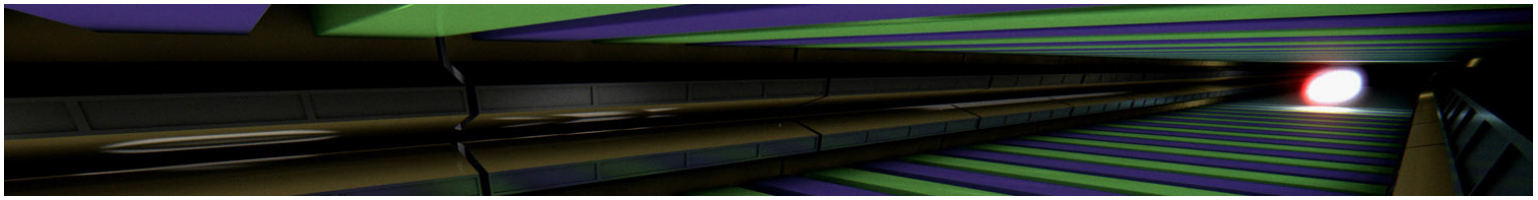


# Spectroscopy and Coherent Scattering: SCS

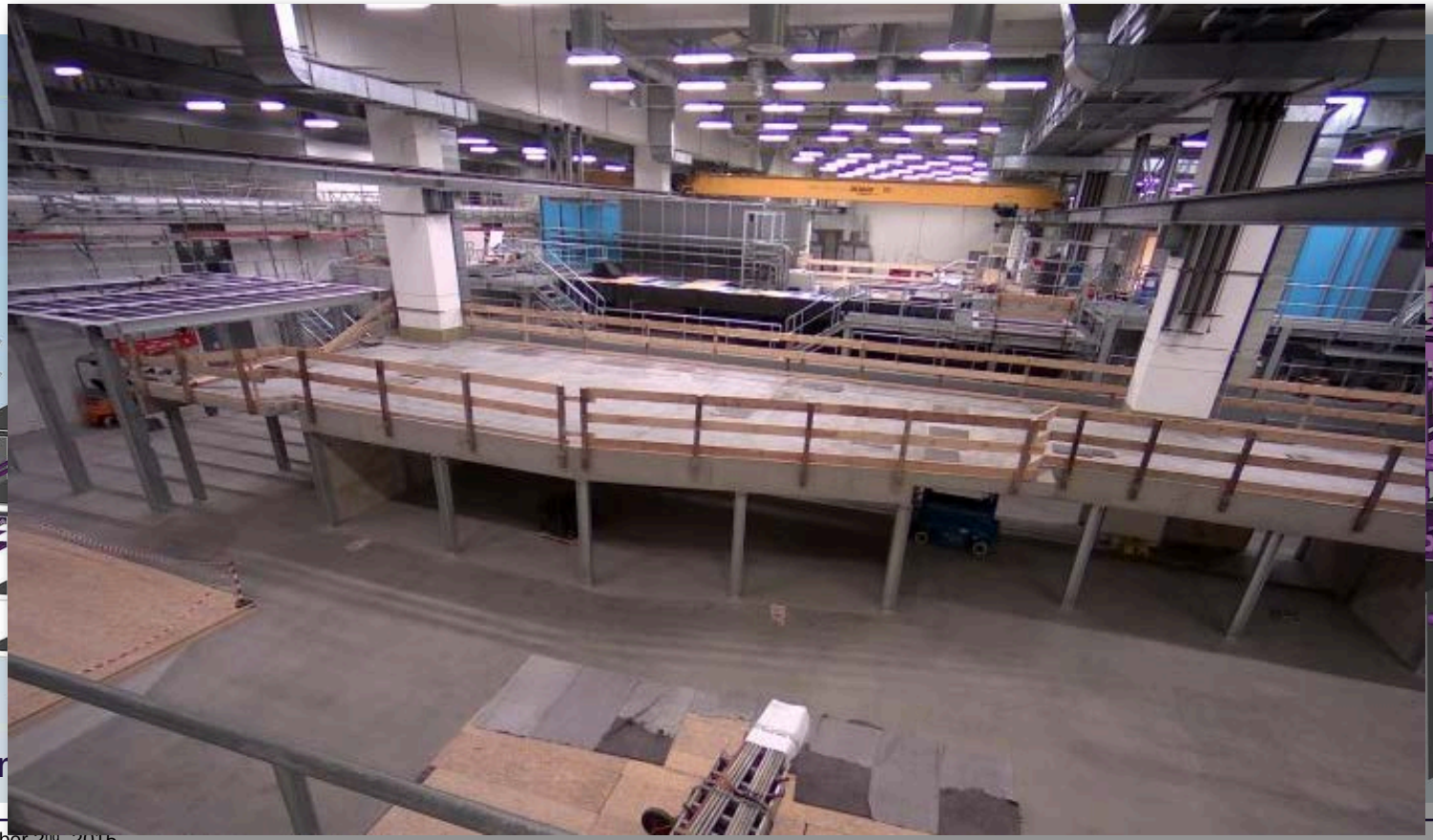
Andreas Scherz for WP86 European XFEL

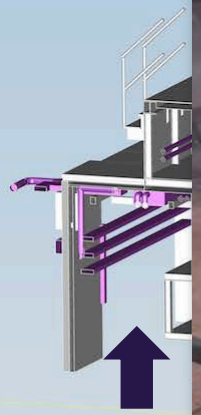
European XFEL

# SCS infrastructure status



- Hutch construction plan completed 03/15 with PSPO, WTM, DERU
- Hutch infrastructure planning completed in 09/15 with PSPO, PI





