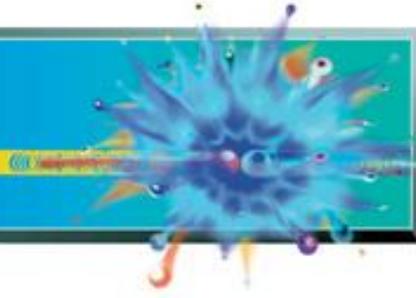


QuarkNet



Moon Shadow, g-2, and Shielding

NATHAN UNTERMAN

RICE UNIVERSITY JUNE 2021



Reports of Lunar Shadow

- ▶ Reports of shadow range from 35 degrees to 120 degrees
- ▶ Possible two shadows (muons, anti muons)

Heavens Above

▶ <https://www.heavens-above.com/>

User:	anonymous	Login
Location:	Unspecified (0.0000°N, 0.0000°E)	
Time:	08:21:41 (UTC+00:00)	
Language:	English	▼

Moon

Year Month Day Time

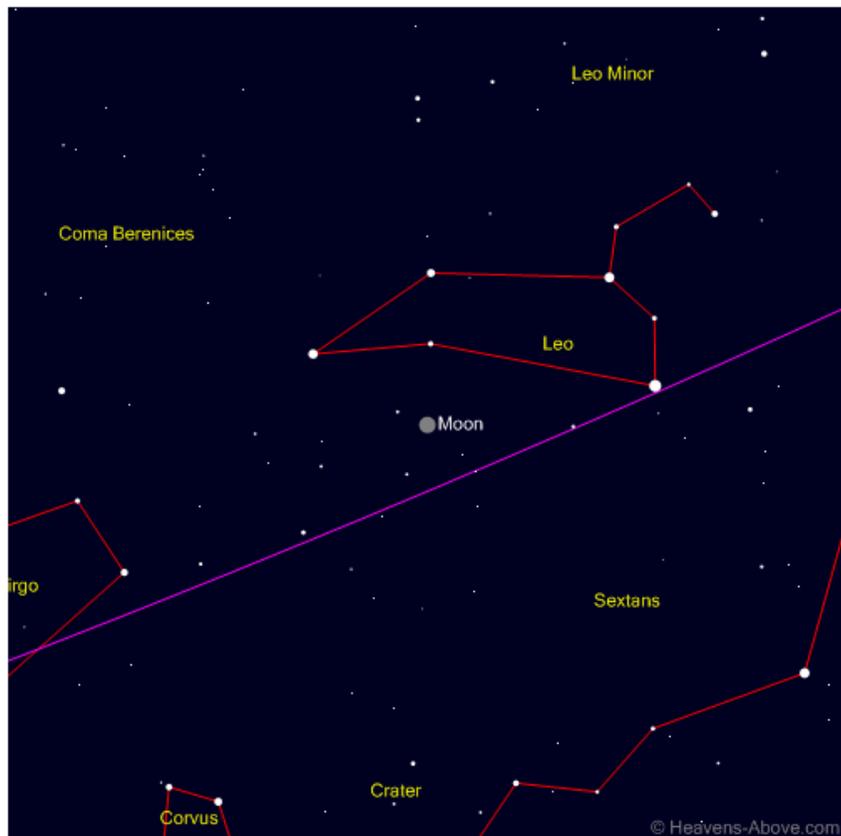
Position	
Altitude	-24.0°
Azimuth	310.4° (NW)
Right ascension	11 ^h 15 ^m 12 ^s
Declination	9° 35' 5"
Range	381,022 km
Constellation	Leo

Appearance	
Diameter	31.36'
Illumination of disk	41%
Libration in longitude	-6.812°
Libration in latitude	-6.756°

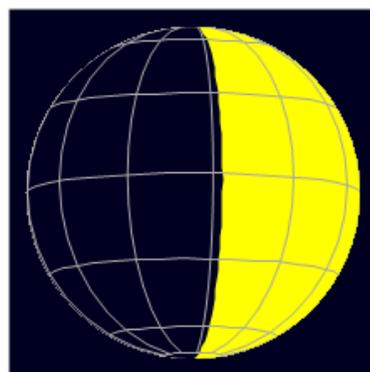
Event	Time	Altitude	Azimuth
Sets	01:00	-0.8°	285°
Rises	12:12	-0.8°	79°
Maximum altitude	18:51	54.1°	179°

