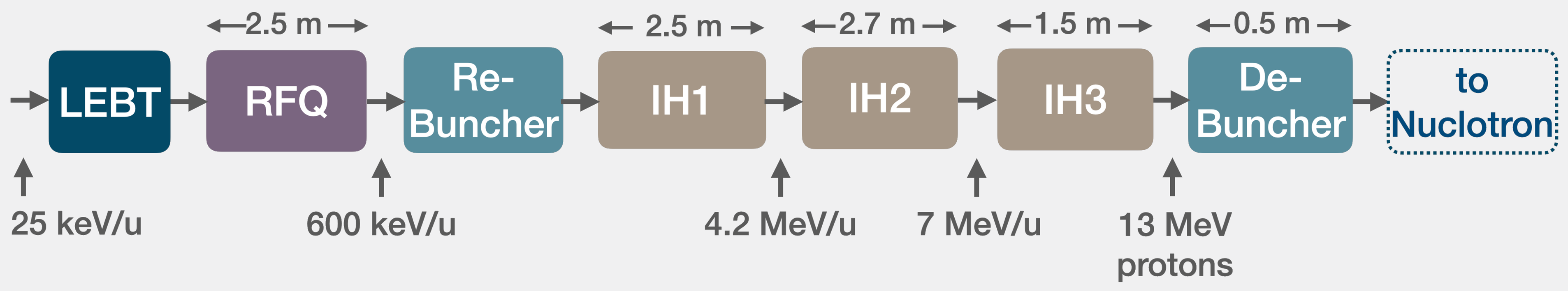
LILac Energy Upgrade to 13 MeV

B. Koubek*, S. Altürk, M. Busch, H. Höltermann, J. Kaiser, H. Podlech, U. Ratzinger,
M. Schütt, M. Schwarz, W. Schweizer, D. Strehl, R. Tiede, C. Trageser, BEVATECH GmbH, Frankfurt am Main, Germany
A. Butenko, A. Govorov, B. Golovenskiy, D. Donets, K. Levterov, D. Lyuosev, A. Martynov,
V. Monchinskiy, D. Ponkin, K. Shevchenko, I. Shirikov, E. Syresin, JINR, Dubna, Russia
A. Brunzel, P. Nonn, H. Schlarb, DESY, Hamburg, Germany

INTRODUCTION

In the frame of the NICA (Nuclotron-based Ion Collider fAcility) ion collider upgrade a new light ion LINAC for protons and ions will be built in collaboration between JINR and BEVATECH GmbH. Ions with a mass-to-charge ratio up to 3 will be fed into the NUCLOTRON ring with an energy of 7 MeV/u.

Protons are supposed to be accelerated up to an energy of 13 MeV using a third IH structure. This energy upgrade comprises a third IH structure, a dual-use Debuncher cavity as well as an extension of the LLRF control system built on MicroTCA technology.



Parameter	Protons	C^{4+}
Mass to Charge	1	3
Injection Energy	25 keV	300 keV
Exit Energy	7/13 MeV	84 MeV
Beam Current	5 mA	10 mA
Repetition Rate Limit	≤ 5 Hz	
Current Pulse	30 µs	
RF Pulse Length	200 µs	
RF Frequency	162.5 MHz	
Transmission	≥ 80 %	

