Developments for the CR stochastic cooling system

C. Dimopoulou[1], *D. Barker*[1], *R. Böhm*[1], *M. Bräscher*[1], *M. Dolinska*[2], *R. Hettrich*[1], *M. Kelnhofer*[1], *J. Krieg*[1], *W. Maier*[1], *R. Menges*[1], *C. Peschke*[1], *J. Roßbach*[1], *A. Stuhl*[1], *L. Thorndahl*[3], *and S. Wunderlich*[1]

[1]GSI, Darmstadt, Germany; [2]Frankfurt University; [3]CERN, Geneva, Switzerland

The pertinent CR stochastic cooling system in the frequency bandwidth 1-2 GHz has been reviewed in [1] in the context of the FAIR project. Further progress was made in 2014 on in-house engineering and testing activities as well as procurements.

Metallised ceramic plates for slotline pick-up electrodes are under development in close interaction with a provider.

The water-cooled linear motor drive units, tested synchronously in the prototype pick-up tank (Fig. 1) at room temperature, fulfill the specifications: (i) their max. range of plunging is 70 mm and (ii) at the end, they move back out to their max. aperture within 200 ms, before a new beam is injected.

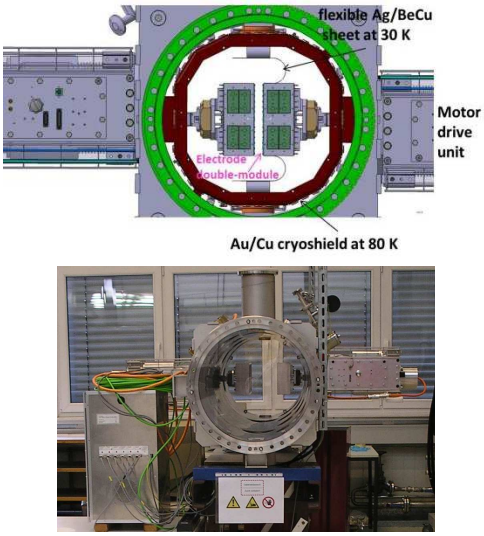

Figure 1: Section of the prototype pick-up tank. The motor units drive synchronously the slotline electrodes.

A special chamber for testing motor drive units under pre-vacuum conditions, at room temperature, was engineered, built and commissioned. It permits long-term tests and improvements of the mechanical concepts in horizontal or vertical orientation in view of the final pick-up tanks. It consists of 1/8 of pick-up tank with Cu-cryoshield dummy and an observation window (Fig. 2). One motor drive unit with electrode module can be mounted so as to slide along the flexible silver-plated copper beryllium sheets.

Simulations with the HFSS code converged to possible designs of the Faltin-type electrodes of the Palmer pick-up. Then, the Palmer cooling performance in the CR with such electrodes has been confirmed in a Fokker-Planck approach. Consequently, demanding prototype electrodes were manufactured, their measured RF poperties confirm the HFSS simulation (see [2] for details).

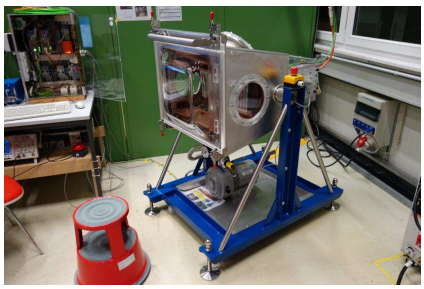

Figure 2: The testing chamber for motor drive units.

The procurement contract for the 1-2 GHz power amplifiers providing a total cw microwave power of 8 kW at the kickers has been awarded. The preseries unit is under development. The 2 optical notch filters (one for antiprotrons at v=0.97 c, one for RIBs at v=0.83 c) are finished (Fig. 3), their measured RF properties fulfill the specification i.e. notch depth below -30 dB within 1-2 GHz. In-house design of demanding RF components such as the pick-up module controller as well as the integrated powermeter has started.

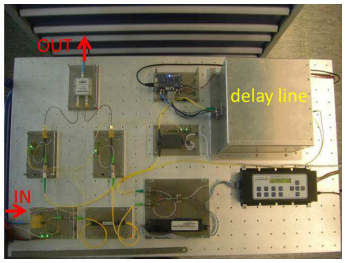

Figure 3: CR optical notch filter layout (0.6 m^2).

The new FAIR-compatible operation program covering the ESR stochastic cooling system has been successfully used with beam in 2014, particularly in demonstrating stochastic cooling of protons at v=0.71 c. This is a major step towards preparing such codes for the CR and gaining benchmarking experience for antiproton cooling in the CR.

A numerical model for simulating stochastic cooling of ions in the time domain is now available, benchmarked against ESR experimental data [3].

References

[1] CR Technical Design Report 2014 and C.Dimopoulou, ICFA Beam Dynamics Newsletter No. 64, p.108 (2014).

[2] D.Barker et al, this report.

[3] M. Dolinska et al., Proc. STORI'14, (in Physica Scripta).

DOI:10.15120/GR-2015-1-FG-GENERAL-36