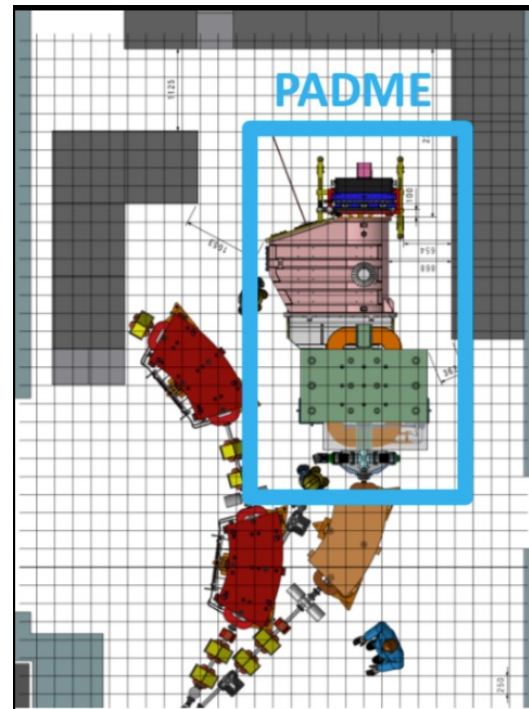


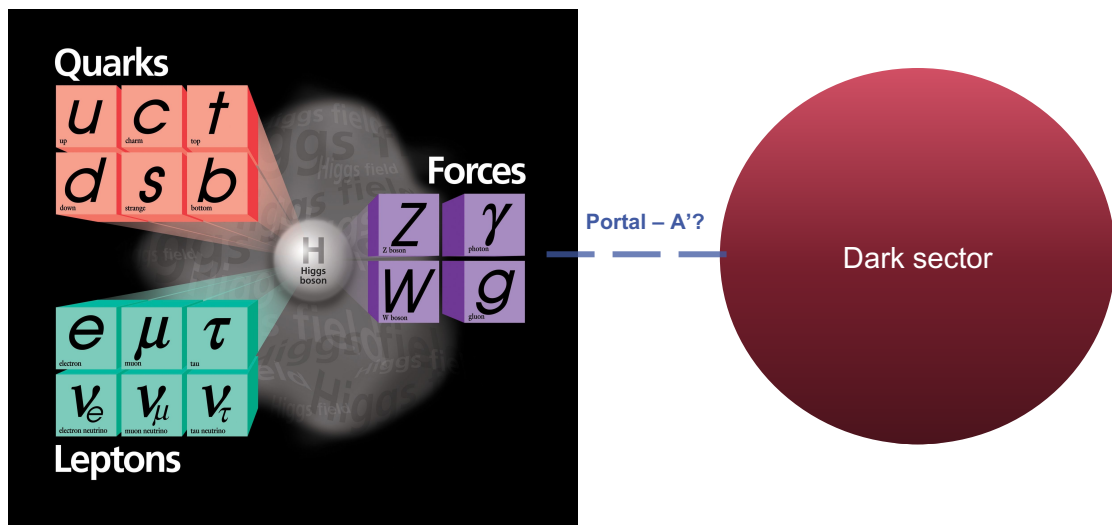
Searching for the Dark Photon at the PADME Experiment