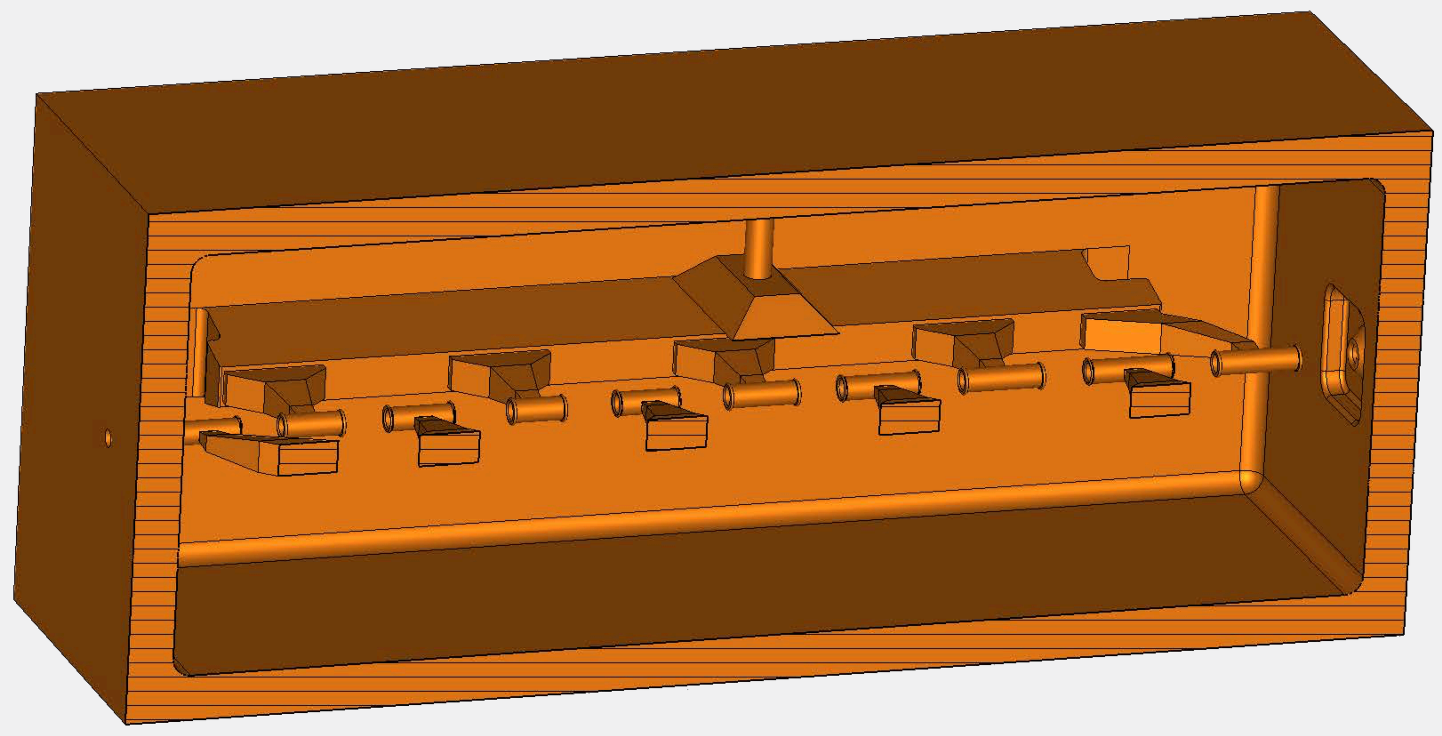
IH3

Beam Dynamics

It was intended to fit the post accelerator cavities for protons into the linac in such a way, that the beam transport of the 7 MeV/u beam was properly solved as well as the proton post acceleration up to 13 MeV - by the same two quadrupole triplets in front and behind this cavity. This led to a very compact cavity with only 11 gaps. The effective voltage gain of 5 MV/m is a safe value for IH-type structures.

RF Design

IH3 of the LILac has the purpose to serve as an energy upgrade for proton beam operation up to 13 MeV. The cavity consists of eleven gaps and due to the rather high energy for an IH, which leads to large cell lengths, it was decided to reduce the end gap lengths and additionally implement "pockets" at the inner part of the IH entry and exit. Thus, the total length can be kept to a reasonable measure.



