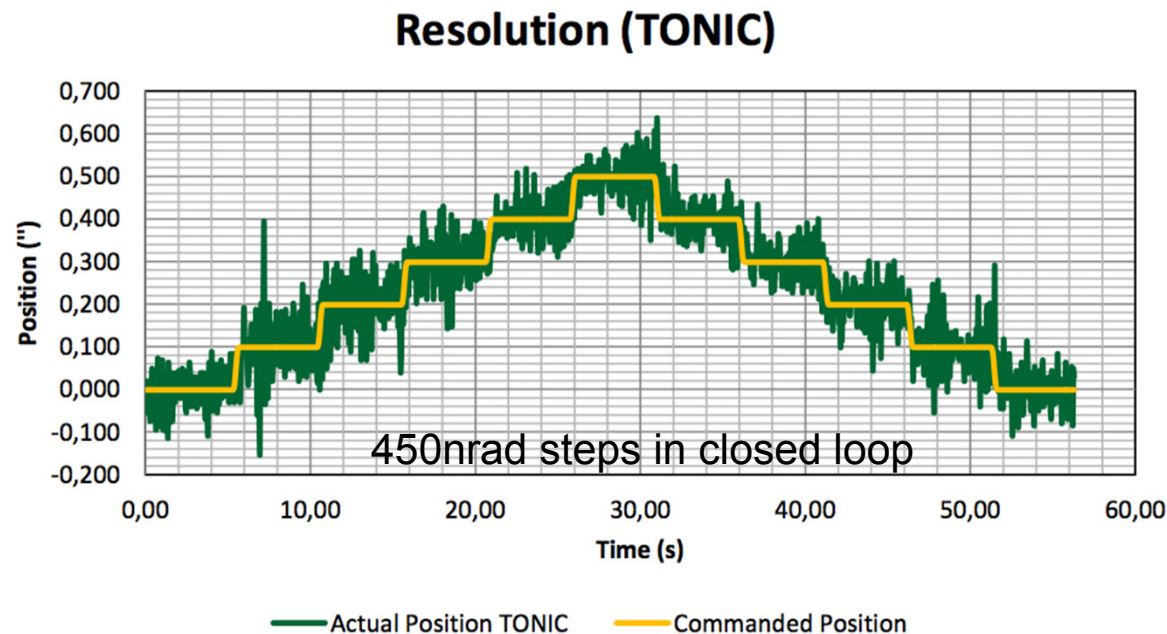


- More than 100kg cradle
- 1m long arm
- nm resolution of the actuator

Grating pitch control

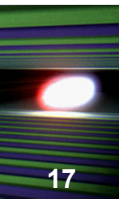
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- Very challenging (better than 50nrad rms) specification for the angular resolution of the grating pitch
- ... not so nice preliminary results: 150nrad rms