XTD10 tur

European XFEL

# SCS ASSEMBLY AREA AT HERA-SOUTH

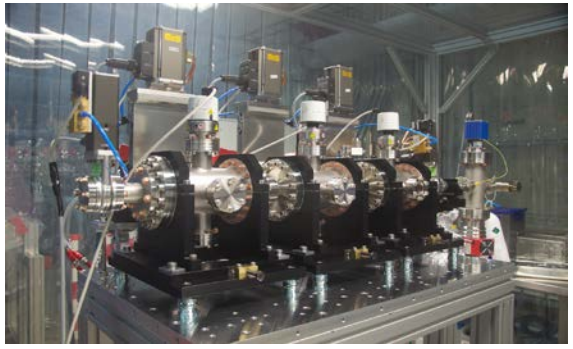


# TESTING AND PREPARATION FOR INSTALLATION



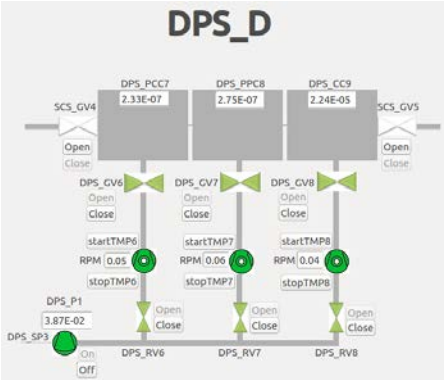
## PRODUCTION/TESTING

### SCS ASSEMBLY LAB @ HERA – SOUTH



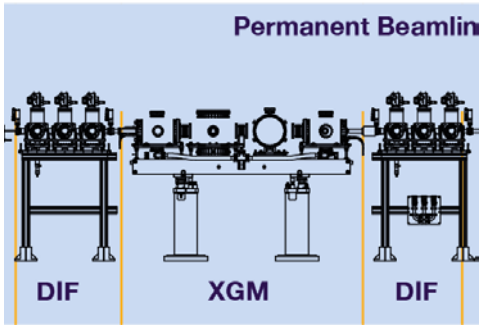
Cables for test in lab

- CIE ePlan
- AE Beckhoff
- CAS Karabo




## INSTALLATION PHASE

### SCS EXPERIMENT HUTCH




Cables

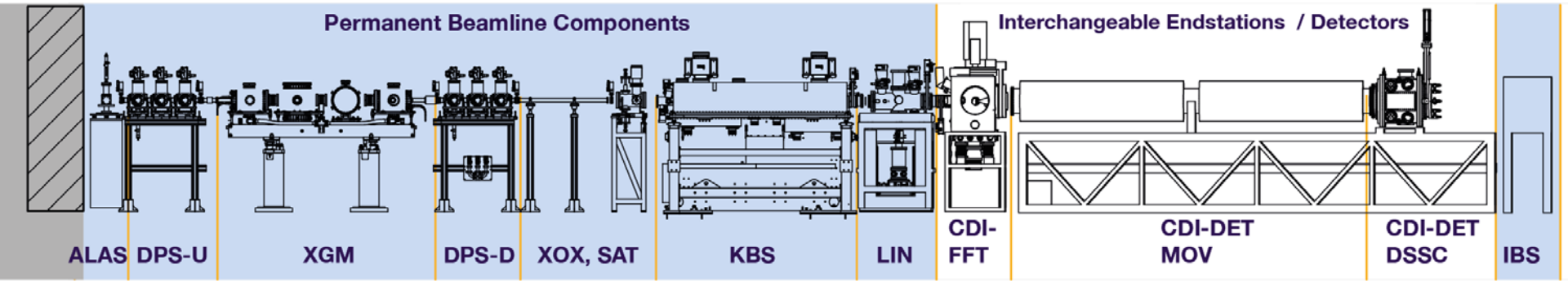
PATCH PANEL

CABLES TO BE ROUTED DURING INSTALLATION

SCS RACK ROOM

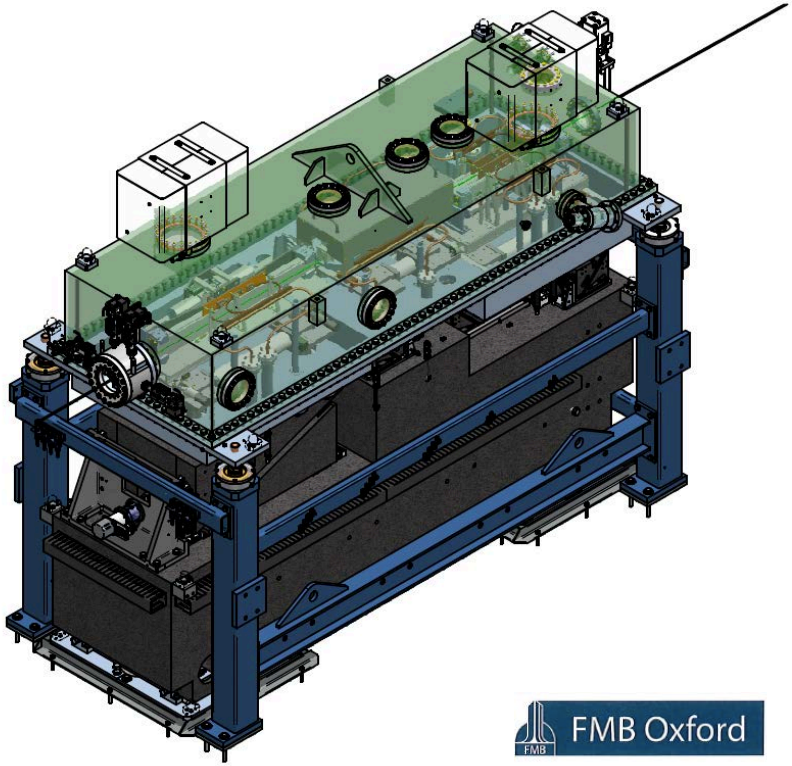
# SCS BEAMLINE: KB mirror system





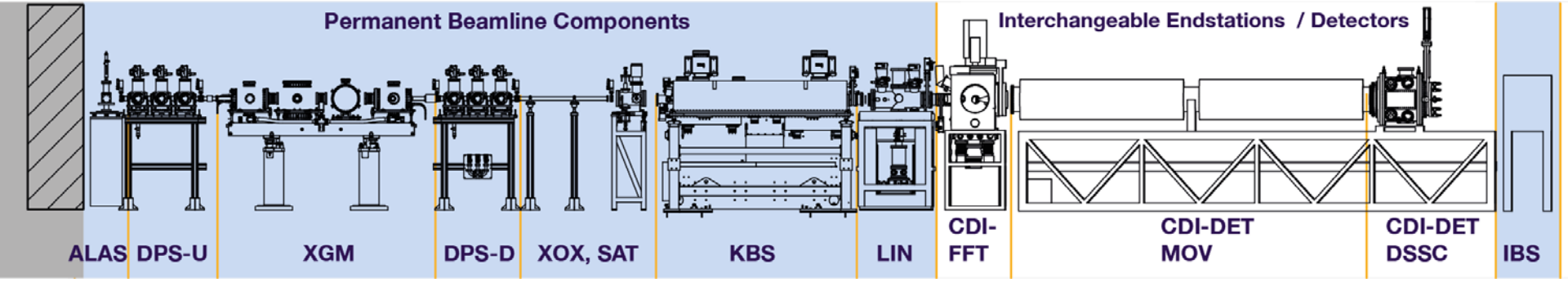

## SCS KB mirrors

- Contract awarded to FMB/Oxford, kick-off meeting 04/2015
- Concept design review 06/2015: substrate shapes, bender, vessel, stand, vacuum
- Final Design review in 12/2015
- Delivery of vessel and stand 12/2016
- Optics ready for installation mid/2017



