Technical design of the SCS instrument at European XFEL

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Overview

The Spectroscopy and Coherent Scattering (SCS) instrument provides the opportunity to investigate electronic and atomic structures in the condensed phase, as well as the dynamics of soft matter, and magnetic and biological materials. The experiments will use the scattering of coherent X-Rays and the resulting diffraction pattern. In coherent diffraction experiments imaging (CDI) 2D and 3D structures of condensed matter samples will be investigated up to a spatial regime of 10 nm. Resonant magnetic scattering and X-Ray correlation spectroscopy are techniques which can be conducted at the SCS instrument. Besides a general overview this poster describes the Fixed Forward Target chamber (FFT) and the technical realisation of the optical laser delivery setup (LIN) foreseen to perform pump-probe experiments.

Conceptual Design Report:
SCS Instrument
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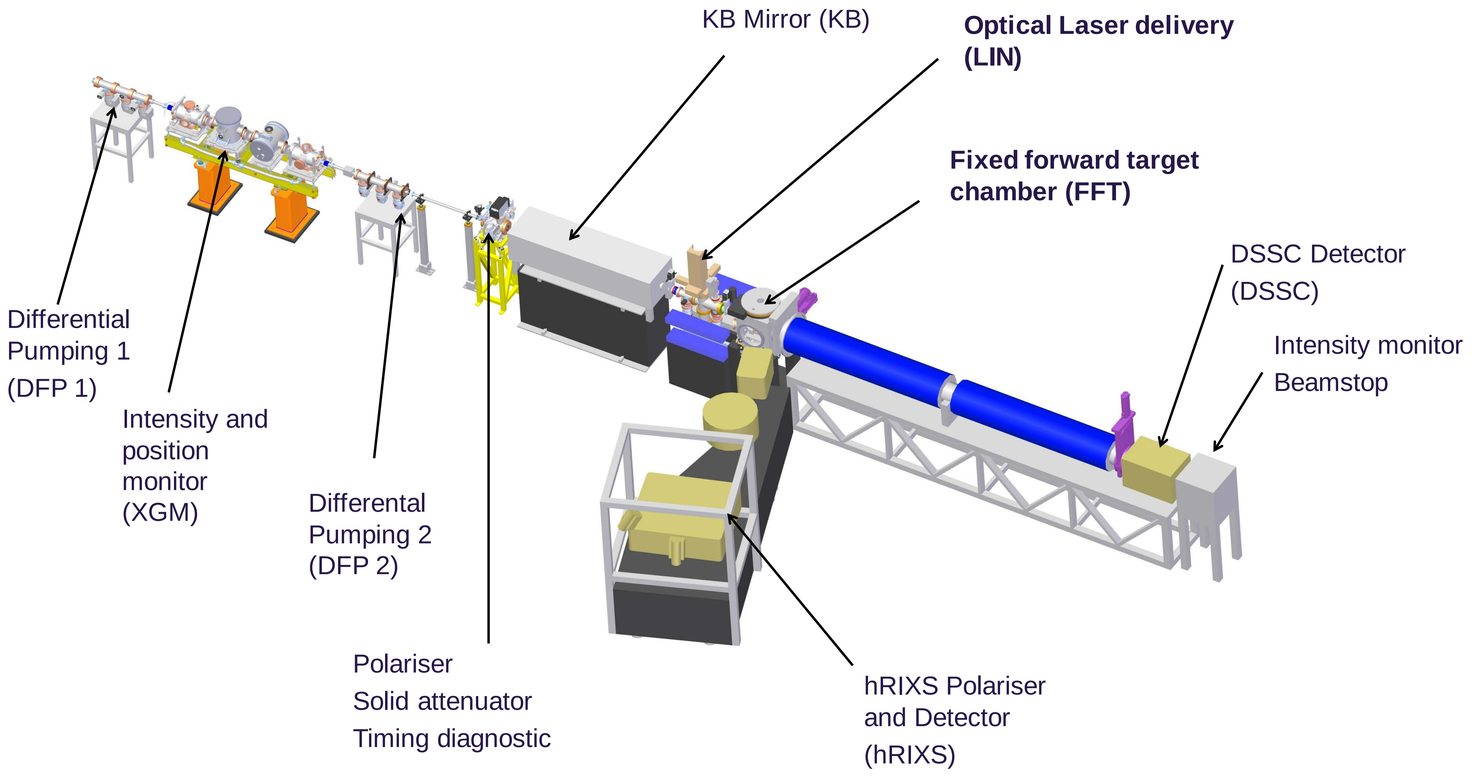
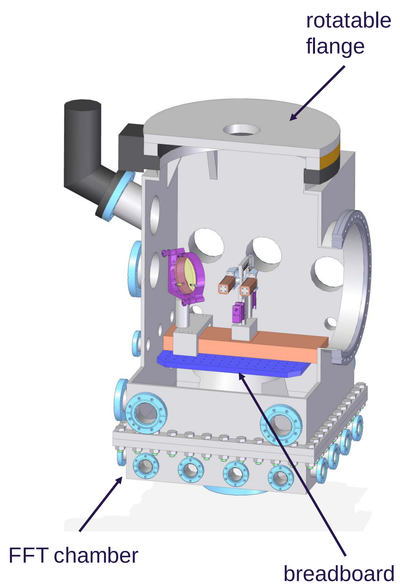
Key Facts