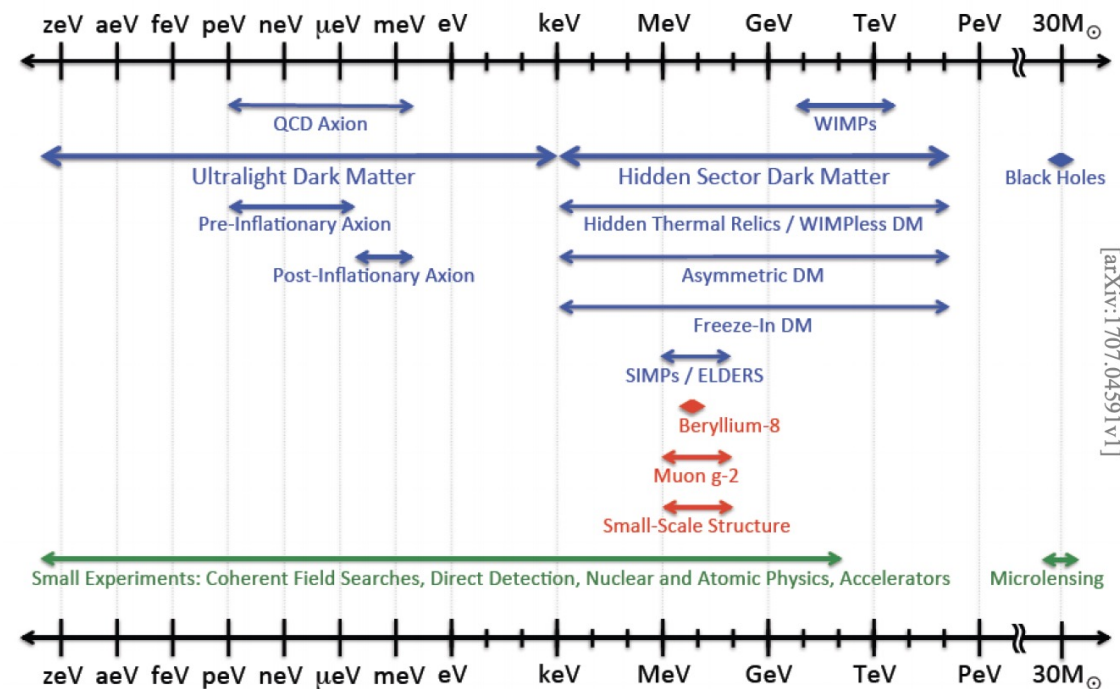
Elizabeth Long - Sapienza Università di Roma

The Dark Photon

- Dark photon (A') = portal between Standard Model & Dark Sector
- Massive vector boson
- SM- A' coupling $\epsilon \ll 1 \Rightarrow$ hidden
- Certain parameters could also explain other anomalies

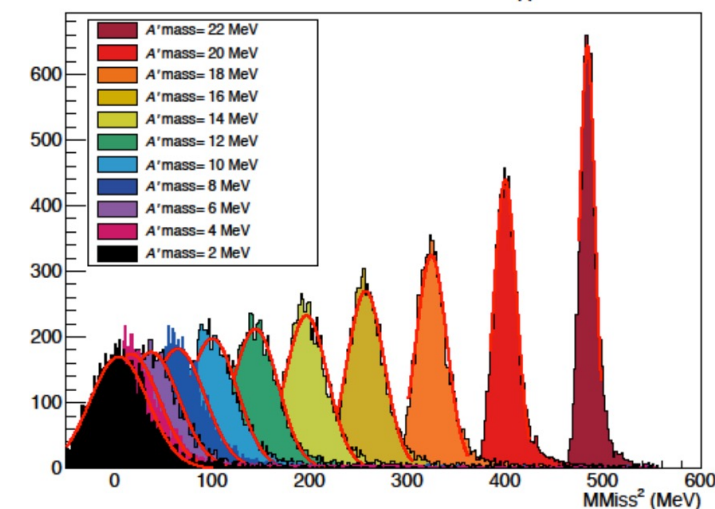
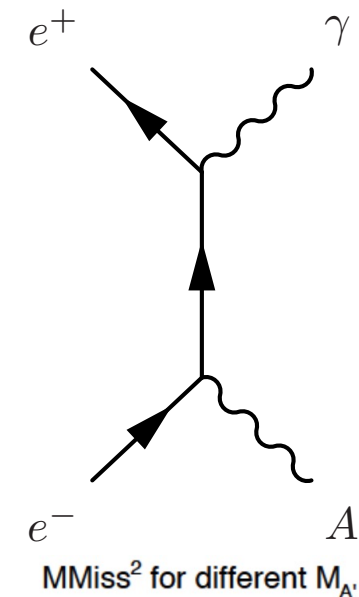
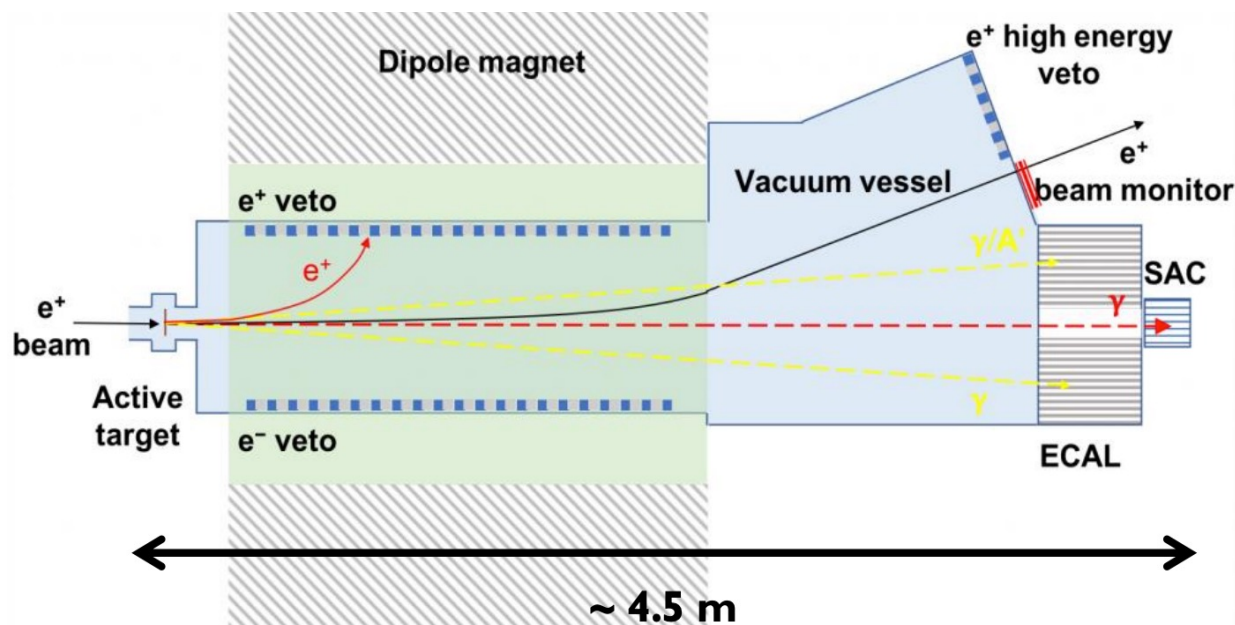


