Copper-61 (61Cu)  
- The radiometal 61Cu is a short-lived (T1/2 = 3.4h) positron emitting isotope (β+ : 61.4%, EC: 38.6%) which is suitable for use in labelling hypoxic agents [1].
- It also has two important gamma ray transitions; 282keV (12.2%) and 656keV (10.77%) that are used for characterisation in labelling hypoxic agents.
- 61Cu can be produced by proton bombardment using several nuclear reactions, including 62Ni (p, 2n)61Cu; 61Ni (p, n)61Cu; & 65Zn (p, α)61Cu.
- This study investigates the low-energy proton reactions of natZn (p, x)61Cu & 64Zn (p, α)61Cu, using protons from an 18 MeV isochronous cyclotron.

Study Aim  
To evaluate & compare the production of 61Cu from enriched 64Zn and natural Zn (64Zn nat. abund., 48.6%) targets and to optimise the methods of product separation & purification.

Target Irradiation  
- Proton energies : 11.7, 14.5 & 17.6MeV
- Targets: 64Zn electroplated on to backing plate, or natZn disc. (See Table for target masses)
- Beam line: External, in-house designed & constructed, suitable for normal-incidence bombardment & foil/disc targets
- Beam current : 30μA
- Irradiation time: 30 – 60min
- Beam degraders : Graphite or aluminium
- Target backing materials: Au (foil), Ag (foil) & Al (disc) used at proton energies of 11.7, 14.5 & 17.6MeV, respectively.

Results  

<table>
<thead>
<tr>
<th>Proton Energy (MeV)</th>
<th>64Zn</th>
<th>64Zn</th>
<th>64Zn</th>
<th>64Zn</th>
<th>64Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.7</td>
<td>11.7</td>
<td>14.5</td>
<td>14.5</td>
<td>17.7</td>
<td>17.7</td>
</tr>
<tr>
<td>Irradiation time (min)</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>Zn target (mg)</td>
<td>63</td>
<td>15</td>
<td>61</td>
<td>15</td>
<td>58</td>
</tr>
<tr>
<td>64Cu activity (MBq)</td>
<td>162.21</td>
<td>75.77</td>
<td>95.29</td>
<td>195.16</td>
<td>62.8</td>
</tr>
<tr>
<td>Yield (MBq/μA.h)</td>
<td>13.08</td>
<td>5.05</td>
<td>6.35</td>
<td>6.50</td>
<td>4.18</td>
</tr>
<tr>
<td>Cu (μg) (ICP-MS)</td>
<td>0.79</td>
<td>1.35</td>
<td>0.30</td>
<td>2.87</td>
<td>0.257</td>
</tr>
<tr>
<td>ICP-MS Cu/Zn ratio</td>
<td>0.88</td>
<td>2.25</td>
<td>0.03</td>
<td>0.92</td>
<td>0.04</td>
</tr>
<tr>
<td>ICP-MS-based Specific activity (GBq/μmol)</td>
<td>12.96</td>
<td>3.57</td>
<td>20.02</td>
<td>4.31</td>
<td>15.49</td>
</tr>
</tbody>
</table>

Summary & Discussion  
- Highest production yield for 61Cu was from enriched 64Zn target using 14.5 MeV protons
- Cu vs. Zn ratio by ICP MS shows separation method was consistent and high yielding
- Radiochemical (>95% at 2 hours EOS) and chemical (< 8.6 ppm of Zn < 2.9 ppm of Cu) purities were acceptable
- Zn target is a viable alternative to 61Ni (nat. abundance 1.14%, 50 < /μg)

References  

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Cyclotron Production of 61Cu using an Enriched 64Zn Target  
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