

Stony Brook University
STATE UNIVERSITY OF NEW YORK

October 19 - 23, 2026

Probing the Standard Model and Beyond at MESA

JG|U HIM HELMHOLTZ Helmholtz-Institut Mainz

Hadrons Nuclei CRC 1660

FOR 5327
Photon-photon interactions in the Standard Model and beyond
Project TFF · Project XYZ · Project JRP · Project LBL · Project ALP

Cluster of Excellence PRISMA++

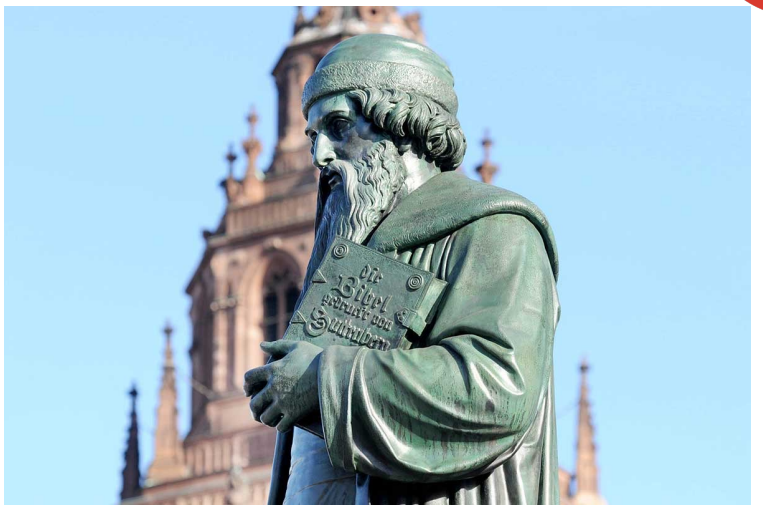
Achim Denig
JGU and HIM Mainz

Mainz – Rhine, Wine, Carnival, Gutenberg …





bistummainz.de





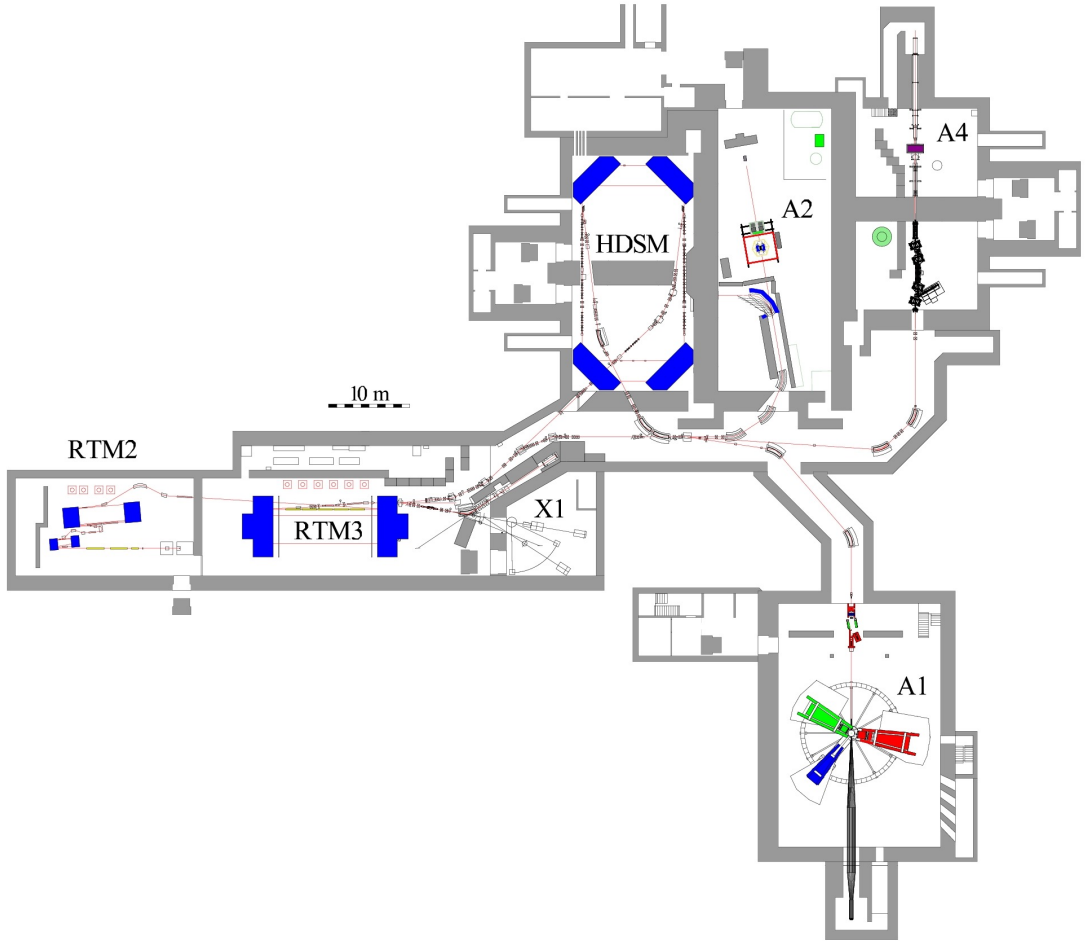


rheinhessen.de: Laubenheimer Klosterberg



… and Subatomic Physics



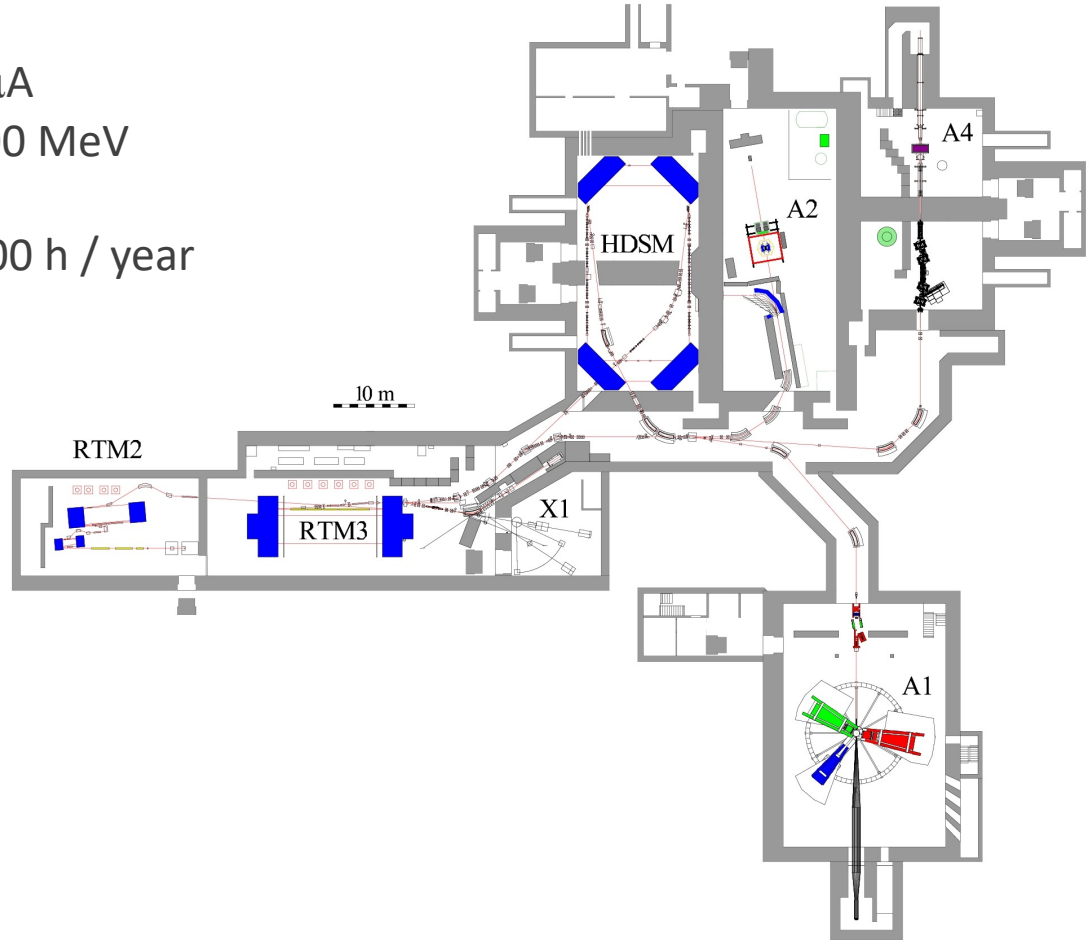


MAINZER MIKROTRON

The Mainz Microtron MAMI

Electron Accelerator E = 0.185 GeV - 1.6 GeV (CW – 2.45 GHz)
operated at JGU Mainz
Hallmarks

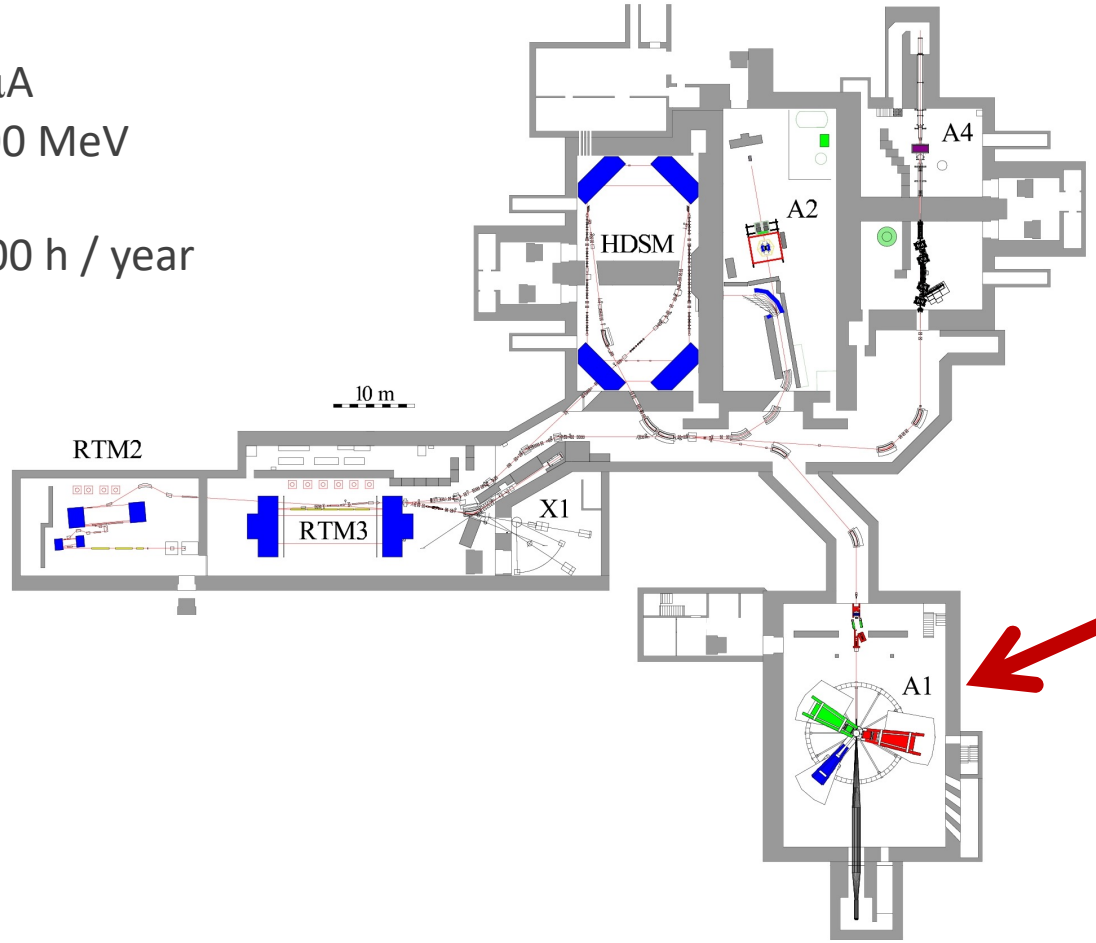
- Intensity max. 100 µA
- Resolution σ_E < 0.100 MeV
- Polarization 85%
- Reliability: up to 7000 h / year



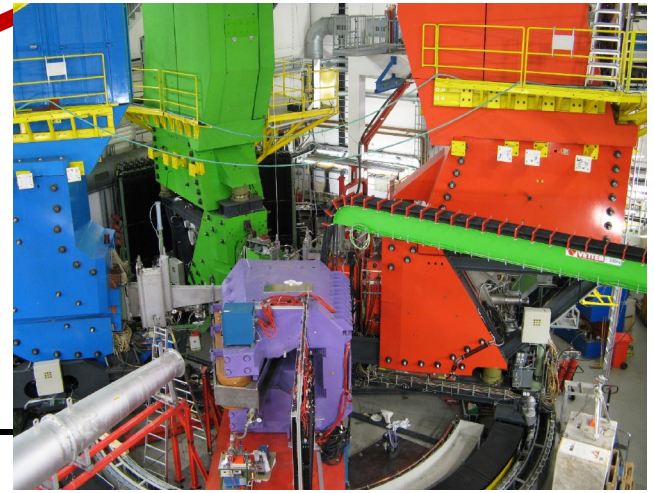
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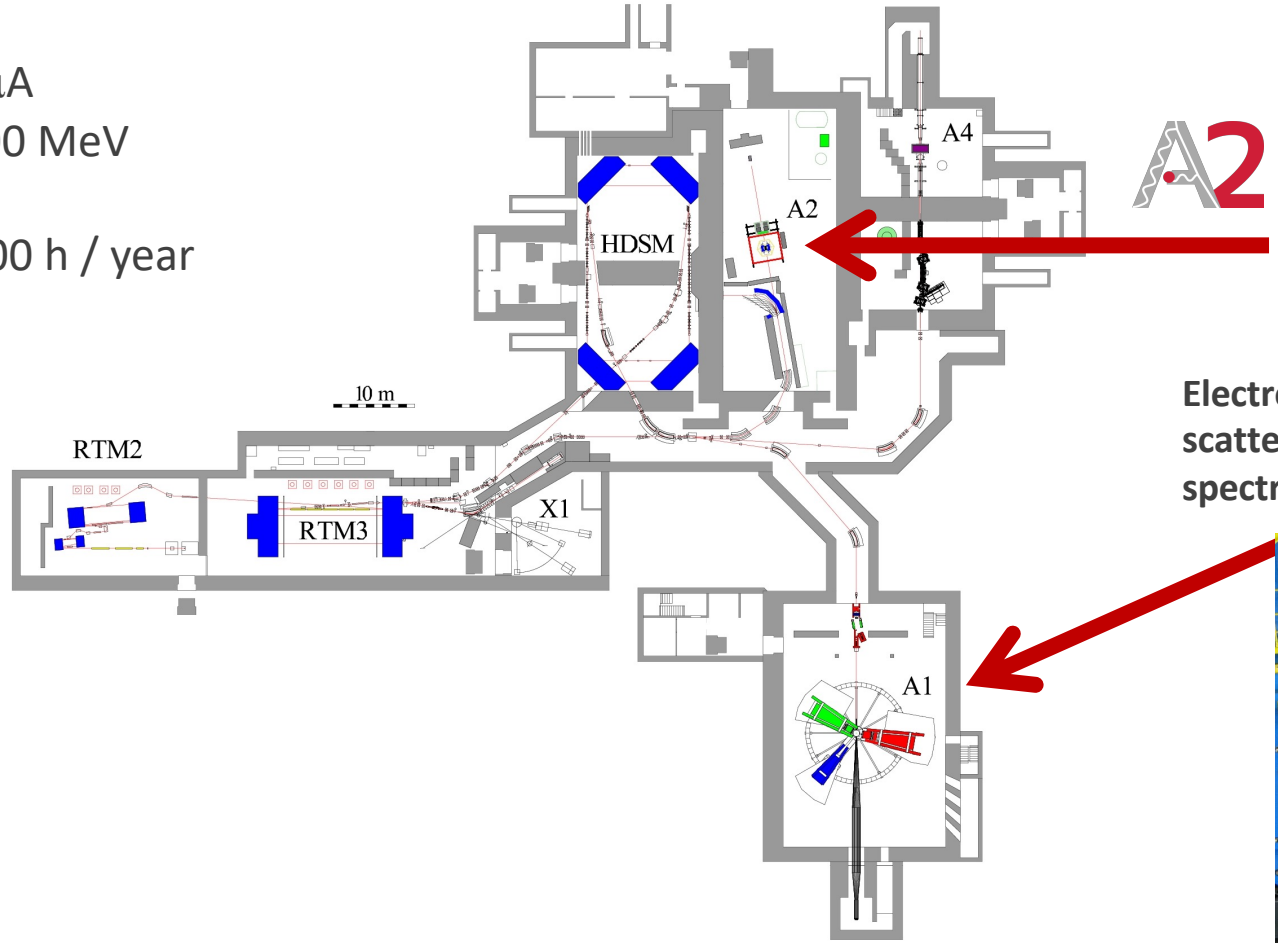
Electron scattering (high resolution spectrometer setup)

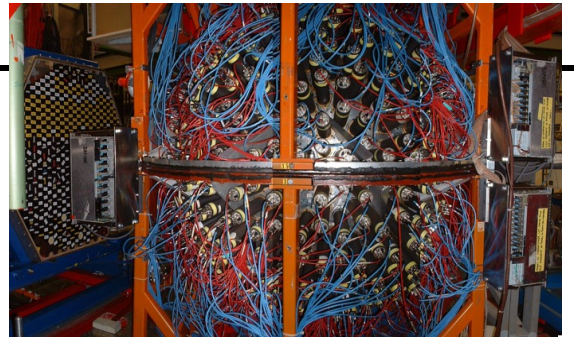


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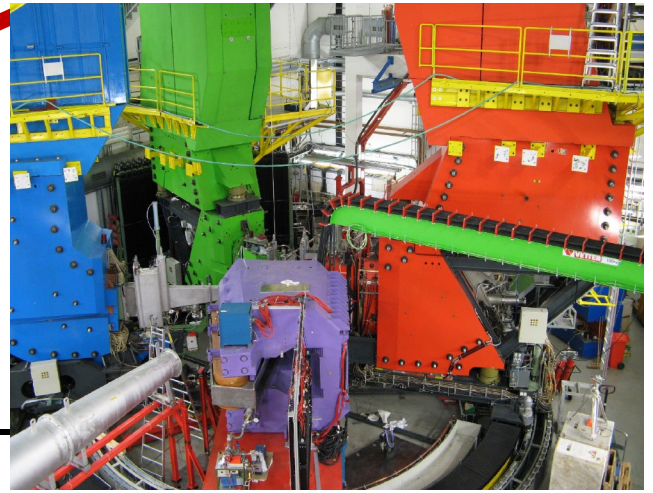
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Photon scattering (A2 hall) (Crystal Ball / TAPS calorimeters; Polarized frozen-spin target → currently at Univ. Bonn)

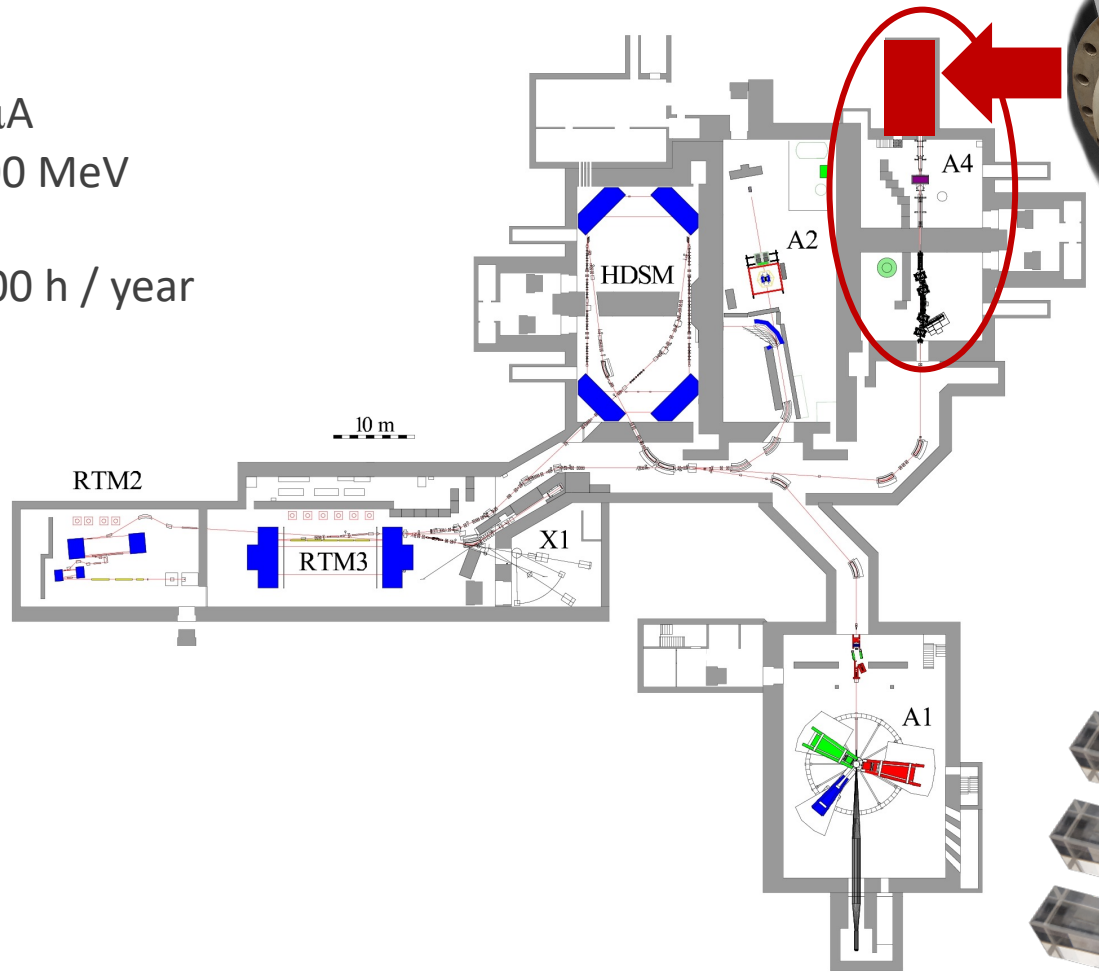
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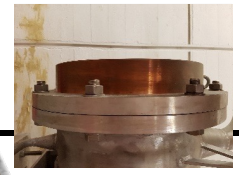


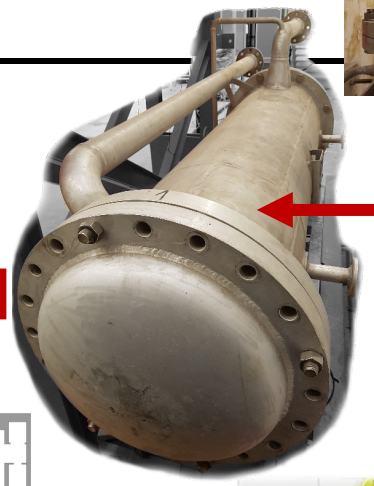
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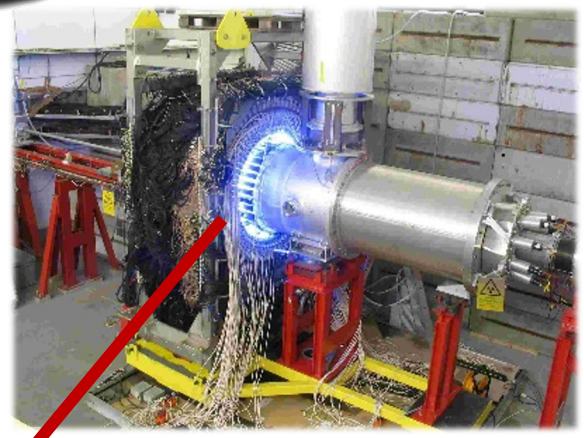
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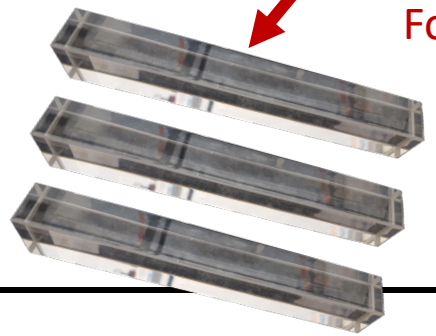






Former A4 beam dump:
Al, H_20, Cu → 20 X_0



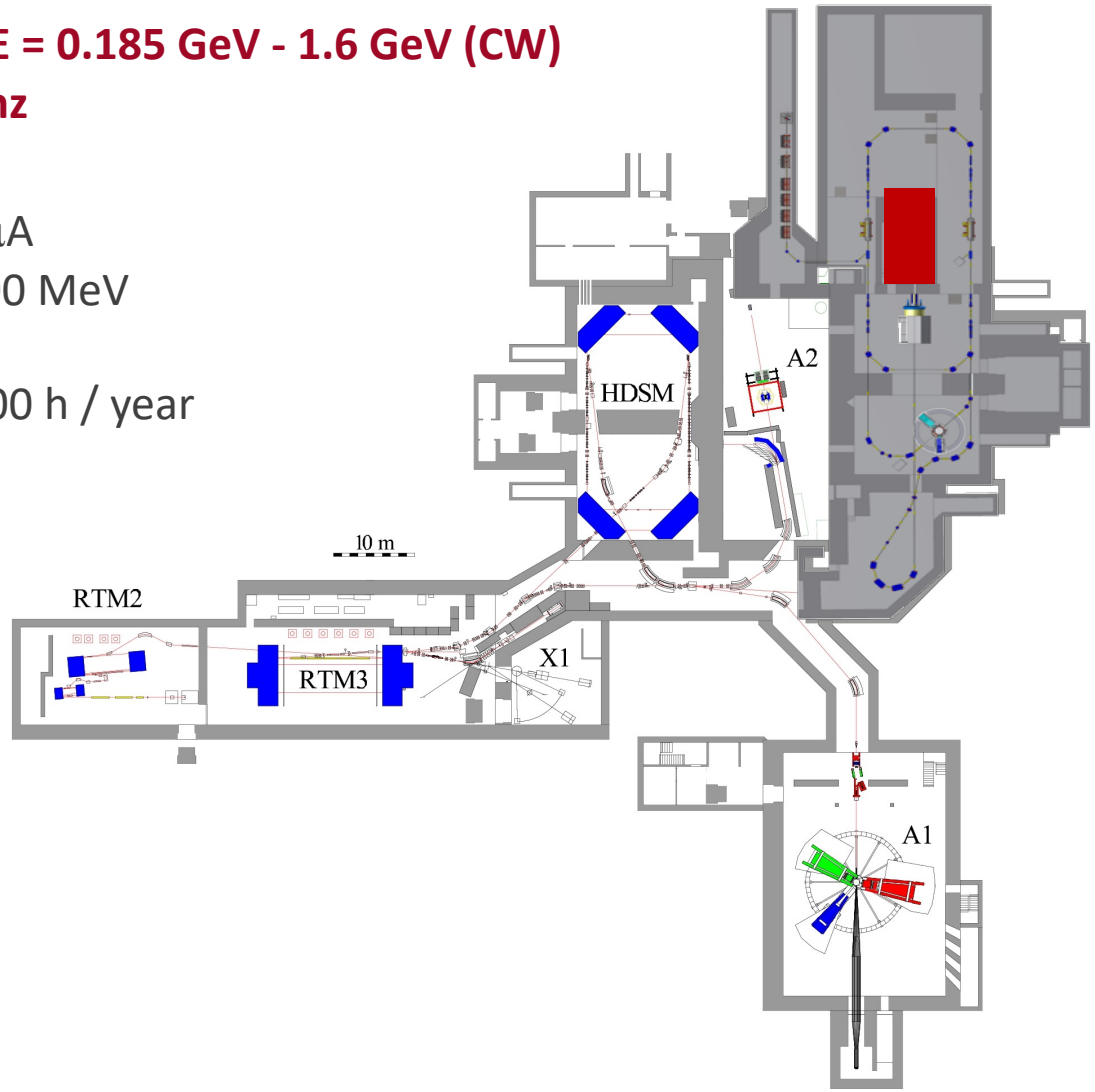


Former A4 experiment:
1000 PbF_2 crystals
and PMTs

The Mainz Microtron MAMI

Electron Accelerator E = 0.185 GeV - 1.6 GeV (CW)
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Hallmarks

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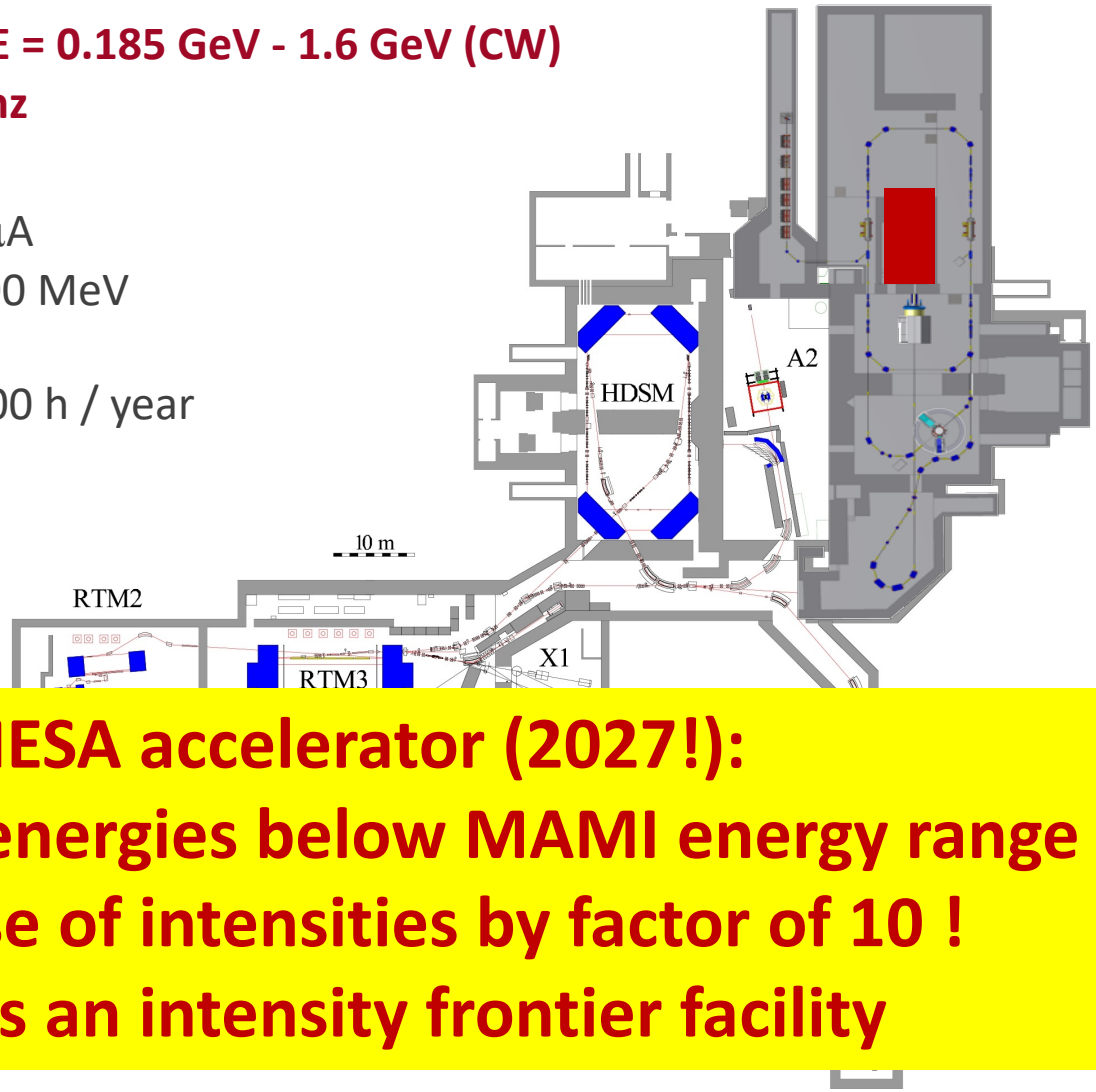
New experimental hall
MAMI and MESA
11m under ground

Cluster of Excellence
PRISMA++

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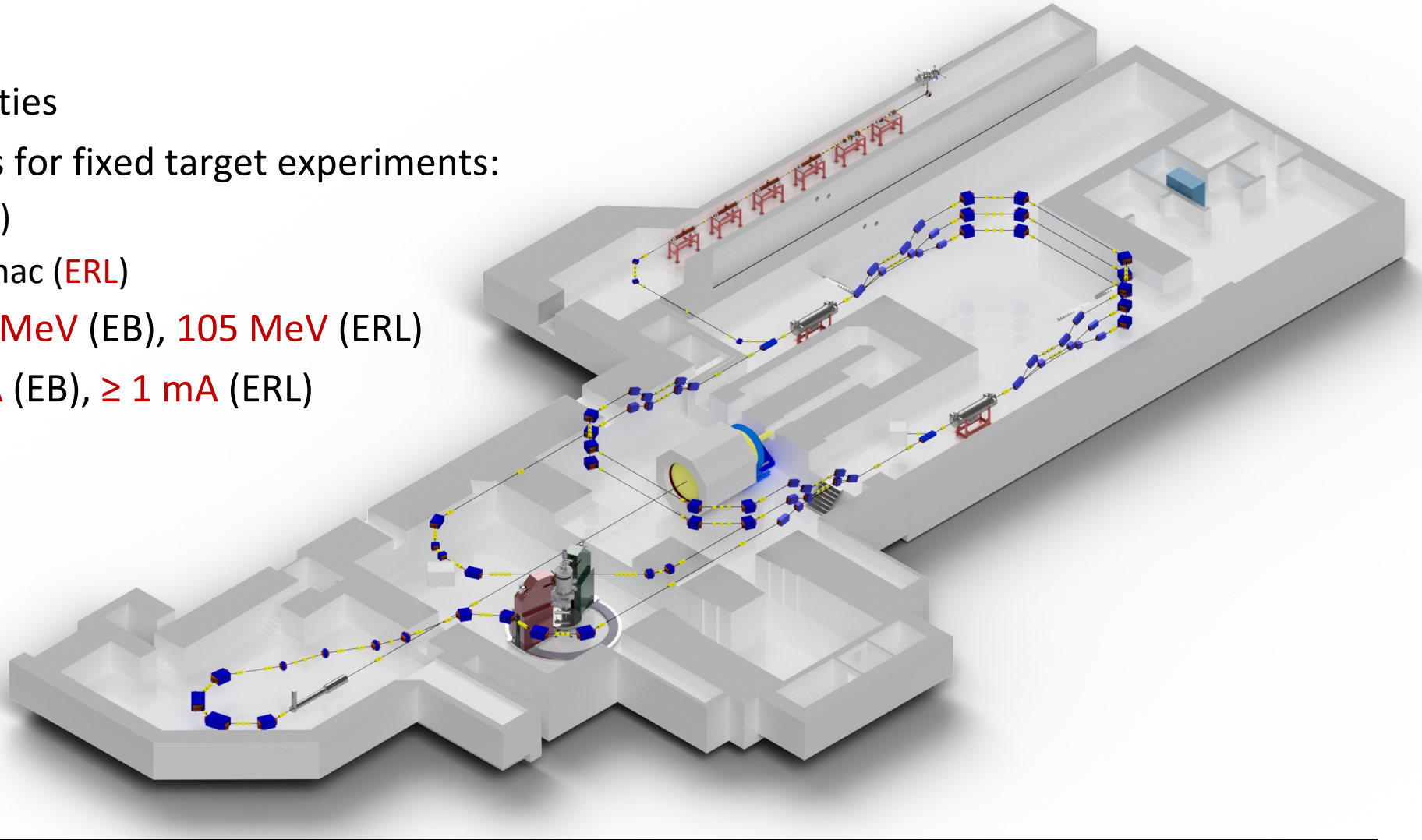
New experimental hall
MAMI and MESA
11m under ground

New MESA accelerator (2027!):
Beam energies below MAMI energy range !
Increase of intensities by factor of 10 !
MESA is an intensity frontier facility

Cluster of Excellence
PRISMA++

The Mainz Energy-Recovering Superconducting Accelerator.

