TA3: Transnational Access to LNF

Catalina Curceanu

INFN-LNF

STRONG-2020 ANNUAL MEETING (2022)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093

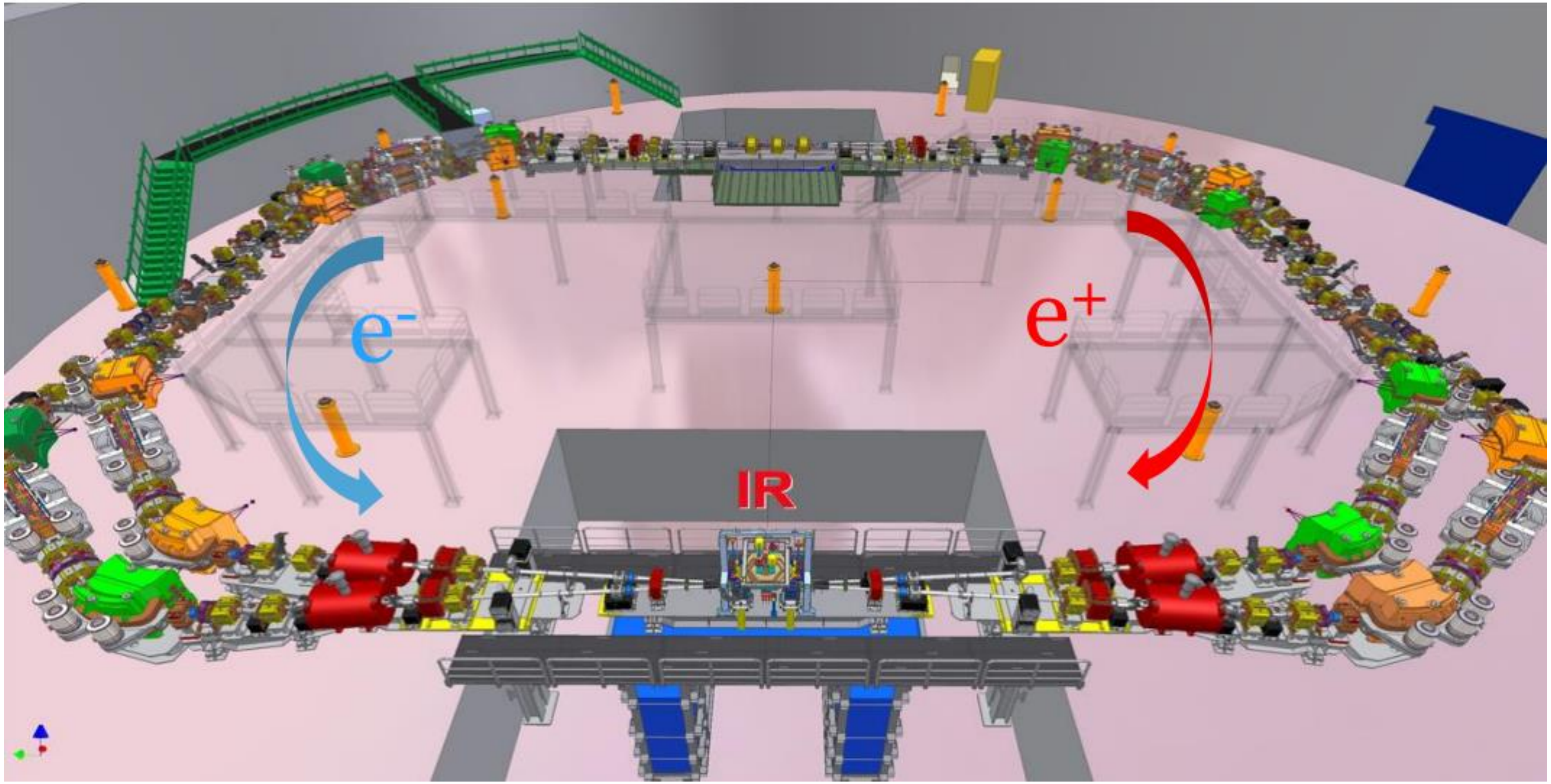
The DAΦNE Complex including LINAC, BTF and lectron-positron collider

TA3 – Transnational Access to LNF

DAΦNE

Laboratori Nazionali di Frascati (LNF-INFN)

- $\Phi \rightarrow K^- K^+$ (49.1%)
- Monochromatic low-energy K^- (~127 MeV/c ; $\Delta p/p$ = 0.1%)



TA3 – TRANSNATIONAL ACCESS TO LNF (FRASCATI – ITALY)

- **RP2 1 December 2020 - 30 May 2022**
  The **pandemic situation did not allow users** to travel to Frascati **until September 2021**.