Dark Sector Candidates, Anomalies, and Search Techniques



Dark photon production and detection at PADME

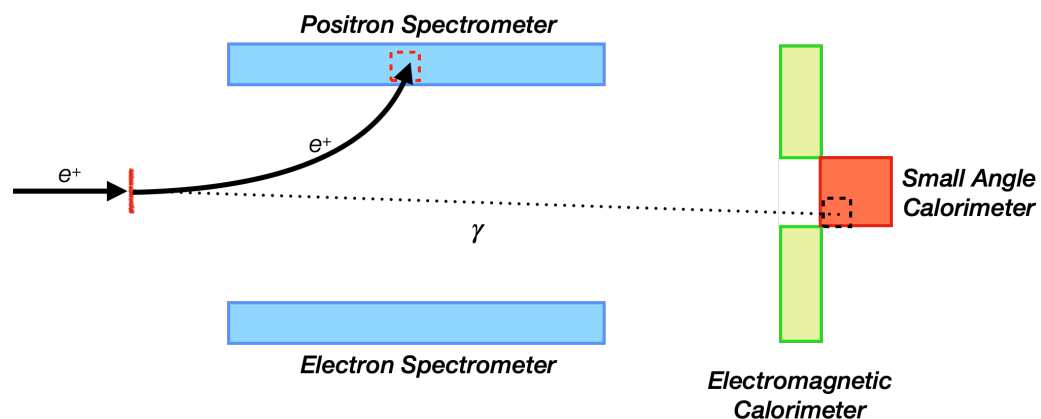
- Positron Annihilation to Dark Matter Experiment: $e^+e^- \rightarrow \gamma A'$
- Up to 550 MeV e^+ beam on diamond target
- Signal: 1 γ in Electromagnetic Calorimeter & nothing elsewhere
- ΔM_{miss}^2 then gives access to $M_{A'}$



