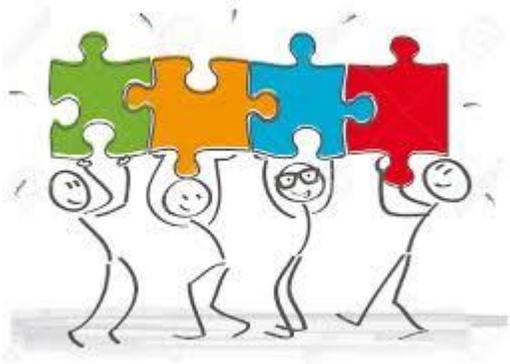




HESEB – The Helmholtz-SESAME soft X-ray beamline

Annick Froideval
HZDR, Dresden, Germany

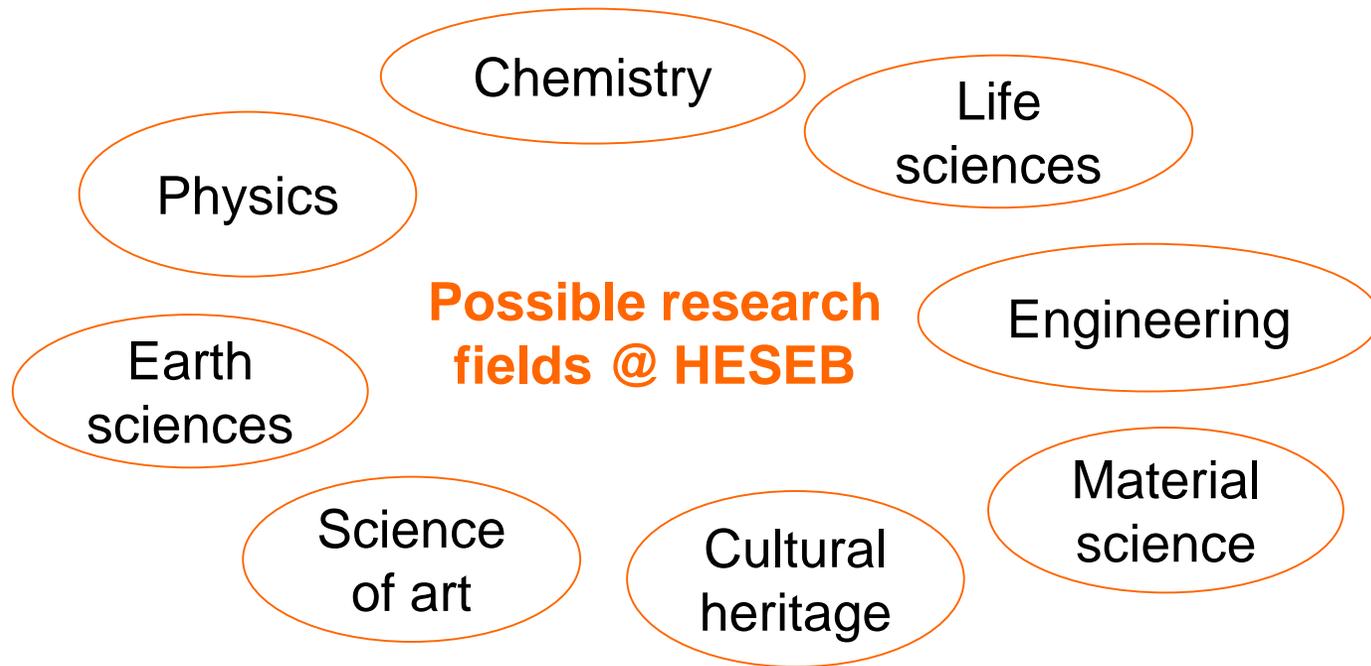
Outline



- HESEB project:
 - structure, goals, timeline, achievements and next steps -
- Beamline description
- Examples of possible experiments @HESEB

HESEB initiative: a short introduction

- An initiative by the **Helmholtz Association of German Research Centers** to implement a **new beamline at SESAME** for scientific applications using **soft X-ray spectroscopic techniques**



HESEB project: an international cooperation

- Large number of top-class scientific applications
- New cooperation potentials with German and international research groups



- **SESAME member states:**

Jordan

Cyprus

Egypt

Iran

Israel

Pakistan

Palestinian authority

Turkey



The HESEB project in a nutshell

- **Project consortium:**

5 centers of the Helmholtz Association of German Research Centers

DESY: Deutsches Elektronen-Synchrotron (project coordinator)

FZJ: Forschungszentrum Jülich

HZB: Helmholtz Zentrum Berlin für Materialien und Energie GmbH

HZDR: Helmholtz-Zentrum Dresden-Rossendorf e.V.