# SCS BEAMLINE: LASER IN-COUPLING



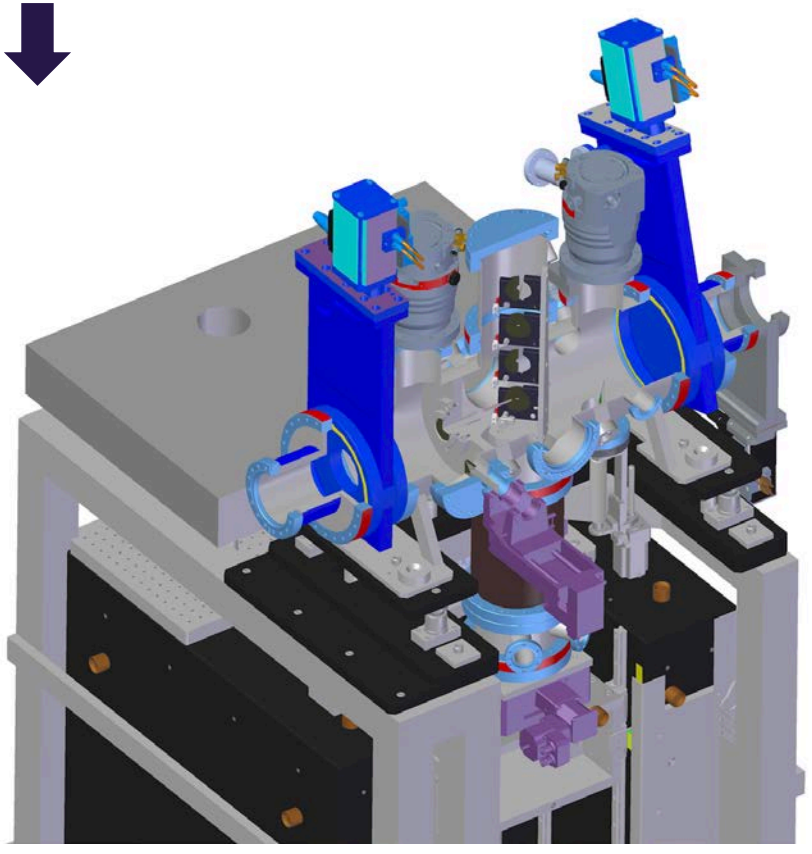



**Technical design July-Oct. 2015**

**Procurement 12/2015**

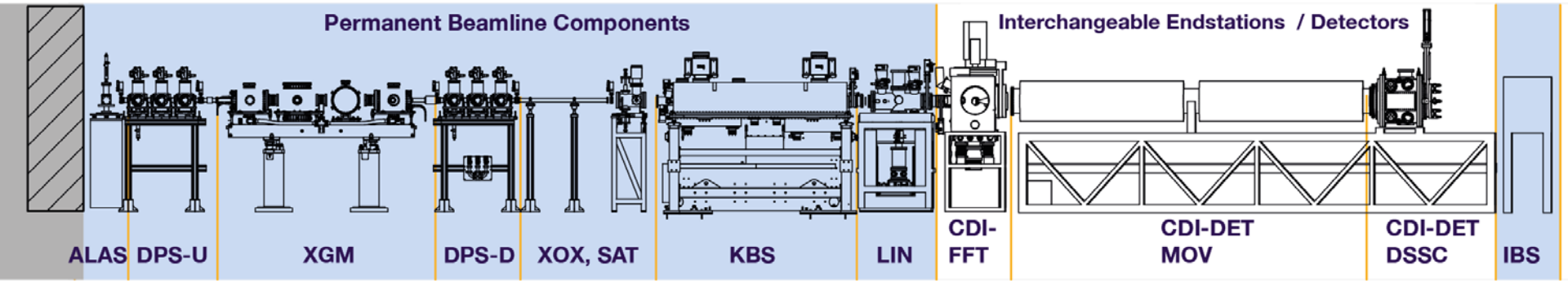
## Flexible Design

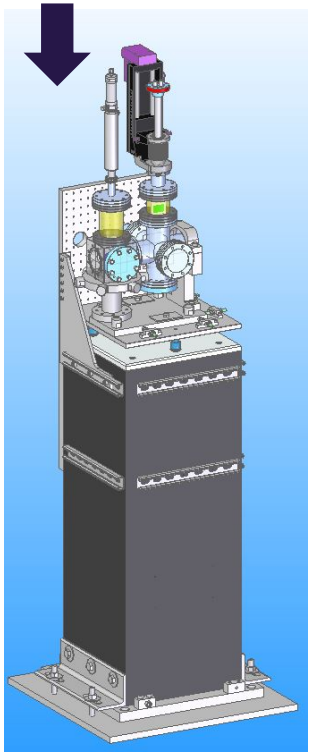
- 4 mirrors for wide wavelength range
- Large mirrors for high energy pulses
- External x, y and z translation on stable translator
- Internal θ, Φ (piezo motors)
- On-axis and off-axis geometry