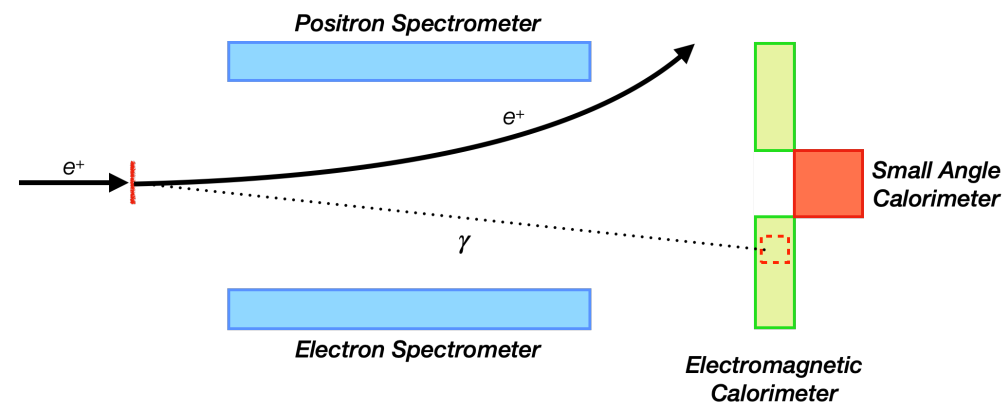
Background sources and rejection

- Main backgrounds:
 - Bremsstrahlung $e^+N \rightarrow e^+\gamma N$
 - 2 or 3 photon annihilation with 1 or 2 undetected photons
- Background rejection:
 - Bremsstrahlung:
 - Detect irradiating e^+ in Positron Spectrometer
 - Cut on photon energy

Bremsstrahlung detected ✓

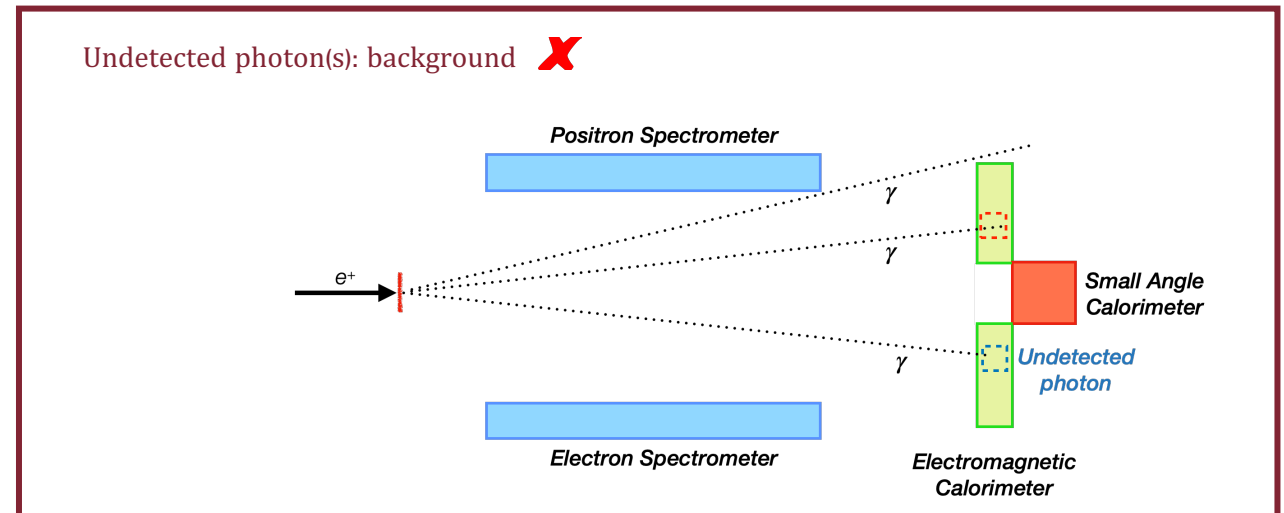
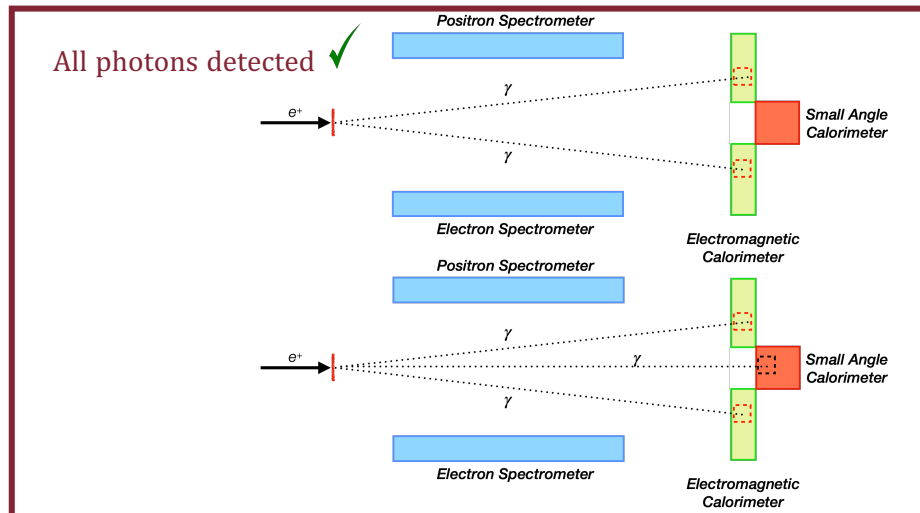