KIT: Karlsruhe Institute of Technology

in collaboration with SESAME and SESAME member countries and beyond

- **Project running time:**

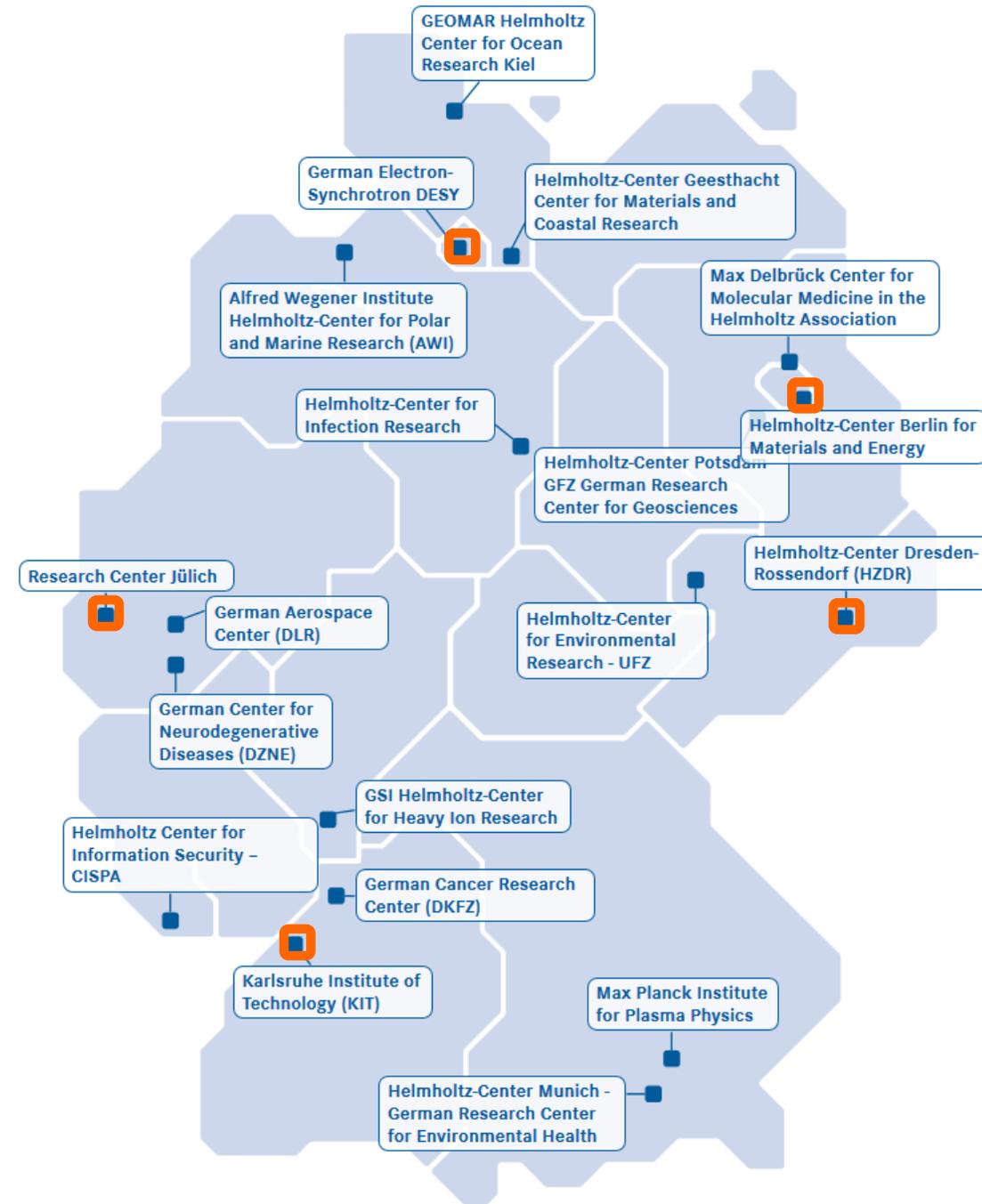
Starting date: 1 January 2019

End date: 31 December 2022

- **Budget:**

3.5 Mio EUR from the Helmholtz Initiative & Networking Fund

<https://heseb.desy.de/>



HESEB - Project goals

Main goals to be achieved:



→ the **construction and commissioning of the beamline at SESAME**

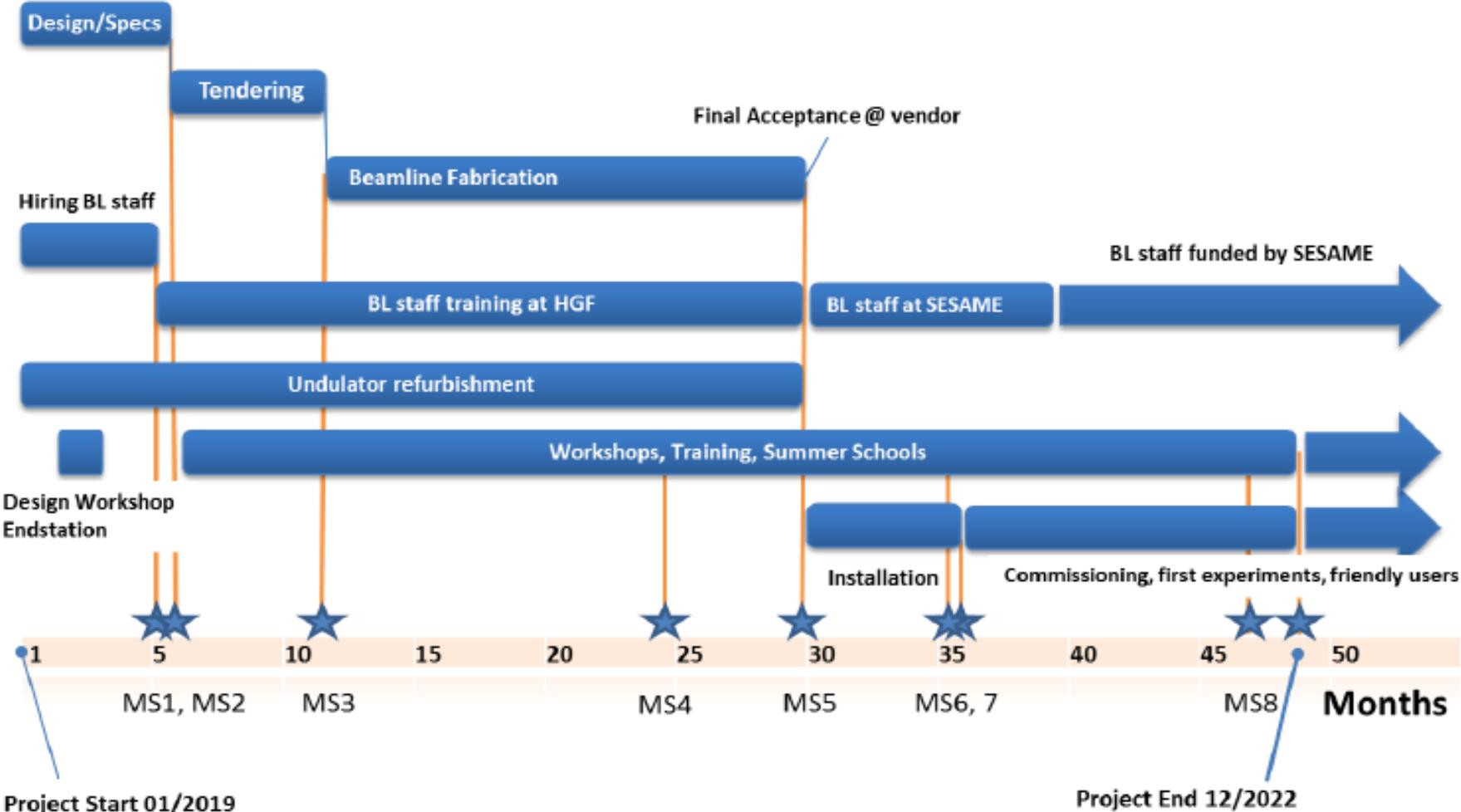
→ the **leveraging of additional contributions from the SESAME member countries** to promote the build-up of international user consortia and to secure funding for experimental endstations and additional instrumentation

