UNILAC Status and Development*

L. Groening, G. Clemente L. Dahl, P. Gerhard, M.S. Kaiser, M. Maier, S. Mickat, A. Orzhekhovskaya, B. Schlitt, H. Vormann, S. Yaramyshev

GSI, Darmstadt, Germany

Operation

Commissioning started in March with ^{40}Ar-beam from the PIG source. Operation of the PIG-branch was dominated by serving the TASCA experiment for a total of five months with $^{50}Ti^{2+}$ beam stripped to 12+ and further accelerated to 6.0 MeV/u. A beam current of more than 40 eμA at the experiment was achieved exceeding the expectations. SHIP was provided with the same beam through the month of June. $^{50}Ti^{12+}$ was delivered to the SIS18 for 11 days as well as $^{208}Pb^{26+}$ beam. Additionally, the PIG provided beams of $^{197}Au^{25+}$, with $^{20}Ne^{7+}$ beam, and $^{12}C^{6+}$.

The HLI with its ECR source also served TASCA with $^{48}Ca^{10+}$ for six weeks in fall. For two weeks $^{138}Xe^{54+}$ beam was taken by the SIS18. Finally, the HLI provided also $^{12}C^{6+}$ for the SIS18.

The MEVVA source was used during the full month of April to provide high current of $^{197}Au^{25+}$ for the SIS18. Another three weeks $^{58}Ni^{26+}$ was delivered to the same destination. Various experiments in the experimental hall and behind SIS18 were served with intense ^{238}U beams. Notably, dedicated SIS18 beam experiments used a stable $^{238}U^{28+}$ beam of 2 emA for dedicated beam experiments resulting in a new intensity record [1].

Operating the high current source terminal with the MUCIS ion source an intense $^{138}Xe^{54+}$ beam could be delivered to the SIS18 for two weeks and for ten days to the M-branch. Another eleven days saw $^{86}Kr^{33+}$ beam provided to the SIS18. Shorter beam times served the ions of $^{14}N^{7+}$ and the rare isotope of $^{36}Ar^{10+}$. Finally, a beam of singly charged D_3 molecules was provided in preparation of the novel beam experiment EMTEX [2]. The UNILAC provided 6501 hours of beam on target and 766 hours of scheduled beam time were not served due to failures [3].

The operation of the HLI RFQ was affected by presumably mechanical oscillations of the rods. The amplitude of the latter depends on the rf-pulse length and repetition rate and is subject to on-going investigations [4]. In June the rf-coupling loop of the cavity A2a needed to be replaced causing a downtime of 2.5 days. During the last week of June an internal HSI-IH quadrupole lense needed to be switched off due to a water leak. As a consequence the beam transmissions dropped by about 40% in this period, triggering the anticipation of the consecutive shutdown by one week.

Shutdown Activities

The first shutdown started with a general maintenance of the cavities A2a&b including a full revision of one of the inter-tank quadrupoles. New diagnostic chambers were installed into the LEBT of the HSI. The eigen-frequency control of the poststripper cavities was updated. Finally, the first shutdown was used for follow-up of the HLI-RFQ investigations [4]. Repair of the internal HSI-quadrupole was finished as scheduled during the second shutdown. A new rf-data-acquisition system was put into operation for cavity A3.

Machine Experiments

The mayor part of machine experiments was dedicated to experiments on stripping uranium ions to charge stated of about 40+ at energies of 1.4 and 3.6 MeV/u. The latter energy was used to irradiate foils mounted on a rotating wheel in the SHIP cave. Long pulses of low intensity U-beams did not reveal any damage of the foils. In contrast, high current pulses of less than 100 μs in length at 1.4 MeV/u at the HSI exit, impacting on fixed foils did destroy some foils. These experiments were done with different foils that underwent different production procedures. The damages revealed holes of few mm in diameter but some foils were fully ripped after seeing few pulses. Evaluation w.r.t. systematics in the damage pattern is on-going and partially reported in [5]. Apart from these findings, long-resisting (some 1000 pulses) foils were investigated w.r.t. long-term drifts in the beam parameters after the foil as transmission, charge spectrum, energy, and transverse emittance.

Alternative gaseous stripping media (H and CH_4) were tested behind the HSI [7], since results reported in [6] suggested significant increase of the medium charge state. Our experiments suffered from gas pressure limitations for safety reasons and did not confirm the findings of [6] so far.

References

[1] Y.A. El-Hayek et al. (this report).
[2] C. Xiao et al., ArXiv:1212.2034 [physics.acc-ph].
[3] W. Bayer et al. (this report).
[4] P. Gerhard and H. Vormann (this report).
[5] H. Vormann et al. (this report)
[6] H. Okuno, Proc. OINTDS Workshop, Mainz, Germany, 2012.
[7] B. Schlitt et al. (this report).