The PETRA III Variable Polarization XUV Beamline

Jens Viefhaus and Frank Scholz

Apart from hard X-ray photons, the 6 GeV storage ring PETRA III will also be a unique light source of XUV photons. Using only the first harmonic of an APPLE-II-type insertion device of 5 m length, it will provide radiation in the range from $\leq$250 eV to about 3000 eV. The source is essentially diffraction limited (except for the horizontal source size) and will therefore provide highest brilliance and flux in this photon energy range with variable polarization. Starting with the user operation in 2009 the XUV beamline will offer outstanding research possibilities in various disciplines of science. The science case includes gas phase studies, surface chemistry, spectro-microscopy, magnetism, high resolution PES as well as different soft X-ray scattering techniques.

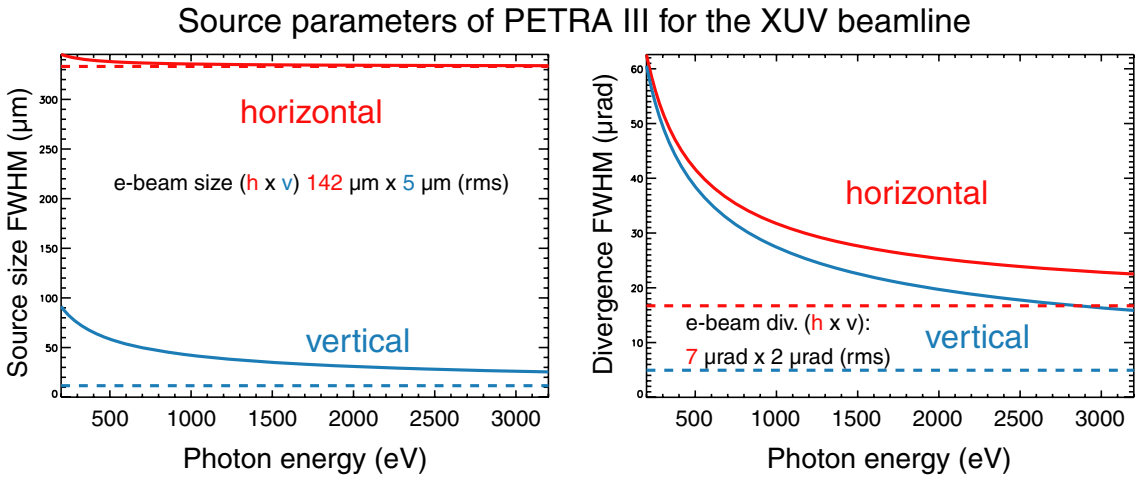

Figure 1: The main source parameters of the APPLE-2 undulator for the XUV beamline at PETRA III

During 2006 the beamline design progressed. It was based on the recommendations made by the PETRA III TDR [1] as well as two user workshops in June and October 2006, respectively. Altogether 41 different participants (12 from DESY) contributed to the success of the user workshops. In addition, several consultations of international experts were made.

The main challenge of the beamline design is the fact that most of the experiments want to take advantage of the wide photon energy tuning range covering a large selection of scientifically relevant absorption edges. This full tunability can only be achieved with reasonable transmission if at least two different coating materials are used for the optical elements. In contrast to the preliminary TDR, an alternative design of the beamline was developed which will consist of plane or plane elliptical optical elements only. Each optical element will have two stripes of different coating material.

The main advantage of the new design would be that only rather small (and therefore precise) movements would allow the user to change the working energy over the full range. Despite this change the optical properties of the beamline would be preserved to the highest possible extent.

Current investigations concentrated on the improvement of the horizontal beam spread employing an additional horizontal focussing by the first mirror. Of further special interest are heatload issues as well as mirror cooling schemes. The whole design process will continue to profit from a tight interaction with the user community. For example parts of the user community require lower photon energies to enable reference measurements. Therefore an "off-axis" option is currently under investigation which would supply photons in the energy range starting from about 50 eV with one to two orders of magnitude less flux compared to the normal mode.