Monthly phases	
● New moon	10 June 2021 05:53
◐ First quarter	17 June 2021 22:54
● Full moon	24 June 2021 13:40
◑ Last quarter	01 July 2021 16:11
● New moon	09 July 2021 20:17

Perigee, Apogee		
Perigee	357,311 km	25 May 2021 20:51
Apogee	406,228 km	07 June 2021 21:28
Perigee	359,956 km	23 June 2021 04:56
Apogee	405,341 km	05 July 2021 09:47



Position of the Moon



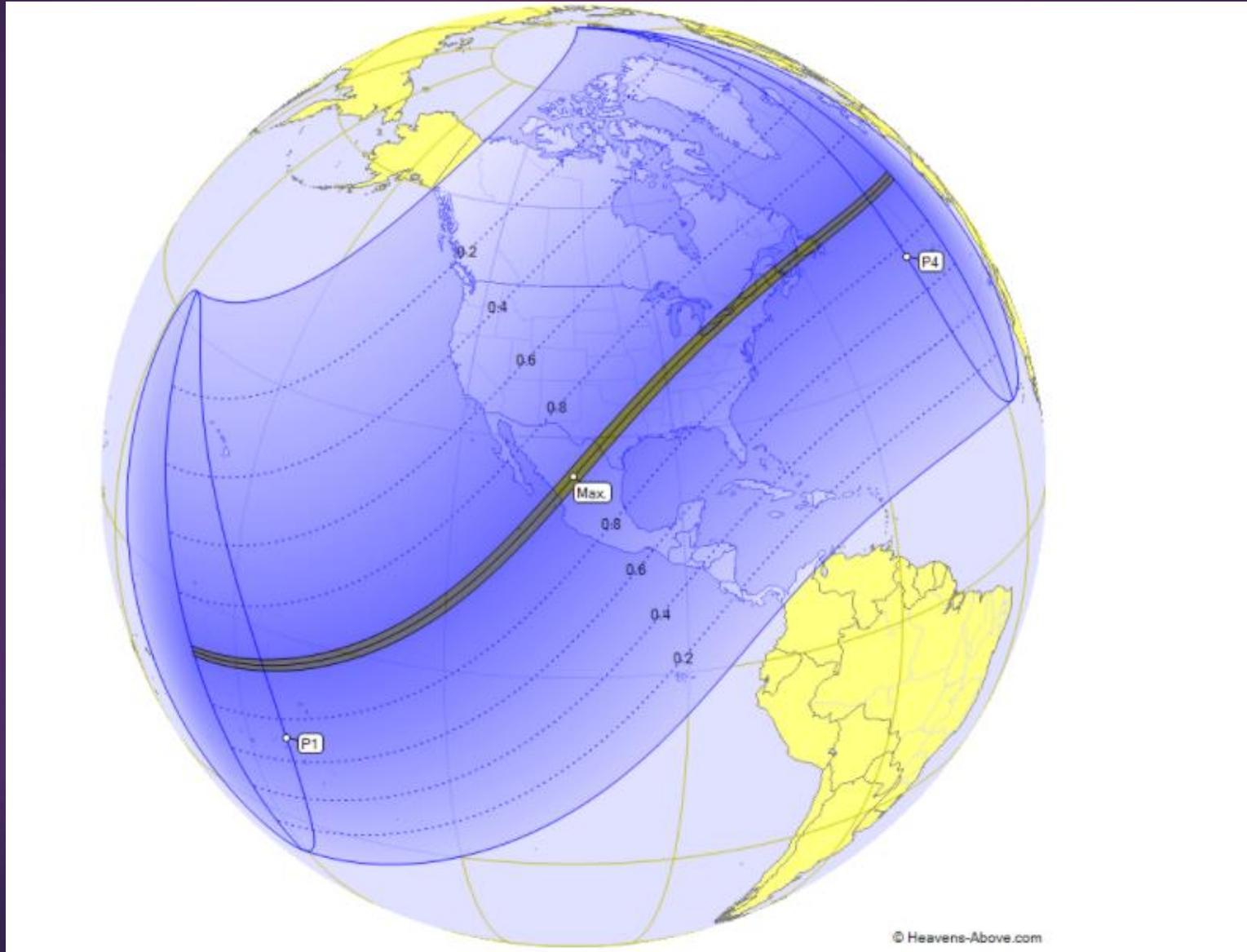
Appearance of the Moon, celestial north is upwards