# Alignment laser for SCS and SASE3





## Student assistant (Internship)

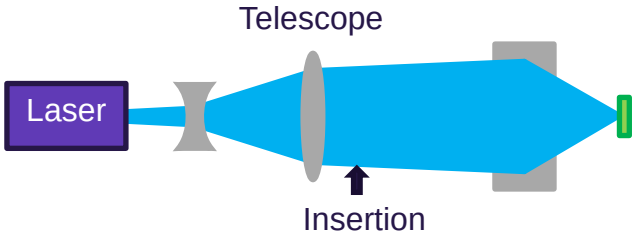
**Technical design July-Oct. 2015**

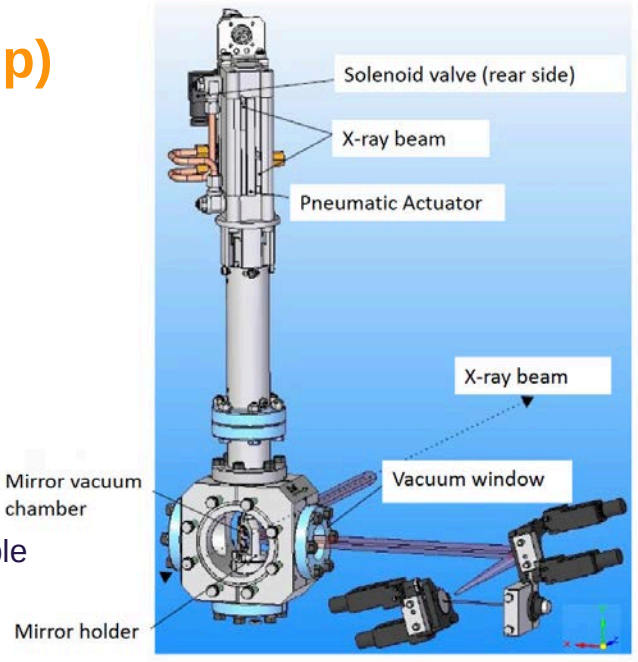
**Procurement 12/2015**

**(Batchelor thesis)**

**Assembly 03/2016**

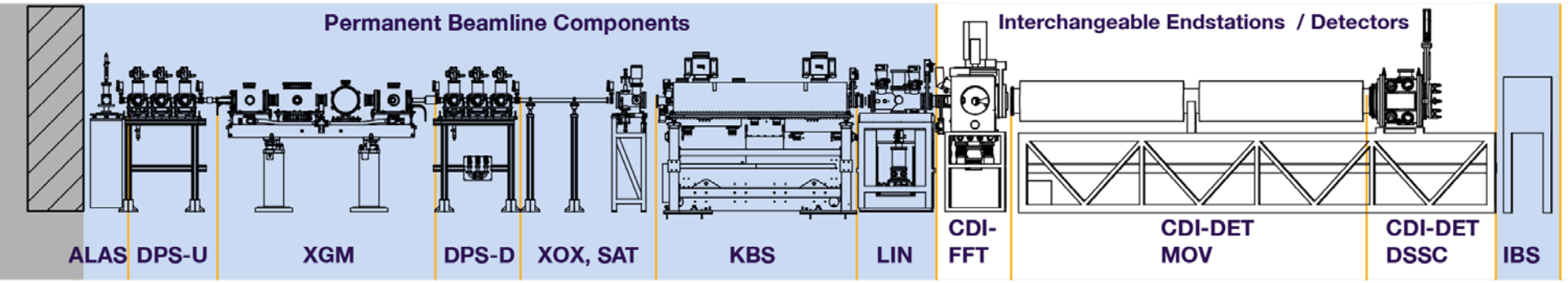
**Test done 05/2016**

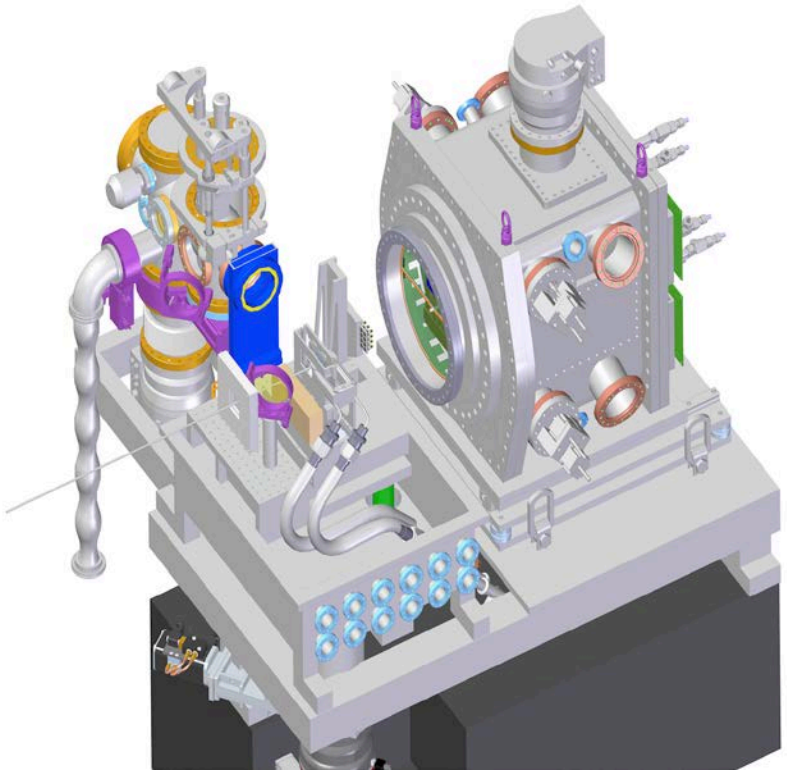