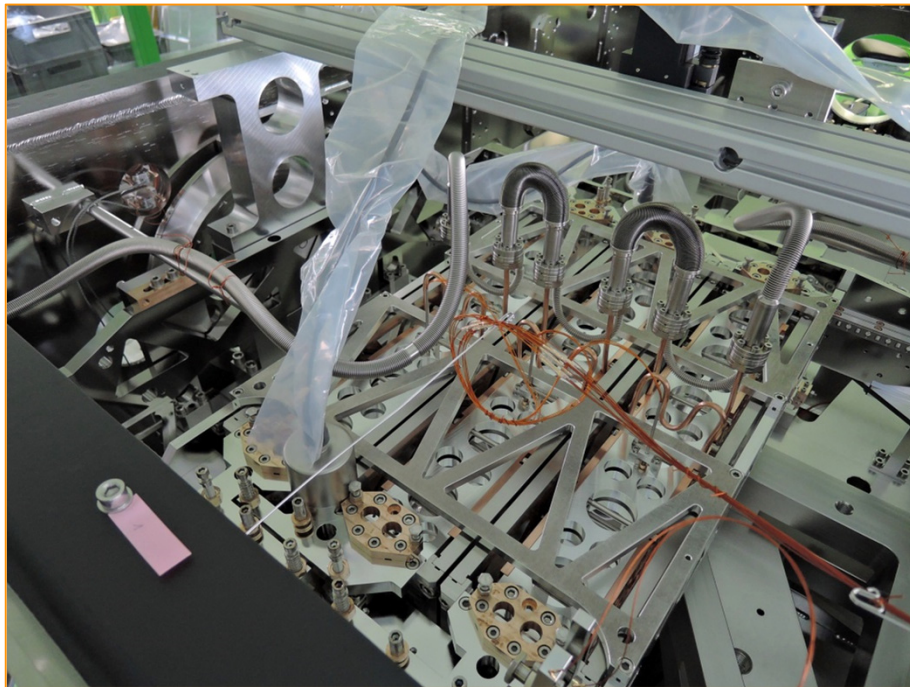
- Vibrational measurements campaign

Grating pitch vibrational measurements

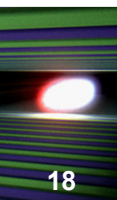


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- Vibration analysis based on transfer function study
 - Baseplate vs. grating cradle
 - Front cradle vs. back cradle
 - Vertical signal recorded

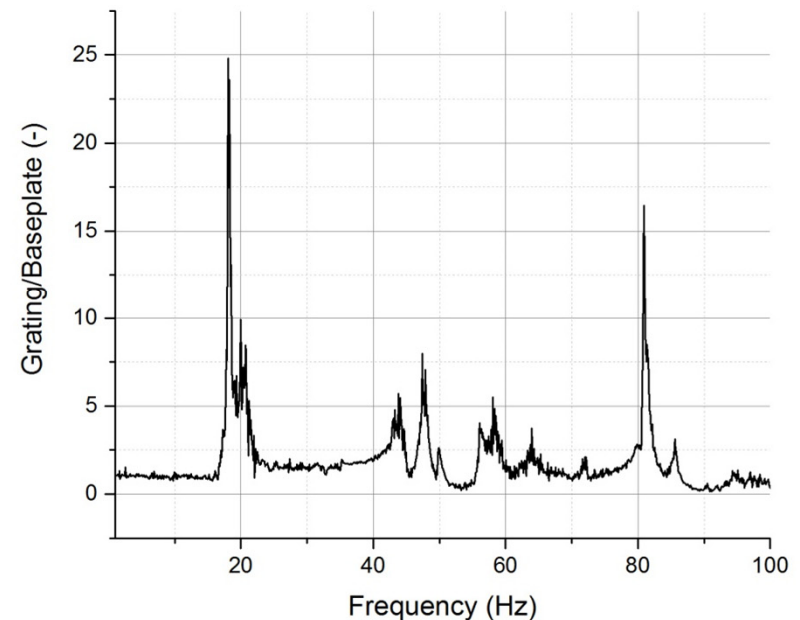
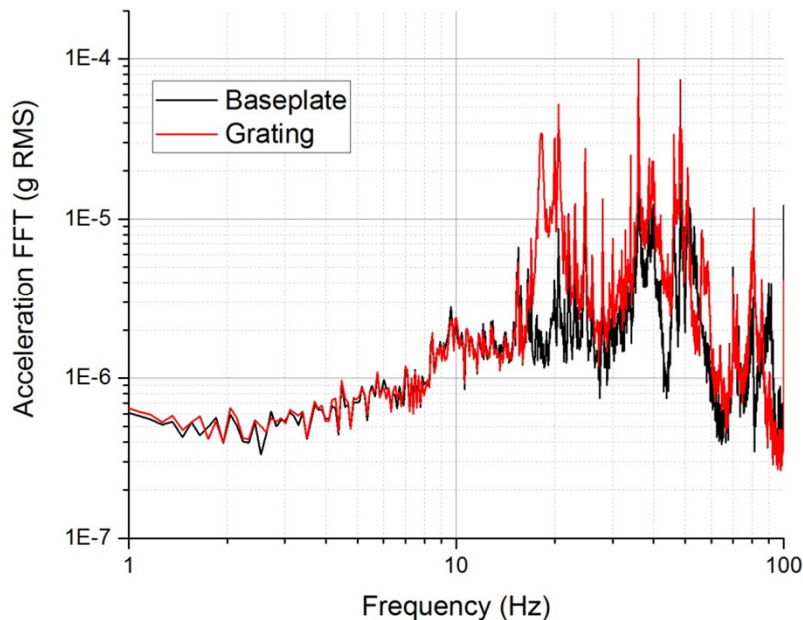