Bremsstrahlung undetected: background ✗



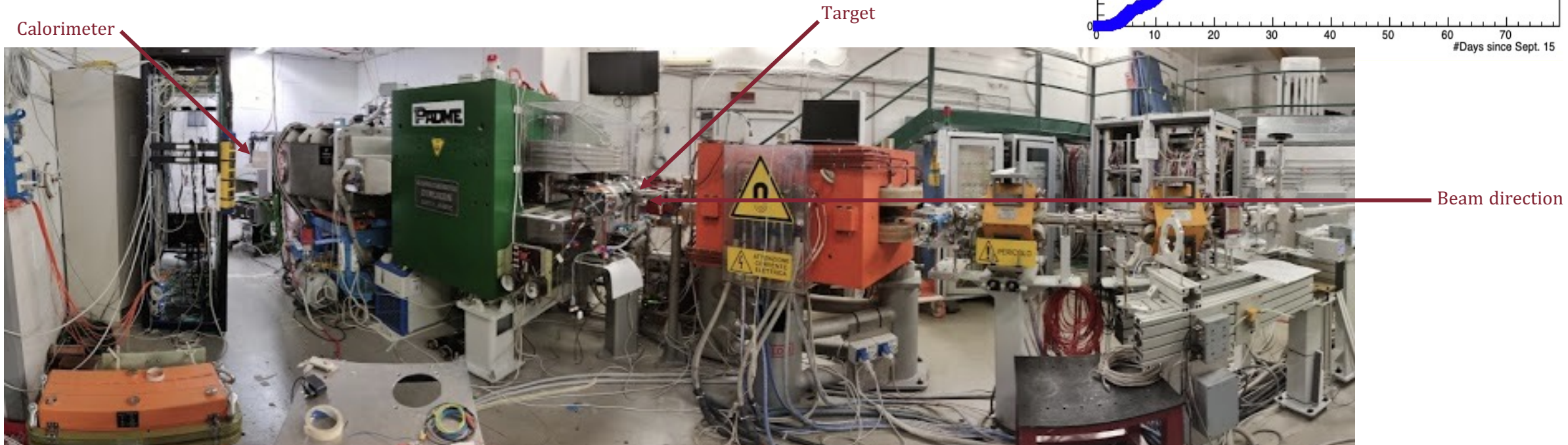
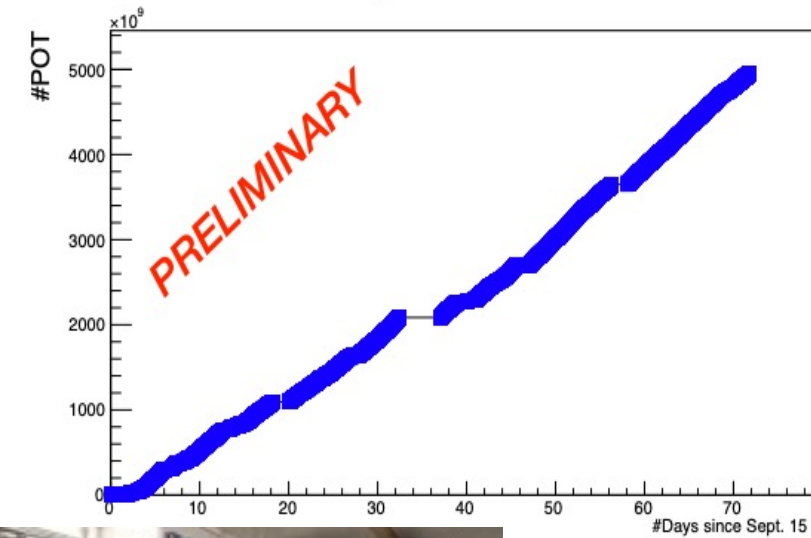
Background sources and rejection

