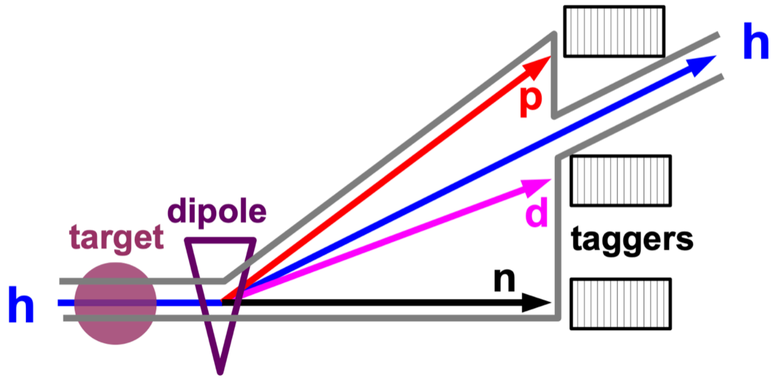
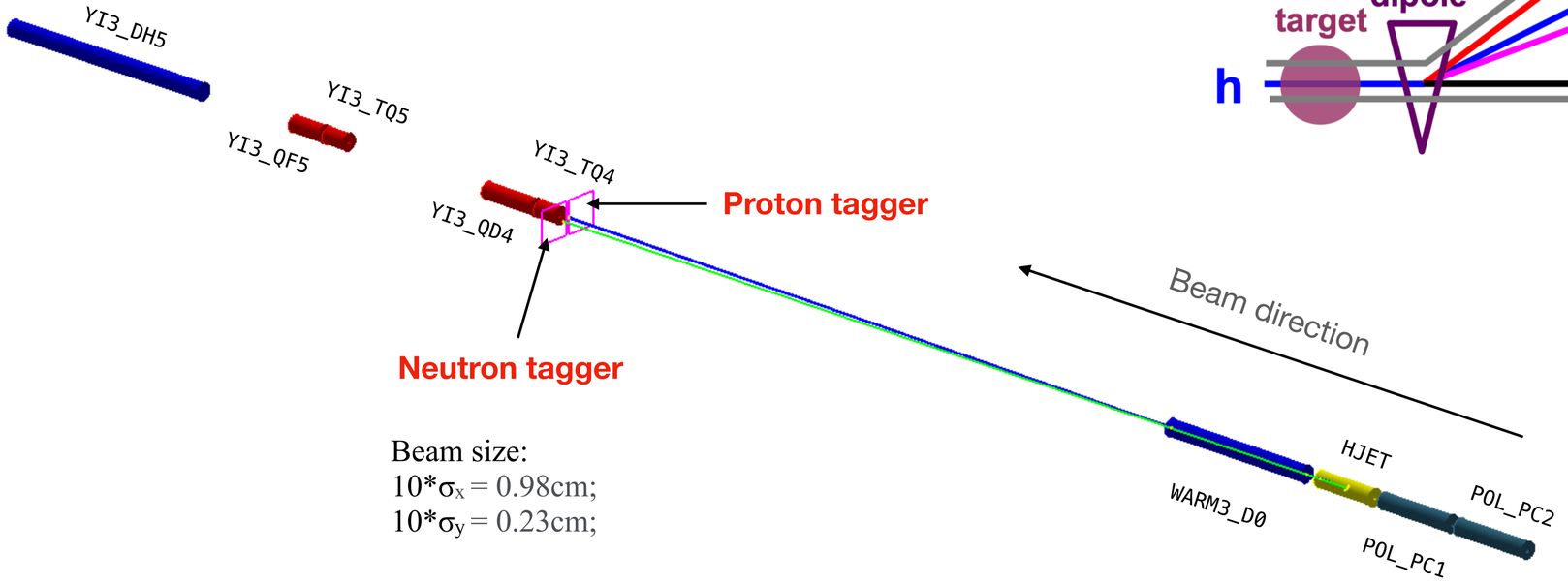
HJET beam pipe

Zhengqiao Zhang

The layout of the HJET in IR4

- We need dipole and drift space to separate the breakup fragments from the beam line.



