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The variable polarization undulator beamline UE52 PGM nanocluster trap at BESSY II

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Abstract: UE52 PGM nanocluster trap is a soft x-ray beamline at BESSY II that delivers an unfocussed low-divergence beam of variable polarization. Its characteristics are ideally suited for ion trap studies of magnetic properties.

1 Introduction

The variable polarization undulator beamline with plane-grating monochromator UE52 PGM nanocluster trap currently hosts the nanocluster trap end station.

2 Instrument application

Beamline UE52 PGM is used to investigate magnetic and electronic properties of a large variety of different samples. Because of its beam characteristics, UE52 PGM nanocluster trap currently hosts the nanocluster trap end station, which is set up behind the focal point.

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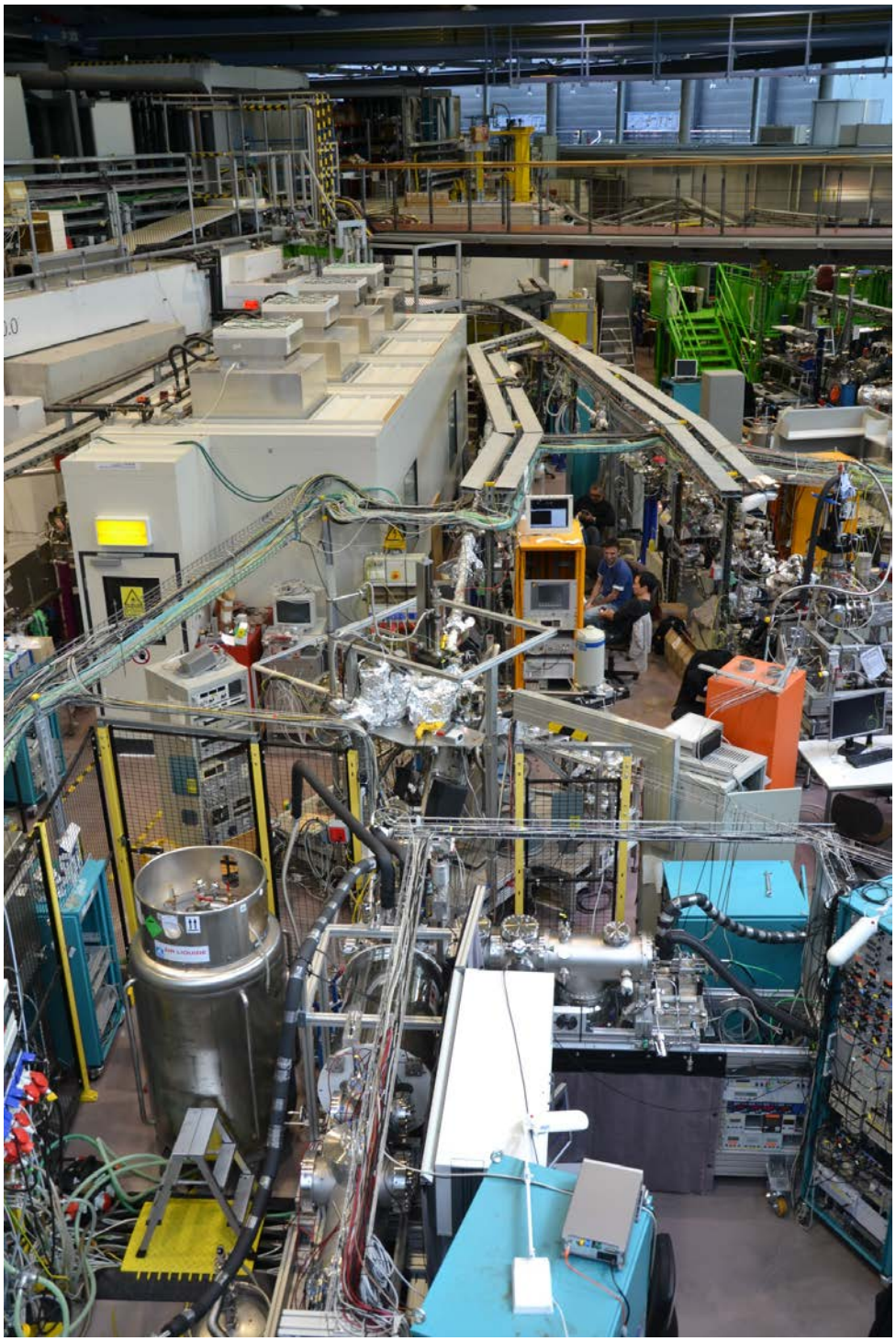

Figure 1: Top-view of beamline UE52 PGM Nano cluster trap.