- Superconducting cavities
- Two operating modes for fixed target experiments:
  - Extracted Beam (EB)
  - Energy-Recovery Linac (ERL)
- Beam energies ≤ 155 MeV (EB), 105 MeV (ERL)
- Beam currents 150µA (EB), ≥ 1 mA (ERL)

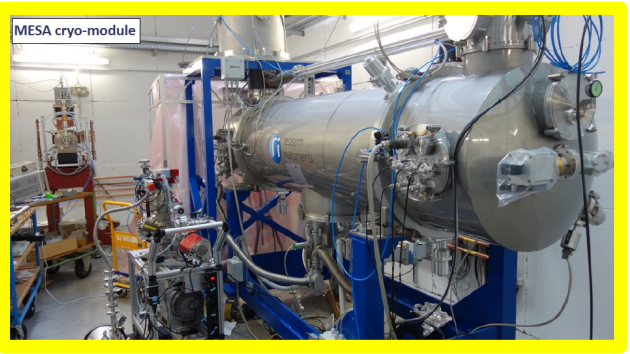


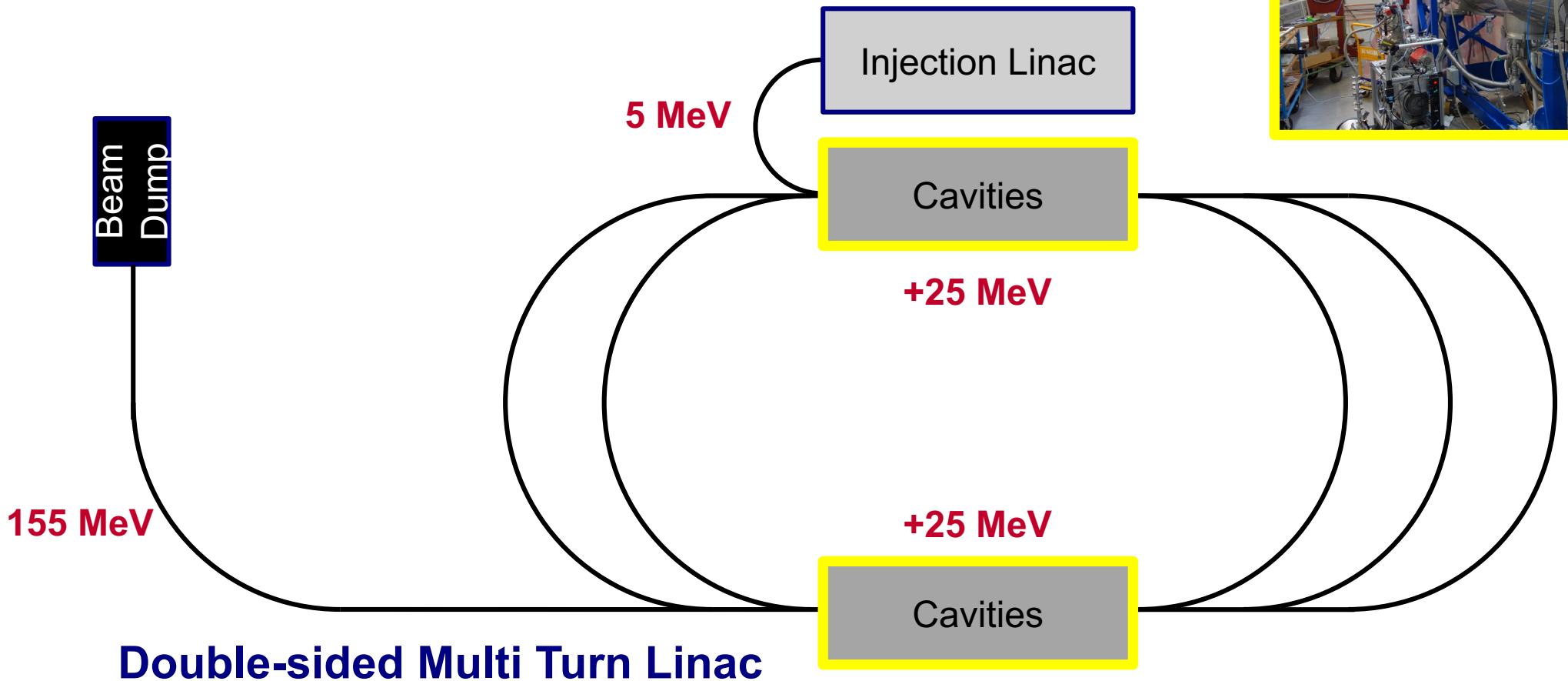
Extracted Beam (EB) Mode for MESA

Extracted Beam Mode

beam currents ~ 150 µA

Superconducting TESLA-like cavities



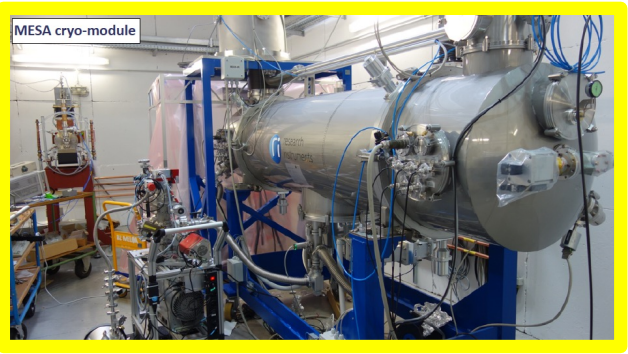


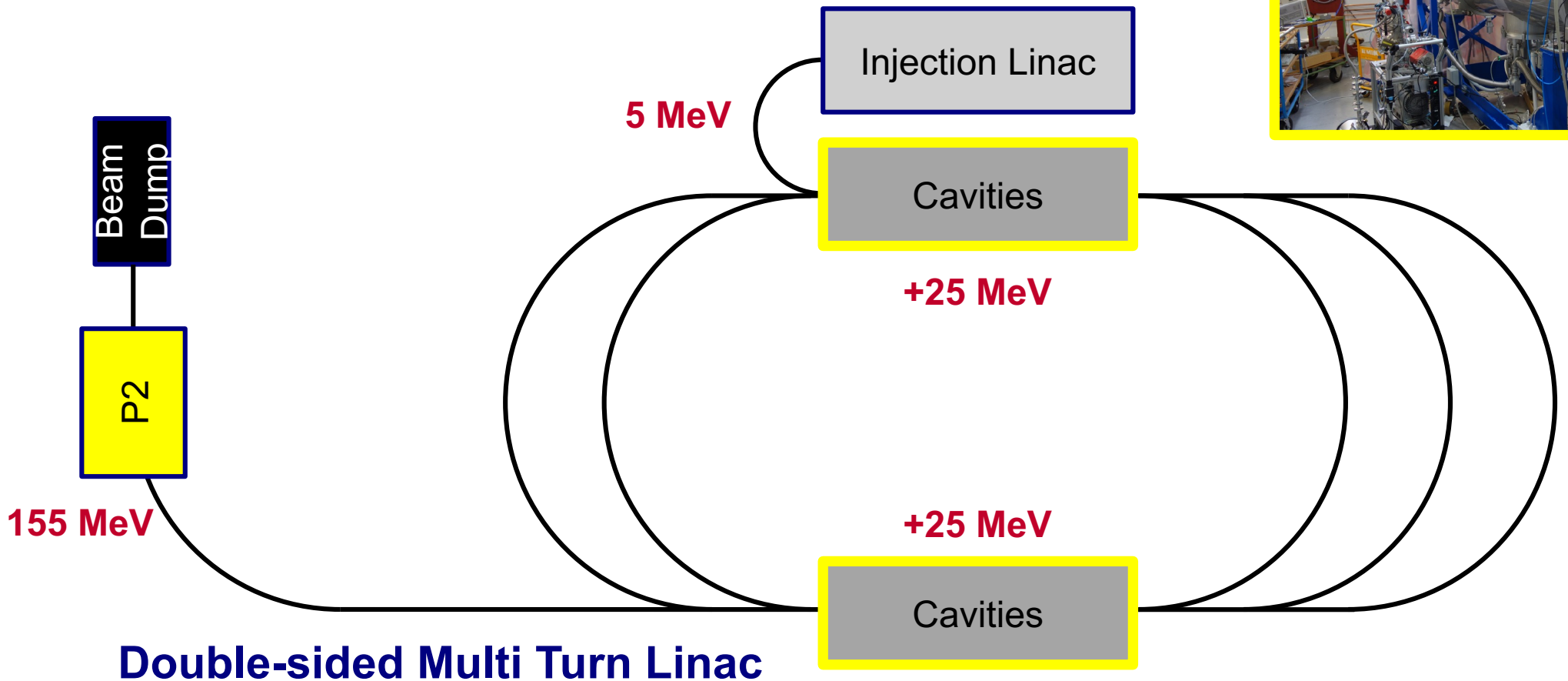
Extracted Beam (EB) Mode for MESA

Extracted Beam Mode

beam currents ~ 150 µA

Superconducting TESLA-like cavities





Extracted Beam (EB) Mode for MESA

Beam Dump Experiment in parallel to P2

DarkMESA

Beam Dump

Extracted beam mode

P2

155 MeV

5 MeV

Injection Linac

Cavities

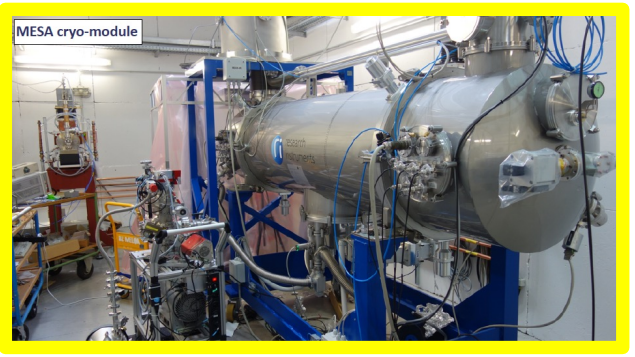
+25 MeV

+25 MeV

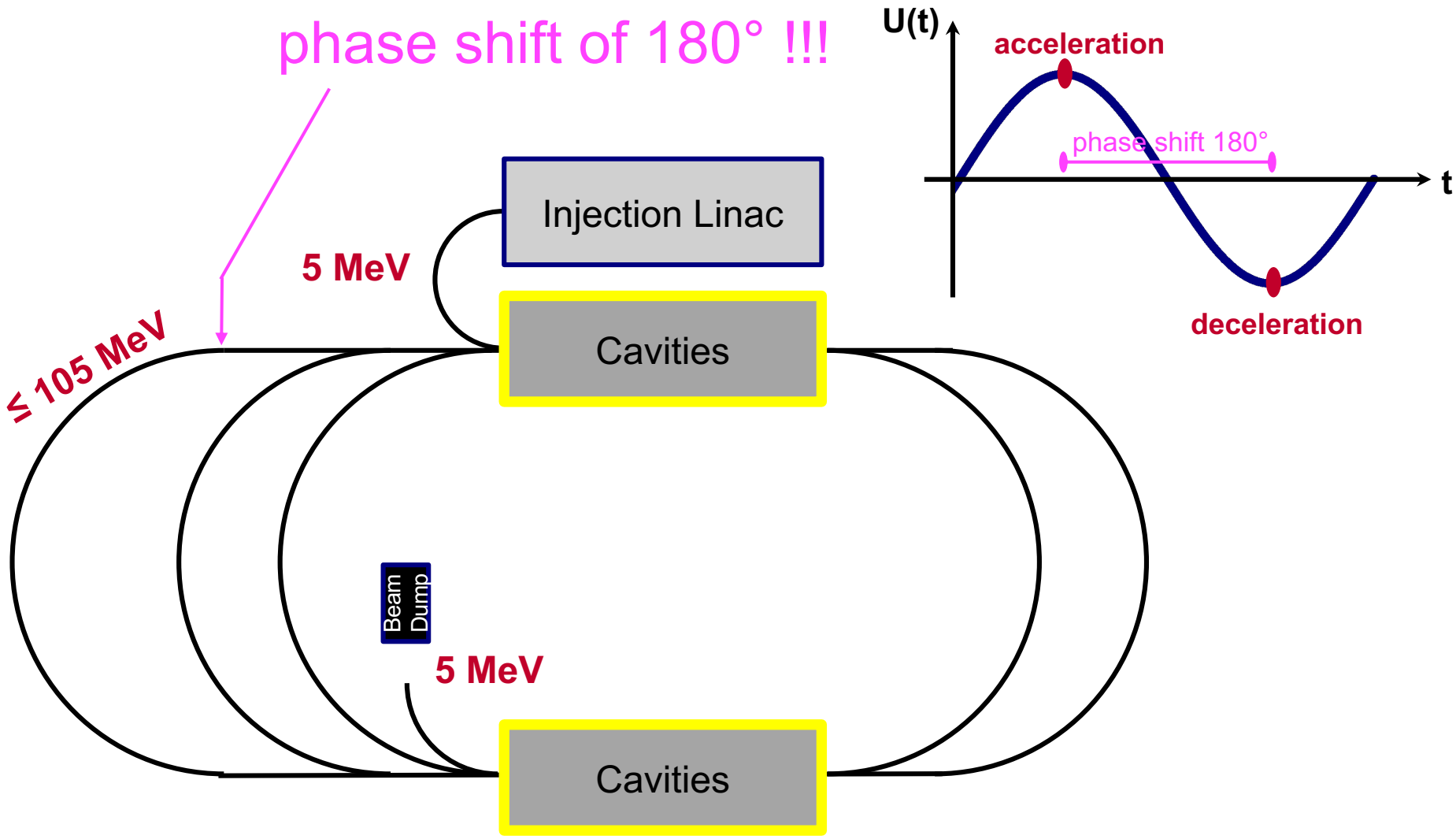
Cavities

Double-sided Multi Turn Linac

Superconducting TESLA-like cavities



Energy-Recovery Linac (ERL) Mode for MESA



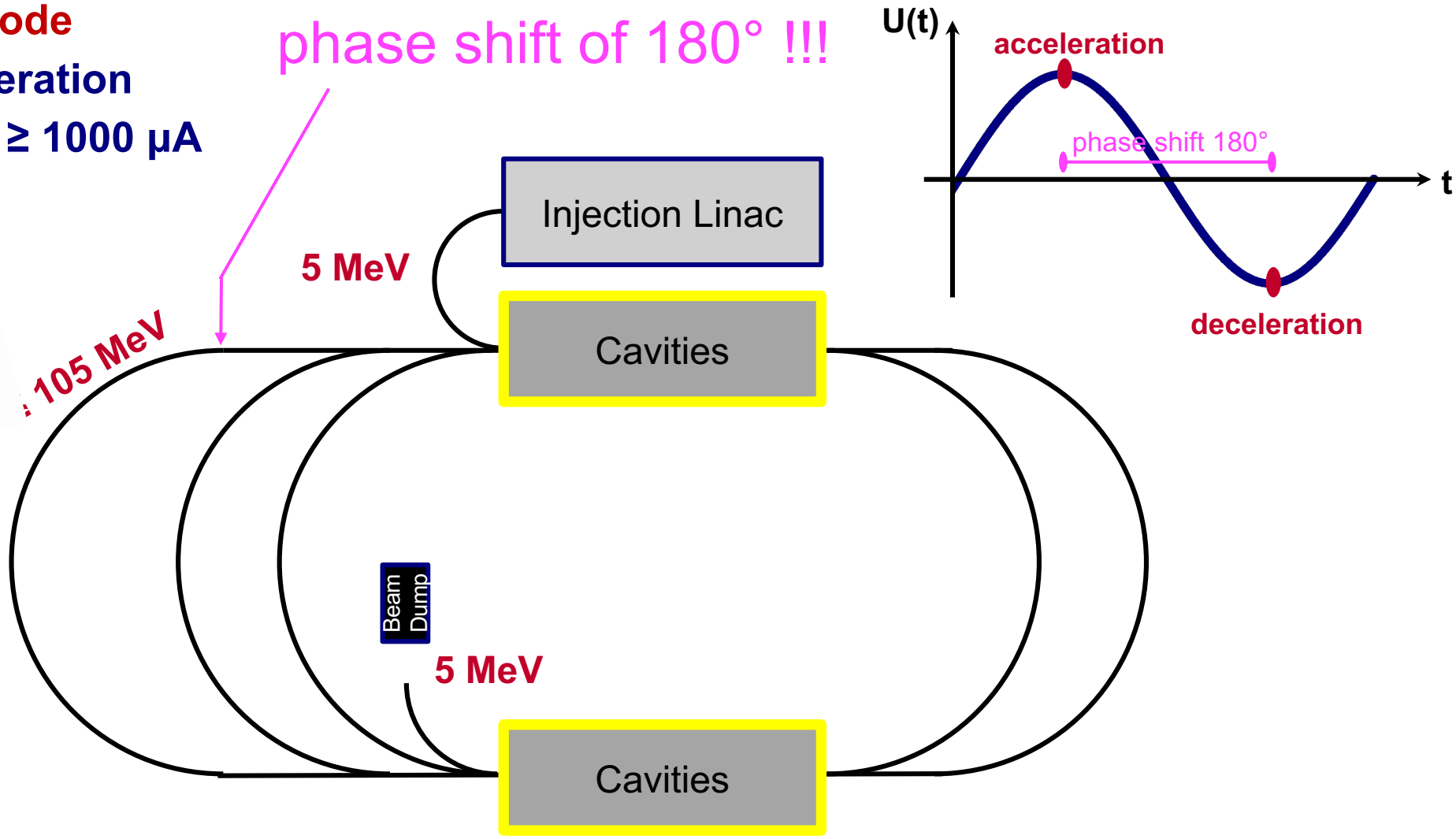
Energy-Recovery Linac (ERL) Mode for MESA

Energy-Recovering mode

energy-efficient acceleration

►high beam currents ≥ 1000 µA





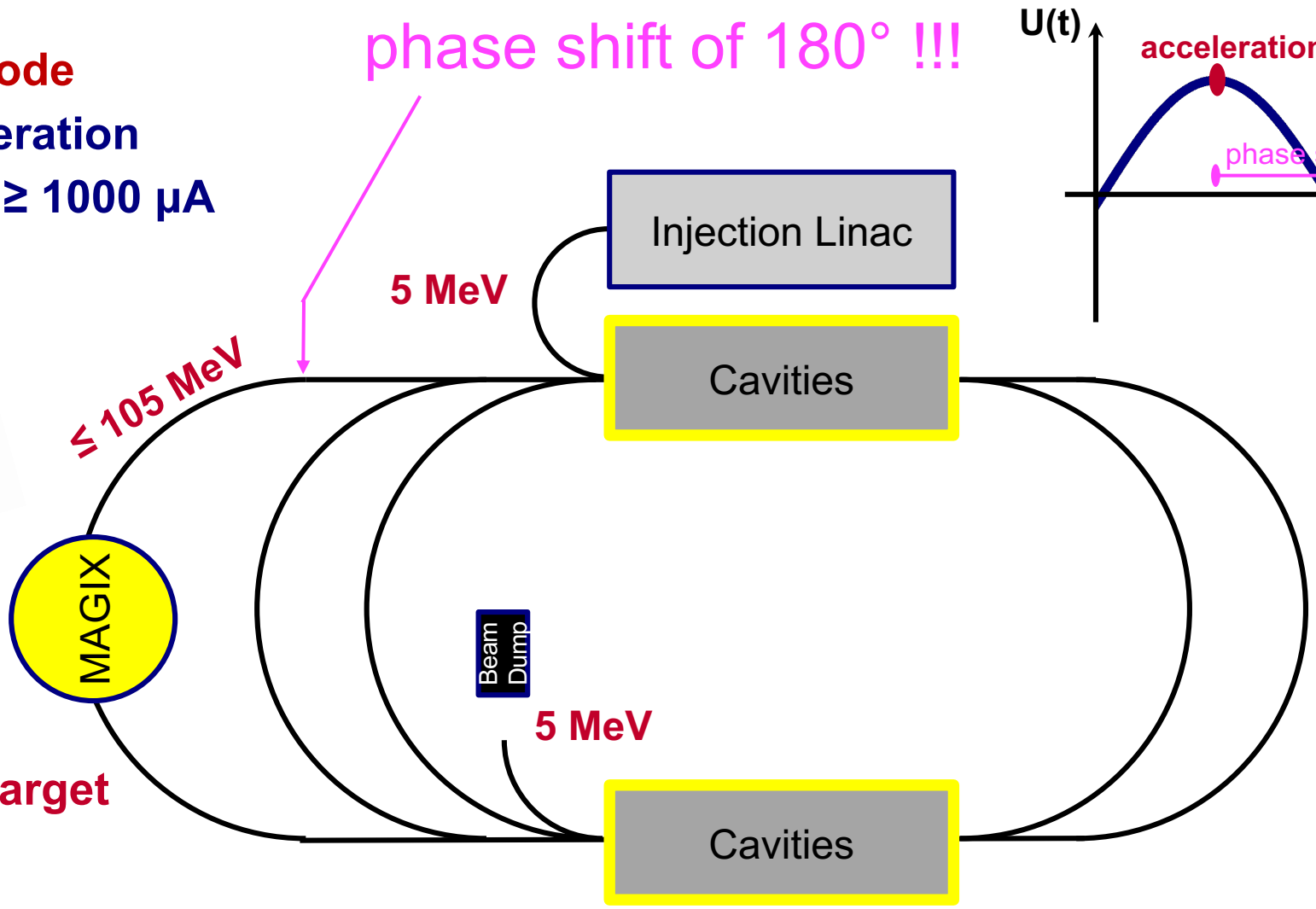
Energy-Recovery Linac (ERL) Mode for MESA

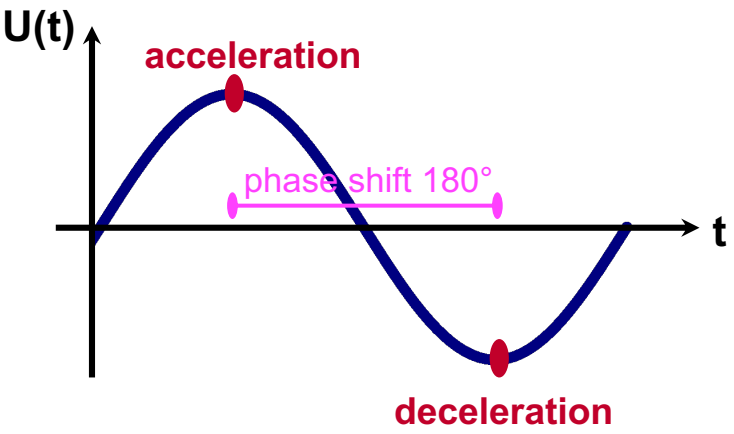
Energy-Recovering mode

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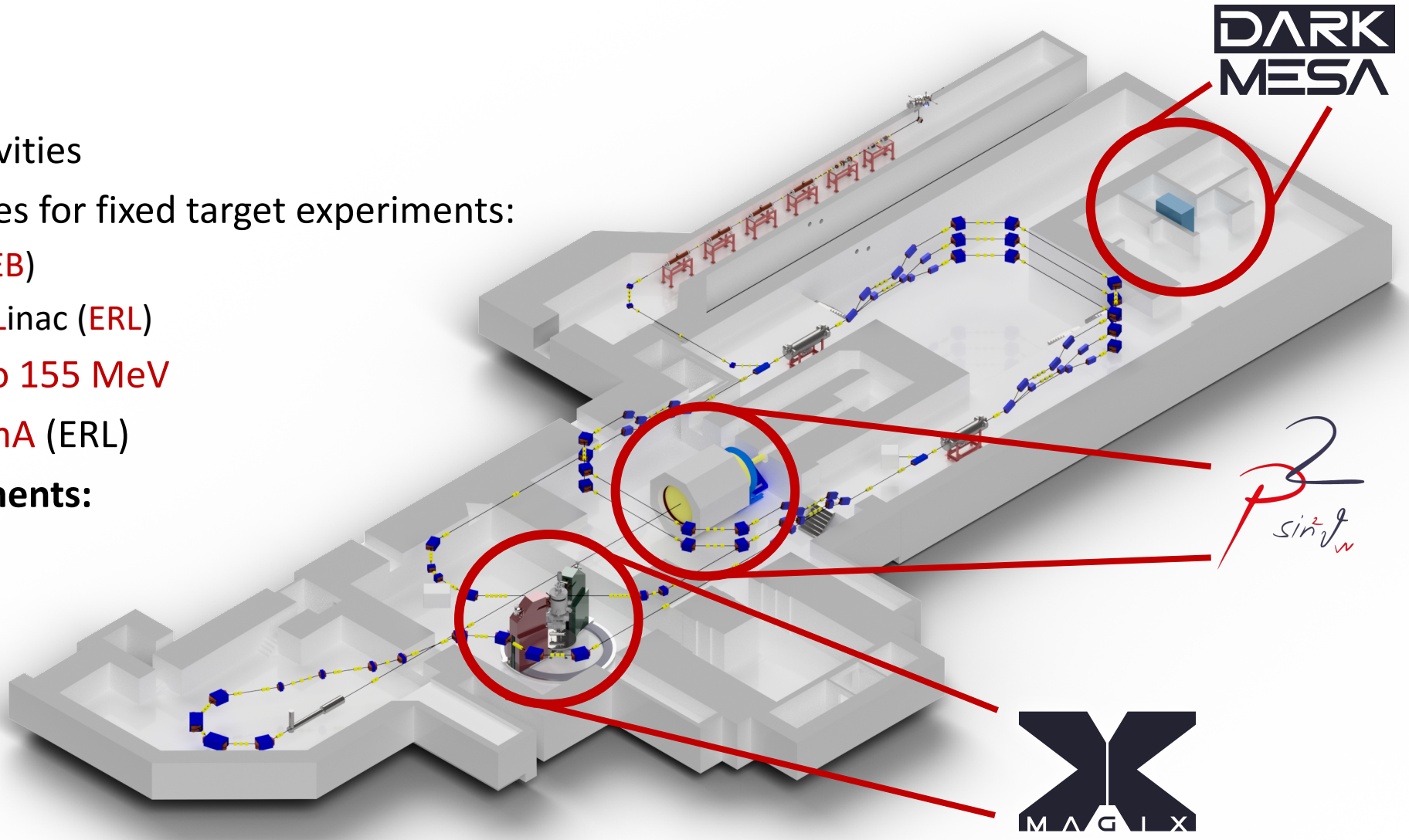




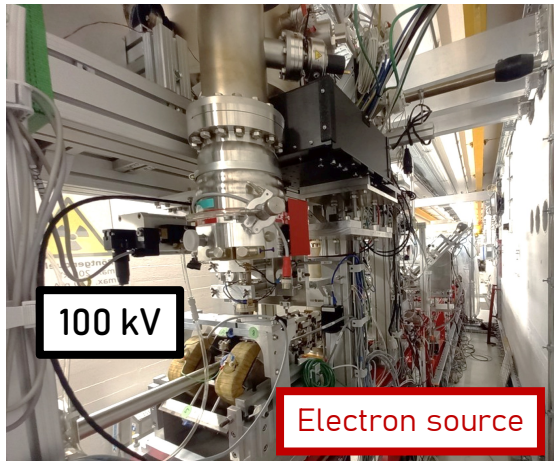
thin internal MAGIX target
to allow
for ERL recollection

The Mainz Energy-Recovering Superconducting Accelerator.

- Superconducting cavities
- Two operating modes for fixed target experiments:
  - Extracted Beam (EB)
  - Energy-Recovery Linac (ERL)
- Beam energies up to 155 MeV
- Beam currents ≥ 1 mA (ERL)
- **Three main experiments:**
  - **P2 (EB)**
  - **DarkMESA (EB)**
  - **MAGIX (ERL)**

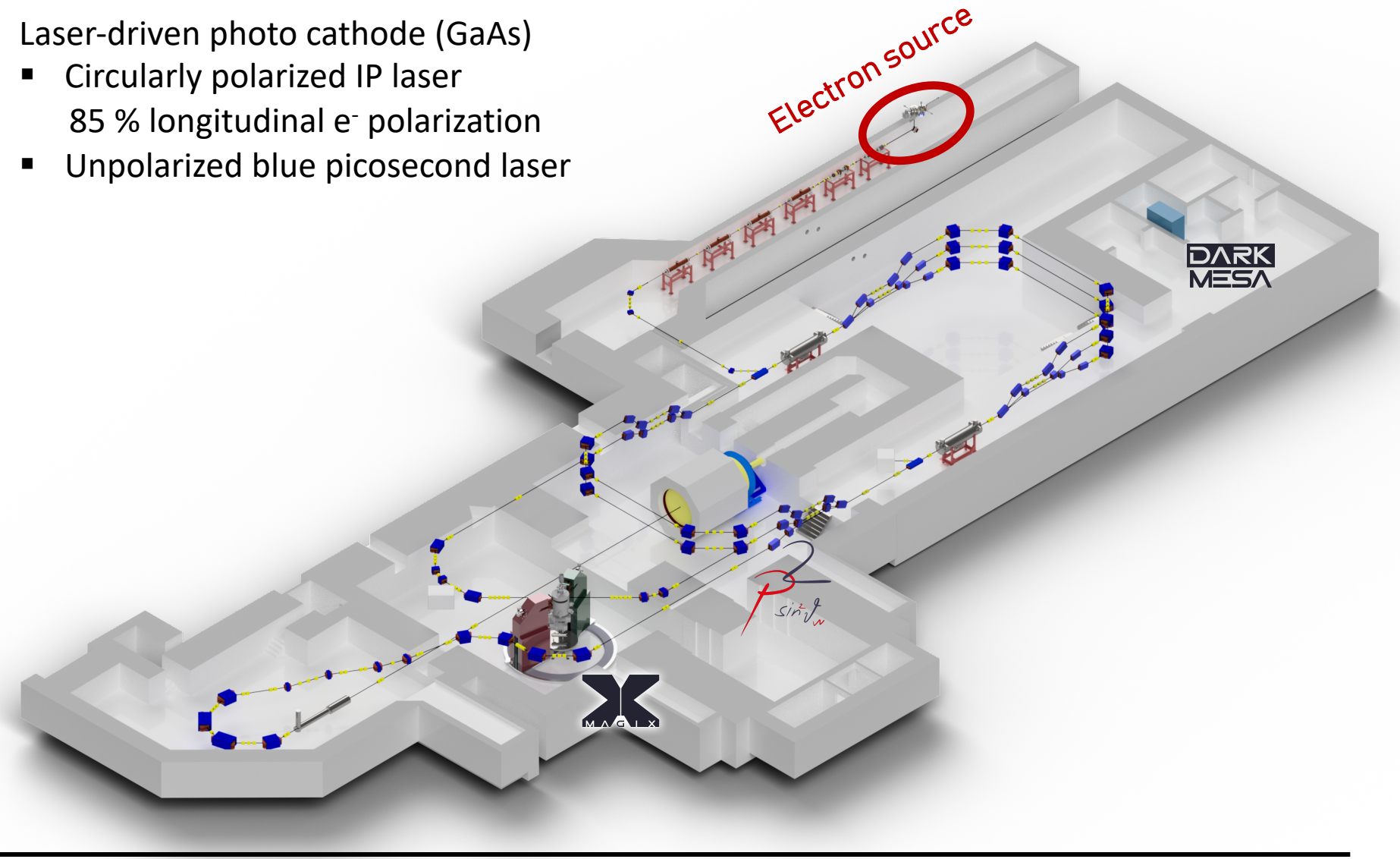


MESA – Status & Impressions

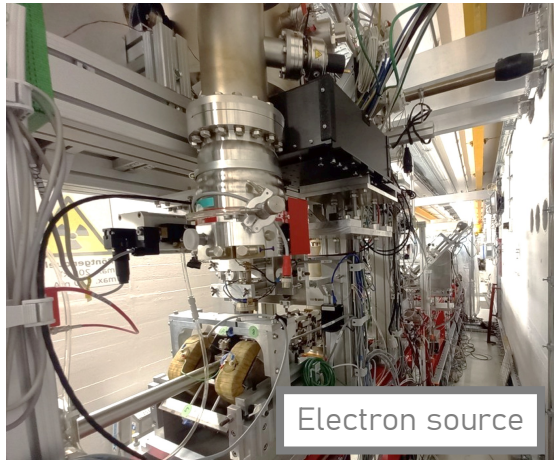


Laser-driven photo cathode (GaAs)

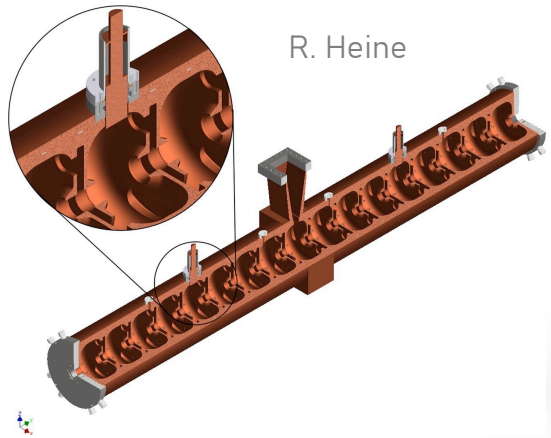
- Circularly polarized IP laser
  85 % longitudinal e^- polarization
- Unpolarized blue picosecond laser