Grating pitch vibrational measurements



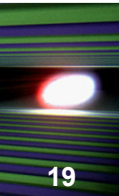
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■ Baseplate vs. grating – Vertical direction

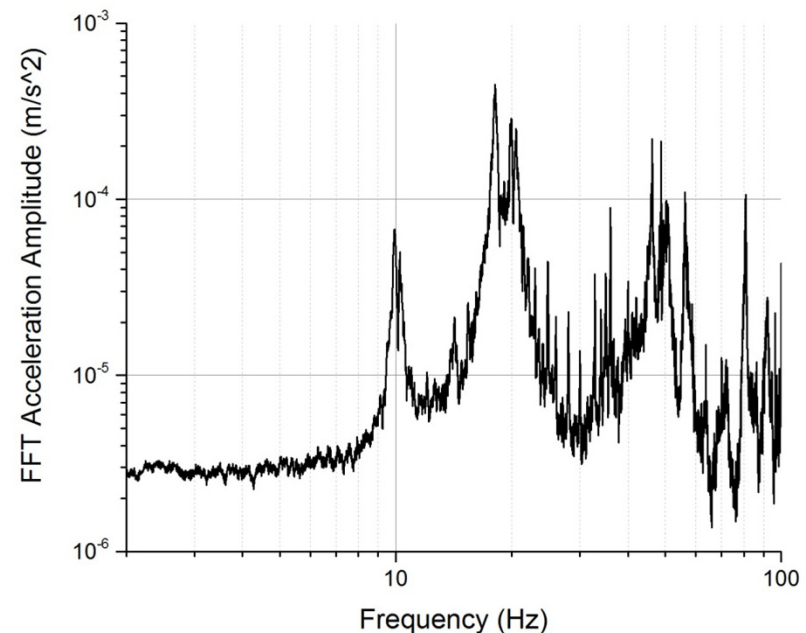
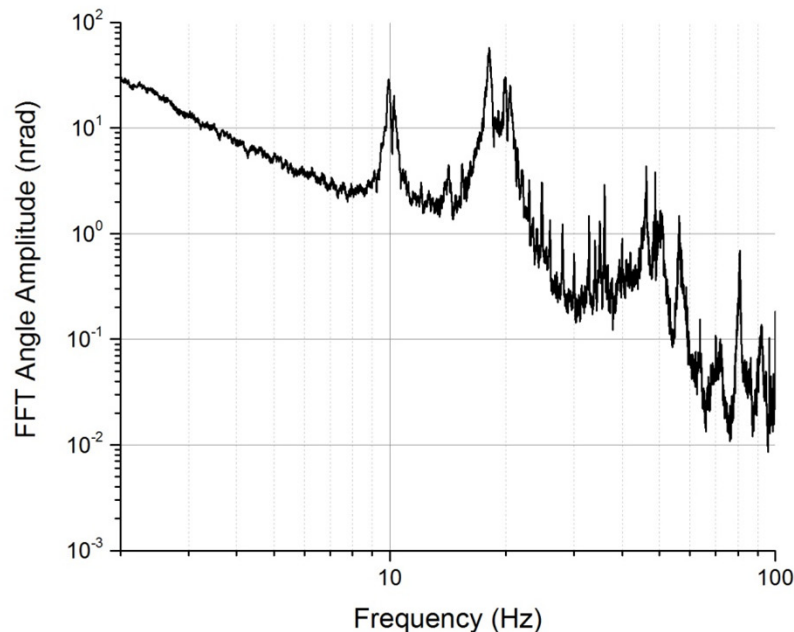


- Grating cradle has its own mode in the 20Hz area
- This mode does not come from the baseplate
- Baseplate is quite stiff in the vertical direction

Grating pitch vibrational measurements

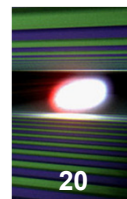


- Grating front vs. back – Vertical direction
- Difference and post-process of the time signal

