DarkLight@ARIEL

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APS Global Physics Summit 2025

Center for Frontiers in Nuclear Science

Stony Brook University

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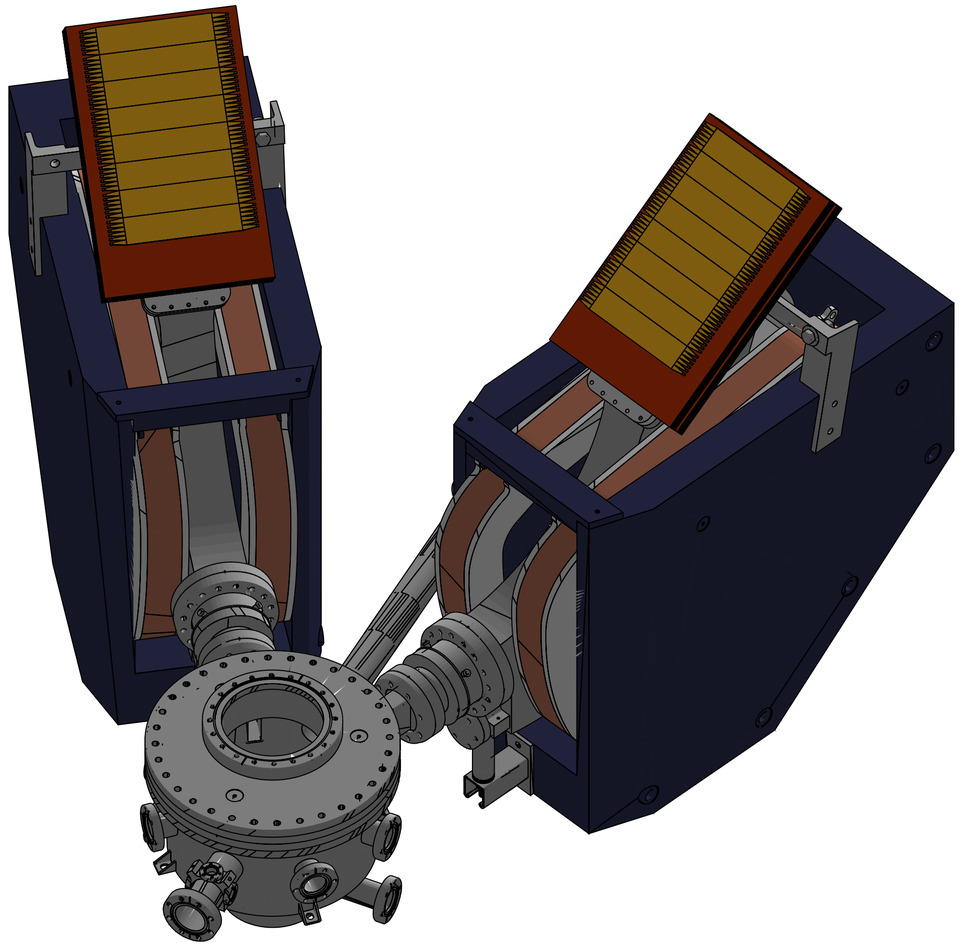
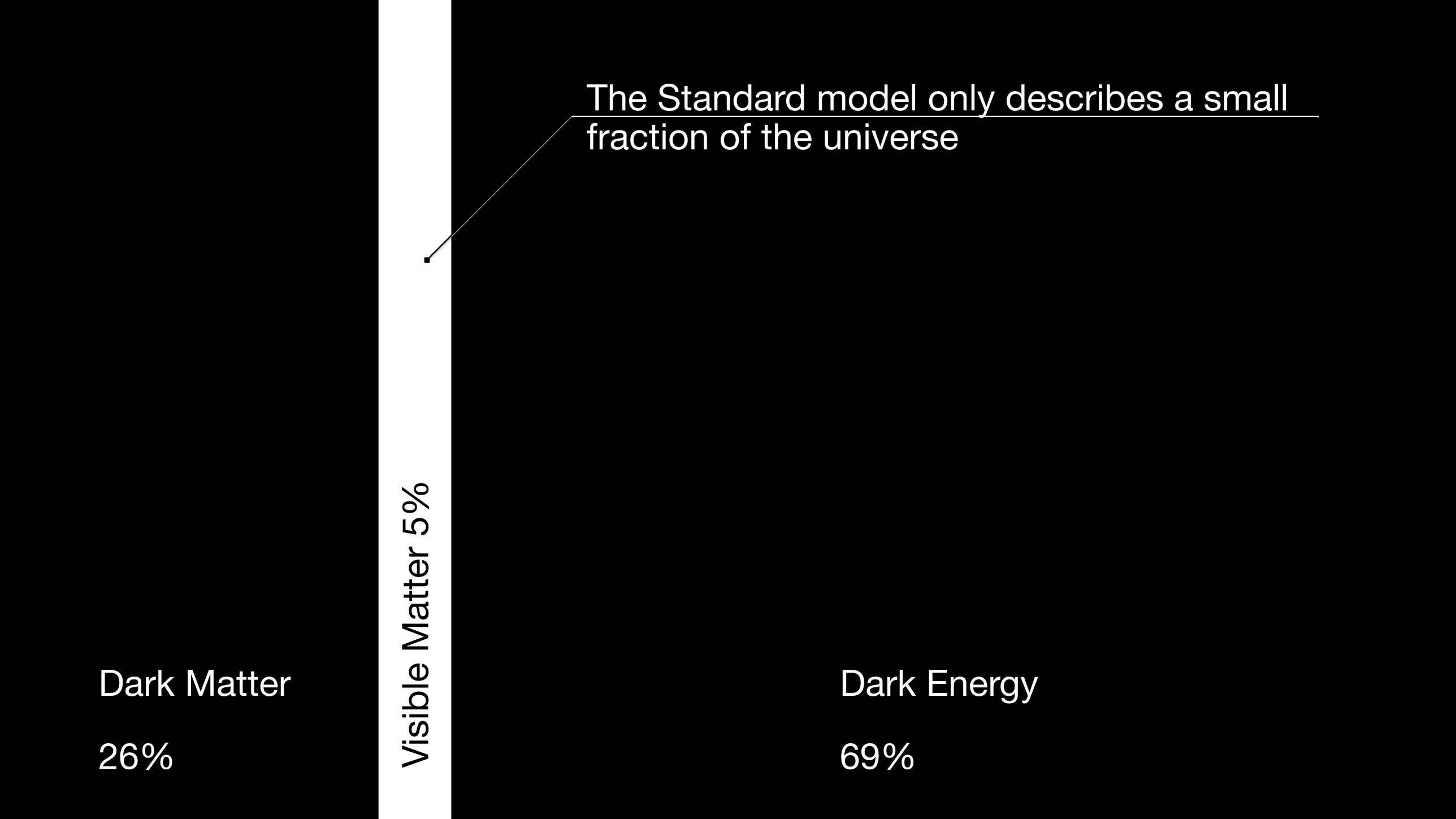
DARKLIGHT @ ARIEL




The Standard model only describes a small fraction of the universe
Visible Matter 5%
Dark Matter
26%
Dark Energy
69%

Dark Matter

Visible Matter

One way to search for BSM physics:

Sweep the phase space and check for simple models

Dark Matter

Visible Matter

One way to search for BSM physics:

Sweep the phase space and check for simple models

Another way:

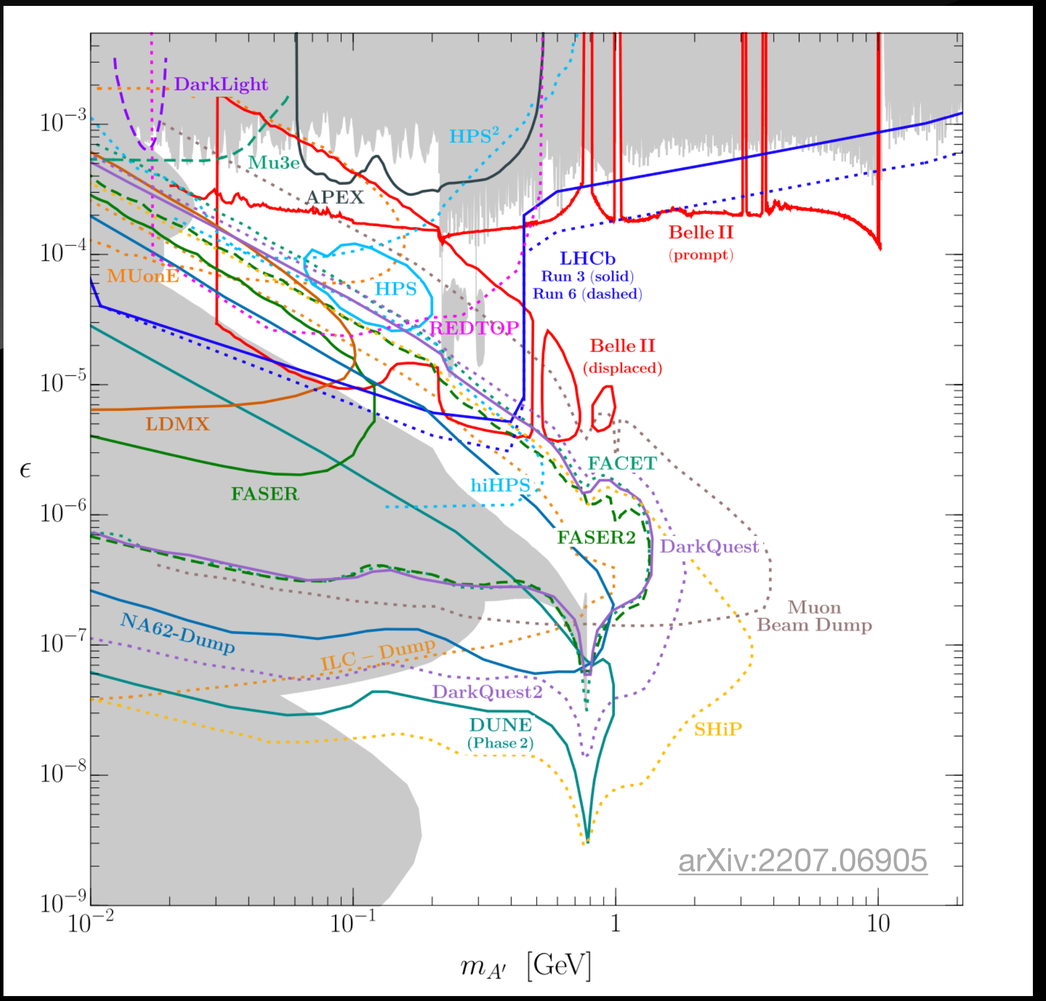
Look at anomalies for complex models

Dark Matter

Visible Matter

One way to search for BSM physics:

Sweep the phase space and check for simple models



Another way:

Look at anomalies for complex models

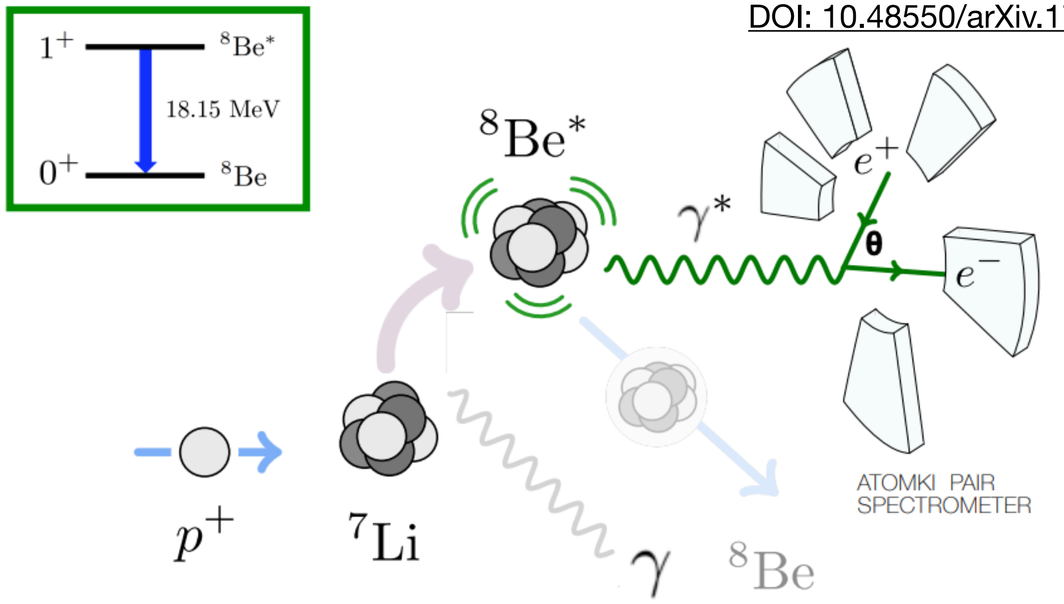
Dark Matter

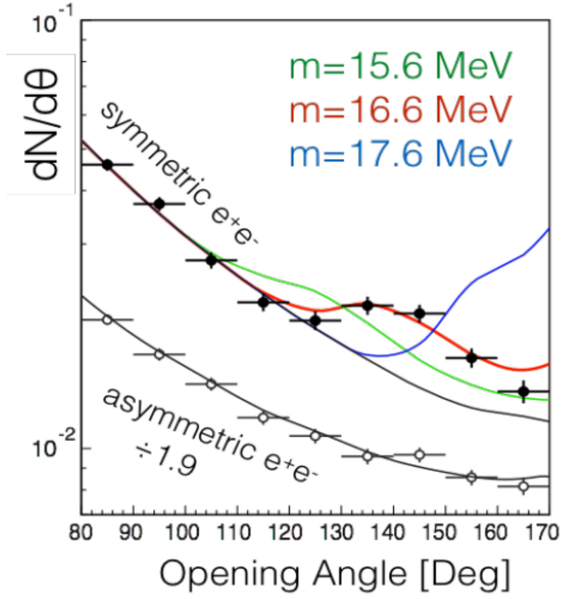
Visible Matter

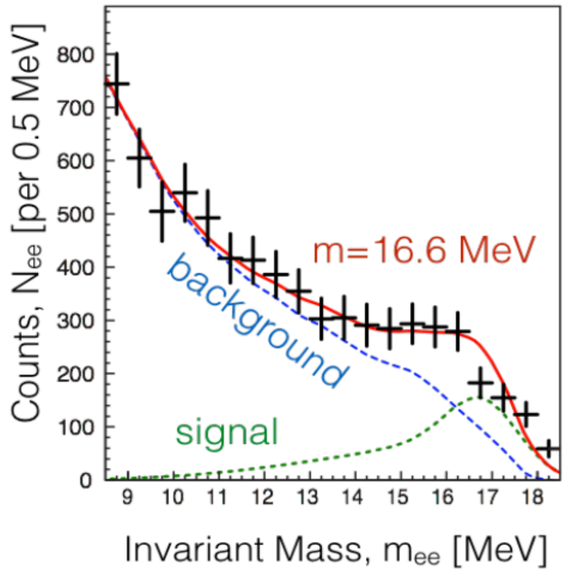
X17:
The ATOMKI Experiment

- New boson with mass 17 MeV?
- Photon like but protophobic

DOI: 10.1103/PhysRevLett.116.042501
DOI: 10.48550/arXiv.1707.09749







X17:
The ATOMKI Experiment

- New boson with mass 17 MeV?
- Photon like but protophobic
- Also observed in other decayed measurements with separated apparatus: DOI: 10.1103/PhysRevC.104.044003

DOI: 10.1103/PhysRevLett.116.042501

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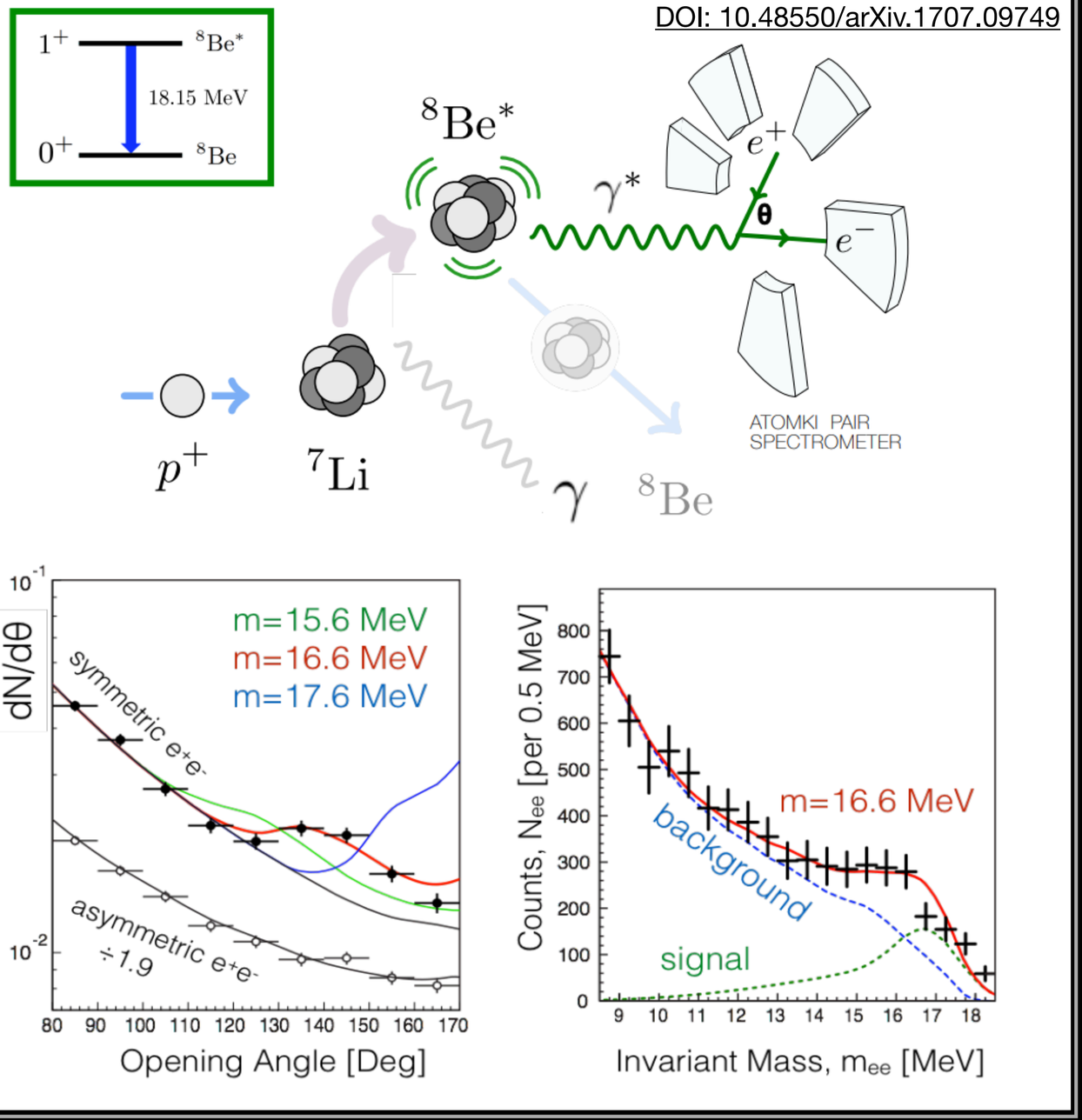
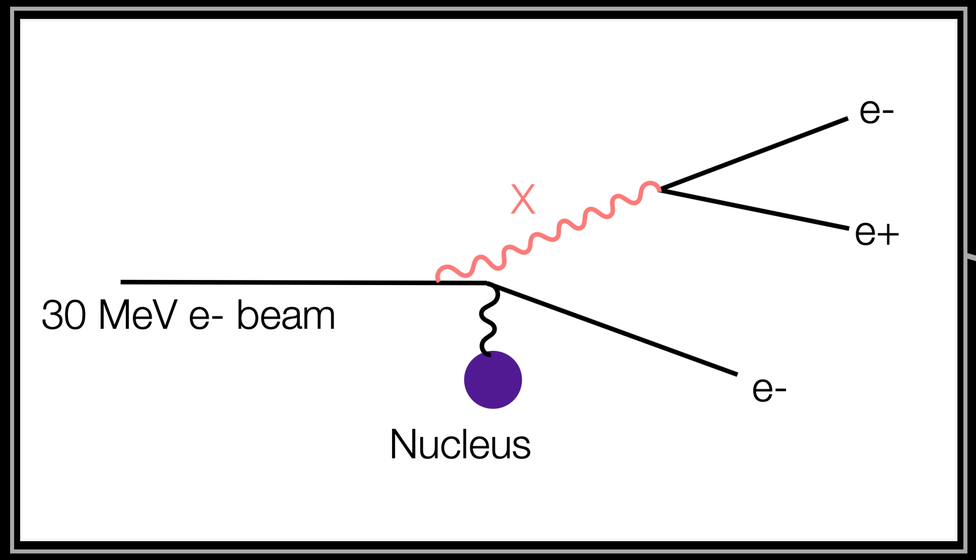
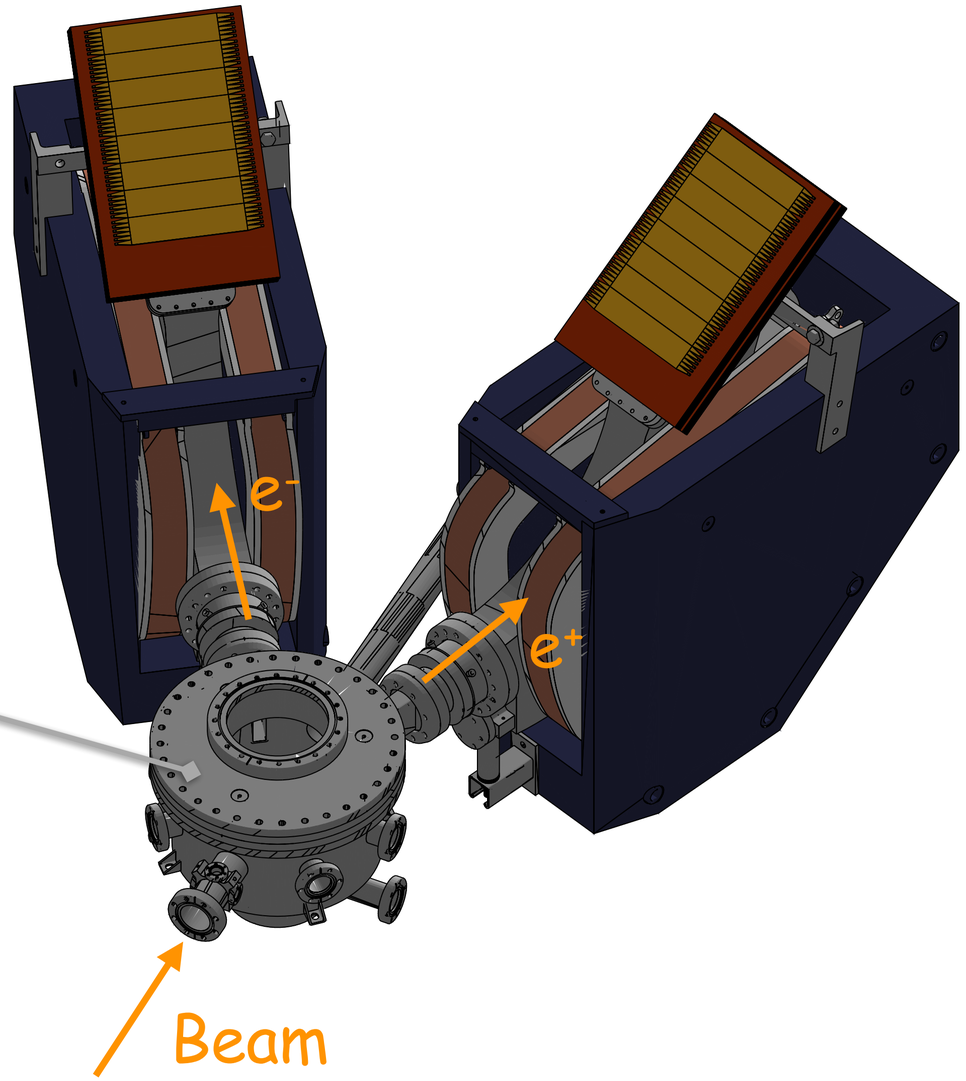


