Collection device for the production of Li-8 and B-8 radioactive ions

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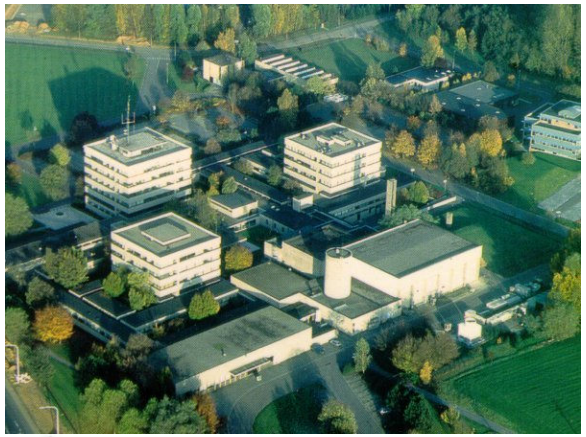
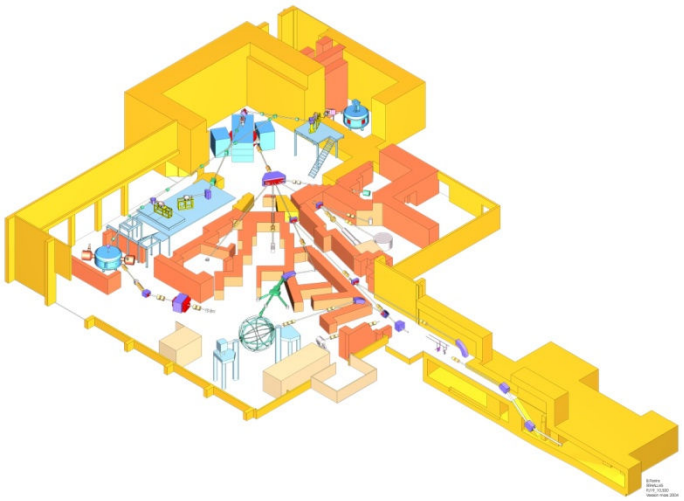
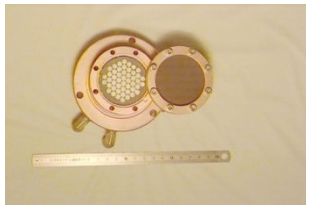






Element	$T_{1/2}$	q	Energy Range [MeV]	Intensity [pps]*
^{6}Helium	0.8 s	1+	5.3 – 18	$1 \cdot 10^{7}$
		2+	30 – 73	$3 \cdot 10^{5}$
^{7}Beryllium	53 days	**1+**	5.3 – 12.9	$2 \cdot 10^{7}$
		2+	25 – 62	$4 \cdot 10^{6}$
^{10}Carbon	19.3 s	**1+**	5.6 - 11	$2 \cdot 10^{5}$
		2+	24 - 44	$1\ 10^{4}$
^{11}Carbon	20 min	1+	6.2 – 10	$1 \cdot 10^{7}$
^{13}Nitrogen	10 min	1+	7.3 – 8.5	$4 \cdot 10^{8}$
		2+	11 – 34	$3 \cdot 10^{8}$
		3+	45 – 70	$1 \cdot 10^{8}$
^{15}Oxygen	2 min	2+	10 – 29	$6 \cdot 10^{7}$
^{18}Fluorine	110 min	2+	11 – 24	$5 \cdot 10^{6}$
^{18}Neon	1.7 s	2+	11 – 24	$1 \cdot 10^{7}$
		3+	24 – 33, 45 – 55	$4 \cdot 10^{5}$
^{19}Neon	17 s	2+	11 – 23	$2 \cdot 10^{9}$
		2+	7.5 – 9.5	$5 \cdot 10^{9}$ (CYC44)
		3+	23 – 35, 45 – 50	$1.5 \cdot 10^{9}$
		4+	60 – 93	$8 \cdot 10^{8}$
^{35}Argon	1.8 s	3+	20 – 28	$2 \cdot 10^{6}$
		5+	50 – 79	$1 \cdot 10^{5}$

LLN RIB typical intensities **after** post-acceleration **and** isobaric separation on experimenter's target.