❖ ***PADME projects***

✓ **Dark And Rare,** In RP2 no data-taking was foreseen for the experiment. **None of the users was able to come to LNF.**
The **first scientific result of PADME** has been the **cross-section of the process $e^+ e^- \rightarrow \gamma\gamma$** with a **precision measurement** at $\sqrt{}$21 MeV.

❖ ***SIDDHARTA-2 projects***

Five projects contributed to the various stages of the experiment with strong support of the LNF group.
All the projects have contributed to the scientific results obtained in the period: in particular, **the most precise measurement of the transitions to the 2p level in kaonic helium** and the measurement of the **transition yields in kaonic helium** at different gas densities

✓ **SIDDHARTA-2,** working on final setup assembly.
✓ **KRAKOW@SIDDHARTA-2,** working on calibration of the luminometer with the DAΦNE luminometer
✓ **SIDDHARTA-2 & HPGEtest,** working on the installation of the Ge detector and its debugging
✓ **ANTIKD,** participating to SIDDHARTINO beam time shifts and to data analysis
✓ **EARS-2,** working on a new interface Lab View for the Detector Control System.

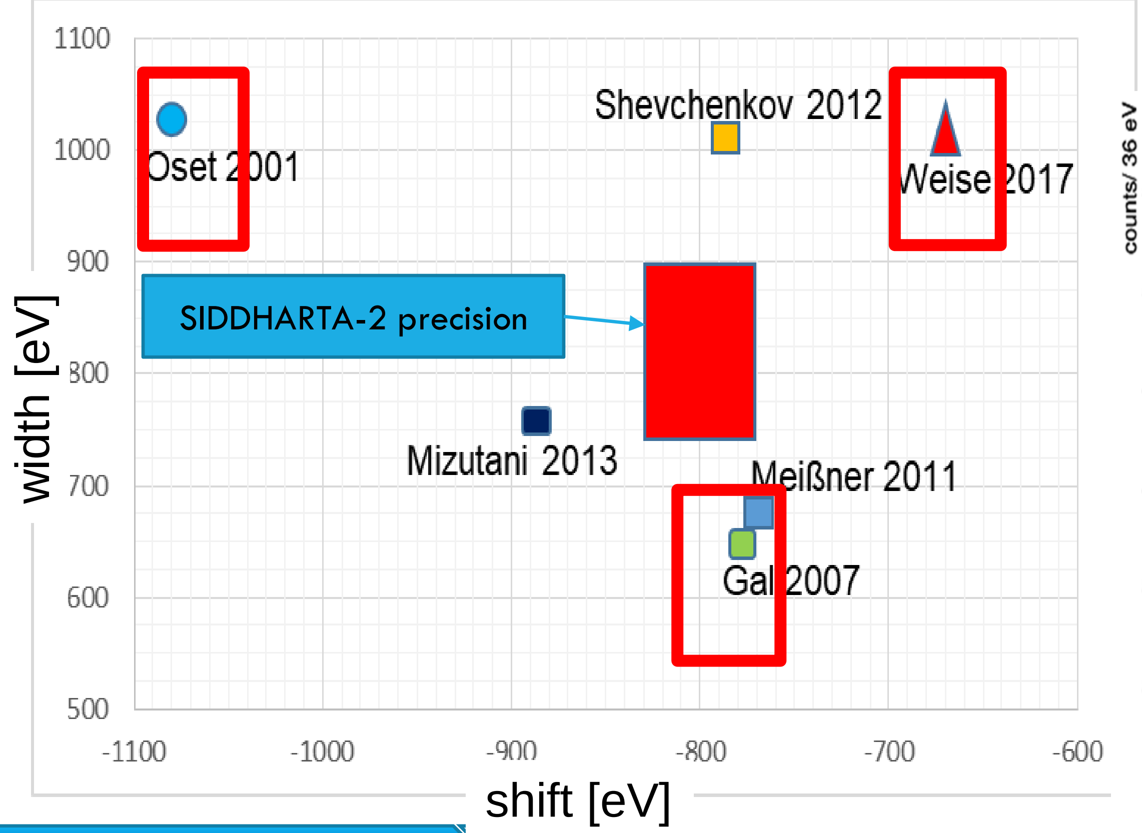
RP1 and 2: - 1200 days; we would like to request to consider extension beyond Nov. 2023