MESA – Status & Impressions



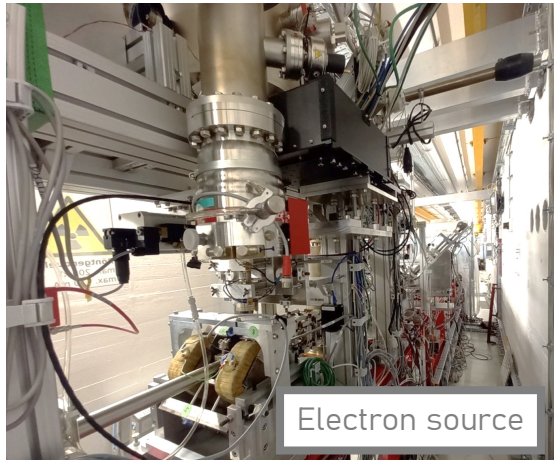




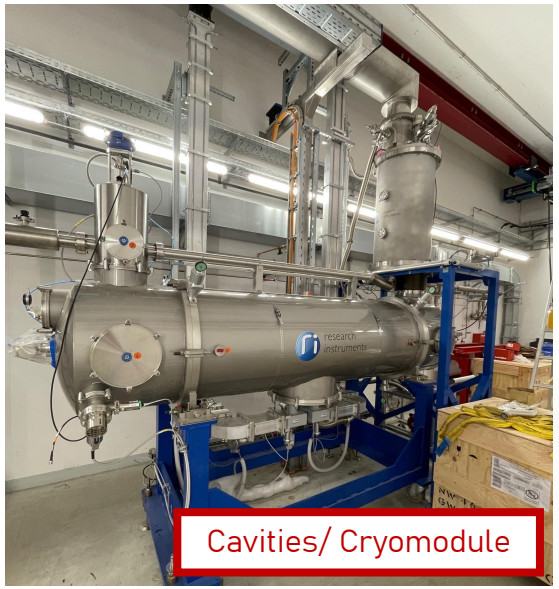
R. Heine

Pre-accelerator MAMBO: 5 MeV

MESA – Status & Impressions







MESA enhanced ELBE cryomodule

- 2 XFEL cavities
- Tested and installed within MESA

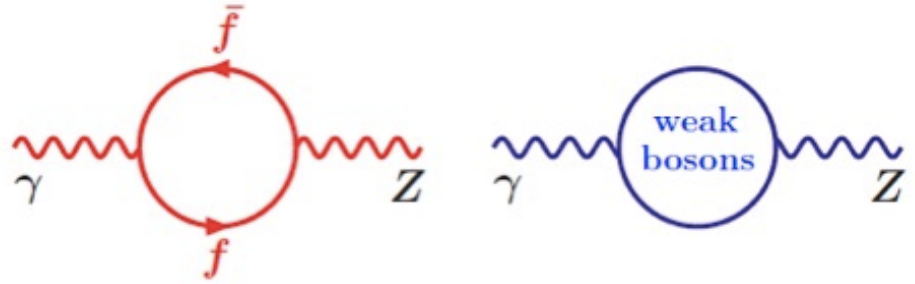
f_0 = 1.3 GHz

P2 Experiment

MESA Extracted Beam Mode

Measurement of: $\sin^2\Theta_W = (e/g)^2 = 1 - (M_W/M_Z)^2$

Rad. corrections strongly correlated with quarks, W-Bosons, Higgs, …

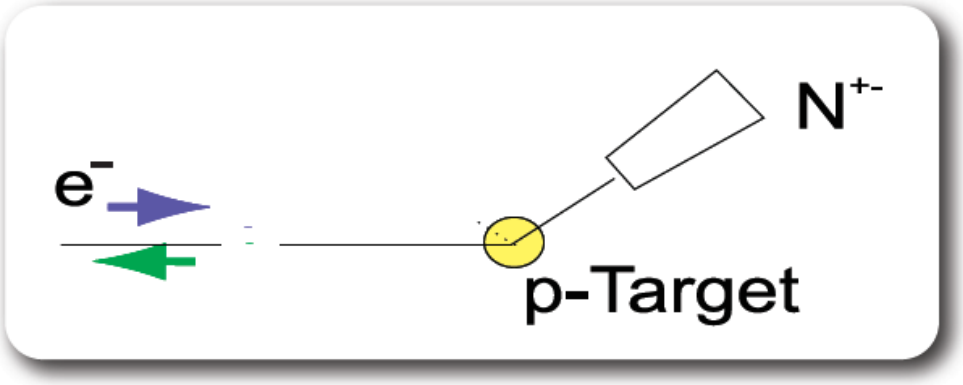


Leads to running (Q^2 dependence) of $\sin^2\Theta_W$ → Precision test of SM

Measurement of the Weak Charge of the Proton

Scattering of longitudinally polarized electrons on unpolarized protons

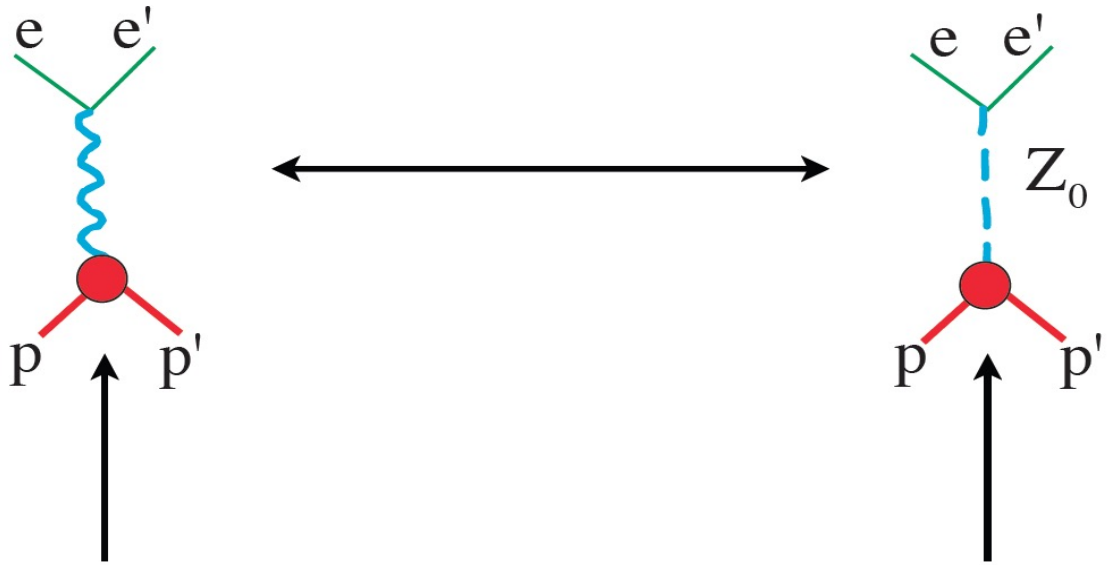
→ **Z boson exchange** in electron-proton scattering introduces **parity-violating effect**
→ Measure **parity-violating Left-Right cross section asymmetry A_{LR}**



Measurement of the Weak Charge of the Proton

Scattering of longitudinally polarized electrons on unpolarized protons

→ **Z boson exchange** in electron-proton scattering introduces **parity-violating effect**
→ Measure **parity-violating Left-Right cross section asymmetry A_{LR}**



$Q_e(p) = +e$
electric charge of the proton

$Q_W(p) = 1 - 4 \sin^2 \theta_W$
weak charge of the proton

Measurement of the Weak Charge of the Proton

Scattering of longitudinally polarized electrons on unpolarized protons

→ **Z boson exchange** in electron-proton scattering introduces **parity-violating effect**
→ Measure **parity-violating Left-Right cross section asymmetry A_{LR}**

weak charge of proton

$$A_{LR} = \frac{\sigma(e\uparrow) - \sigma(e\downarrow)}{\sigma(e\uparrow) + \sigma(e\downarrow)} = -\frac{G_F Q^2}{4\sqrt{2}\pi\alpha}\left(Q_W - F(Q^2)\right)$$

$$Q_W = 1 - 4\sin^2 Q_W(Q^2)$$

hadron structure

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Scattering of longitudinally polarized electrons on unpolarized protons

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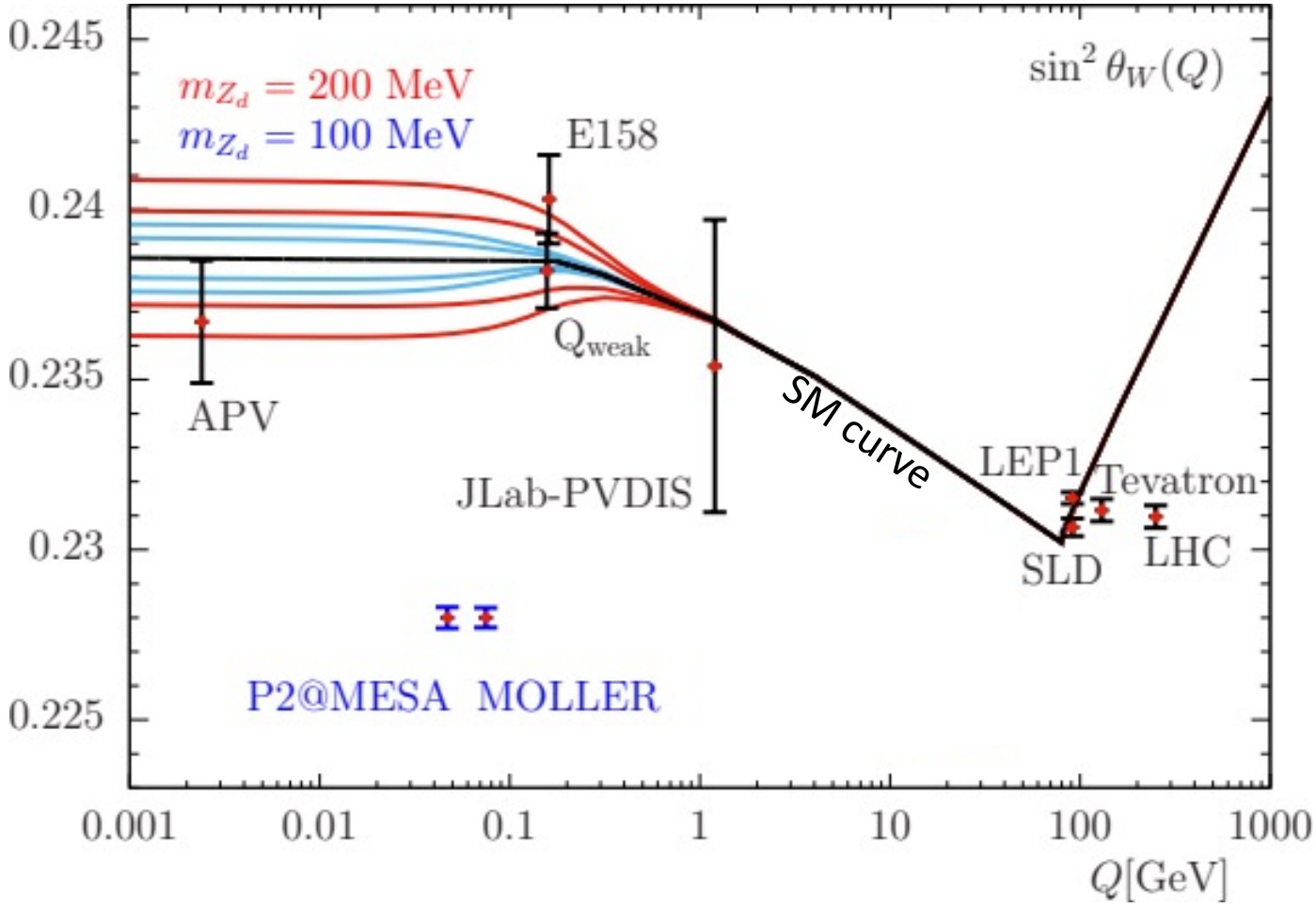
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hadron structure

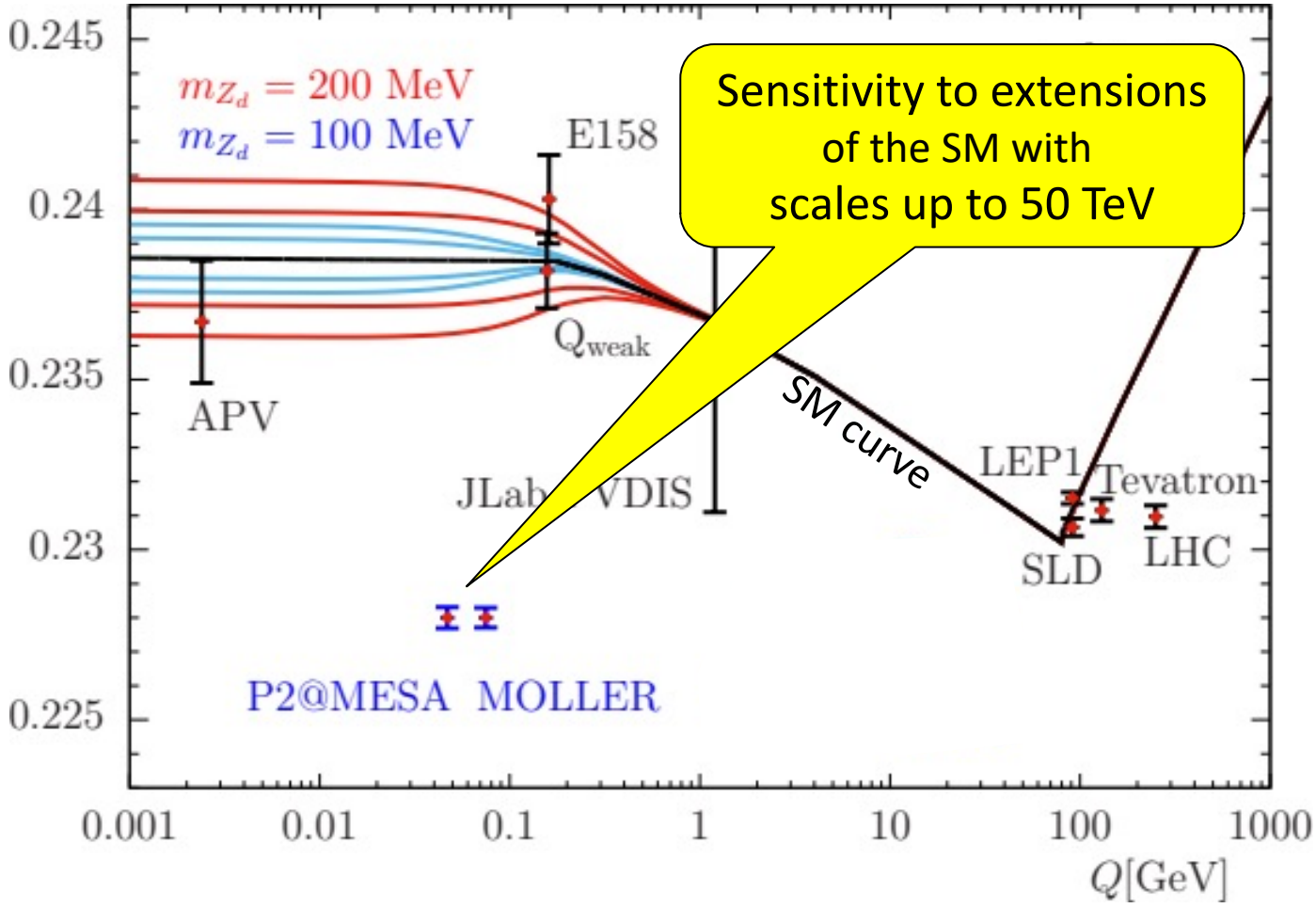
P2@MESA goal:

Measure parity-violating Left-Right asymmetry A_{LR} of 20 x 10^{-9} with 2.4% precision –> 0.16% error on $\sin^2\Theta_W$

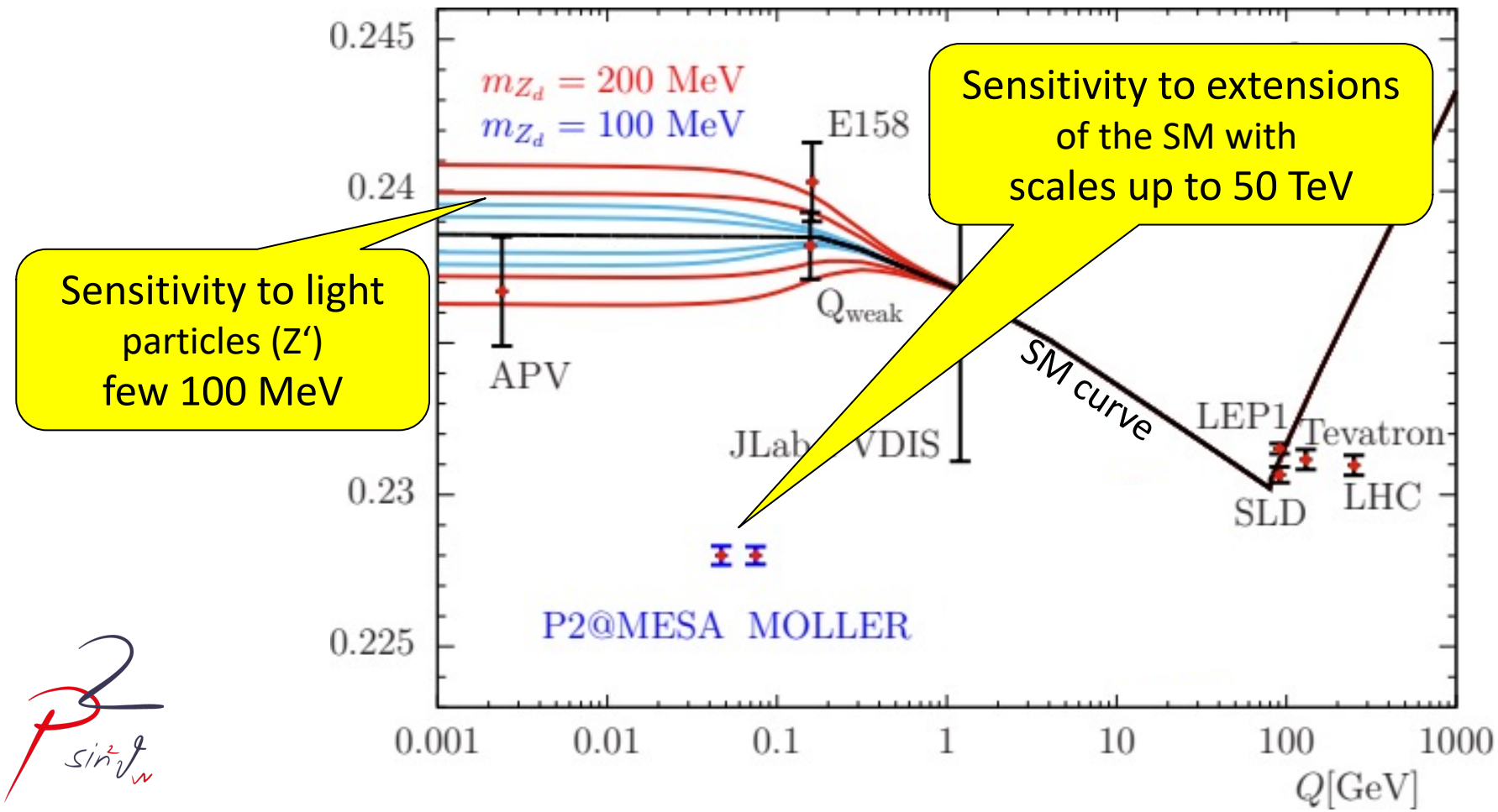
A Low-Q^2 Measurement of $\sin^2\theta_W$ at MESA



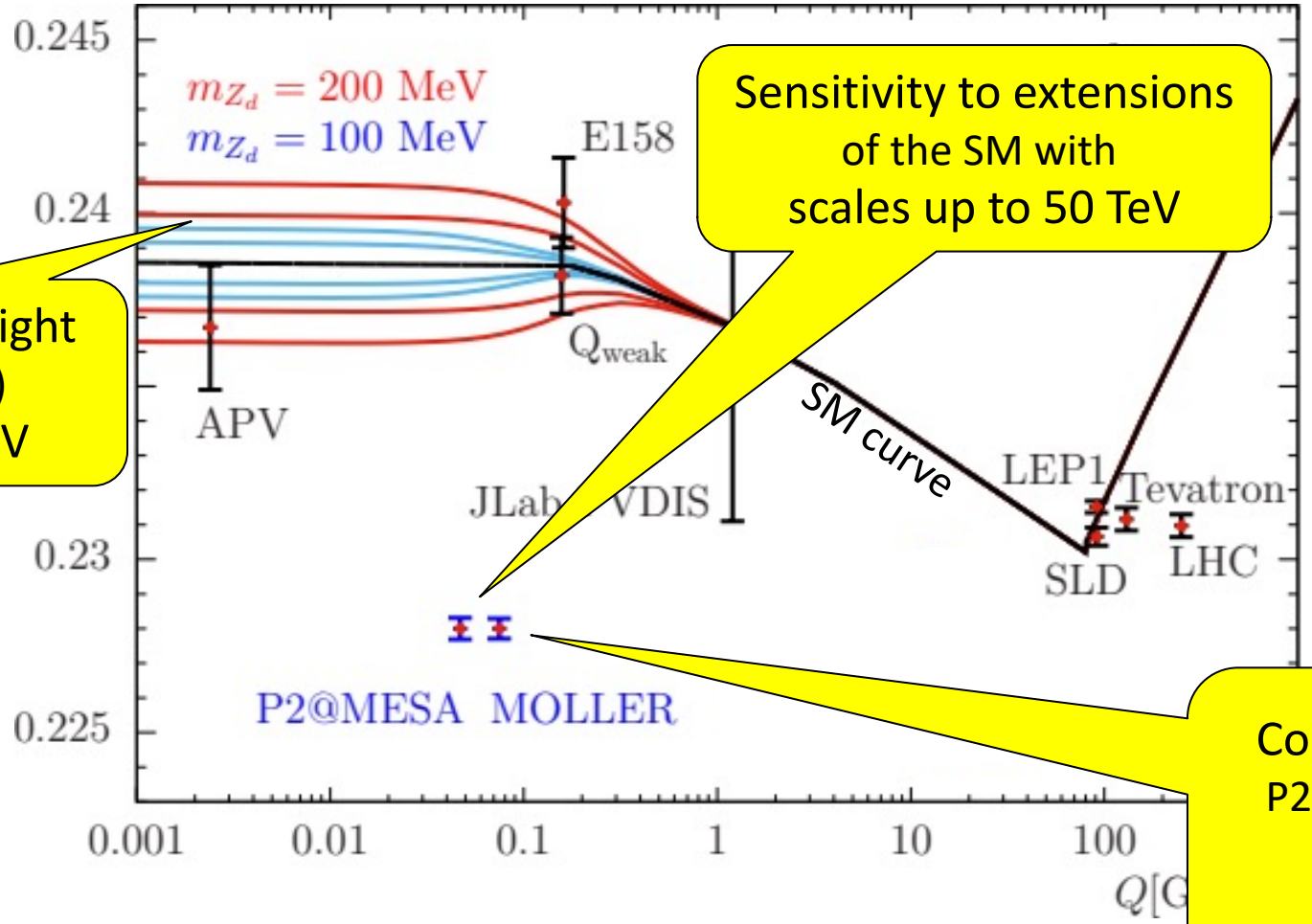
A Low-Q^2 Measurement of $\sin^2\theta_W$ at MESA



A Low-Q^2 Measurement of $\sin^2\theta_W$ at MESA



A Low-Q^2 Measurement of $\sin^2\theta_W$ at MESA



Sensitivity to light particles (Z‘) few 100 MeV

Sensitivity to extensions of the SM with scales up to 50 TeV

Complementarity between P2 (proton weak charge) and MOLLER@JLAB (electron weak charge)

Physics Program of P2 Experiment

Hydrogen

Measurement of parity-violating A_{LR} and **extraction of proton weak charge** → Improvement QWEAK x 3

$$A_{LR} = \frac{\sigma(e\uparrow) - \sigma(e\downarrow)}{\sigma(e\uparrow) + \sigma(e\downarrow)} \propto (1 - 4\sin^2\theta_W)$$

^{12}C

Measurement of parity-violating A_{LR} and **extraction of ^{12}C weak charge** → First precision measurement

$$A_{LR} \propto -24 \cdot \sin^2\theta_W$$

complementary to hydrogen measurement in BSM reach

Pb

Measurement of parity-violating A_{LR} and **extraction of weak form factor**

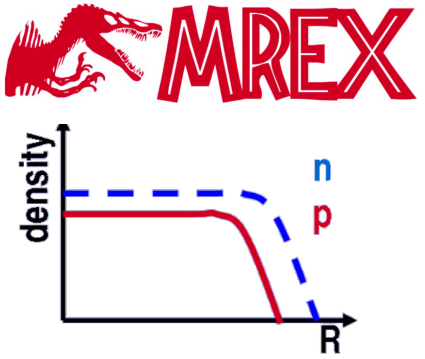
- sensitive to neutron skin thickness
- related to the Equation of State (EOS)
- relation to neutron star density

→ Improvement upon PREX x 2

$$A_{LR} \propto \frac{F_{\text{weak}}(Q^2)}{F_{\text{charge}}(Q^2)}$$

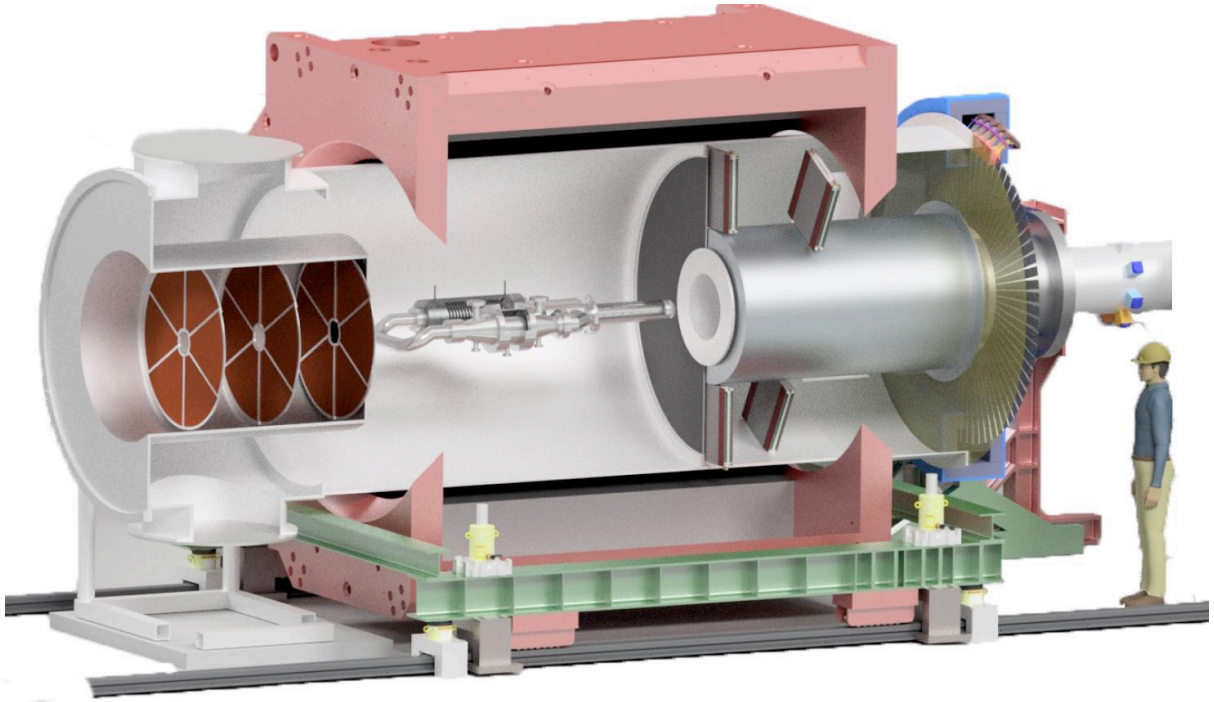
dominated by neutrons

dominated by protons



P2 Experiment

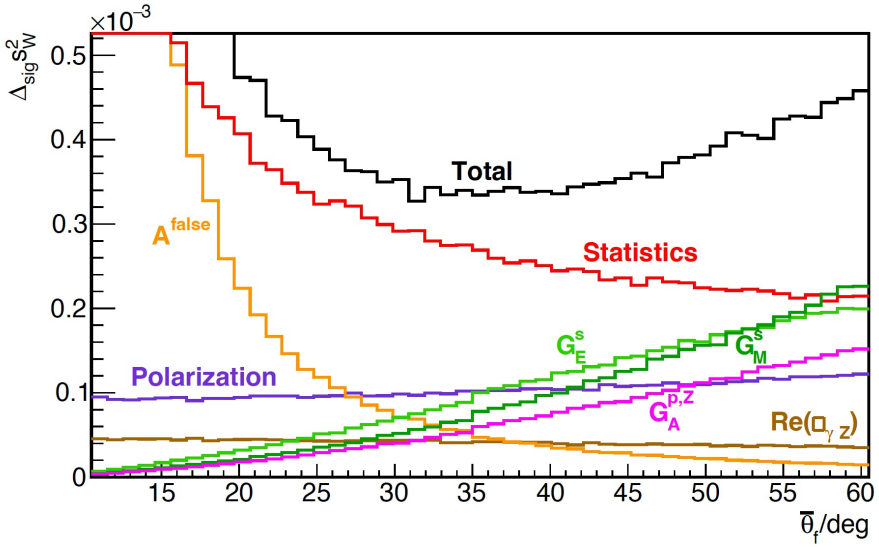
arXiv: 1802.04759



E_{beam}	155 MeV
$\overline{\theta_f}$	35°
$\delta\theta_f$	20°
s_W^2	0.23116
$\Delta_{exp} s_W^2$	$3.7 \cdot 10^{-4}$ (0.16%)
$\Delta_{exp,stat} s_W^2$	$3.1 \cdot 10^{-4}$ (0.13%)
$\Delta_{exp,P} s_W^2$	$0.7 \cdot 10^{-4}$ (0.03%)
$\Delta_{exp,false} s_W^2$	$0.6 \cdot 10^{-4}$ (0.03%)
$\Delta_{exp,t.w.} s_W^2$	$1.2 \cdot 10^{-4}$ (0.05%)
$\Delta_{exp,t.p.} s_W^2$	$0.1 \cdot 10^{-4}$ (0.00%)
$\Delta_{exp,\Box_{\gamma Z}} s_W^2$	$0.4 \cdot 10^{-4}$ (0.02%)
$\Delta_{exp,nucl.FF} s_W^2$	$1.2 \cdot 10^{-4}$ (0.05%)

P2 – Solenoid spectrometer → $3 \cdot 10^{22}$ EOT (!)

- Superconducting solenoid
- Integrating Cherenkov detector ring
- Tracking detectors (HV-MAPS & MicroMegas)
- Chain of polarimeters (90% polarization)
- LH_2 target (60cm)



P2 – Status & Impressions

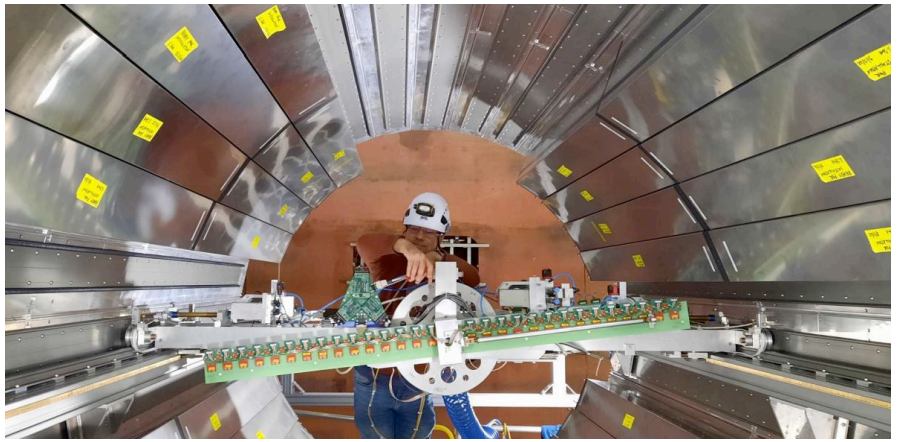


- Solenoid delivery
- Vacuum chamber delivery
- 90 m³ hydrogen tank delivery
- Field mapping in Nov 2026

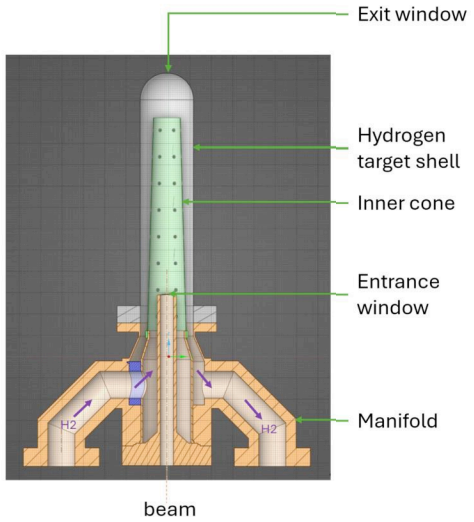


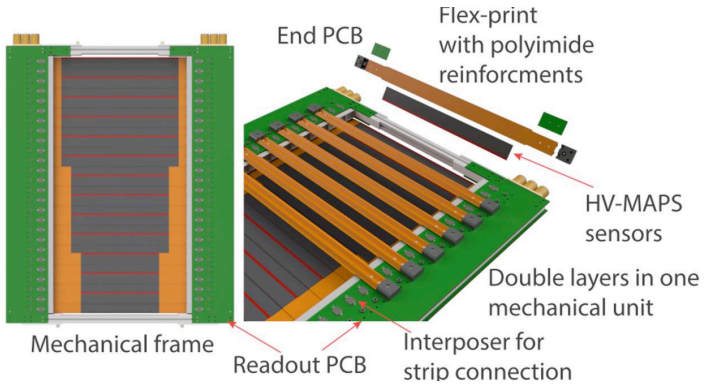
- Superconducting Magnet (NbTi)
- Maximum field of 0.7 T
- Outer Diameter 3.3 m
- Length 4 m

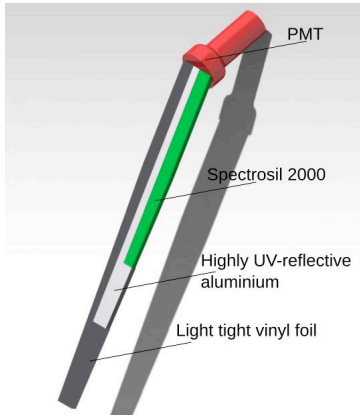




P2 – Status & Impressions

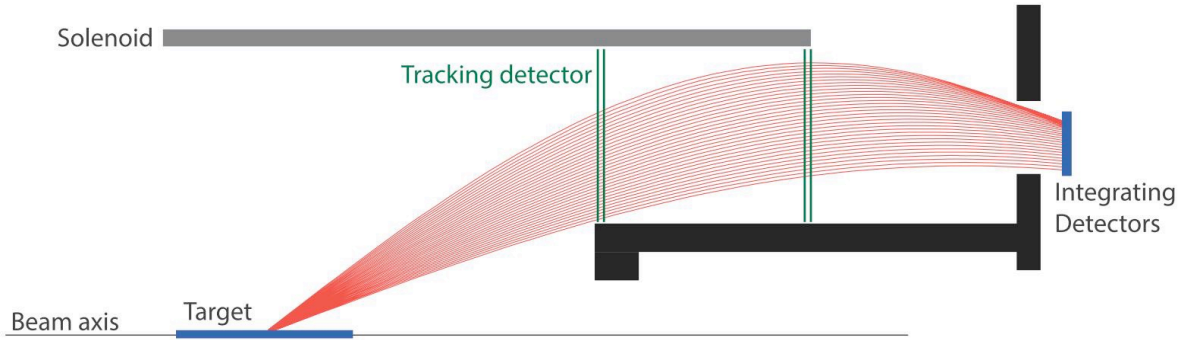


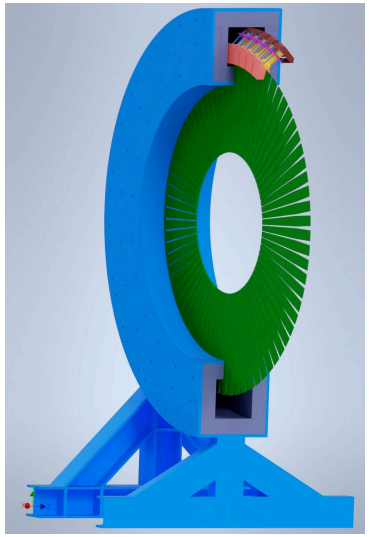






- Target installation in July 2027
- Manufacturing and assembly ongoing
- Integrating detectors ready in early 2027



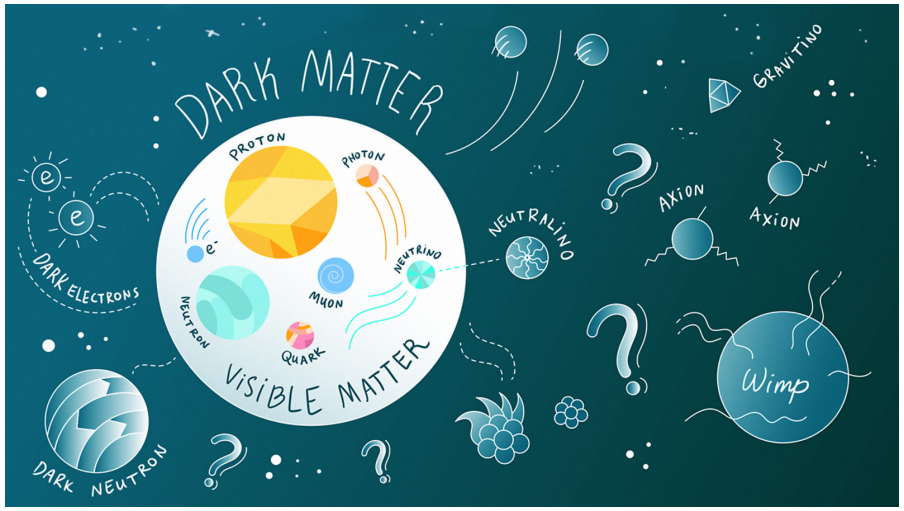


Detector shielding and holding structure



DarkMESA Experiment

Parasitically running to P2
MESA Extracted Beam Mode

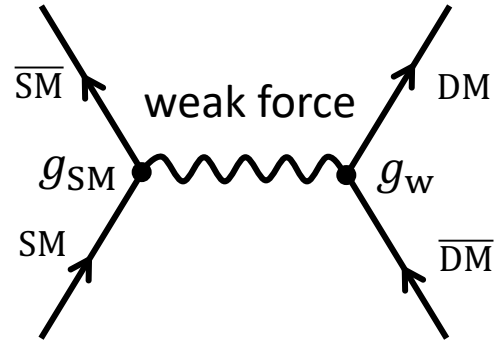


DARK MESA

Light Dark Matter (LDM)