DarkLight Experiment

- Two-spectrometer setup
- Tantalum foil target



DARKLIGHT @ ARIEL

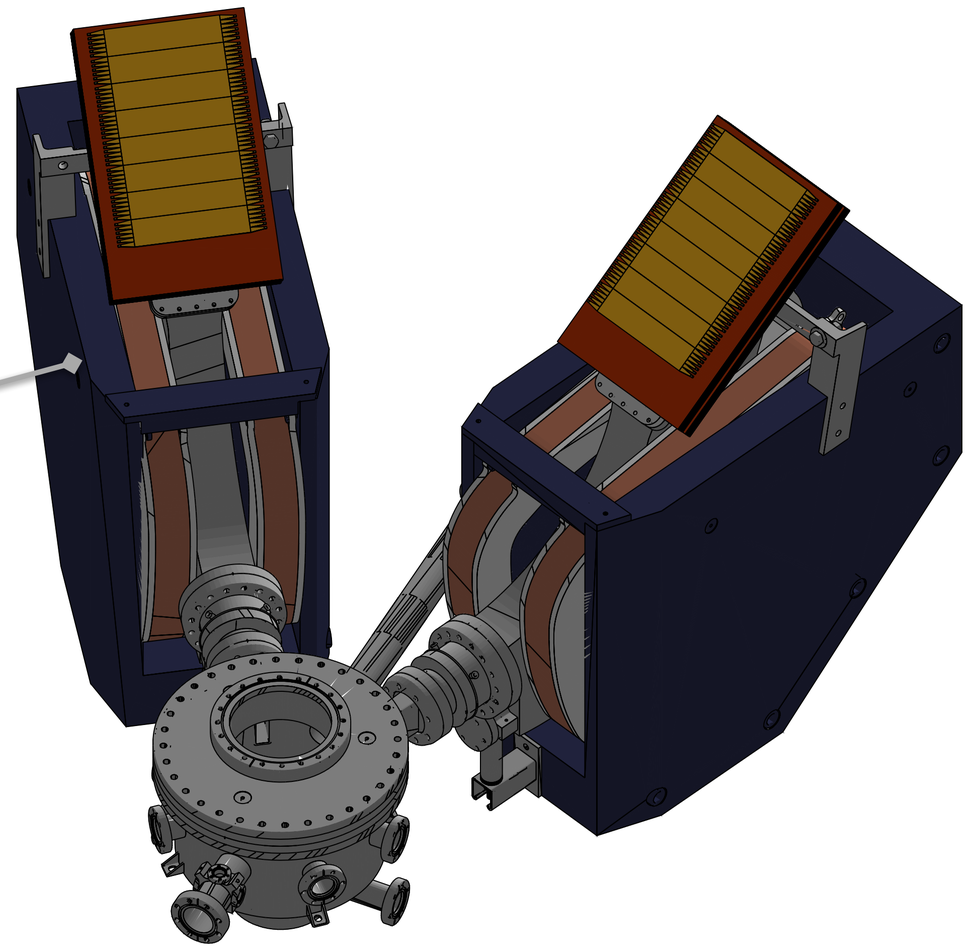


Detector setup:

- **Magnetic spectrometers**

- $\pm 1.35^{\circ}$ in-plane, $\pm 5^{\circ}$ out-of-plane angle
- $\pm 20\,\%$ momentum

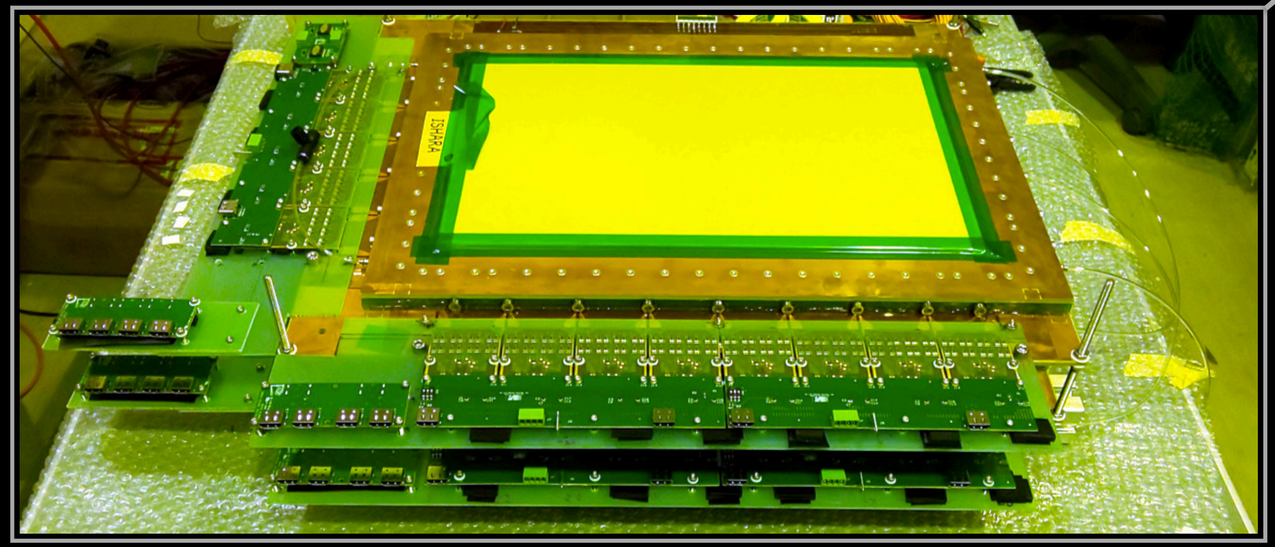
DARKLIGHT @ ARIEL



Detector setup:

- **GEM trackers**

- 25 x 40 cm triple layer GEMs
- 2 planes per spectrometer arm
- APV + MPD4 readout



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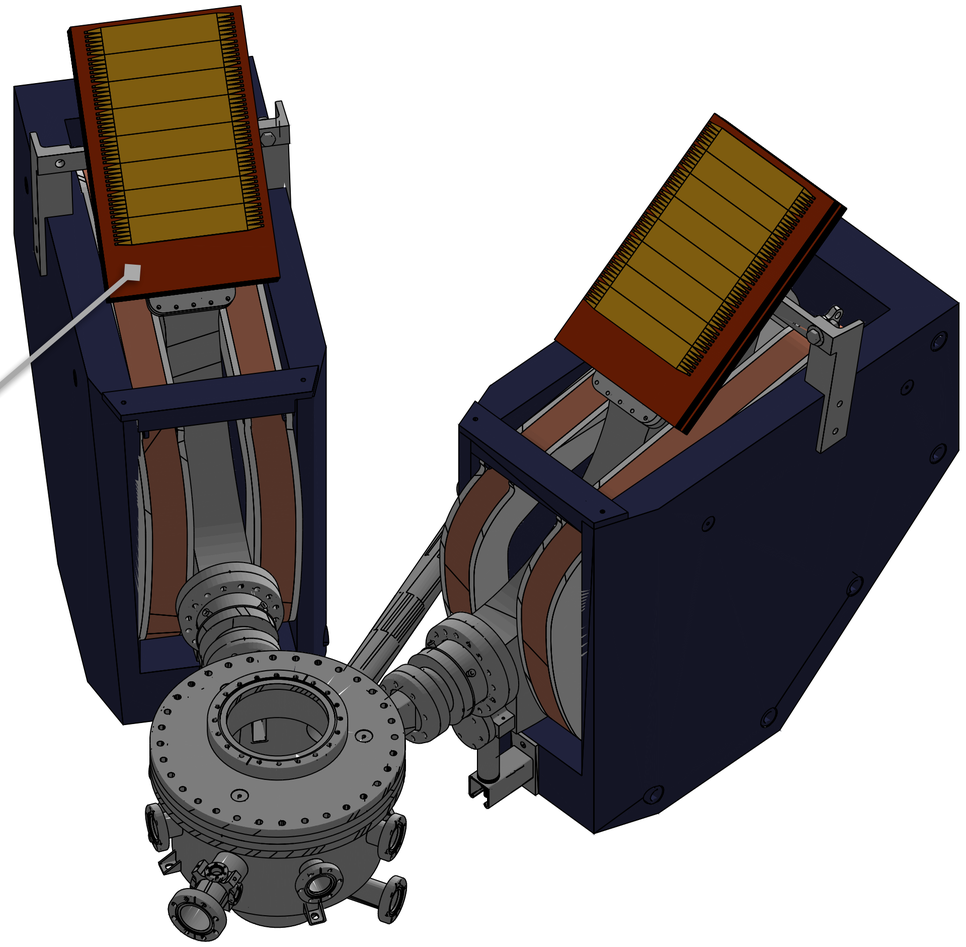
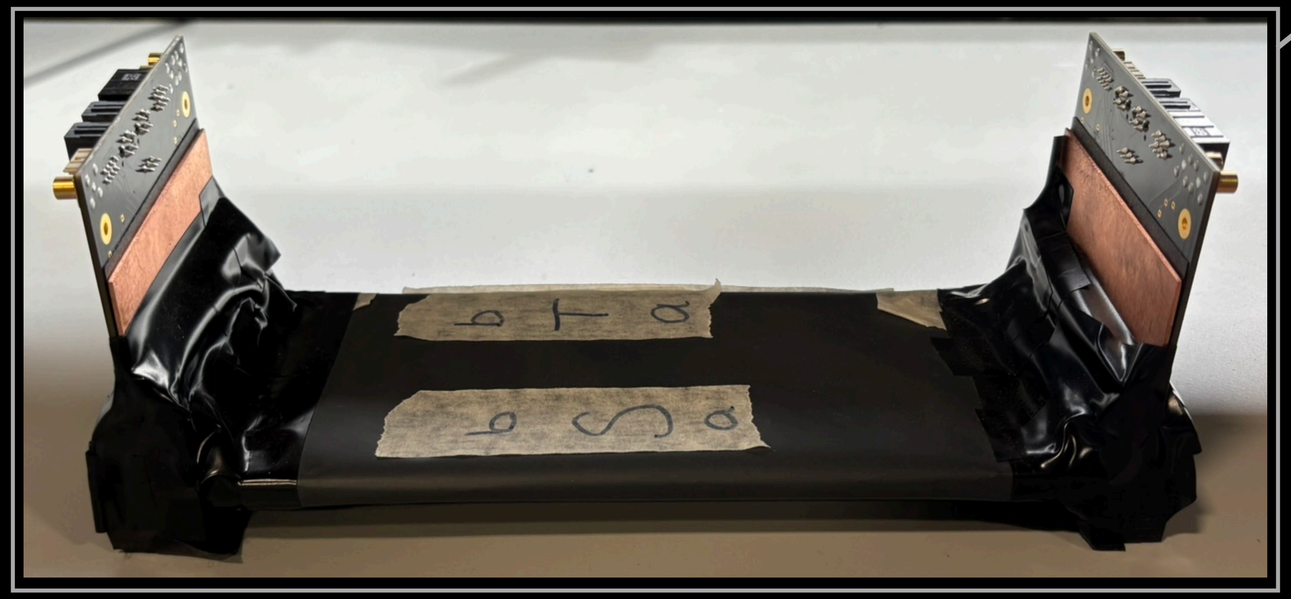


