Overview and Status of LLRF System Developments at the MicroTCA Technology Lab

P. Nonn, Ch. Kampmeyer, Ç. Gümüş, Ch. Schmidt, M. Hierholzer, U. Mavrič, M. Hoffmann, T. Walter, H. Schlarb
7th MTCA Workshop for Research and Industry
Who are we and what do we do?

LLRF Development Team of MicroTCA Techlab

Çağil Gümüş

Christoph Kampmeyer

Patrick Nonn

System Integration

Software
Firmware
Hardware

Training
Support
Hardware: DS8VM1

- Direct sampling card with ten input channels (8x AC, 2x DC) plus one vector modulator
- Vector Modulator: 100 MHz to 700 MHz
- Low noise PLL to generate clocks

Example:
- Input: 26 MHz, DC coupled
- Sample Frequency: 78 MHz
- Uroš Mavrič
- Matthias Hoffmann
Abstracts your Application from Hardware and Control System.

More about ChimeraTK in Martin Killenbergs Talk, later today!
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Projects

Turkish Accelerator and Radiation Laboratory in Ankara

...as contractor of...

BEVATECH
### TARLA: Introduction

<table>
<thead>
<tr>
<th>Particles</th>
<th>Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Energy</td>
<td>40 MeV</td>
</tr>
<tr>
<td>Avg. Beam Current</td>
<td>1 mA</td>
</tr>
<tr>
<td>RF Operation</td>
<td>CW</td>
</tr>
<tr>
<td>Micro Pulse Rep. Rate</td>
<td>13 MHz</td>
</tr>
<tr>
<td>Macro Pulse Rep. Rate</td>
<td>10 Hz - CW</td>
</tr>
<tr>
<td>Transversal Emittance</td>
<td>&lt; 13 mm mrad</td>
</tr>
<tr>
<td>Longitudinal Emittance</td>
<td>&lt; 50 keV ps</td>
</tr>
</tbody>
</table>

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TARLA: LLRF System

Sub-harmonic Buncher

Superconducting 9-Cell Cavities

RF 260 MHz
RF 1.3 GHz
Tuner
Piezo

External CPU
PCIe Extension
MCH
X2Timer
DS8VM1
Downconverter
MD22 + PZT4
TARLA: First Tests on Site

- A MTCA Crate was prepared for LLRF operation and shipped to Ankara
- Çağıl Gümüş and Christian Schmidt went to Ankara during November
• Stable closed-loop operation of a 1.3 GHz buncher cavity at high power was achieved
TARLA: To Do

- Inner rack cabling + completing the system integration at DESY
- Shipping Rack to Ankara
- Commissioning of LLRF-System in Ankara
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NICA LILac: Introduction

• Light Ion Injector (LILac) for the Nuclotron-based Ion Collider fAcility (NICA) at the Joint Institute for Nuclear Research (JINR) in Dubna, Russia
• Providing light ions of mass-to-charge ratio up to 3
• Collaboration with Bevatec GmbH

From: NICA: Recreating the first moments of the Universe in the Lab @ youtube

<table>
<thead>
<tr>
<th>Particles</th>
<th>Polarized, Light Ions</th>
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<tbody>
<tr>
<td>Beam Energy</td>
<td>7 MeV/u</td>
</tr>
<tr>
<td>Beam Current</td>
<td>5 mA</td>
</tr>
<tr>
<td>Beam Pulse Length</td>
<td>30 µs</td>
</tr>
<tr>
<td>Duty cycle</td>
<td>0.15 %</td>
</tr>
</tbody>
</table>

Curtesy of Benjamin Koubek, BEVATECH GmbH
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NICA LiLac: LLRF

- 1 RFQ, Rebuncher, 2 IH-DTL and Debuncher cavities
- Single-cavity regulations with dedicated solid-state amplifiers

<table>
<thead>
<tr>
<th>Control</th>
<th>Single Cavity</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Frequency</td>
<td>162.5 MHz</td>
</tr>
<tr>
<td>Repetition rate</td>
<td>≤ 5 Hz</td>
</tr>
<tr>
<td>RF Pulse Length</td>
<td>1 µs – 300 µs</td>
</tr>
</tbody>
</table>

Diagrams courtesy of Benjamin Koubek, BEVATECH GmbH
NICA LILac: Down the Road

- Adaption of Firmware / Software
- Testing components
- Compilation of MTCA Hardware, Firmware and Software
- Installation on site by Bevatech
- Commissioning and Support in collaboration with Bevatech
THANK YOU FOR YOUR ATTENTION