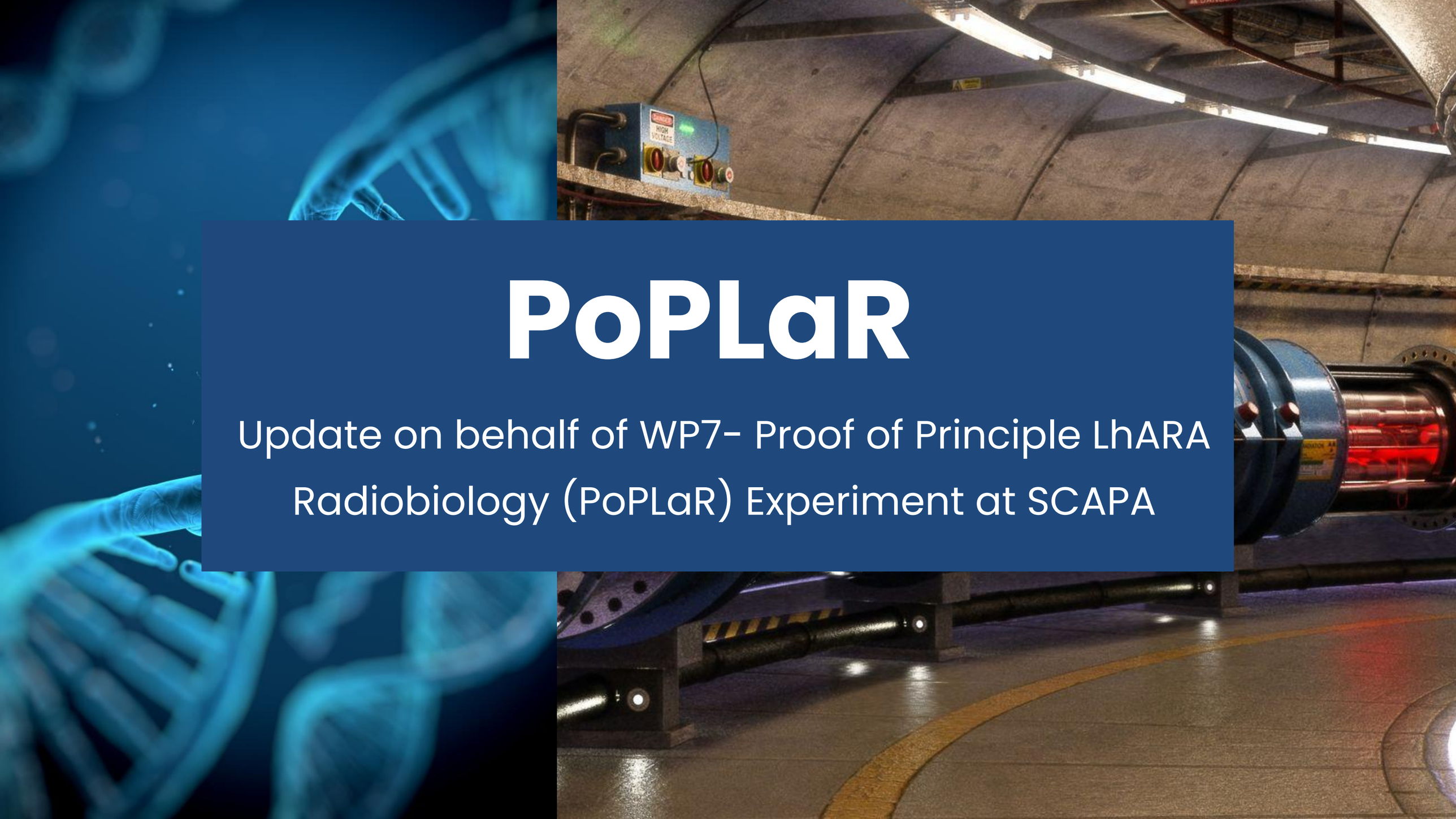
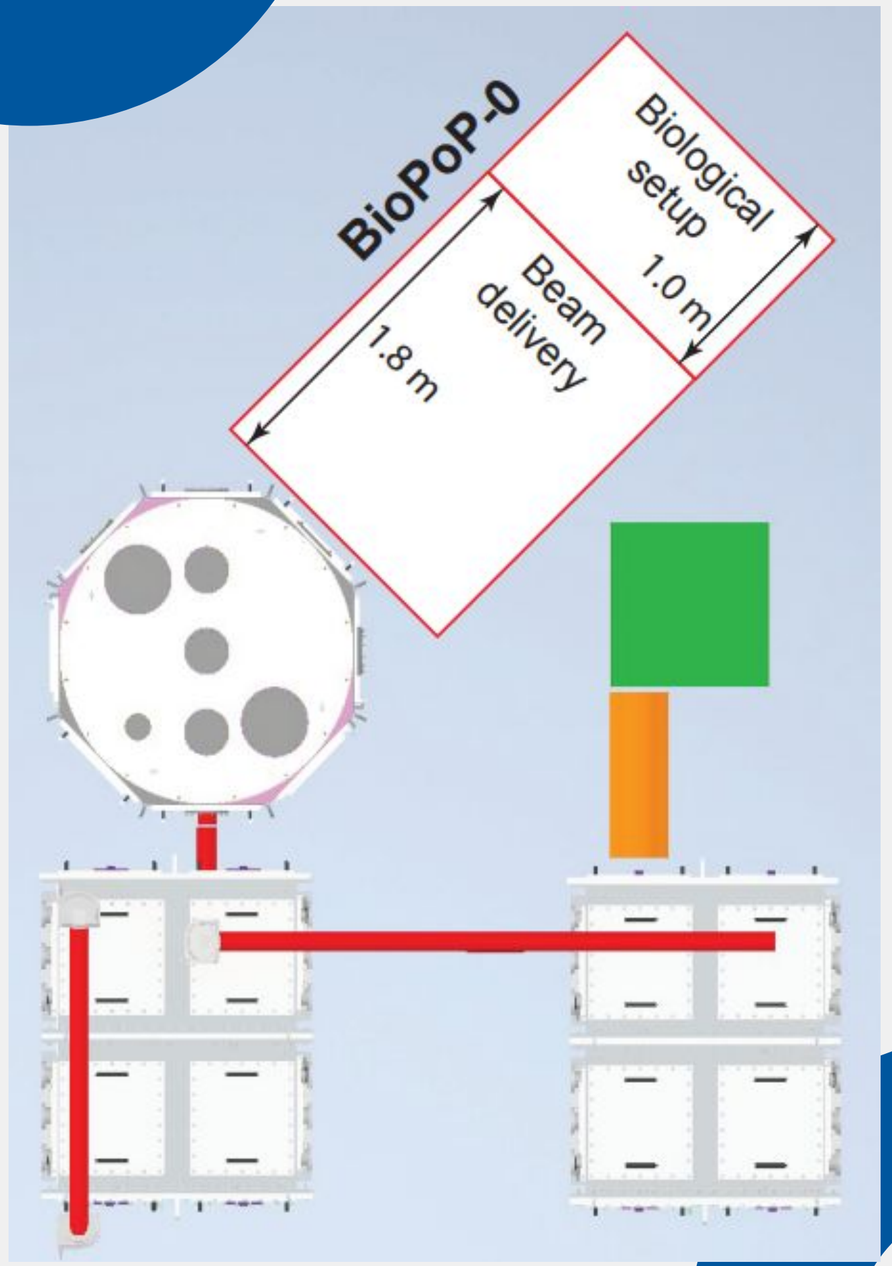