Detector setup:

- **Scintillator triggers**

- 8 paddles per spectrometer
- Plastic scintillators, SiPM readouts



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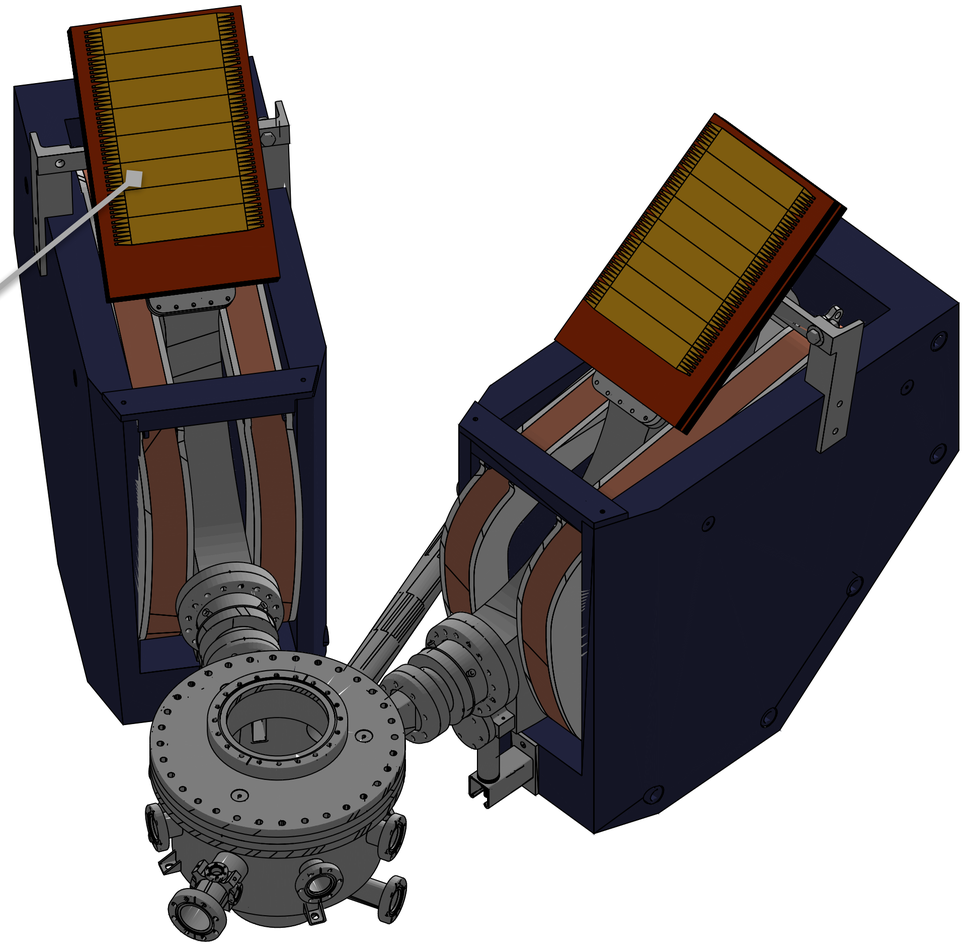
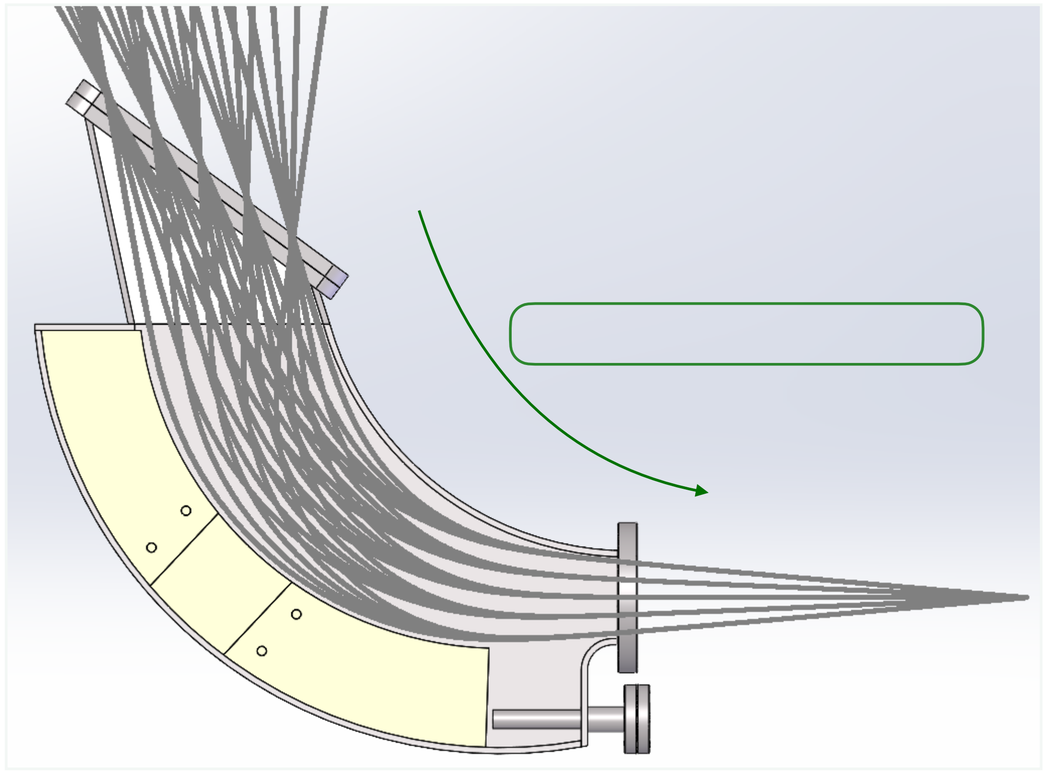
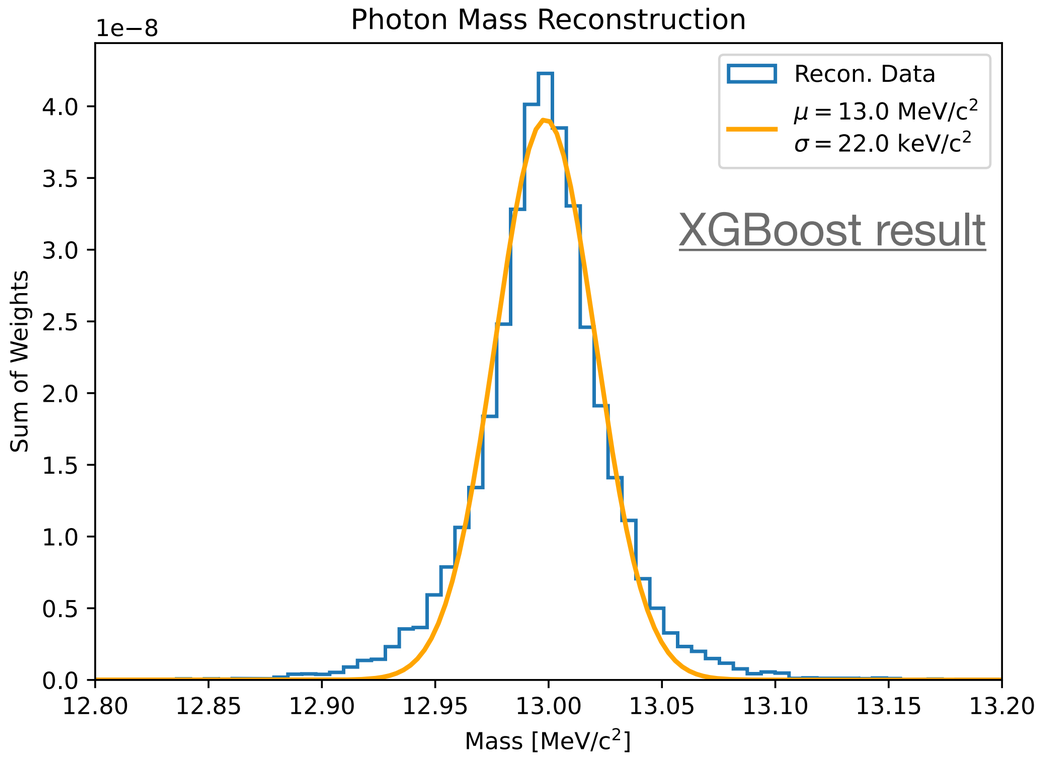


Mass Reconstruction

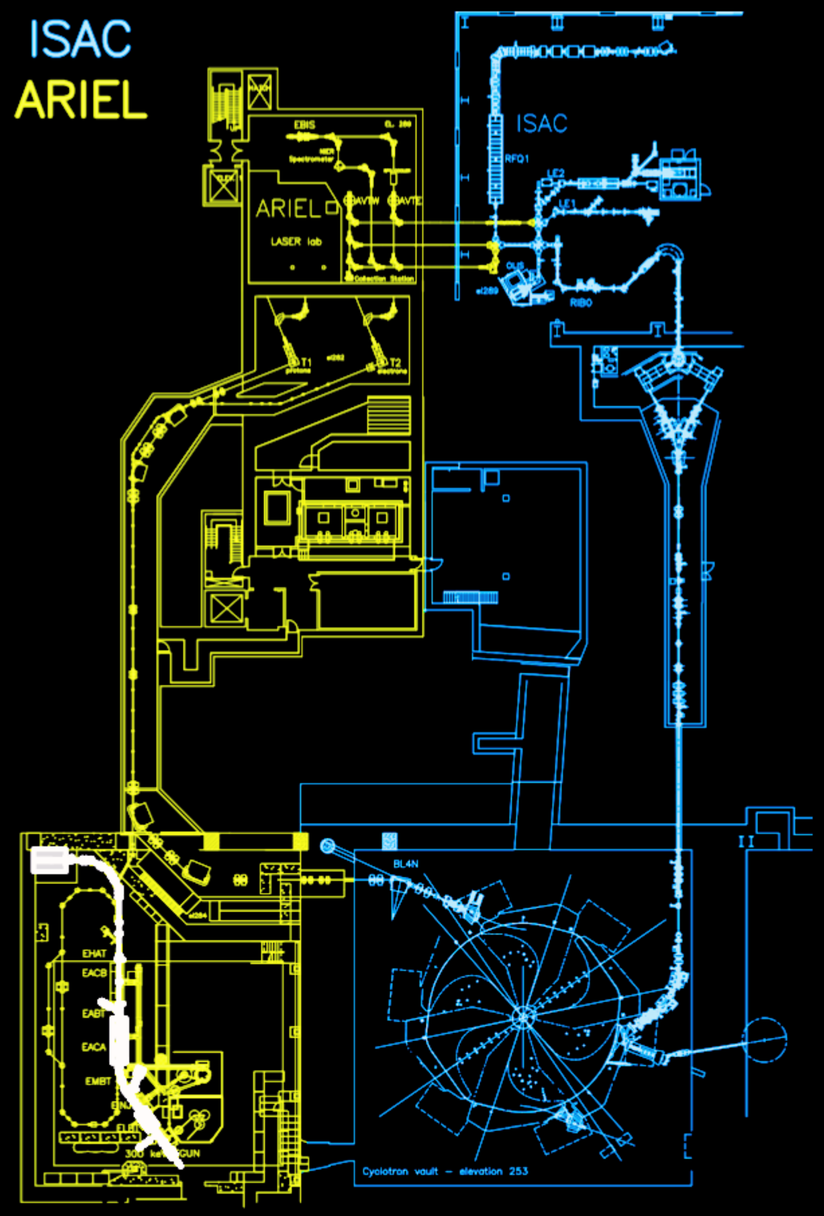
- Magnetic field map is imported to simulation for reconstruction study





