Proton form factor measurement using electron proton scattering with the gas jet target at MAMI A1

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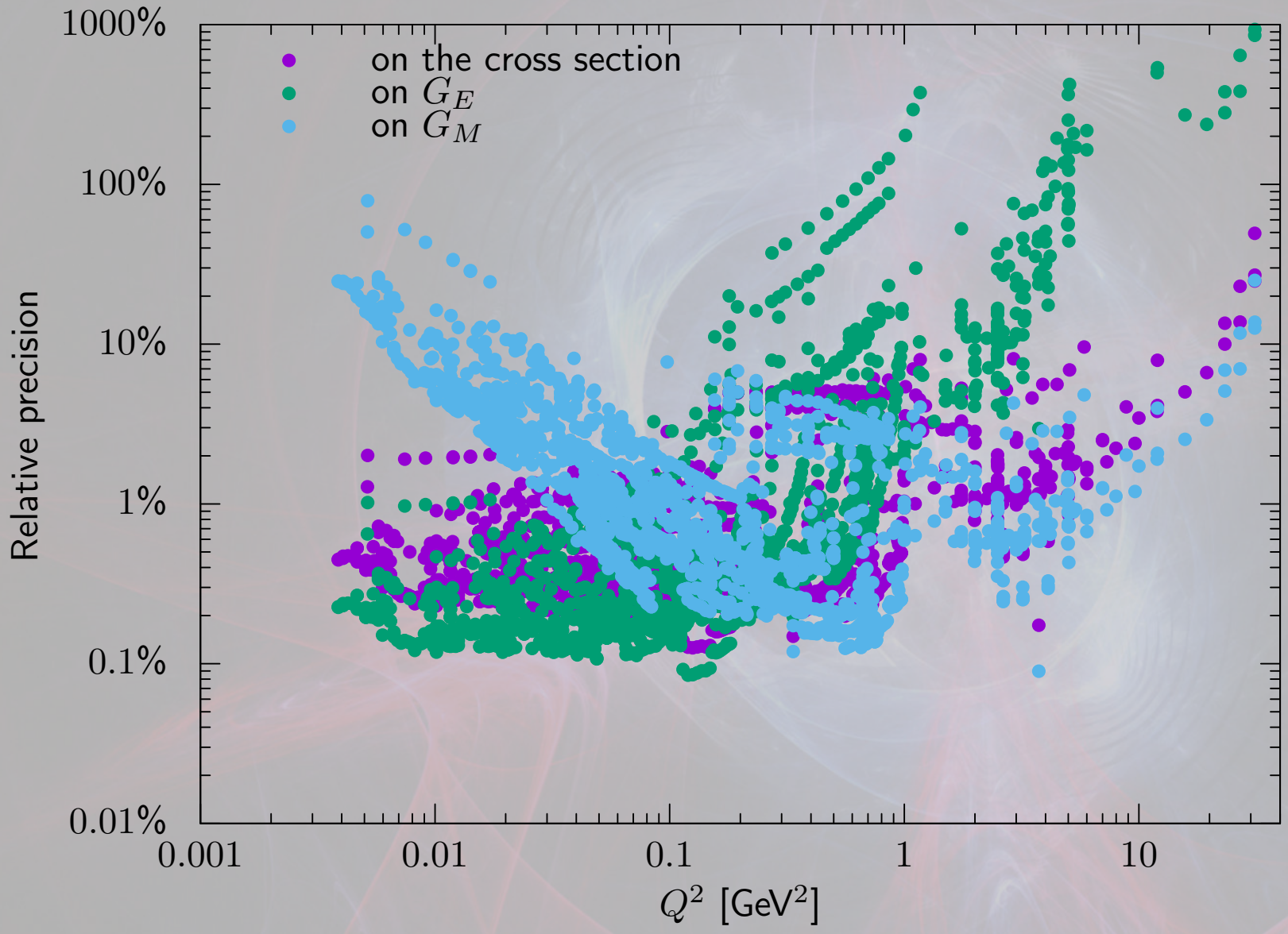
Losinj, September 2019

RBRC
RIKEN BNL Research Center

Stony Brook
University

Remember this?



New A1/MAGIX measurement for G_E AND G_M

- Validate Mainz data set with equal or better data
- Get a better handle on G_M
- Opens up another comparison point with spectroscopy: Zemach radius, sensitive to r_M (see talks this week)

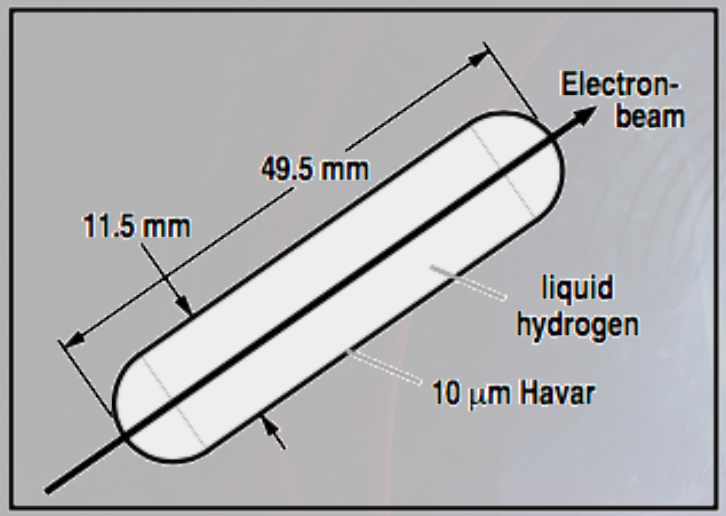
What can we do better?

- Avoid all the mistakes we made before
  - Keep B and C apart
  - Don't use C if you can
  - Fewer normalization groups

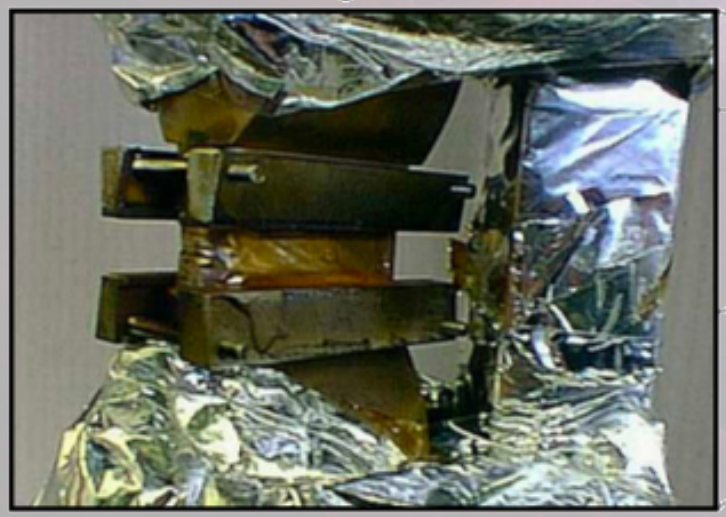
What can we do better?