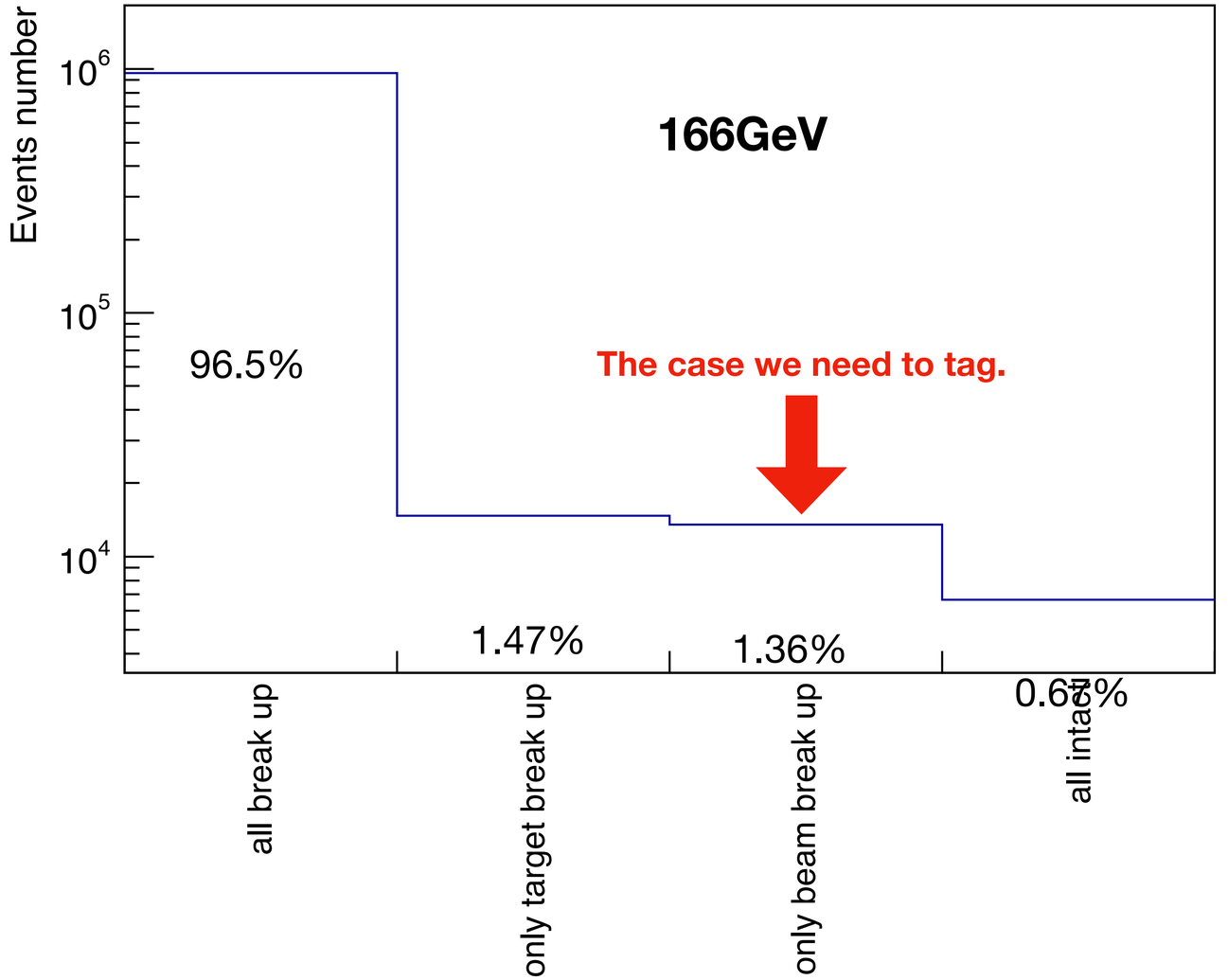


Beam size:
$10*\sigma_x = 0.98$cm;
$10*\sigma_y = 0.23$cm;