PoPLaR

Update on behalf of WP7- Proof of Principle LhARA Radiobiology (PoPLaR) Experiment at SCAPA

SCAPA

- Scottish Centre for the Application of Plasma-based Accelerators (SCAPA).
- The SCAPA research centre is a major initiative within the Scottish Universities Physics Alliance (SUPA).
- Facilities include state-of-the-art laser laboratories, laser-driven plasma accelerators and radiation sources.
- Research is focused on the development and application of next generation accelerator technology.



PoPLaR Planning Stages

SCAPA

- Dimensions
- Beam capabilities
- Set up

Linear Optics

- Test energies
- Test hardware
- Find beam properties

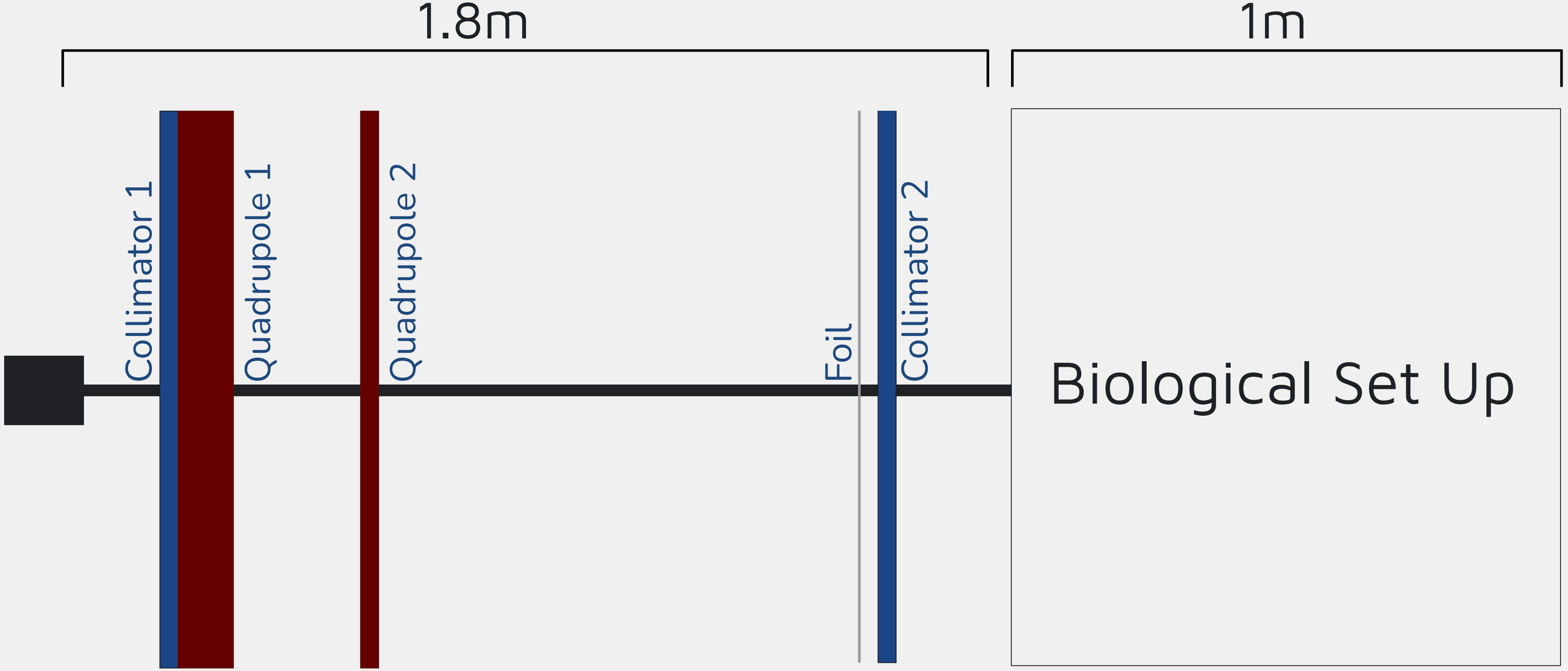
Hardware

- Budget
- Purchase

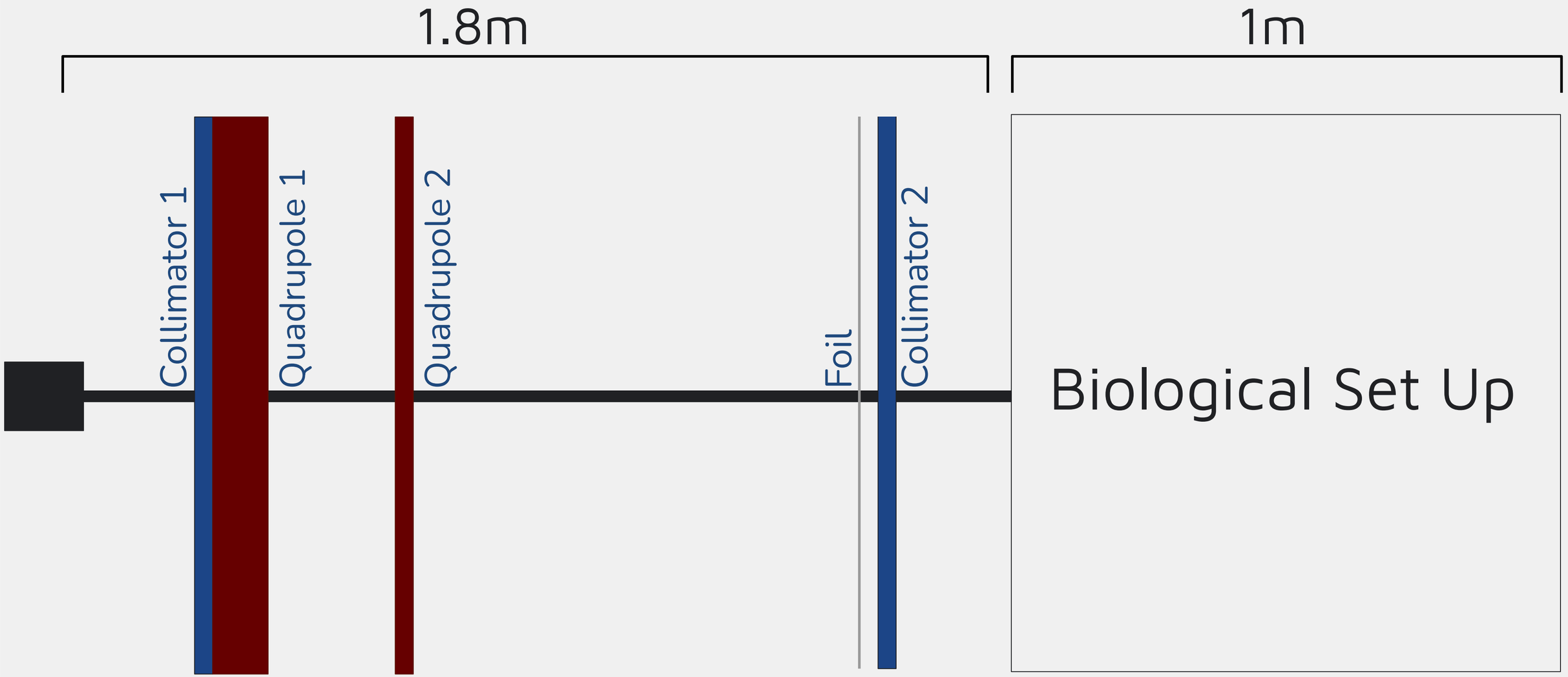
Radiobiology

- Plan Experiment
- Design SCAPA bio/prep room

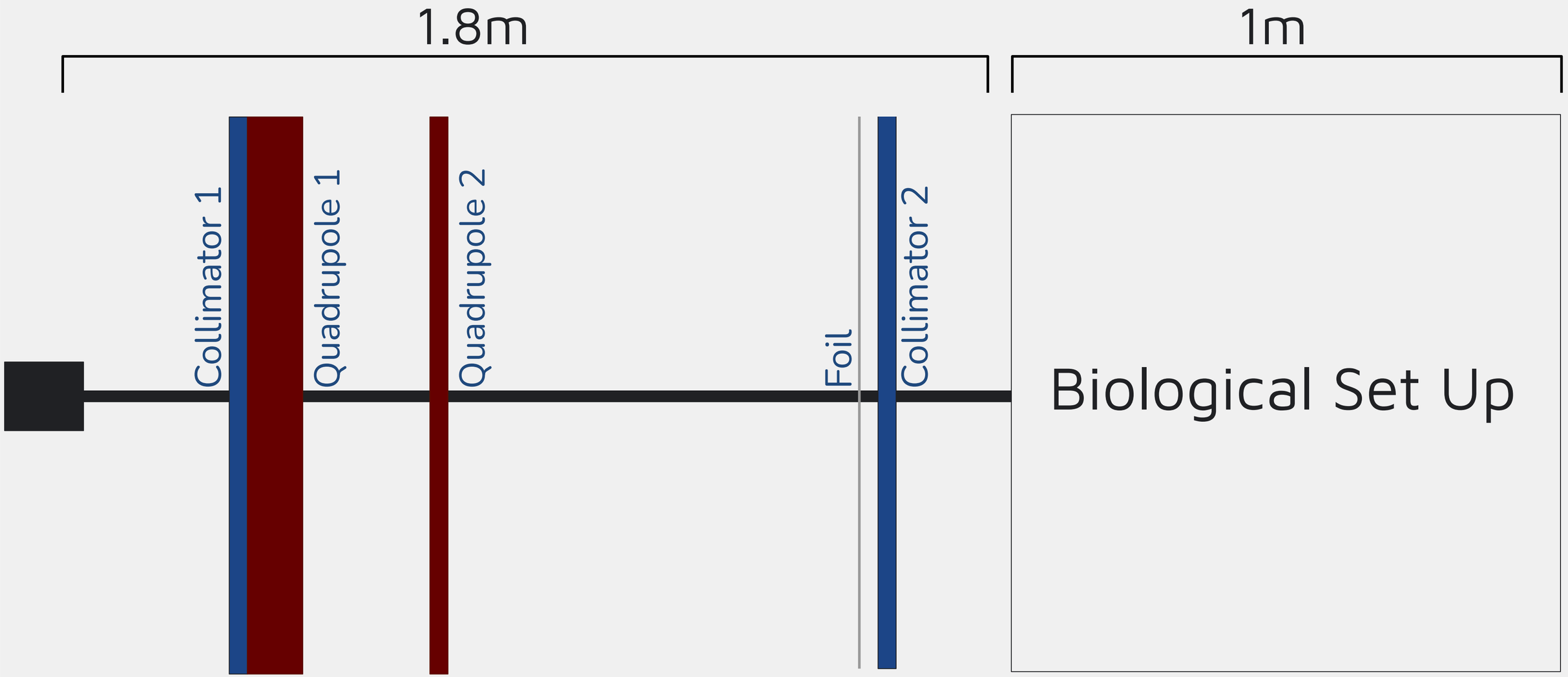
PoPLaR Set Up



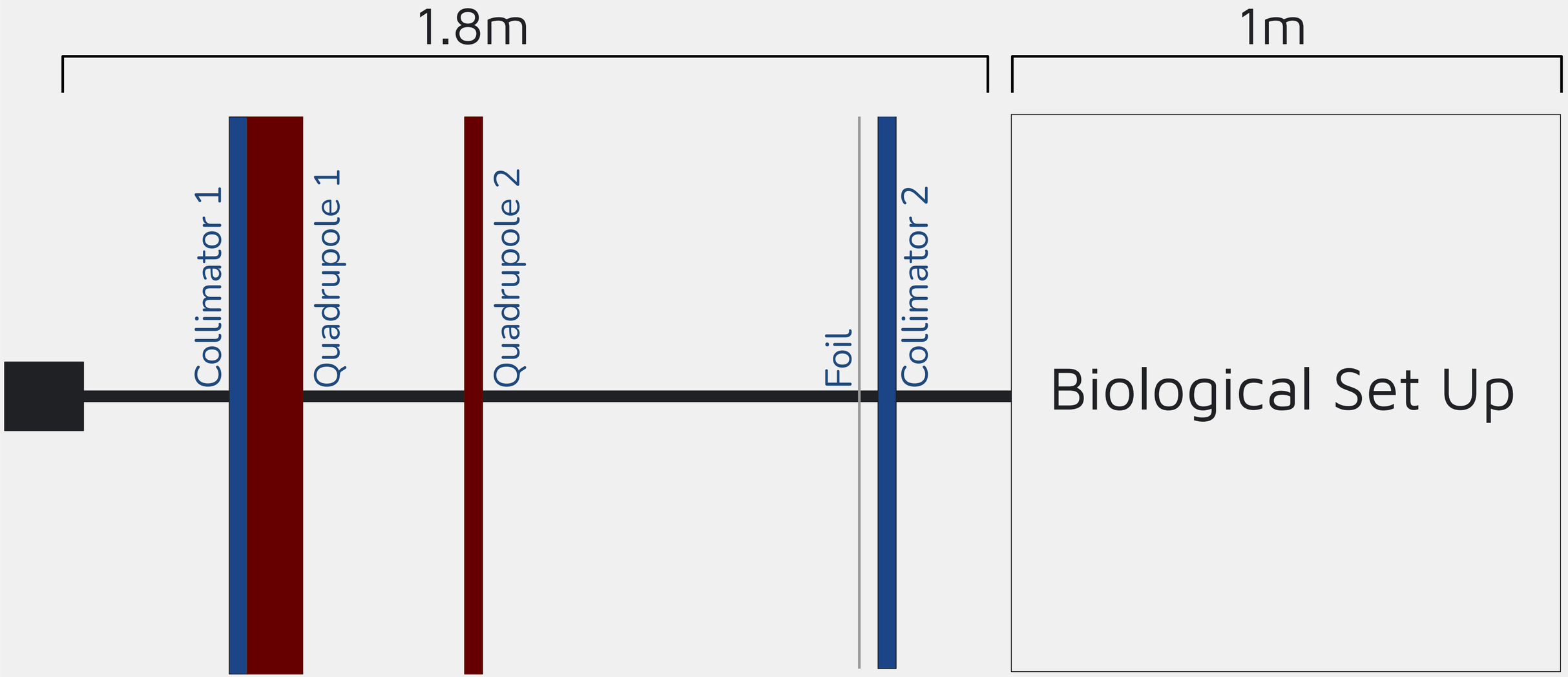
PoPLaR Set Up



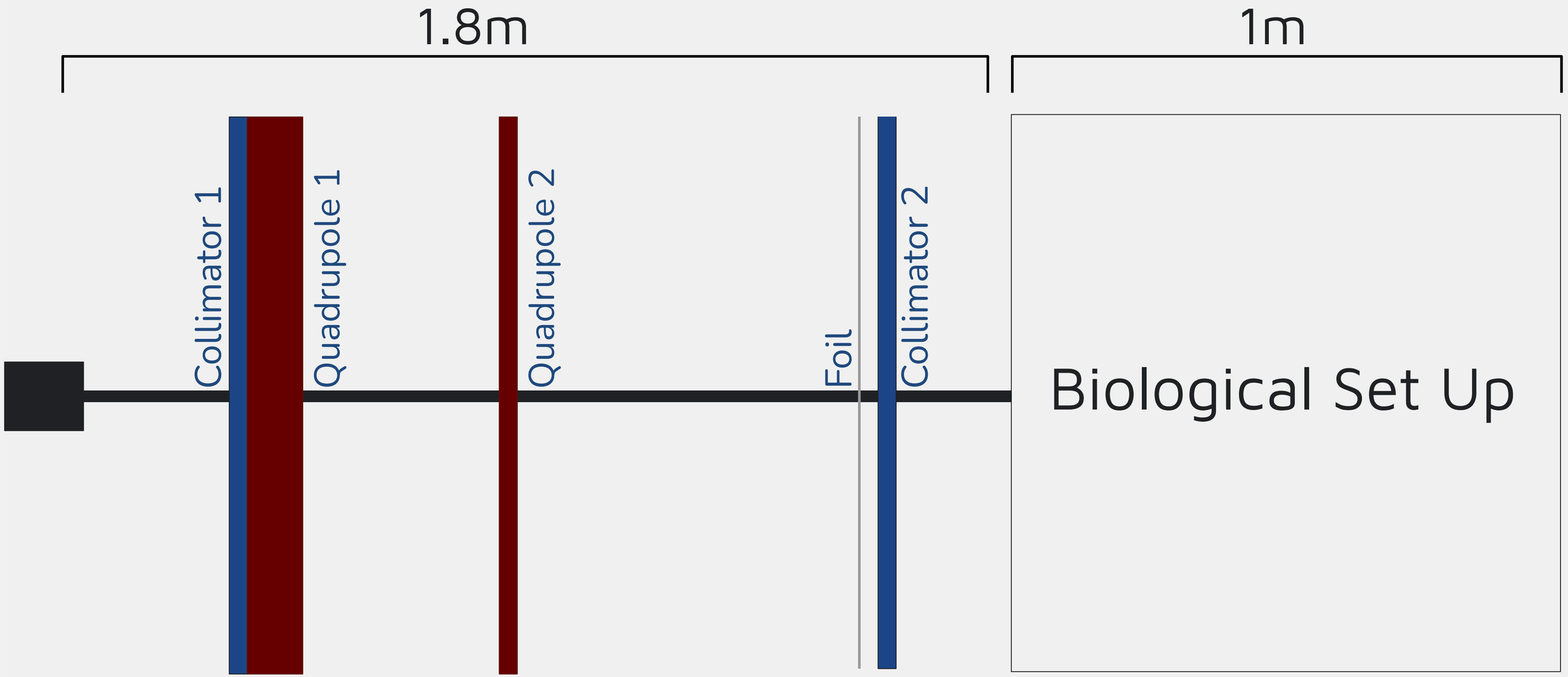
PoPLaR Set Up



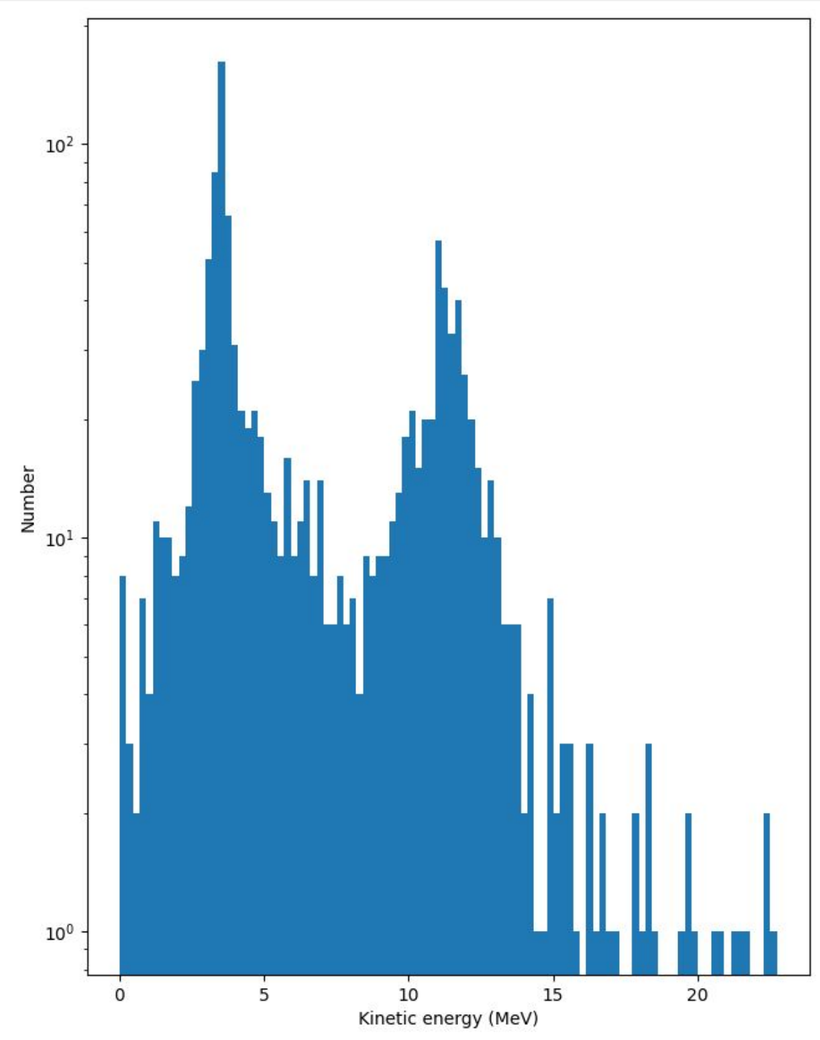