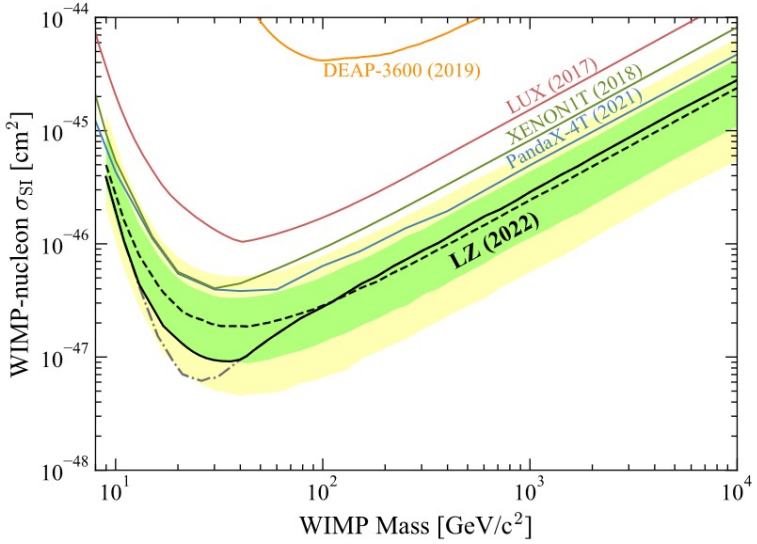
WIMPs

GeV < m_{DM} < ~ TeV



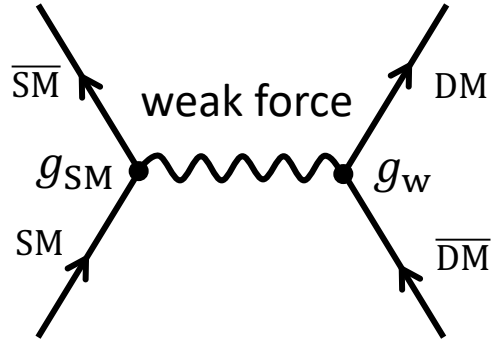
- Matching relic abundance for the electroweak mass scale
- WIMPs require only SM interaction
- No positive evidence after LHC and galactic DM searches

Light Dark Matter (LDM)



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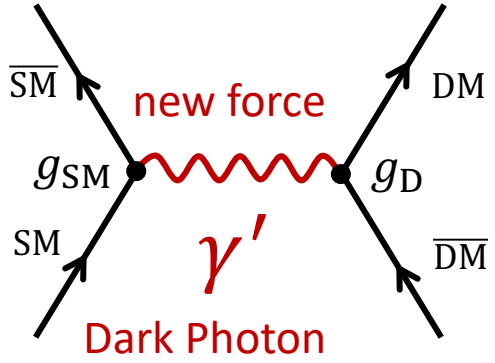


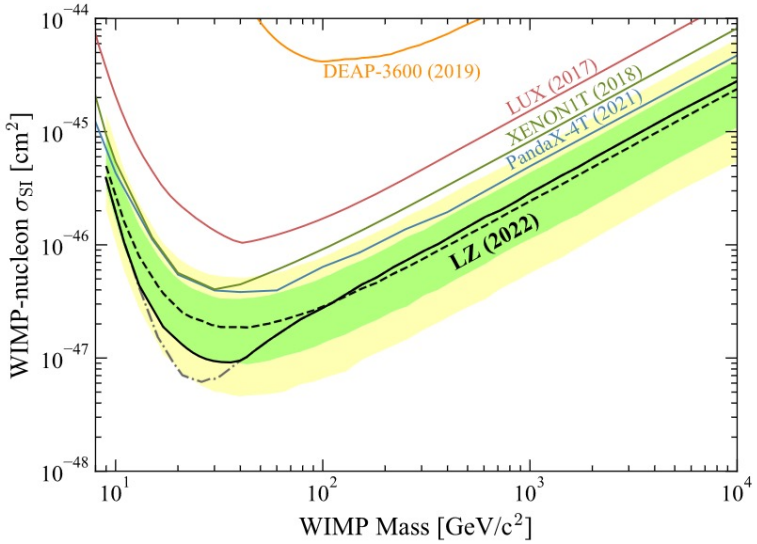
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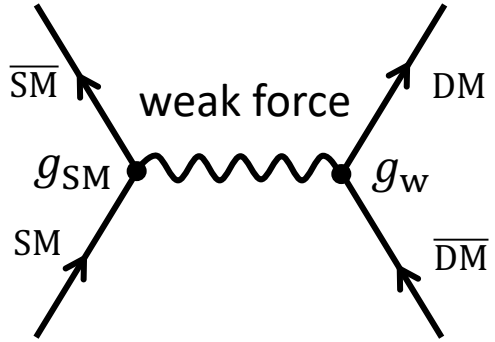




- Thermal relic targets exist for the MeV-GeV mass scale
- LDM requires a beyond SM force
- Rich phenomenology of portals: vector, higgs, neutrino, axion

WIMPs

GeV < m_{DM} < ~ TeV



- Matching relic abundance for the electroweak mass scale
- WIMPs require only SM interaction
- No positive evidence after LHC and galactic DM searches

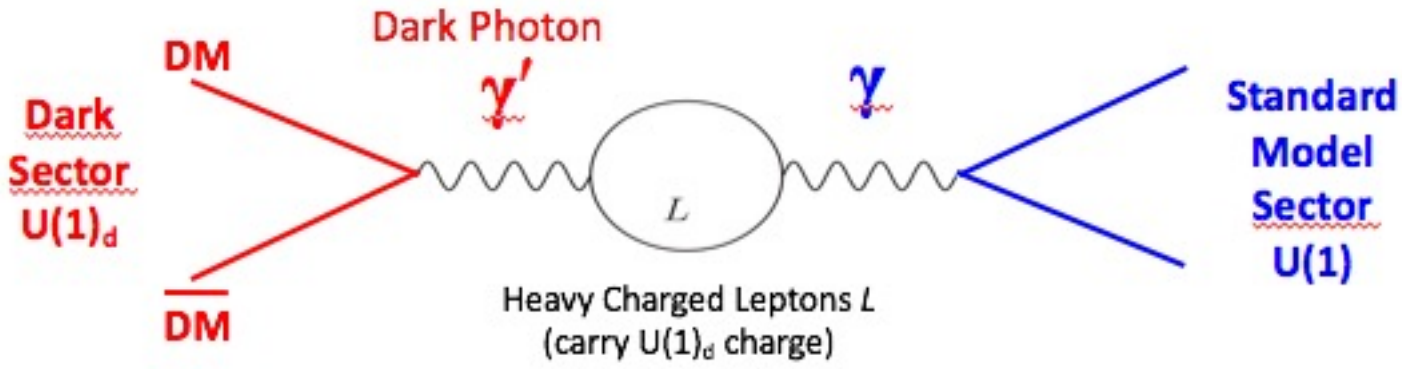
Vector Mediator: Dark Photon

Model 1: $m_{\gamma'} \ll 2m_{DM}$

Dark Photon decaying into SM particles – coupling ϵ
→ MAGIX visible decay

$$\frac{1}{2}\epsilon_Y F^Y_{\mu\nu} F'^{\mu\nu}$$

Holdom [1986]



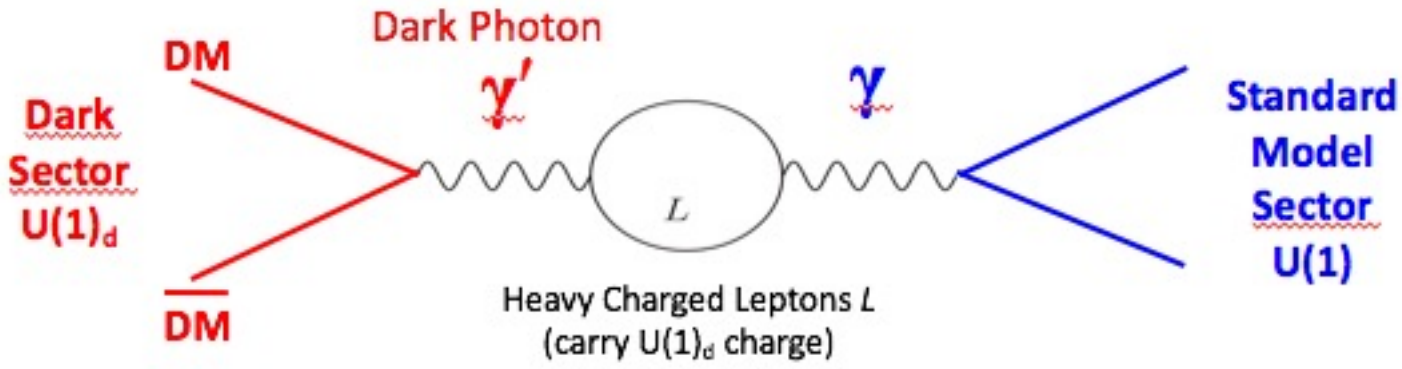
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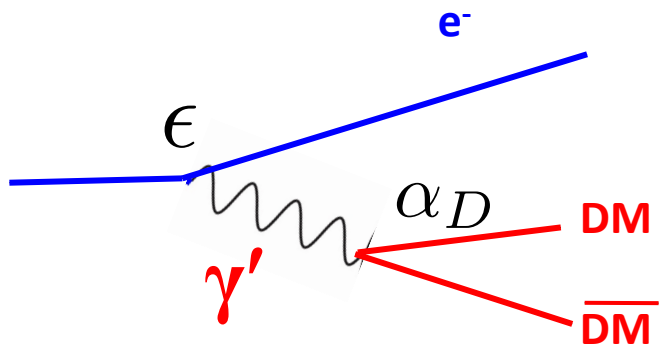
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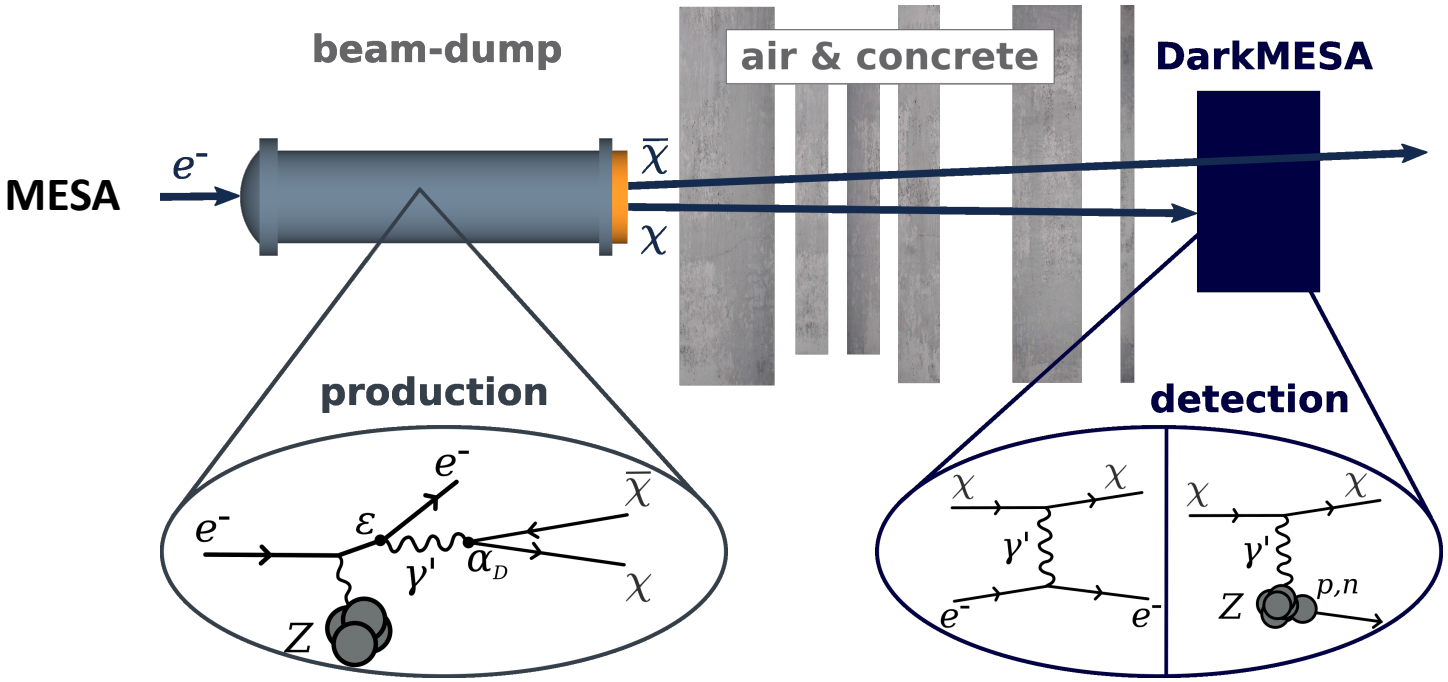
Model 2: $m_{\gamma'} > 2m_{DM}$

Dark Photon decaying into Dark Matter
→ MAGIX invisible decay and DarkMESA



Beam Dump Experiment DarkMESA

Model 2: $m_{\gamma'} > 2m_{DM}$

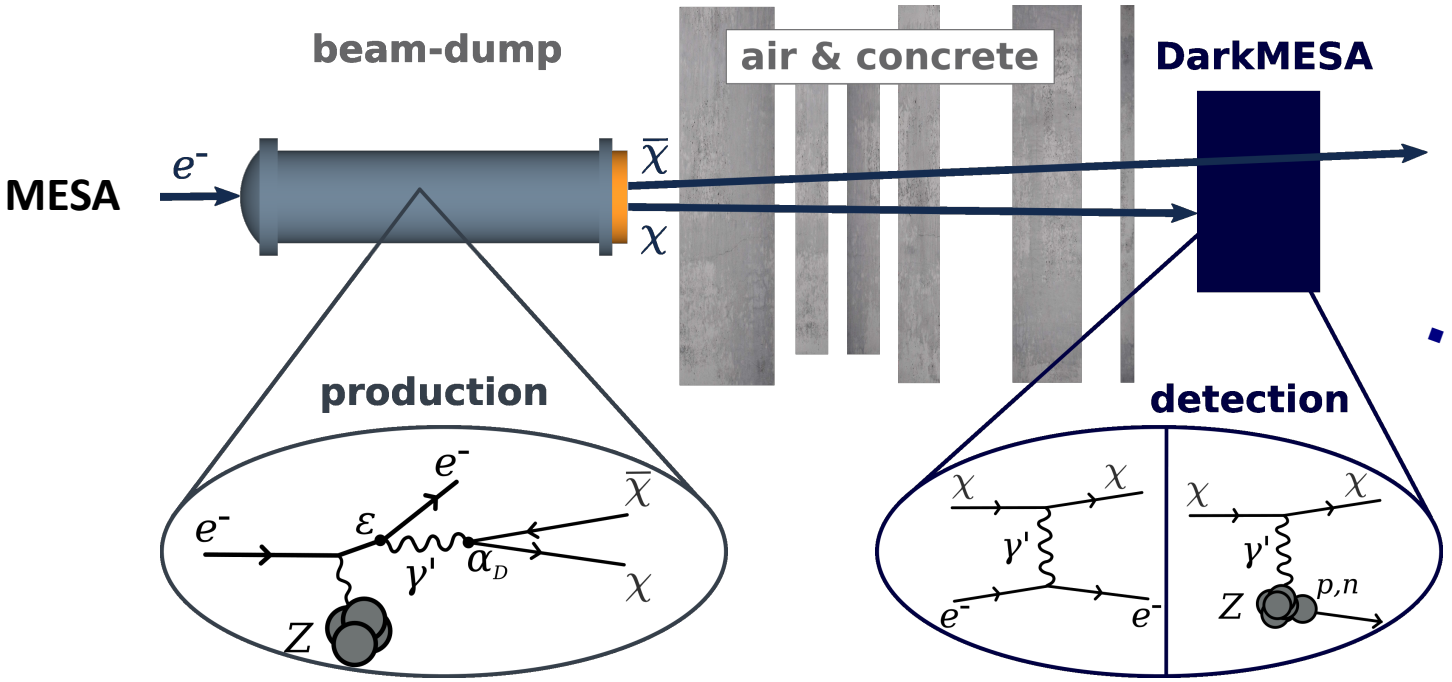


Electron Scattering of 3×10^{22} EOT (MESA) on Beam Dump

→ Collimated pair of Dark Matter particles !

Beam Dump Experiment DarkMESA

Model 2: $m_{\gamma'} > 2m_{DM}$



Background
- Detector shielded from beam-related SM
- MESA below π production threshold,
  → no neutrinos from π decay
- Cosmogenic background (μ, γ, p, n, e, ν, ...)
  → Active veto detector needed

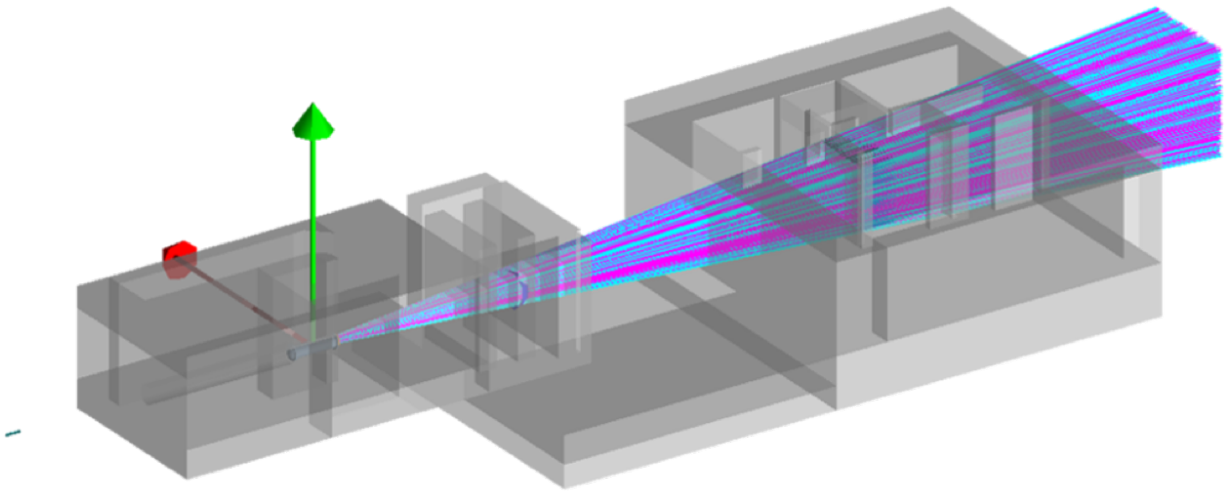
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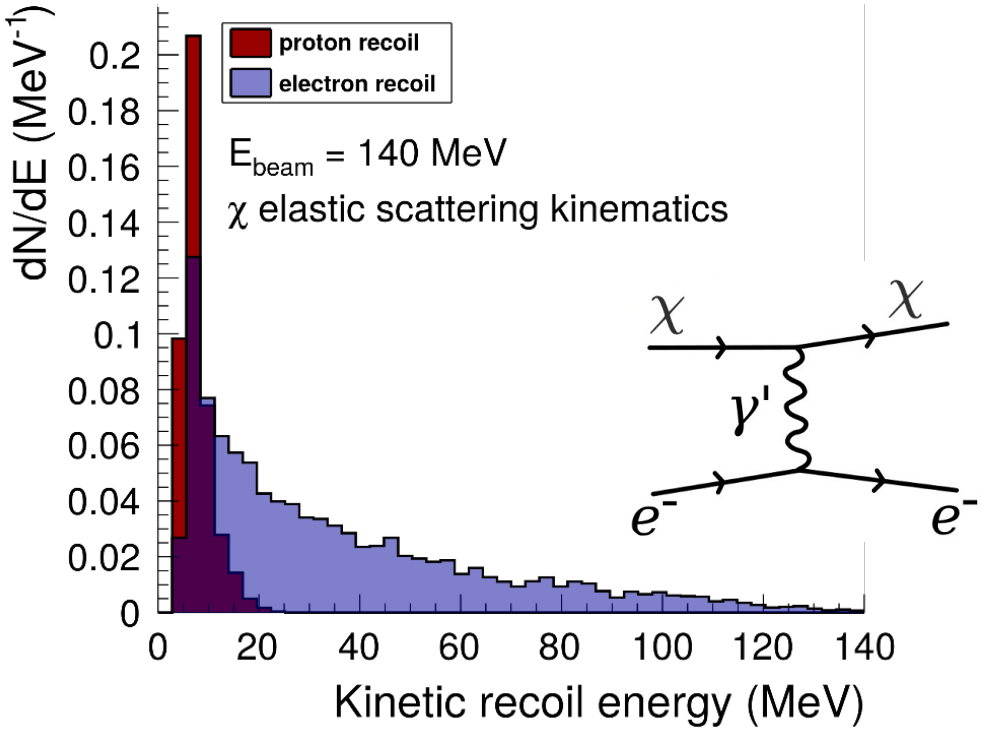
Beam Dump Experiment DarkMESA

Full GEANT4 simulation:
P2 target, beam dump, DarkMESA detector volume, walls etc.

Possibility to place a
second detector off-axis



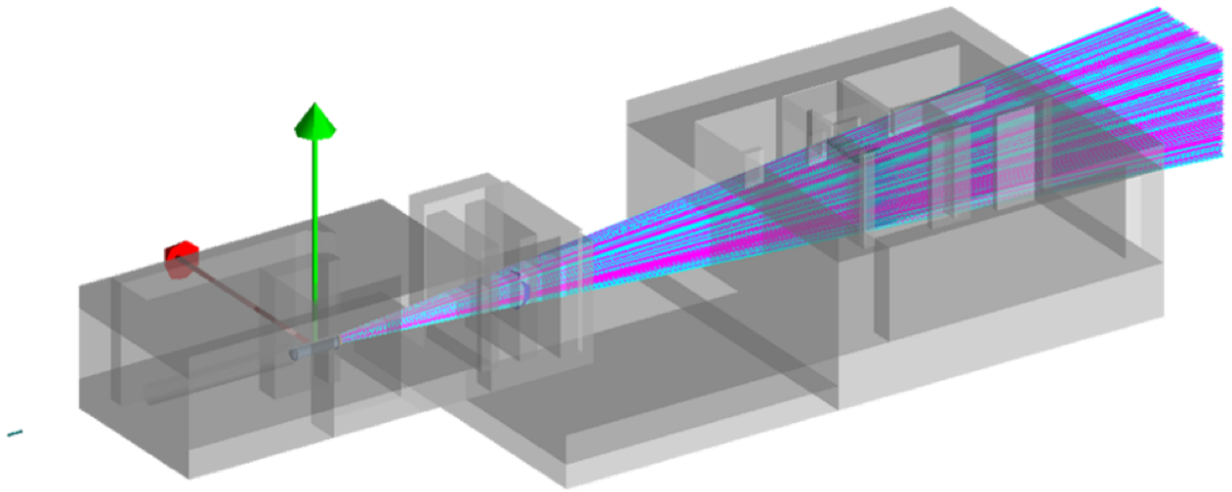
→ **LDM interaction with DarkMESA material (electron recoil)**



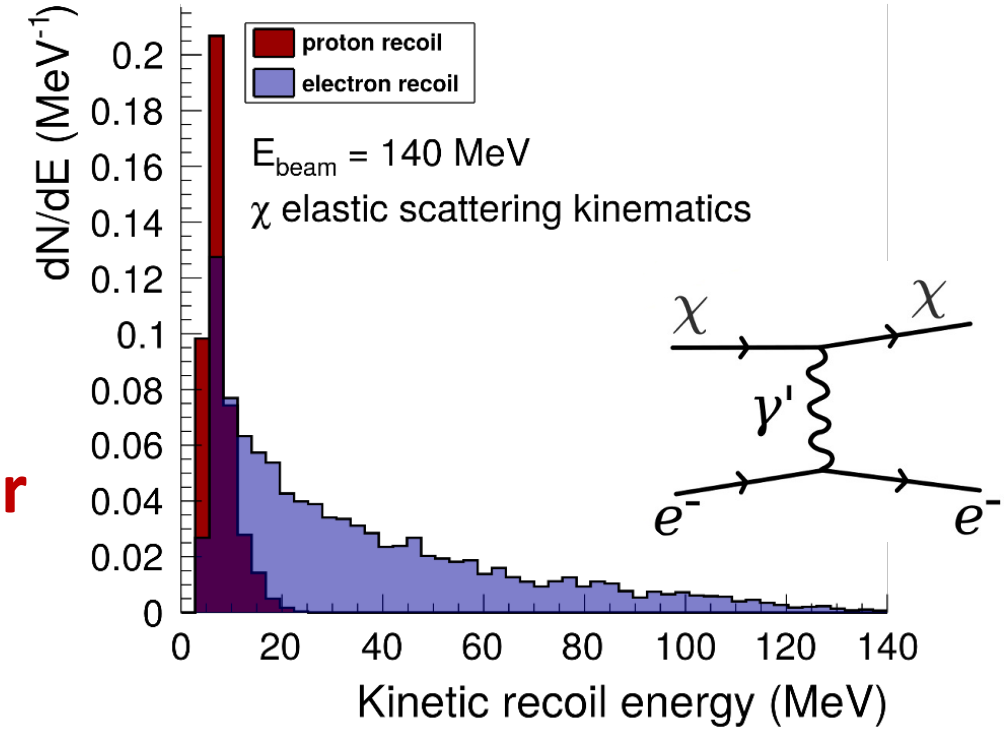
Beam Dump Experiment DarkMESA

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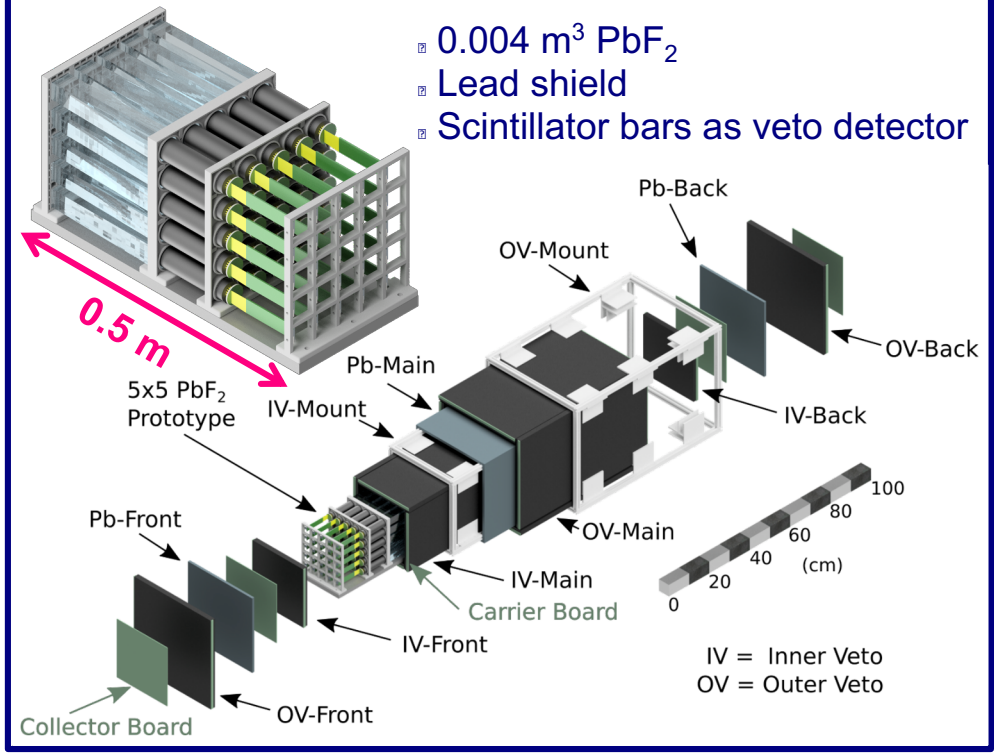
Baseline Concept: Inorganic crystal calorimeter

- Cherenkov (fast, no neutrons)
- Scintillator (higher light yield)

Detector Concept for DarkMESA

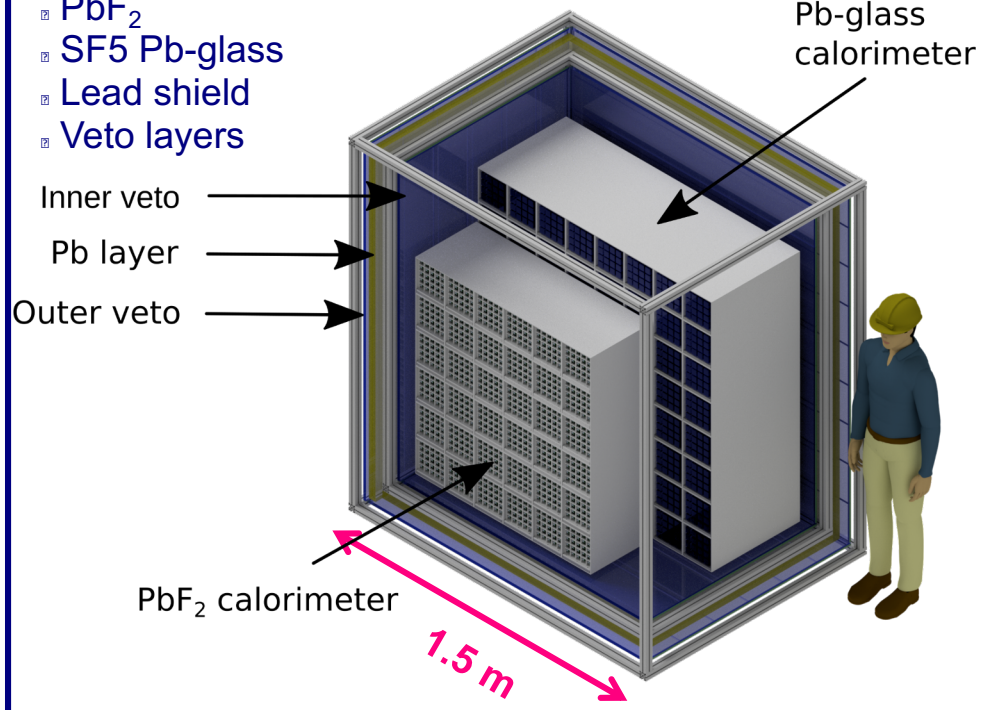
Phase A (prototype)

- 0.004 m^3 PbF_2
- Lead shield
- Scintillator bars as veto detector



Phase B (increase volume / yield)

- PbF_2
- SF5 Pb-glass
- Lead shield
- Veto layers



Phase C (range extension – various options)

Larger Calorimeter (e.g. based on $PbWO_4$ crystals)

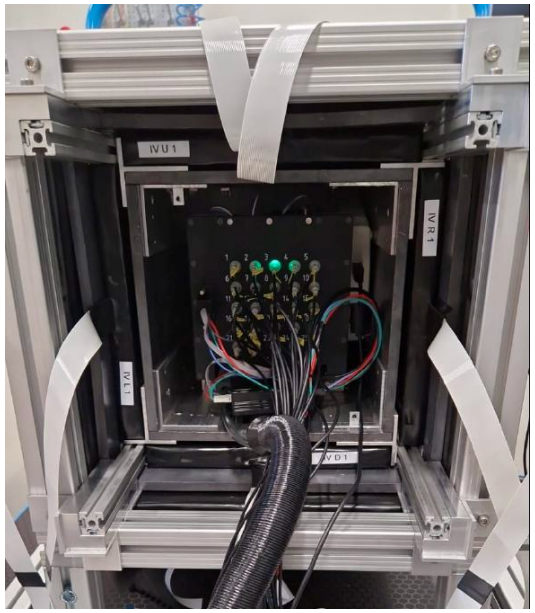
Opaque scintillator technology

DarkMESA Phase A Detectors (PbF_2 and $PbWO_4$)



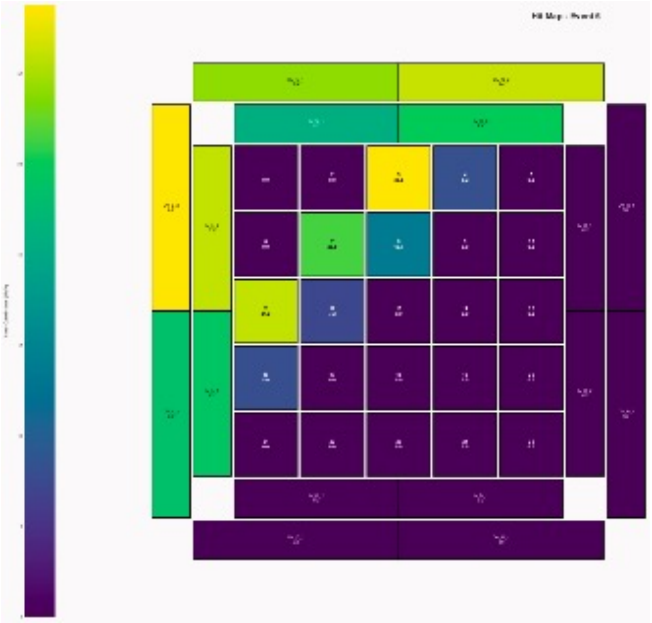
PbF_2 Phase A Detector
Cerenkov calorimeter

☺ **Fast signal**
☹ **Limited light yield**



$PbWO_4$ Phase A Detector
Scintillating crystal calorimeter
(on loan from Crytur company)
☺ **Significant light yield**
☹ **Slow signal**

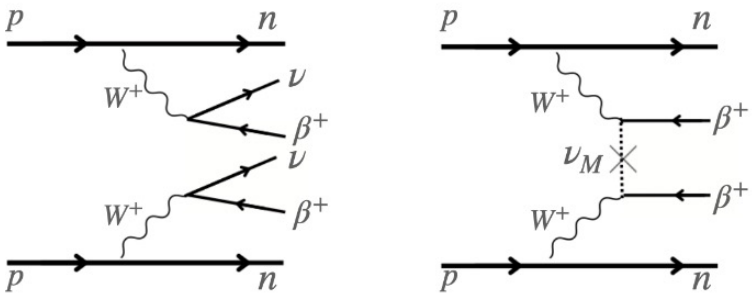
Cosmic ray test of full setup

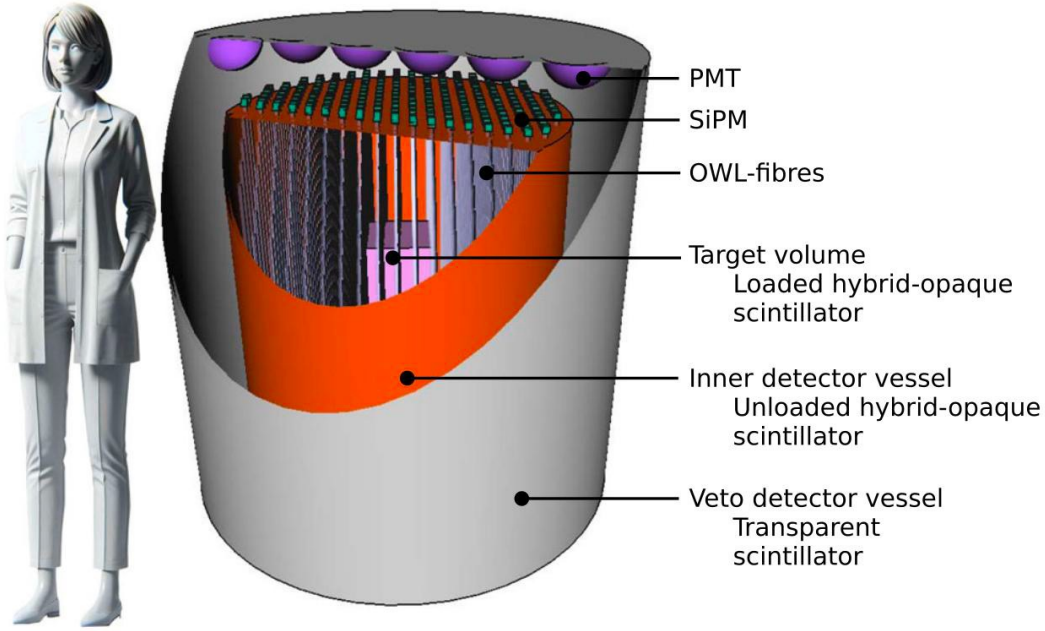


Cosmic veto detector
(scintillator bars and Pb shielding)

