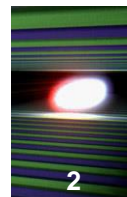




# EUCALL HIREP

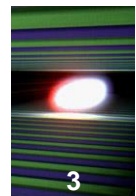
High repetition rate sample delivery  
Joachim Schulz

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- Unify sample positioning and characterization
- Give external users easy access to our facilities
- Enable users to characterize their samples/targets in their home labs
- Create a unified sample/target positioning system
  - Define common interfaces
- Share know-how and experiences
  - Open source software

# Who we are





**LUND UNIVERSITY**

Synchrotron  
light sources



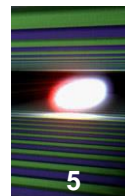



**High power  
laser facilities**

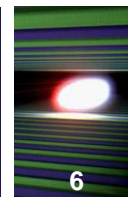



**X-ray free-electron  
lasers**

- 6.1 Automatic sample screening (ELI, XFEL, DESY)
  - Use positioning systems of commercial or custom made microscopes to find sample positions
  - Unify sample holder and coordinates
- 6.2 Position control (DESY, LU, HZDR, ELI, XFEL)
  - Learn from each other how we position samples and targets
  - Develop a prototype for an automated positioning system
  - Define an integrated system
  - Program automatization software
  - Making know how available for everyone!

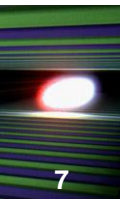


<b>Deliv. No.</b>	<b>Deliverable name</b>	<b>Lead participant</b>	<b>Type</b>	<b>Dissemination level</b>	<b>Delivery date</b>
<b>6.1</b>	Standard sample frame	<b>EuXFEL</b>	DEM	PU	Oct 2016
<b>6.2</b>	High precision scanning stages	<b>DESY MAX</b>	DEM	PU	Mar 2017
<b>6.3</b>	Beta version of sample identification software	<b>ELI</b>	DEM	PU	Mar 2017
<b>6.4</b>	EMP-compatible stages	<b>HZDR</b>	DEM	PU	Sep 2017
<b>6.5</b>	Sample frame with cooling and heating	<b>EuXFEL</b>	DEM	PU	Mar 2018
<b>6.6</b>	UHV microscope	<b>MAX DESY</b>	DEM	PU	Mar 2018
<b>6.7</b>	Automatic sample identification software	<b>ELI</b>	DEM	PU	Sep 2018
<b>6.8</b>	Integration of scanning stages with microscope	<b>EuXFEL</b>	DEM	PU	Sep 2018



Mil. no.	Milestone name	Work package(s)	Milestone date	Means of verification	Lead Participant
6.1 ✓	Specification for sample holder and sample stages	6.1/6.2	Oct 2015	Written agreement	XFEL & DESY
6.2 ✓	List of sample types for identification software compiled	6.1	Jan 2016	Written agreement	XFEL
6.3 ✓	Specification of the UHV microscope	6.2	Mar 2016	Written agreement	DESY
6.4	Specification of cooling and heating demands for samples	6.1	Dec 2016	Written agreement	XFEL

# Milestone 6.1: Specification for sample holder and sample stages (Oct 2015)



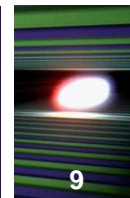
- 1/2: Small sample holder and ultra-high precision cryo sample stage
  - Biology sample  $5\mu\text{m}$  or larger
  - $10\mu\text{m}$  2D-grid up to  $10\times 10\text{ mm}^2$
  - Precision better than  $200\text{ nm}$
  - Standardizes fiducial marks
  - ID-label

# Milestone 6.1: Specification for sample holder and sample stages (Oct 2015)

- 2/2: Large sample holder and high precision sample stage
  - Universal samples or targets
  - Up to several millimetre 2D-grid 100x100 mm<sup>2</sup>
  - $\mu\text{m}$  precision with fast movement
  - Standardizes fiducial marks
  - ID-label
  - Carrier frame:
    - Specialized by facility
  - Inner frame
    - Optimized to sample/target