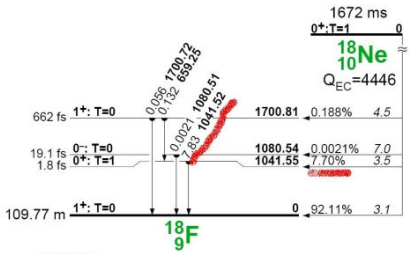
Noble gases or extraction as molecules

Step by step: from Eurisol DS to Euroν

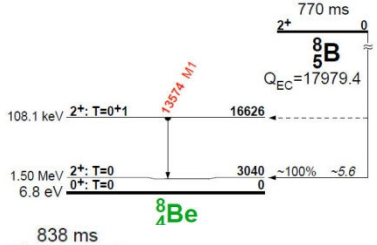
- alternative way of to produce neon-18:
  ^{19}F (p, 2n) ^{18}Ne and $^{16}O(^{3}He,n)^{18}Ne$

- alternative particles: from ^{18}Ne and ^{6}He to ^{8}Li and ^{8}B

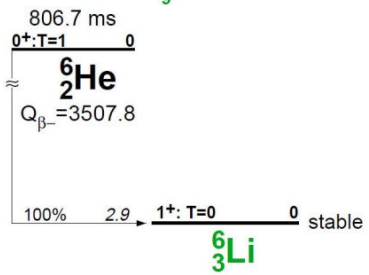
β^+ ^{18}Ne



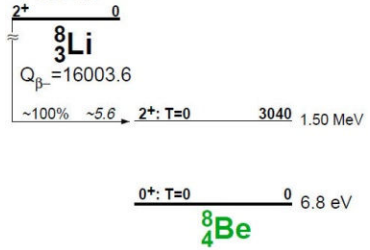
β^+ ^{8}B



β^- ^{6}He

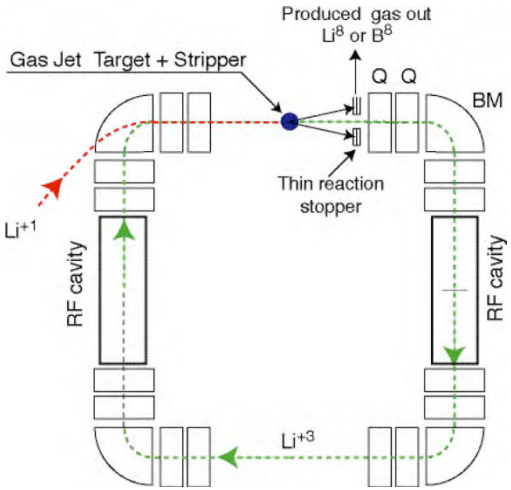


β^- ^{8}Li

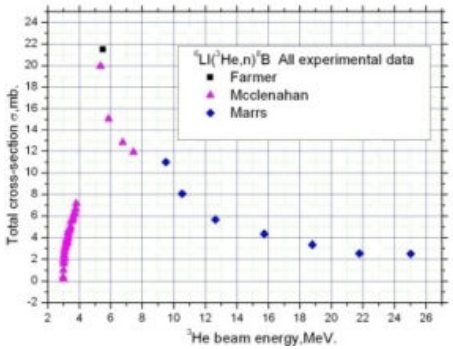


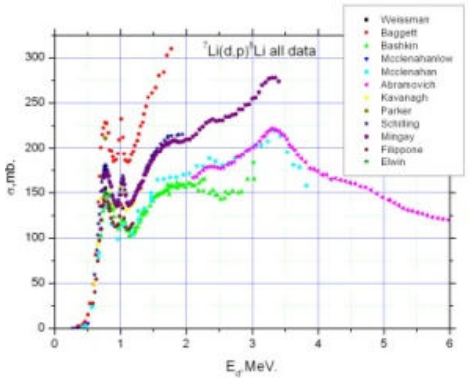
Advantage of ^{8}Li and ^{8}B : Q value is higher => ν energy is higher

Main idea – "Beam cooling with ionisation losses" – C. Rubbia, A Ferrari, Y. Kadi and V. Vlachoudis in NIM A 568 (2006) 475-487