Beamline:

TRIUMF ARIEL
ADVANCED RARE ISOTOPE LABORATORY



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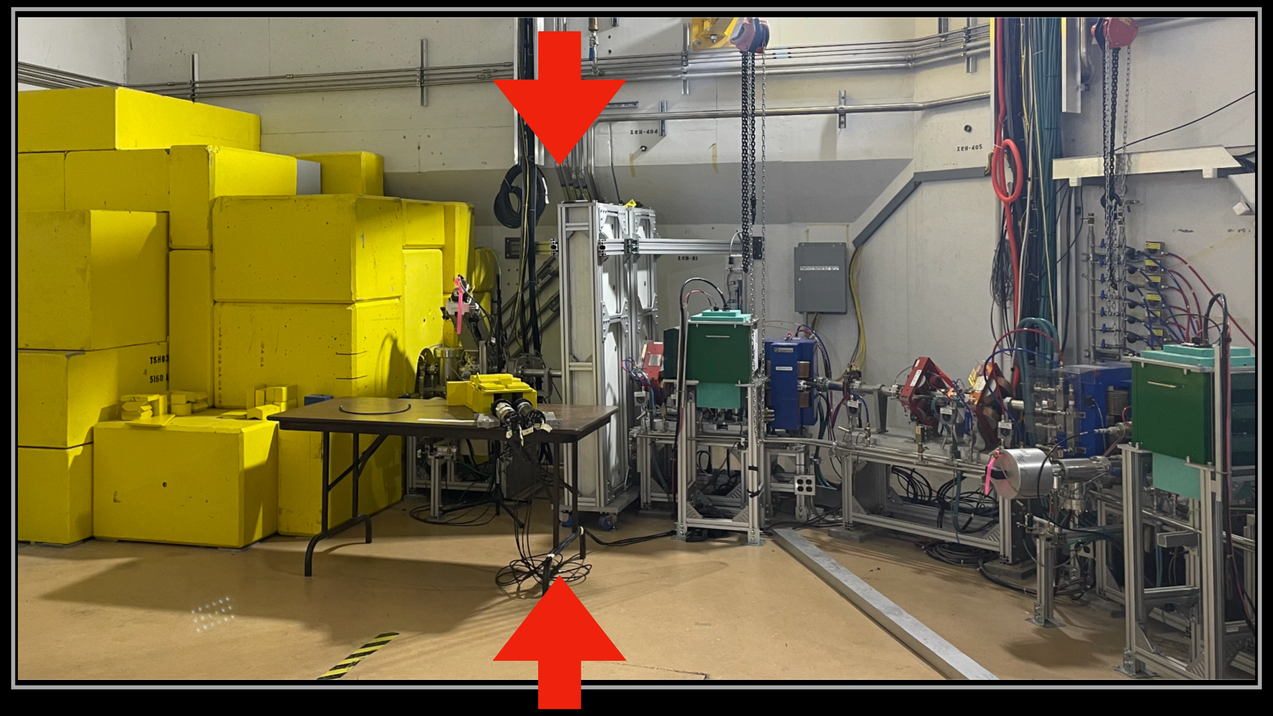
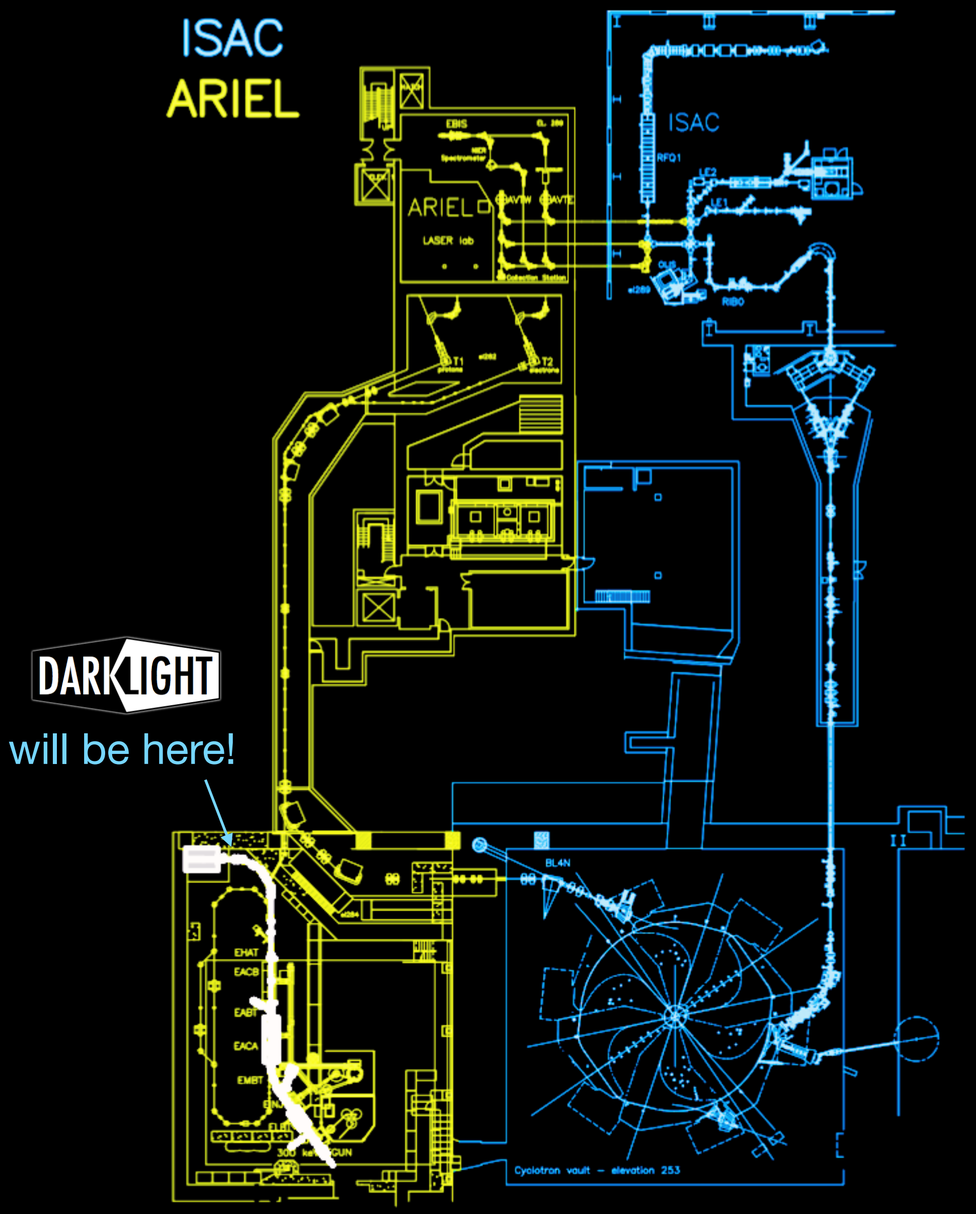


ISAC
ARIEL



DARKLIGHT will be here!

Electron linac

Beamline:

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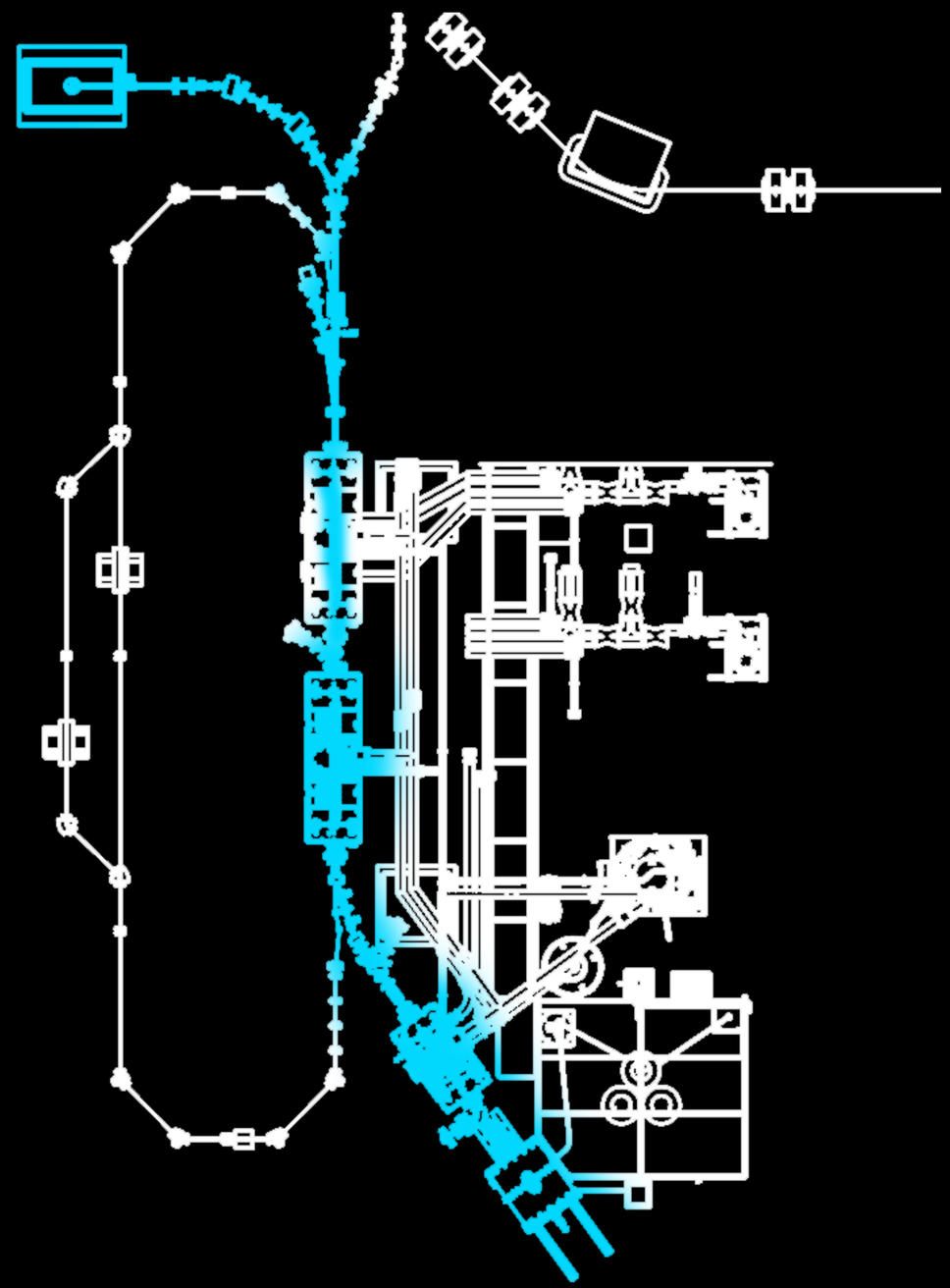

Beamline:

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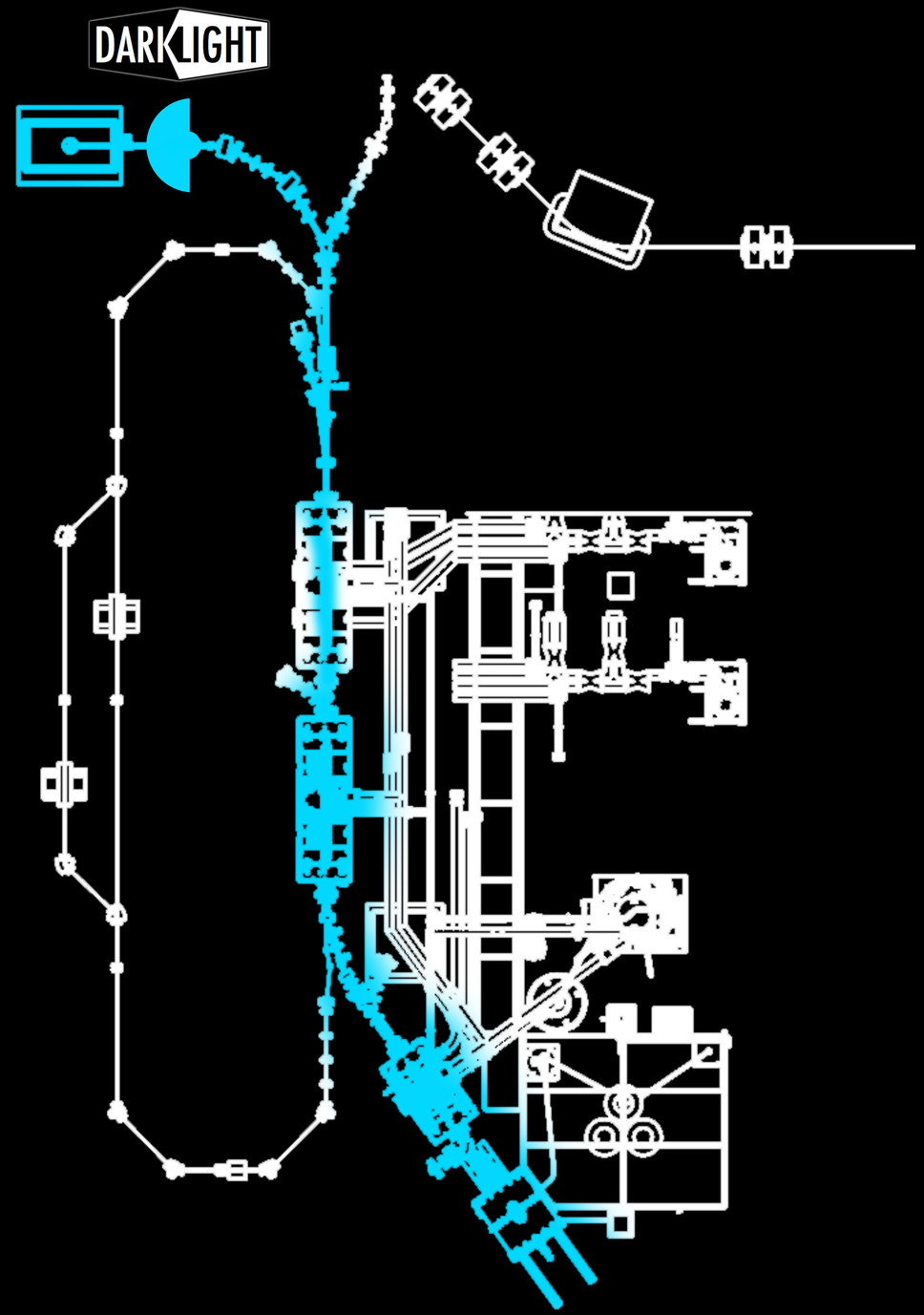
- Phase 1: up to 30 MeV



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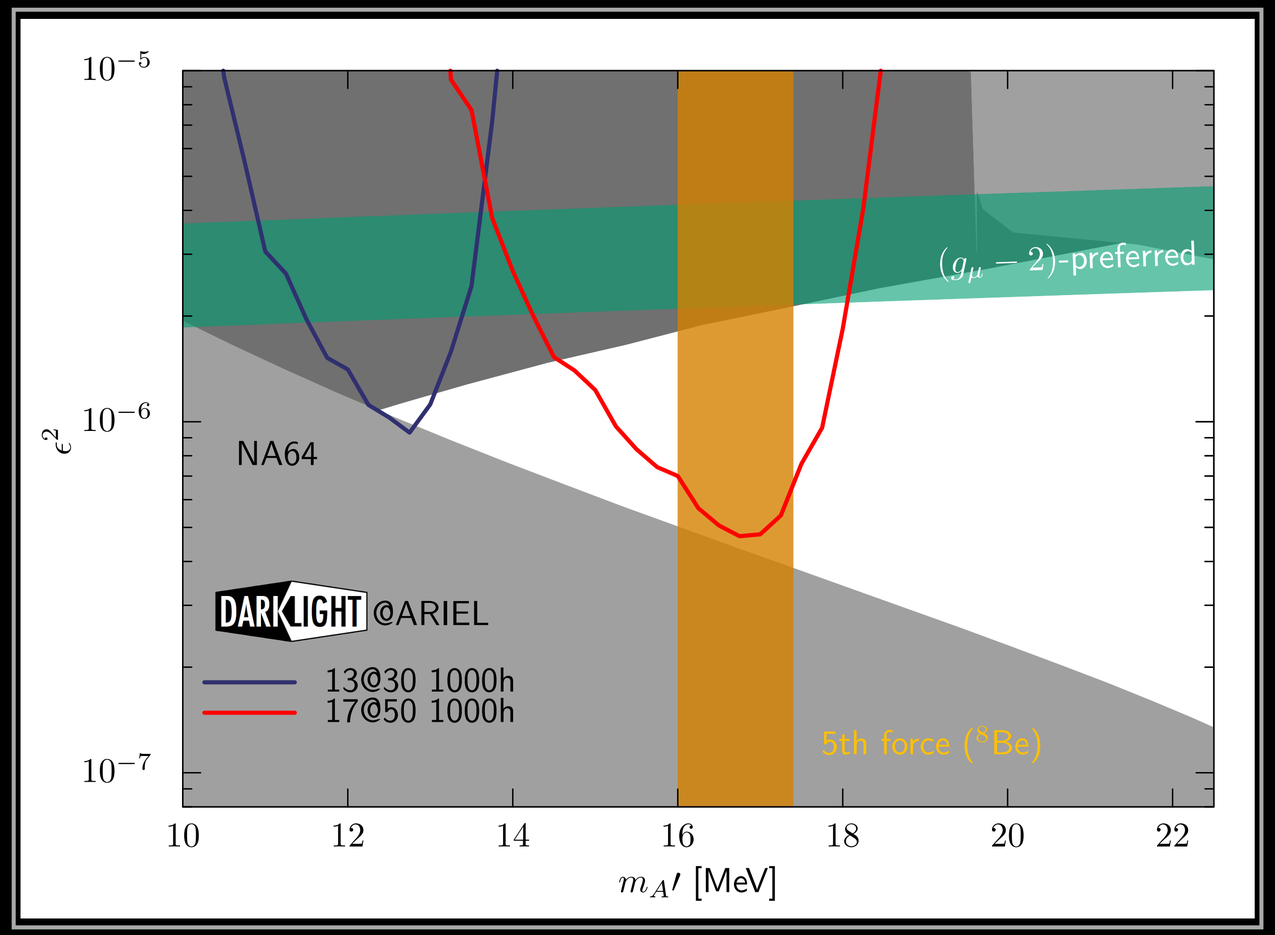