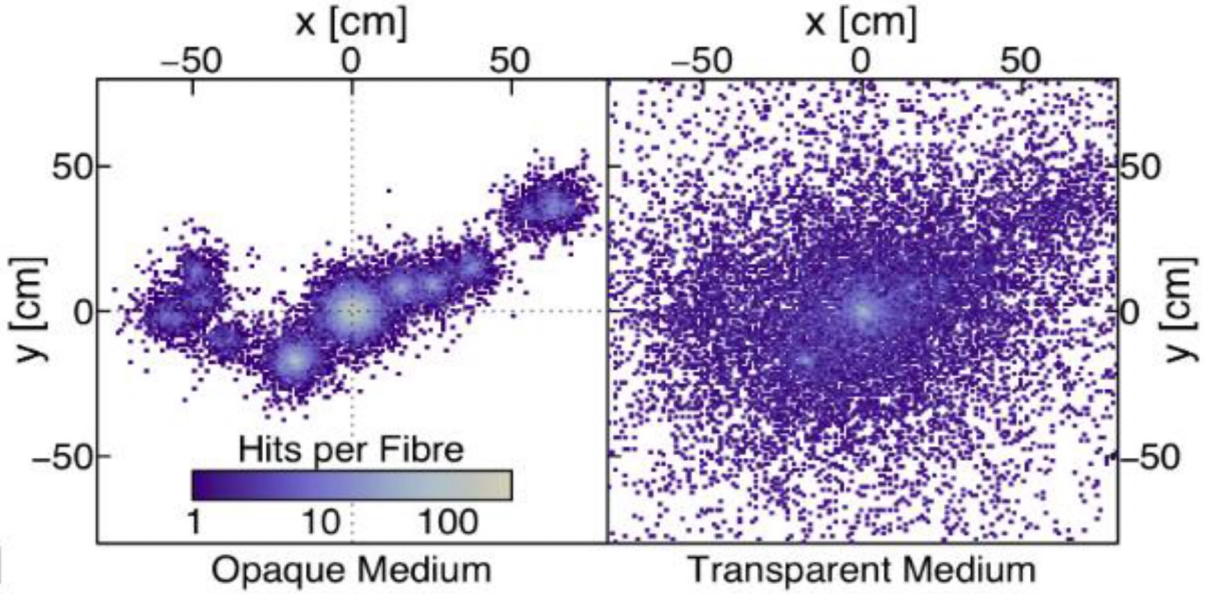
Opaque Scintillators – Synergy with NuDoubt++

NuDoubt++ - an experiment to look for (neutrino-less) double beta+ decays





Technology choice: opaque liquid scintillator; readout via grid of scintillating fibres

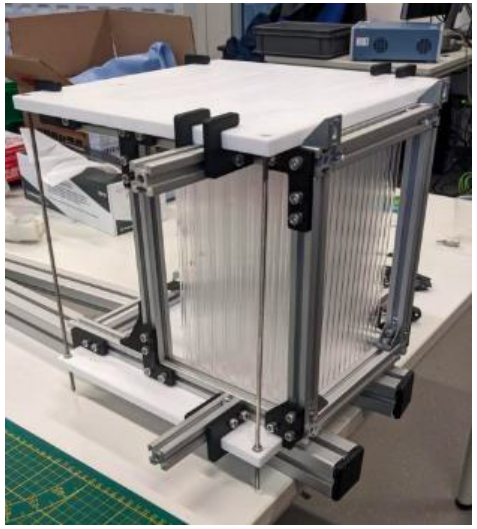


Opaque medium
(1 … 20% wax):
Signal confined, PID

Transparent medium:
signal washed out

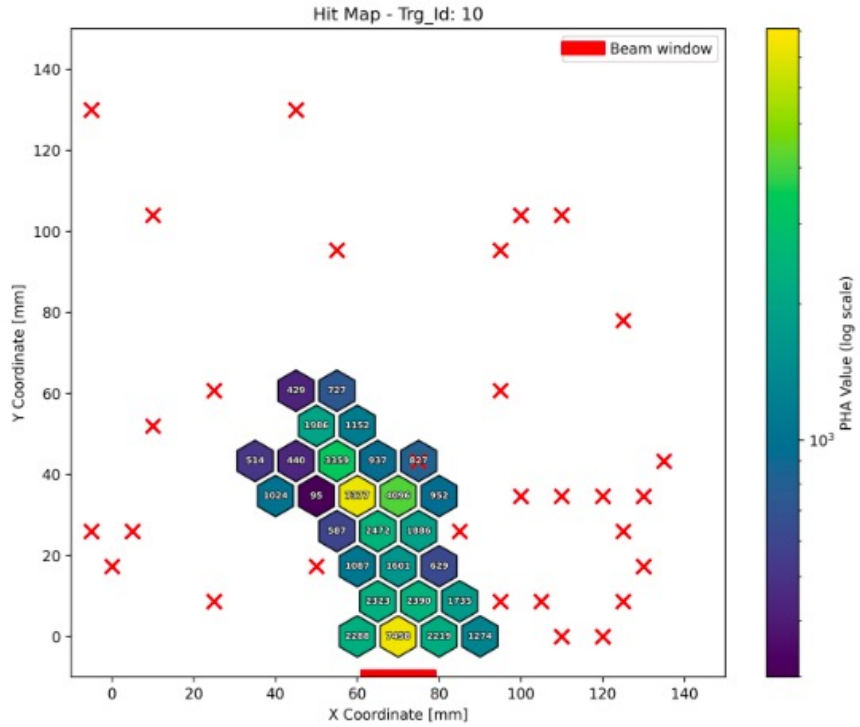
Opaque Scintillators – Synergy with NuDoubt++

Prototype test at MAMI (Nov. 2025)
with 7 – 14 MeV electrons







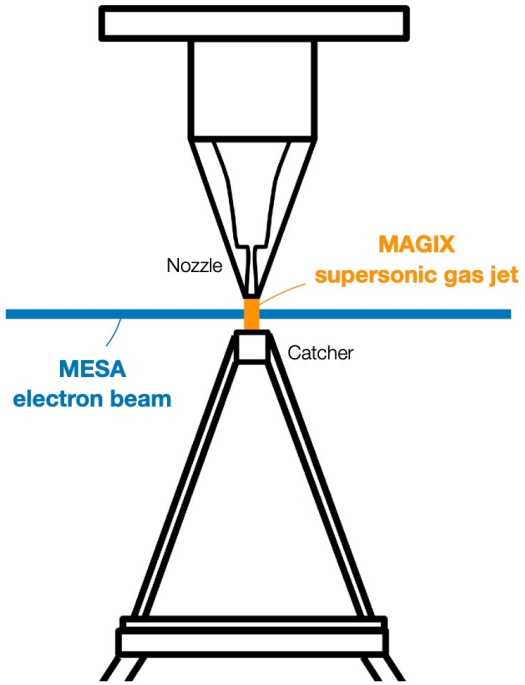


MAMI electrons

Successfully tested electron tracking in opaque liquid scintillator
Option to use Gd-loaded scintillator for veto detector

MAGIX Experiment

Energy-Recovering Mode (ERL) of MESA



Windowless gas jet target
and minimal material budget

+

High-intensity electron beam
in the low-energy regime

↓

Clean experimental environment
with drastically reduced particle interactions prior to detection

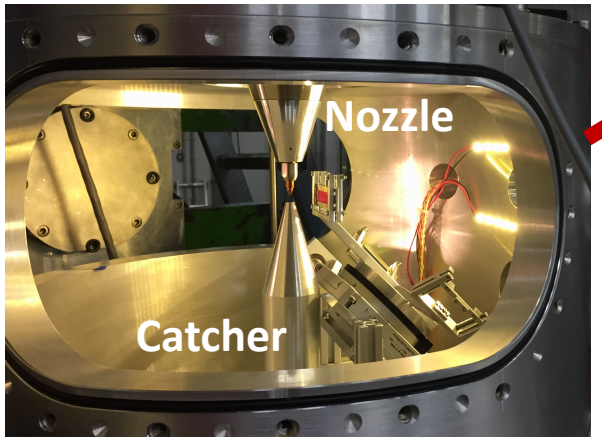
+

Competitive luminosities
in the order of 10^{35} $cm^{-2}s^{-1}$

Operation of a high-intensity (polarized) ERL beam in conjunction with light internal target
→ **a novel technique in nuclear and particle physics**

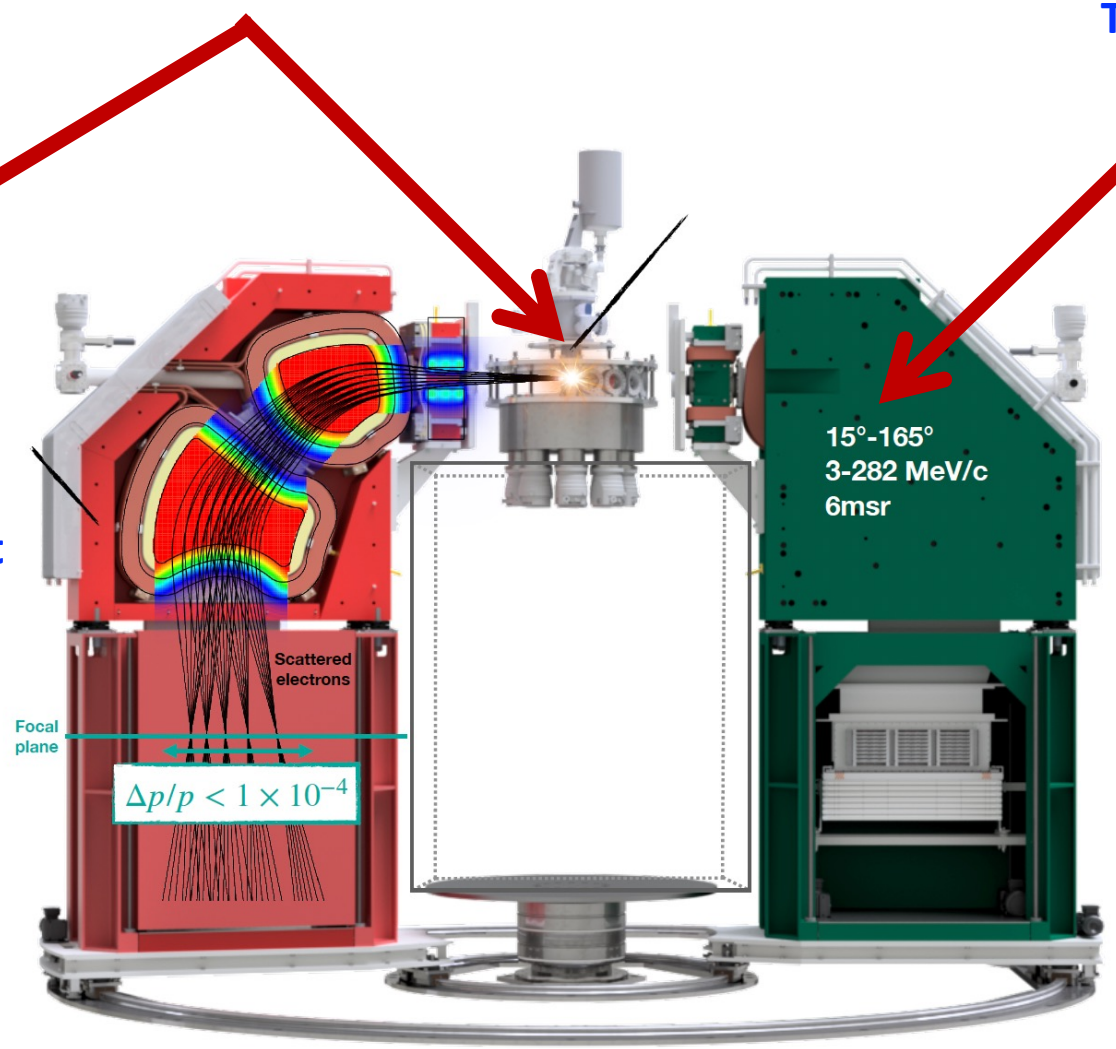
High-Resolution MAGIX Spectrometers

NIM A1013 (2021)



Supersonic crygenic gas jet target

- Windowless environment
- Commissioned at A1/MAMI
- Design density $10^{19}/cm^2$

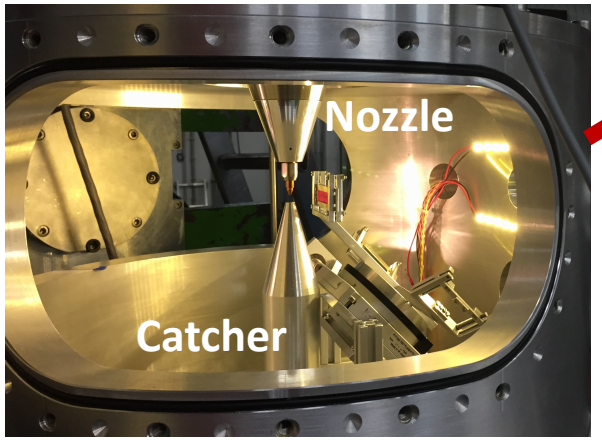


Two identical spectrometers

- Two dipoles each
- One quadrupole each

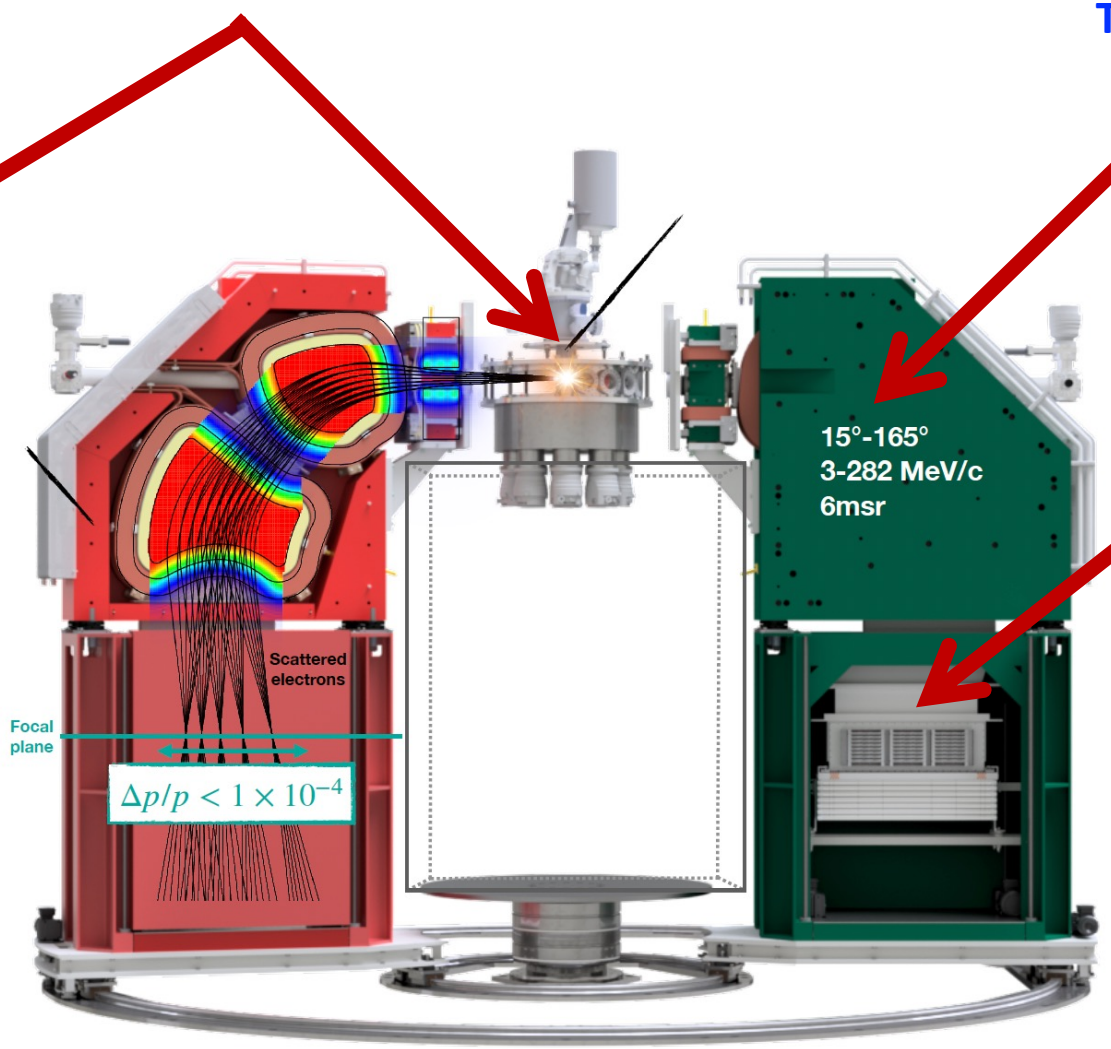
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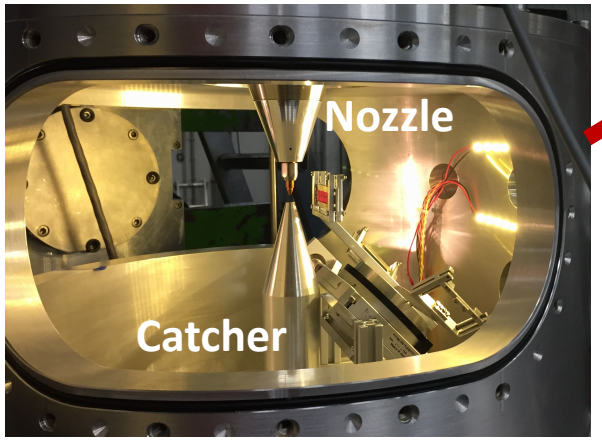
- Two dipoles each
- One quadrupole each

TPC-based focal plane detector

- 10^{-4} momentum resolution
- Requires spatial resolution of O(100 µm)
- Open field cage
- GEM readout

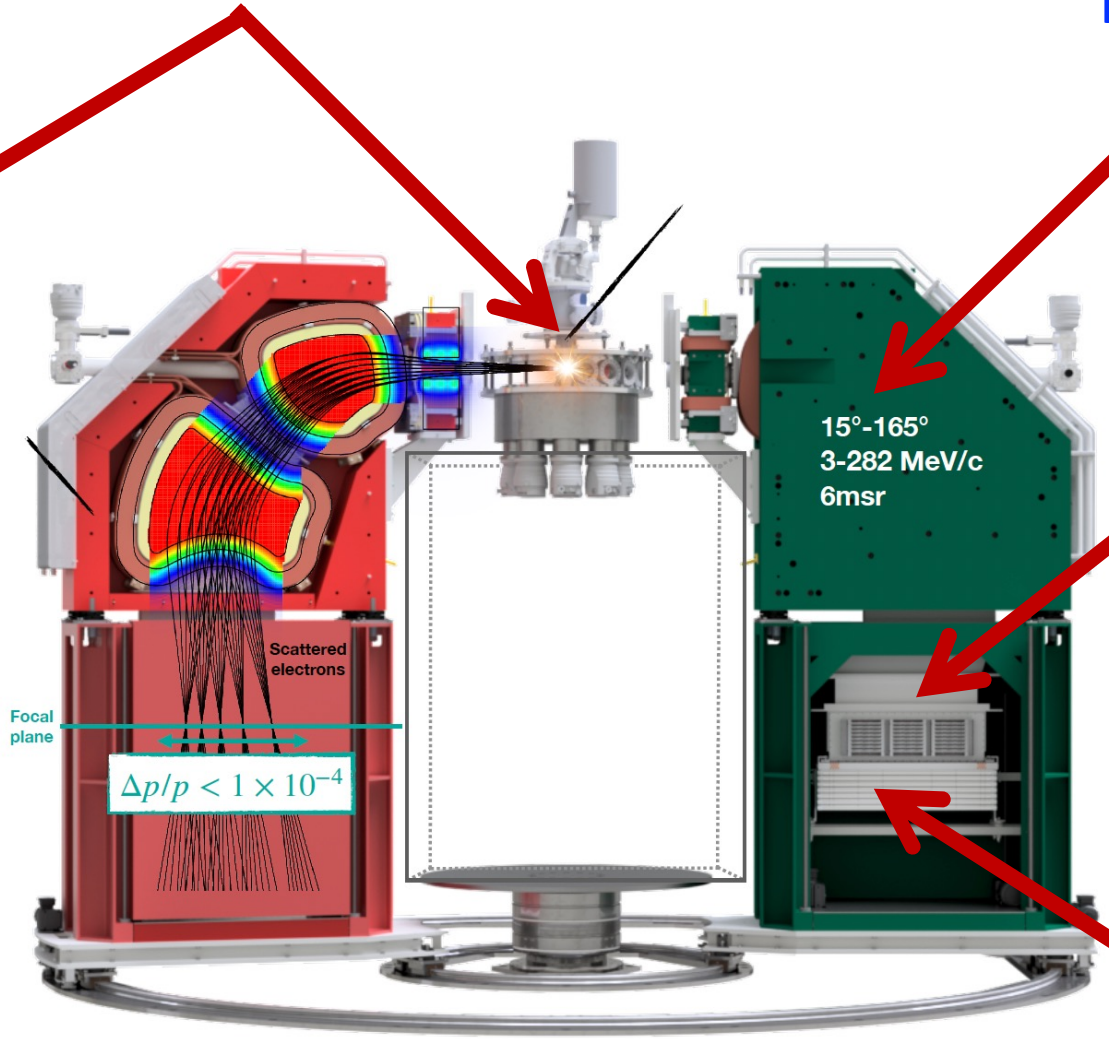
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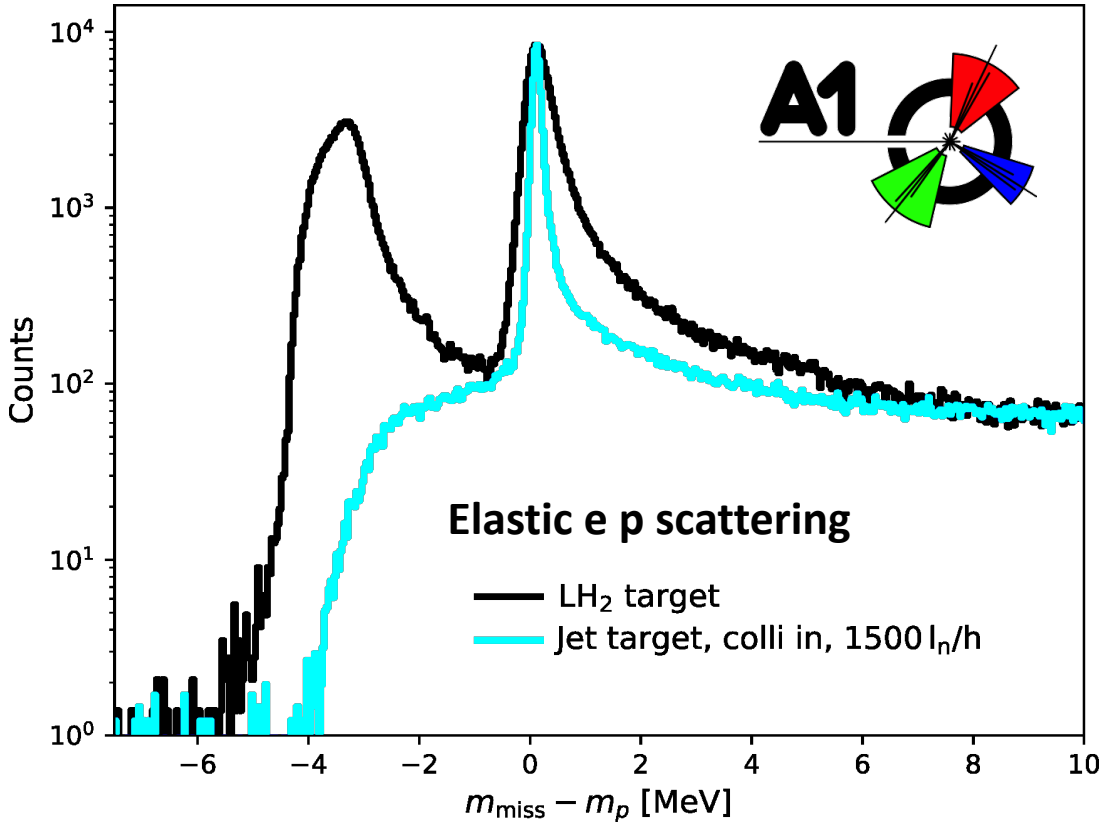
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TPC-based focal plane detector

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- Open field cage
- GEM readout

Trigger – Veto System

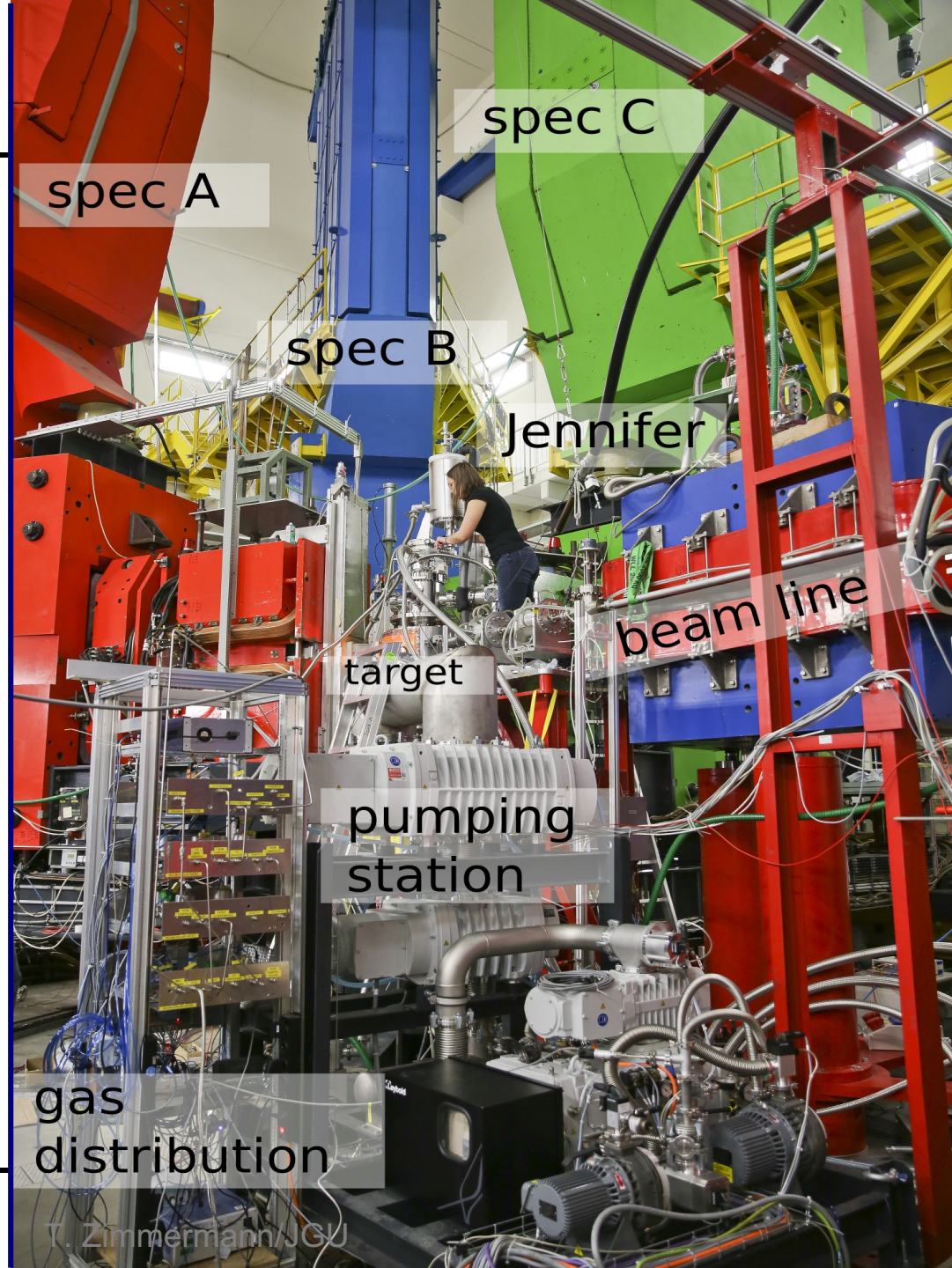
MAGIX Gas Jet Target



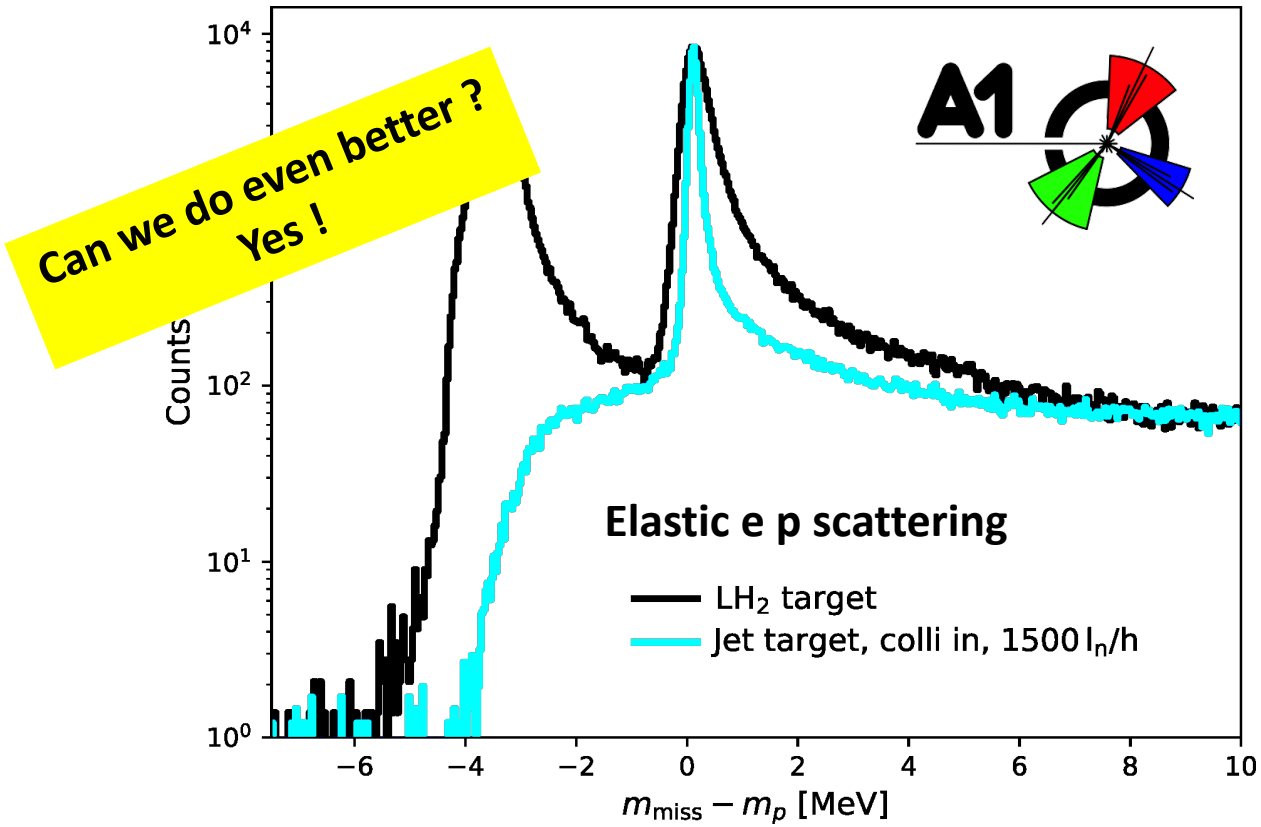
Gas Jet Target commissioned at A1/MAMI

→ Windowless design

→ Much less background from scattering (target walls!) compared to liquid hydrogen LH_2 target



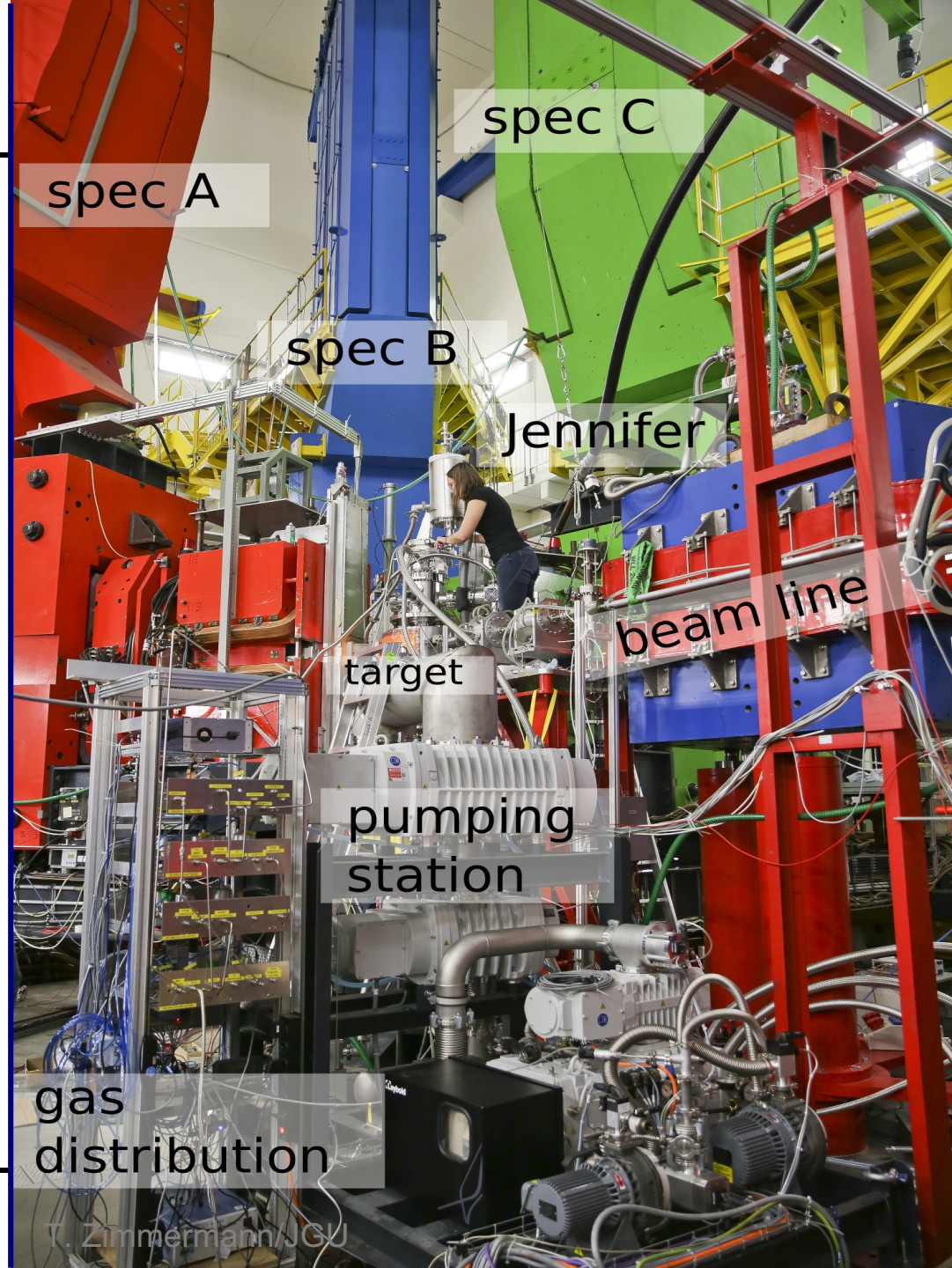
MAGIX Gas Jet Target



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MAGIX – Filament Target

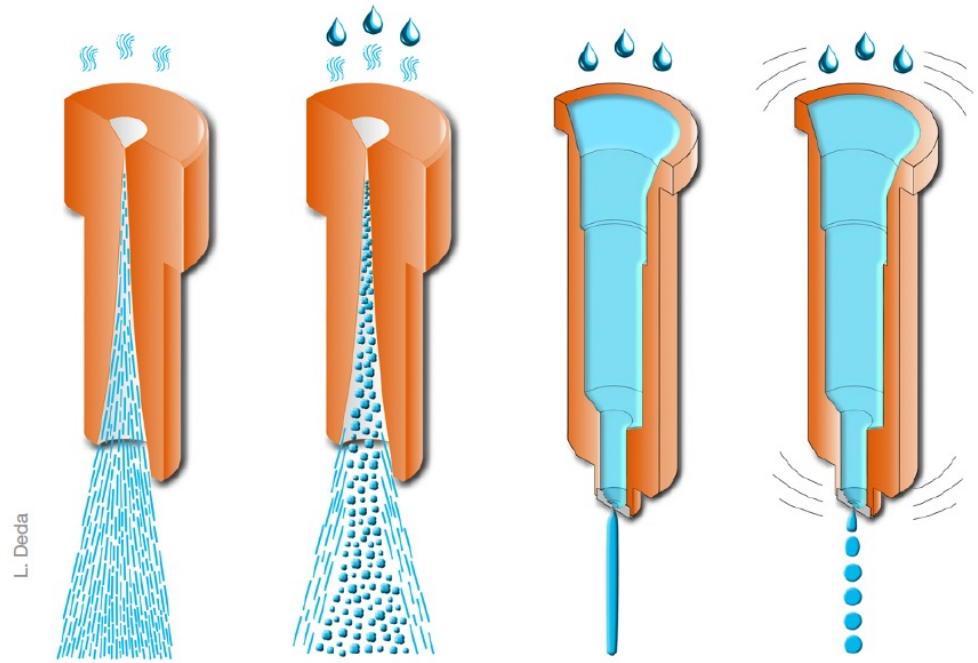
- New Münster approach:

  „Filament target“ → liquid phase

- Minor changes:
  - Cartridge for gas purification
  - Aperture nozzle
  - Additional particle filter

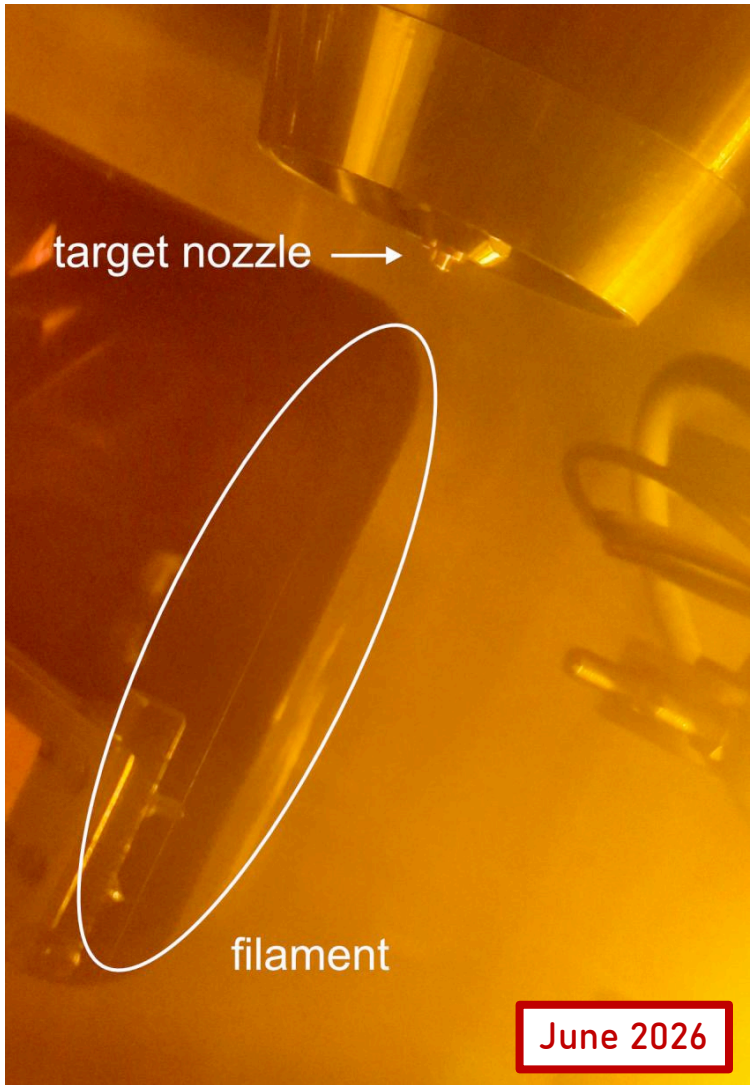


Target	MAGIX gas jet	Filament
Flow rate	40 l/min	160 ml/min
Vacuum	10^{-1} mbar	10^{-4} mbar
Thickness	10^{18} atoms/cm²	$4.5 \cdot 10^{19}$ atoms/cm²
Nozzle	de Laval 200 µm	Aperture 10 µm



Gas jet | **Cluster jet** | **Filament mode** | **Droplet mode**

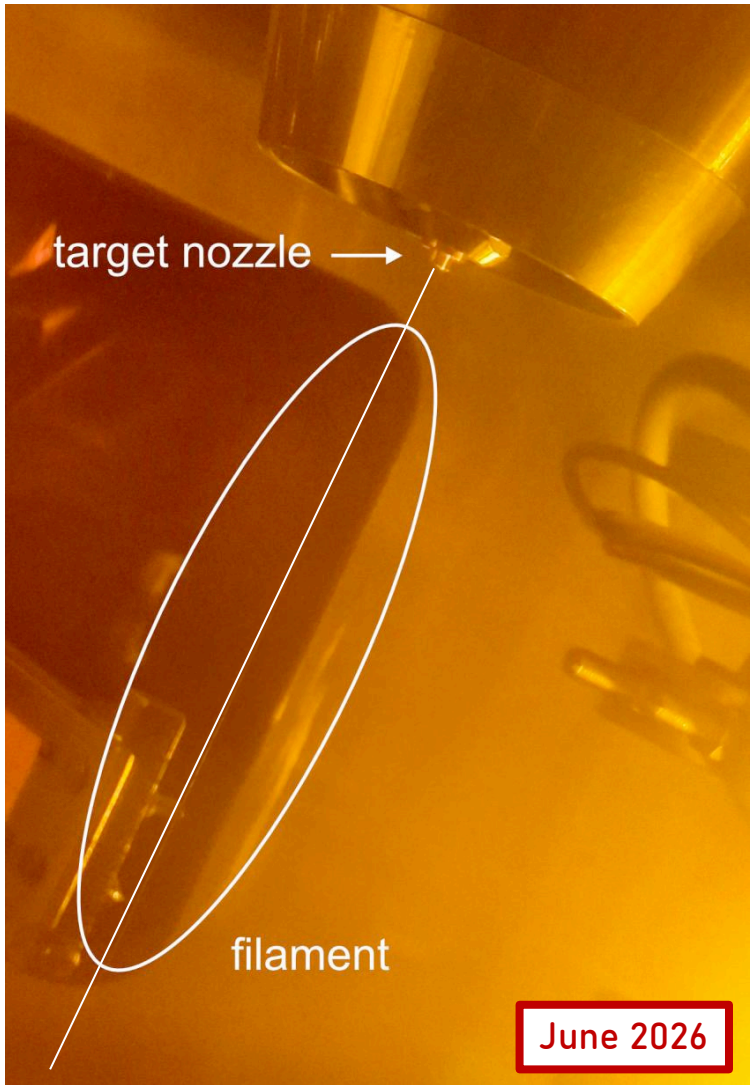
MAGIX – Filament Target



J. Froning

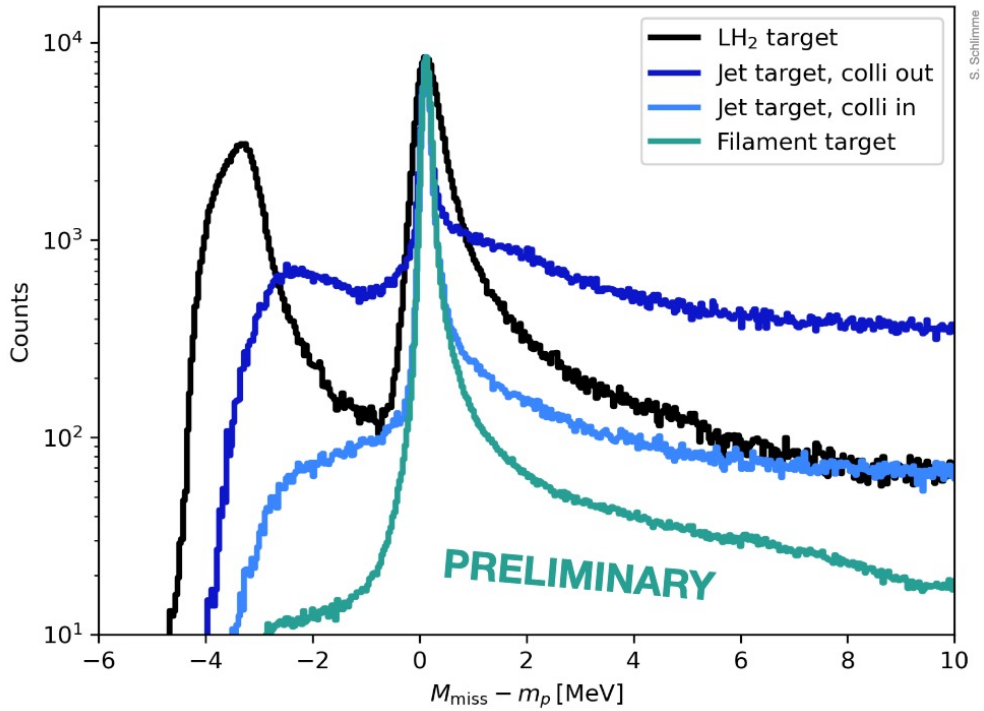
- Beam time with hydrogen filament operation (Jun 26)
- Operation condition: 1.2 bar and 16 K
- Catcher and nozzle further away from electron beam

MAGIX – Filament Target

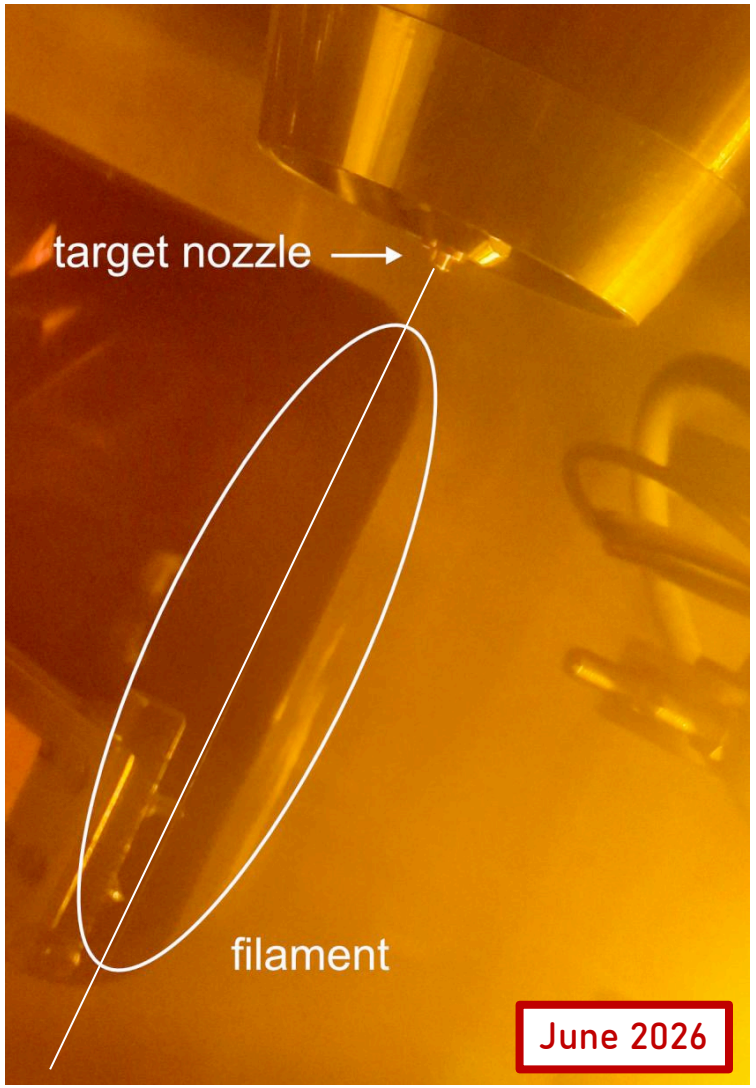


J. Froning

- Hydrogen filament (Jun 26)
- Operation condition: 1.2 bar and 16 K
- Catcher and nozzle further away from electron beam
- Highly background-suppressed measurement

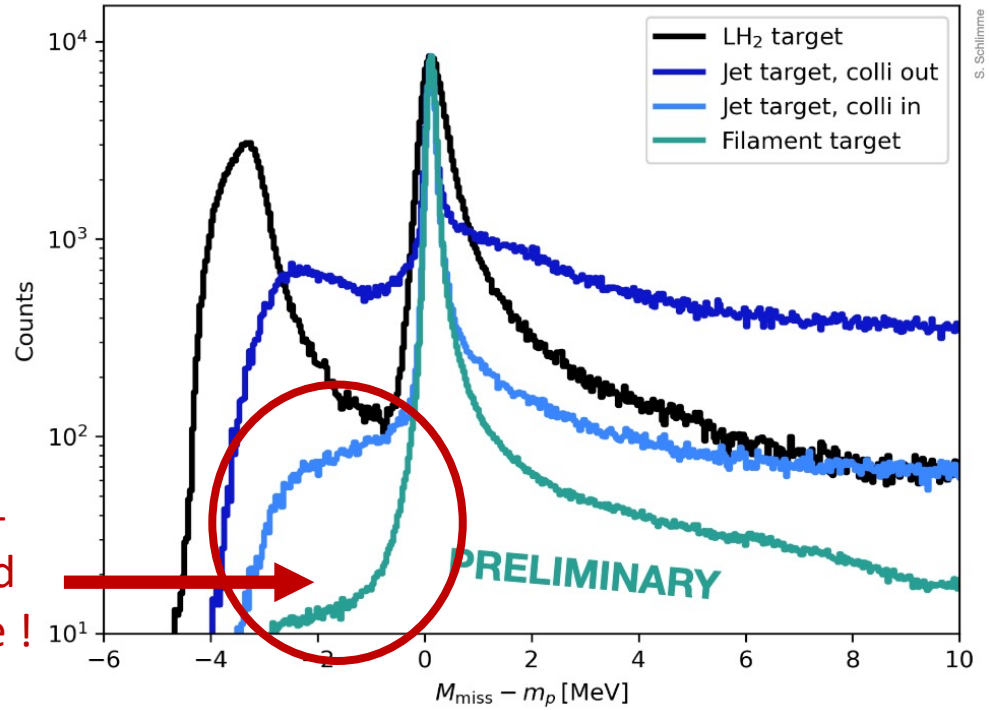


MAGIX – Filament Target



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- Catcher and nozzle further away from electron beam
- Highly background-suppressed measurement

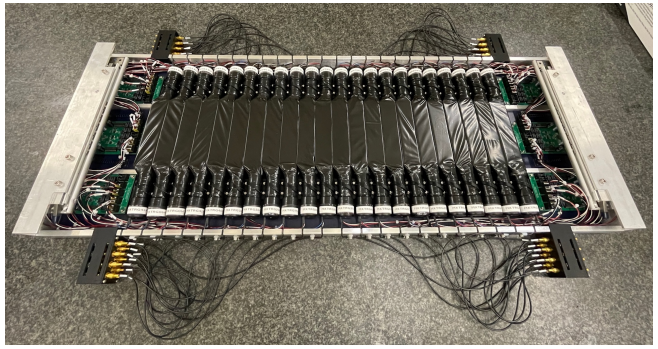


No more beam-halo background in filament mode !

- Extremely successful Argon filament beam time (Aug 26)

MAGIX – Status & Impressions



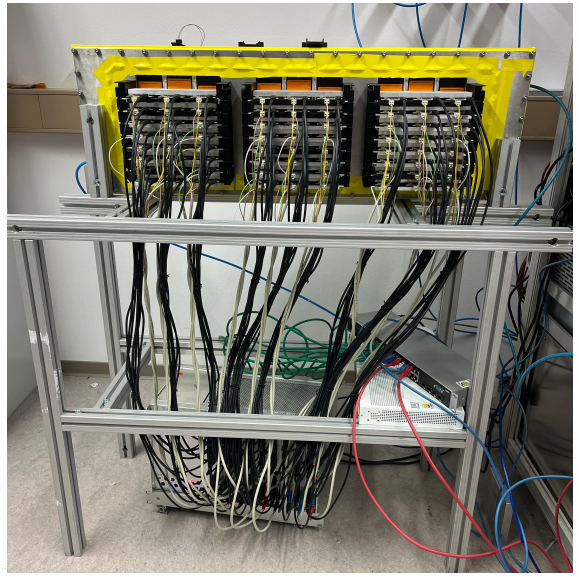


Trigger



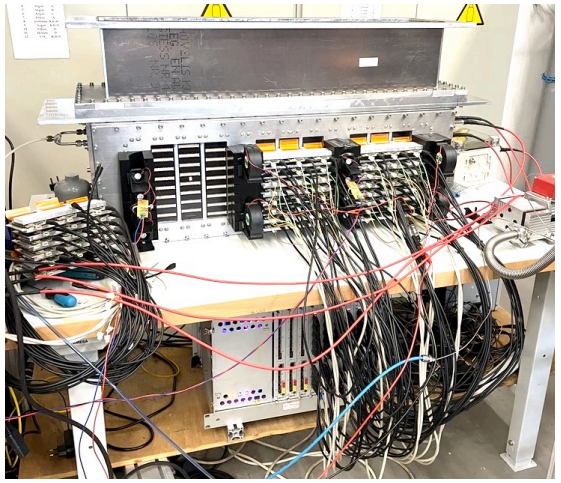
Veto drawers



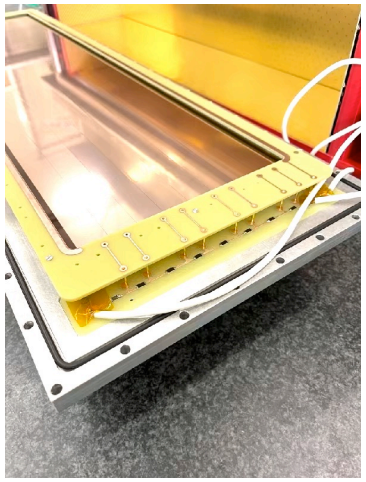


TPC

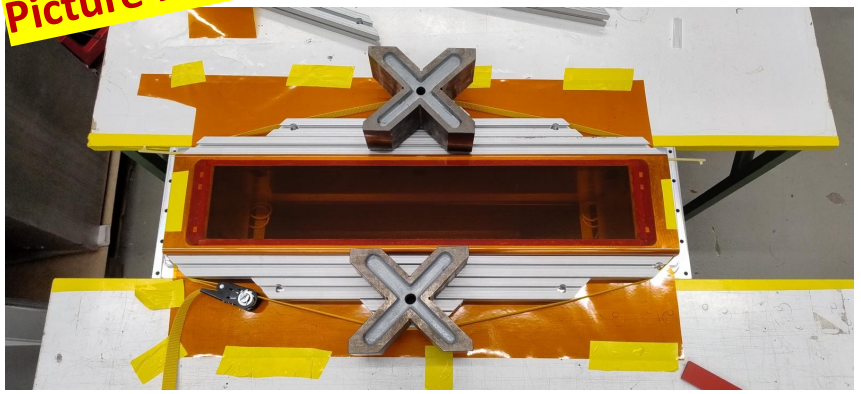
MAGIX – Status & Impressions

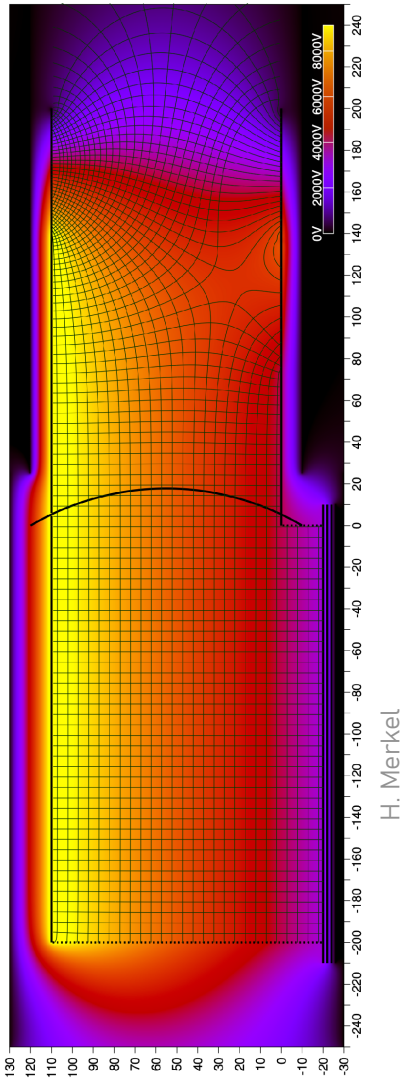


L. Bister

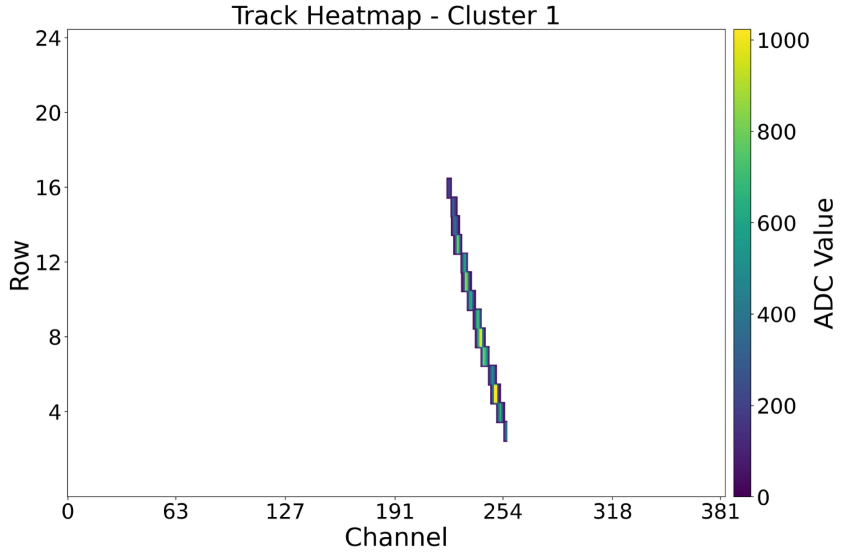


L. Bister

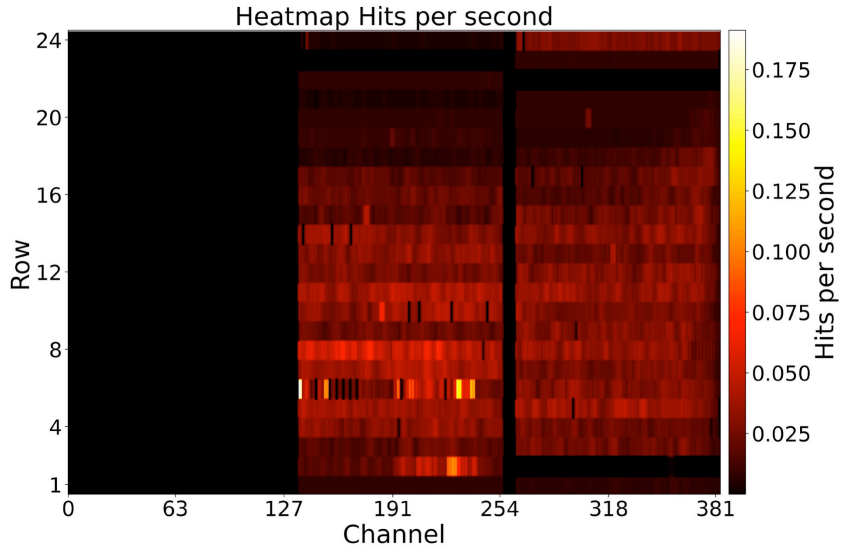




H. Merkel



L. Bister



L. Bister

MAGIX Spectrometers almost fully installed



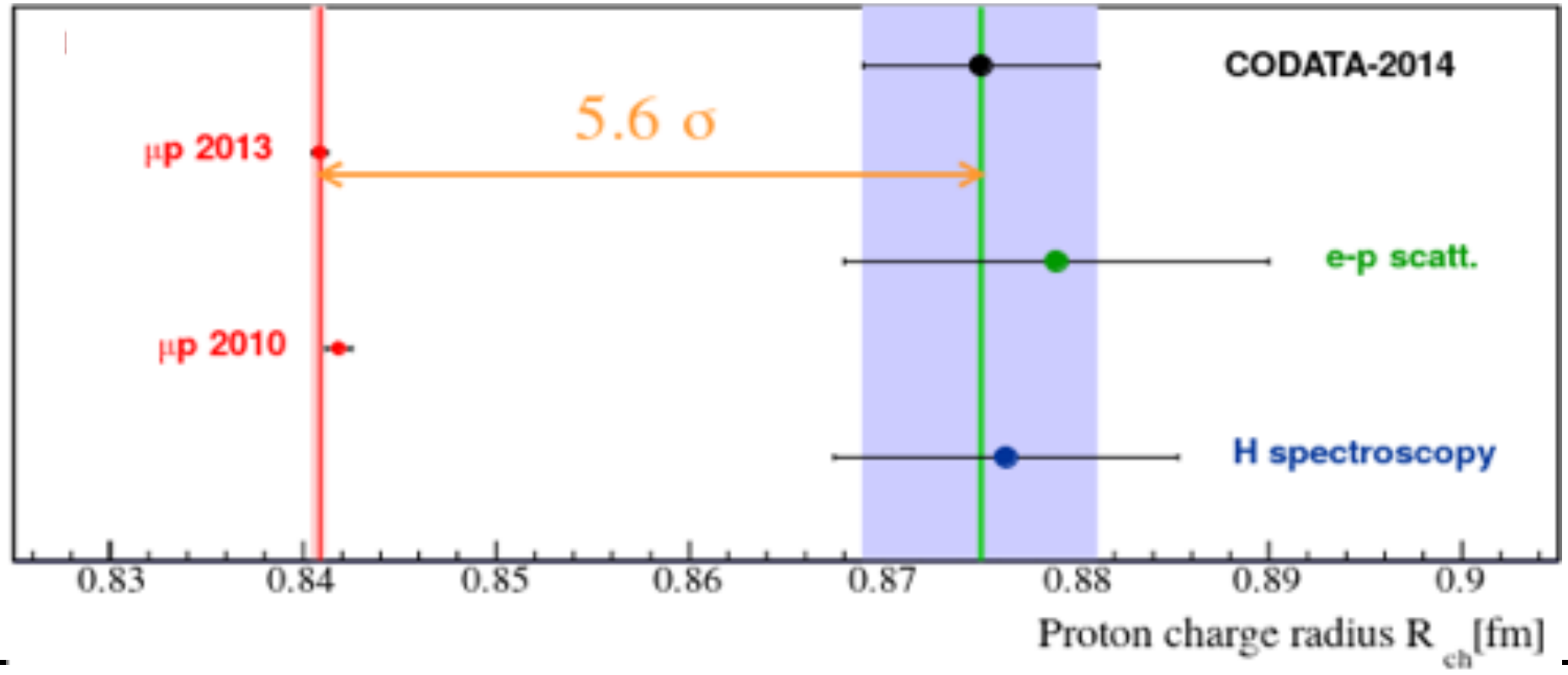
MAGIX Spectrometers almost fully installed

Physics program:
EM Form Factors – Proton Radius
Few Body Physics
Nuclear Astrophysics
Dark Sector Searches



EM Form Factors and the Proton Radius (Puzzle ?)

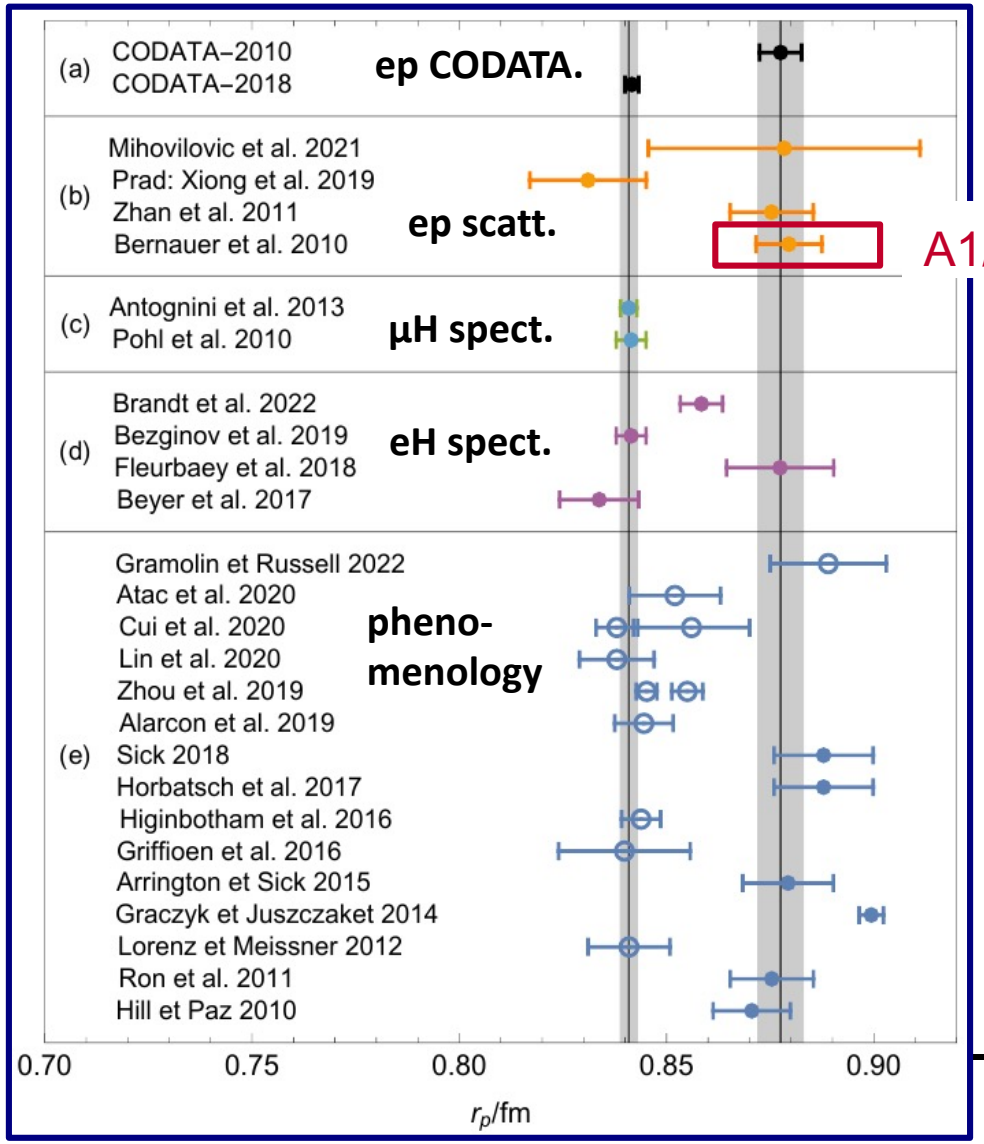
Discrepancy between proton radius extractions from
muonic hydrogen spectroscopy and electron scattering/electronic hydrogen spectroscopy
(Situation 2016)



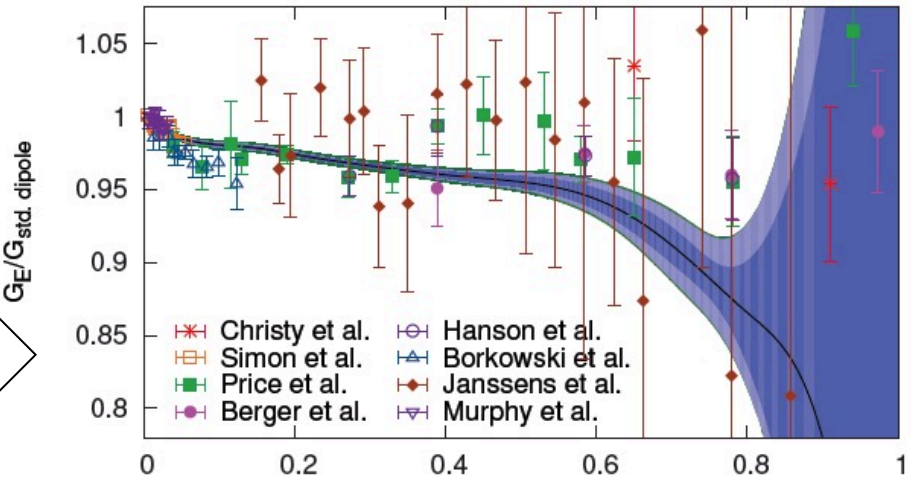
The Proton Radius (Puzzle ?)

$$\frac{d\sigma}{d\Omega} = \left(\frac{d\sigma}{d\Omega}\right)_{Mott} \frac{1}{\varepsilon(1+\tau)} \left[\varepsilon G_E^2(Q^2) + \tau G_M^2(Q^2)\right]$$

arXiv:2304.07035



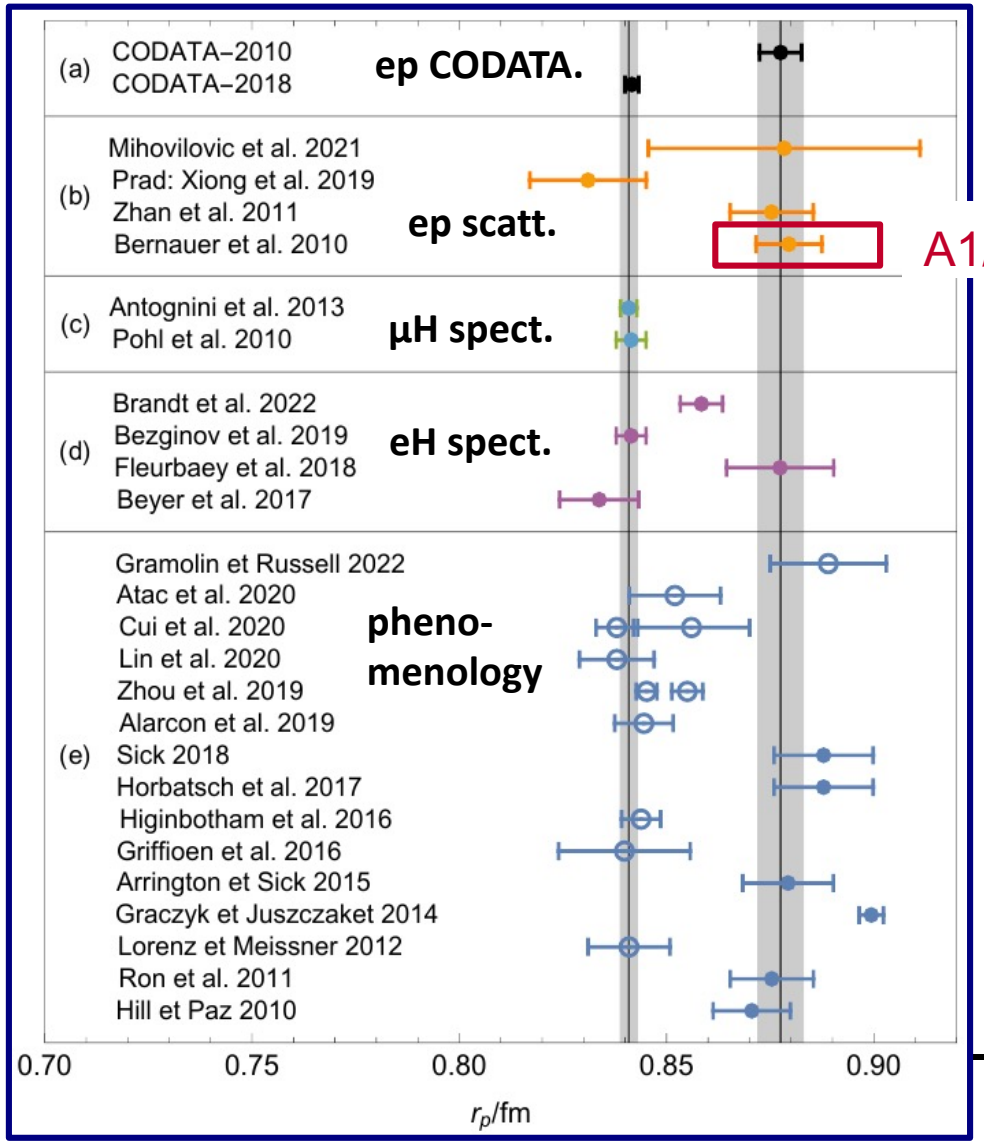
A1/MAMI



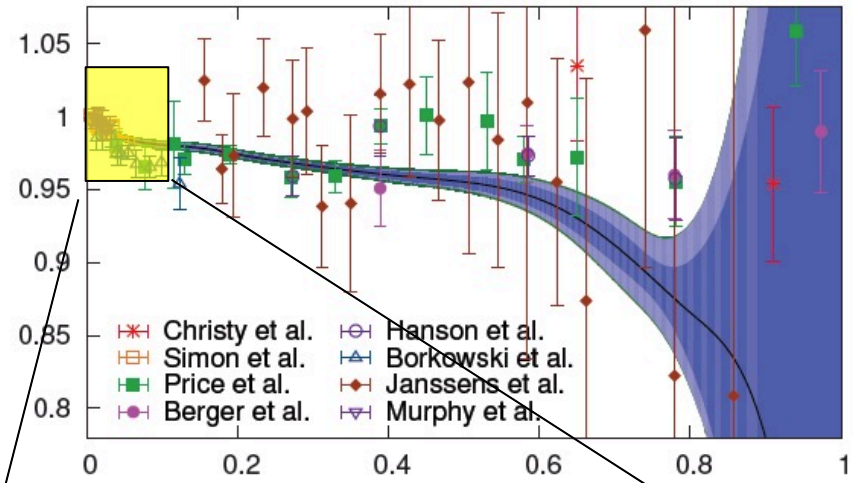
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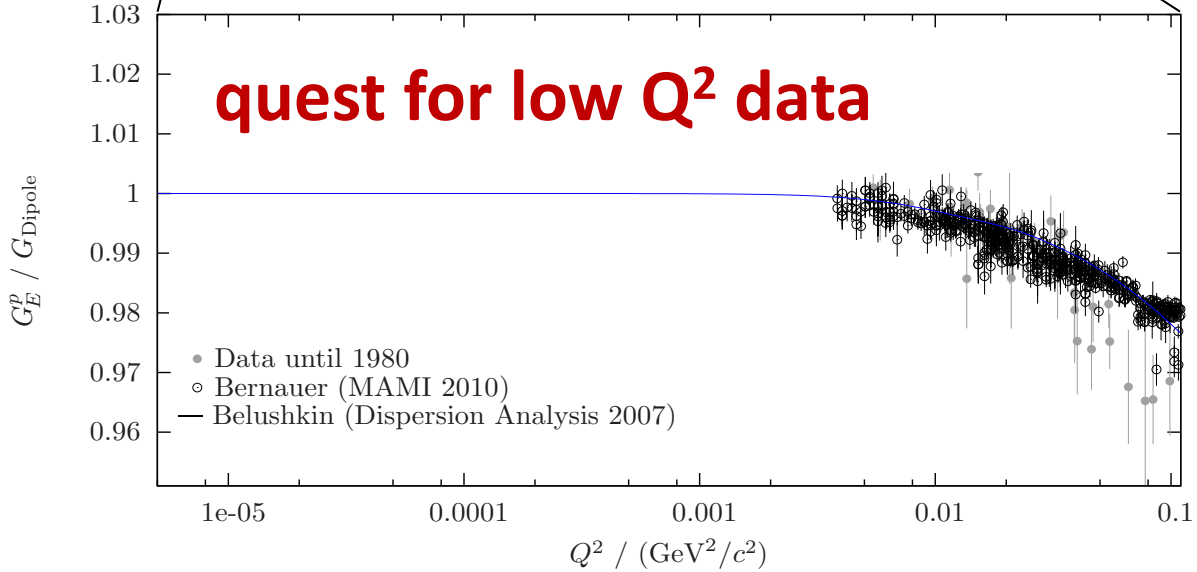
arXiv:2304.07035