$^7Li(d,p)\,^8Li$ and $^6Li(^3He,n)\,^8B$



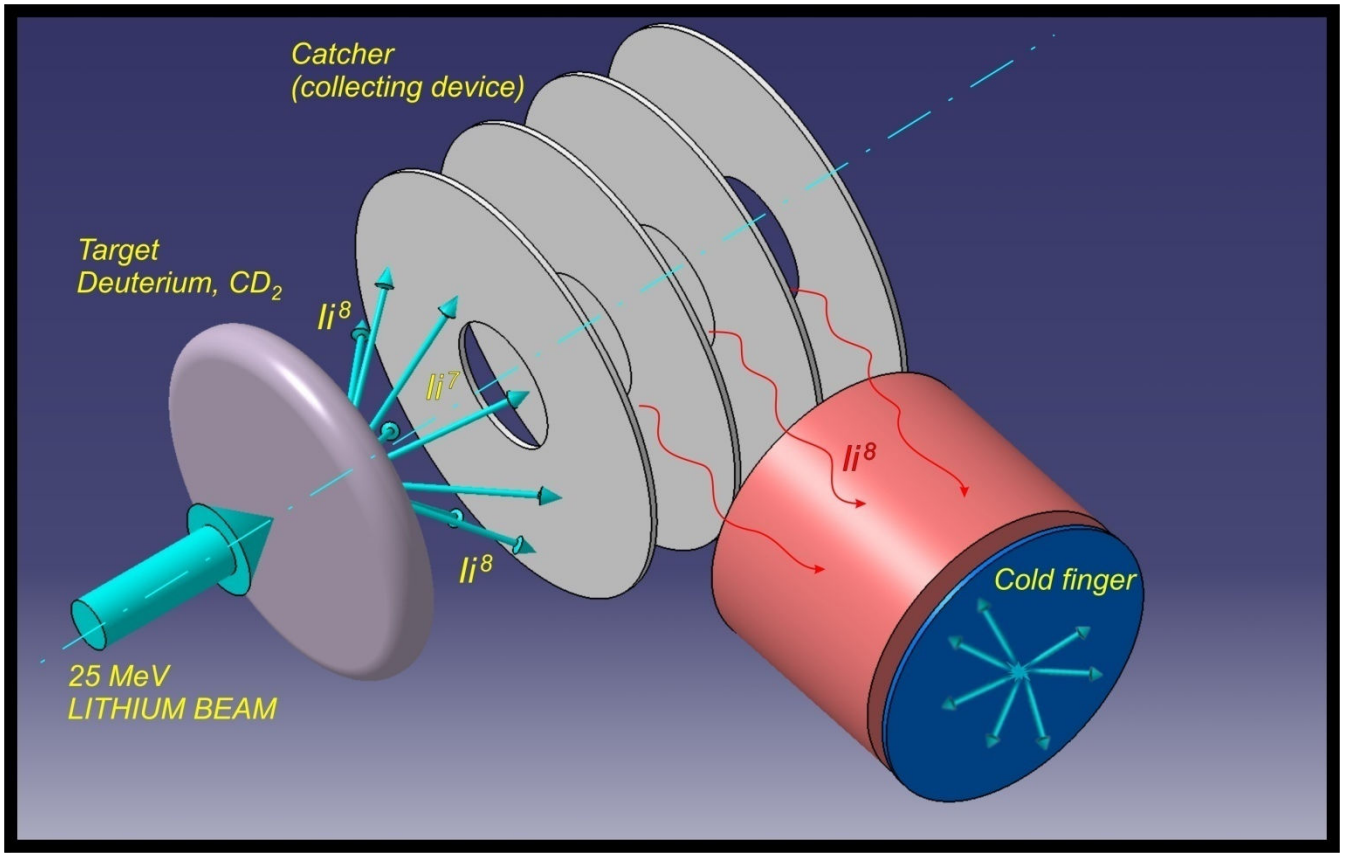


Collection device task:

- ✓ To build the prototype of the collection device and test it on-line.
- ✓ To measure the extraction efficiency for Li-8.
- ✓ To study extraction technique of B-8.