Event	Time	Altitude	Azimuth
Sets	01:00	-0.8°	285°
Rises	12:12	-0.8°	79°
Maximum altitude	18:51	54.1°	179°

08.April.2024



Aiming Device I

Robust

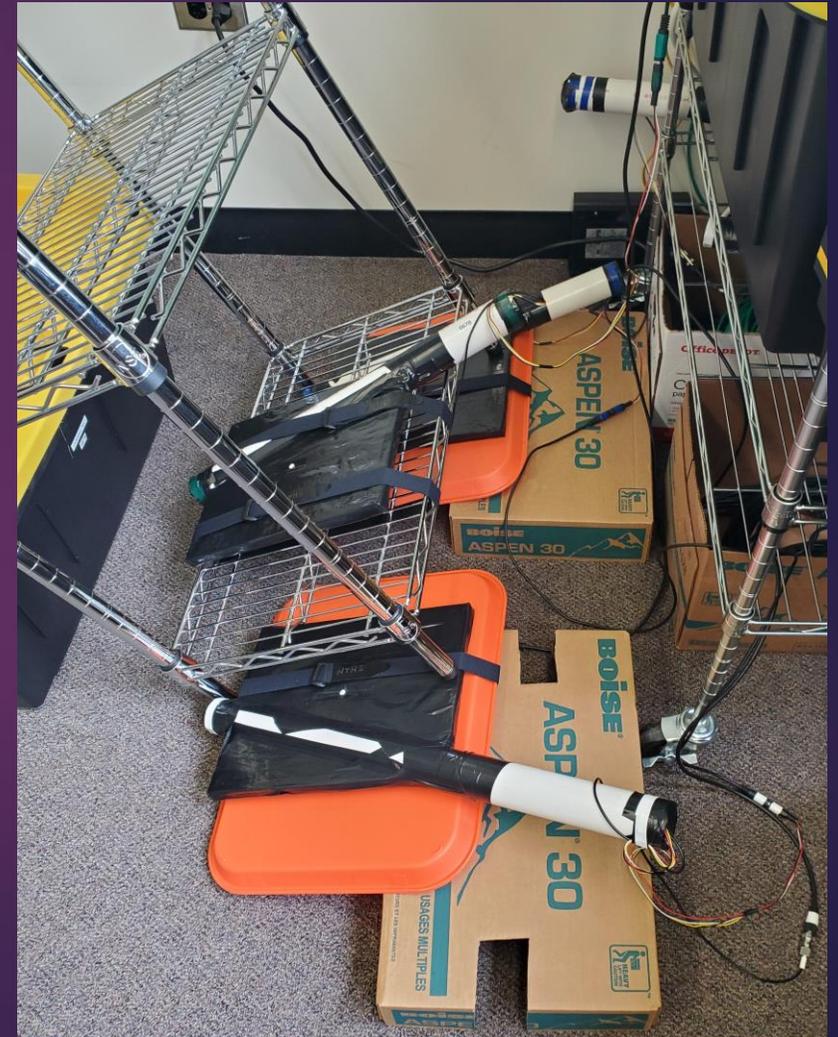
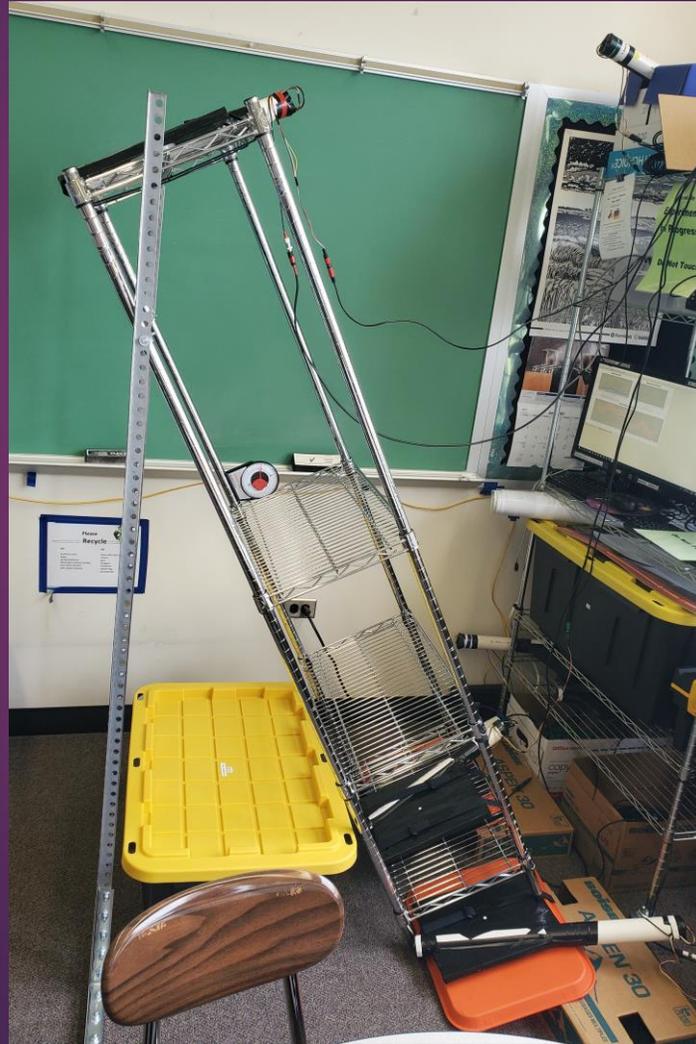
Slightly less expensive

