

TEAM PHYSICAL:

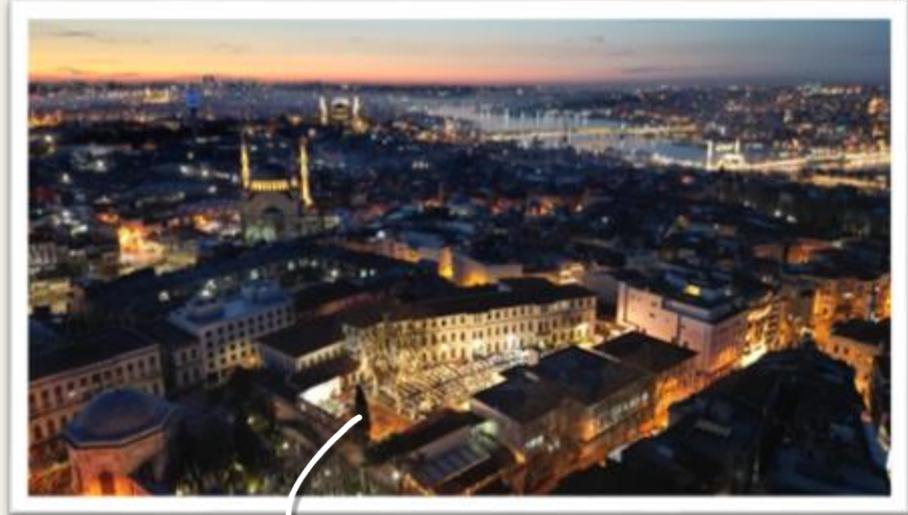
Nuclear Spallation Efficiency:
Target Material Optimization



Who are we?

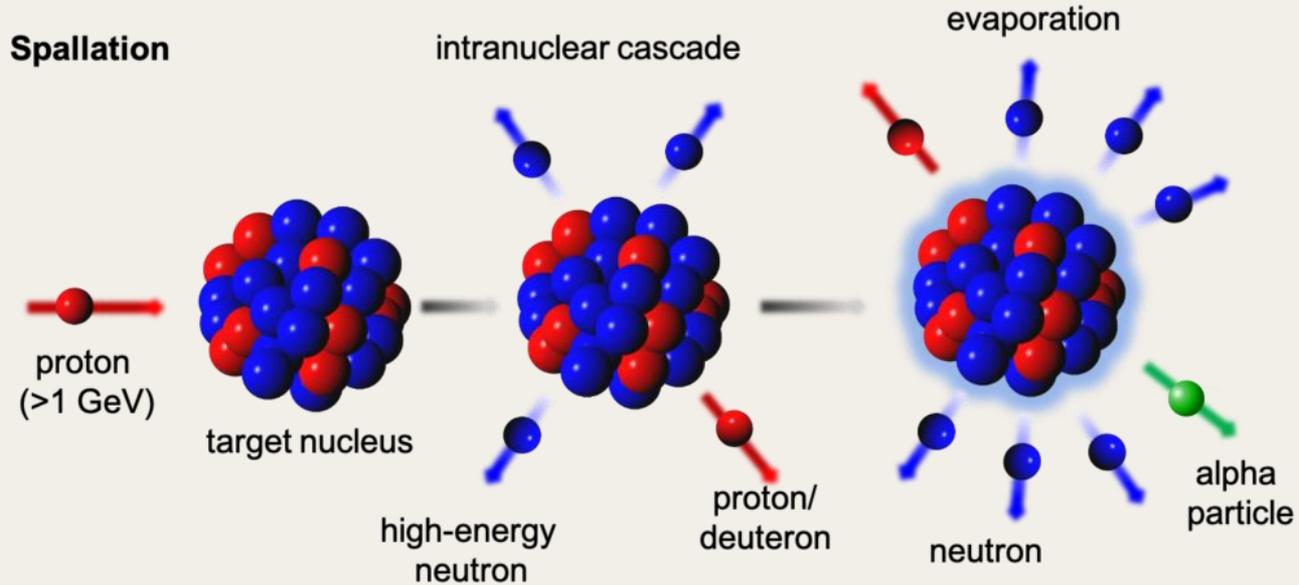


Our team consists of :
Baran Buluttekın, Emir Özaktaş, Defne Karaođluol, Defne abukel, Ela Kırdemir,
Yaren Bařman, Mert Musluođlu,
Osman Tőrcan and Gökhan Gündüz (Our Mentors)



Our school, Cađalođlu
Anatolian High School in
Istanbul

What is Nuclear Spallation?





