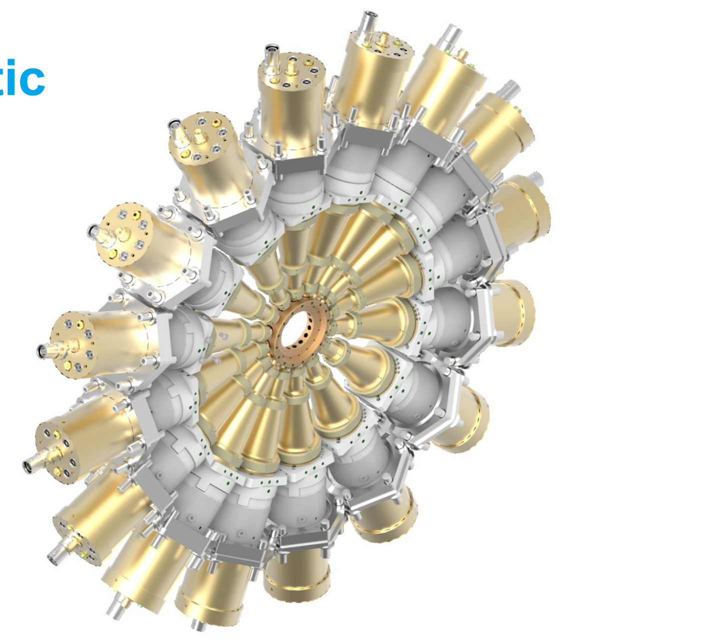
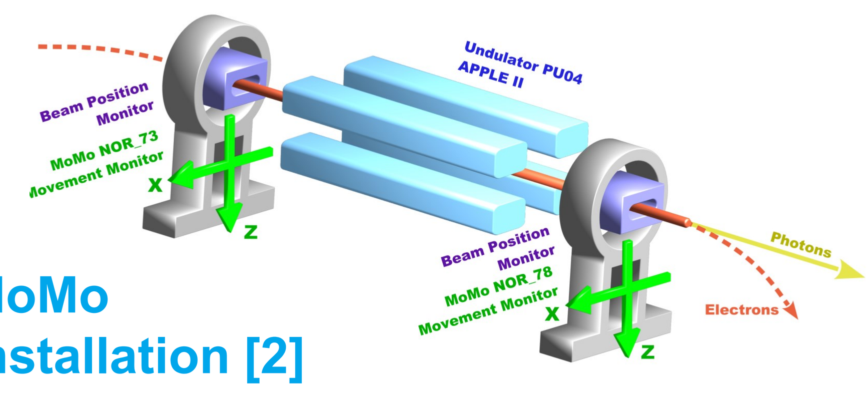
24

Performance of the variable polarization XUV beamline P04: Benchmarking and studies on stability.