Heavy

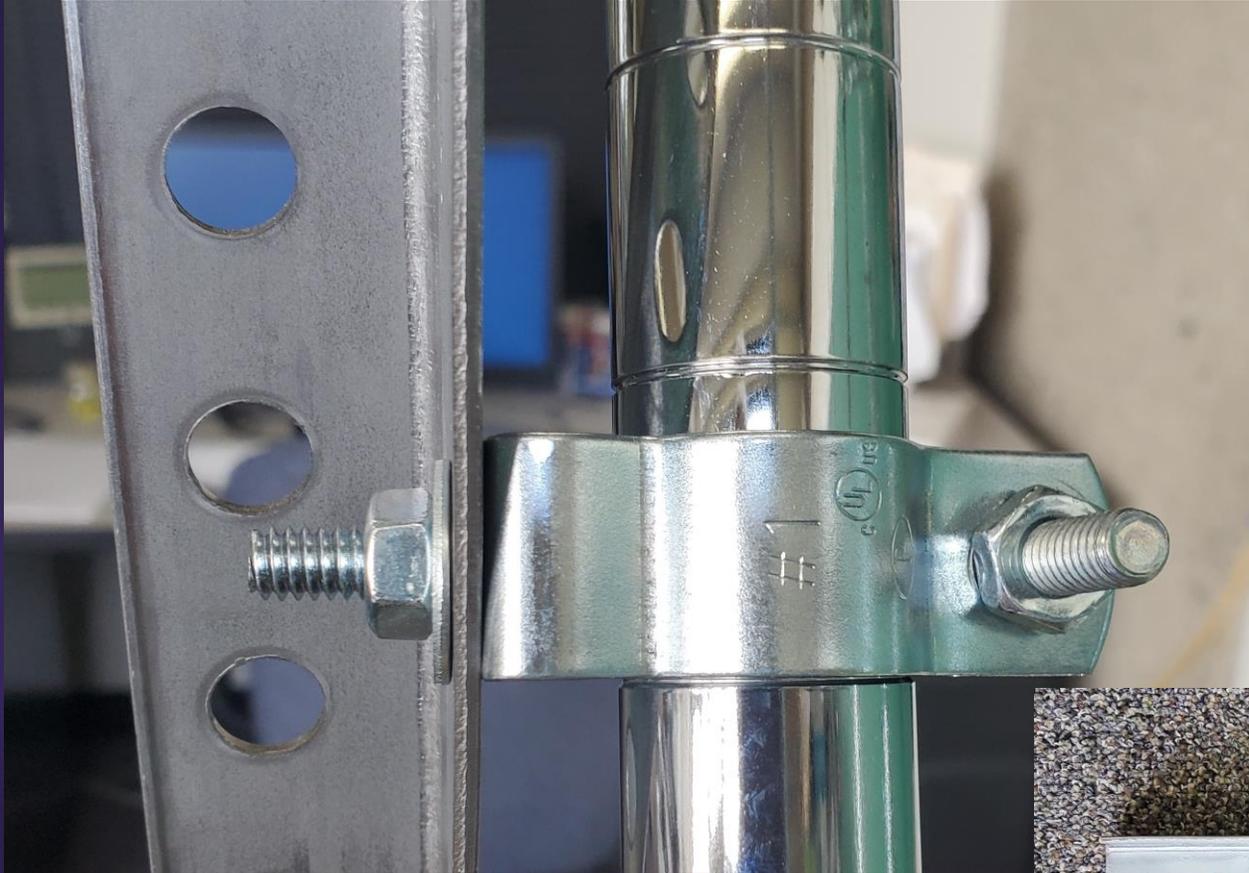
Not easy to transport

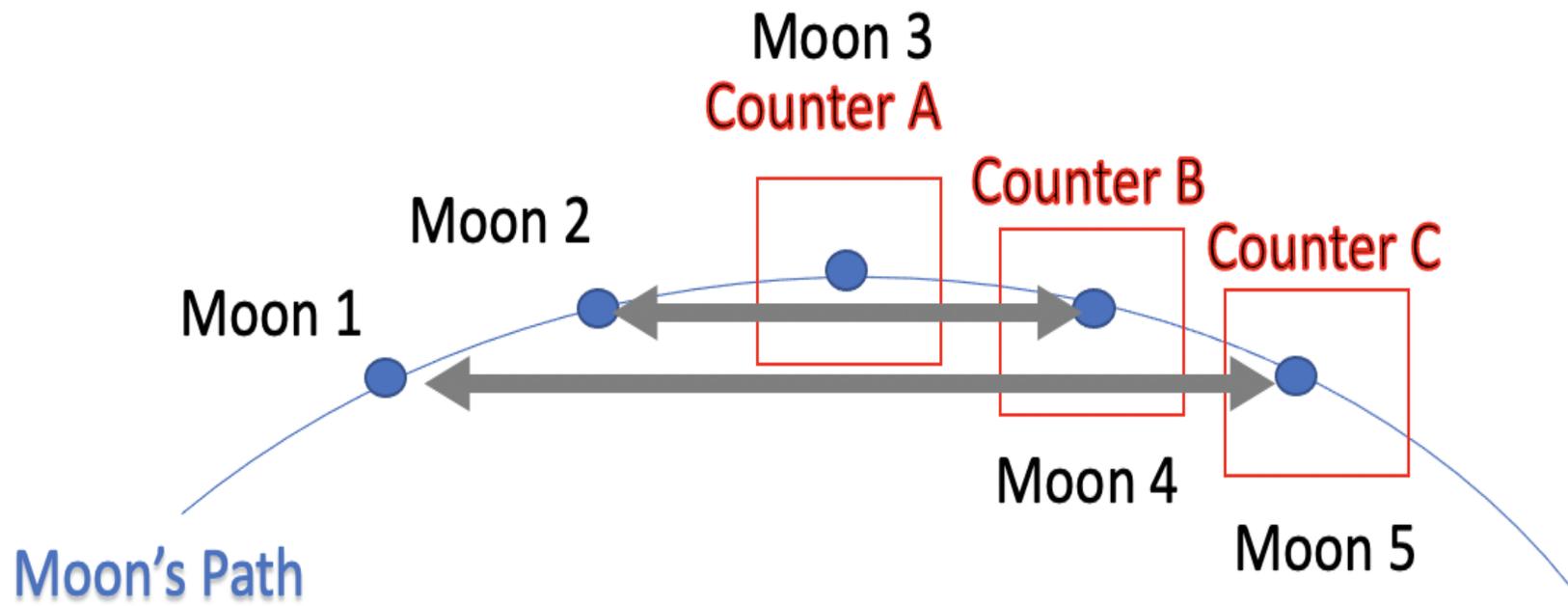


Aiming Device 2



Details Device 2





g-2 Prototype Criteria

Operate QuarkNet stack to study role of absorber in stopping muons.

Goals:

Stop cosmic ray muons, maintaining some polarization of the spin (in direction opposite of the m^+ incoming direction).

Use metal absorber to stop muons and remove m^- s through capture.

Measure muon polarization through decay electrons going upward versus downward using new Lifetime module currently under development.

Study different materials: copper; aluminum; and lead.

Optimize thickness of absorber to produce acceptable polarization and high efficiency for electron detection.

Design of stack and support

Design Issues

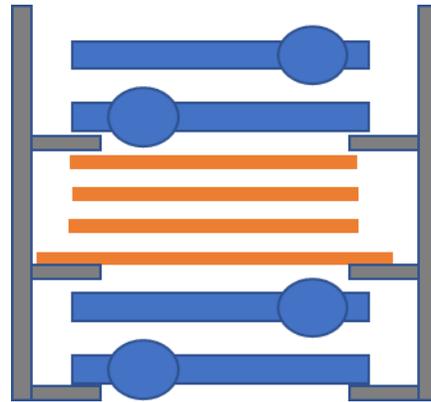
- Should we use one absorber between B and C or two absorbers between B-C and C-D?
- Should we keep the vertical space for absorber fixed to maintain acceptance as we change thickness, or minimize the space for each thickness? My first guess is to minimize
- We cannot find or afford copper at this moment – explore lead and aluminum

Criteria for stack and support stand

- Support absorber above counters C and D
- Support A and B above absorber

The vertical supports should probably have slots for adjustable levels of L-brackets