Collection device – what is it

Scheme: beam->target->catcher->diffusion + effusion-> ^{8}Li detection



What we should do to realize it

R&D stages:

- produce ^{8}Li in deuterium target
- stop and catch ^{8}Li in stopper
- extract ^{8}Li from the catcher
- detect and count β – decay of ^{8}Li

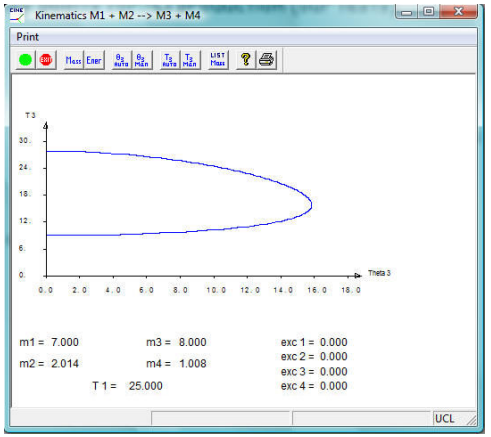
Main goal now is:

We should start from ^{8}Li to make all tests and probe the whole system

R&D stages:

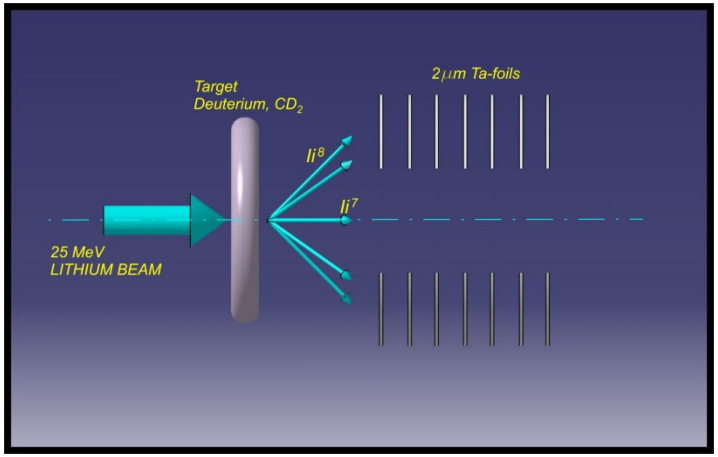
1. The key points for ^{8}Li production (our tests)

- ^{7}Li beam energy 10 ÷ 27 MeV
- intensity 1 pnA
- deuterium or CD_2 targets (0.2 mg/cm^2)
- kinematics => narrow output angular cone for the ^{8}Li
- 10^3 per 1 pnA



2. Stop and Catch

- tantalum foils with 2μm thickness
- toroidal geometry (future)



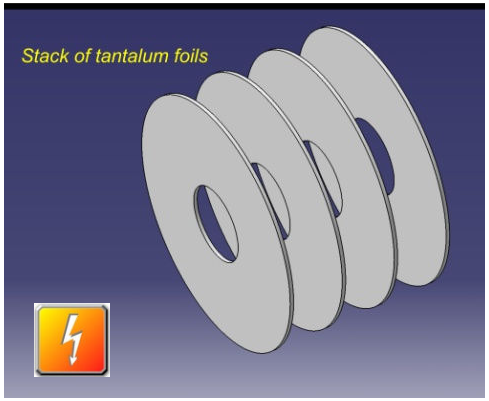
R&D stages:

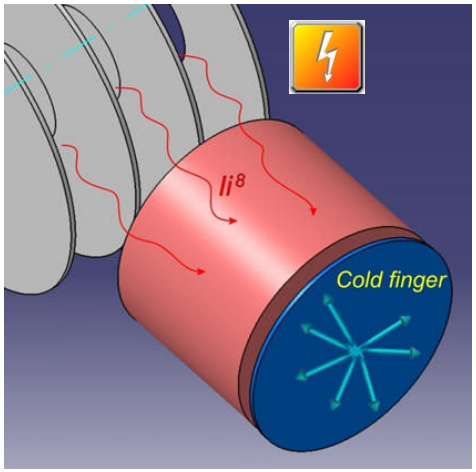
3. ^{8}Li extraction and effusing

- ohmic heating up to 2000°

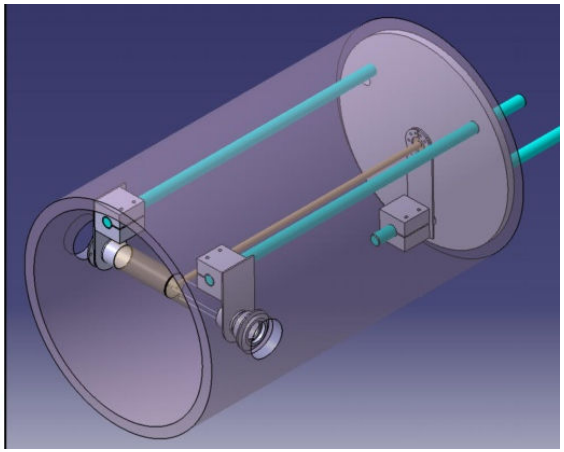
4. Detecting

- catch the ^{8}Li on "cold finger"
- detect the β decay of ^{8}Li using scintillators
- measuring ΔE, E, time structure, counting

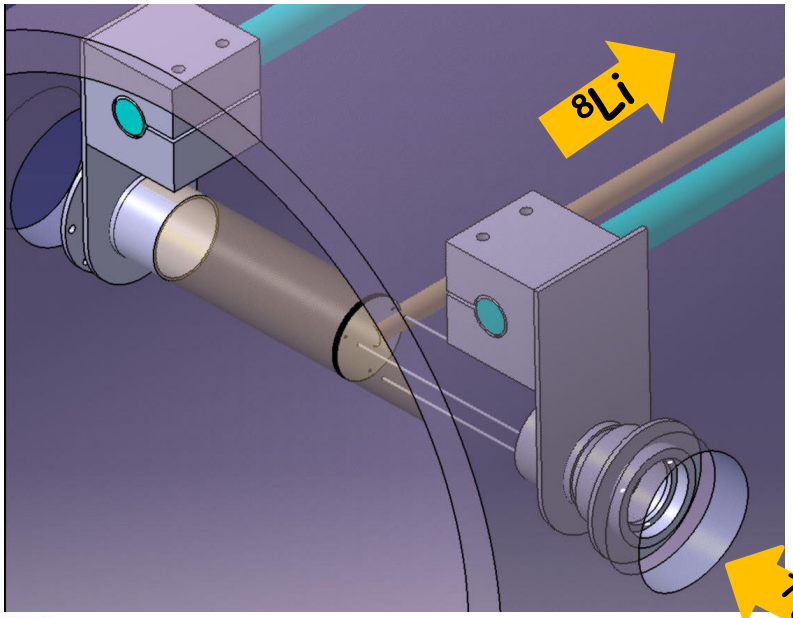




What we have today



Drawings are under construction
At the moment we use solid geometry
for the foils



The main goal is **to extract** Li8
all works devoted to this
(1st stage of our work).

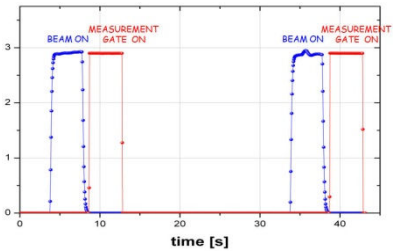
What is going on

1. Shopping material and electronics
2. Data acquisition system test
3. High temperature test

Off-line tests

4. Preparation of on-line tests

- testing the beam time structure (ON+OFF)
- background measurements



Time schedule - ^{8}Li

- Start point: March 09 
- Prototype design study: June 09 
- Prototype technical drawings: July-October 09 
- Workshop manufacture: September-November 09 
- Off-line test: October ÷ November 09 
- First beam test (beam test in cabin): December 09 
- Background measurements: February 10 
- Full-time beam experiments: March ÷ April 10 
- ^{8}Li stage progress report: May ÷ July 10 

End of the summer 2010  *we hope we will finish with ^{8}Li.* 

We have half of year to discover how to produce ^{8}B beam via ISOL method
and 1.5 year to develop the production technique

Thank You for Your attention

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