J. Buck[1], G. Hartmann[1,2], F. Scholz[1], J. Seltmann[1], J. Viefhaus[1]
[1]DESY FS-PE, Hamburg, [2]Universität Kassel

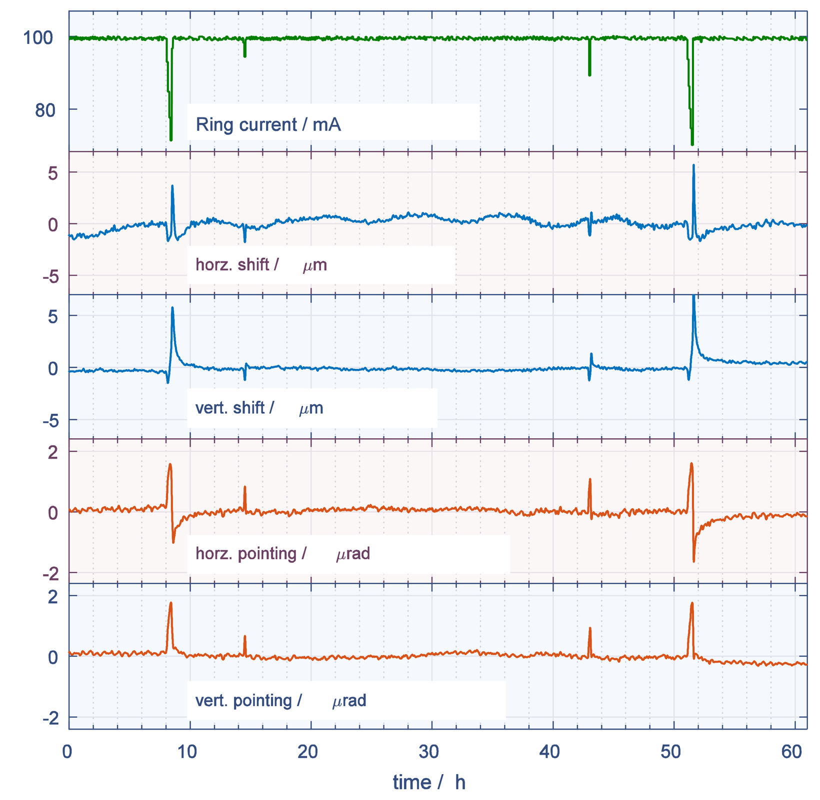
Diagnostic unit



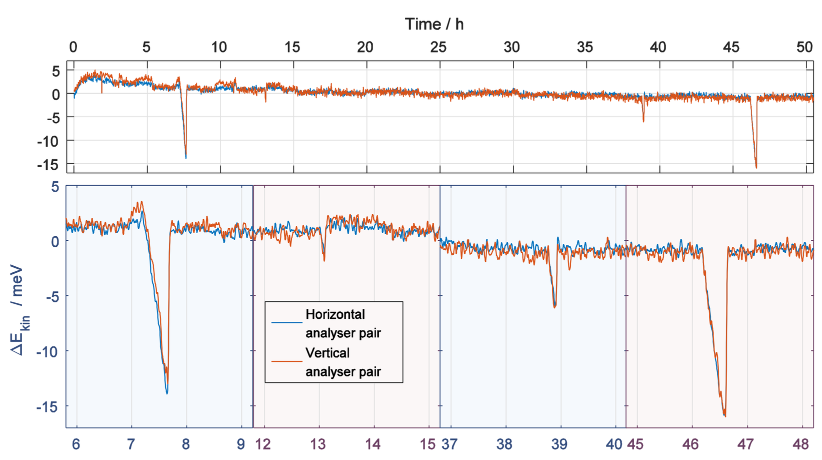


MoMo Installation [2]

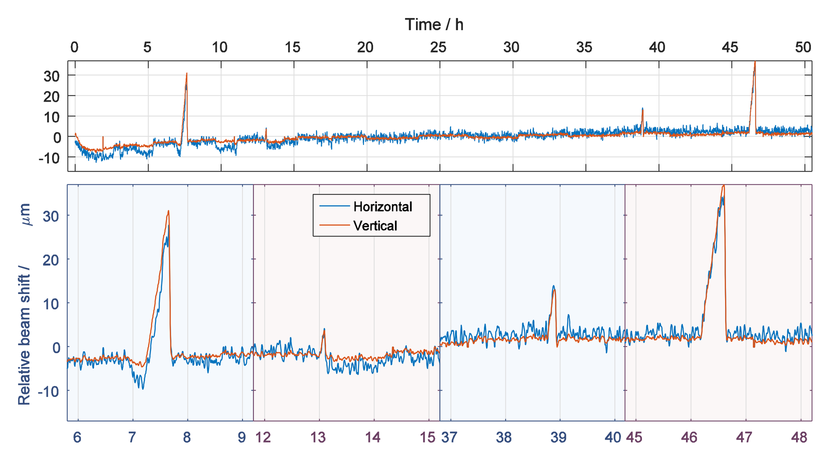
BPM movement [5]