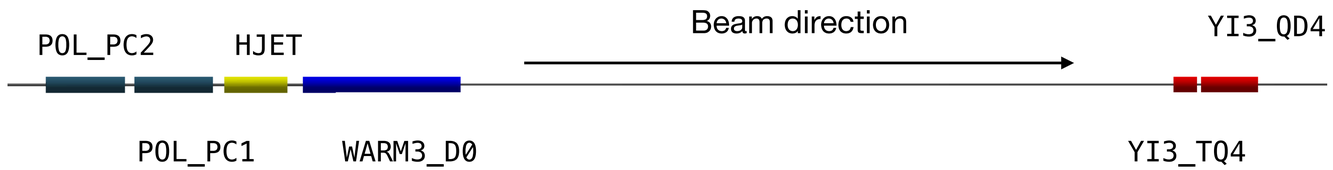
He3-He3 events in DMPJet model

- We use DMPJet model to simulate He3-He3 fix target collision;
- Four cases in the DMPJet events:

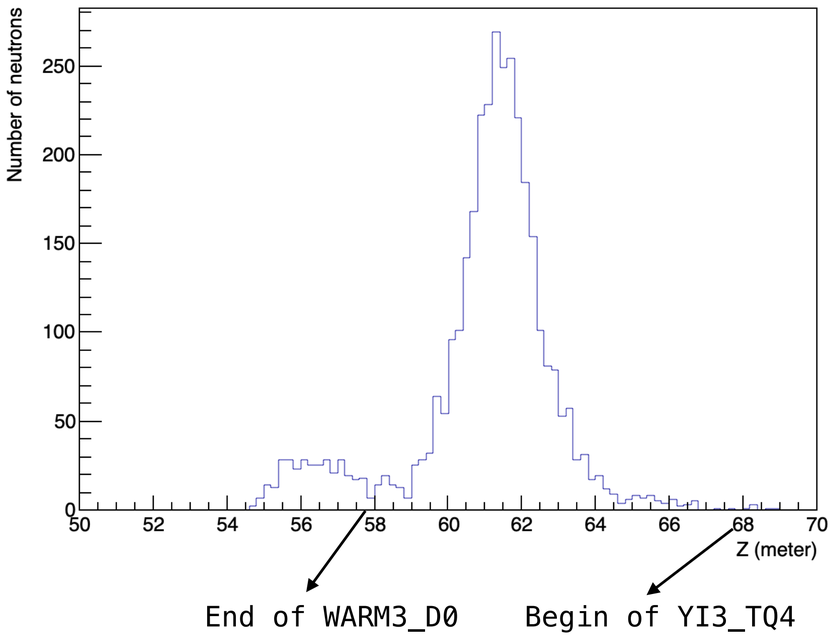
  ✓All He3 break up;
  ✓Only target He3 break up
  ✓Only beam He3 break up
  ✓All He3
- We need to tag the events that only the beam He3 break up;

