Within the PETRA III extension project, several new beamlines will be provided to compensate for the shutdown of DORIS III in October 2012. Among these, P63 will replace the micro-fluorescence spectroscopy beamline L. In contrast to beamline L, the maximum excitation energy at P63 is limited to 44 keV. Therefore, analysis of K-lines of high Z elements \( (Z \geq 57) \) will be impossible. L shell fluorescence of elements (e.g., REE) in samples with significant concentrations of first-row transition elements cannot be detected using energy dispersive detection (EDX) due to the poor energy resolution (e.g., 160 eV at 7 keV). An energy resolution of approximately 50 eV at 7 keV is needed to analyze for example Eu in an iron or manganese rich matrix. Instead of EDX one can apply wavelength–dispersive detection (WDX) which will significantly improve the energy resolution.

In order to enable detection of high Z elements via L shell excitation with a high energy resolution, a simple WDX setup has been constructed and tested at beamline L. The setup is shown in Fig. 1 and consists of I) a focusing capillary fixed on a hexapod, II) a xyz sample stage, III) a collimating capillary mounted on a second hexapod, IV) an exit slit system, and V) a detection unit, i.e. a analyzer crystal (Si111) and a silicon drift detector in \( \theta-2\theta \) geometry.

First test measurements have been performed on gold and iron foils at an excitation energy of 15 keV using the multilayer monochromator to ensure a high photon flux at the sample.

Figure 1: Top view image of the WDX setup at beamline L (DORIS III).
Figure 2: Figures 2(a) to 2(c) show high energy-resolution XRF spectra of Fe and Au. In each figure, the measured spectrum and corresponding overall fit is presented in the middle, the fitted curves for individual Kα1–Kα2, Lα1–Lα2, or Lβ1–Lβ2 lines are shown at the bottom and the resulting residual curve at the top. A summary of all FWHM data vs. energy is given in Fig. 2(d).

First test measurements show that even with a relatively simple WDX detection setup, a FWHM of less than 50 eV can be easily obtained for fluorescence energies < 7 keV. The data also demonstrate that the FWHM increases significantly with increasing fluorescence energy. In order to apply this setup also to the detection of lower concentrated elements, a much higher photon flux at the detector is inevitable. Several improvements, including I) exchange of focusing and collimating capillary, II) usage of a slit-like collimator, and III) application of other analyser crystals, will be tested in spring 2012.