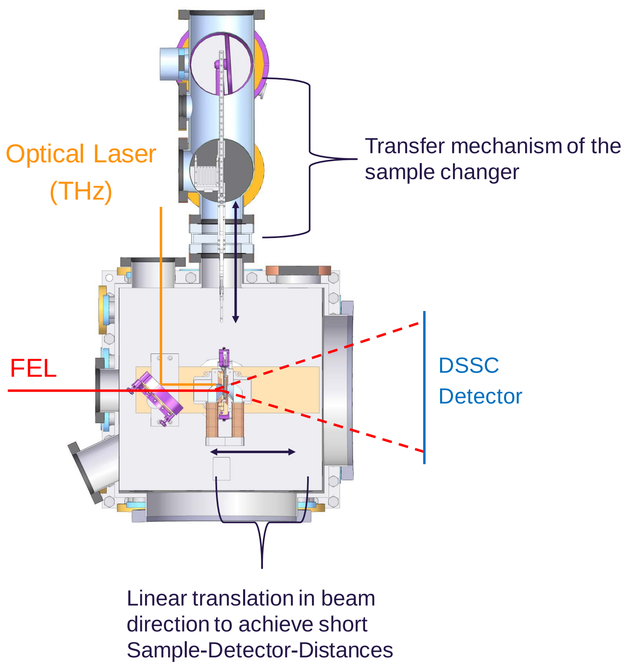
- Coherent X-Ray beam
- Energy range 0,5 keV – 3 keV
- Pulse duration 2 fs to 100 fs
- Energy resolution monochromator tunable:
  - up to $\Delta E / E \sim 1 \times 10^{-4}$
- Precision bent KB system
  - Focus: 1.5 × 1.5 µm² - 1 × 1 mm²
- DSSC Detector (DEPFET Technology)
  - Pixel number: 1024 × 1024
  - Pixel size: ~ 230 µm (hexagonal)
  - Frame rate 0.9 – 4.5 MHz
  - Stored frames per bunch ≥ 640
  - Sample detector distance: 0.34 m – 5.5 m

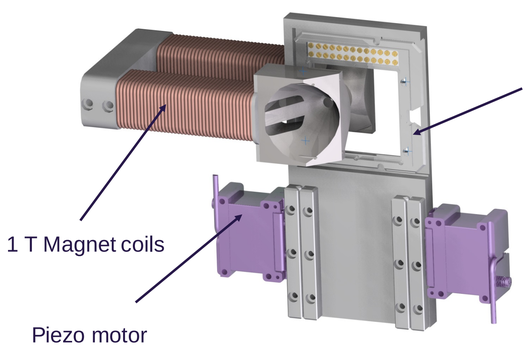


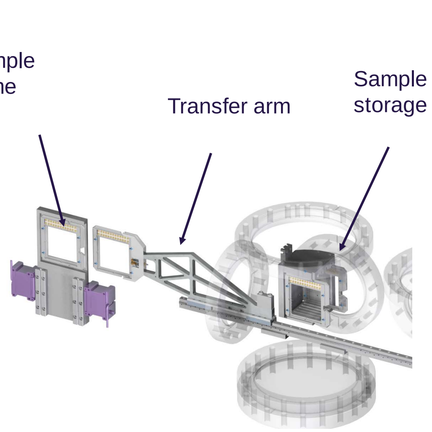
Fixed Forward Target chamber (FFT)