→ the **training of SESAME staff** at participating Helmholtz centers to enable reliable operation of the beamline by local staff

→ the fostering of the **establishment of a broad user community of HESEB** from the SESAME member states through training, workshops, and schools



HESEB - Project timeline



HESEB - Project structure

- **6 work packages:**

WP1: Beamline

WP2: Undulator

WP3: Commissioning

WP4: Beamline staff

WP5: User support

WP6: Project management



WP1: Beamline

- Design, specifications and procurement
- Lead Partner: DESY

WP2: Undulator

- Design and refurbishment
- Lead Partner: HZB

WP3: Commissioning

- Installation and commissioning
- Lead Partner: FZJ

WP4: Beamline staff

- Recruitment, training and education of staff
- Lead Partner: KIT

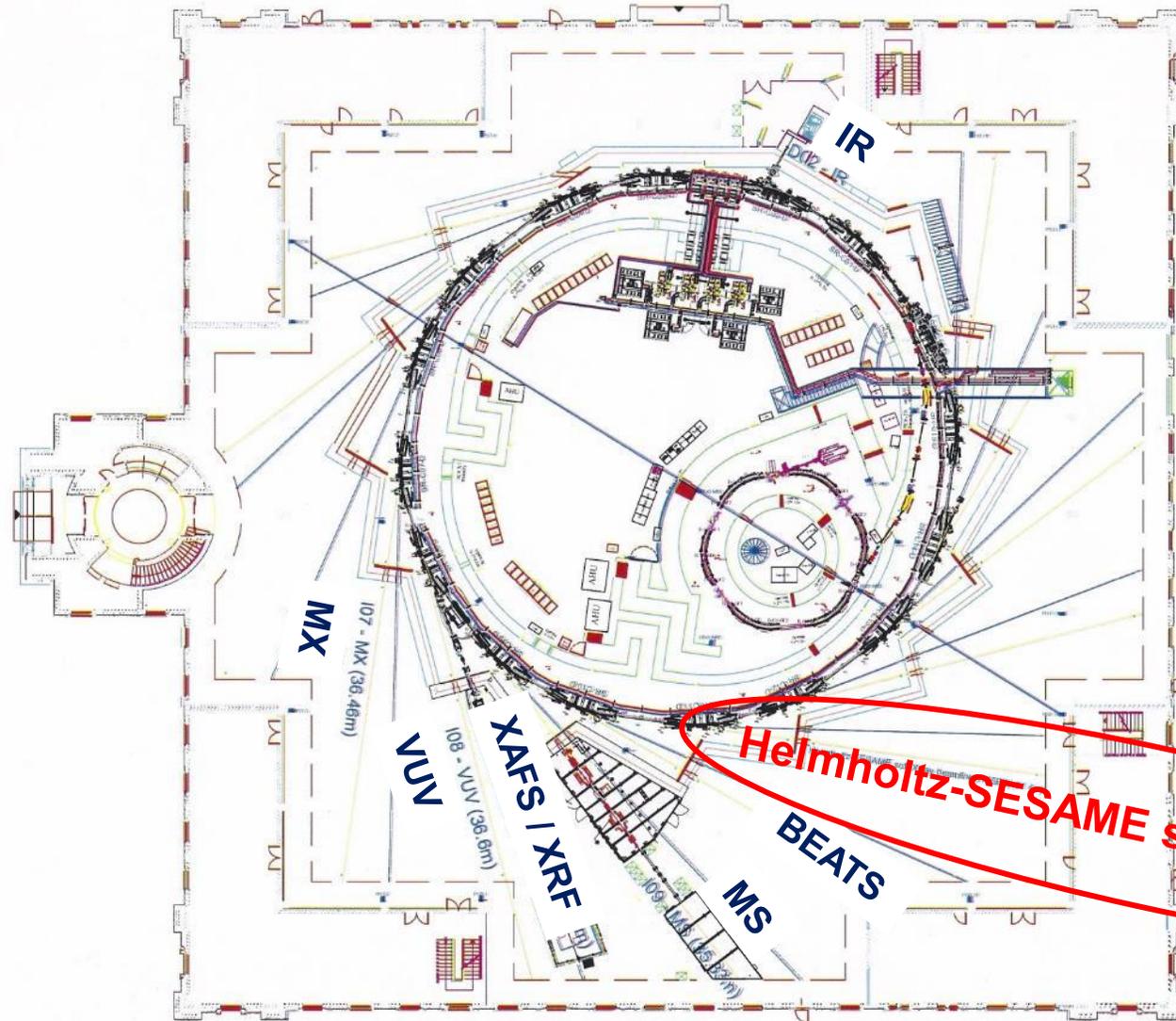
WP5: User support

- Training and user community build-up
- Lead Partner: HZDR

WP6: Project Management

- Management of project, communication, outreach
- Lead Partner: DESY

SESAME layout and position of HESEB



HESEB will become available for the SESAME user community within the four-year HESEB project duration.