- We have two principle sources of background:
 - Bremsstrahlung in the target: missing e^+
 - 2 (3) photon annihilation where 1 (2) of the photons goes undetected
- Annihilation background suppression:
 - We veto events with 2 in-time photons in **ECal**
 - Maximising granularity, angular coverage and energy resolution of **ECal** reduces the probability of photons escaping detection



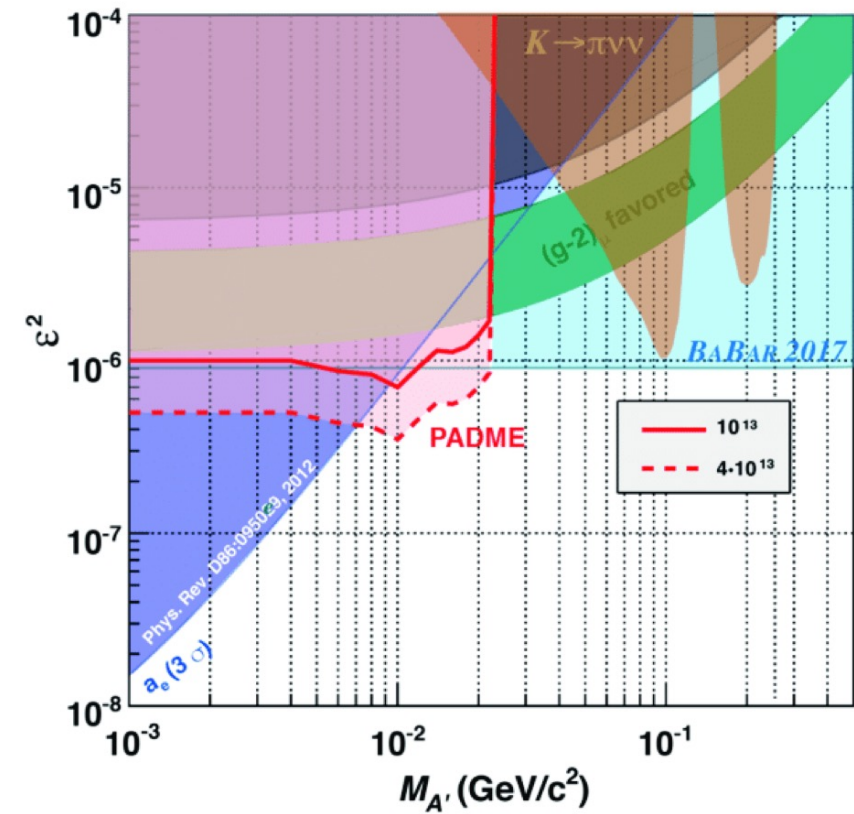
Current status

- Run2 was from September-December 2020
- We collected 5.6×10^{12} positrons on target
- Now in data analysis mode!