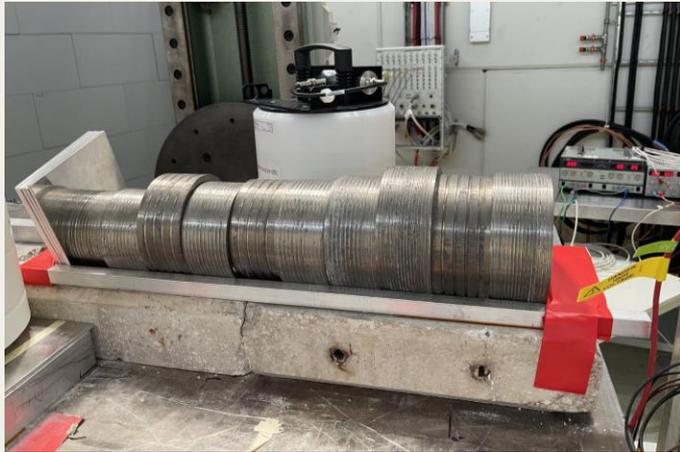
Our Experiment

Materials: Tungsten and Copper

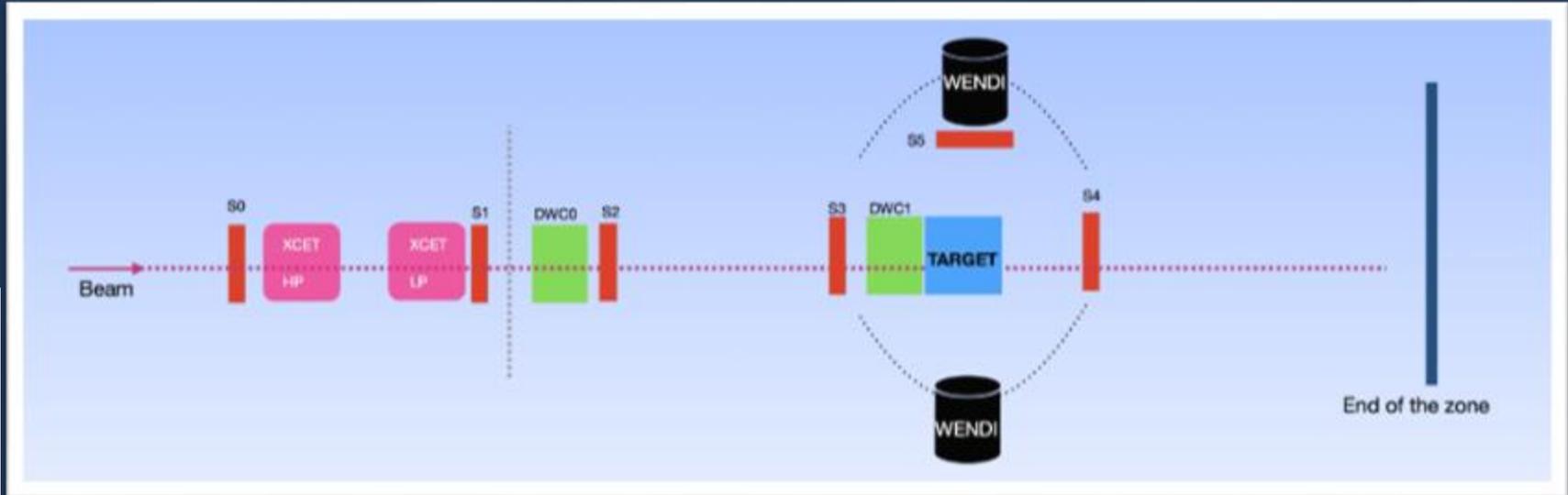
Beam Properties: 1, 5, 10 GeV both positive and negative beams