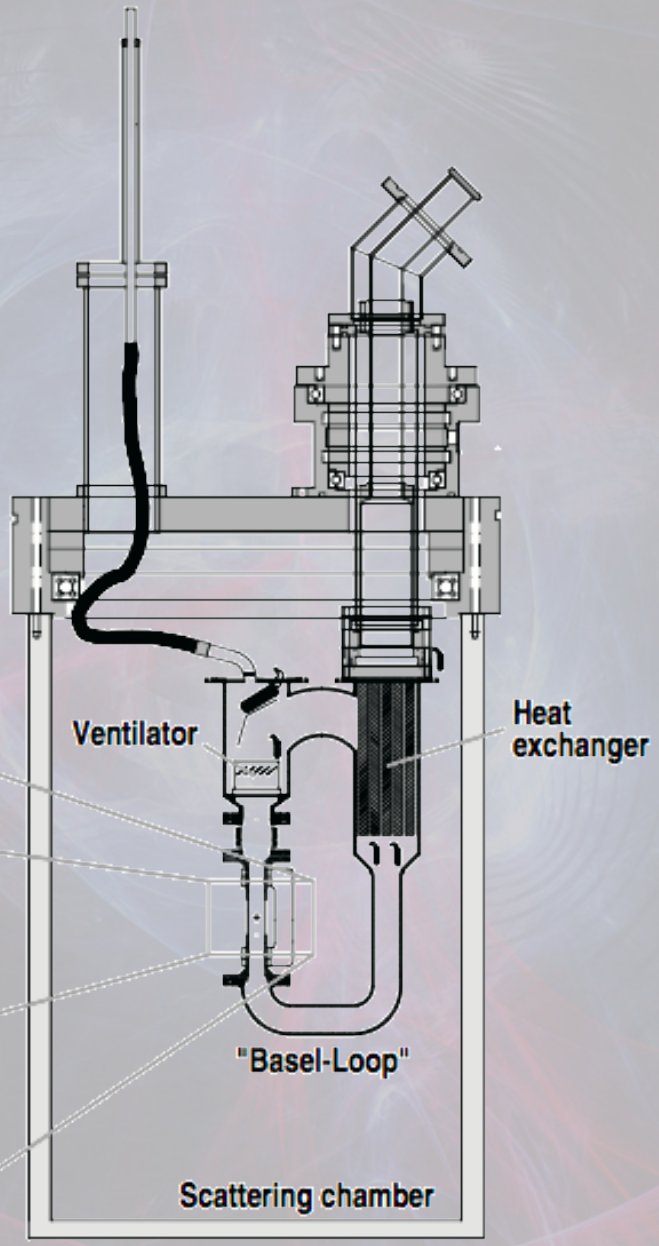
- Avoid all the mistakes we made before
  - Keep B and C apart
  - Don't use C if you can
  - Fewer normalization groups
- MESA: smaller beam energies, better G_M
- Better target

Old target



Target cell





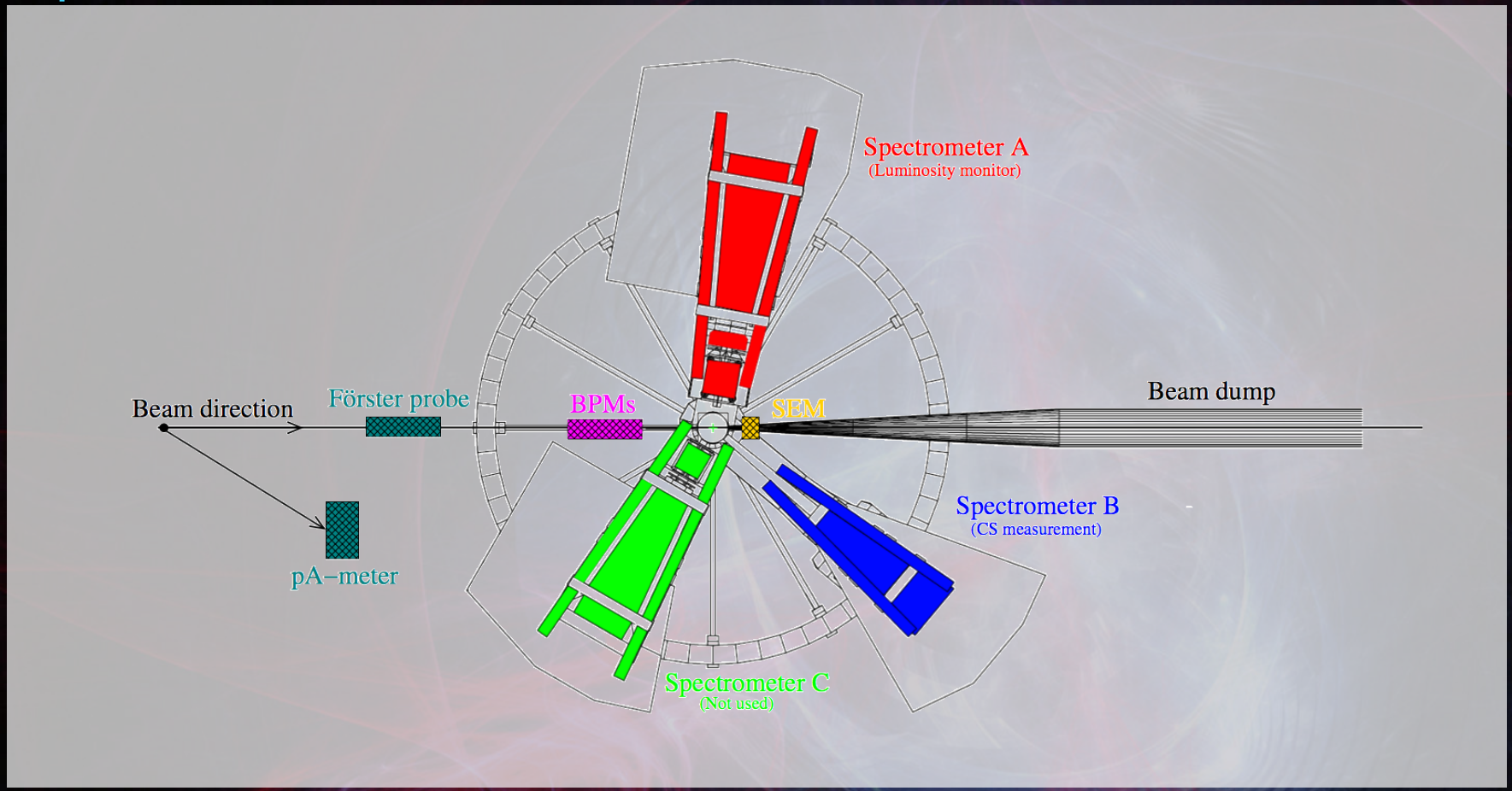
Cluster jet target

- Windowless, ideally no background
- Density 10^{19} cm^{-2}
- Collaboration with U. Münster

Commissioning run 2018

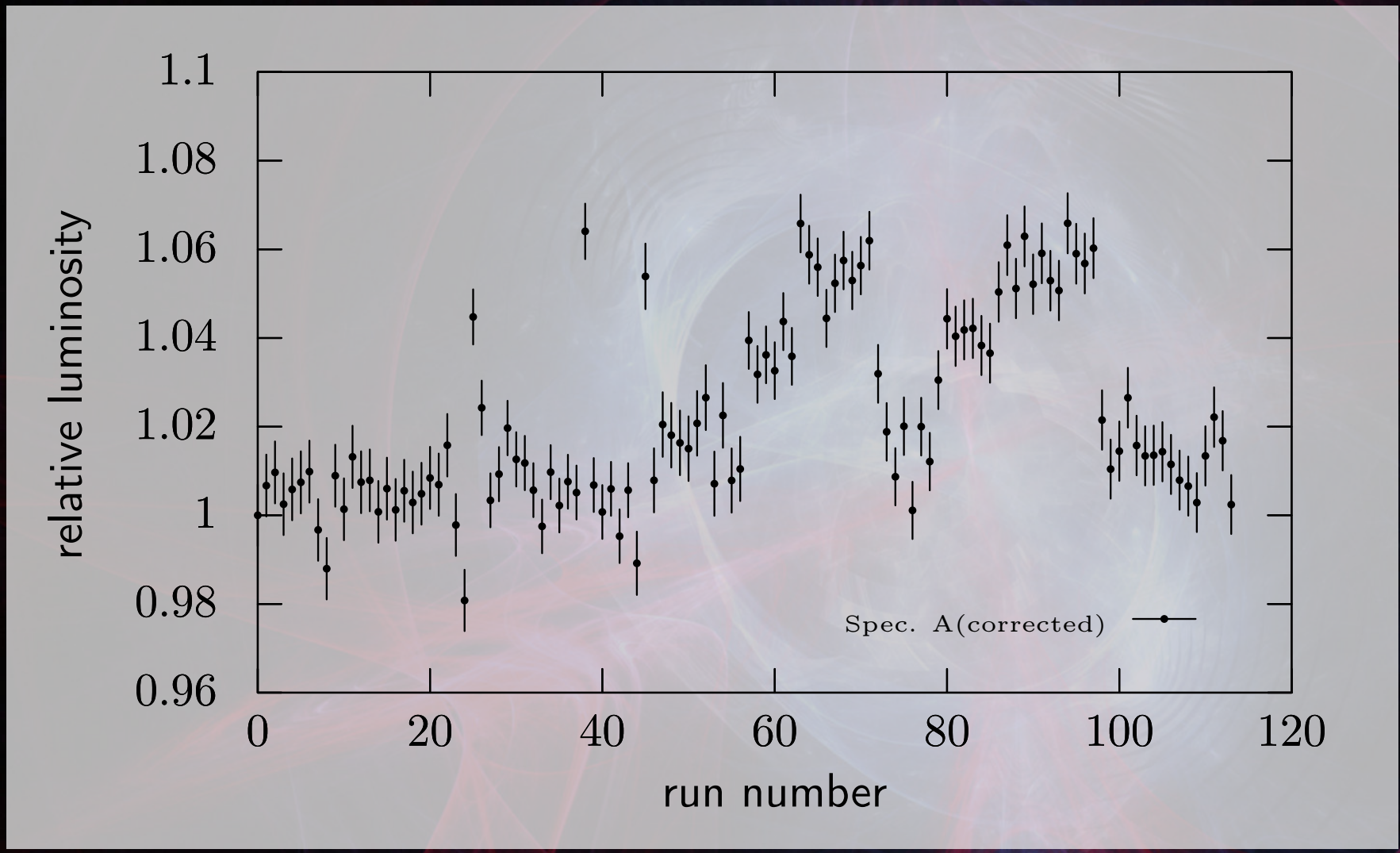
- April 11 to 23
- Multiple jet profile measurements
- $I = 20\mu A$, 15h of data in 2° steps from 20° to 32°
- 25h of data for 21°
- Vacuum not optimal