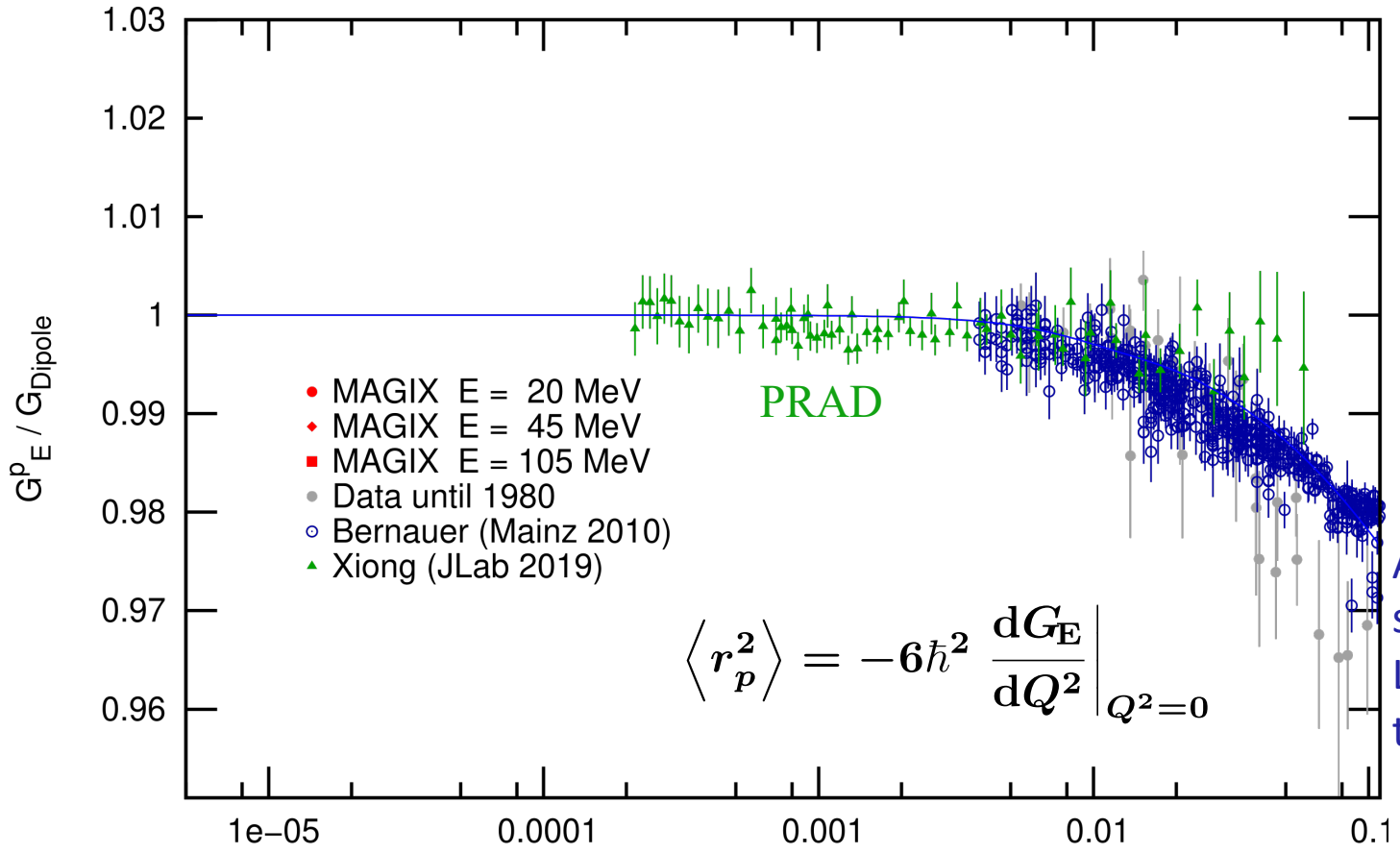
A1/MAMI



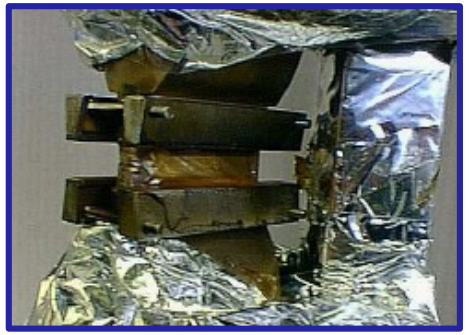
$$\left\langle r_p^2 \right\rangle = -6\hbar^2 \left.\frac{dG_E}{dQ^2}\right|_{Q^2=0}$$



Electromagnetic Form Factors at MAGIX



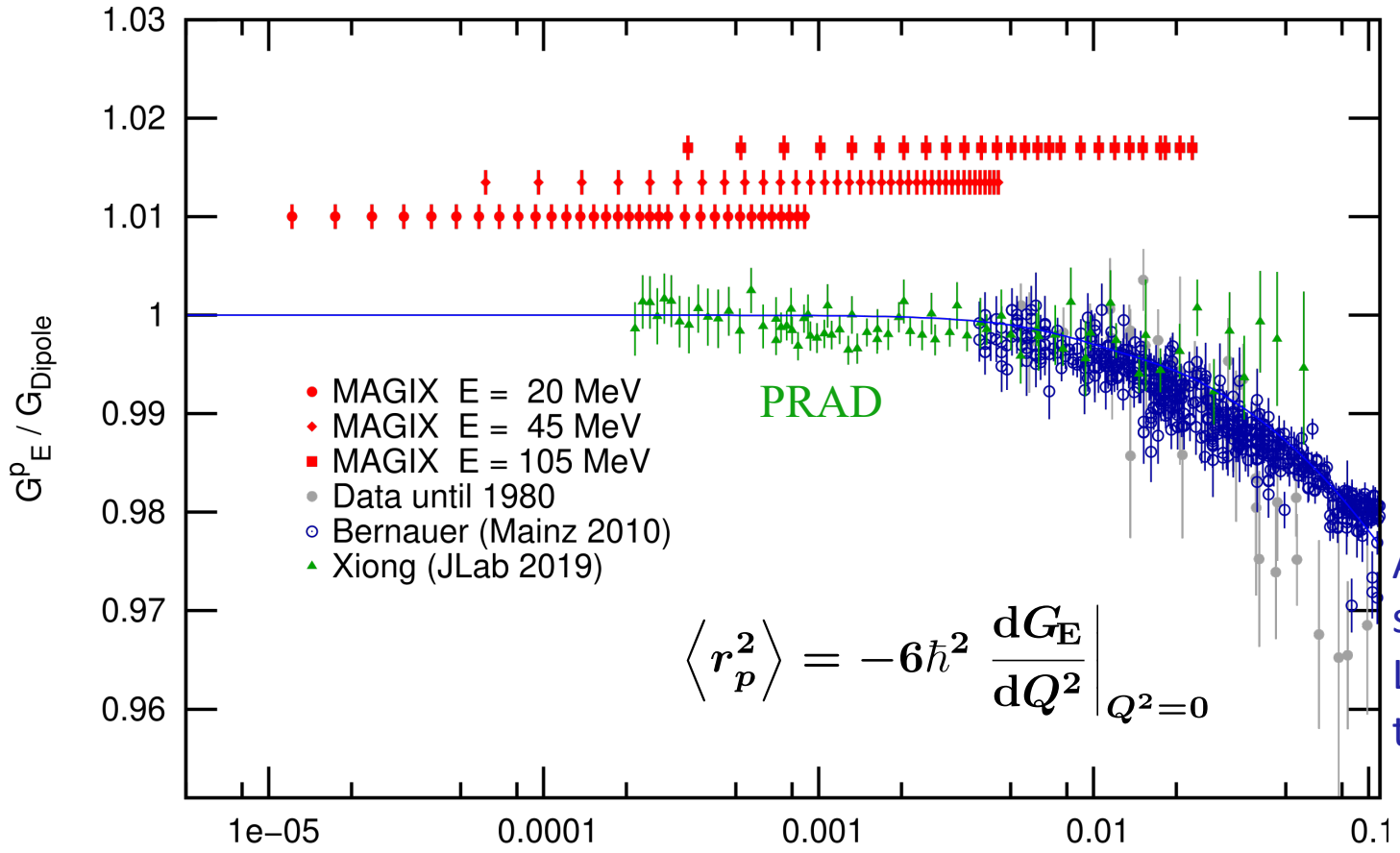
A1 data: scattering on LH_2 target target walls



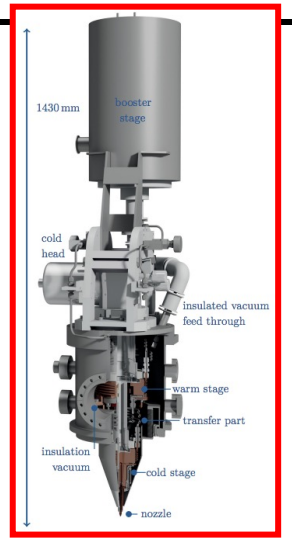
Electromagnetic Form Factors at MAGIX

MAGIX: Coverage from **$Q^2 = 1 \cdot 10^{-5}$ to 0.03 GeV^2**

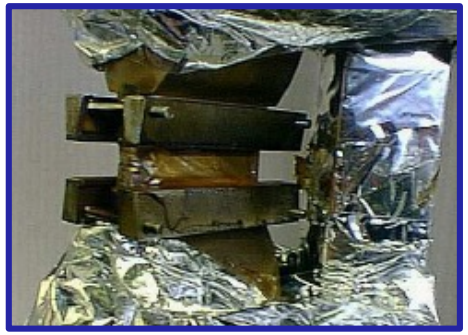
→ proton charge and magnetic radius!



MAGIX: truly windowless gas target



A1 data: scattering on LH_2 target target walls

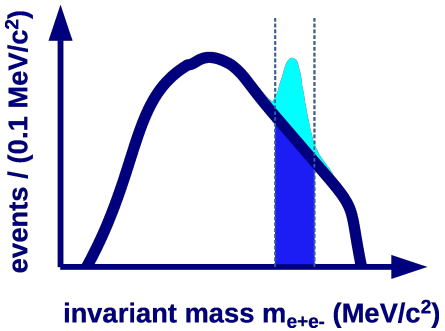


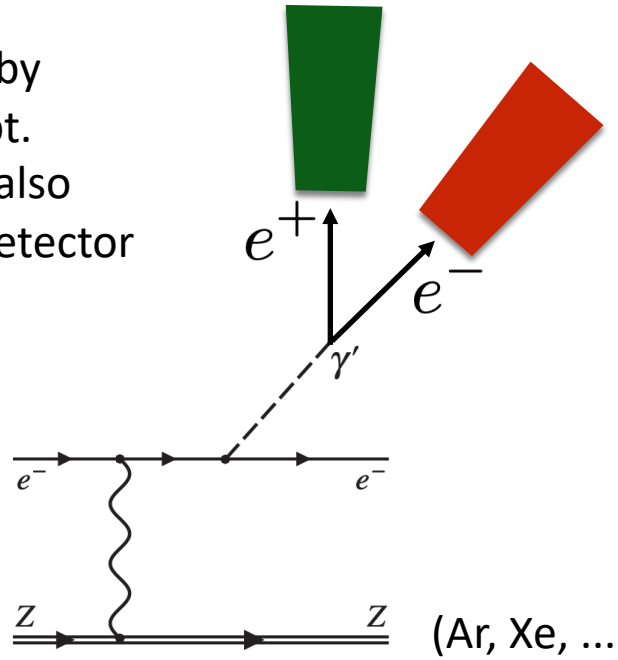
Dark Photon Search at MAGIX

Model 1: $m_{\gamma'} \ll 2m_{DM}$

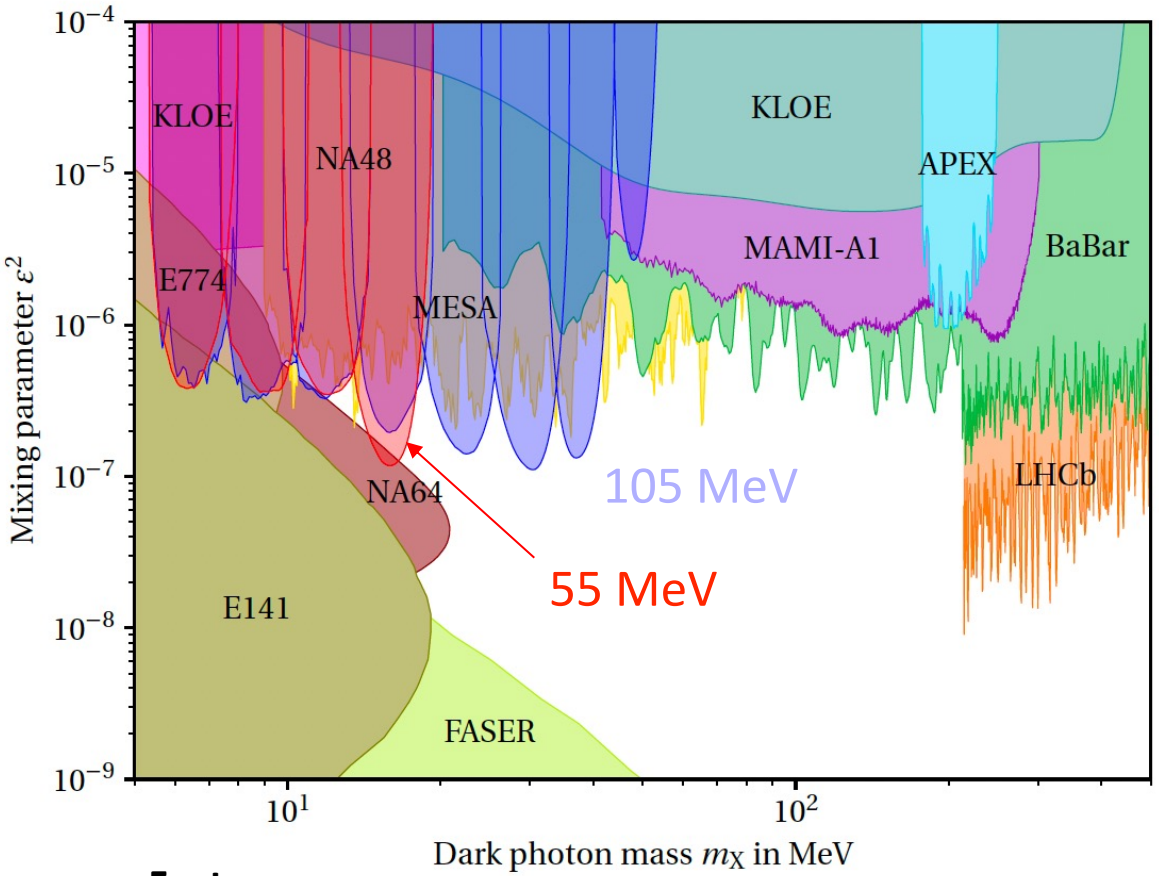
Dark Photon decaying into SM particles – coupling ε

- Method pioneered by A1/MAMI and APEX/JLAB
- Parameter range motivated by X17 anomaly of ATOMKI expt.
- Invisible dark photon decay also possible thanks to Si recoil detector





(Ar, Xe, ...)



Features:

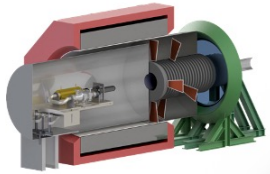
- Ta solid state target (not in ERL)
- Stack of 17 Ta foils (1 µm thickness each)
- 2 weeks of data taking per kinematic setting

Conclusions

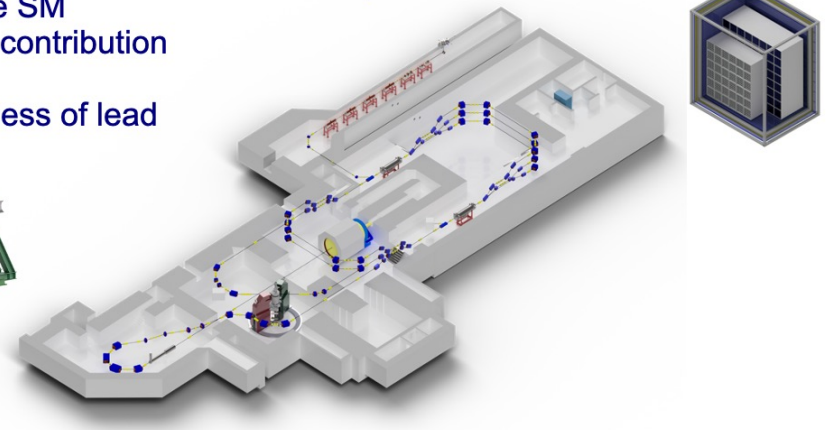
- New MESA electron accelerator (increase in intensity x 10 wrt. MAMI) starting operation in 2027 !
- Energy-Recovery Linac mode: innovative and „green“ technique!
- 3 experiments under construction:

→ Parity-violation experiment P2
→ Versatile MAGIX spectrometer
→ Beam dump experiment DarkMESA

P2 – Parity Violation Experiments
- prec. meas. of $\sin^2\theta_W$ / search for physics beyond the SM
- axial FF + strange contribution to magnetic FF
- neutron skin thickness of lead



DarkMESA – Beam Dump Experiment
- quest for dark matter and other exotic particles



S. Schlimme



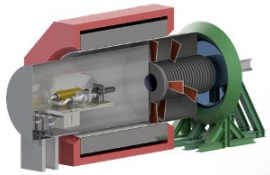
MAGIX – Versatile Electron Scattering Experiment
- Structure of Nucleons and Nuclei
- Few-Body Systems
- Nuclear Astrophysics
- Dark Sector Searches

Conclusions

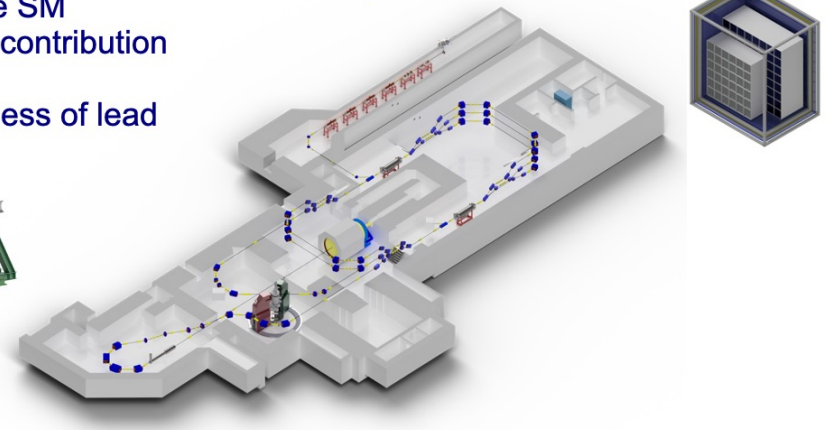
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DarkMESA – Beam Dump Experiment
- quest for dark matter and other exotic particles



S. Schlimme

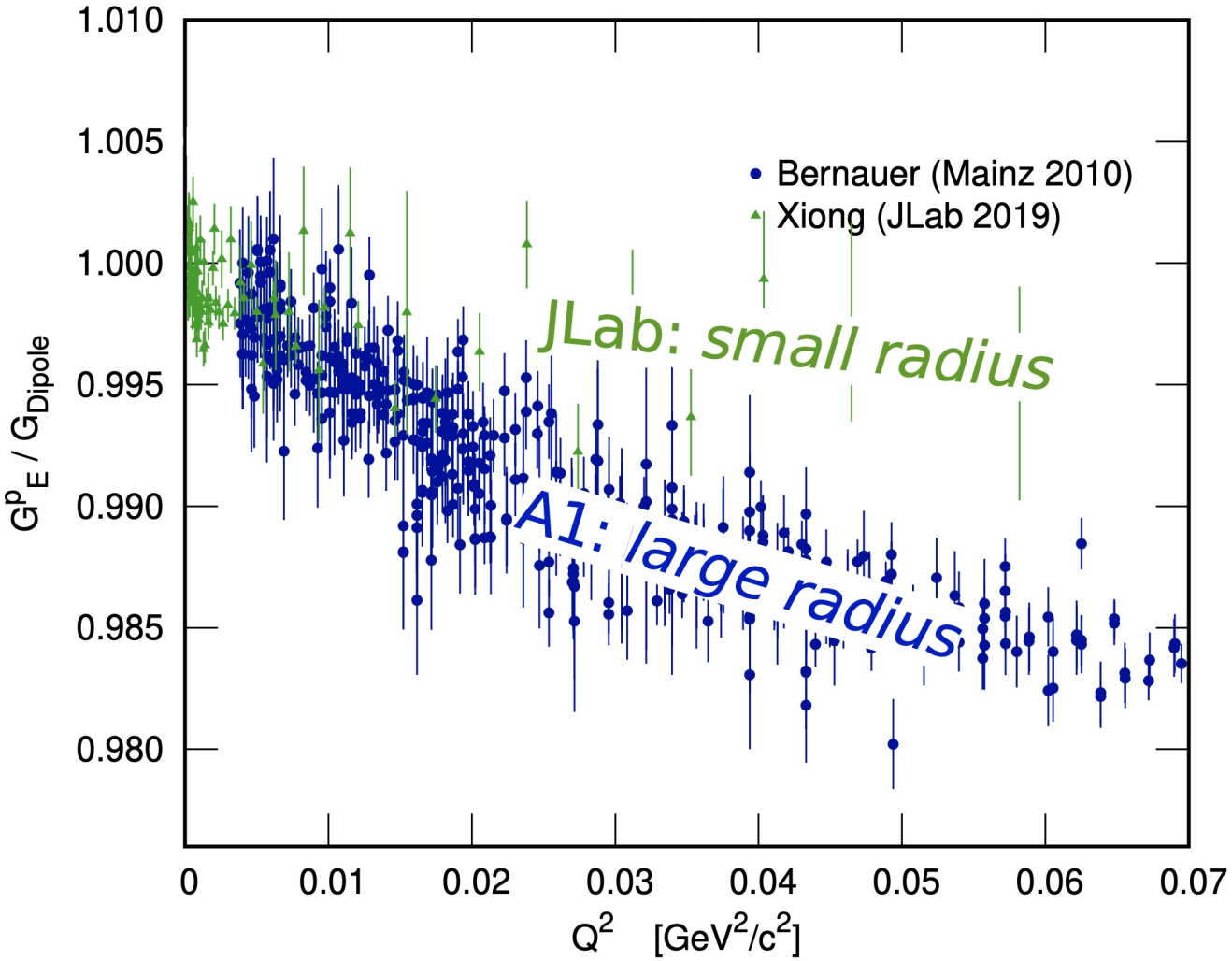


MAGIX – Versatile Electron Scattering Experiment
- Structure of Nucleons and Nuclei
- Few-Body Systems
- Nuclear Astrophysics
- Dark Sector Searches

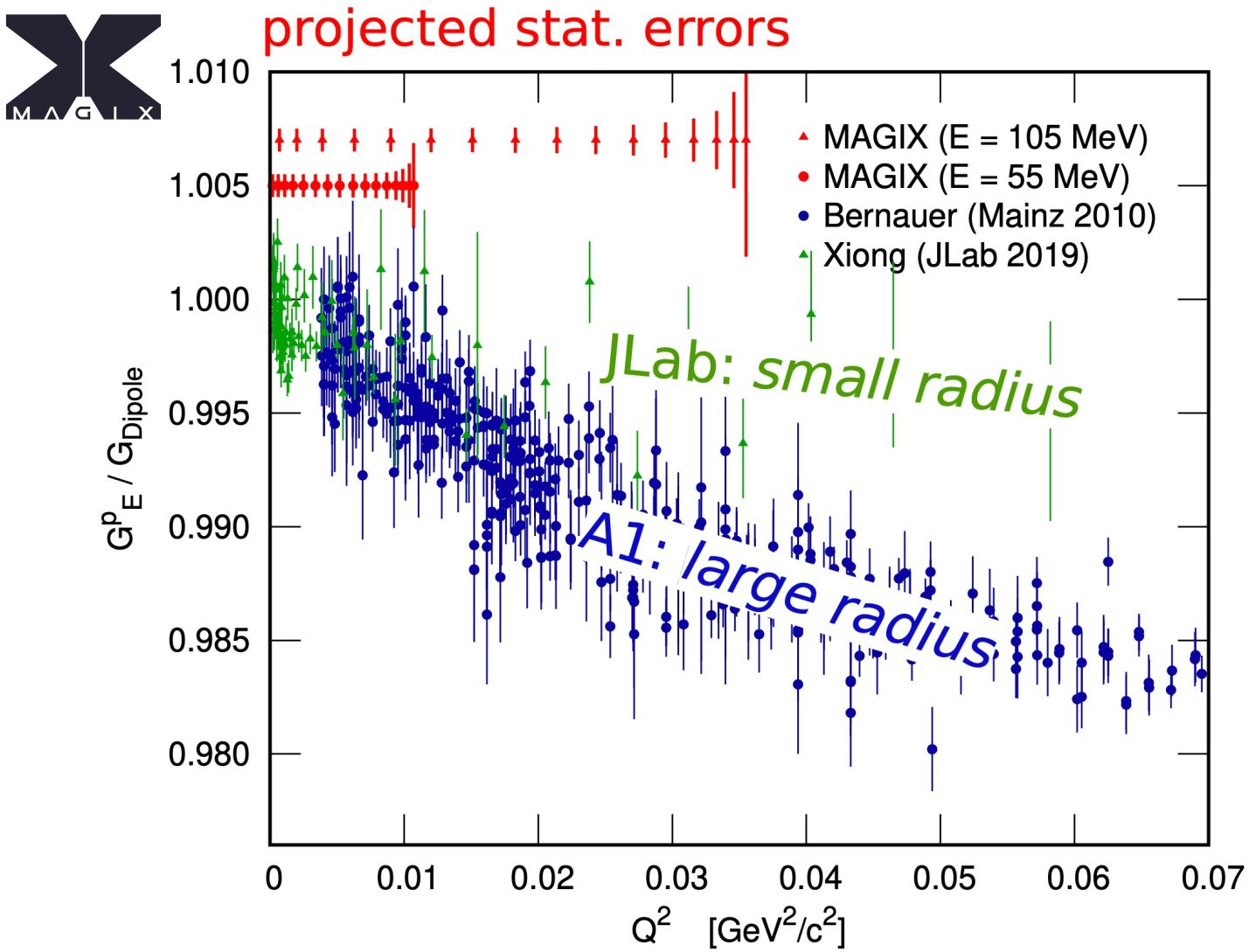
→ **High intensity and low energy enabling exciting precision experiments**
→ **New collaborators very welcome**

Backup.

Proton Radius at MAGIX.

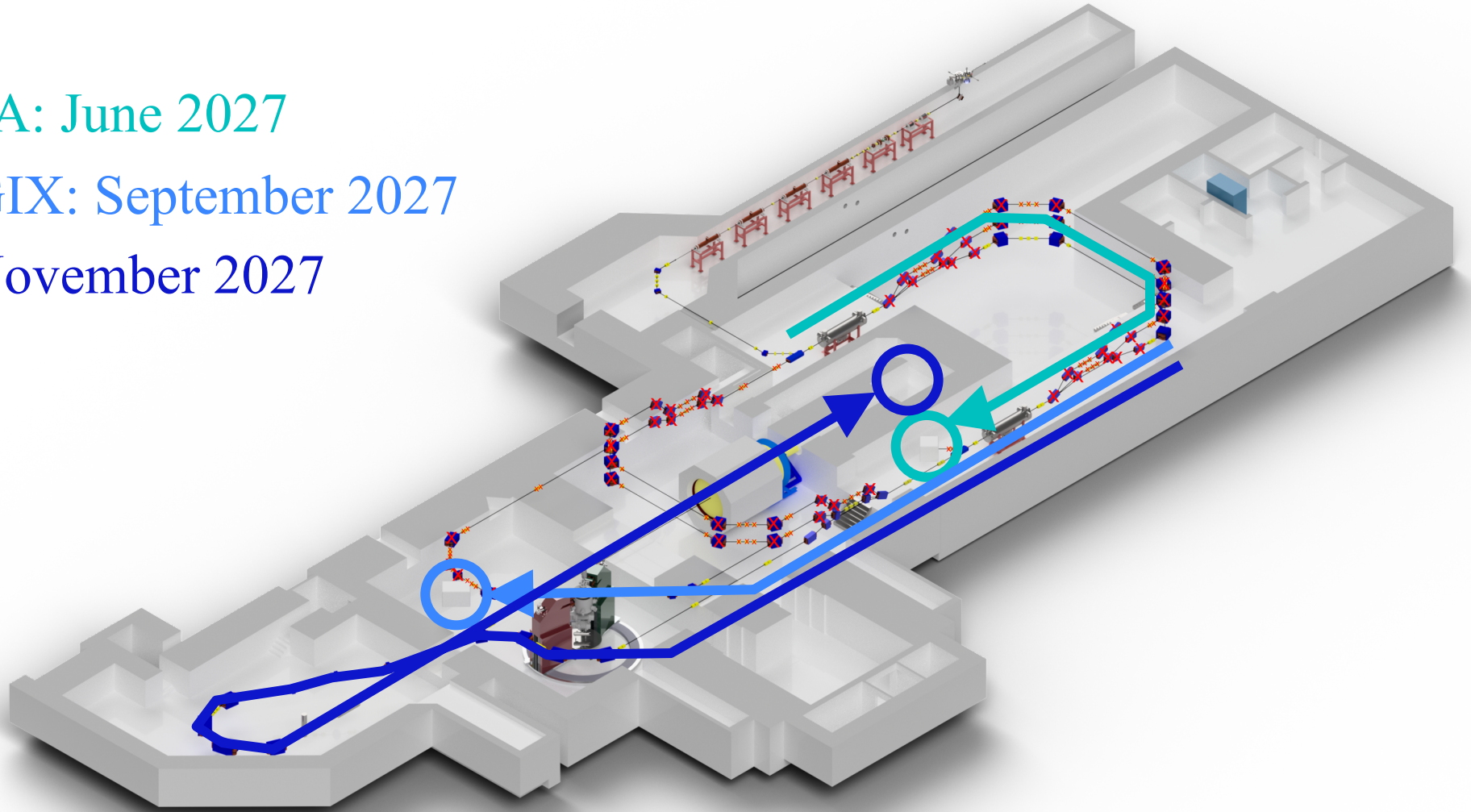


Proton Radius at MAGIX.



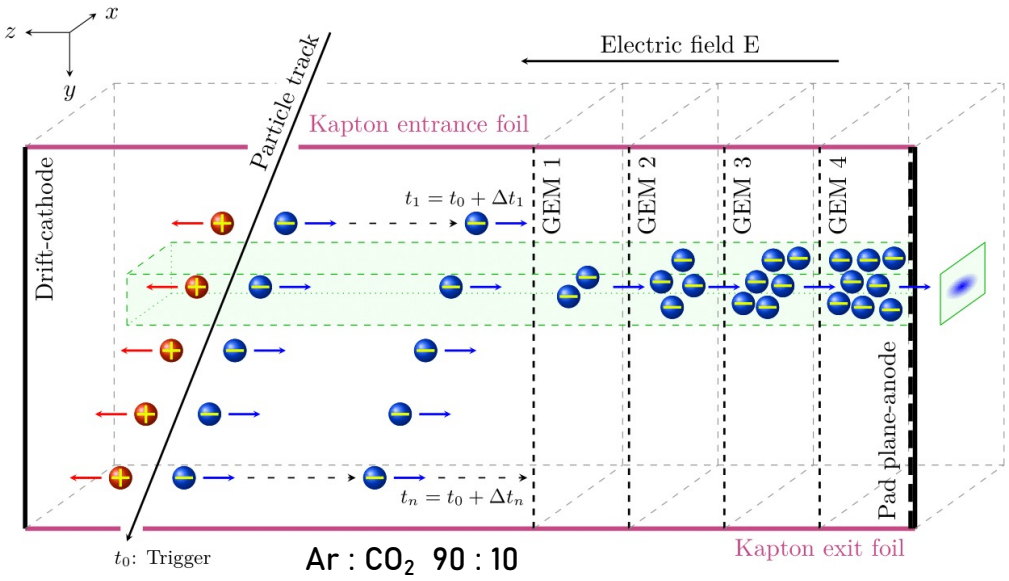
MESA Facility timeline.