# FFT endstation and sample environment (WP79)





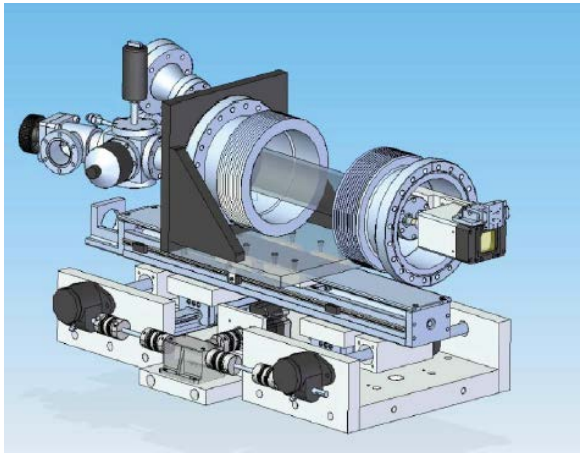



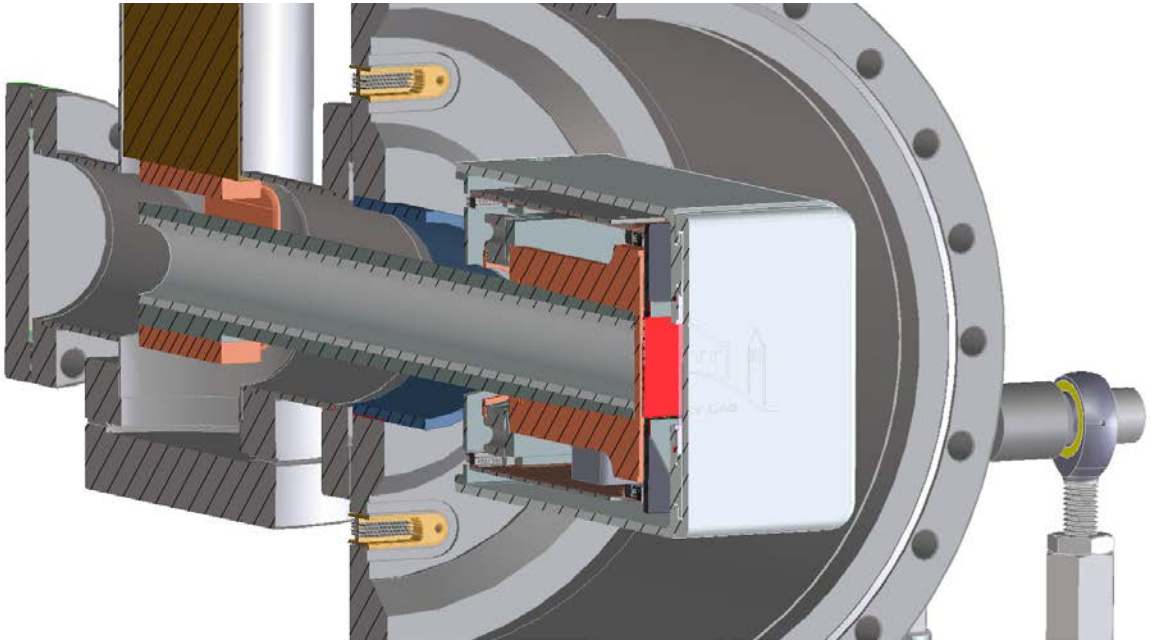
## Instrument – Sample environment

- Sample manipulation ✓
- Load Lock ✓
- Magnet ✓
- Detector interface
- THz in-coupling ✓
- Technical specifications for positioning mechanics ✓
- Vibration and vacuum ✓
- Diagnostics stage ✓