Dimensions:

- Tungsten: 15 cm diameter, lengths of 18, 36 and 60 cm
- Copper: 7.5 cm diameter, length of 31.5 cm / 6.5 cm diameter, 21 cm diameter



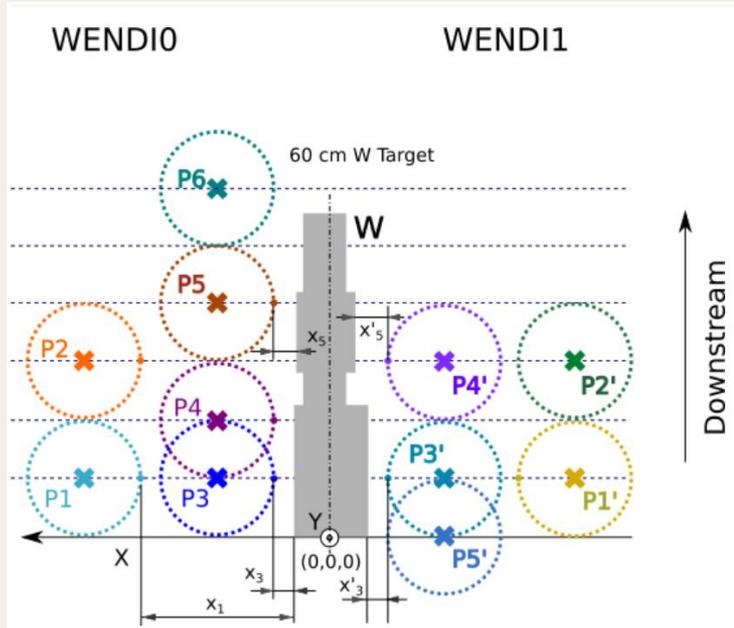
Experimental Setup



Our Experimental Area



WENDI Detectors



Data Analysis



Table 6: Measured beam composition, positive particles. Data denoted with * from lead-glass calorimeter, ** from ToF, and *** from fixed-point XCET. Remaining points from XCET scan.

p (GeV/c)	e^+	μ^+	π^+	K^+	P
0.5	0.959 ± 0.004				
1.0	0.806 ± 0.003				0.044 ± 0.008**
1.5	0.574 ± 0.001	0.018 ± 0.007	0.257 ± 0.012		
2.0	0.392 ± 0.001	0.021 ± 0.005	0.395 ± 0.019		0.209 ± 0.006**
2.5	0.265 ± 0.001	0.024 ± 0.004	0.510 ± 0.019		
3.0	0.180 ± 0.001	0.021 ± 0.003	0.569 ± 0.013		
3.5	0.126 ± 0.001	0.022 ± 0.002	0.606 ± 0.031		
4.0	0.085 ± 0.003	0.023 ± 0.003	0.626 ± 0.021		
4.5	0.060 ± 0.020*		0.630 ± 0.022***	0.031 ± 0.004***	0.246 ± 0.008***
5.0	0.041 ± 0.002	0.019 ± 0.002	0.615 ± 0.020	0.021 ± 0.009	0.291 ± 0.010
6.0	0.020 ± 0.002	0.016 ± 0.002	0.554 ± 0.020	0.020 ± 0.008	0.377 ± 0.008
7.0			0.484 ± 0.014	0.021 ± 0.007	0.466 ± 0.007
8.0			0.402 ± 0.016	0.025 ± 0.006	0.550 ± 0.015
8.5			0.355 ± 0.017	0.025 ± 0.006	0.584 ± 0.015
9.0			0.318 ± 0.008	0.025 ± 0.006	0.616 ± 0.014
9.5			0.285 ± 0.009	0.022 ± 0.006	0.647 ± 0.014
10.0			0.259 ± 0.007	0.022 ± 0.006	0.684 ± 0.014
10.5			0.228 ± 0.007	0.020 ± 0.005	0.719 ± 0.012
11.0			0.204 ± 0.002	0.019 ± 0.005	0.756 ± 0.012
11.5			0.178 ± 0.002	0.016 ± 0.004	0.785 ± 0.012