Experiments on the DAΦNE complex and progress during reporting period

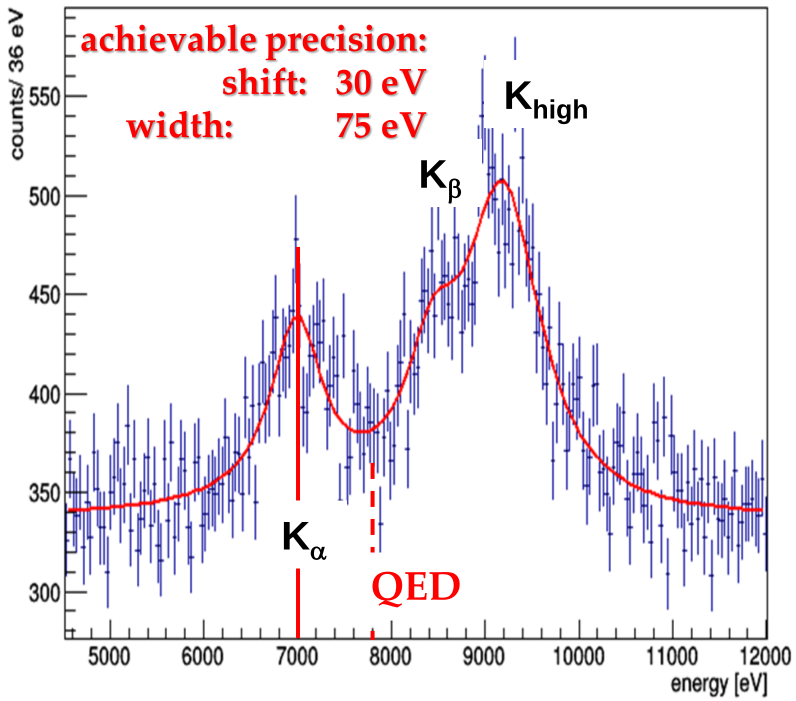
- SIDDHARTA-2
- PADME

SIDDHARTA-2: the scientific aim

- To perform precision measurement of kaonic atoms X-ray transitions
 -> unique info about the QCD in non-perturbative regime in the strangeness sector not obtainable otherwise; impact in astrophysics (EOS neutron stars)
- Precision *measurement of the shift* and *of the width* of the 1s level of kaonic deuterium and the of and of other types of kaonic atoms
- Comparison with various theoretical models



MCarlo Kd spectrum
for 800 pb^{-1}



SIDDHARTA-2 setup
Installed on DAFNE within early November 2022
Ready for Run

ent No 824093

PROJECT TIMELINE IN THE LAST YEAR

2022, Nov.
Setup installed

SIDDHARTA-2 debug
2021, Nov. – December.

SDD calibration
DAQ optimization

SIDDHARTA-2 Optimization
(while awaiting for DAFNE)
HPGE activitty
January – 7th April 2022

Change of cryo lines
Installation and calib of HPGe

Start SIDDHARTA-2 debug with beam
7 – 13 April 2022

Debug of system with beam (trigger and luminometer)