DEBUNCHER

Beam Dynamics

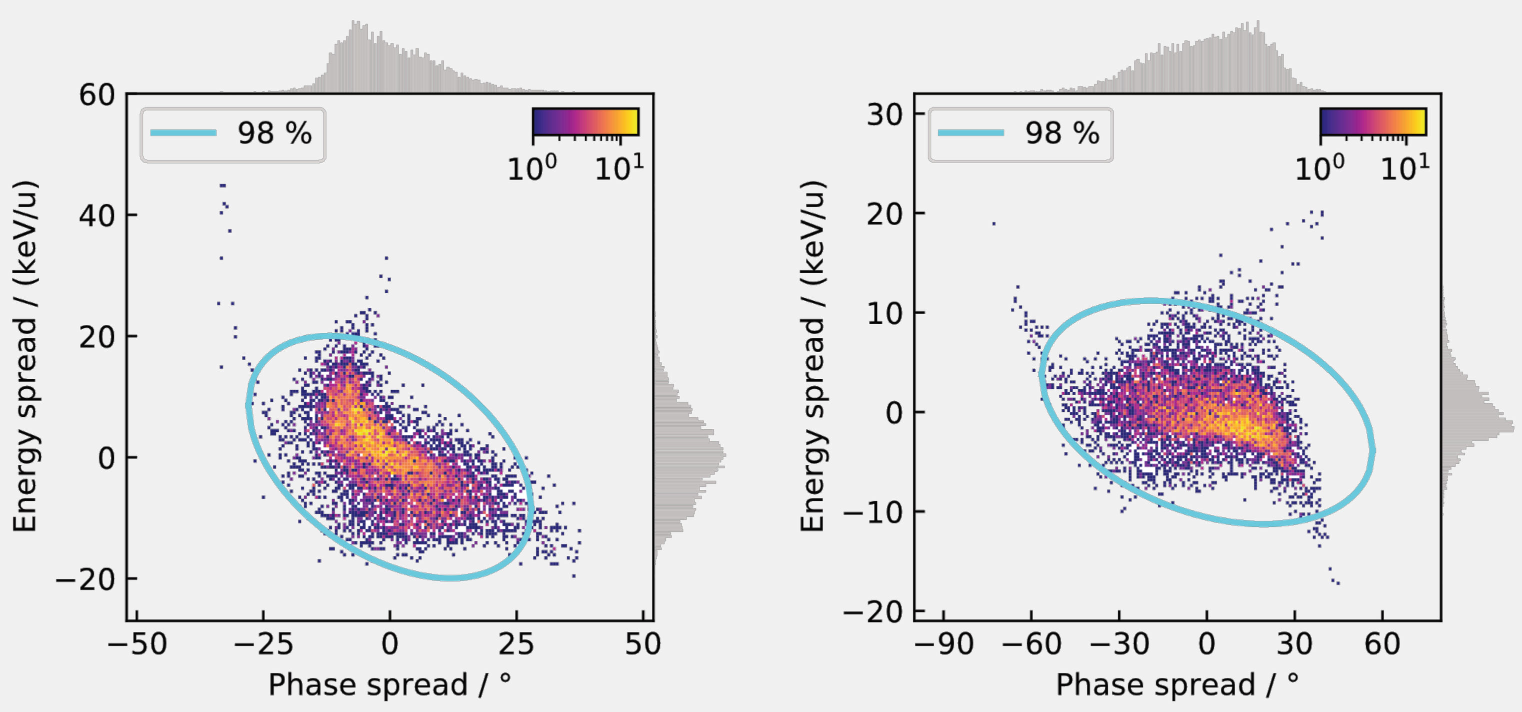
In order to reduce the number of systems on the LINAC a two-in-one Debuncher solution was investigated. The fact, that one cavity should deal with a 7 MeV/u and a 13 MeV beam lead to a two gap cavity.

The drift for both beams has to be adequate for an effective de-bunching. At the Debuncher the 7 MeV/u as well as the 13 MeV beam have a phase width of below 80°. That is adequate to reach the specified energy widths for synchrotron injection.

RF Design

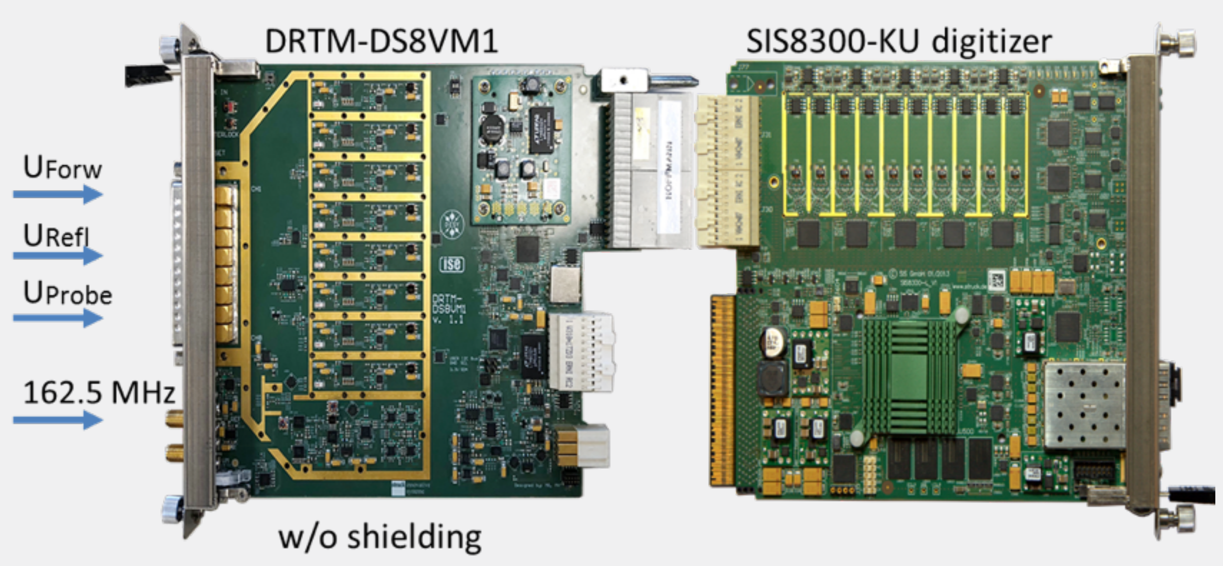
The RF design of the 2-gap Debuncher is based on a spiral-shaped stem whose inductance significantly reduces the inner radius of the cavity. In order to improve field deflection inside the drift tube the period length is increased to 3βλ/2.