Setup



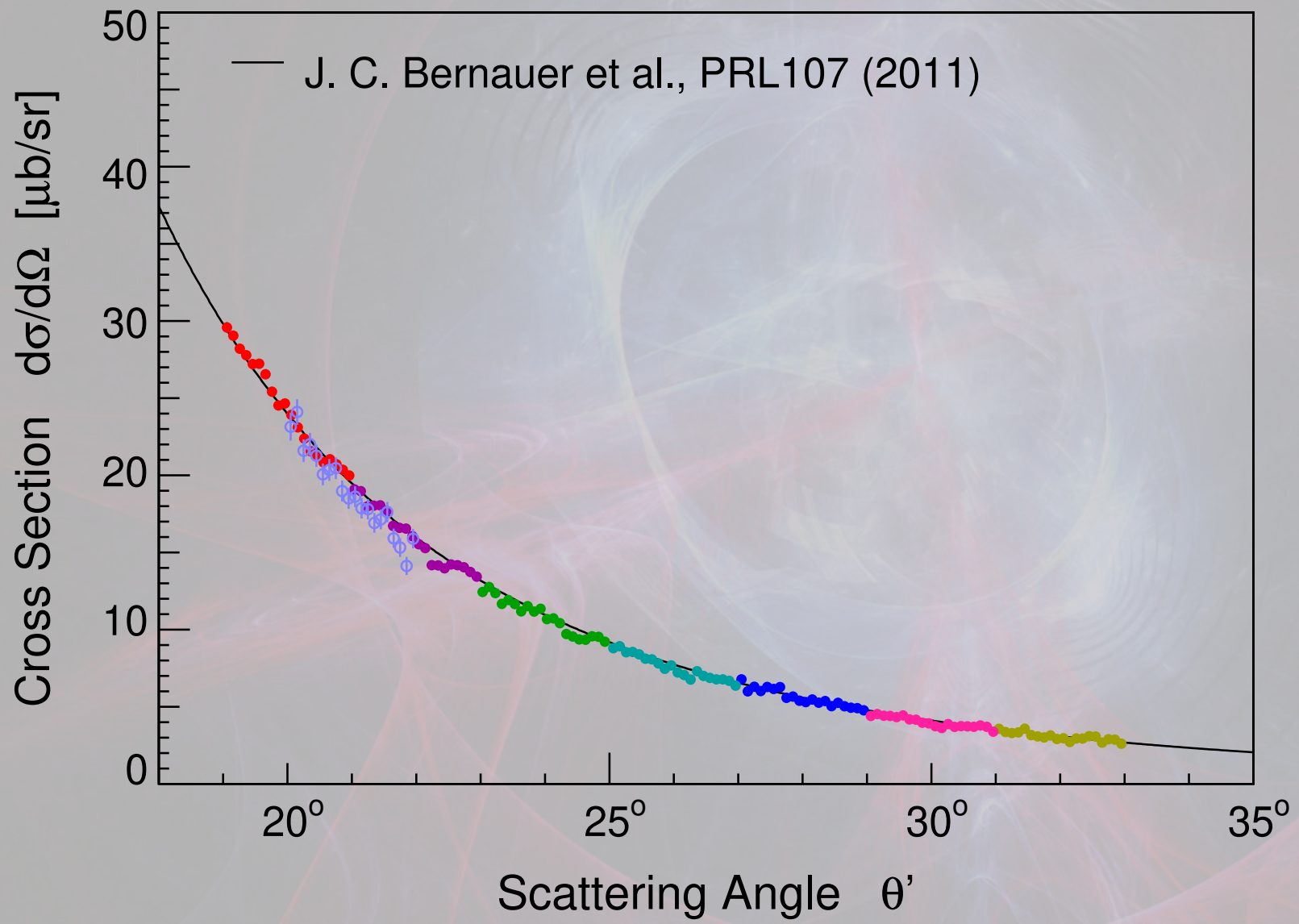
- Spec A: Luminosity
- Spec B: Cross section
- Spec C: not used