Table 7: Measured beam composition, negative particles. Data denoted with * from lead-glass calorimeter and *** from fixed-point XCET. Remaining points from XCET scan.

p (GeV/c)	e^-	μ^-	π^-	K^-
0.5	0.973 ± 0.001			
1.0	0.867 ± 0.001	0.015 ± 0.005		
1.5	0.683 ± 0.001	0.019 ± 0.005	0.280 ± 0.010	
2.0	0.491 ± 0.001	0.028 ± 0.005	0.428 ± 0.022	
2.5	0.375 ± 0.001	0.034 ± 0.003	0.570 ± 0.008	
3.0	0.290 ± 0.002	0.035 ± 0.003	0.645 ± 0.018	
3.5	0.206 ± 0.001	0.035 ± 0.002	0.730 ± 0.030	
4.0	0.162 ± 0.002	0.035 ± 0.002	0.778 ± 0.023	
4.5	0.122 ± 0.020*		0.813 ± 0.022***	0.011 ± 0.005***
5.0	0.110 ± 0.005	0.026 ± 0.003	0.837 ± 0.016	0.013 ± 0.002
6.0	0.052 ± 0.016		0.867 ± 0.030	0.017 ± 0.002
7.0	0.023 ± 0.016		0.895 ± 0.035	0.021 ± 0.002
8.0	0.020 ± 0.013		0.914 ± 0.035	0.022 ± 0.002
8.5			0.920 ± 0.036	0.022 ± 0.004
9.0			0.924 ± 0.033	0.022 ± 0.004
10.0	0.03 ± 0.001*		0.943 ± 0.024	0.022 ± 0.006
11.5			0.975 ± 0.006	0.023 ± 0.009

Before:

WENDi0 Count per Hadron	WENDi0 Weighted Average	
0,005281704875	/ 0.00325992	<input type="checkbox"/>
0,0133071755	0,000826858905	<input type="checkbox"/>
0,003149154487	0,0000136471584	<input type="checkbox"/>

After:

WENDi0 Count per Hadron	WENDi0 Weighted Average	
0,0269652227	0,0222141433	<input checked="" type="checkbox"/>
0,02461244766	/ 0.02436807	<input checked="" type="checkbox"/>
0,01406918049	0,01015599225	<input checked="" type="checkbox"/>



Conclusions

1) Effect of Target Size (Tungsten)

						1.2	1.04		
6W	10	(?,5.5,?)P5	(?,5.5,?)P5	370	382	12k/10	21k/10		
10W	10	(8, 5.5, 34.5) P5	11.6,5.5,-11.5) P5	142066	231656	14500/10	22000/10		
						1.16	1.07		
6W	5	(?,5.5,?) P5	(?,5.5,?) P5	31347	71931	3k/10	7k/10		
10W	5	(8, 5.5, 34.5) P5	11.6,5.5,-11.5) P5	19564	41874	3500/10	7500/10		
						1.19	1.15		
6W	-5	(?,5.5,?) P5	(?,5.5,?) P5	8501	19108	1255/10	2820/10		
10W	-5	(8, 5.5, 34.5) P5	11.6,5.5,-11.5) P5	16916	36832	1500/10	3250/10		
						1.25	1.41		
6W	1	(?,5.5,?) P5	(?,5.5,?) P5	1016	1122	40/10	39/10		
10W	1	(8, 5.5, 34.5) P5	11.6,5.5,-11.5) P5	1294	1530	50/10	55/10		
10W	1	(7,5.5,57.3) P6	(12.2,5.5,22) P4'	933	1075	32/10	45/10	0.003149154487	0.003628447025
10W	-1	(7,5.5,57.3) P6	(12.2,5.5,22) P4'	6236	7048	60/10	~60/10	0.00413107895	0.004668993656
10W	-10	(7,5.5,57.3) P6	(12.2,5.5,22) P4'	7602	39955	580/10	2800/10	0.003226822907	0.01695970919
10W	10	(7,5.5,57.3) P6	(12.2,5.5,22) P4'	31401	161880	4100/10	22000/10	0.003598892172	0.01855318827
10W	5	(7,5.5,57.3) P6	(12.2,5.5,22) P4'	6202	35355	1000/10	6000/10	0.001547309062	0.008820559801
10W	-5	(7,5.5,57.3) P6	(12.2,5.5,22) P4'	4587	26380	450/10	2400/10	0.001636082412	0.009409168089
6W	5	(?,5.5,?) P5	(?,5.5,?) P5	31347	71931	3k/10	7k/10	0.004473261251	0.01026465547
6W	-5	(?,5.5,?) P5	(?,5.5,?) P5	8501	19108	1255/10	2820/10	0.004784617766	0.0107545555