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3 Source

The insertion device is the elliptical undulator UE52 with the following parameters

Type	APPLE2
Location	H09
Periode length	52 mm
Periods/Pols	77 n
Minimal Energy at 1,7 GeV	72 eV
Minimal Gap	16 mm
Polarisation	linear variable 0° ... +90° elliptical, circular

Table 1: Parameters of insertion device UE52.

4 Optical Design

UE52 PGM is equipped with an elliptical undulator and plane-grating monochromator with refocusing optics. The energy range of beamline UE52 PGM is similar to most soft x-ray beamlines at BESSY II; it covers 82 eV – 1900 eV in horizontal polarization and 115 eV – 1390 eV in elliptical polarization.

Two gratings with 360 l/mm and 1200 l/mm are in principle available in the plane-grating monochromator. The standard grating that is utilized by all user groups is the 1200 l/mm grating. This delivers a flux of 10^{10} to 10^{12} photons per second, per 100 mA ring current, and per energy bandwidth at 100 μm exit slit, depending on the photon energy.

Because the focal point of the beamline is occupied by the permanently installed UE52 PGM Co-ESCA end station, UE52 PGM nanocluster trap beamline does not deliver a focused beam, but rather a medium-sized beam profile of 0.65 mm × 0.70 mm, with a low divergence of 0.06 mrad in the horizontal and 0.14 mrad in the vertical direction at 700 eV photon energy as shown in Figure 2.

The low-divergence beam profile makes the UE52 PGM nanocluster trap beamline ideally suited for ion trap studies of atomic, molecular, and cluster physics on dilute samples in the gas-phase, where the overlap of ion cloud and photon beam has to be matched over distances of more than 20 cm. This is the main purpose of the beamline (Egorov et al., 2015; Hirsch et al., 2015; Langenberg et al., 2014; Niemeyer et al., 2012; Zamudio-Bayer, Hirsch, Langenberg, Kossick, et al., 2015; Zamudio-Bayer, Hirsch, Langenberg, Ławicki, et al., 2015; Zamudio-Bayer et al., n.d., 2013). In this respect, UE52 PGM nanocluster trap beamline is unique at BESSY II, because all other beamlines with elliptical polarization for flexible use at BESSY II feature high divergence beam profiles with very short distances between the beamline exit port (last valve) due to the installed micrometer focus optics.

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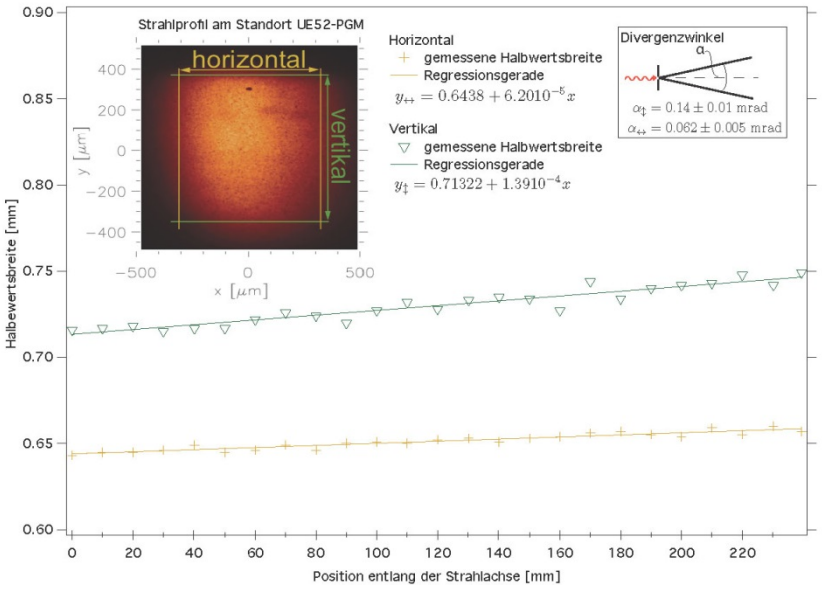

Figure 2: Typical beam profile (FWHM vs. position) at UE52 PGM. The spot size is ~0.6 × 0.7 mm^2 with a low divergence of 0.06 mrad (horizontal) and 0.14 mrad (vertical) at 700 eV and 100 μm exit slit.

5 Technical Data

Location	10.2
Source	UE52
Monochromator	PGM
Energy range	85 - 1600 eV
Energy resolution	> 10000 at 400 eV
Flux	10^{12}
Polarization	Variable
Divergence horizontal	0.8 mrad
Divergence vertical	0.2 mrad
Distance Focus/last valve	unfocussed low-divergence beam
Height Focus/floor level	1412 mm
Free photon beam available	No
Fixed end station	Yes

Table 2: Technical data of beamline UE52 nanocluster trap.

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