PoPLaR Set Up



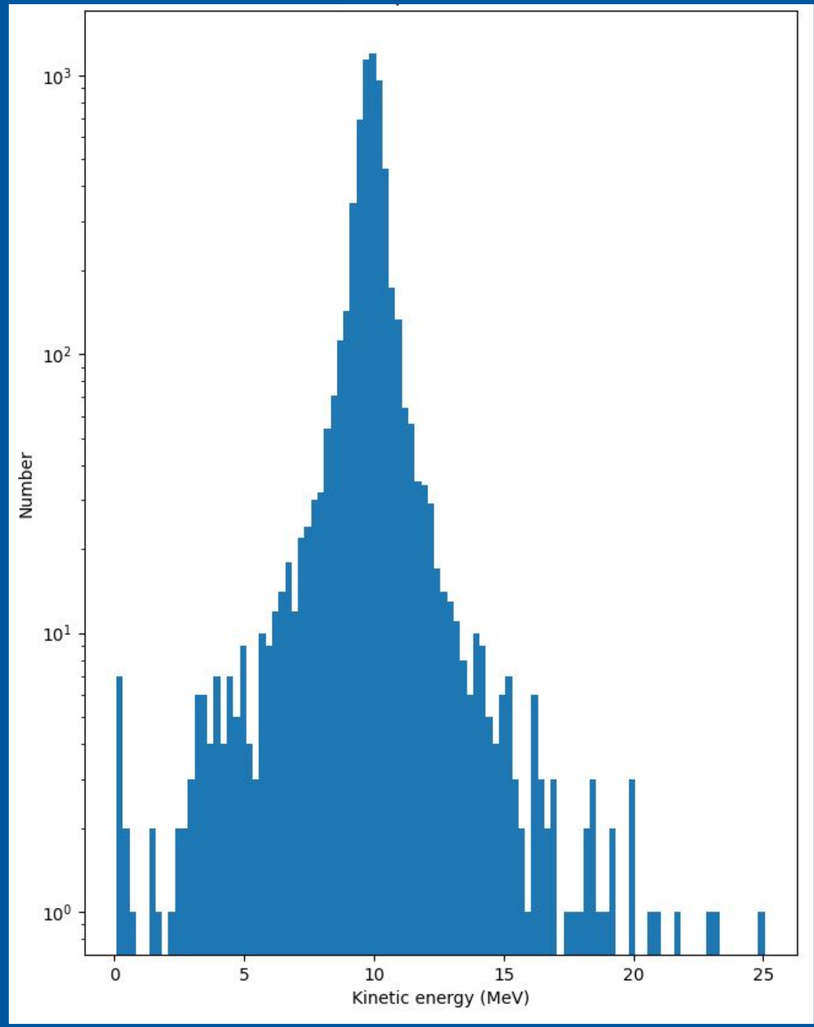
PoPLaR Set Up



Distributions



Two peak distributions



Single peak distributions

Linear Optics

$$\phi = \begin{pmatrix} x \\ x' \\ y \\ y' \\ z \\ \delta \end{pmatrix}$$

Trace Space Matrix

$$\text{Tdrift} = \begin{pmatrix} 1 & l & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & l & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1/\beta 0\text{^}2\gamma 0\text{^}2 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

Drift Matrix

