Perspective of LINAC 2016

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PIP-II Technical Meeting
18-Oct-2016
## Incomplete Summary of RFQ Effort at LINAC 2016

<table>
<thead>
<tr>
<th>Accelerator</th>
<th>Facility</th>
<th>Freq</th>
<th>Energy</th>
<th>Current</th>
<th>Species</th>
<th>Duty</th>
<th>Style</th>
<th>Status</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boron Neutron Capture Therapy</td>
<td>PKU</td>
<td>162.5 MHz</td>
<td>2.5 MeV</td>
<td>20mA</td>
<td>H+</td>
<td>CW</td>
<td>4-vane</td>
<td>Simulated (very similar to ours)</td>
<td>TUPRC007</td>
</tr>
<tr>
<td>FAIR Upgrade</td>
<td>Institute for Applied Physics</td>
<td>108 MHz</td>
<td>700 keV</td>
<td>200mA</td>
<td>Proton</td>
<td>CW</td>
<td>4-rod</td>
<td>6-9 month delivery</td>
<td>TUPLR057</td>
</tr>
<tr>
<td>LEAF</td>
<td>IMP</td>
<td>81.25 MHz</td>
<td></td>
<td></td>
<td></td>
<td>CW</td>
<td>4-vane</td>
<td>Simulated</td>
<td>THPLR064</td>
</tr>
<tr>
<td>Material Irradiation Facility</td>
<td>IMP</td>
<td>162.5 MHz</td>
<td>1.52 MeV/u</td>
<td></td>
<td></td>
<td></td>
<td>4-vane</td>
<td>Simulated</td>
<td>THPLR063</td>
</tr>
<tr>
<td>FAIR</td>
<td>IAP</td>
<td>325 MHz</td>
<td>3 MeV</td>
<td></td>
<td>Proton</td>
<td>.08%</td>
<td>Ladder</td>
<td>Testing 0.8m aluminum prototype</td>
<td>TUPLR053</td>
</tr>
<tr>
<td>CIADS</td>
<td>IMP</td>
<td>162.5 MHz</td>
<td>2.1 MeV</td>
<td>10 mA</td>
<td>H-</td>
<td>CW</td>
<td>4-vane</td>
<td>Successful beam commissioning</td>
<td>MOPLR053</td>
</tr>
<tr>
<td>JINR</td>
<td></td>
<td>145.2 MHz</td>
<td>156 keV/u</td>
<td></td>
<td></td>
<td></td>
<td>4-vane</td>
<td>w/coupling windows</td>
<td>TUPLR060</td>
</tr>
<tr>
<td>HIRFL</td>
<td>IMP</td>
<td>53.667 MHz</td>
<td>142.8 keV/u</td>
<td>198 euA</td>
<td>Heavy Ion</td>
<td>CW</td>
<td>4-rod</td>
<td>Tested with beam</td>
<td>No paper</td>
</tr>
<tr>
<td>SPIRAL2</td>
<td>GANIL</td>
<td>88.05 MHz</td>
<td>5 mA</td>
<td></td>
<td>Deuterium</td>
<td>CW</td>
<td>4-rod</td>
<td>Tested with CW beam. May have fast chopper.</td>
<td>WE1A06</td>
</tr>
<tr>
<td>IFMIF-EVEDA</td>
<td></td>
<td>175 MHz</td>
<td>5 MeV</td>
<td>130 mA</td>
<td>Deuteron</td>
<td>CW</td>
<td>4-vane</td>
<td>Modules Tested</td>
<td>TH1A05</td>
</tr>
<tr>
<td>SARAF</td>
<td></td>
<td>176 MHz</td>
<td>2.6 MeV</td>
<td>5 mA</td>
<td>Deuteron</td>
<td>CW</td>
<td>4-rod</td>
<td>2-4 mA, 1.5 MeV, limited by couplers</td>
<td>MOOPO2</td>
</tr>
<tr>
<td>ESS</td>
<td></td>
<td>352.21 MHz</td>
<td>3.62 MeV</td>
<td>70mA</td>
<td>Proton</td>
<td>4%</td>
<td>4-vane</td>
<td>Design</td>
<td>THPLR054</td>
</tr>
</tbody>
</table>
Almost same design for Boron Neutron Capture Therapy (TUPRC007)
China Medical Irradiation Facility RFQ Design

- Basically LBNL design with an extra module.
- THPLR063
Low Energy Accelerator Facility (LEAF) @IMP

Very close to same design for FRIB. (THPLR064)
SARAF RFQ (Israel) (TH1A04)

One of first CW RFQs. Many issues with CW stability. New design splits power between couplers.
Institute for Applied Physics (Frankfurt)

- 4-rod RFQ for protons
- 175 MHz, 700 keV
- 2-50 mA DC beam
- TUPLR075
325 MHz Ladder-RFQ GSI TUPLR053

- New type of rod RFQ. Prototype module tested under full field.
IFMIF RFQ (THPLR050 – Tuning)

- 10m long, 8-module, 8 input couplers, 130 mA CW Beam, 132kV vane potential.
Couplers were the by far the most challenging single items in the supply chain of the modules

- A total of 800 RF power couplers was produced at three different vendors
- The largest fraction was procured by LAL Orsay and produced by Thales / RI
- Approx. 20% were procured from CPI
- RF conditioning of all couplers was done at LAL Orsay at a rate of 10+ couplers/week
- **Coupler delivery rate did not match the module assembly rate**
- Continuing quality and delivery issues needed to be addressed
- The coupler production is still not finished (non-conformities are addressed)
- Approx. 24 couplers are needed for the repair of modules
Potential PIP-II Injector Test Collaborators

- IMP (Already started commissioning CW HWR to 10mA beam current)
- IFMIF (Installing full RFQ for power and beam tests now)
- SPIRAL (CW RFQ with CW cryomodules at low energy. Need to close the loop with them on status.)
- SARAF (Working through many issues with warm, CW operation)
Fermilab Talks

• Dan Broemmelsiek – IOTA/FAST
• Warren Schappert – SRF Cavity Resonance Control
• Paul Derwent – PIP-II Injector Test
• Dave Johnson – The Linac Laser Notcher
• M. Martinello – Impurity Content Optimization to Maximize Q-Factors of Superconducting Resonantors
  – First prize for student poster