Luminosity stability



Lumi stable to 10%

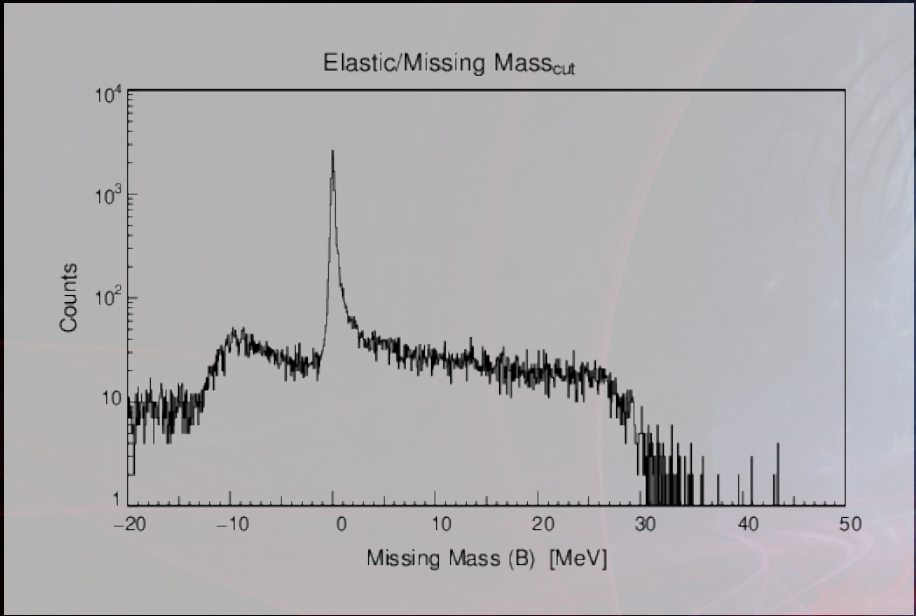
Online results

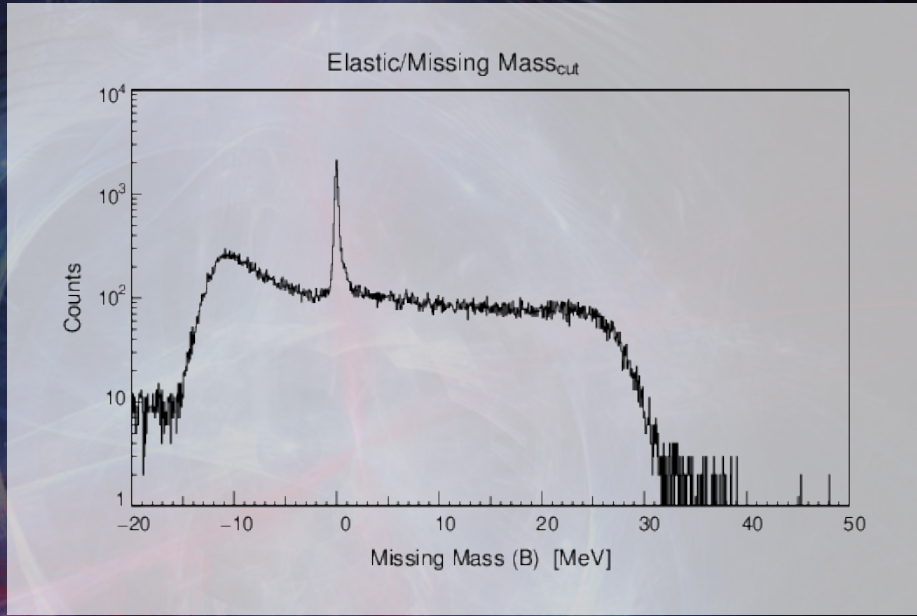


Background

- Not gone
- Not by a long shot
- :(

Background

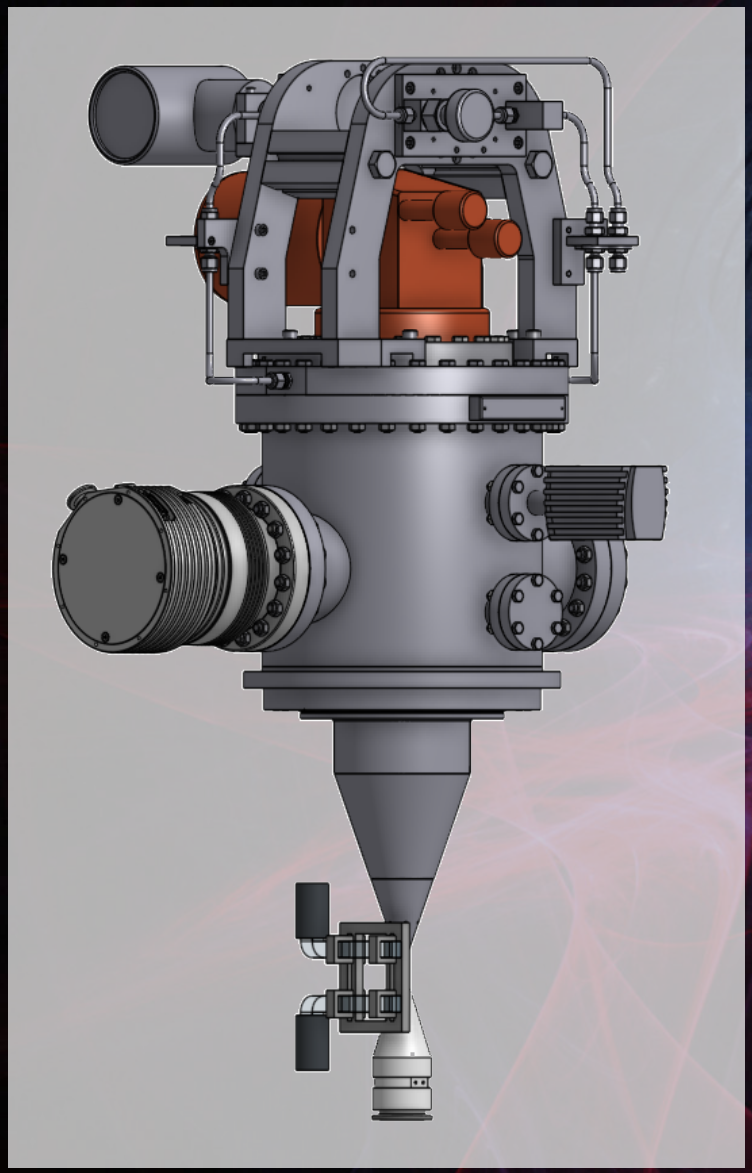


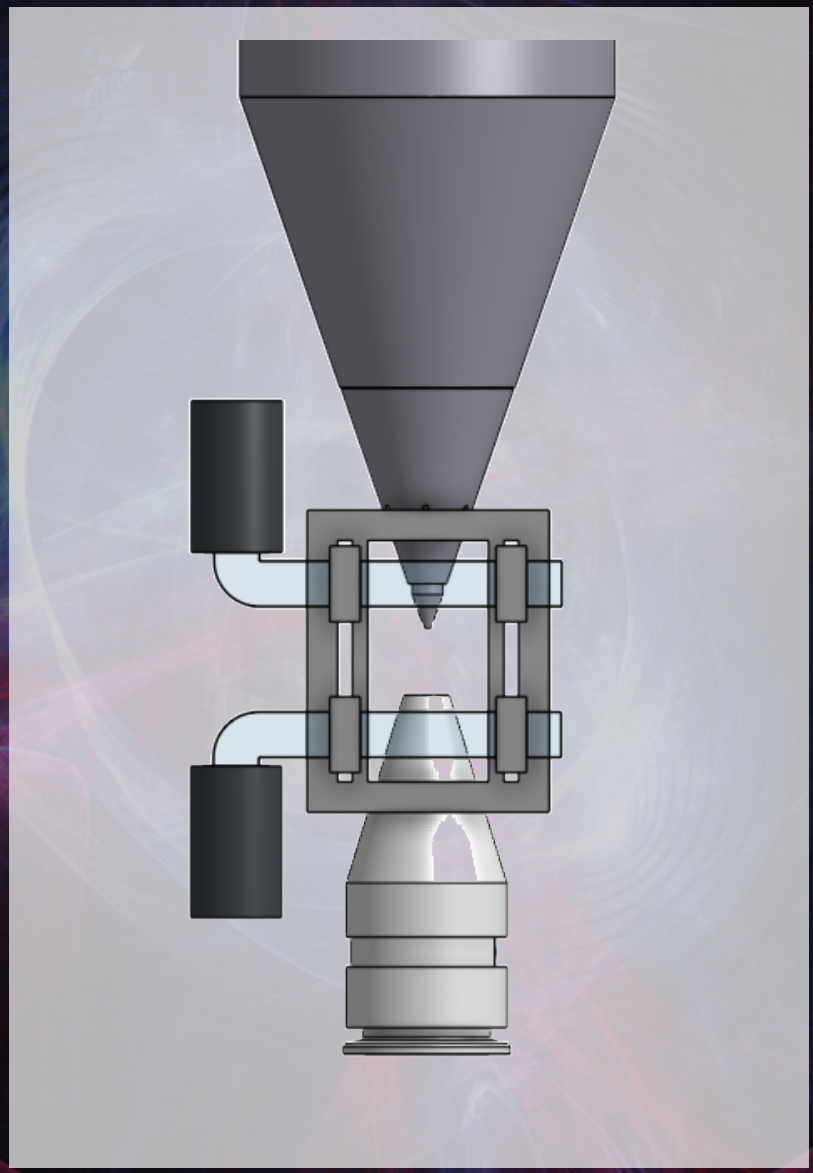


on April 13 on April 21

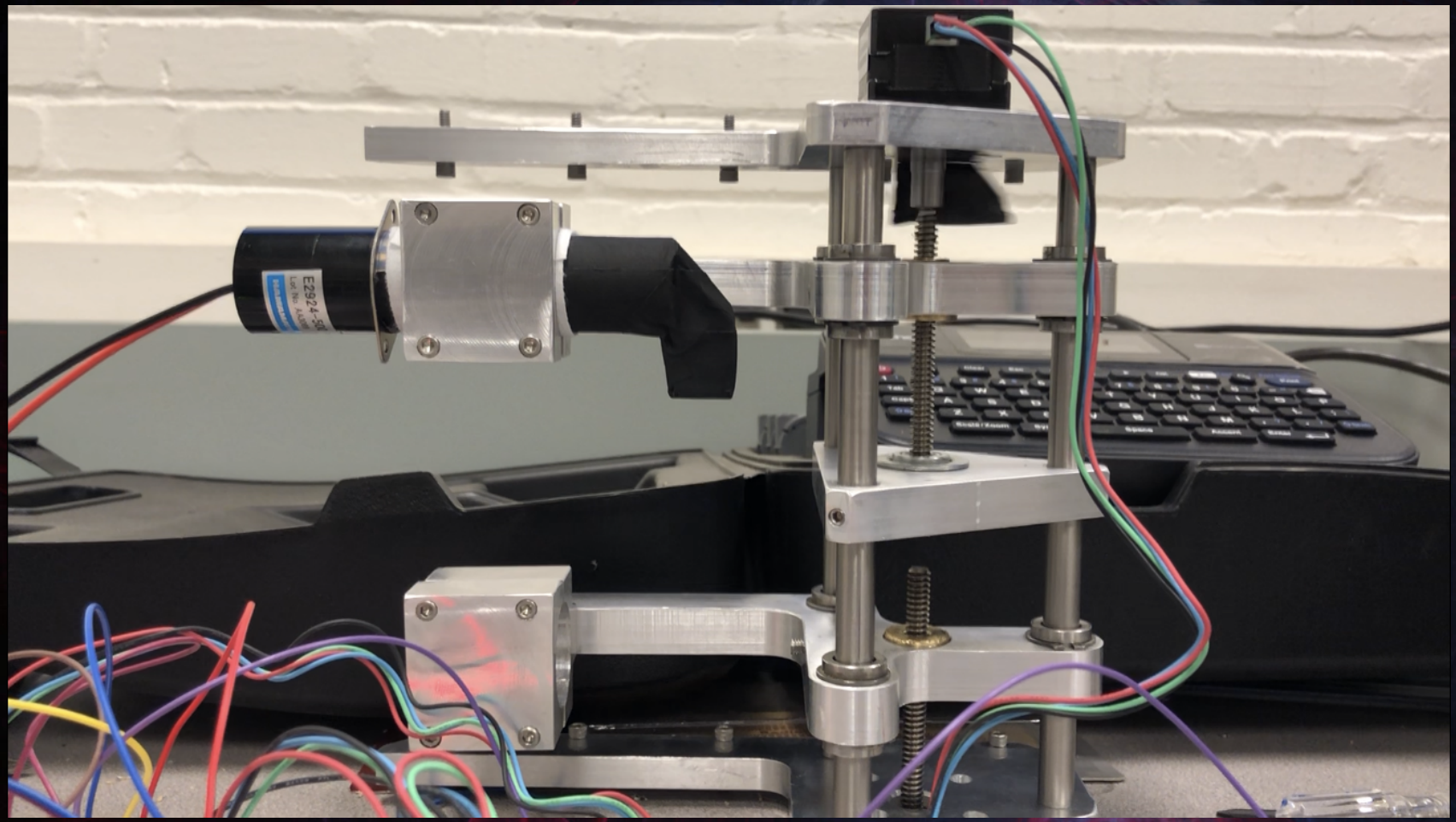
Beam halo hitting nozzle/catcher $\rightarrow$ build an active veto

Active Veto design





It is alive!



Veto test