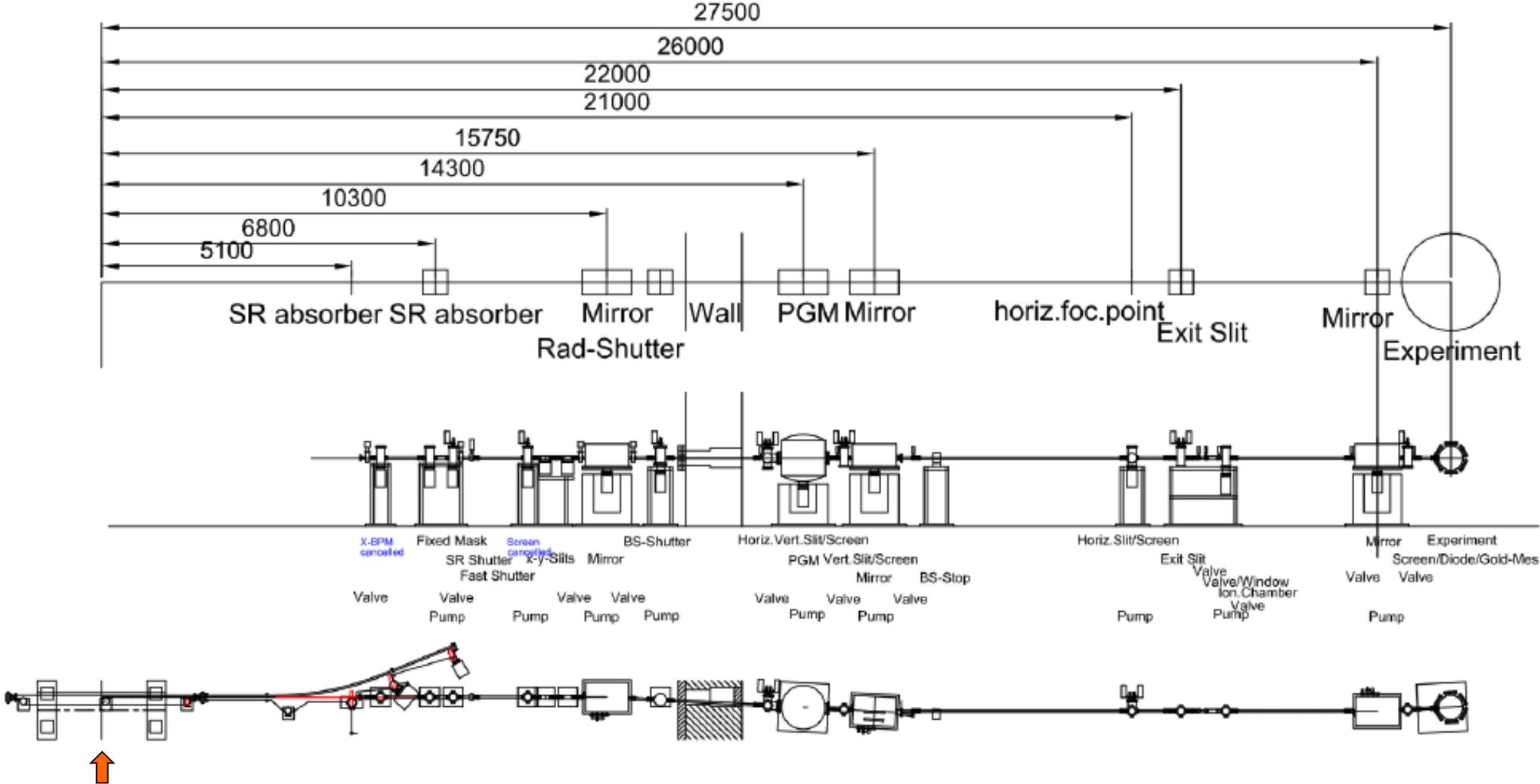
1st light @ HESEB expected first half of 2021

Helmholtz-SESAME soft X-ray beamline

HESEB Beamline

Beamline Layout

Distances (in mm) from undulator center to beamline components

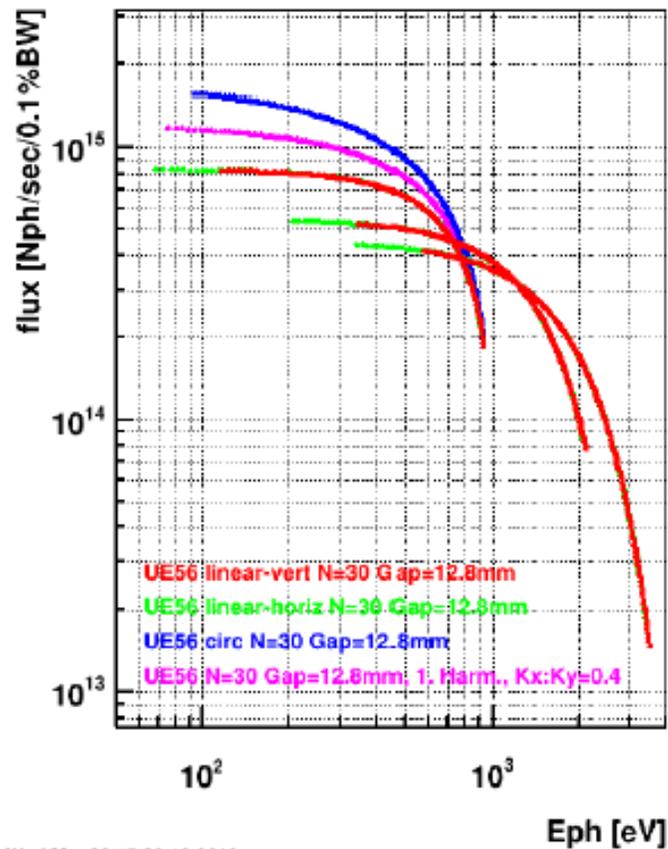


HESEB Beamline

Undulator UE56 with variable polarization

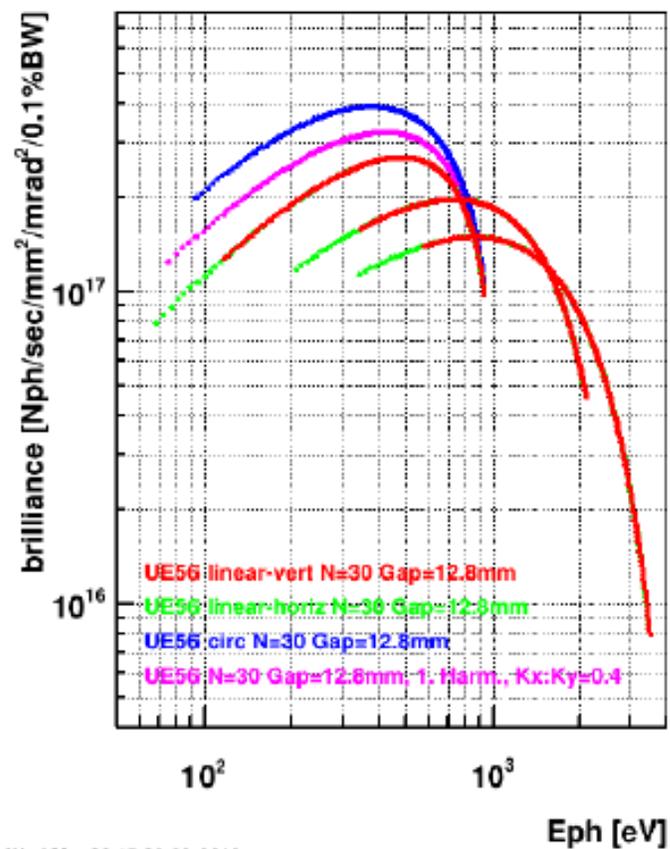
Spectral properties of UE56 undulator for a Gap of 13.4 mm:

Flux, 2.5 GeV, 400 mA

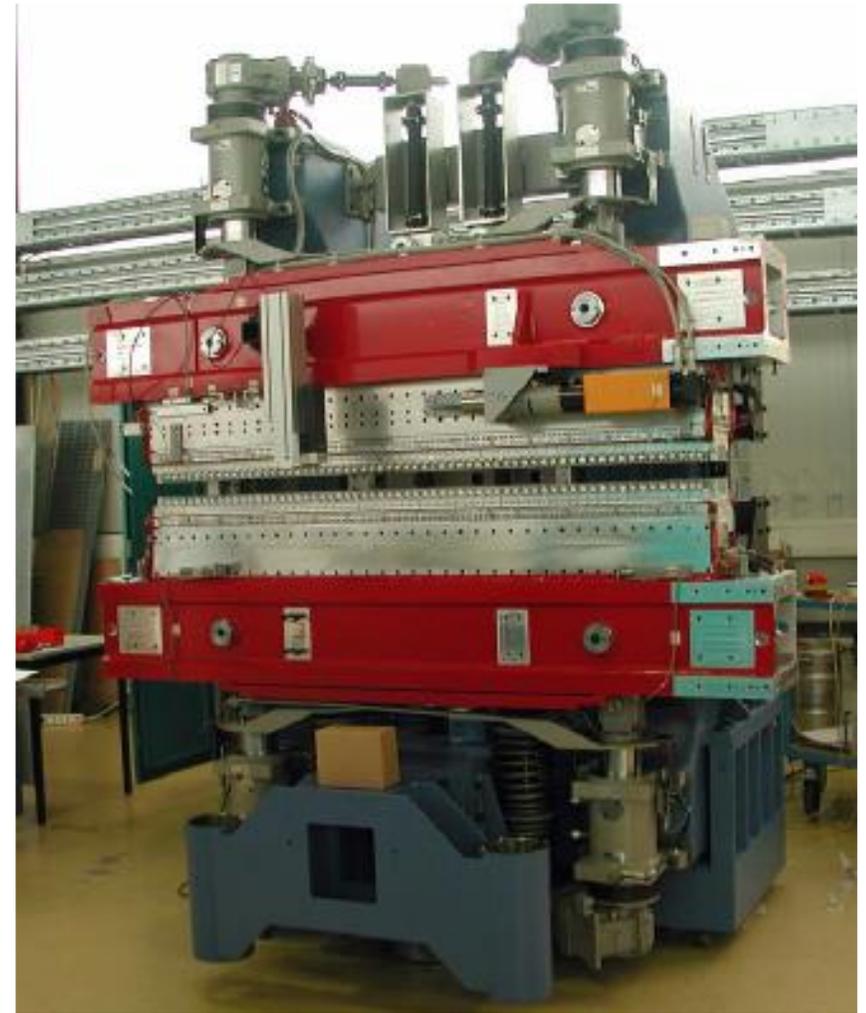


Wed Mar 28 15:39:13 2016

Brilliance, 2.5 GeV, 400 mA



Wed Mar 28 15:39:03 2016



A photograph of an UE56 undulator (HZB)

HESEB - Activities within WP1

Design, specification and procurement of a beamline in the soft X-ray range

Design:

✓ **June 2019: Technical design review** of the HESEB beamline by three international experts

April 2020 - Kick-off meeting beamline fabrication at FMB GmbH (April 7th, 2020)

Beamline component	Value
Undulator	UE56 APPLE II type device – donation of BESSY II, being refurbished) –
Length / Period	1.7 m / 56 mm
Polarization modes	circular, linear
E_{photon} range	from ~ 70 eV to 1.8 keV
Photon flux (on sample)	$10^{12}/\text{s}$
Monochromator	collimated plane-grating monochromator (BESSY design)*
Beamline layout / endstations	(i) NEXAFS, XMCD, RIXS (ii) ARPES (iii) PEEM (optional)

*R. Follath and F. Senf., Nucl. Instrum & Methods Phys Res A, **390**, 388 (1997).

HESEB - Activities within WP4

Training and Education of future beamline staff



- **Position of beamline scientist @HESEB**
 - **Hiring of Mustafa Genişel**
Dicle University, Turkey
Surface and Material Advanced Research and Technology Lab (SMART Lab)



- **Official start: February 1st, 2020**



- **Beamline training at KIT @WERA beamline** with Stefan Schuppler and co-workers

I. HESEB - Activities within WP5

User support, cooperation development, Seed Projects / Teaming



Activities during the project phase aiming at building a strong HESEB User Community:

- **Focused workshops**
- **Summer schools** adopting the format of the renowned HERCULES specialized courses
- **Research stays** of several weeks at suitable facilities of Helmholtz centers or collaborating European partners
- **Twinning program** with experienced soft X-ray users acting as mentors for new HESEB users and offering support for experiment set up, during beamtime and for data analysis

II. HESEB - Activities within WP5

User support, cooperation development, Seed Projects / Teaming



HESEB - Helmholtz-SESAME soft X-ray beamline



First HESEB workshop on soft X-Rays
Istanbul, March 30th to April 1st, 2020

- **Workshop postponed to Autumn this year due to the spread of the coronavirus (COVID-19) and its international consequences**

Information about the dates as soon as possible

<https://www.hzdr.de/db/Cms?pOid=58977&pNid=0>

- **Today's webinar offered with introduction to:**
(i) HESEB Project & (ii) Twinning Programme