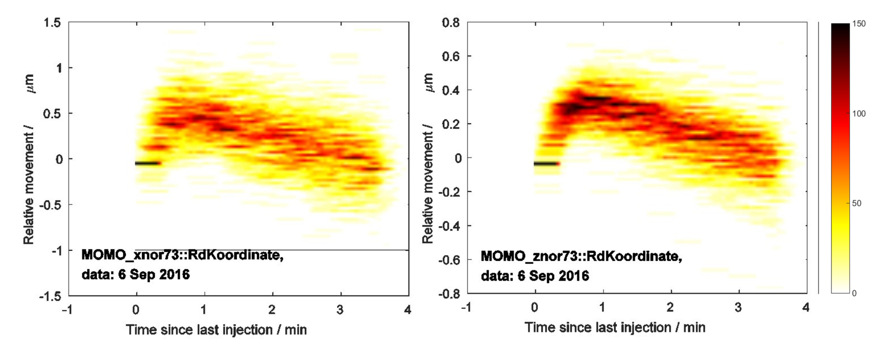
Photon energy shift



Beam position shift



MoMos during top-up



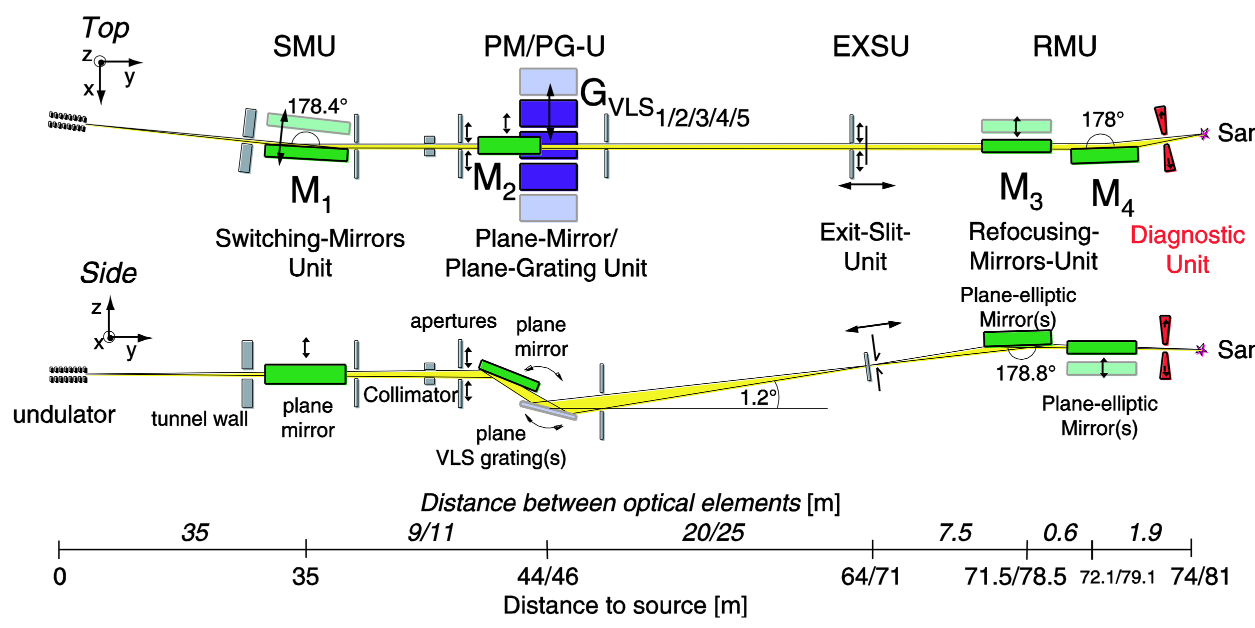
Introduction

The variable polarization XUV beamline P04 is now routinely operating at resolving powers beyond 10.000 and with a focal spot size at the end station of approximately 10 x 10 µm². User experiments can only make full benefit of these parameters in case the magnitude of instabilities does not exceed these values. The various diagnostic tools developed by the P04 team implemented at the beamline are not only capable of providing direct proof of the specs, but also serve as the basis for constant improvements of the beamline. We present recent measurements of stability and beamline alignment using the permanently installed non-invasive diagnostic unit and the hemispherical photoelectron analyzer setup (ARGUS) as well as the "focus finder" setup for beam profiling.

Experiment focus

The focus finder instrument as developed by P04 group [3] is optimized for fast image acquisition during continuous movement.
By scanning a thin YAG screen and a CCD camera in beam direction, it acquires 3D intensity profiles of the XUV beam in the region around the experiment focus.

We find a good match between the horizontal and vertical focal position, both reaching design values with minimal dimensions below 10 µm. The beam profiles obtained allow for a detailed assessment of carbon-induced optics degradation of all optical elements in the beamline. Among the aims of our future studies are the optimum placement of the refocusing mirrors and the reconstruction of the wavefront.



Source stability

The alignment of the beamline crucially depends on the stability pointing and position of the electron beam in the undulator. While the fast orbit stabilization of the storage ring typically proves great performance, we observe significant drifts of the beam position monitors indicated by the movement monitors (HF-MoMo, [2]), which are expected to affect monochromatized photon energy on the order of 10 meV and beam position on the order of µm. Substantial effects result from beam losses and failures of the top-up mode. Periodic drifts of the MoMo positions over the course of 24 h and even as an effect of injection while in top-up mode are recognizable.
The long-term observations of photon energy and beam position employing the non-invasive diagnostics unit in the beamline generally reveals high stability at a superior reproducibility. The effects observed near the beamline focus correlate extremely well with the MoMo data. Minor drifts comprise the combined effects of the electron beam, the beamline, and the diagnostics unit.

