MAFF Test Setup

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A test setup for the central part of the MAFF beamline SR-6 at the FRM-II has been designed and manufactured that will be installed in the experimental hall 3 of the MLL (see Fig. 1).

It is designed to closely approximate the dimensions of the central region of the beamtube SR-6 that houses the MAFF fission source and the cryopanel, while still allowing for modular access to different regions relevant for testing procedures.

A prototype of the MAFF fission source (see Fig. 2) including the heat shields and the external heating capability will be mounted in the center of the test setup. Alignment procedures for the source will be developed, tested and optimized, which is an essential prerequisite for an efficient extraction of the ion beams at the FRM-II, where a reproducible, precise alignment of the source even in an almost non-accessible environment has to be guaranteed. Since the losses of fissile uranium during the reactor cycle of 52 days will be compensated by an external heating of the fission source, extensive heating tests under realistic conditions have to be performed. The temperature profile in the vicinity of the hot source, which is operated at typically 2500 ^{o}C, will be monitored by up to 10 thermo-sensors, giving additional information on the mechanical stability and influence on the precision of the source alignment. Additionally the performance and durability of the heating wire and the heat reflecting shields has to be studied. The fission source will be operated at a high potential of 30 kV modulated by extraction voltages with an external heating of up to 1 kW. The reliability of the necessary electrical contacts under extreme temperature conditions will be investigated. Leakage currents due to the temperature dependence of the electric conductivity of ceramic insulators have to be measured, which would give rise to an internal heat load that would interfere with the nearby He-cooled cryopanel operated at 14-18 K. Variable access ports to the central test region allow for a pyrometric surveillance of the hot source prototype as well as for monitoring temperature dependent mechanical deformations affecting the required precise alignment of the fission source.

The test setup will be connected to the liquid Helium refrigerator in the experimental hall in order to allow for a longterm operation of the cryopanel inside the beam tube designed to localize short-lived, volatile gaseous radioactivity. The mechanical shape and mounting of the cryopanel has to be optimized and the pumping capacity has to be studied with and without a surrounding 80 K shield operated with liquid nitrogen. This 80 K shield would require a very compact design of the cryopanel favouring a radially segmented double-wall tube for the cryopanel and the LN_2 shield. Vacuum measurements at different positions relative to the hot source and the cold cryopanel will give information on a region of the MAFF beamline that will not be accessible during routine operation at the FRM-II. In the final setup at the FRM-II the gas load from the vacuum pumping system will be stored temporarily in tanks to allow for a cooling down of the radioactivity level. The layout of this storage tank system has to include the gas load added by a potential warm-up of the cryopanel. This has to be studied with our test setup.

Special attention will be given to the investigation of various system failure scenarios such as air- and water breakins, warming-up of the cryopanel or leaks in the Helium circuit. The setup has a modular design which allows for gradual extensions once additional mechanical components such as the source exchange mechanism or the source trolley become available.

The safety issues studied with this test setup will be adressed within the framework of an EU-RTD project (SAFERIB) aiming at developing techniques for the safe handling of production targets for high-intensity RIB facilities, while the results of the test programme will be part of the approval procedure required for the operation of the MAFF fission source.

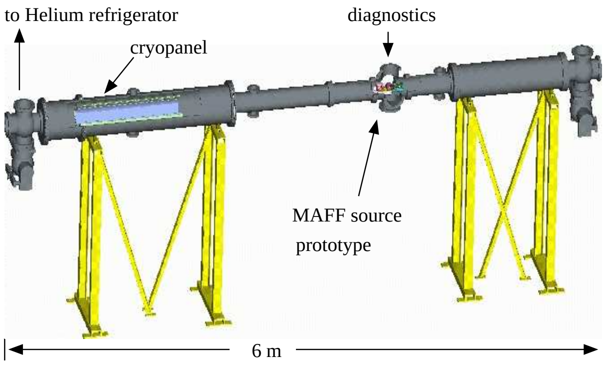

Fig. 1: Schematic view of the test setup that will be installed at the experimental hall 3 of the MLL.

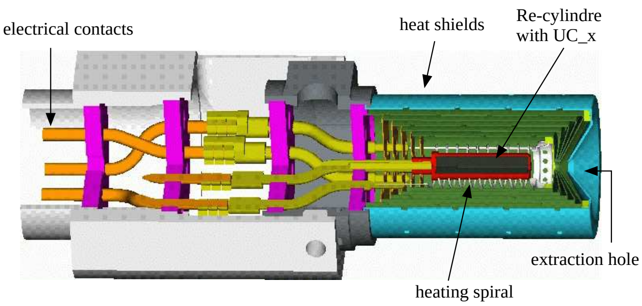

Fig. 2: Schematic view of the MAFF fission source prototype