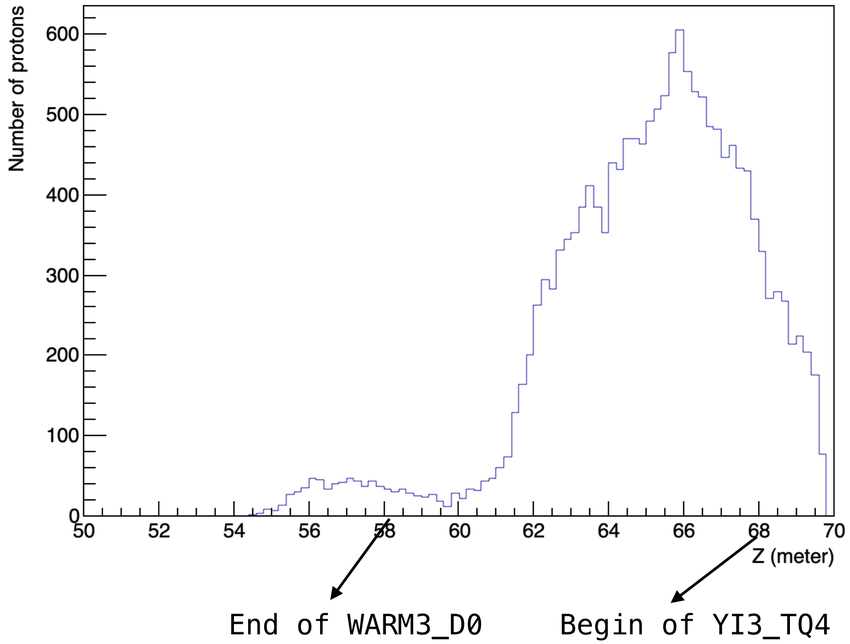


The layout of the HJET in IR4



The z position of the protons and neutrons that hit the beam pipe.





- Default beam pipe diameter: 7.0cm;
- Beam size before YI3_TQ4:

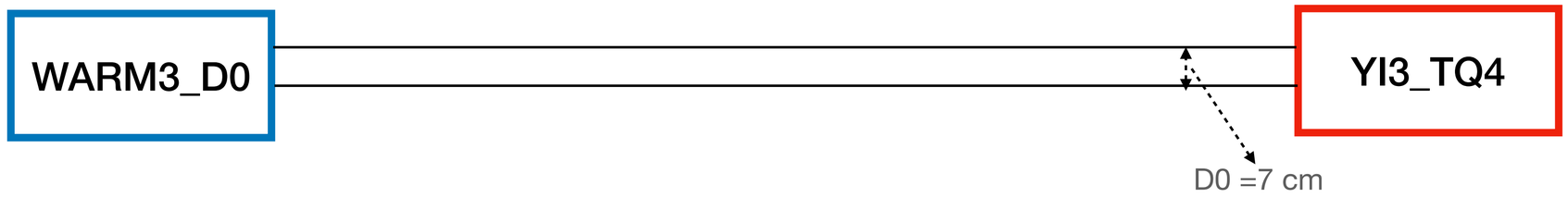
$$10*\sigma_x = 0.98\text{cm};$$
$$10*\sigma_y = 0.23\text{cm};$$

- Most of the protons and neutrons hit the beam pipe between WARM3D0 and YI3_TQ4;

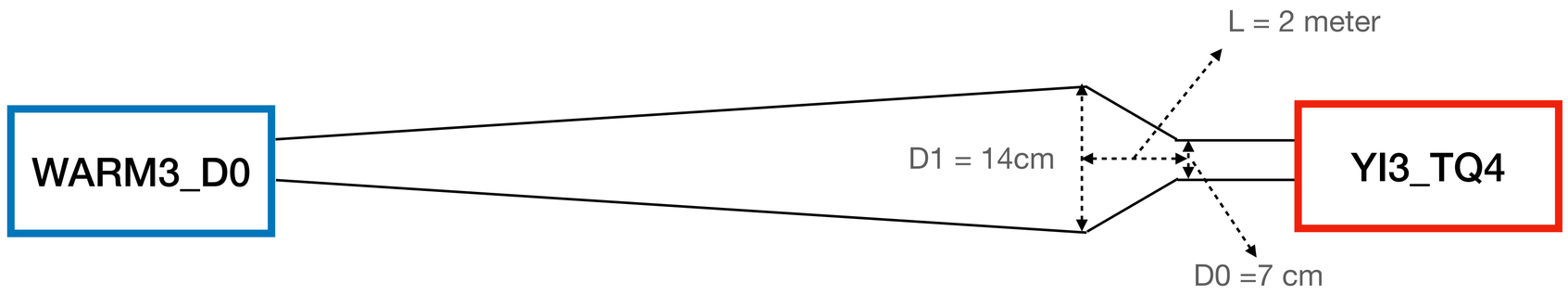
Beam pipe between WARM3_D0 and YI3_TQ4

- We need to tag the events that only the beam He3 break up;
- The sensor is located in front of YI3_TQ4