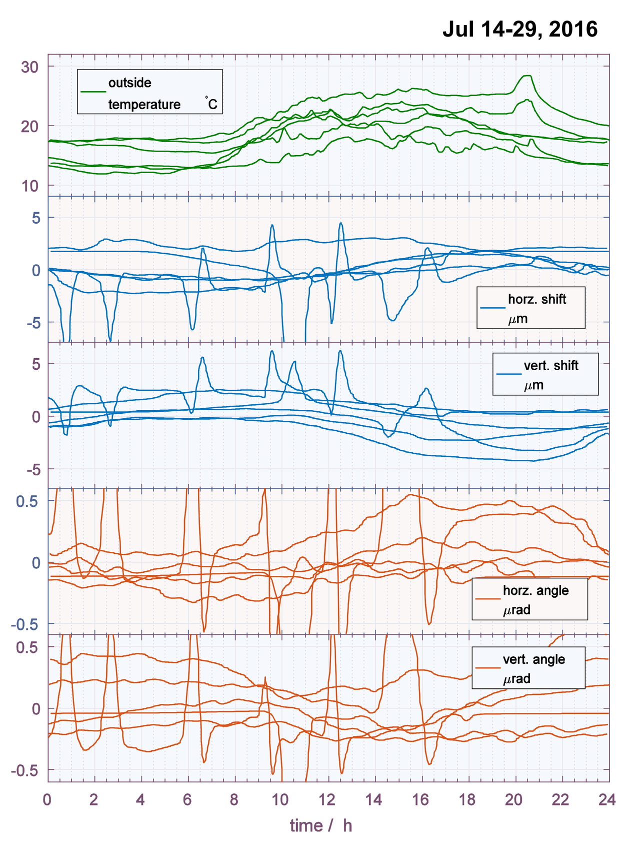
Energy calibration

Measuring the photon energy as a function of the fixed-focus constant (cff) of the monochromator at constant photon energy is a proven strategy to reveal angular misalignment of the monochromator grating and its premirror and can also be employed for an absolute calibration of photon energy [1].

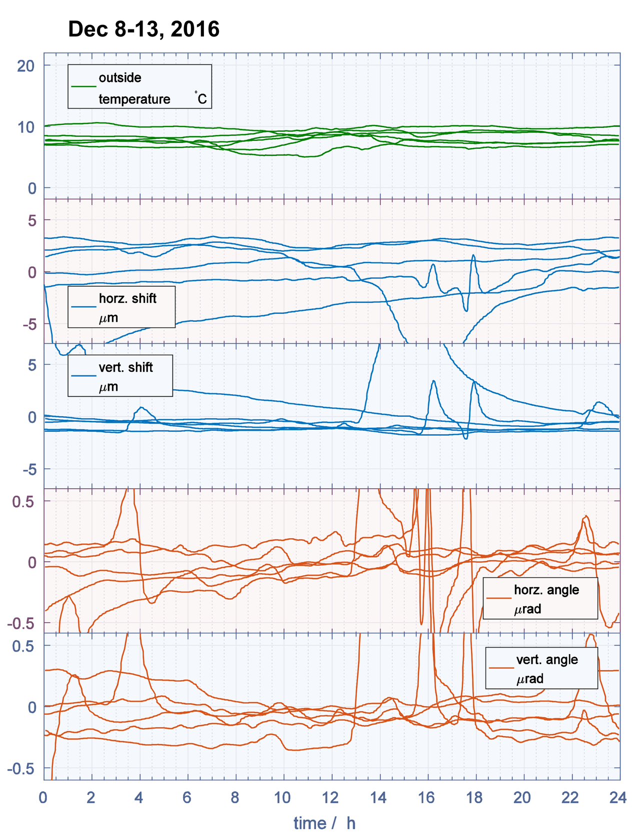
Using the permanently installed ARGUS photoelectron spectrometer [4] to measure the kinetic energy of Au 4f photo-electrons, we find a clear deviation from the monotonous effect of grating misalignment reported in the literature [1]. We attribute this result to alignment errors not included in the model, which accounts for offsets in mirror and grating angles only.