# FastCCD Detector Integration with WP75



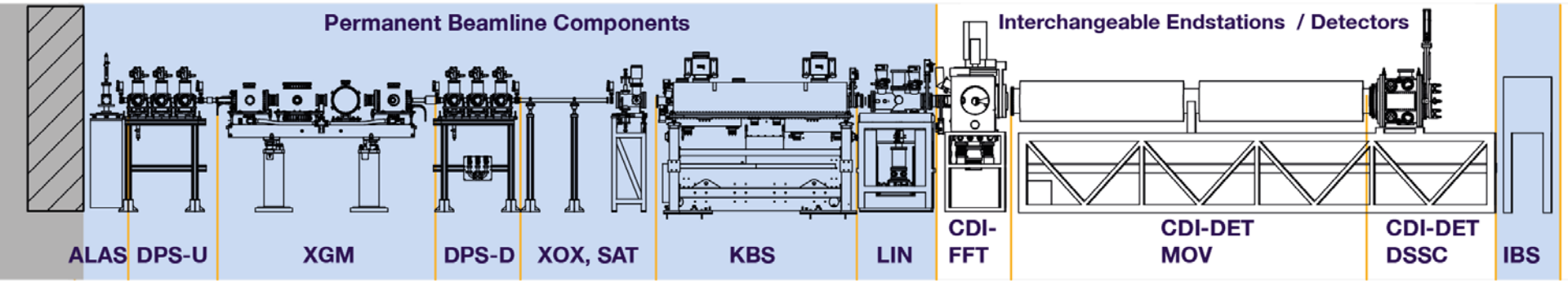




| FastCCD Plan | |
|---|---|
| Discussion SCS requirements | February 2015 |
| Final SCS concept | May 2015 |
| Start Production | June 2015 |
| Delivery | October 2015 |
| Integration at XFEL and End-to-End Test | middle November 2015 |
| Calibration Measurements with PHOEBE | end November/beginning December 2015 |
| Multi-Energy Calibration with PANTER | December 2015 |
| Preparation of Calibration Data and Injection into CALDB | January 2016 |
| Calibrated and Ready for Installation at Experiment | end January 2016 |

# INSTALLATION PLAN

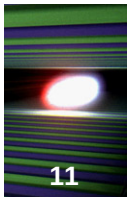





- 11/2016 (store HS until)
- 11/2016 (store HS until)
- 11/2016 (store HS until)
- 11/2016 (store HS until)
- 01/2017 (ATT)
- 12/2016 (SAT KBS tank)
- 11/2016 (store HS until)
- 01/2017 after assembly of all subcomponents
- 03/2017
- 01/2018 (WP-75)
- 11/2016 (CIE)

- **PHASE 1 – Beamline**
- **PHASE 2 - INSTRUMENT**

# What's in the box?
# Commissioning and early user program in 2017





**COMMISSIONING (March 2017)**

**17.5GeV, >1000 eV,**

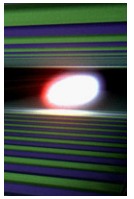
- Working points (photon energy) for early user program commissioned
  - Commissioning of Beam transport and soft x-ray monochromator (with WP73 and WP85 )
  - Commissioning of beam properties and beam focus
  - Commissioning Optical laser delivery (with WP78)

**EARLY USER PROGRAM – FIRST EXPERIMENTS(Q4 / 2017)**

**17.5GeV, >1000 eV, FastCCD, SASE3 Optical Laser**

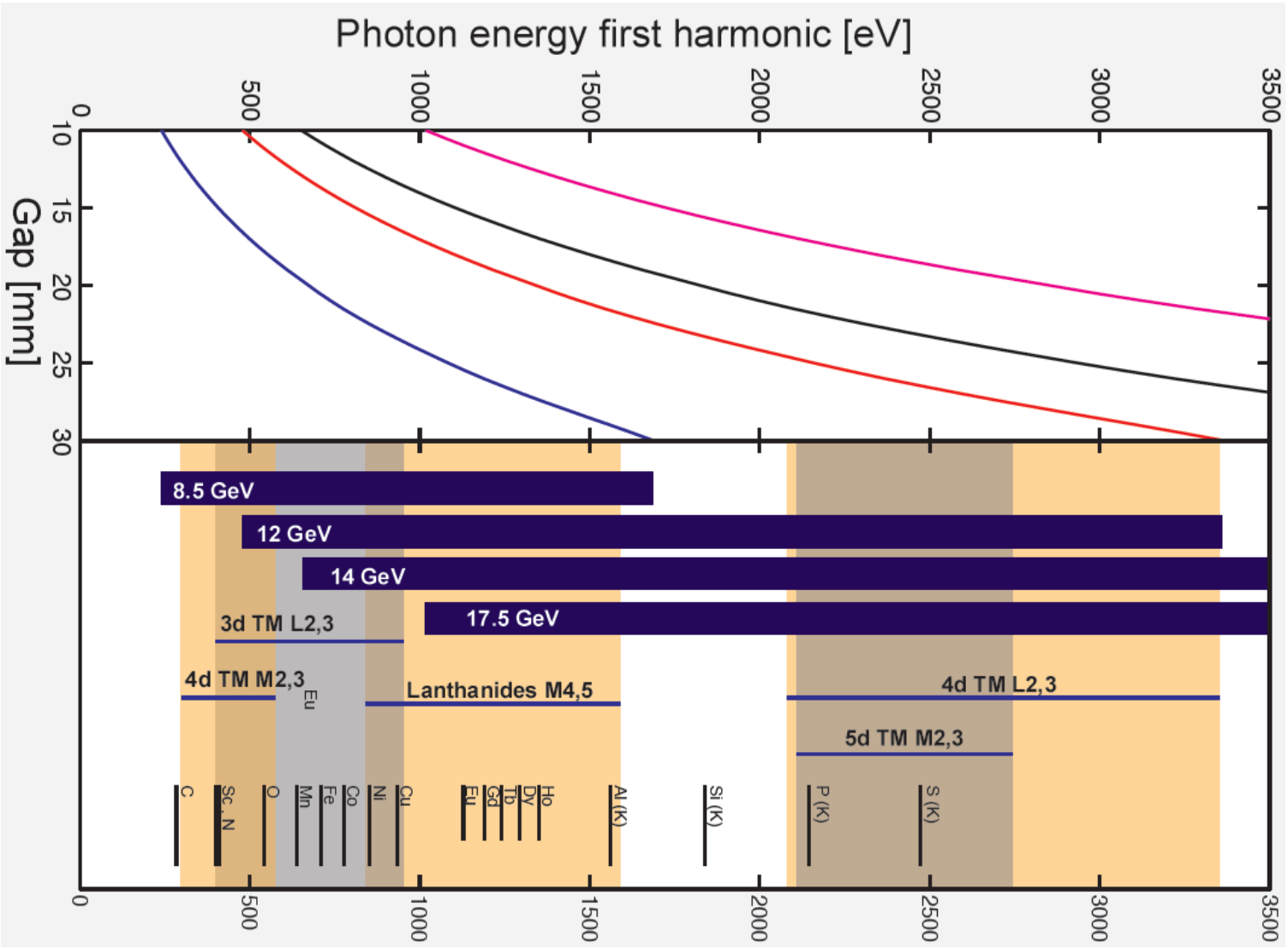
- Coherent diffraction imaging, single-shot imaging on fixed targets
- Time-resolved X-ray resonant spectroscopy of transient states
- Time-resolved coherent scattering with limitation in photon energy range, spatial and time resolution