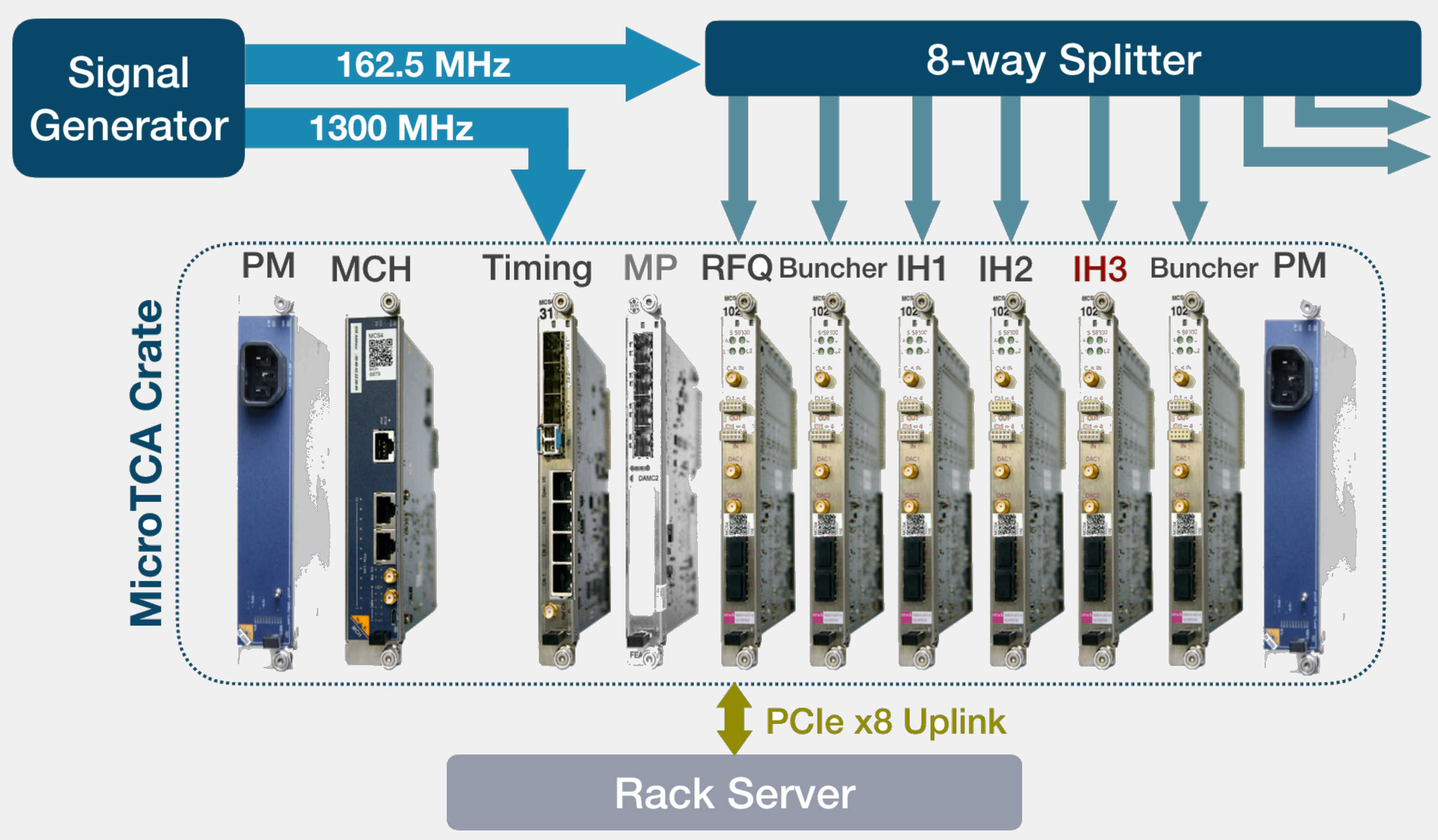
The dual-use Debuncher offers a compact solution that also reduces the number of systems in the accelerator chain at the cost of a higher power consumption.



LLRF

The generator given Low Level Radio Frequency (LLRF) system, to control the RF fields of the accelerating cavities, is based on MicroTCA.4 standard. Each LLRF for a cavity consists of a digitiser card at the back and a RF pre processing module. For the additional IH3, one card set consisting of an RTM and an AMC digitiser card can simply be added.





JINR

DESY.

NICA

BEVATECH