Progress Report of the Munich Accelerator for Fission Fragments MAFF

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A detailed description of the MAFF project can be found in [1,2,3]. The progress of MAFF in 1999 comprises the following points:

- The general technical concept of MAFF and its integration into the FRM-II has been approved by the safety authorities (TÜV) and subsequently by the Bavarian ministry for environmental affairs (StMLU). This was a necessary prerequisite for successful application for funding of several key components of MAFF by the German ministry for education and research (BMBF).
- The through-going zircaloy beam tube in the moderator vessel of the FRM-II is being built at present. The order has been placed in July 1999, the installation into the reactor will take place during the end of March 2000.
- A more detailed and coordinated partition of experimental areas among the different instruments in the FRM-II experimental hall took place. This resulted in a slightly modified low-energy beam line of MAFF. Details of the radiation shielding are still to decide.

A drawback was the decision of the BMBF, not to grant financial support to experiments at the FRM-II before the reactor receives its final approval. The latter is foreseen to be given in September 2000. Immediately afterwards, the procedure for the authorization to install MAFF will be initiated.

A positive event in the context of funding of MAFF, however, was the confirmation by the Bavarian government, that funding is granted for the construction of the eastern experimental hall, neighbouring the FRM-II, which will house the high-energy beam line of MAFF (LINAC and experiments) in its southern part. An instrument for neutron radiography and tomography as well as another experiment dedicated to basic research on cold neutrons will be placed in the northern part of the hall.

Some experiments have been prepared or carried out in order to test crucial aspects of MAFF:

- A vacuum furnace, which allows continuous operation at temperatures of up to 2500° C for extended periods of time (≈ 1000 h), is — after some modifications — now finally operational [4]. This device will enable us to study in detail the long-term behaviour of the target/ion source unit. Our special attention will be turned to the following topics: integrity of the target container, chemical reactions of the container material (Re) with carbon or uranium, recrystallization and grain growth, evaporation rate of Re, C, and U as well as surface characteristics (emissivity) of the container. Rhenium target containers are now available.
- Usually, all reactor beam tubes at the FRM-II are filled with He at a pressure of 1.2 bar to avoid the so-called "water hammer" in case of a rupture of the beam tube. This is, however, not possible for the MAFF beam tube, where ions will be extracted, and was the reason for reinforcements and quality improvements of this beam tube unit. Additionally, an experiment has been set up at the accelerator laboratory in order to determine the maximum pressure values which may occur in case of a massive ingress of water into an evacuated beam tube [5]. It has been shown that even in case of big leaks (100 mm diameter) the peak pressure remains below 2 bar.

Moreover, a very promising idea to significantly enhance the efficiency of MAFF regarding the production of superheavy elements came up last year: the use of a recycling ring which re-uses with an acceptance of $\frac{\Delta(Q/p)}{Q/p} = \pm 20\,\%$ more than 99 % of the projectiles which have not undergone fusion reactions. This recycling ring is basically the combination of an isochronous storage ring of large Q/p acceptance with a resonator that compensates the energy loss of the projectiles in the target. A detailed description is given in [6].

Besides, there has been progress in a number of other projects which are also relevant for MAFF:

- The french Phenix ECR source has successfully started operation. Within the frame of an EU network for charge breeding that recently has been installed, the performance data of EBIS and ECR sources will be compared systematically at CERN.
- The successful test of the REX-ISOLDE RFQ [7] and IH-structure [8] confirms their design, and a modified layout of MAFF accelerator components (IH-RFQ, 7-gap IH-resonator) [9] will result in a further improved performance.
- Shiptrap can be regarded as a predecessor of MAFFtrap and will allow efficient storage of very heavy elements in a Penning trap. The development of the buffer gas cell and the extraction RFQ is pursued [10].
- The Miniball cluster detector is an ideal system for the spectroscopic investigation of fission products. Its progress is reported in [11].

References

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