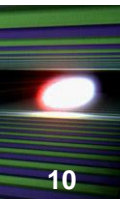


## Milestone 6.2: List of sample types for identification software (Jan 2016)



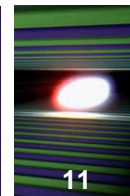
1. Periodically placed or manufactured targets on a support
  - Windows on foils or wafers
  - Reduced mass and nanostructures targets
  - Precisely placed biological samples
2. Statistically distributed targets on a support
  - Dried out suspensions
  - Self-organized growth
3. Homogenous materials with defects / cracks / discontinuities
  - Metallic glasses
  - Thin films

## Milestone 6.3: Specification of the UHV microscope (Mar 2016)

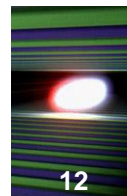


- Vacuum compatible
- Mounted on CF flange
- Accuracy better than  $1\ \mu\text{m}$ ; travel range  $>2\ \text{mm}$
- Camera outside vacuum
- On-axis viewing
- Field of view  $> 0.3 \times 0.3\ \text{mm}$
- Resolution better than  $1\ \mu\text{m}$
- Depth of field  $< 10\ \mu\text{m}$  to assist alignment
- Possibilities to insert filters for fluorescence microscopy
- Prototype available: March 2018 (Deliverable 6.6)

# Deliverable 6.1 due Oct 2016: Standard sample frame

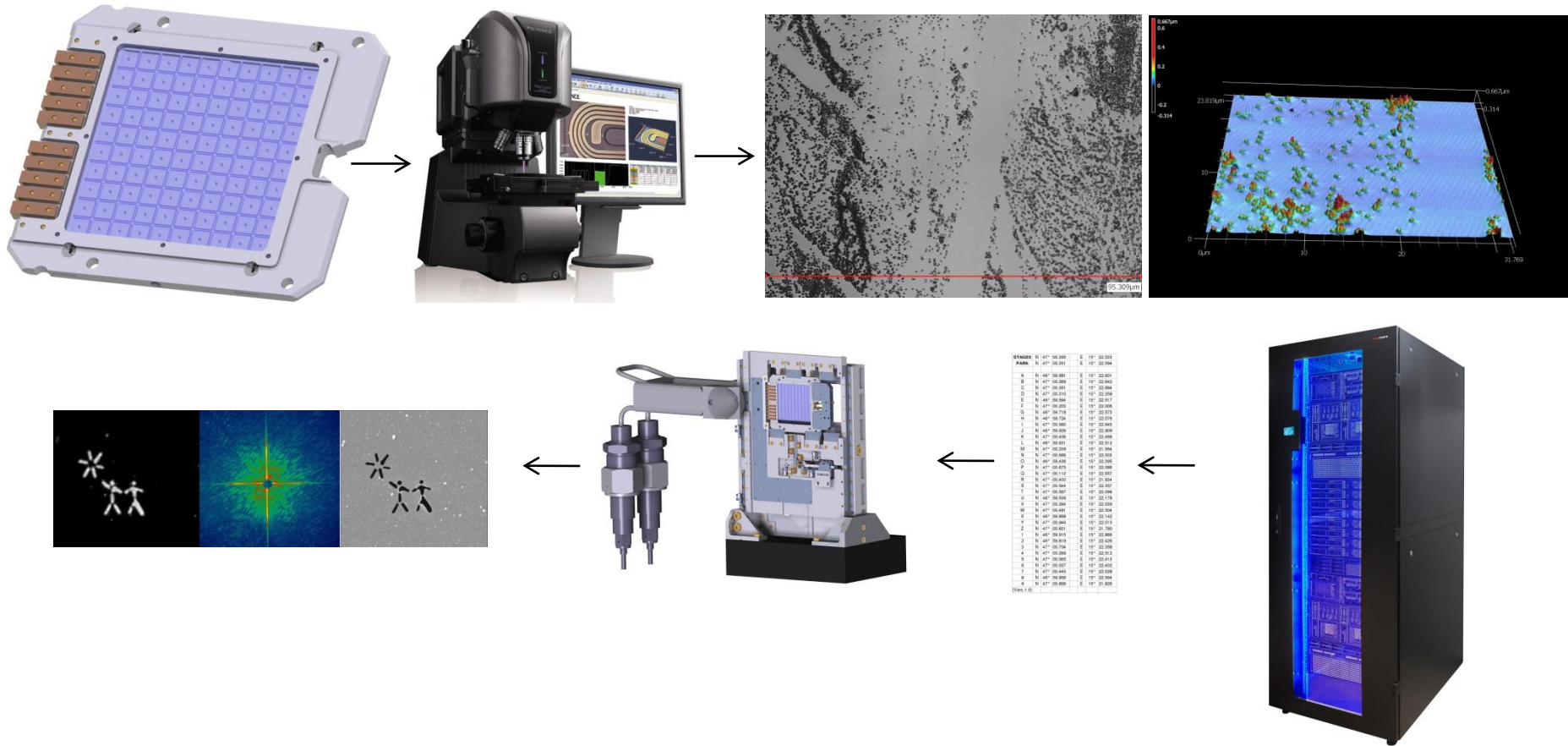
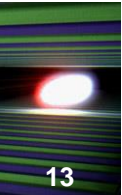