Scintillators with PVC, absorber, c



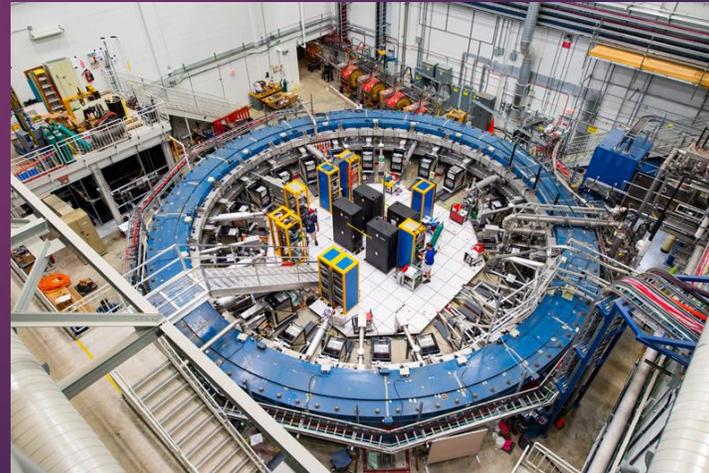
Issues

- ▶ Cost of materials
- ▶ Safety of electromagnet for classroom environment

If Interested

- ▶ Moon Shadow
 - ▶ Nathan Unterman

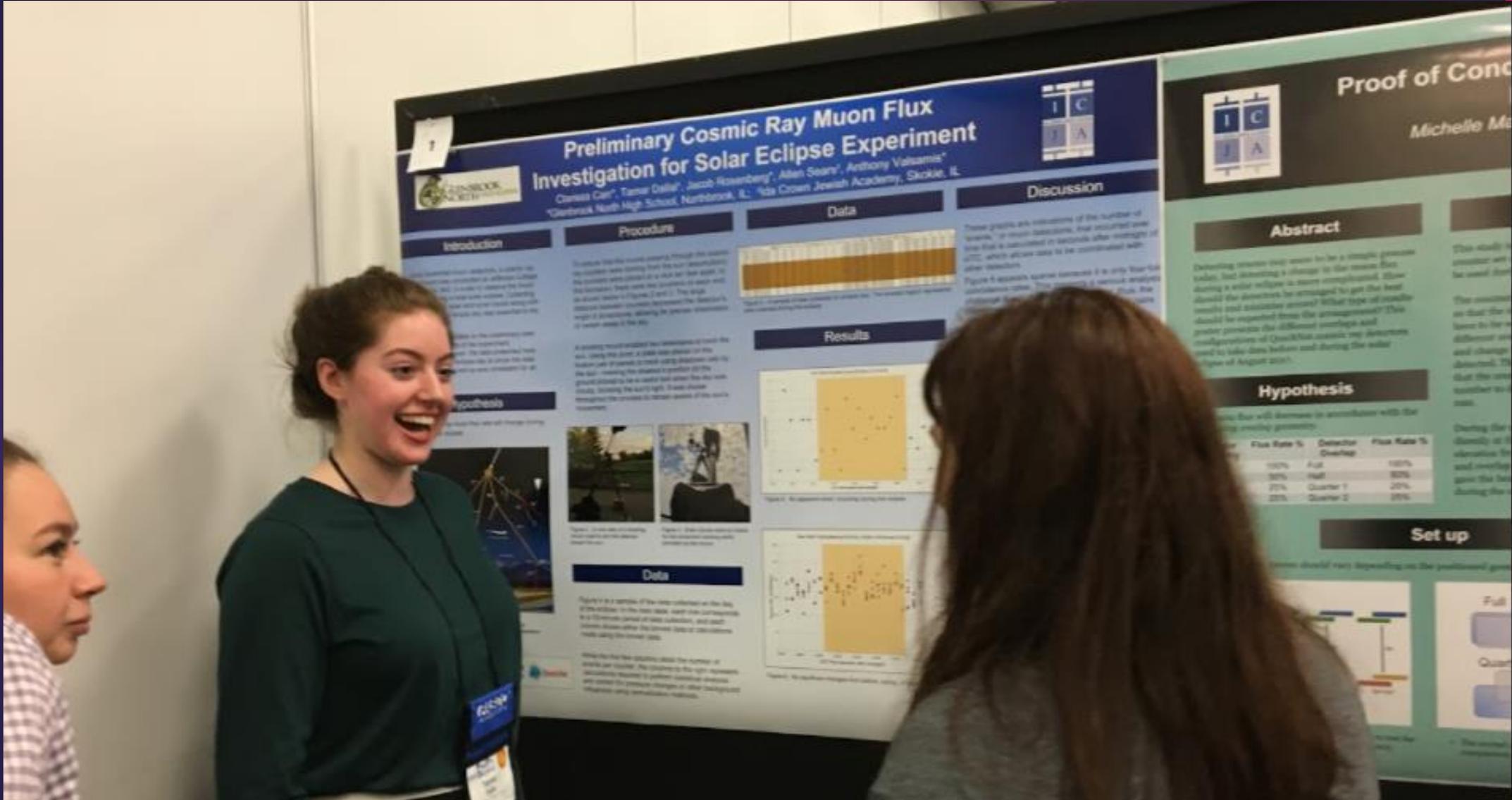
- ▶ g-2
 - ▶ Mark Adams
 - ▶ adams@fnal.gov



Shielding

- ▶ g-2 experiment
- ▶ Depth in building
- ▶ Attempt to reduce low energy muons in studies
- ▶ Pyramid project Chicago State University
(Edmundo Garcia)

Questions?



Contact

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- ▶ nunterman@gmail.com
- ▶ 773 758-0464