» Immediately saw hits at much too high rate

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- In coincidence on both sides

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Veto test

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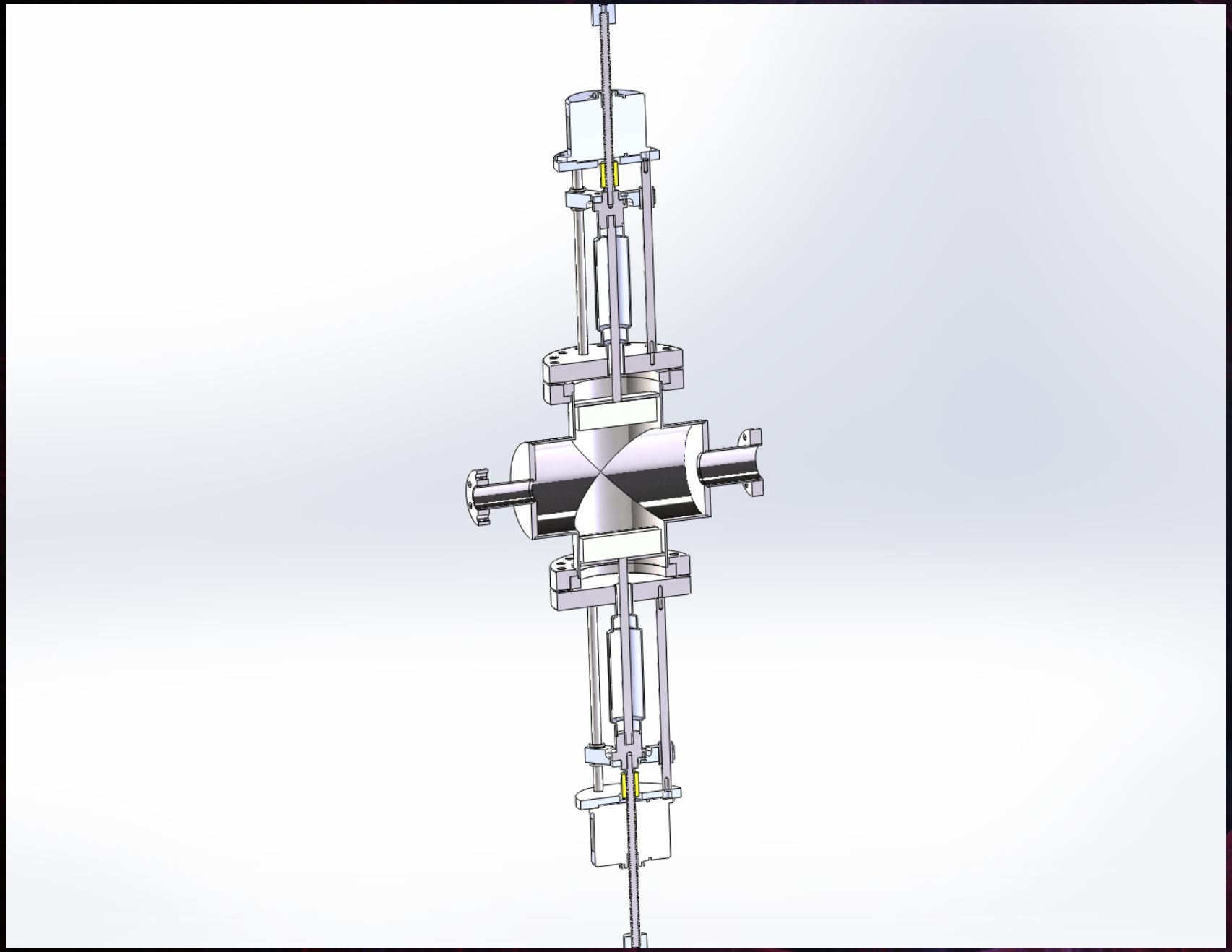
- In coincidence on both sides
- Periodic, correlated with power grid!
- Marco Dehn (accelerator expert): Probably dead power supply somewhere in the accelerator
- Was found after beam time. Could not retest yet.