HESEB: a versatile state-of-the-art instrument

Offered soft X-ray experimental techniques

→ photon-in photon-out spectroscopy

→ photon-in electron-out spectroscopy

- **Initial planned experimental station:**

= a **sample scanning stage** and a **solid-state detector** allowing photon-in photon-out spectroscopy, and energy dependent x-ray absorption spectroscopy

→ probing of the **elemental structure of matter**, with a focus on the study of archeology artifacts of regional cultural heritage (XRF)

→ probing the **elemental and chemical composition of materials** (NEXAFS)

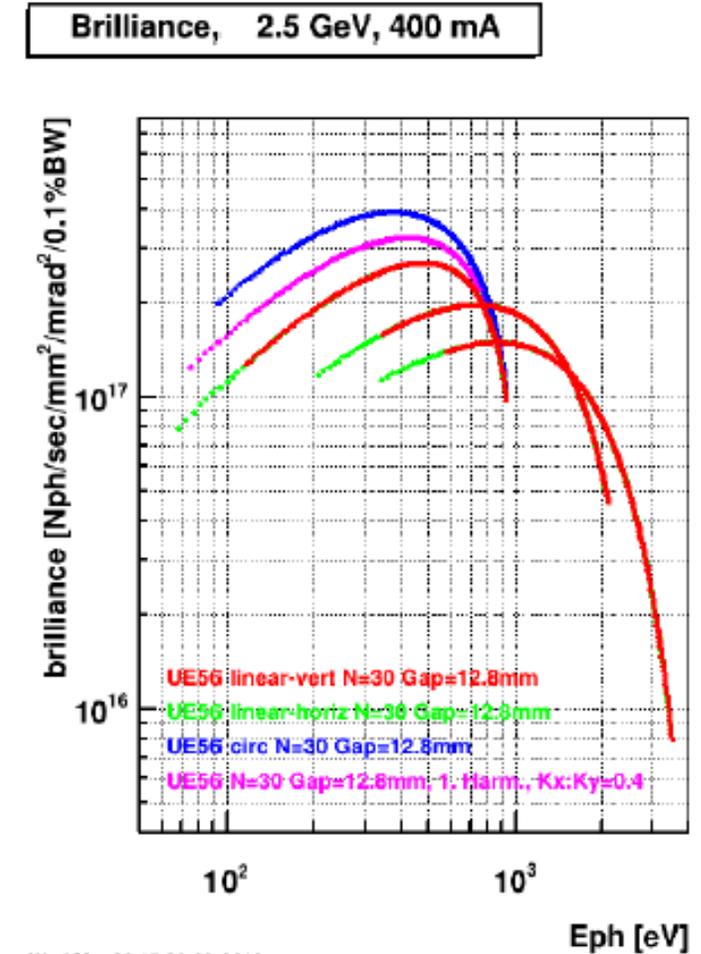
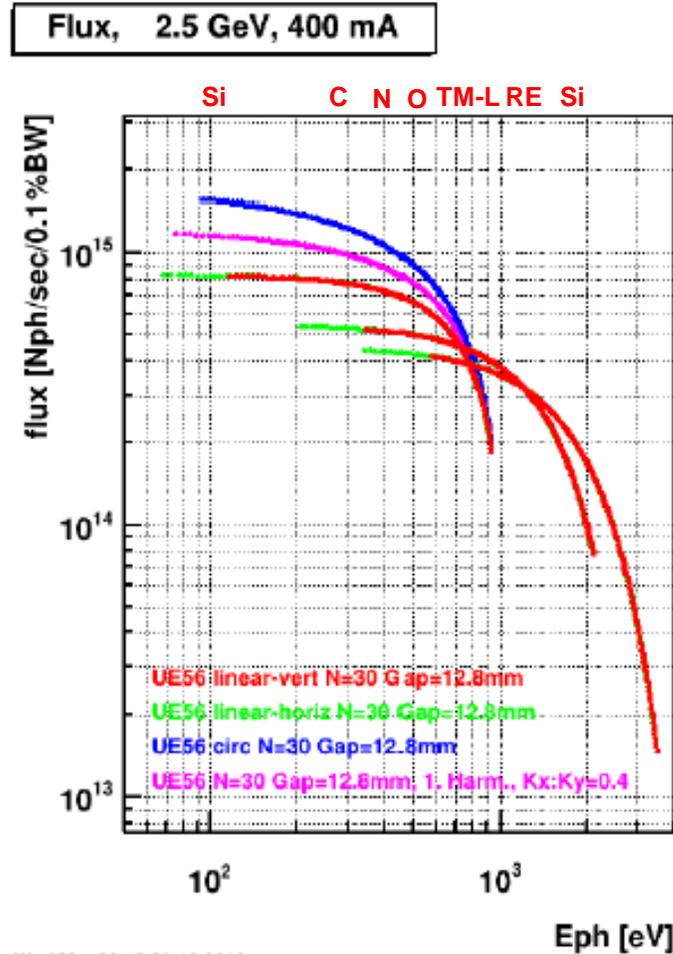
→ studying **elemental specific magnetic properties of materials** (XMCD) by using circular polarization

- **A large range of possible experiments offered to the users**

Soft X-ray science possible @HESEB

Soft X-rays → High Resolution Spectroscopy

- Covers a wide range of core absorption edges:
 - Si L-edge
Semiconductors
 - C-, N-, O- K-edge
Organics catalysis
 - TM- L-edges **magnetics**
 - RE 3d edges **magnetics**
 - Al- K-edge, Si-K-edge