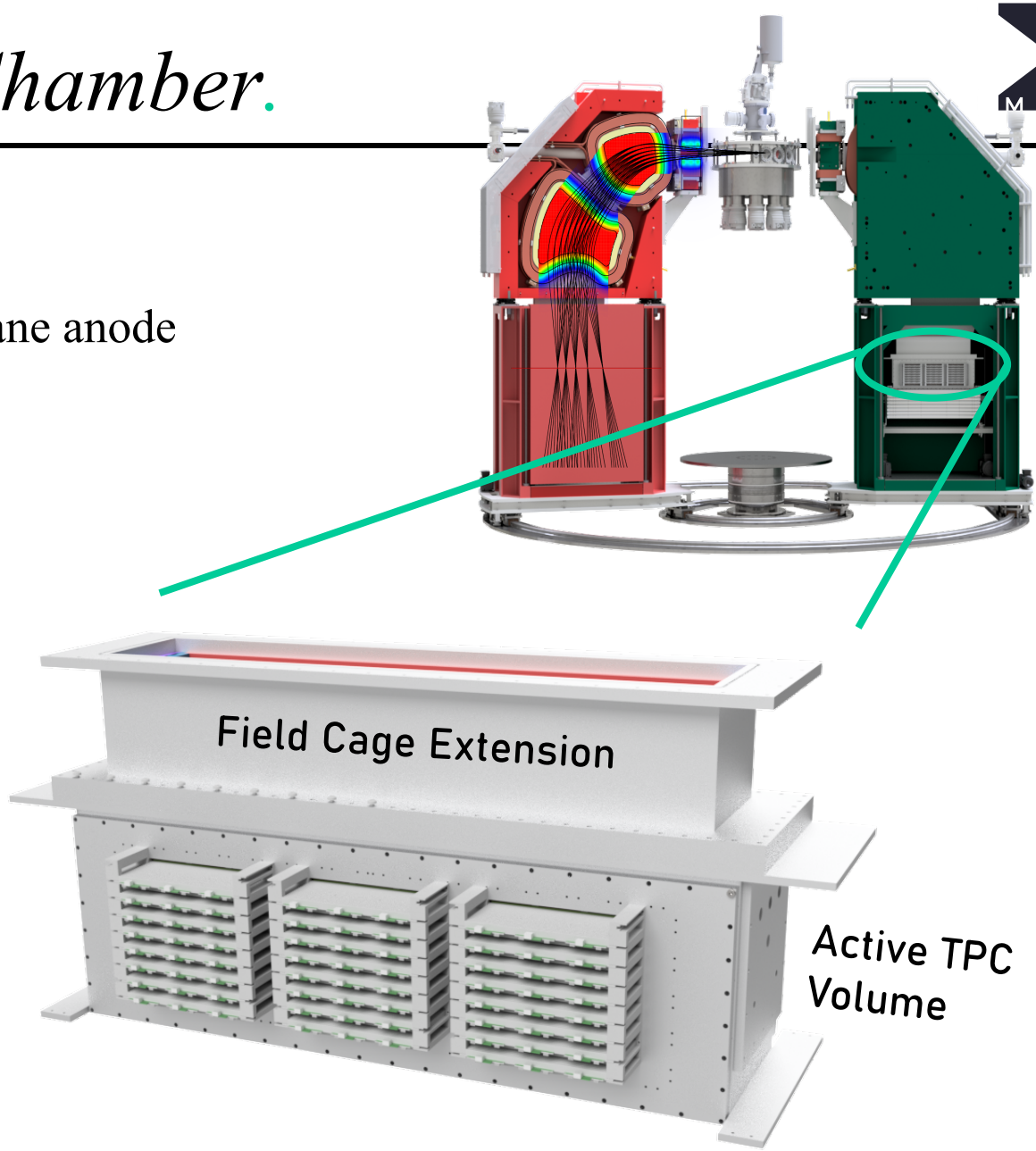
- First beam MESA: June 2027
- First beam MAGIX: September 2027
- First beam P2: November 2027



MAGIX – Time Projection Chamber.

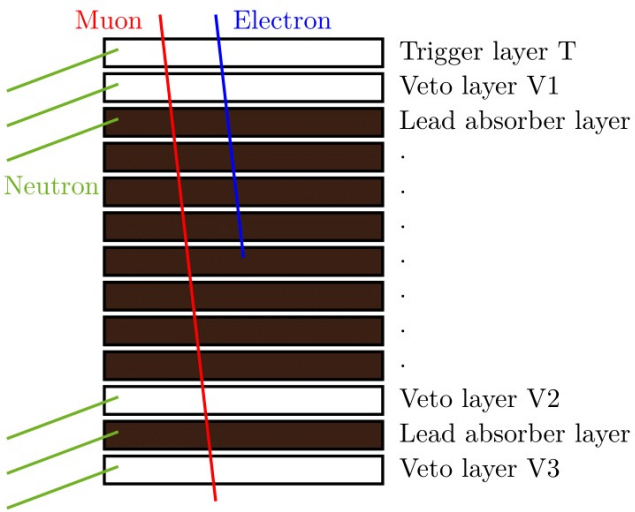
- Gas Electron Multiplier (GEM) stack and pad plane anode
- 3D Track reconstruction
- $\Delta x = 100\ \mu m$ and $\Delta\theta = 3.5$ mrad

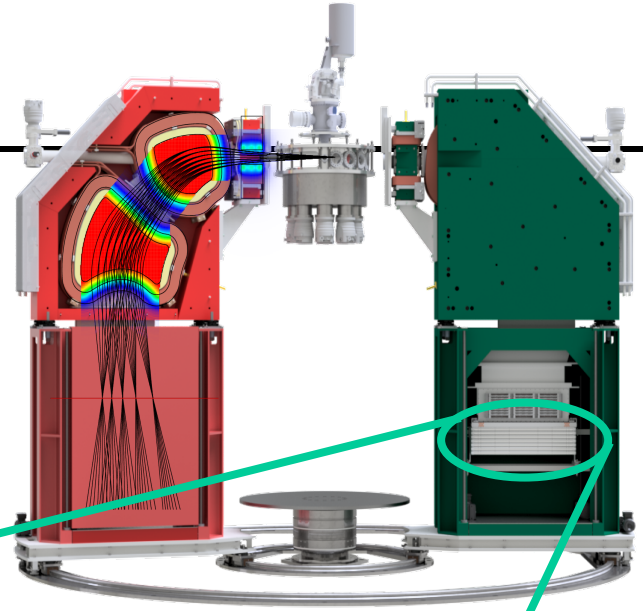


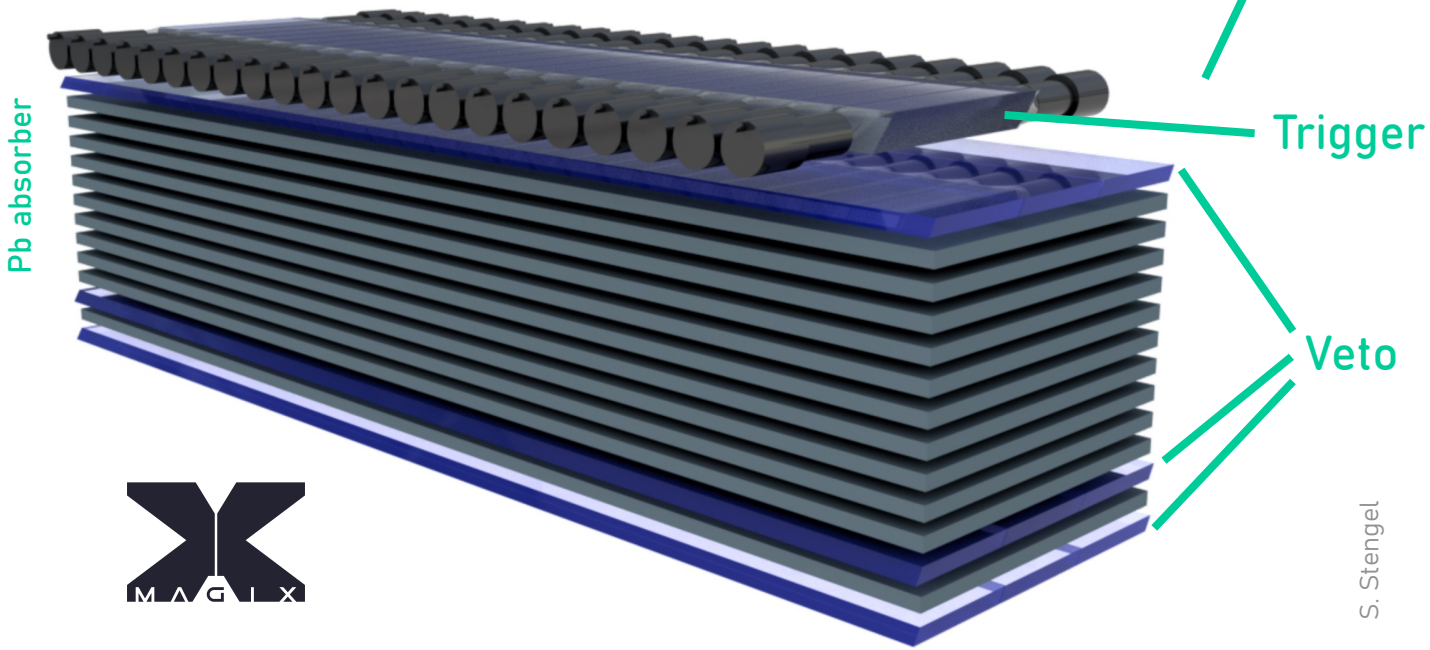


MAGIX – Trigger and Veto System.

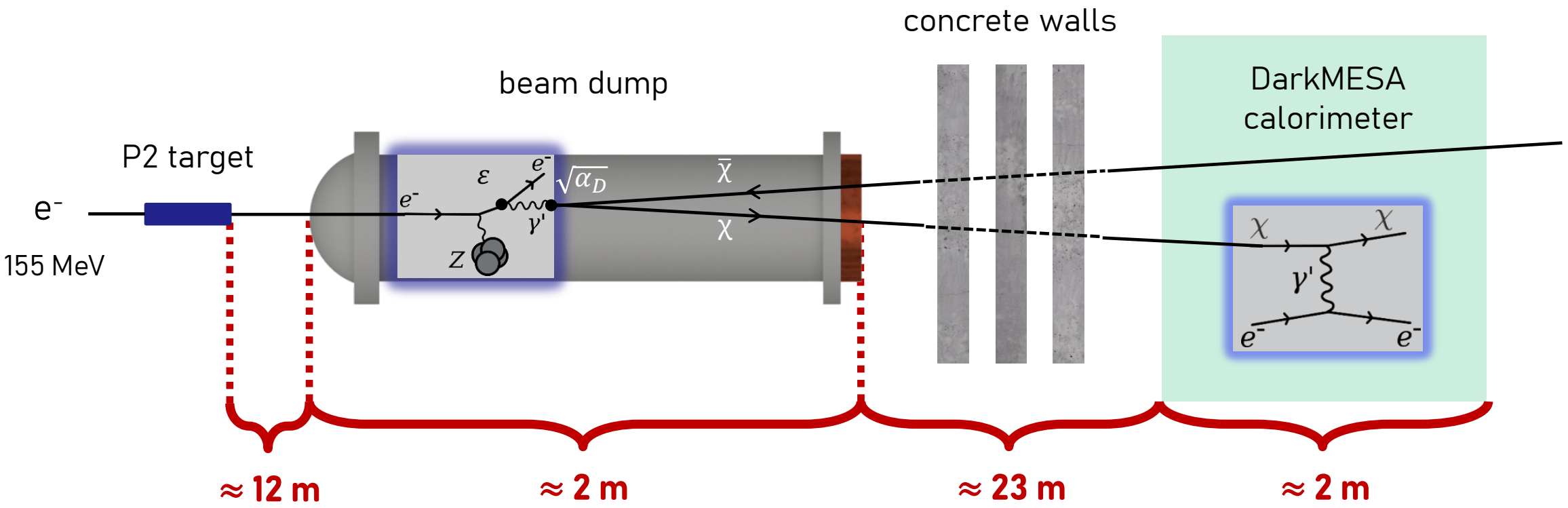
- System for PID and triggering
- Segmented trigger and veto layers
- PID via distinct trigger-veto signatures
- Flexible drawer system







Experimental Concept.

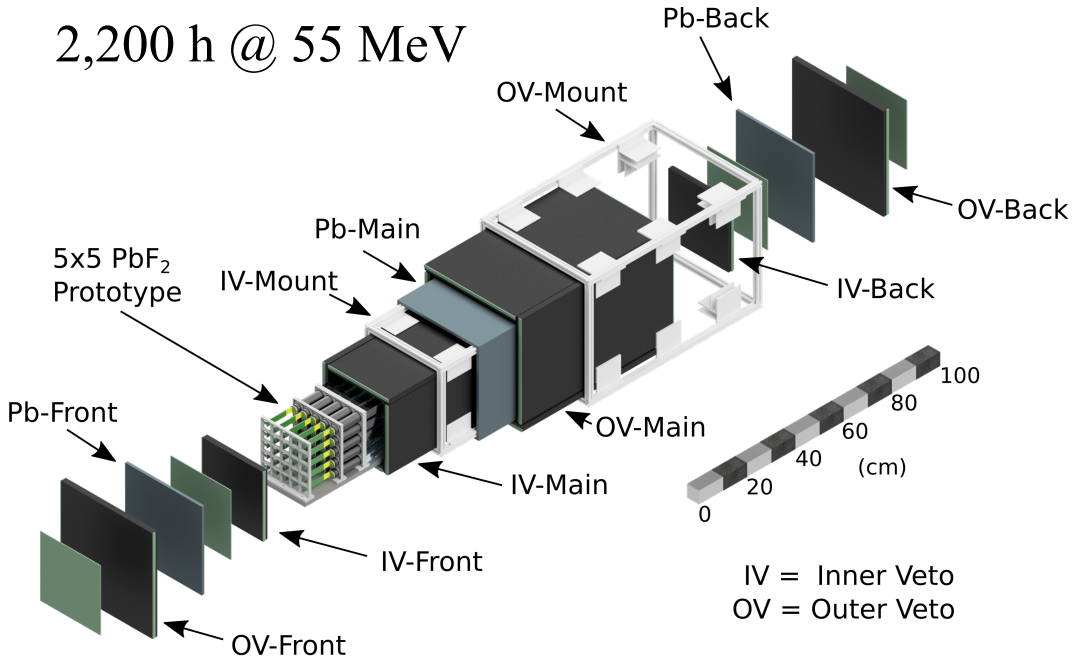


Testing ground for DM production at $m_{\gamma'} < 140$ MeV

Proposed Phase A and B.

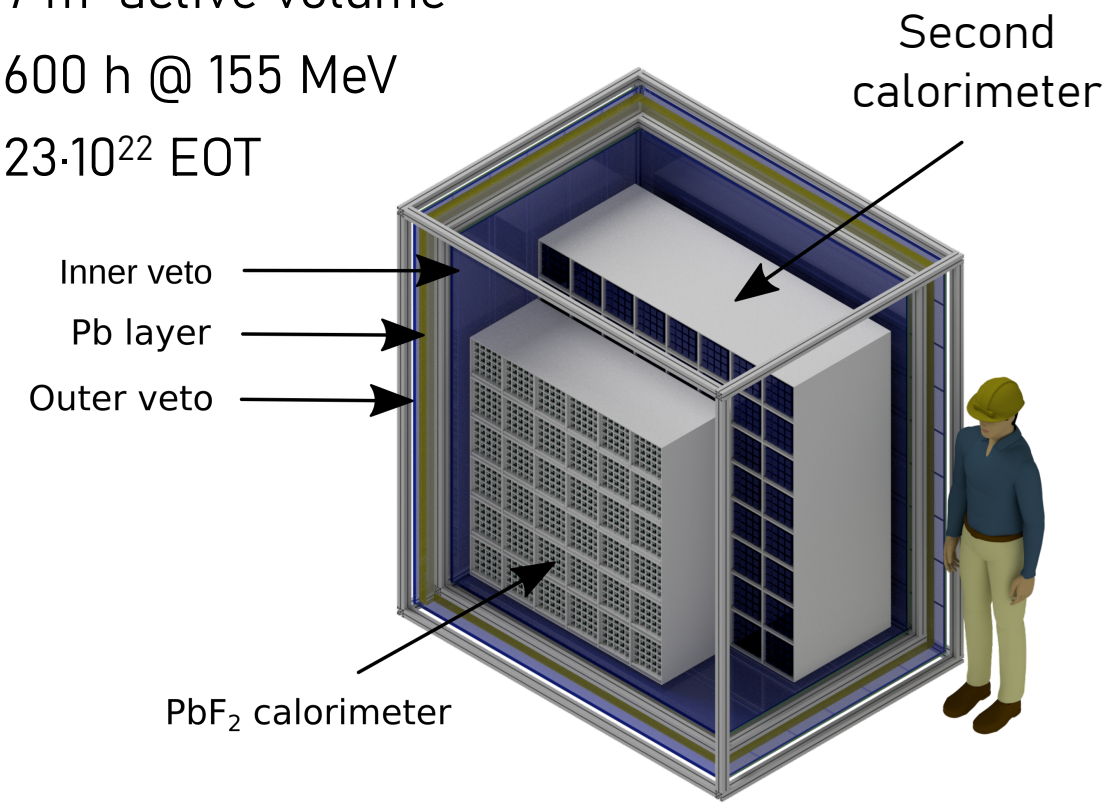
Phase A

- One PbF_2 module (5 × 5 crystals)
- 0.004 m^3 active volume
- 2,200 h @ 55 MeV



Phase B

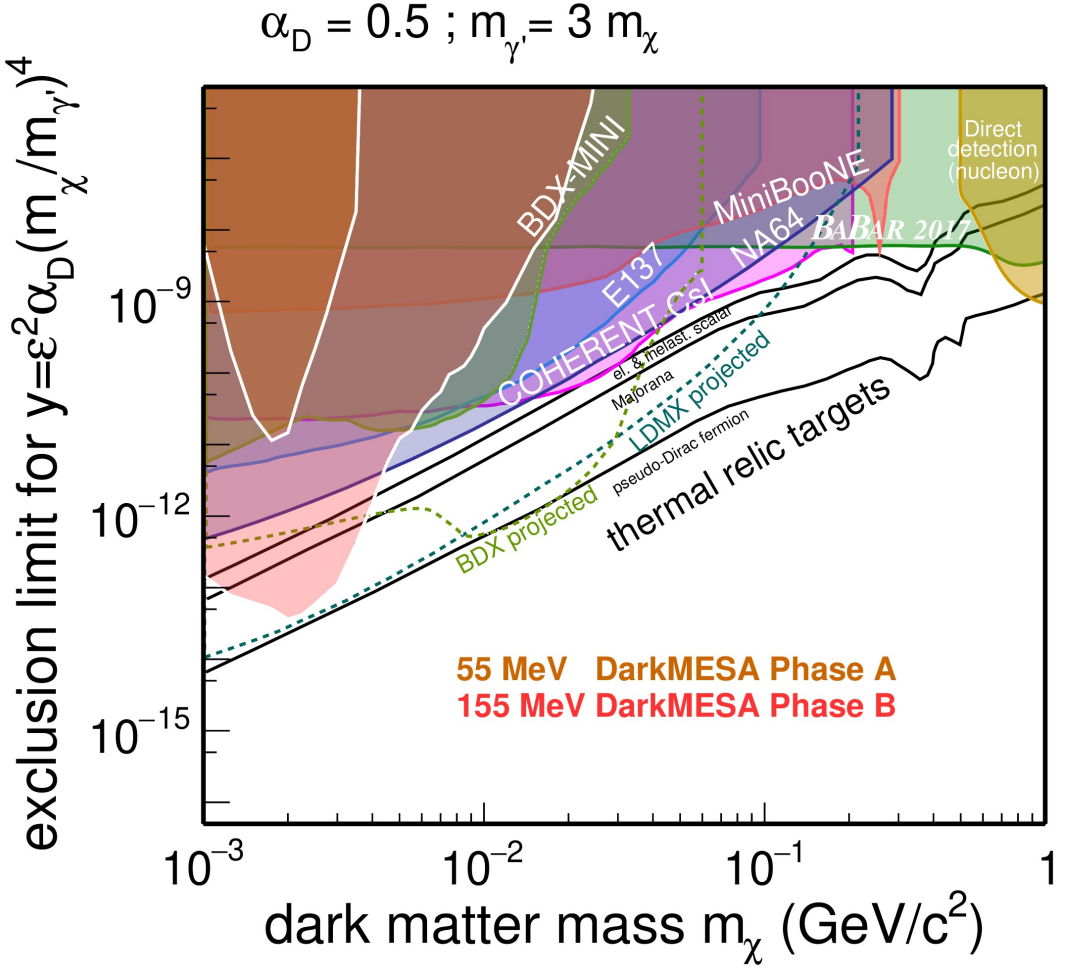
- 36 PbF_2 modules + second wall
- 0.7 m^3 active volume
- 6,600 h @ 155 MeV
- $2.23 \cdot 10^{22}$ EOT



DarkMESA Exclusion Limits.

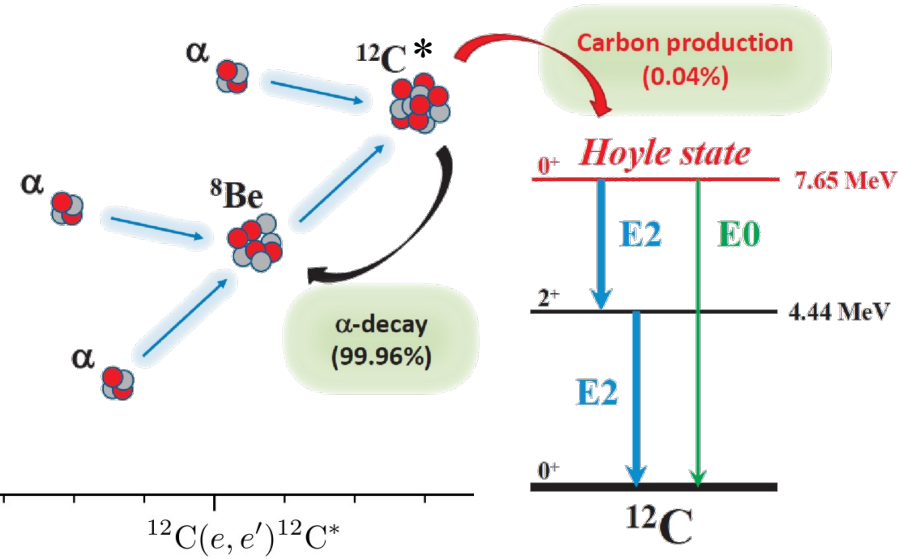
	Description	Time	EOT
Phase A	Prototype PbF_2	2,200 h	$7.42 \cdot 10^{21}$
Phase B	PbF_2 SF5/PWO	6,600 h	$2.23 \cdot 10^{22}$

- Additional assumptions:
  - Detection threshold 10 MeV (electron recoil)
  - Detector efficiency 95%
  - Confidence level 90%
  - No backgrounds
- Positron annihilation on e^- of the beam-dump $e^+ + e^- \rightarrow \gamma + \gamma'$

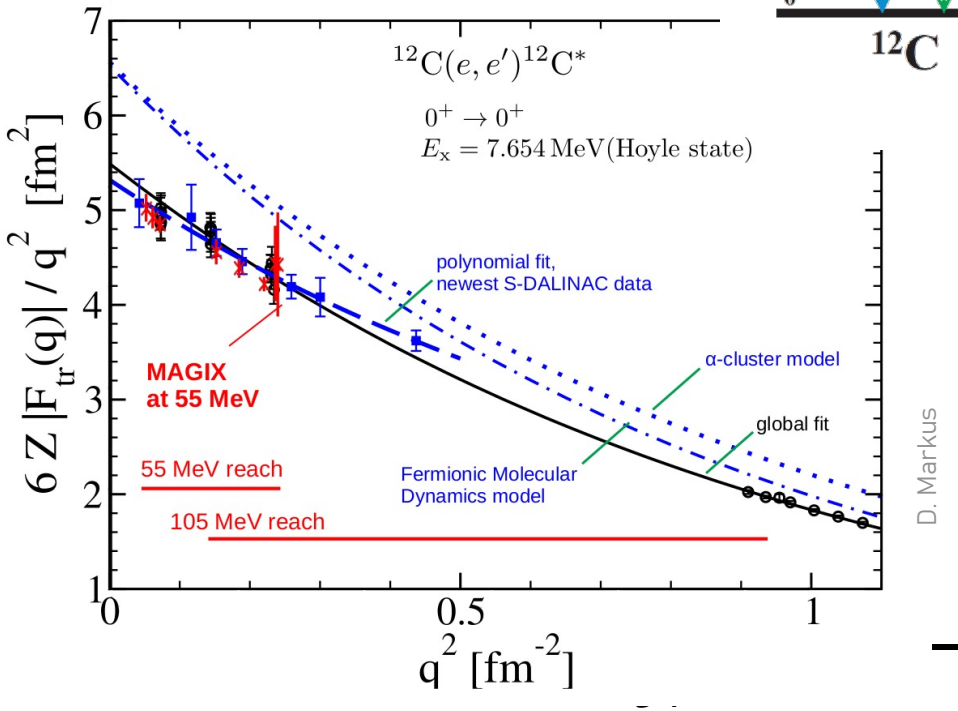


Hoyle state measurement @ MAGIX.

- First MAGIX physics in 2027 along with commissioning and calibration
- MESA's EB mode:
  - 55 MeV beam energy
  - At least 1 µA beam current
- Inelastic e^- scattering on ^{12}C target
- Measure E0 transition form factor
- Probe α-cluster structure of ^{12}C

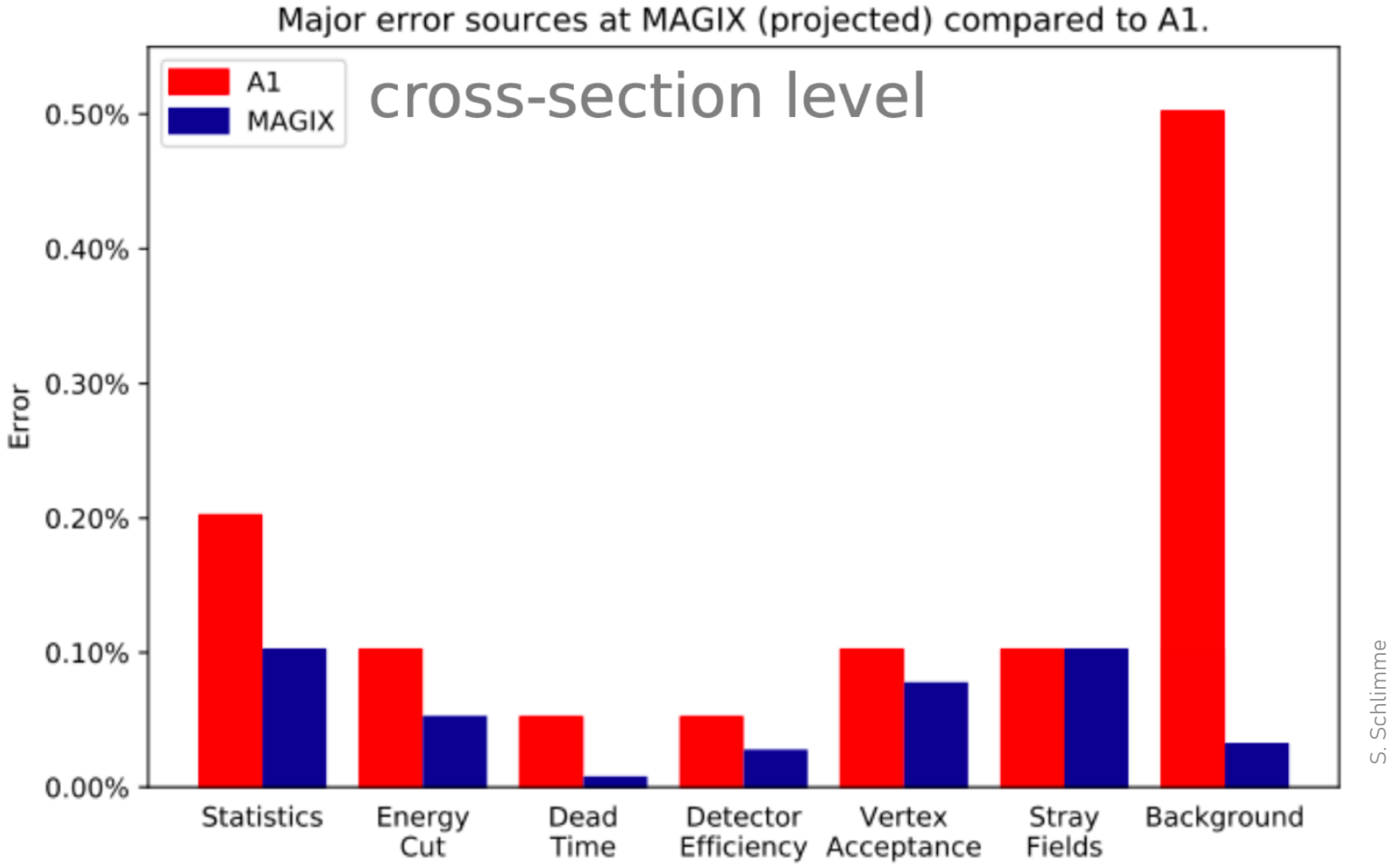


T.K. Eriksen *et al.*, 10.7566/JPSCP.14.020404



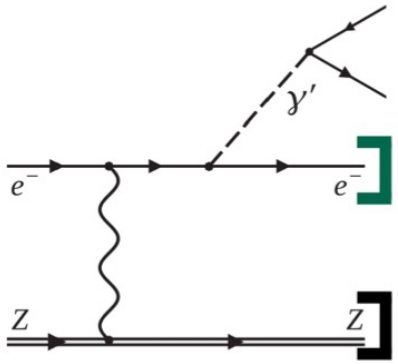
D. Markus

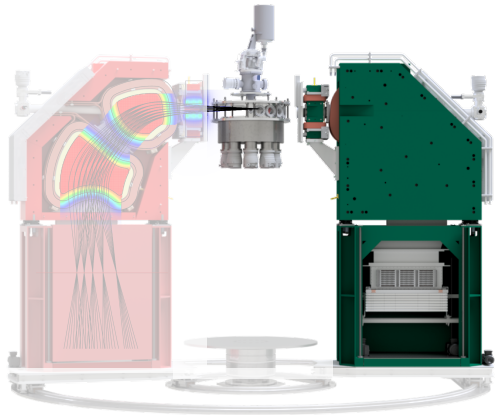
Error reduction at MAGIX.

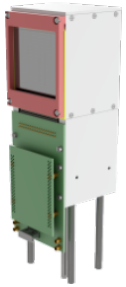


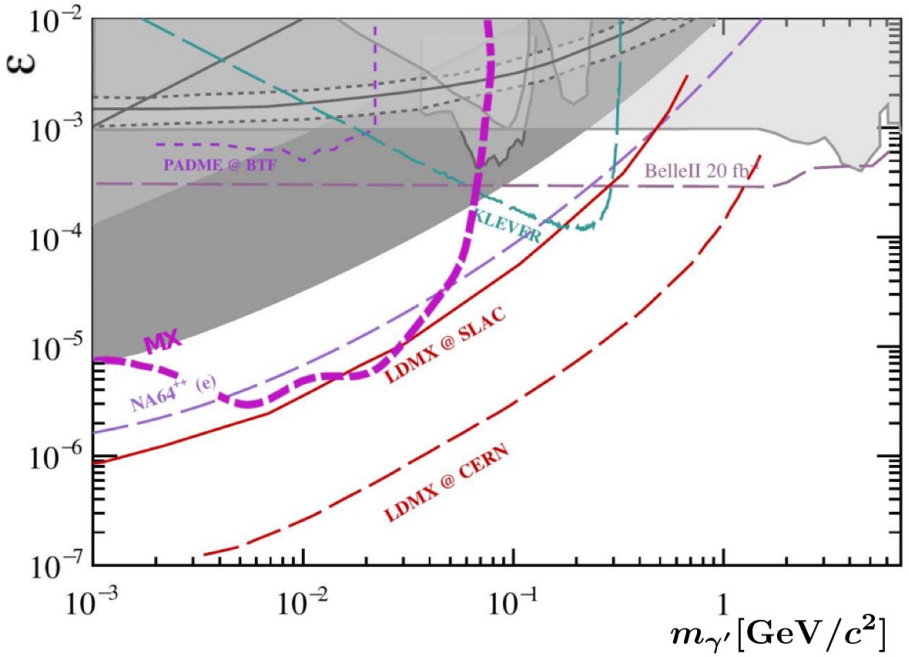
MAGIX – Dark Photon.

Invisible decay

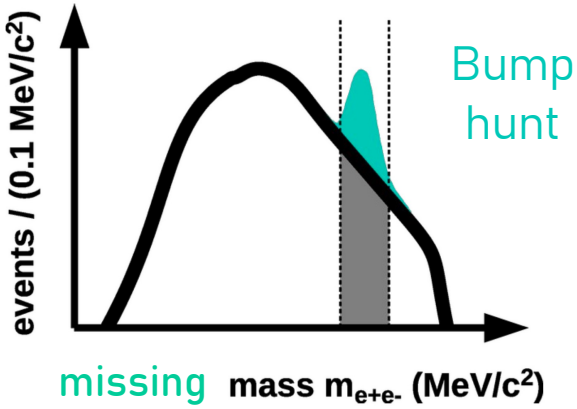








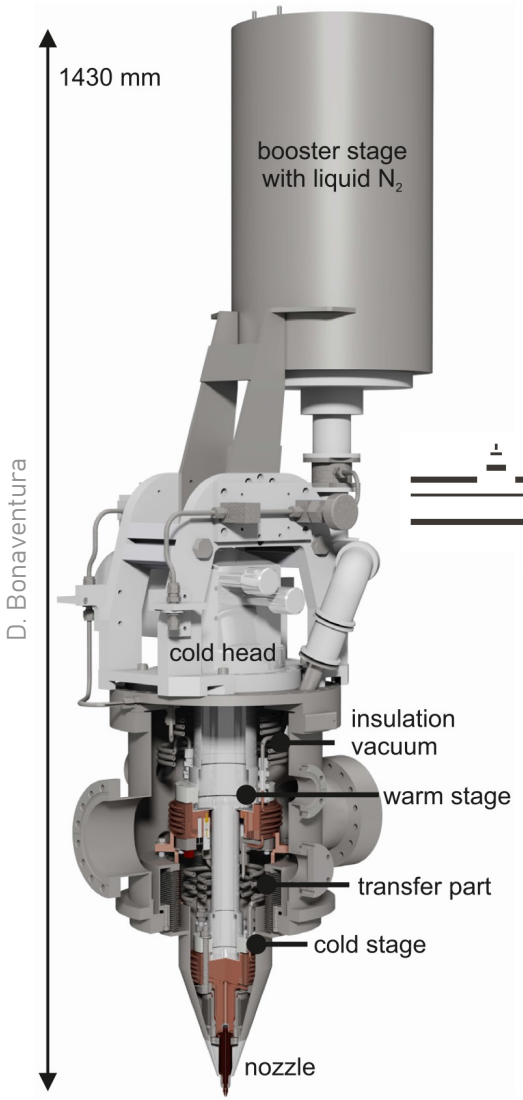
Coincidence measurement between one spectrometer and the silicon strip detectors



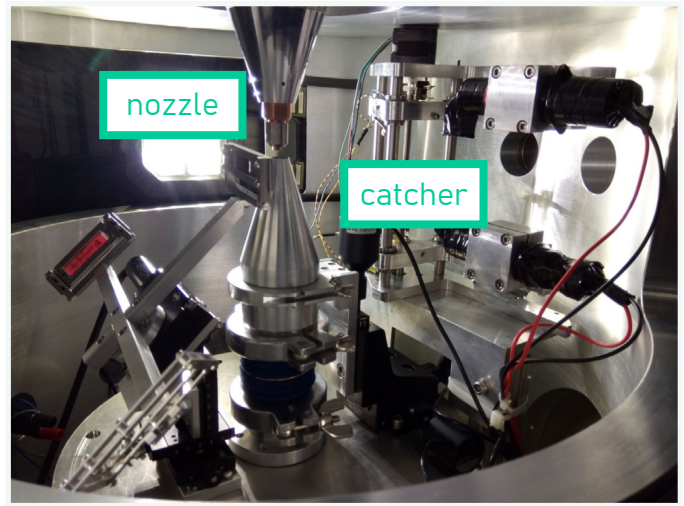
MAGIX – Gas Jet Target.

- Windowless gas jet target
- Operated with gases from hydrogen up to xenon
- Typical value for hydrogen operation: 40 K and 40 l/min
- Target thickness: $\geq 10^{18}$ atoms/cm^2

➡ Luminosity: 10^{35} cm^{-2}s^{-1}




P. Brand



S. Schlimme *et al.*, 10.1016/j.nima.2021.165668

MESA – Status & Impressions.



