Status of the New Microbeam Facility SNAKE

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A new microbeam facility SNAKE (Supraleitendes Nanoskop für Angewandte Kernphysikalische Experimente) at the Munich tandem accelerator is currently under construction. The planned facility aims to investigate interdisciplinary topics such as solid state physics, biology and medicine. It will offer new capabilities in material analysis and in ion beam modification of materials. For different types of light and heavy ions the new facility shall achieve a lateral resolution of 100 nm in standard analysis. Especially the usage of protons up to 30 MeV and heavy ions with energies up to 200 MeV q^2/A are unprecedented in microprobe setups.

Thereby a variety of new analysing and modification methods will be enabled. A 25 MeV proton beam e.g. offers a powerful tool for detection of hydrogen in submicron dimensions by coincident measurement of elastic proton-proton-scattering [1]. STIM (Scanning Transmission Ion Microscopy) experiments belong to another type of measurments planned for this facility. Due to the high stopping power of heavy ions in matter and a large 90° magnet behind the target chamber, thickness or density measurements can be performed with a very high accuracy. Standard analysis of nuclear microprobes such as PIXE (Particle Induced X-Ray Emission), PIGE (Particle Induced Gamma Emission), NRA (Nuclear Reaction Analysis) etc. will also be available.

The experimental setup will be realised at the 0° beamline behind the analysing magnet. The whole ion optical system consists of a two stage demagnification with an intermediate focus. The analysing slit provides the object for the demagnification. With a 20 μm aperture at the object slits and an total demagnification factor of 200 in both transversal directions an image size of 100 nm can be reached. The intermediate focus offers a possibility to reduce halo effect by using an additional pair of scattering slits (fig. 1).

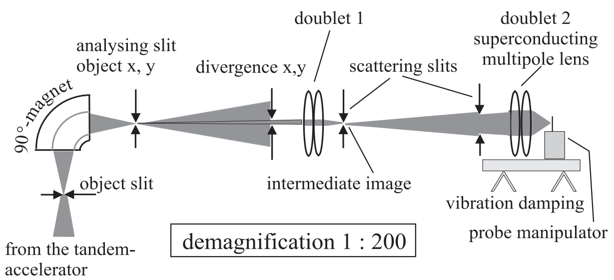

Fig. 1: Ion optic of the nuclear microprobe.

To reach this ambitious goal essential parts of SNAKE are completely new designed and under construction now.

- A high precision slit system.
- A superconducting multipole lens, providing the second and main stage of demagnification [2].

New high precision slits are able to drive each slit edge separately in one micron steps. Furthermore linear expansion due to the heating up of the slits by beam current is compensated by a special heating control unit. In order to eliminate vibrations of the floor of the accelerator building an isolation system is planned. To reduce vibrations originating from the beam tube the slits are isolated by a flexible coupling. First tests of the high precision slit system will be in January 98.

The superconducting lens will be placed in a He bath cryostat. Adjacent to this cryostat a target chamber with a 5-axis manipulator will be mounted. The chamber contains different type of detectors and an optical microscope which is used for finding regions of interest on the sample. Cryostat and multipole lens will be ready for operation in spring 98. Target scanning can be achieved by two different methods. Piezo elements in x- and y-direction manage the fine positioning of the target and perform a slow but a linear target scan. On the other hand a two dimensional magnetic steerer will be installed right in front of the multipole lens to accomplish a fast scanning mode (approx. 1 mm in 1 ms for 30 MeV protons). This mode will be very helpful in high current measurements of radiation sensitive material. Since the power density of a 30 MeV proton beam at 100 pA focused on a 100 nm spot graphite is 10^8 W/g it will be necessary to distribute the energy over a wide area in a short time. The whole equipment as depicted in fig. 2 is mounted on a passive vibration isolation table.

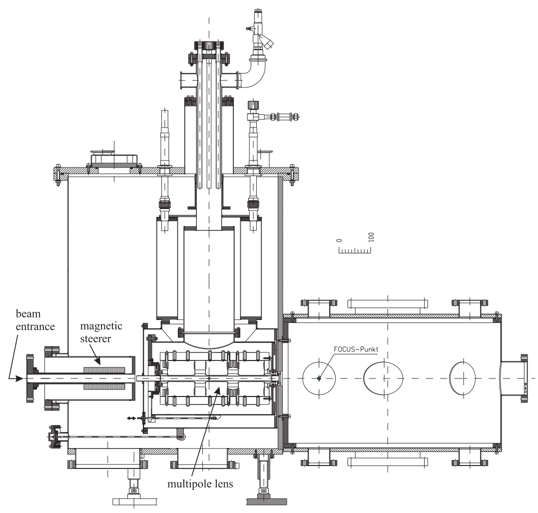

Fig. 2: Cryostat for multipole lens and target chamber.

Although standard duoplasmatron ion sources have sufficient brightness to achieve high beam currents (100 pA protons within 100 nm beam spot) a brighter H^- source is aimed for in order to get optimum microscope performance. Due to the promising results of a prototype this will be further investigated in the limits of a PhD thesis.

References

[1] B. L. Cohen, C. L. Fink, J. K. Degnan J. Appl. Phys. **43** (1972) 19
[2] G. Datzmann *et al.*, this report p. 107