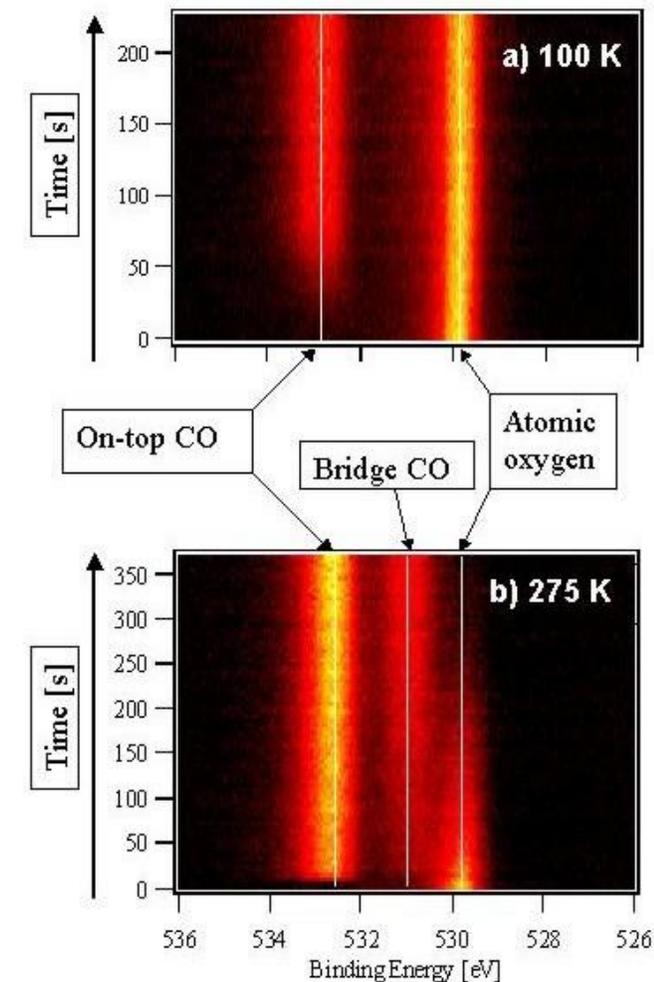
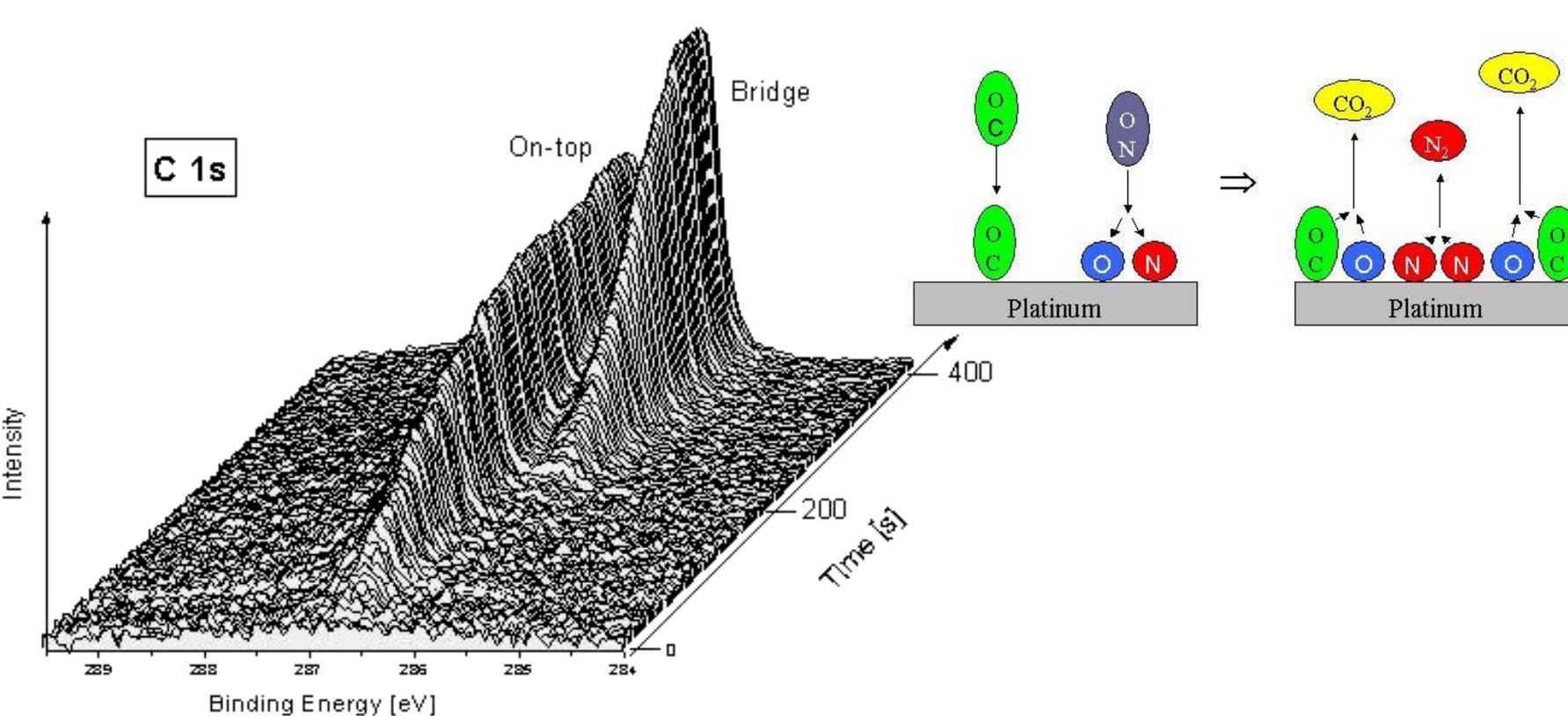


Chemical reaction dynamics on surfaces

R. Denecke, M. Kinne, T. Fuhrmann, C. Whelan, J. Zhu, H.P. Steinrück (Univ. Erlangen)

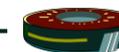


Study of the kinetics of the adsorption system CO/NO/Pt(111) by time-resolved high-resolution XPS