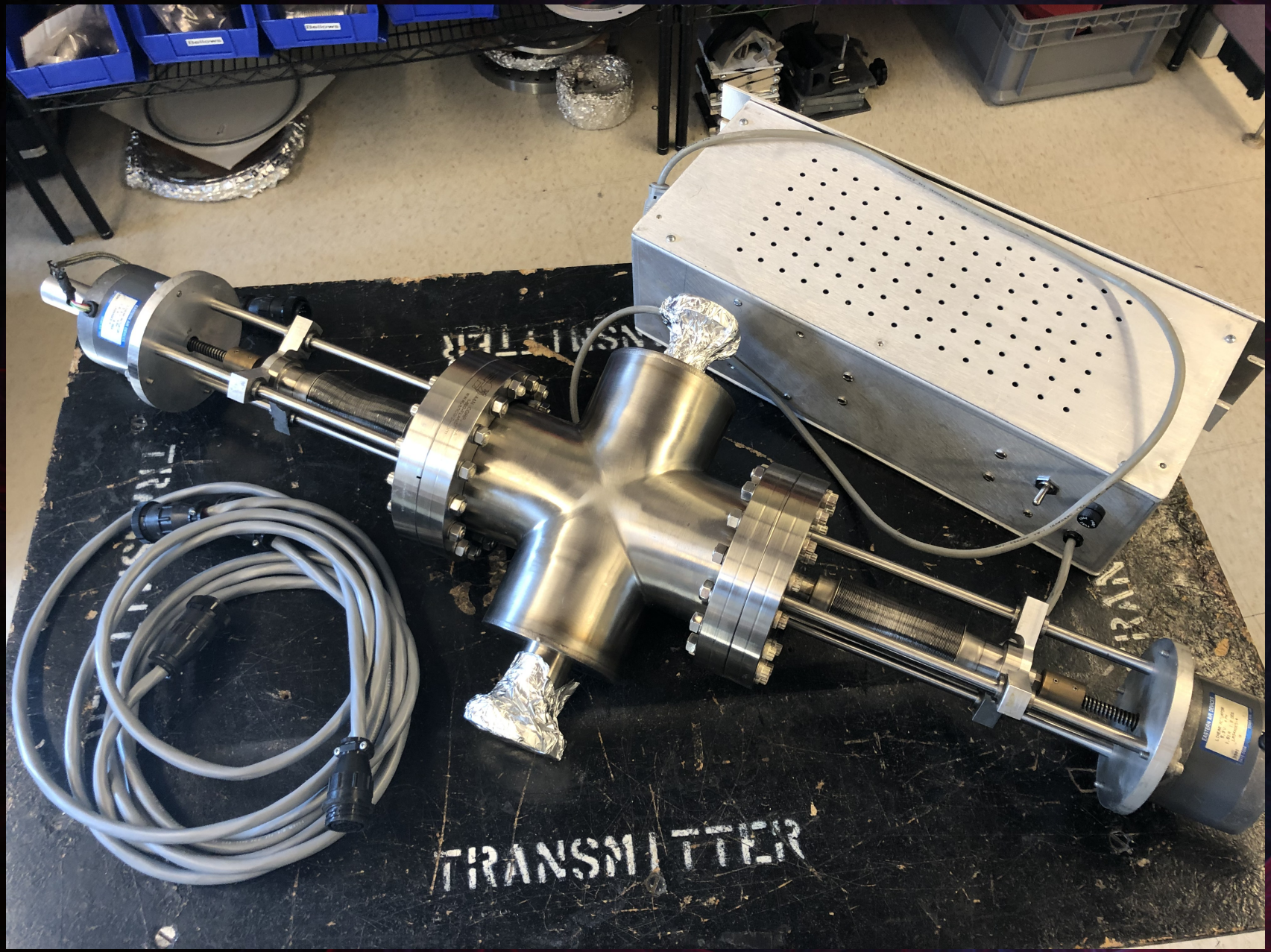
Collimator

- To reduce veto rate
- Movable for optimization
- Produced by MIT, will ship to A1 soon
- Test in December