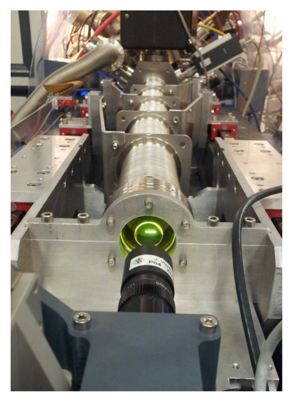
Among the degrees of freedom of the optics actuators, the potential effect of a misplaced rotational axis of both pre-mirror and grating is currently under investigation with the aim to achieve a complete understanding of alignment errors and to generalize this approach of beamline alignment and calibration.

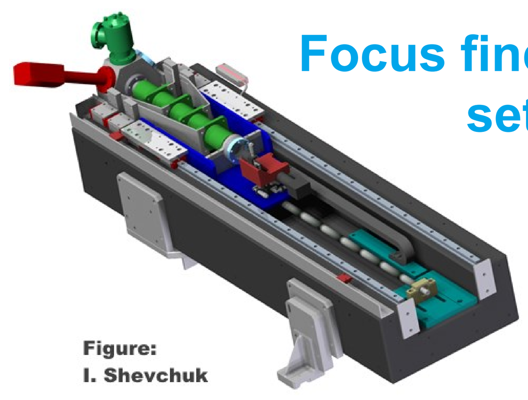
BPM drift (summer)



BPM drift (winter)