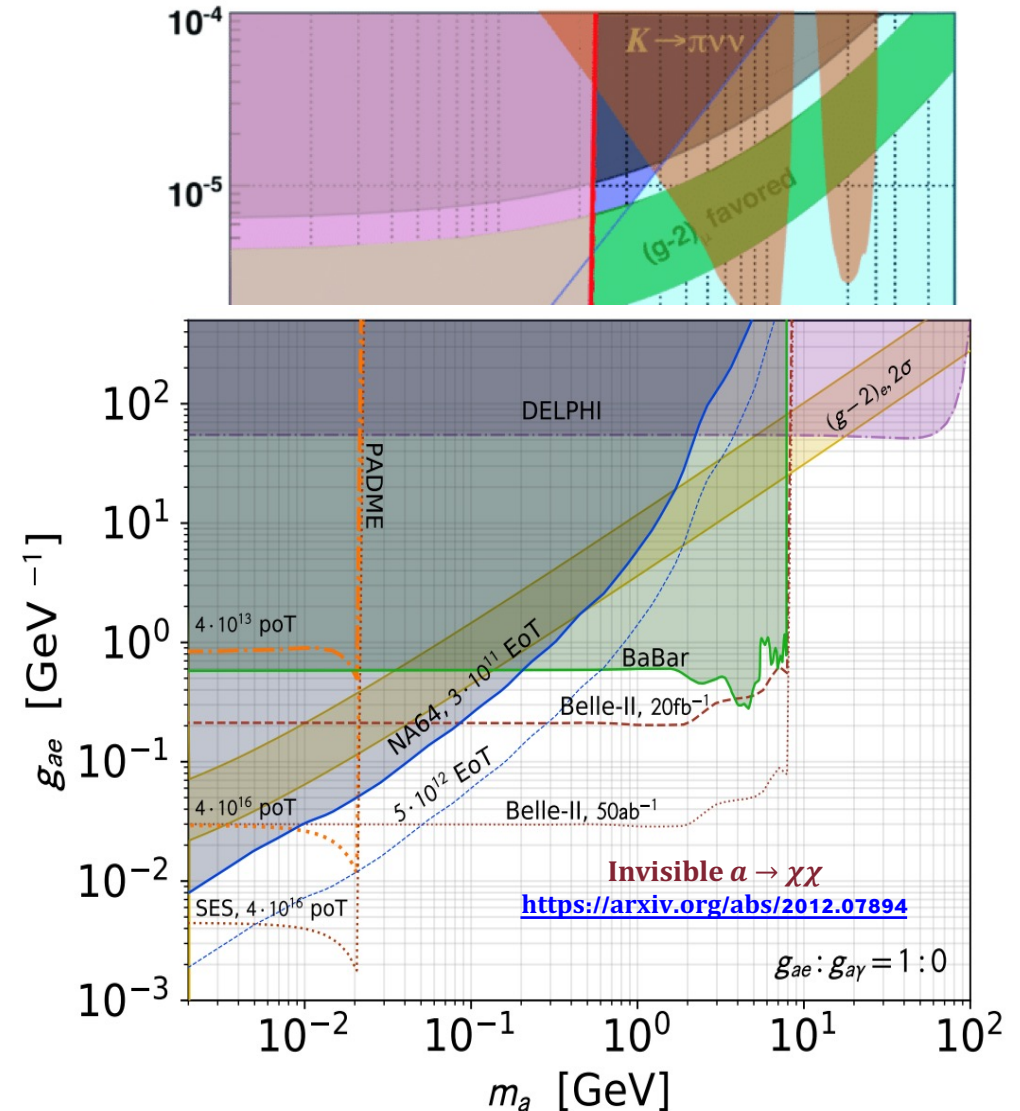
Physics goals

- Dark photons: $e^+e^- \rightarrow \gamma A'$
 - Final states:
 - Visible $A' \rightarrow e^+e^-$
 - Invisible $A' \rightarrow \chi\chi$



Physics goals

- Dark photons: $e^+e^- \rightarrow \gamma A'$
 - Final states:
 - Visible $A' \rightarrow e^+e^-$
 - Invisible $A' \rightarrow \chi\chi$
- Axion like particles (ALPS): $e^+e^- \rightarrow \gamma^* a$ or $e^+e^- \rightarrow e^+e^- a$
 - Final states:
 - Visible $a \rightarrow \gamma\gamma$ or $a \rightarrow e^+e^-$
 - Invisible $a \rightarrow \chi\chi$



Thank you for your attention.

Backup

ALP production mechanisms