Linear Optics

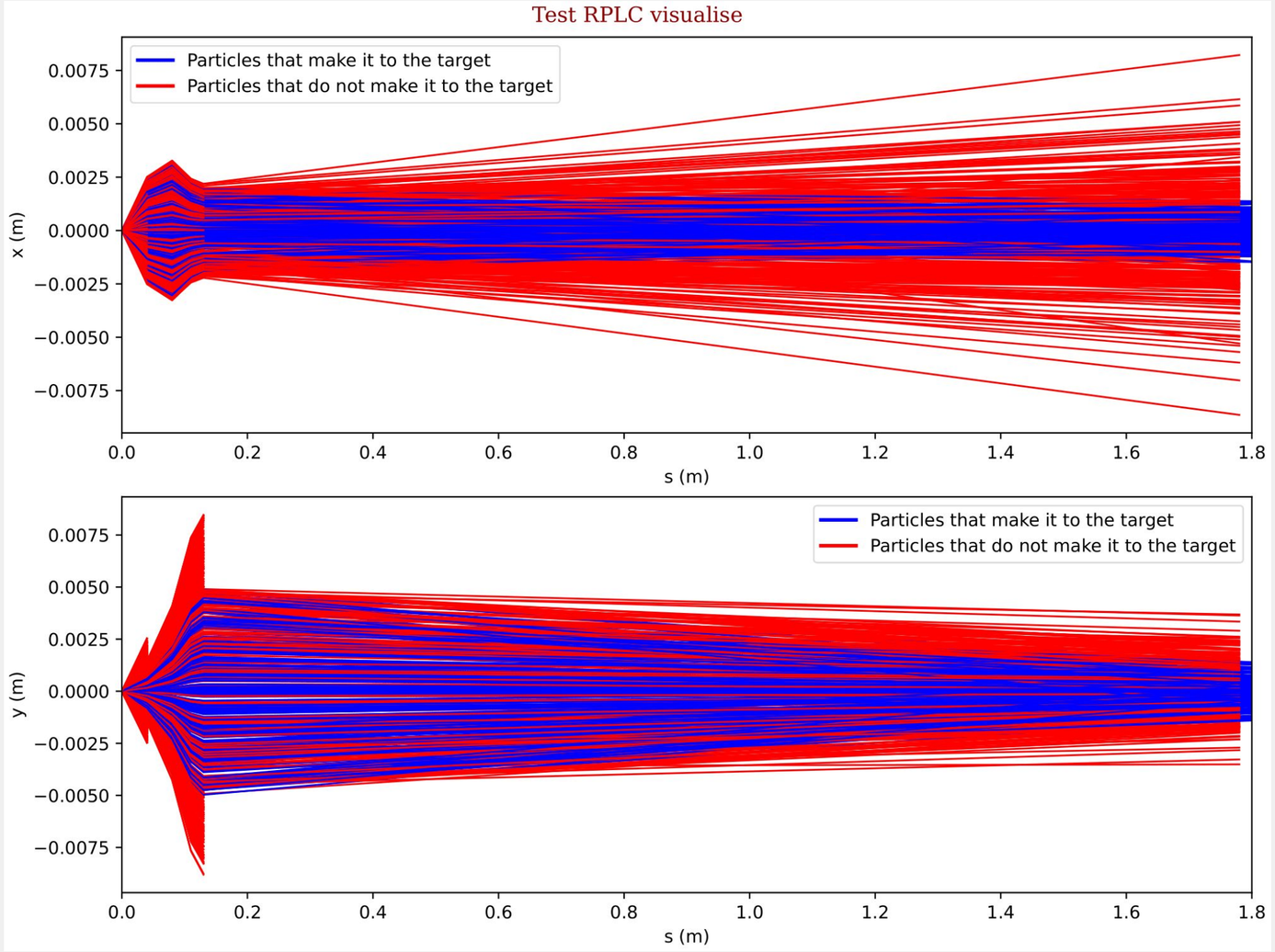
$$
\mathrm{Tfquad} = \begin{pmatrix}
\cos(\sqrt{kq}.lq) & \sin(\sqrt{kq}.lq)/\sqrt{kq} & 0 & 0 & 0 & 0 \\
-\sqrt{kq}.\sin(\sqrt{kq}.lq) & \cos(\sqrt{kq}.lq) & 0 & 0 & 0 & 0 \\
0 & 0 & \cosh(\sqrt{kq}.lq) & \sinh(\sqrt{kq}.lq)/\sqrt{kq} & 0 & 0 \\
0 & 0 & \sqrt{kq}.\sinh(\sqrt{kq}.lq) & \cos(\sqrt{kq}.lq) & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 1/\beta 0\hat{}2\gamma 0\hat{}2 \\
0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}
$$