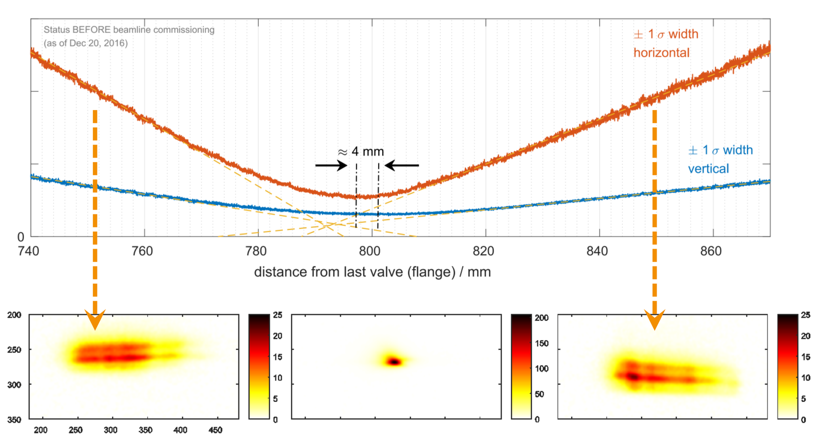




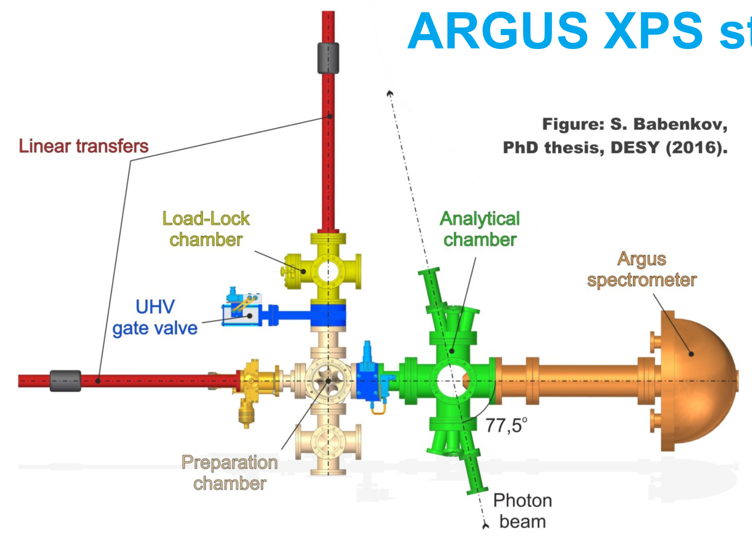


Focus finder setup

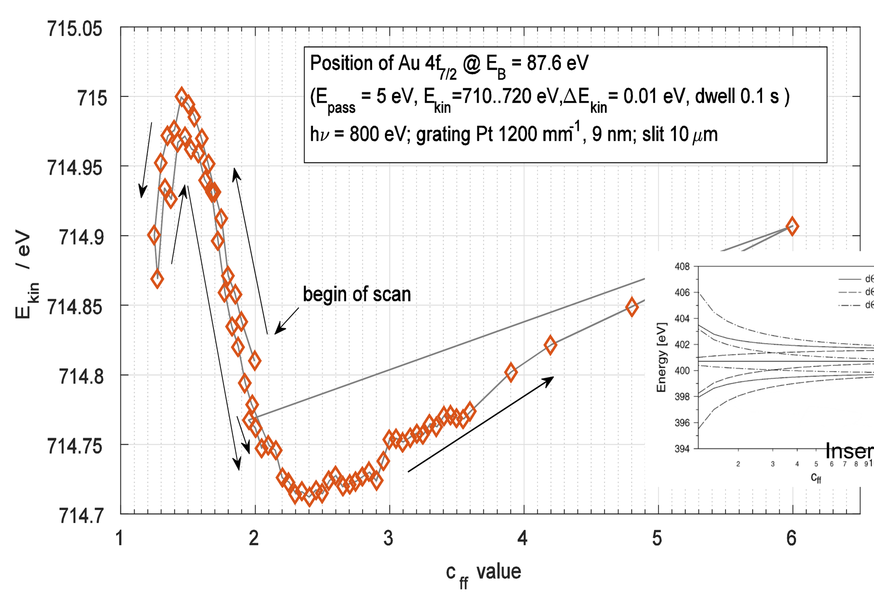
XUV Beam: Focus scan



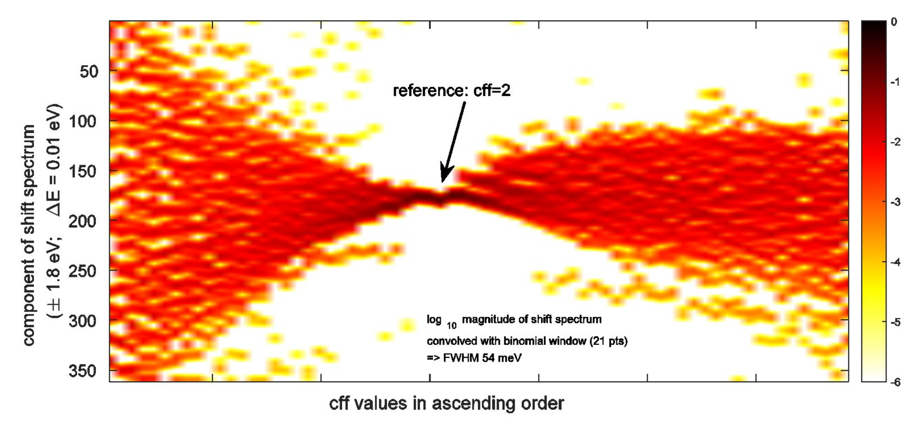
ARGUS XPS station

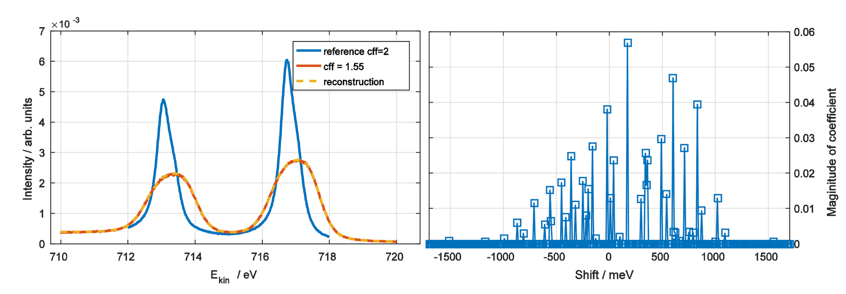


Cff scan: Center energy



Cff scan: Energy spectrum





References

[1] M.R. Weiss, R. Follath, K.J.S. Sawhney, T. Zeschke, NIM A 467–468 (2001).
[2] K. Wittenburg et al., MOVTC06, BIW'08 Conference, Lake Tahoe,California (2008).
[3] I. Shevchuk et al., HASYLAB User's Meeting (2013).
[4] S. Babenkov, PhD thesis, DESY doi:10.3204/PUBDDB-2016-04658 (2016).
[5] PETRA III Archive viewer, http://adweb.desy.de/mca/intranet/autofiles/webapps/released/petra/ser/archiveviewer.jnlp

HELMHOLTZ | ASSOCIATION