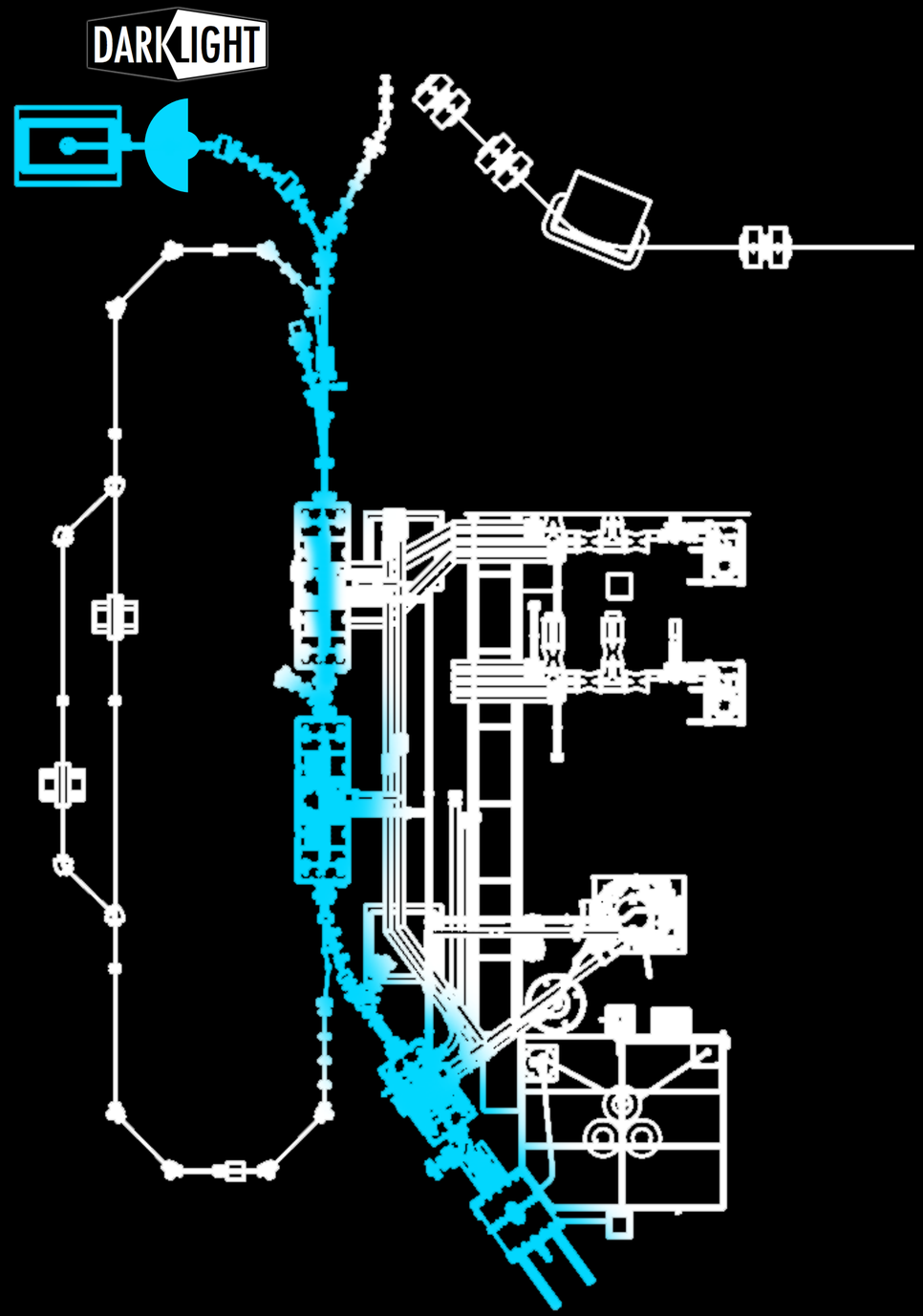

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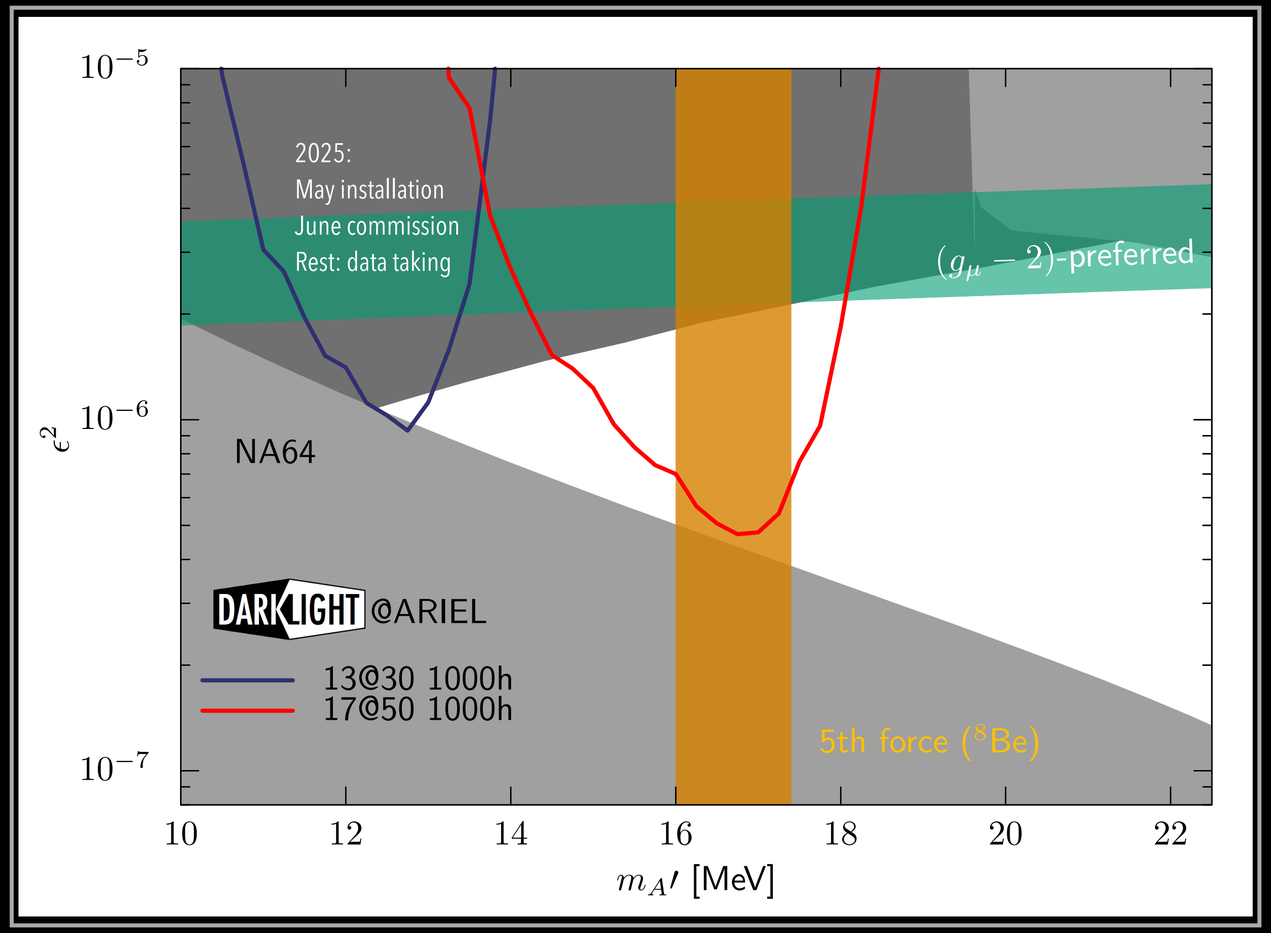

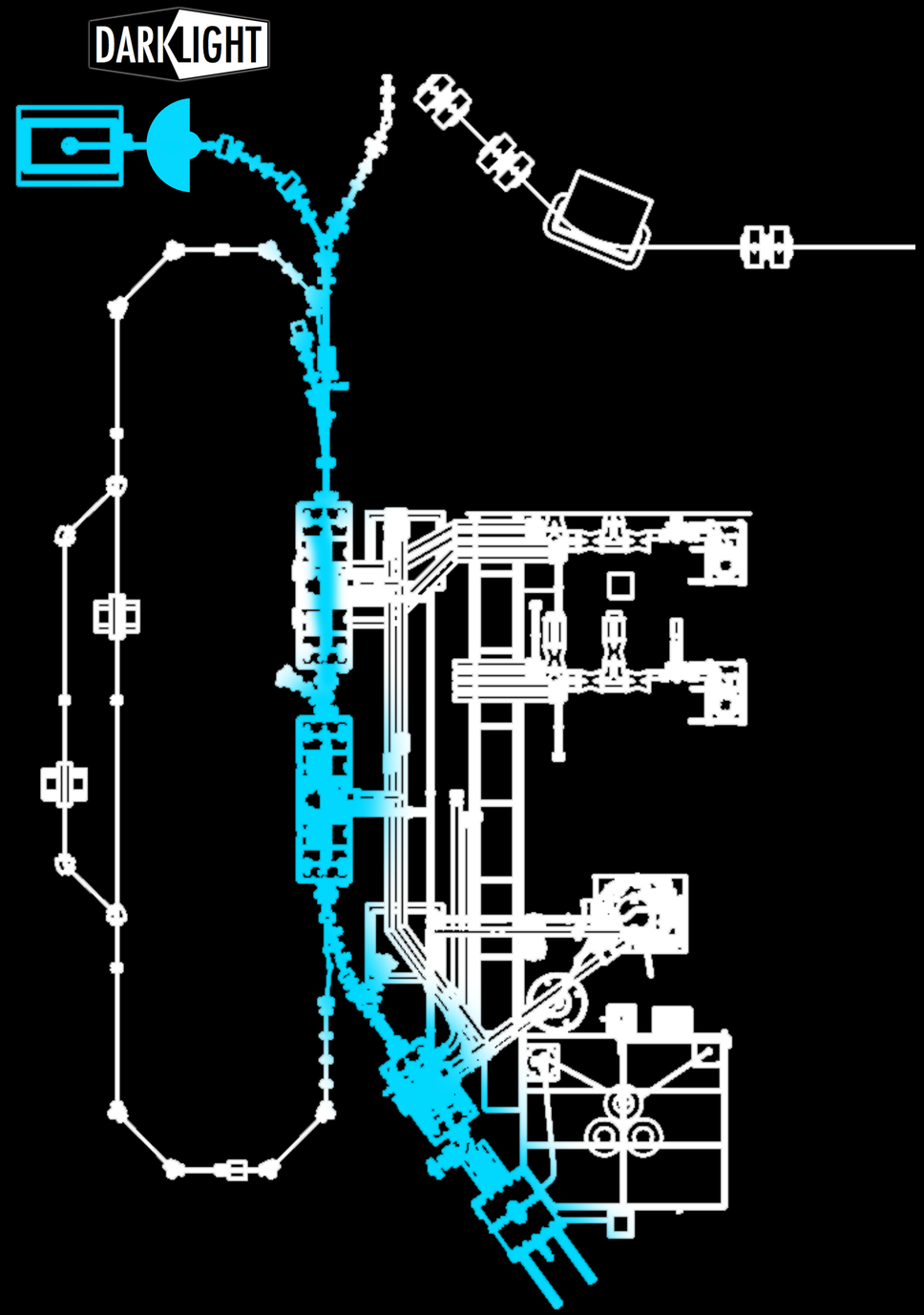

Beamline:

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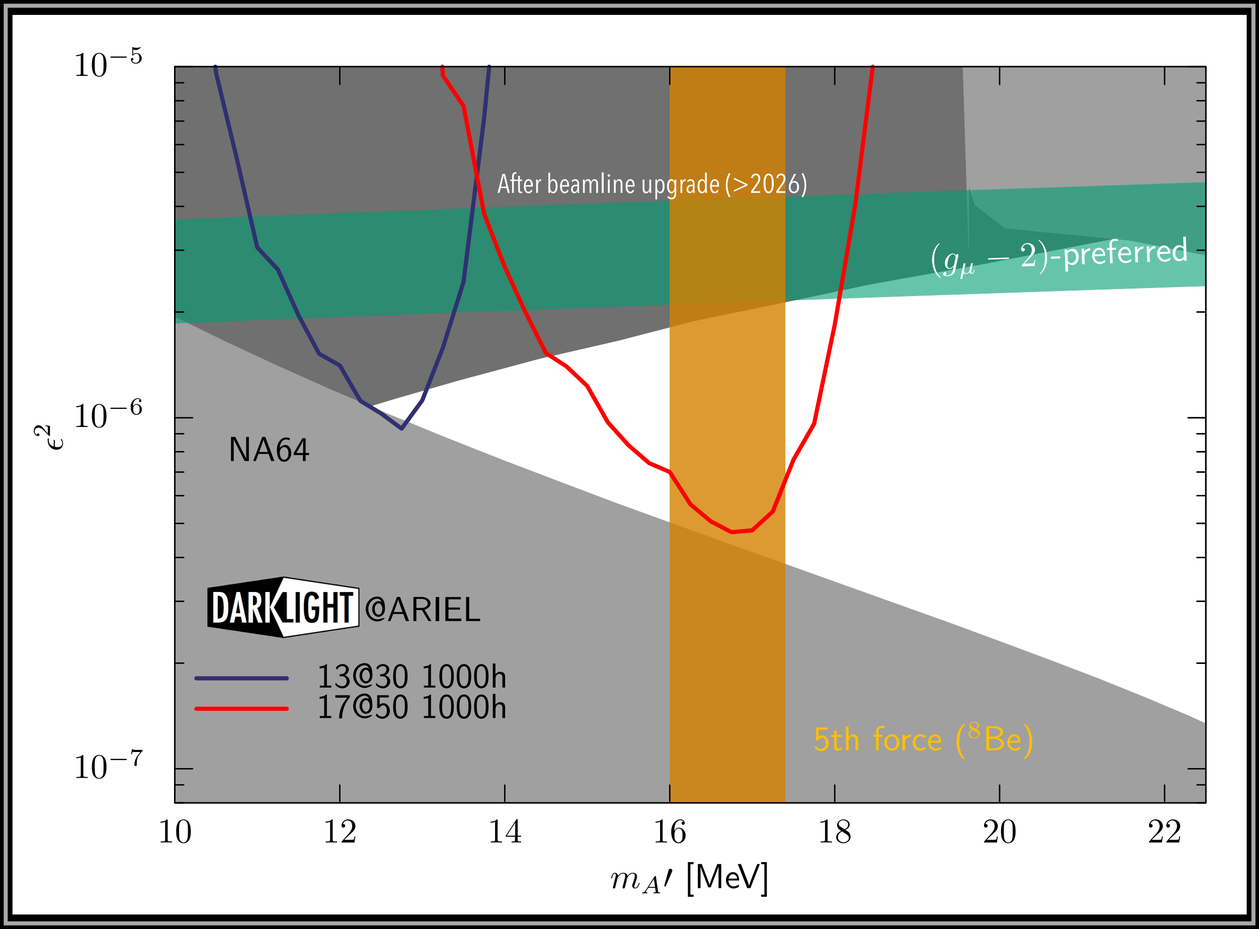
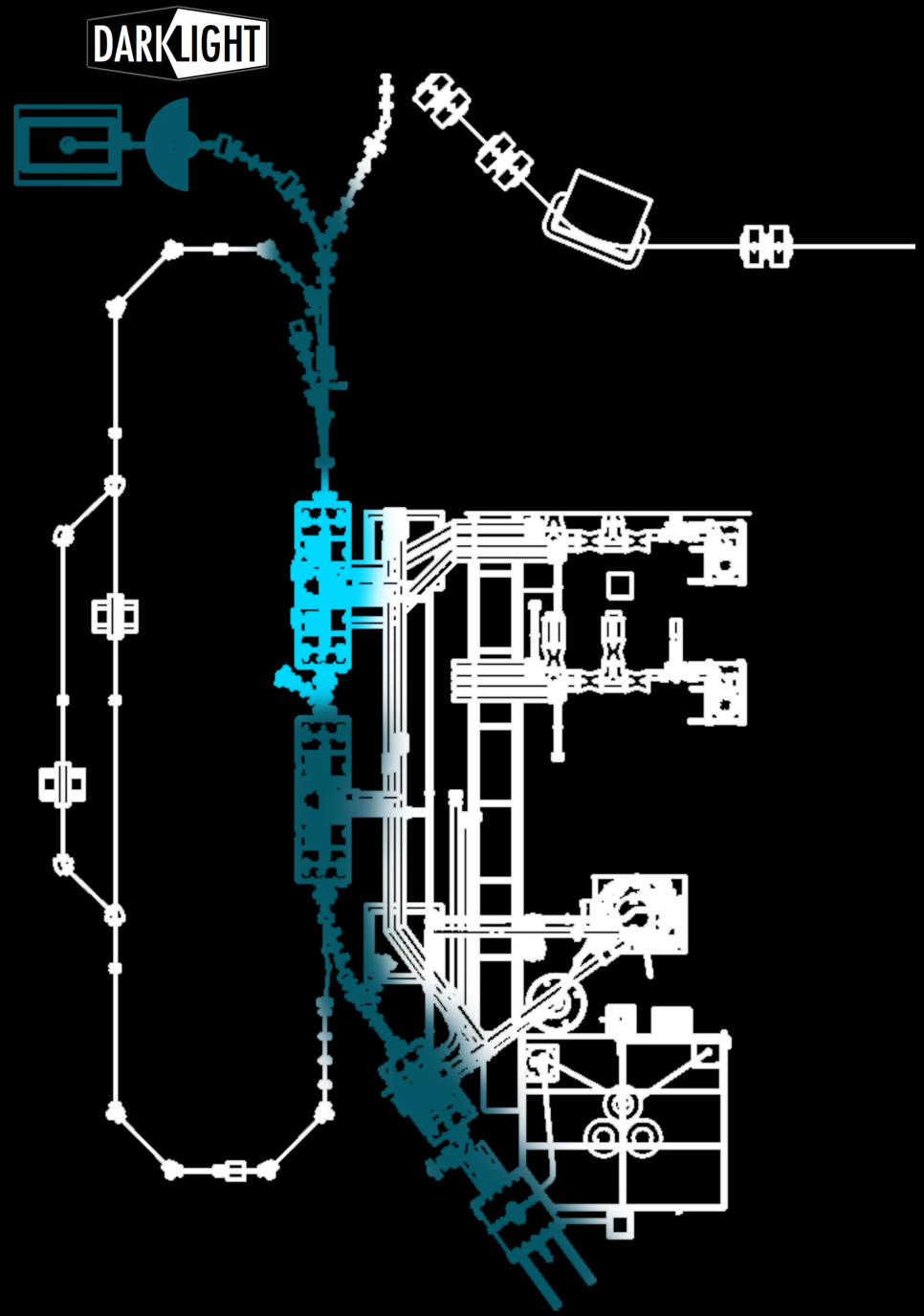
ADVANCED RARE ISOTOPE LABORATORY