Focusing Quadrupole Matrix

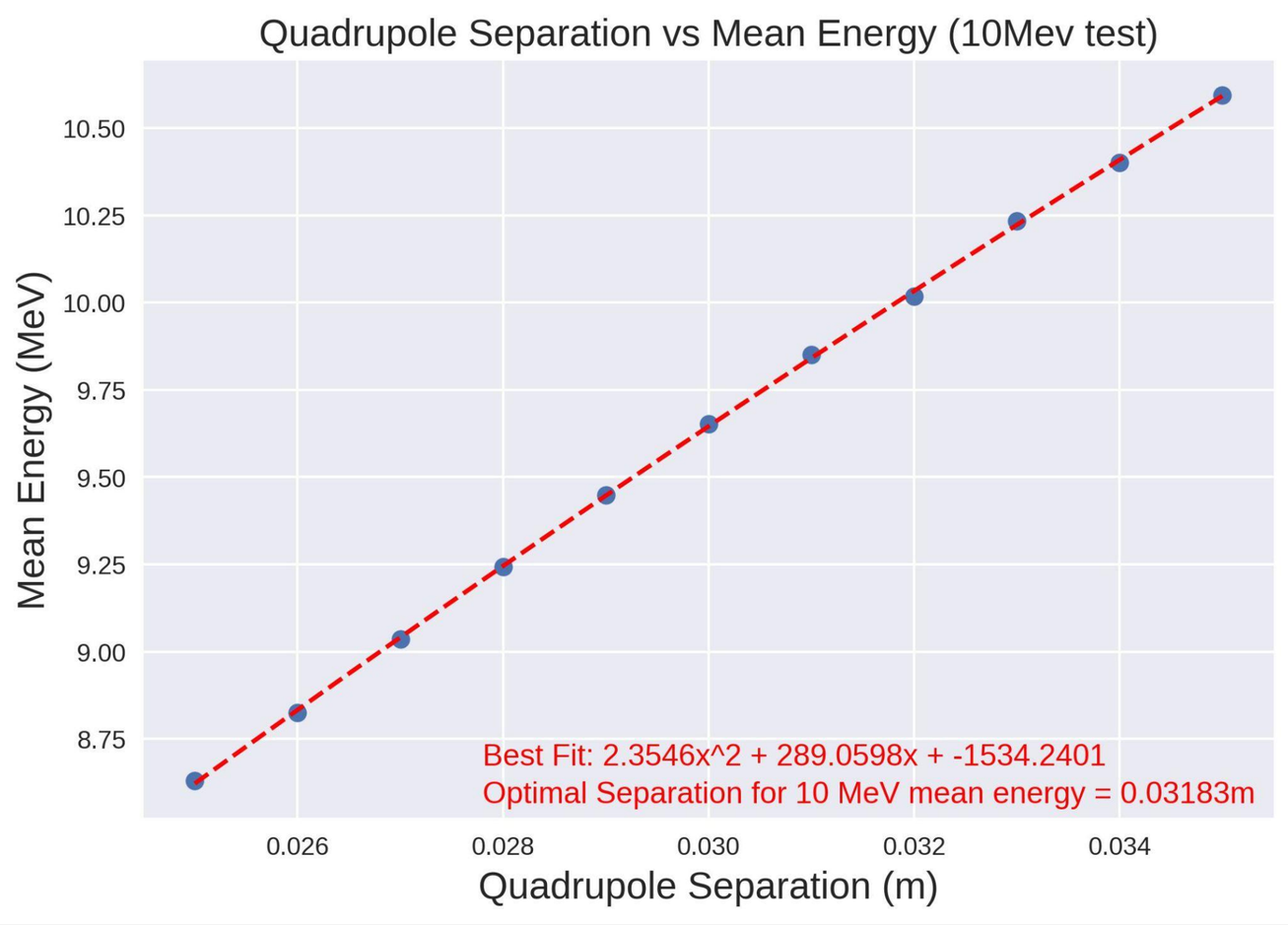
10MeV

Focusing quadrupole position: 0.04m

Defocusing quadrupole position: 0.03m

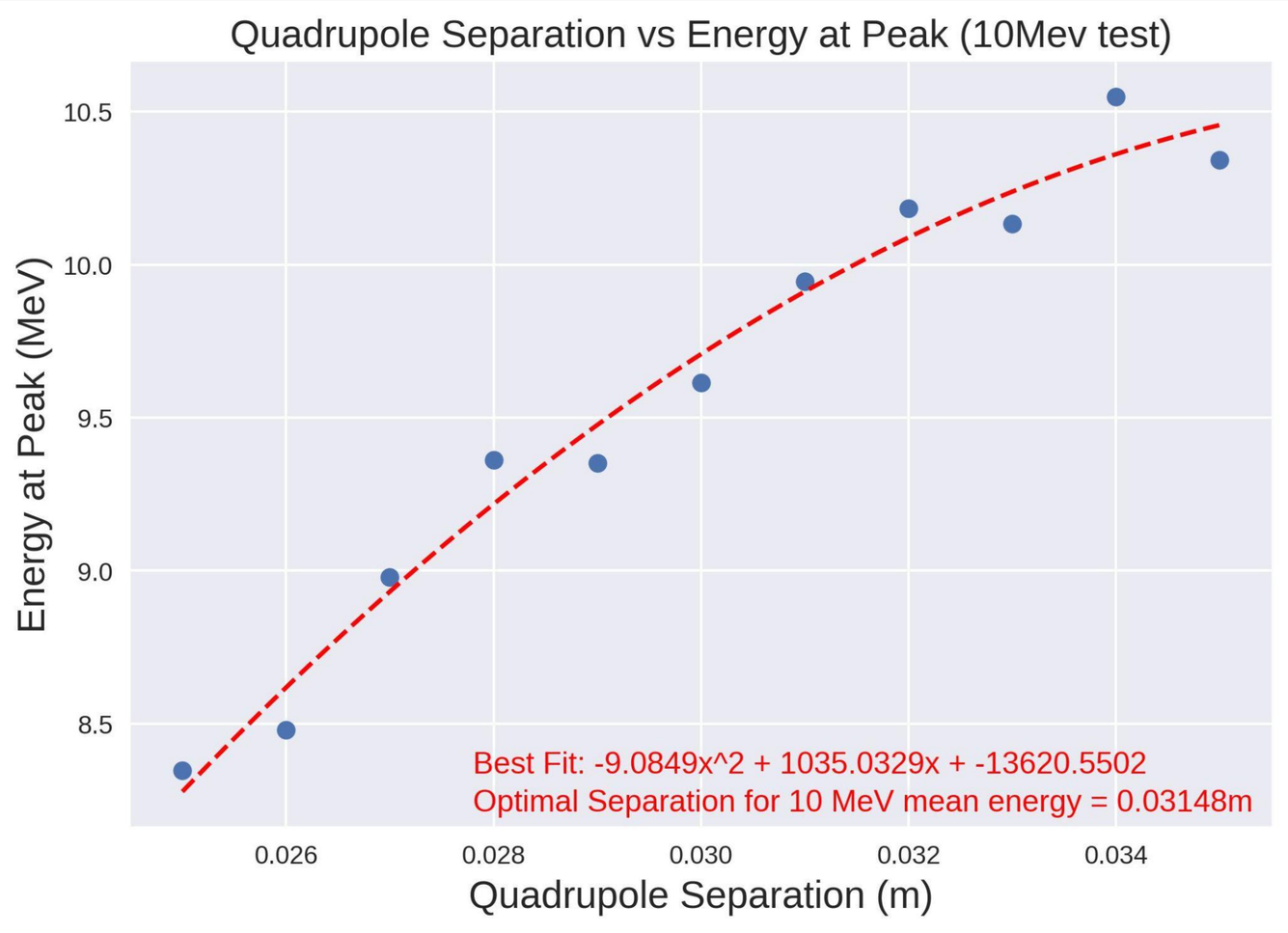


Quadrupole Separation for 10MeV (Mean)



Quadrupole 1 fixed at 0.04m

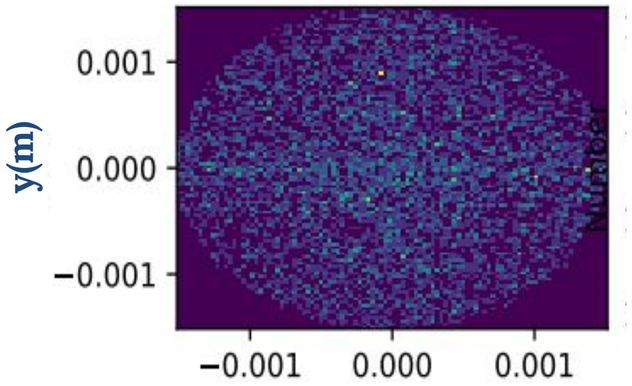
Quadrupole Separation for 10MeV (Peak)