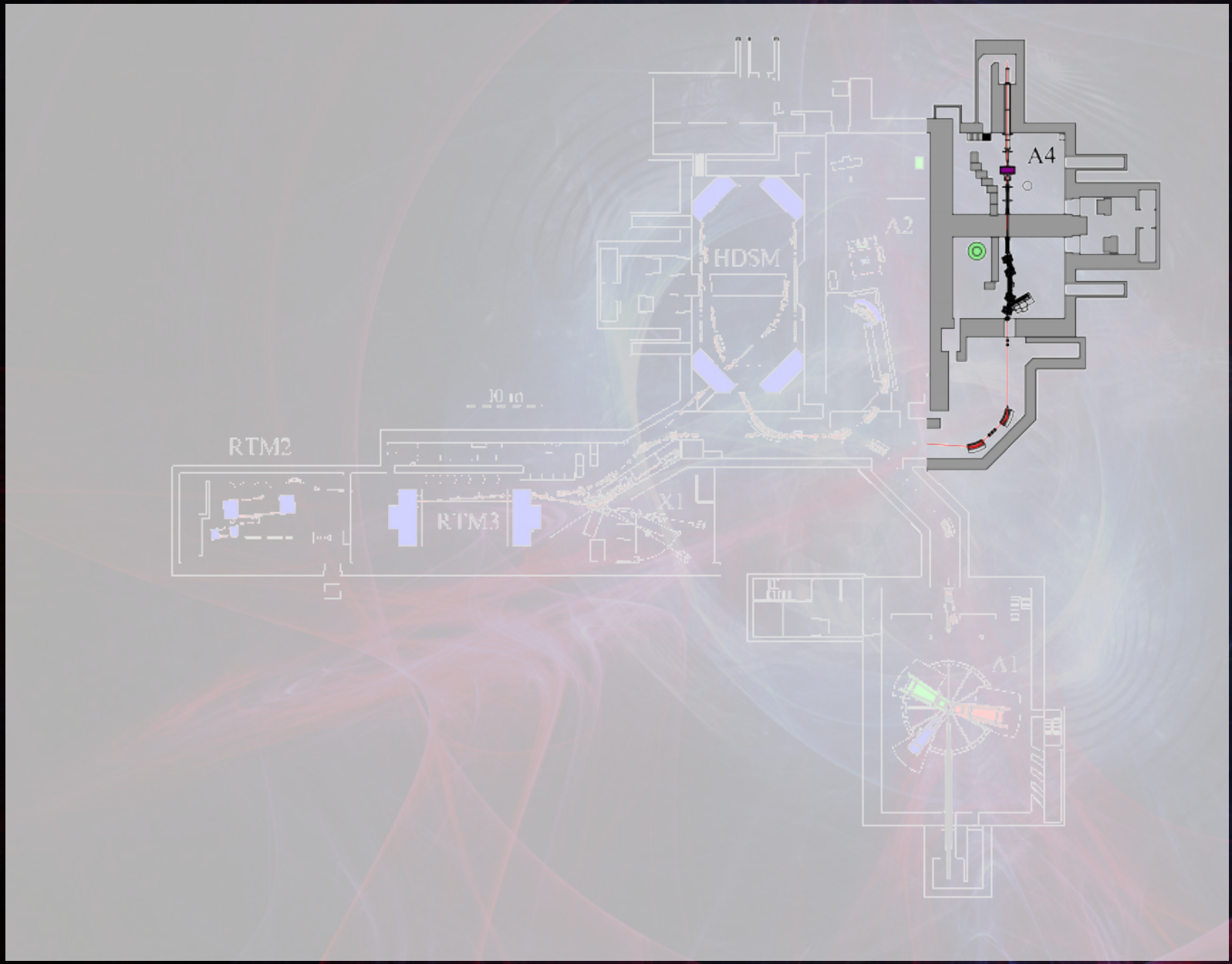
Collimator design



It's also alive



MESA



MESA + MAGIX

- Delayed for the best reason: more money

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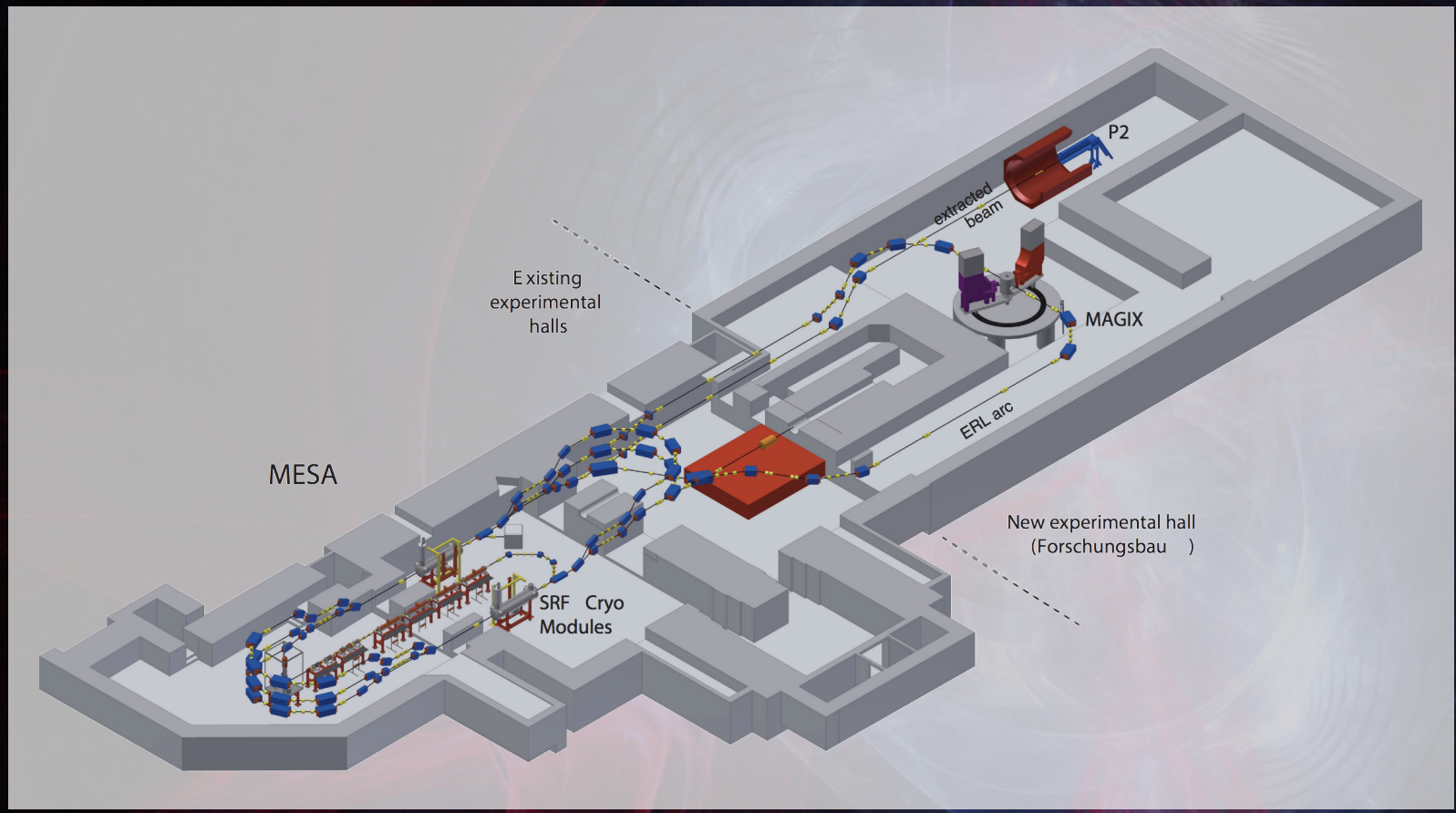
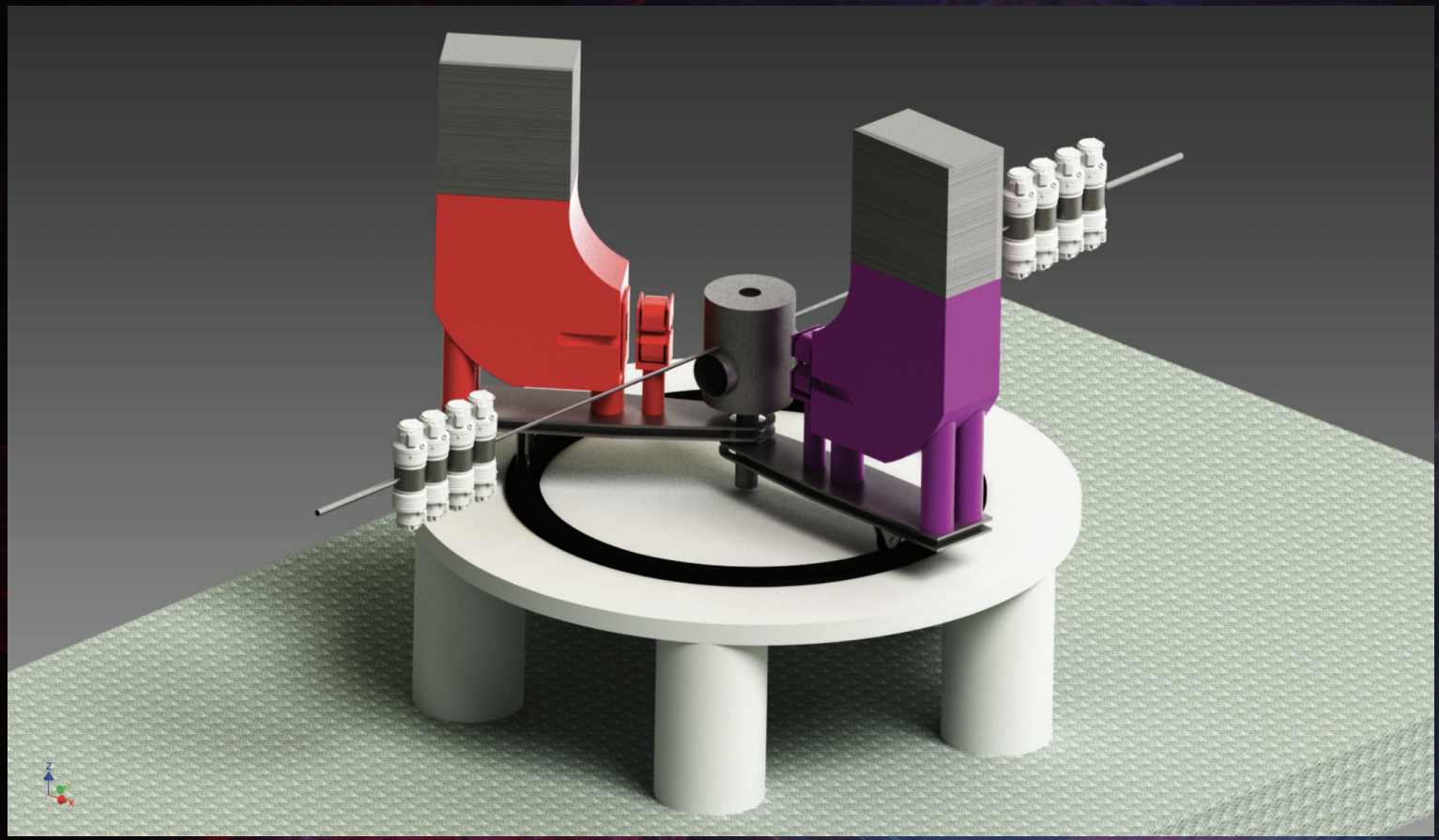


» Mainz Energy recovering Superconducting Accelerator
» Maximum beam energy of 155 MeV
» Beam current of >1mA