Default beam pipe:



Optimized beam pipe:



The detecting ratio of protons and neutrons in only beam he3 break up case

No beam pipe:

- The ratio of events that have at least one proton in the sensor: 0.993876
- The ratio of events that have at least one neutron in the sensor: 0.577984

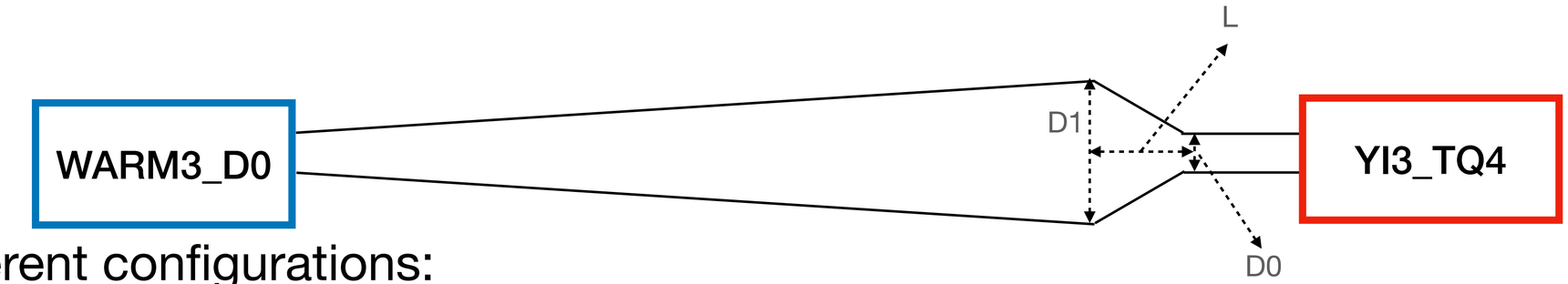
- Here I used energy > 10 GeV cut to select the protons and neutrons;
- There are secondary produced particles like pions that may hit the sensor, shall we set a total deposit energy cut instead of proton or neutron energy cut?
- Increasing D1 would help to improve the neutron detecting ratio;

Beam pipe with different configurations:

Material		Proton ratio	Neutron ratio
Aluminum (2mm)	Default one	0.53096	0.205882
	Optimized	0.832817	0.20743
Aluminum (1mm)	Default one	0.667183	0.393189
	Optimized	0.910217	0.386997
Beryllium (2mm)	Default one	0.678019	0.371517
	Optimized	0.890093	0.335913
Beryllium (1mm)	Default one	0.787926	0.518576
	Optimized	0.928793	0.458204

The detecting ratio of protons and neutrons in only beam he3 break up case

Optimized beam pipe:



Beam pipe with different configurations:

	Has proton	Has neutron	Proton/neutron
Aluminum (2mm) D0 = 7 cm; D1 = 30 cm;	0.856	0.635	0.909
Aluminum (1.5mm) D0 = 7 cm; D1 = 30 cm;	0.861	0.660	0.915
Aluminum (1.0mm) D0 = 7 cm; D1 = 30 cm;	0.870	0.680	0.924
Aluminum (2.0mm) **D0 = 5 cm;** D1 = 30 cm;	0.918	0.622	0.937
Aluminum (2.0mm) **D0 = 4 cm;** D1 = 30 cm;	0.927	0.650	0.937
Aluminum (2.0mm) D0 = 4 cm; **D1 = 20 cm;**	0.873	0.522	0.879

- Thinner aluminum pipe;
- Larger D1;
- Smaller D0;

Summary

- An optimized beam pipe design can significantly increase the proton detecting ratio;
- Increasing D1 would help to improve the neutron detecting ratio;
- Beryllium works better than Aluminum;