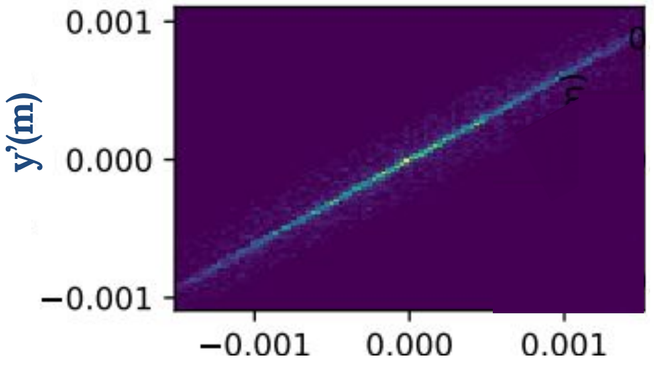


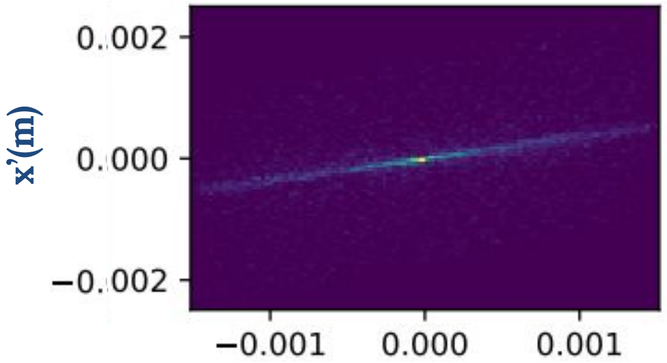
Quadrupole 1 fixed at 0.04m

Beam Properties at the Target

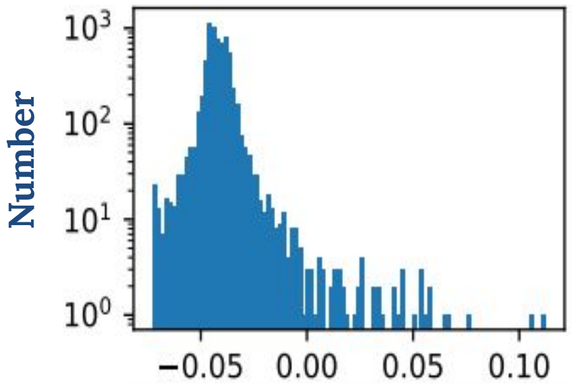
Beam geometrics

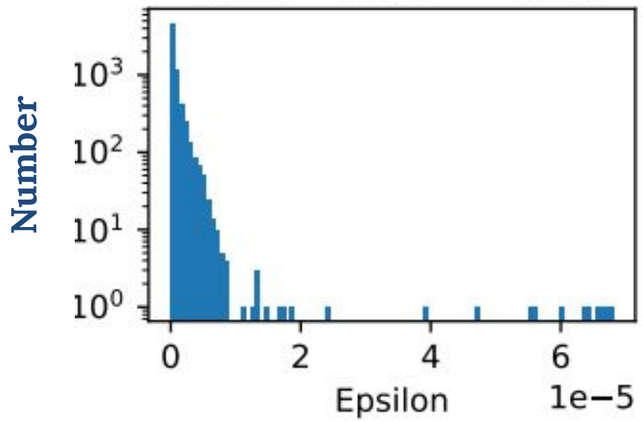


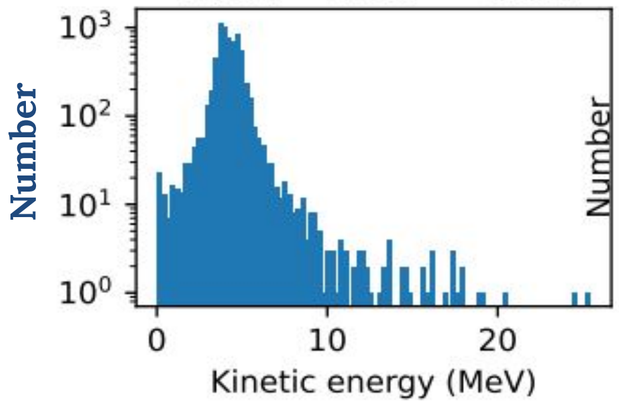




Beam distribution



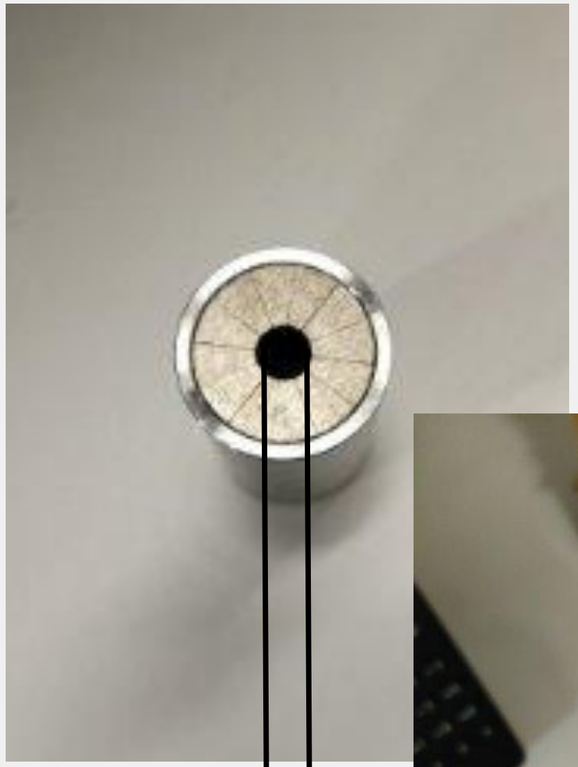


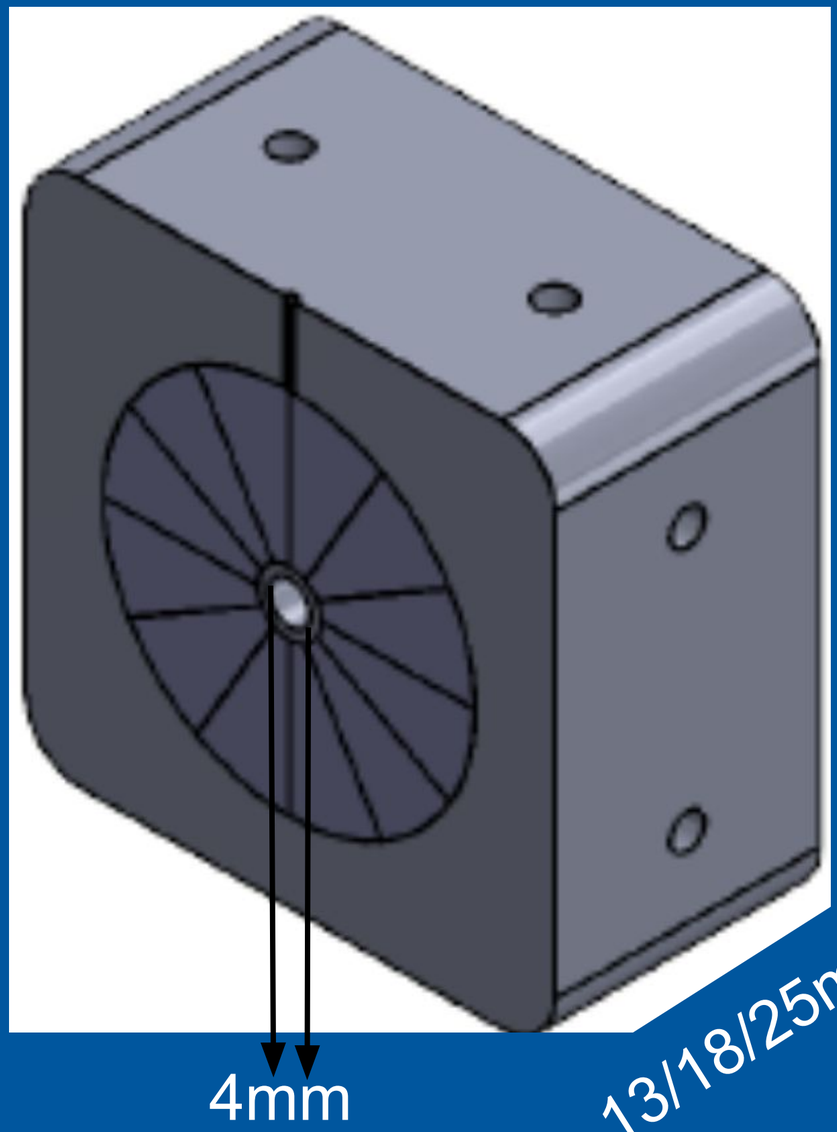


Positions to focus each energy

Energy (MeV)	Focusing quad position (m)	Drift between quads (m)
5	0.03	0.015
7.5	0.025	0.035
10	0.04	0.03
12.5	0.05	0.025
15	0.055	0.03

Potential Quad Options





Next Steps

- **s** SCAPA visit, discuss with Strathclyde biologists & view the spaces/hardware available
- **q** Use linear optic simulations to decide on optimal quadrupole for beam & cost efficiency & purchase
- **d** Design experiment based on energies from SCAPA, beam properties from linear optics
- **e** Do experiment

PROPOSED TIMELINE

Deliverables for PoPLaR to keep the project on track for completion byt October 2024.

Spring 24 — SCAPA visit

Summer 24 — Linear optics- quad decision

Autumn 24 — Experiment Design

By October 24 — Experiment

THANK YOU!