"96Zr beam acceleration for isobar experiment in RHIC"

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To investigate chiral magnetic effect, 96Zr and 96Ru beams have been accelerated at relativistic heavy ion collider (RHIC) in Run18 at Brookhaven National Laboratory (BNL). 96Zr and 96Ru beams were provided from electron beam ion source (EBIS) injector and tandem Van de Graaff, respectively. The total provided shots from laser ion source was counted as 489910. 96Zr16+ beam had been provided at very stable condition without major interruption. Successful data acquisition was achieved at STAR detector at RHIC.

What is the best material to provide 96Zr beam from laser ion source

Mass number
<table>
<thead>
<tr>
<th>90</th>
<th>91</th>
<th>92</th>
<th>94</th>
<th>96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>51.45%</td>
<td>11.22%</td>
<td>17.15%</td>
<td>17.38%</td>
</tr>
<tr>
<td>Enriched</td>
<td>19.27%</td>
<td>5.10%</td>
<td>7.86%</td>
<td>8.17%</td>
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</tbody>
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Natural abundance of 96Zr is only 2.8%.
Metal enriched Zr plate was not available, although target performance is great.
Enriched Zr hydride was not available at that time.
Only choice was ZrO2 powder which can be obtained in the market.

Metal Zr plate showed the best performance.
Zr hydride could last for several hundreds laser shots.
ZrO2 compressed powder could stand only a few laser shot.
Enriched Zr coated film last several shots.

1.0 g of enriched ZrO2 = almost a compact car
We needed estimate accurate consumption rate.

We needed to develop a new laser target using enriched ZrO2 powder.

Sintering ZrO2 powder to form laser target

Using natural abundance ZrO2 powder, sintering process was developed in RIKEN.

Intensive study of the enriched target had been carried out through mid of the RUN18 (Feb. 27 ~ May. 6).

Laser irradiation condition survey

Using natural abundance ZrO2 targets, huge patterns of laser irradiation conditions had been tested.

• What is the adequate target shape?
• Laser energy?
• Laser pot size?
• Target scanning direction vs. incident laser angle?
• Target scanning velocity?
• Estimate consumption rate?
• Laser spot positions for RHIC and NSRL?

At the test, equivalent particle number of 96Zr16+ to Au197 was achieved.

Mechanical development

Target translation mechanism

Beam performance

Typical operation status of 96Zr16+ beam at the EBIS injector