# Parameters for first commissioning (SASE3)

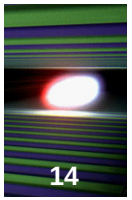


| | |
|---|---|
| Electron energy | 17.5 GeV |
| Photon energy | > 1 keV |
| Repetition rate | 100 kHz (=1/45 of full power) |
| Max. number pulses per train | 60 |
| Undulator K-value | 3.9 |
| Undulator Gap | >=10 mm |
| Pulse energy | 2 mJ (slightly oversaturated) |
| Divergence | 11 urad |
| Pulse duration | 43 fs (0.5nC) |

# Electron energy working points and SASE3 Photon energies



# Instrument upgrades in 2018





**UPGRADES / COMMISSIONING**

(WILL BE ALSO DRIVEN BY THE EARLY USER REQUIREMENTS)

- Photon energies < 1000 eV, gap scan for spectroscopy
- DSSC detector (Q1/2018)
- XRD *or user instrument* (Q2/2018)
- hRIXS instrument (Q3-4/2018)

**SCS WORKSHOP ON**

**Preparation of Commissioning and early user program (EUP)**

September 19-20th, 2016 (Schenefeld)

Program will be announced in April 2016

- Commissioning goals for EUP
- Inform on the instrumentation status and early user requirements for 2017/2018
- Prepare early users for the first call for proposals

# hRIXS integration at SCS



Progress of the user-consortium Heisenberg RIXS project for Resonant Inelastic X-ray Scattering:

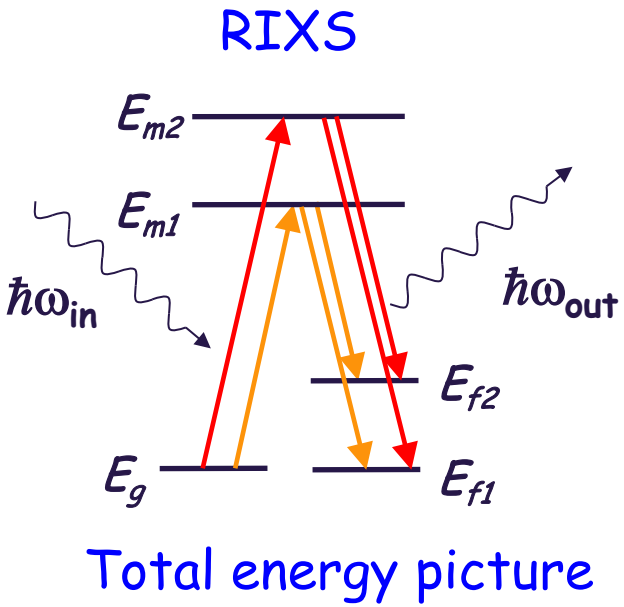
- Optical design has been finalized (Y. Peng and G. Ghiringhelli, Politecnico di Milano, Italy):

  - VLS spherical grating design
  - initially two gratings for medium- and high-energy resolution (optimized for 300-1800 eV).

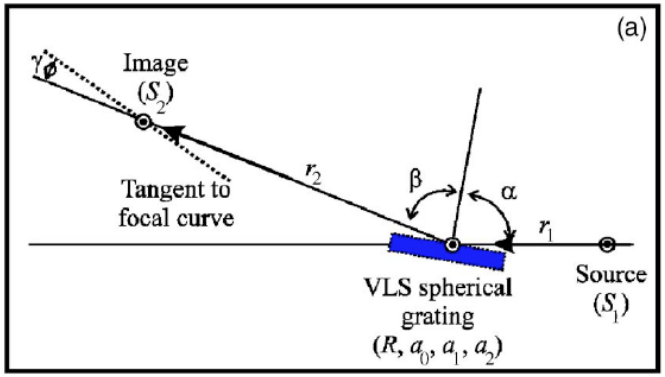
- The high-precision floor for spectrometer rotation has been installed in 2015:

  - It has an average height variation of 54 μm/m$^2$ and a planarity better than 250 μm over the total area of 37 m$^2$.

- The construction of the mechanical design and sample environment are in progress.




