Modernisation of the 108 MHz RF systems of the UNILAC post stripper section

B. Schlitt, G. Eichler, S. Hermann, M. Hörr, A. Schnase, G. Schreiber, W. Vinzenz
GSI, Darmstadt, Germany

For the FAIR facility, all ion beams heavier than protons will be provided by the existing UNILAC for injection into the SIS18 synchrotron. Since the UNILAC is in operation successfully since about 40 years, an extensive modernisation of the post stripper RF systems and a replacement of the Alvarez DTL are planned to assure reliable operation for FAIR as well as the required beam quality [1,2]. To match the FAIR conditions, the UNILAC will be converted into a short-pulse accelerator, the RF beam pulse length and duty cycle being reduced from up to 6 ms / 30 % to ≤ 2 ms / ≤ 2 %. Long duty cycle beams will not be provided anymore.

Modernisation of the existing RF systems

Substantial modernisations of the existing post stripper RF systems are planned:

- The old control components of the existing 1.7 MW high power amplifier (HPA) stages equipped with RS 2074HF tubes to feed the five Alvarez tanks will be substituted by state-of-the-art PLCs. Modern fast measurement and interlock systems and commercial control grid power supplies will replace the old equipment.
- 120 – 150 kW solid state driver amplifiers will replace the existing tube drivers. A call for tenders for a prototype was started recently.
- The original relay based control of the 1 MVA anode power supplies for the HPAs will be substituted by modern PLC systems.
- Substitution of the resonance tuning circuits and of the LLRF systems by new developments.

Extensive preparations and developments of these tasks as well as the procurement of various components were performed in 2014. A stepwise realisation of major measures is planned during longer shutdown periods of the GSI accelerators during 2015 to 2017.

New 1.8 MW cavity amplifier prototype

On a long-term schedule, a replacement of the existing high power amplifiers is considered. The development and manufacturing of a 1.8 MW cavity amplifier prototype was ordered to Thales Electron Devices, based on a Thales TH 558SC tetrode, which is widely used worldwide for broadcast transmitters as well as for scientific applications. Thus, there is no known risk concerning the long-term availability of this tube for the coming decades. The design of the cavity amplifier was almost finished by Thales in 2014 (Fig. 1). Manufacturing, RF tests, and delivery of the amplifier are scheduled for 2015. A test bench will be prepared at the UNILAC RF gallery allowing operation of the new amplifier either on a water dummy load or on one of the Alvarez cavities.

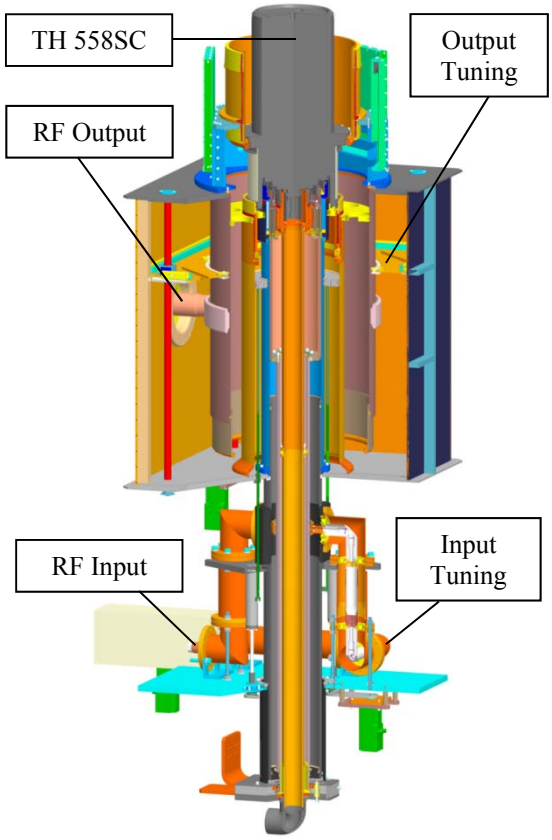

Figure 1: Sketch of the 1.8 MW high power amplifier cavity prototype designed by Thales (by courtesy of Thales Electron Devices, Thonon, France).

D-LLRF system tests

A digital low-level RF (d-LLRF) system designed by industry for 216 MHz linac RF systems for particle therapy facilities [3] was adapted by the supplier to an operating frequency of 108 MHz and was integrated into an existing 160 kW amplifier at GSI [1]. It was tested for RF amplitude and phase control of a single-gap resonator at the UNILAC including ion beam tests using 1.3 mA $^{181}Ta^{24+}$ beams. Stable operation was achieved within a limited amplitude range and beam loading could be partly compensated by the digital control unit [1]. Further improvements and tests of the system are planned.

References

[1] B. Schlitt, M. Hoerr, A. Schnase, G. Schreiber, and W. Vinzenz, RF system development for the new 108 MHz heavy ion high-energy linac at GSI, LINAC2014, Geneva, Switzerland, TUPP058 (2014).
[2] S. Mickat et al., this report.
[3] Ampegon AG, Turgi, Switzerland.

DOI:10.15120/GR-2015-1-FG-UNILAC-18