Beam profile monitors for SPIRAL2 RIB

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    - Very Low intensity Monitor (VLIM)
  - Associated electronic
SPIRAL2 description

Radioactive ion beam lines
Radioactive Ions Beams description

### Table: RIB Parameters

<table>
<thead>
<tr>
<th>Line</th>
<th>Ion mass range</th>
<th>Intensity range</th>
<th>Beam energy</th>
<th>Example of RIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+ line</td>
<td>6 to 240 keV</td>
<td>$10^3$ to $10^{11}$ pps</td>
<td>10 to 60 keV</td>
<td>132 Sn$^{1+}$</td>
</tr>
<tr>
<td>Line n+</td>
<td>6 to 160 keV</td>
<td>$10^3$ to $10^{10}$ pps</td>
<td>10 to 45 keV</td>
<td>132 Sn$^{20+}$</td>
</tr>
<tr>
<td>Existing Ganil</td>
<td>6 to 160</td>
<td>$10^3$ to $10^{9}$ pps</td>
<td>1.2 to 25 MeV/u</td>
<td>20 keV</td>
</tr>
</tbody>
</table>

### Diagram:
- **Linac**
- **S3 hall**
- **Production building**
- **Charge breeder**
- **Transport hall**
- **Production cave**
- **Existing GANIL**
- **CIME cyclotron**
- **DESIR hall**
Radioactive ion beam profileurs

- Low Pressure Gas Monitor (LPGM)

**Principle**: ionization chamber with two wire planes in 10 mBar of C3F8 gas

**Energy range**: from 0.5 MeV/u to 25 MeV/u

**Intensity range**: from $10^2$ pps to $10^7$ pps

**Location lines**: from CIME to GANIL Experimental rooms

![Diagram of a Low Pressure Gas Monitor (LPGM)]

6 µm Mylar entrance window
Radioactive ion beam profileurs

- **Low Pressure Gas Monitor (LPGM)**

  **Pressure**: gas regulation between 5 to 50 mbar (usually 10 mbar)
  **High voltage**: from -300V to -1000 V
Radioactive ion beam profileurs

- Low Pressure Gas Monitor (LPGM)

Experimental result: Azote14 $^2+$ beam profile $E = 1.74$ MeV/u, $I = 3200$ pps

Horizontal profile          Vertical profile          amplification signal versus high voltage variation
Radioactive ion beam profileurs

• Low Pressure Gas Monitor (LPGM)

Further improvements: new design to increase the high voltage limitation, to limit the outgazing and to improve the gas circulation

Test in progress (JINR DUBNA): comparaison of the irradiation flux and thermal resistance between Mylar and Kapton foils
• Emissive Foil Monitor

**Principle**: secondary emission on Al foil, amplification by microchannel plates, reading informations on X-Y matrix

**Energy range**: up to 10 KeV

**Intensity range**: from 10 pps to $10^9$ pps

**Location lines**: from 1+ line to GANIL Experimental rooms
Radioactive ion beam profileurs

• Emissive Foil Monitor

Magnetic field : ~150 G
Electric field : ~ 15V/mm
Amplification : 2 microchannel plates Ø 50 mm
Matrix : 42 x 42 strips (resolution 1 mm)
Radioactive ion beam profileurs

• Emissive Foil Monitor

Two Experimental results

C12 2⁺ beam at 5 MeV/u
Intensity : $10^4$ pps

Xe132 15⁺ beam at 15 KeV/u
Intensity : $2.5 \times 10^{10}$ pps

Reference Profiler:
- gas profiler
- SEM profiler

Emissive foil monitor profile

increase of the profile size

Needing to perform the resolution

Workshop on low current, low energy beam diagnostics - Jean Luc VIGNET - November, 23 - 25 - 2009
Radioactive ion beam profileurs

- Emissive Foil Monitor

New design of magnets pole: beam test in 2010
Radioactive ion beam profileurs

- Very Low Intensity Monitor (VLIM)

**Principle**: direct low intensity beam on MCP and matrix reading

**Energy range**: from 10 keV/u to 25 MeV/u

**Intensity range**: from 10 pps to $10^5$ pps

**Location lines**: from $1^+$ line to GANIL Experimental rooms

Unknown aspect: effect of the microchannel plates radioactive activation, life expectancy…

Under development: first test in 2010
Radioactive ion beam profileurs

• Associated electronics
  (for all beam profile monitors)

  **Principle**: 94 channels in a parallel system (2 x 47).
  **Two conversion possibilities**: passive system for high intensity beams
  active system for low intensity beams
  **Front end**: constituted by 12 daughter boards of 8 channels
  **A/D conversion**: about 4 µs
  **Acquisition**: FPGA (Altera cyclone 3)

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Thank you for your attention