1. Background/Purpose

**Background:**
Imaging of the irradiation field using 14C-beams and OpenPET.
If we can use the 14C beams, - cancer treatment - imaging of the irradiation field can be simultaneously performed.

**Problems of past research:**
1. Autoactivation (target fragmentation)
2. Secondary 14C beams (projectile fragmentation): - wide momentum spread - large emittance - low beam rate due to the low yield of the reaction

**Requirements for 14C-gas production system:**
1. 100 14C molecules.
2. 1CH4 as a 14C molecule.
3. Impurities have to be reduced to the same level as 14C molecules.

2. Experimental Setup

<table>
<thead>
<tr>
<th>Carrier Gas</th>
<th>Radioactivity (mCi) / ratio to total</th>
<th>Num. Of Collected 1CH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elemental</td>
<td>-2</td>
<td>He</td>
</tr>
<tr>
<td>Total</td>
<td>100% 99.8% 0.0% 0.2% 2x10^-1</td>
<td></td>
</tr>
<tr>
<td>NaBH4</td>
<td>25d 185.9 0.70 77.3</td>
<td></td>
</tr>
<tr>
<td>He</td>
<td>100% 70.4% 0.3% 29% 5x10^-2</td>
<td></td>
</tr>
</tbody>
</table>

* Beam: 18-MeV, 18-µA Proton

**NaBH4 target:** Total activity is Lower, but 1CH4 could be obtained much more easily owing to dense-hydrogen atoms.

**Goal of 10^11 methane molecules could be obtained.**

3. Results and Discussion

- Decay curve obtained by the ionization chamber was fitted by a decay function to determine the radionuclide.
- Fitting results: t1/2 = 20 min
  The main radionuclide produced in the target was found to be 14C.

**Summary**
- 1CH4 molecules could be produced and extracted directly from the target box by using a NaBH4 target for proton irradiation.
- The number of collected volatile 1CH4 molecules exceeded the amount of molecules (10^11) required for the ESIS to produce 10^11 14C ions.
- Based on these findings, NaBH4 targets are expected to find application in the new method for producing and separating of 1CH4 molecules.

The peak from the NaI detector was fitted by a decay function to determine the radionuclide.