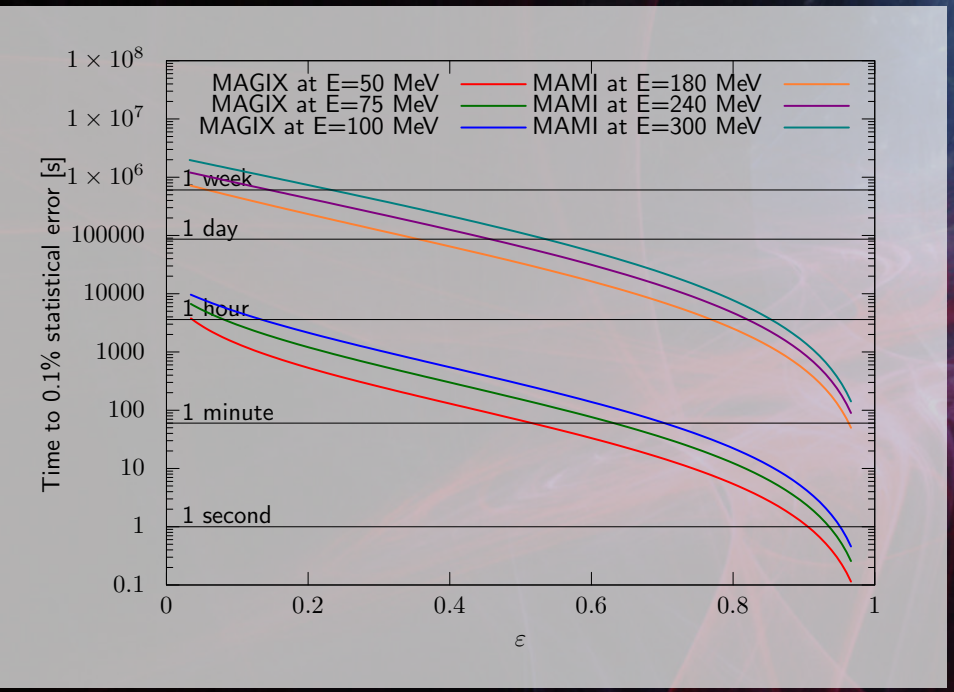
MAGIX: Little brother of A1

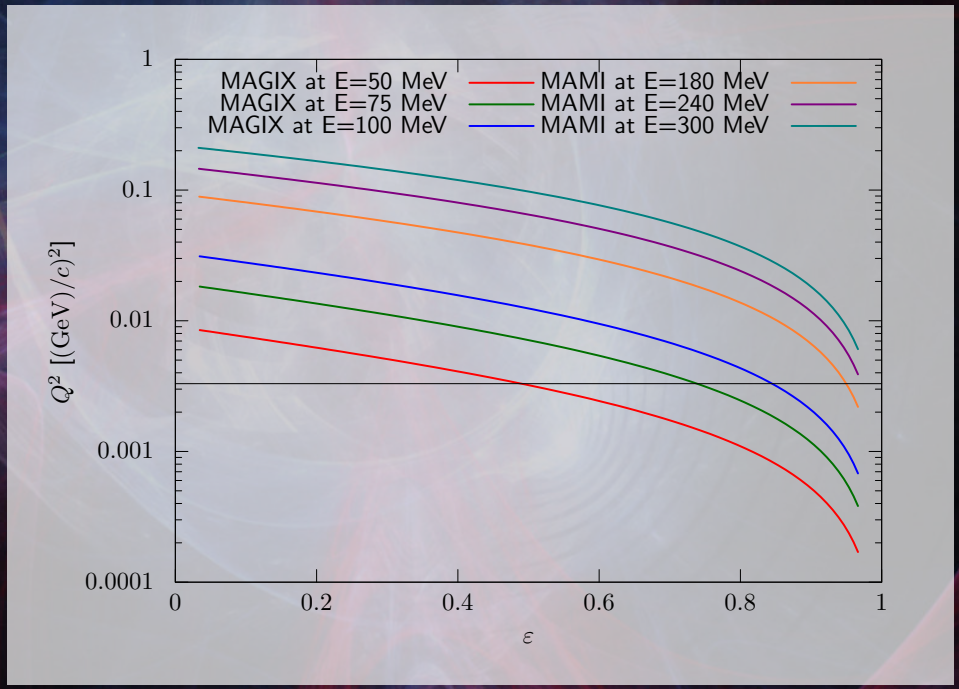


- MAGIX: MESA Gas Internal target eXperiment)
- Ground up designed for cluster jet
- Two high resolution spectrometers, FP-TPC with GEM readout

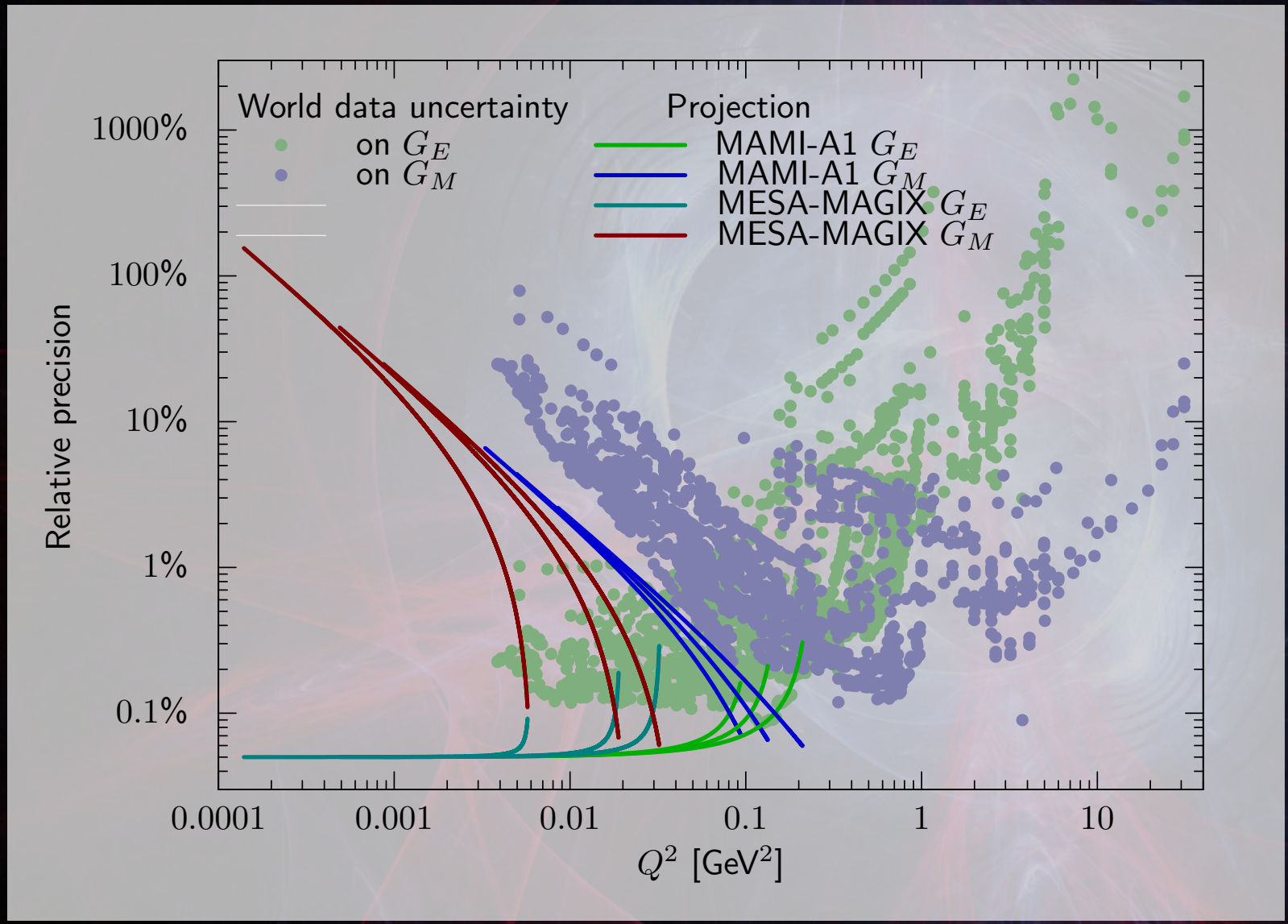
What can we do?

- Cluster jet target to kill major contributions to systematic errors
- Repeat ISR with new target (mainly G_E)
- Use new target also for classical approach





Impact


World data uncertainty
on G_E
on G_M
Projection
MAMI-A1 G_E
MAMI-A1 G_M
MESA-MAGIX G_E
MESA-MAGIX G_M
Relative precision
1000%
100%
10%
1%
0.1%
0.0001
0.001
0.01
0.1
1
10
Q^2 [GeV^2]