Total energy picture

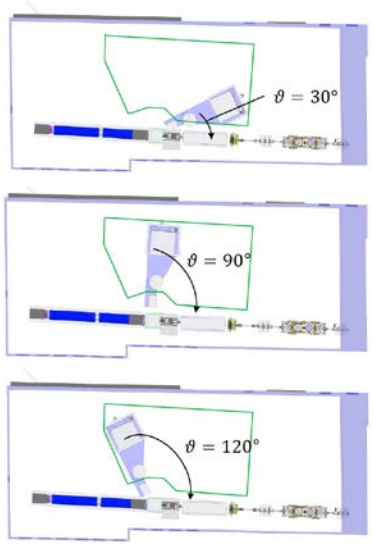


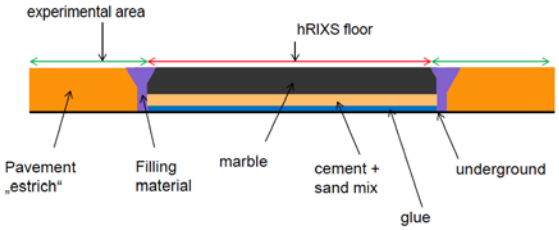

Ghiringhelli et al., Rev. Sci. Instrum. 77, 113108 (2006)

European XFEL

# SCS High quality floor





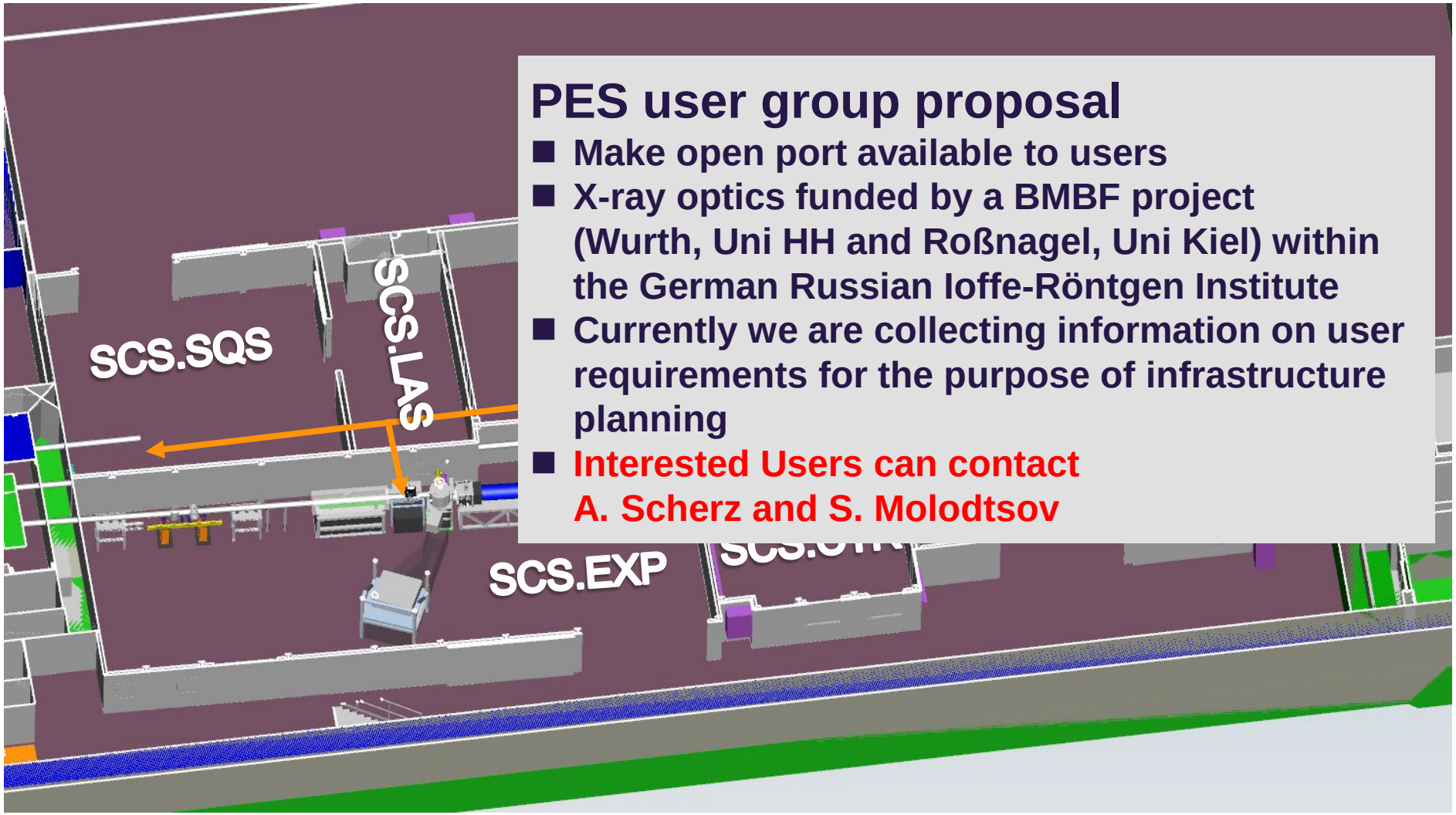




## SCS Precision Floor

- Installation started in March.
- Floor still not fully within specifications because of flood
- Work finished in 10/2015

# SCS/SQS-2 experiment hutch
## User port






### PES user group proposal

- Make open port available to users
- X-ray optics funded by a BMBF project (Wurth, Uni HH and Roßnagel, Uni Kiel) within the German Russian Ioffe-Röntgen Institute
- Currently we are collecting information on user requirements for the purpose of infrastructure planning
- Interested Users can contact A. Scherz and S. Molodtsov

# SCS team and 2016 build-up



**Robert Carley**
*SCS Instrument Scientist*

**Jan Torben Delitz**
*SCS Instrument Engineer*

**Loic Le Guyader**
*Peter Paul Ewald fellowship*
VolkswagenStiftung

**Justine Schlappa**
*SCS Instrument Scientist*

**Alexander Yaroslavtsev**
*SCS Staff Scientist*

**Carsten Broers**
*SCS Technician*

**Manuel Izquierdo**
*SCS Instrument Scientist*

**Komal Khandelwal**
*SCS Student assistant*

**Alexander Sorin**
*SCS Student assistant*


SCS Staff ramp up