Fixed samples in forward scattering geometry will use this chamber. The main components in the FFT chamber are the sample holder (50 mm × 50 mm), the mirror (3'') for THz delivery as well as the diagnostic for position and timing . An automated sample changer with an attached load lock will provide fast exchange of the sample holder. The sample positioning solution based on piezos (v > 0.25 m/s, a > 0.10 m/s²) and is under construction by the XFEL sample environment group.
A magnet with fields up to 1 T can be positioned to the sample.
The breadboard based support for the sample holder and the THz mirror will be moveable, so that they can be aligned precisely onto the X-Ray beam.



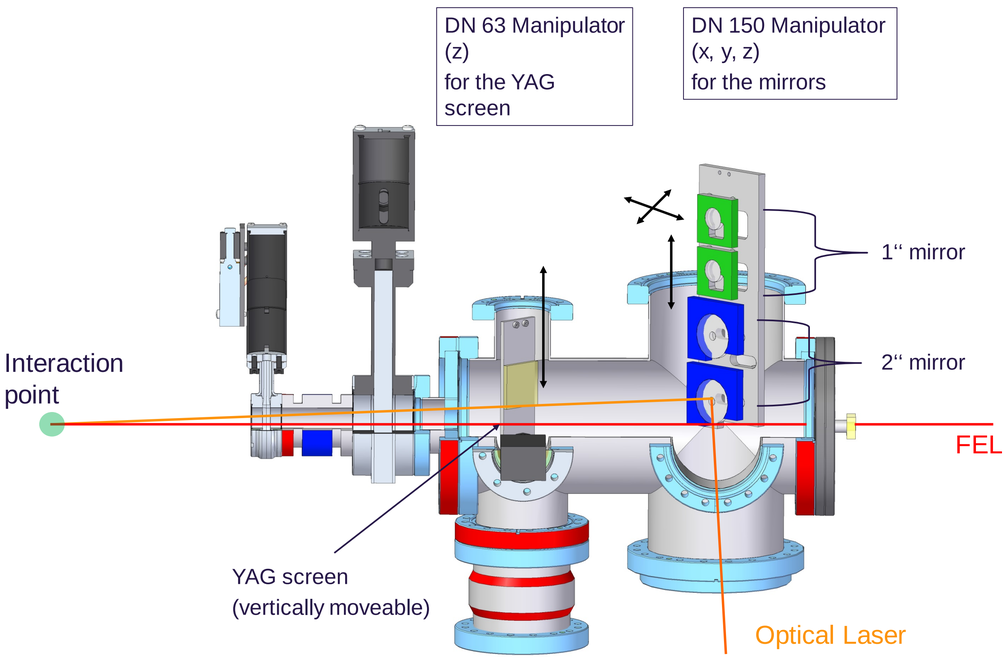




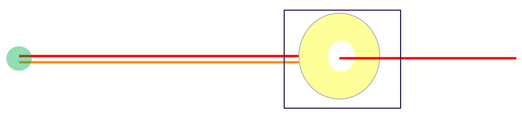


Optical laser delivery (LIN)

Delivery of the optical laser (OL) (for example 800 nm, 15 fs, up to 30mm diameter) is based on a stack of mirrors in vacuum which can be moved by a manipulator (x, y, z). Each mirror holder will be fitted with piezo motors (PI Micos: Piezomike) for horizontal and vertical tilt. Focusing optics outside of vacuum give a focal length of 1200 mm. A coaxial (based on a mirror with a hole for the FEL) and a non coaxial (without a hole) solution are foreseen for different beam sizes.
A moveable YAG screen observed by a camera after the mirror will be used for alignment of the OL and the FEL beam at the same time. Besides the function as an optical delivery the unit will act as a differential pumping stage to maintain good vacuum (10^{-9} mbar) in the KB chamber.



Coaxial solution (2'' mirror)



Non coaxial solution (1'' and 2'' mirror)