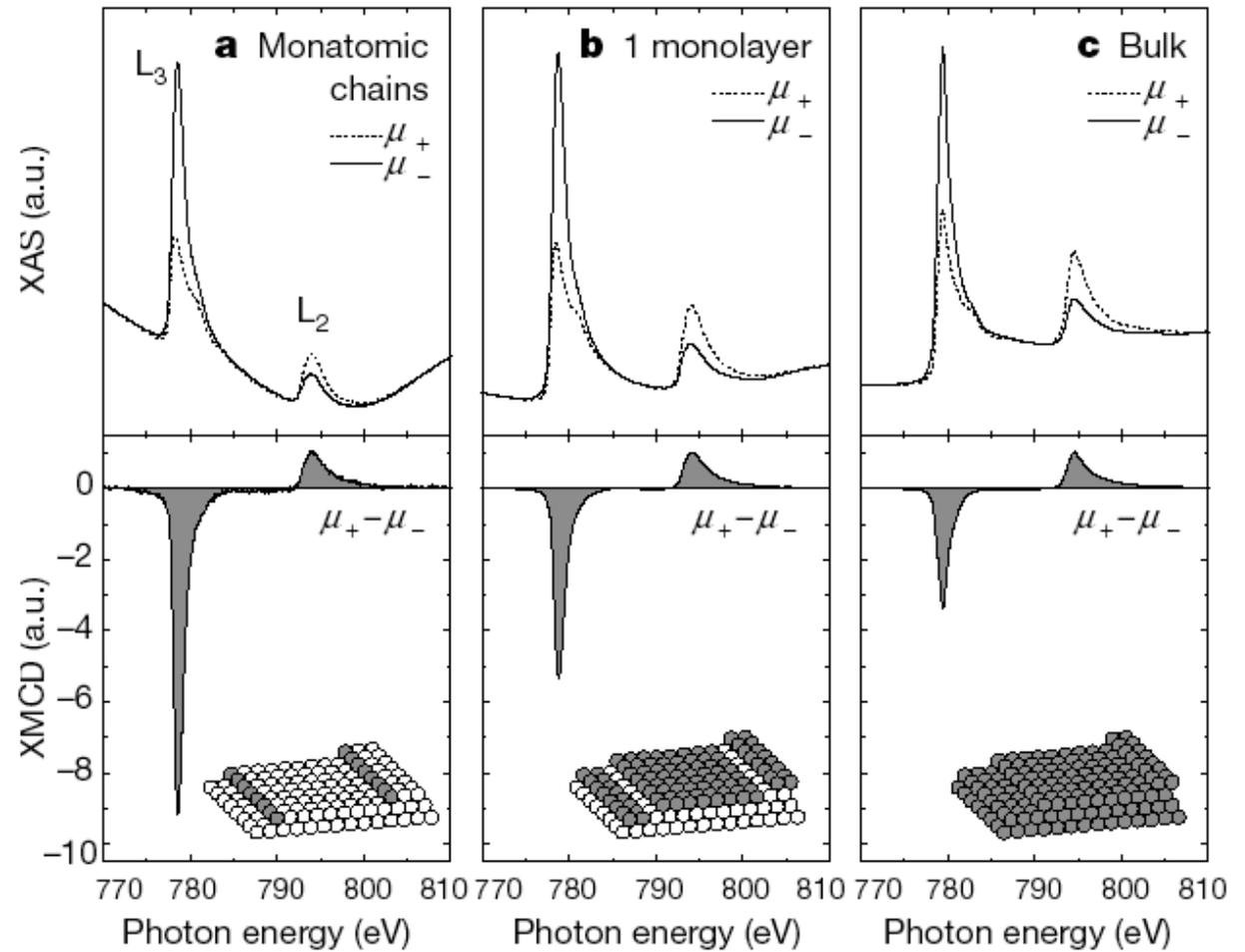
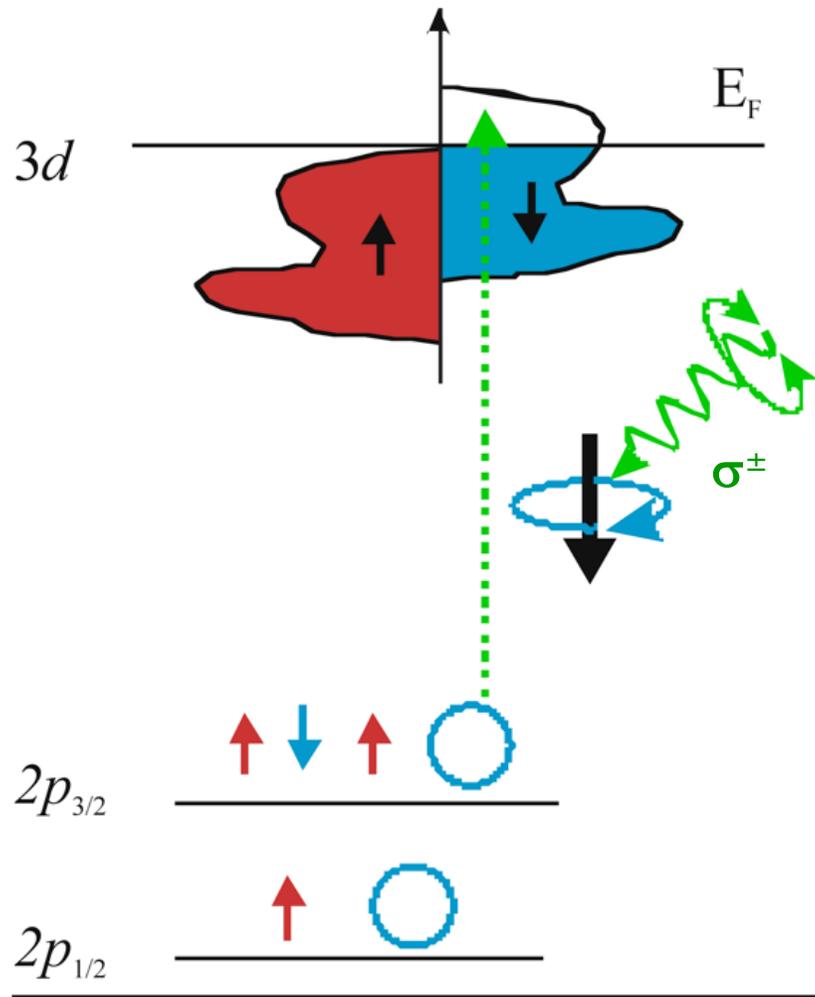


Binding sites of CO on a Pt surface identified by high resolution time-resolved XPS

M. Kinne et al., J. Chem. Phys. 117, 10853 (2002)



Magnetic Systems → CMXD



P. Gambardella, A. Dallmeyer, K. Maiti, M. C. Malagoli, W. Eberhardt, K. Kern, C. Carbone, Nature 416, 301 (2002)

Conclusions

- The HESEB soft X-ray beamline is:
 - an integral part of SESAME's suite of beamlines / instruments, contributing successfully to the scientific output of the facility
 - planned as a versatile instrument offered to the user community
- Technical design completed
- Tender procedure completed
- First light expected early 2021
- User support: fostering of the establishment of a broad user community of HESEB from the SESAME member states through training, workshops, and schools



Acknowledgements

Thank you for your attention.