- Phase 2: up to 50 MeV





Beamline:

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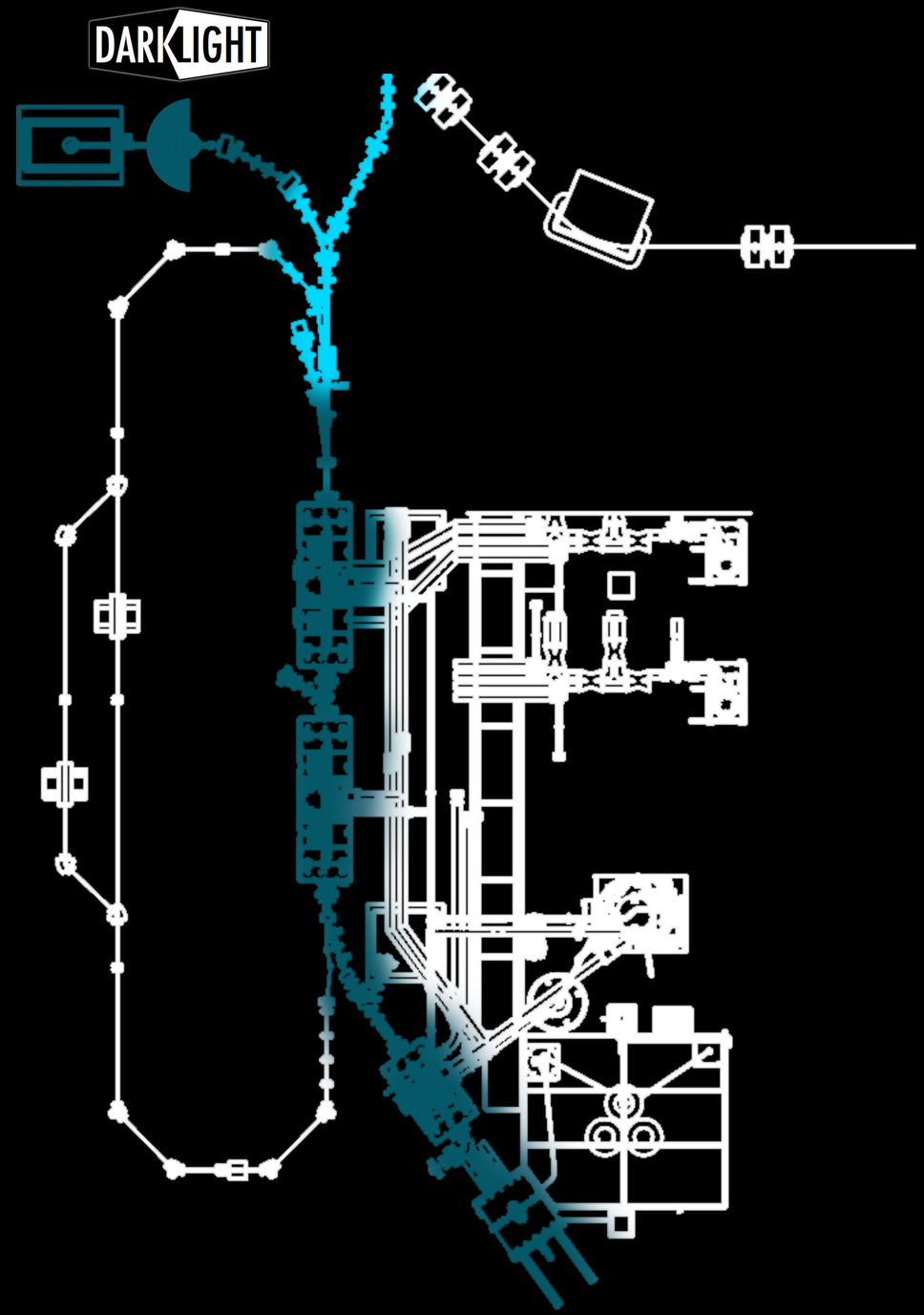
- Phase 3:
  - Fast beam switcher
  - Simultaneous ARIEL+DL



Beamline:

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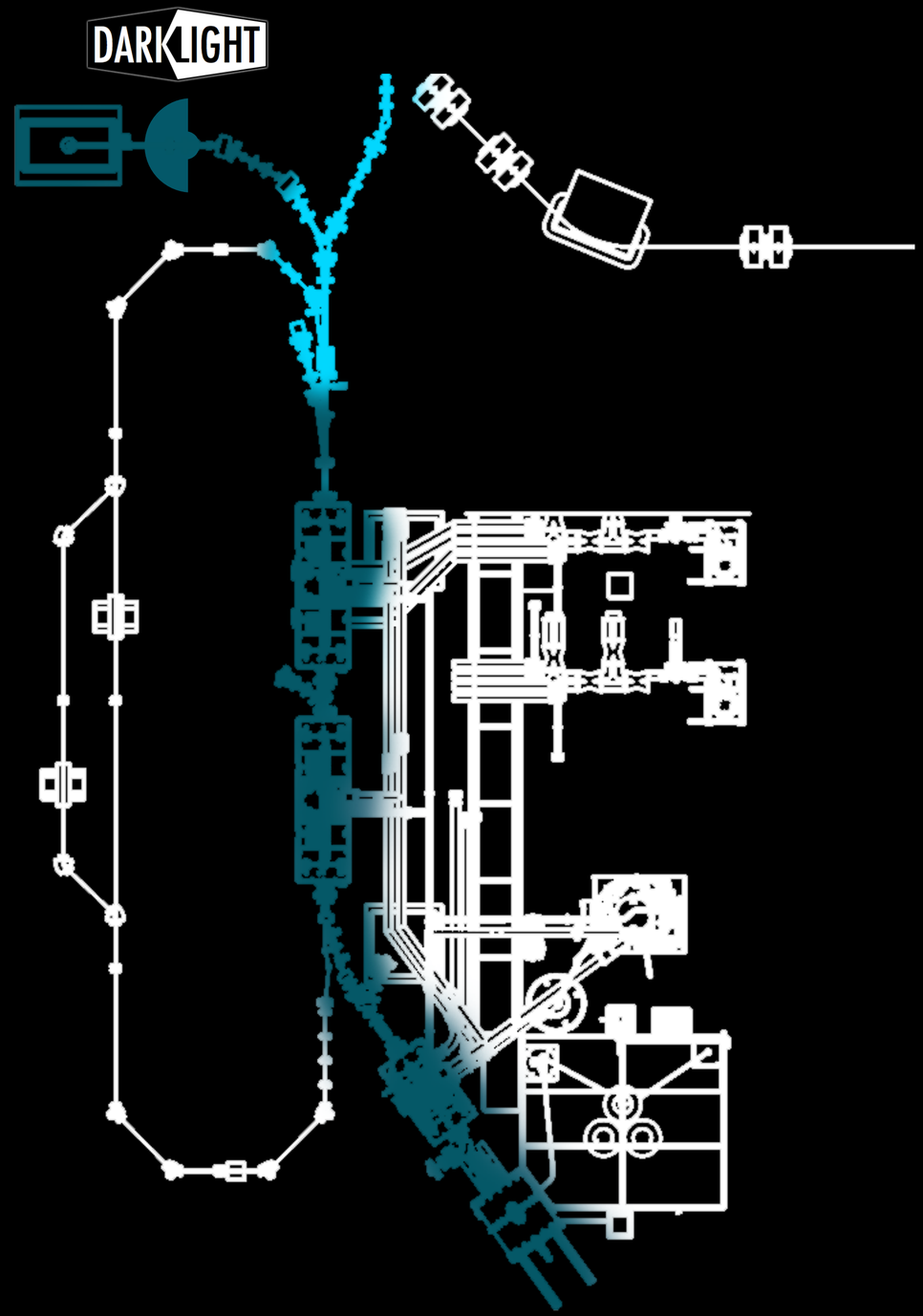
- Additional physics possible:
  - Radii of nuclei
  - S-factor
  - Radiative Møller scattering
  - Axial form factor
  - …

DOI: 10.1088/1742-6596/2391/1/012001

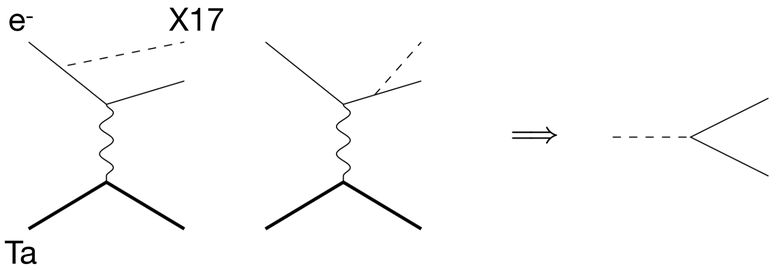


Summary

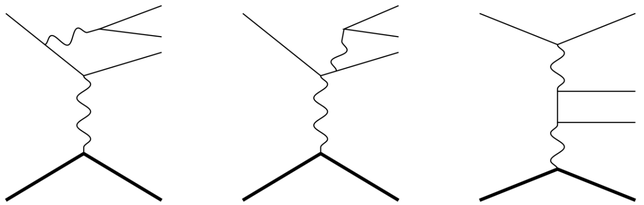
- DarkLight@Ariel is checking for X17
- More physics measurements are possible
- Installation for 30 MeV run in May

Background

Signal



Irreducible background



Combinatorial background