A new home for three versatile powder diffractometers - the optimized thermal beamport SR8 at the research neutron source Heinz Maier-Leibnitz (FRM II)

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The neutron powder diffractometer SPODI, currently located at the thermal beamport SR8a, is one of the most active instruments at the research neutron source Heinz Maier-Leibnitz[1]. However, the demands of the user community far exceed the available beam time. Therefore, the thermal beamport SR8 will be completely rebuilt in the coming year to allow the simultaneous operation of the three independent monochromatic powder diffractometers SPODI, FIREPOD and ERWIN. Due to the unique characteristics of each instrument, which will be presented in detail, the new beamport SR8 will be able to cater for a wide range of experimental demands.

SPODI (yellow in Fig. 1) is going to remain the high-resolution option in this suite of instruments. Monte-Carlo simulations with McStas 2.7 [2] reveal that due to state-of-the-art supermirror guides with optimized geometries in the new beamport, SPODI will feature a 20% increase of the neutron flux, while fully retaining its characteristic flat resolution curve with typical small FWHMs of below 0.35°. Careful Monte-Carlo simulations show that the neutrons transmitted through the SPODI Ge(551) monochromator can be efficiently re-utilized by the powder diffractometer FIREPOD (orange in Fig. 1) in simultaneous operation at the beamport SR8a.

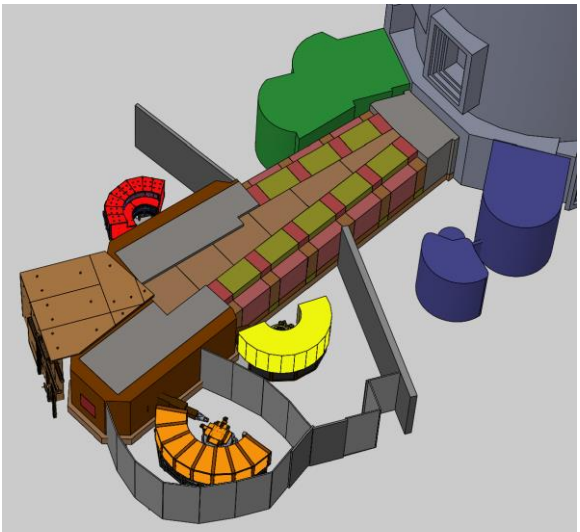

Fig. 1 Layout of the powder diffractometers SPODI (yellow), FIREPOD (orange) and ERWIN (red) at the thermal beamport SR8.

FIREPOD is currently transferred from the BER-II at the Helmholtz Zentrum Berlin. With a planned neutron flux of $2*10^7$ n/s cm^2 – one order of magnitude more than SPODI – and its eight large area detectors (DENEX 300TN), FIREPOD will be a dedicated high throughput instrument, ideally suited for a broad range of fast parametric studies. Finally, ERWIN (red in Fig. 1) will complement the current single crystal option RESI on the port SR8b. It is characterized by a large curved 2D multiwire proportional chamber detector with a virtually seamless 2θ coverage of ~135° and a choice of three different monochromators [3]. A HOPG monochromator allows a high flux option with $5*10^7$ n/s cm^2, while a Ge(511) monochromator can be utilized for a high resolution setup. Lastly, the current single crystal option RESI with a short wavelength of 0.1 nm will be retained with full functionality, while taking advantage of the larger detector.

[1] Hoelzel M, Senyshyn A, Juenke N, Boysen H, Schmahl W, Fuess H. High-resolution neutron powder diffractometer SPODI at research reactor FRM II. Nucl. Instrum. Methods, 667, 32-37 (2012)
[2] Willendrup P, Farhi E, Knudsen E, Filges U, Lefmann K, Journal of Neutron Research, 17, 35-43, (2014)
[3] Heere M, Muehlbauer M, Schoekel A, Knapp M, Ehrenberg H, Senyshyn A, Energy research with neutrons (ErwiN) and installation of a fast neutron powder diffraction option at the MLZ. J. Appl. Cryst, 51, 591–595 (2018)

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