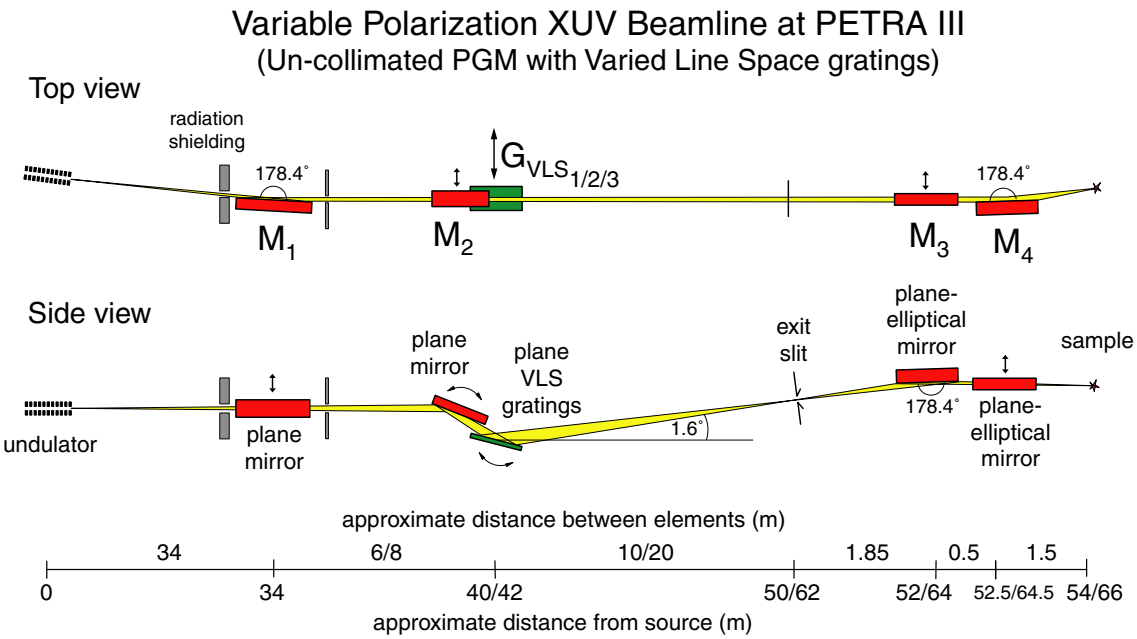

Figure 2: A schematic representation of the tentative XUV beamline design alternative

The wide range of scientific applications requires dedicated user experiments which will have independent access to the two experimental areas. Platforms and suitable alignment lasers will be available which allow for an off-line alignment of the experimental setup just before the actual beamtime.
In order to serve best the different needs of the various user groups, a two branch solution is proposed. Separate monochromators will allow for a high flexibility in choosing specific beamline properties such as photon energy resolution, photon flux as well as spot size on the sample. For example, one of the branches will be designed for a photon energy resolution of less than 30 meV at 1000 eV as well as a focal spot size of about 10 μm at the target position. The flux at a resolving power of 10,000 will be around 10^{12} Photon/s.
In early 2007 the detailed technical design and construction of the beamline components as well as various diagnostic devices will be started. This process will involve external companies and institutions supplementing the inhouse departments.
In addition to standard methods for the quality control of the beamline (such as diodes for intensity measurements or gas cells for photon resolution), an online monitoring system to determine the degree of light polarization is under construction. First tests of the device are planned at beamline BW3 during mid-2007.
The next user workshops will present progress reports on the beamline status as well as recent news from the corresponding fields of research. Further information is found on the PETRA III beamline web site [2].

References

[1] PETRA III - A Low Emittance Synchrotron Radiation Source, Technical Design Report, Editors K. Balewski, W. Brefeld, W. Decking, H. Franz, R. Röhlsberger, E. Weckert, DESY, Hamburg, 370-391 (2004). Available online at `http://www-hasylab.desy.de/facility/upgrade/petra_tdr.htm`

[2] Online at:
`http://petra3.desy.de/beamlines/work_packages/beamlines/xuv_beamline/`