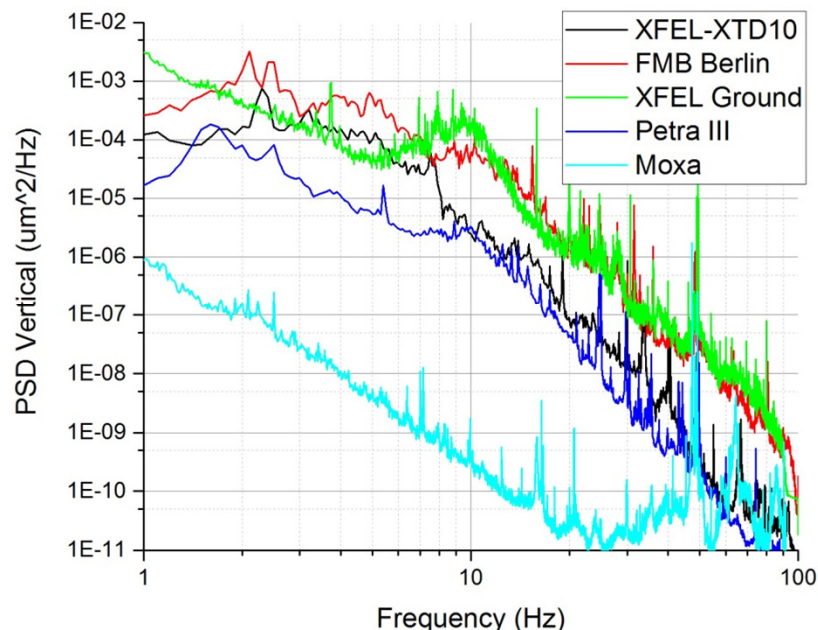
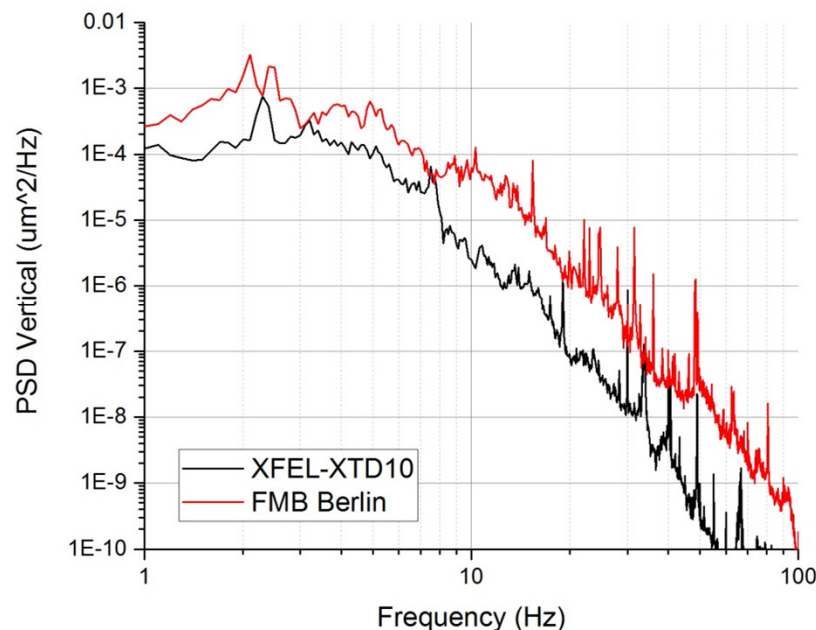


- 10Hz comes from “difference” between front and back: maybe it is not a real contribute to rotation
- 80% of the signal rms is in the 17-21Hz range

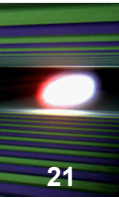
Floor noise comparison



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- FMB floor is quite noisy we can expect factor 3 better
- XFEL Tunnel measurements done during construction phase
- Moxa is a site 50km southeast of Jena, Thüringen, Germany
no street- or rail-traffic close to the station; no industry; next big city in 50km



- Very successful collaboration with FMB Berlin
- Monochromator ready for installation
- Grating pitch resolution has to be “improved” and verified in proper conditions and on the final floor

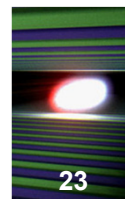
- Next steps
 - Installation, alignment, mirror installation
 - “In-situ” mechanical characterization
 - Commissioning with beam
 - Develop upgrade strategy based on the experiment needs

Actors involved in the project with FMB Berlin

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Actors involved in the project with FMB Berlin



THANK YOU FOR YOUR ATTENTION