P6 for 60 cm W
P5 for 36 cm W
==> 60 cm one
gives 2.5 times
higher results

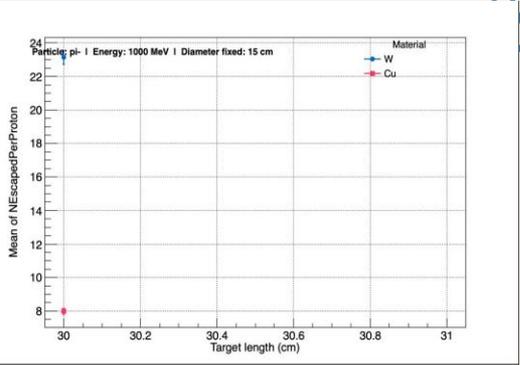
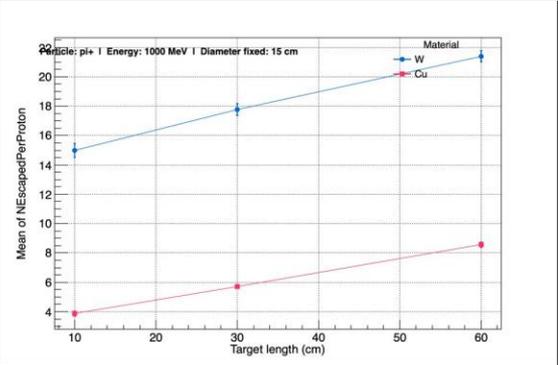
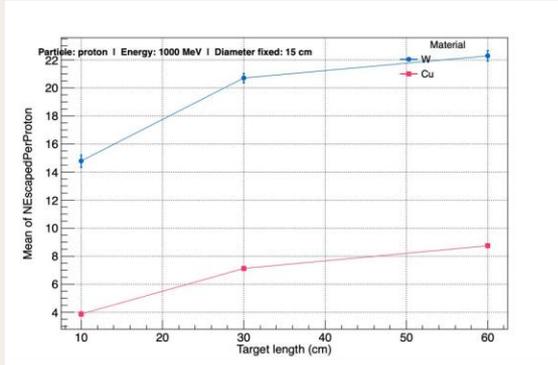


2) Approximate Regions of Spallation at Different Momentums

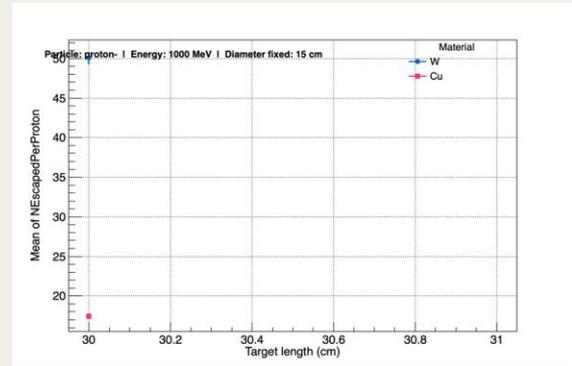
Front part for 1 GeV, Middle section for 5 and 10 GeV