- Based on Milestone 6.1 2/2 we will design
  - Inner frame with:
    - 100 x 100 mm<sup>2</sup> active area
    - Places for four fiducial marks
    - Type and place of ID-tag on the frame
  - Outer frame
    - To hold the inner frame
    - Adapt to the European XFEL fast solid sample scanner or other facility specific instrumentation

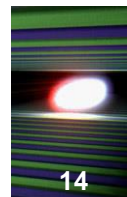


- Coordinating Partner: ELI beamlines
- Beta-Version: March 2017
- Complete: September 2018
- Automatic or semi-automatic sample recognition
- Generates a list of target positions
- Possibly with images of the target surrounding
- Common data format for list to be decided:
  - ASCII table?
  - NEXUS/HDF5

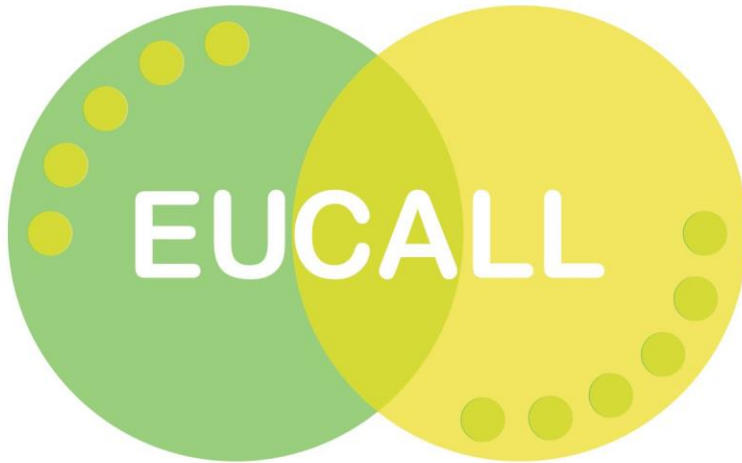
# pre investigation workflow



By Carsten Deiter (XFEL.EU)



- Ensuring EMP hardness of stages (D 6.4 Sep 2017)
  - Coordinating partner: HZDR
  - Test of stages with high power laser sources
  - Development of counter measures
- Integrated demonstration system (D 6.8 Sep 2018)
  - Coordinating partner: European XFEL
  - First integration of all components
  - Demonstration of the full sample investigation workflow
  - Release of all documents to enable users copying our systems



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