Conclusions

3) Energy Ranking by Spallation Yield



10W	10 GeV	(8.5, 5, 34.5) P5	(11.6, 5.5, -11.5) P5	14500/10	22000/10
10W	-10 GeV	(8.5, 5, 34.5) P5	(11.6, 5.5, -11.5) P5	17500/10	30000/10
10W	10	(7.5, 5.5, 11.5) P4	(11.6, 5.5, 22) P4	32k/10	30k/10
10W	-10	(7.5, 5.5, 11.5) P4	(11.6, 5.5, 22) P4	3.8k/10	3.4k/10
10W	-10	(7.5, 5, 57.3) P6	(12.2, 5, 22) P4'	580/10	2800/10
10W	10	(7.5, 5, 57.3) P6	(12.2, 5, 22) P4'	4100/10	22000/10
6W	10	(7.5, 5.5, 11.5)	(10.9, 5.5, 22.9)	33k/10	18k/10
6W	-10	(7.5, 5.5, 11.5)	(10.9, 5.5, 22.9)	4k/10	2.2k/10
6W	5	(7.5, 5.5, 11.5)	(10.9, 5.5, 22.9)	12k/10	5.8k/10
6W	-5	(7.5, 5.5, 11.5)	(10.9, 5.5, 22.9)	4k/10	2.2k/10
10W	-5	(7.5, 5.5, 11.5) P4	(11.6, 5.5, 22) P4	3600/10	3535/10
10W	5	(7.5, 5.5, 11.5) P4	(11.6, 5.5, 22) P4	9k/10	8.5k/10
10W	5	(7.5, 5, 57.3) P6	(12.2, 5, 22) P4'	1000/10	6000/10
10W	-5	(7.5, 5, 57.3) P6	(12.2, 5, 22) P4'	450/10	2400/10
10W	5	(8.5, 5, 34.5) P5	(11.6, 5.5, -11.5) P5	3500/10	7500/10
10W	-5	(8.5, 5, 34.5) P5	(11.6, 5.5, -11.5) P5	1500/10	3250/10



10
-10
5
-5
1
-1

What We've Done So Far

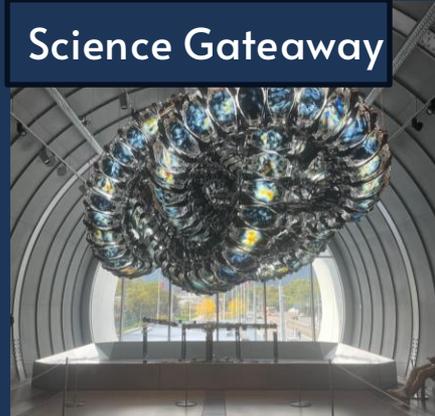
Safety Day



Safety Day



Science Gateway



CERN Controlling Center



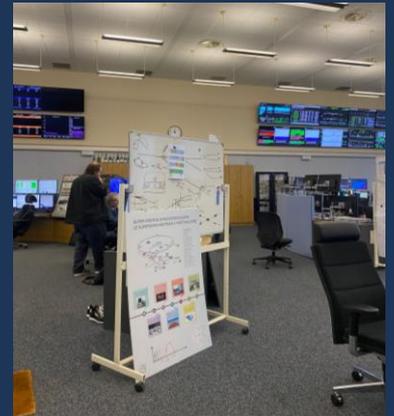
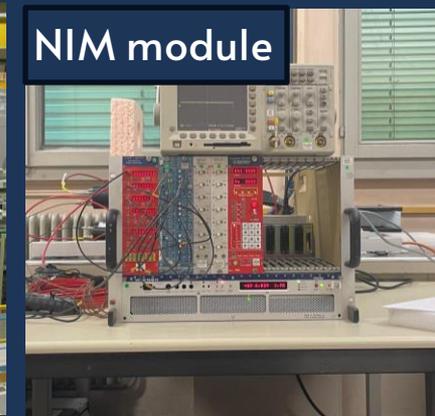
ATLAS Computing Room



AD Factory



NIM module





Thank you for everything!