SIDDHARTA-2 KHe run
and HPGe debug
while commissioning

Kaonic helium runs
Degrader, SDD calib, trigger, veto…

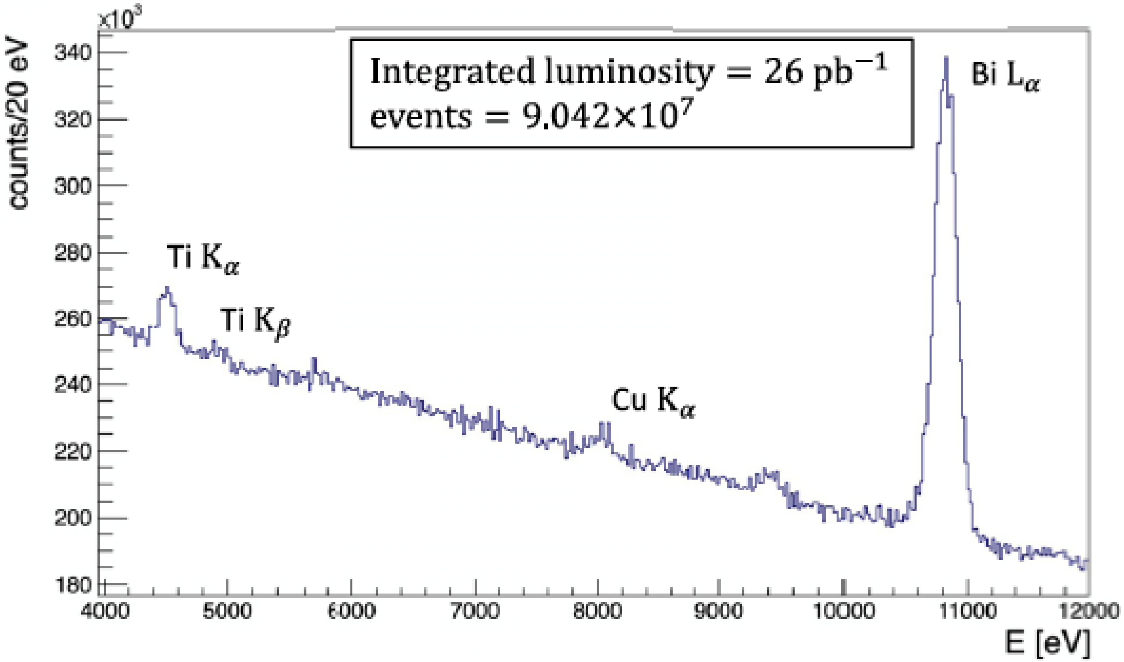
Kd run
end May – 15 June
HPGe run

Ready for Kd run (DAFNE optimization continued)

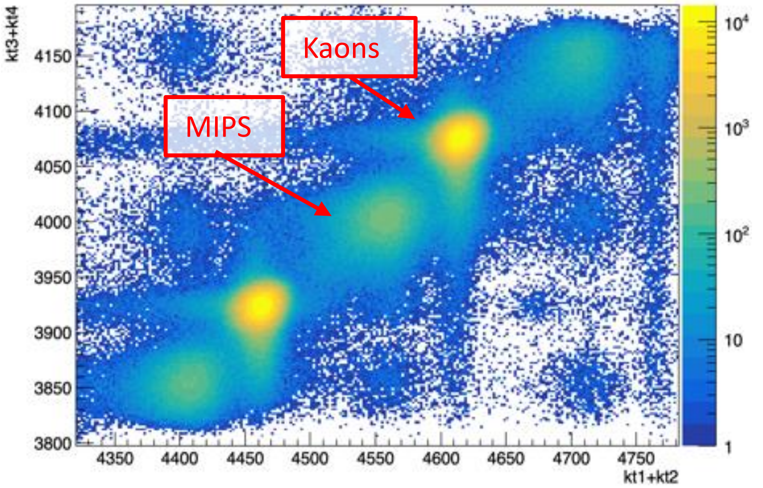
Followed by data analyses and optimization setup (run 2023)

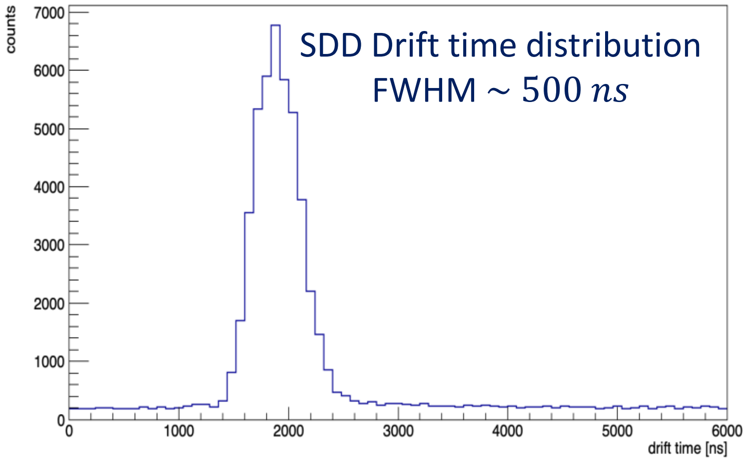
Kaonic ^{4}He $3d \rightarrow 2p$ measurement

Spectrum before applying the **kaon trigger** and the **drift time rejection**

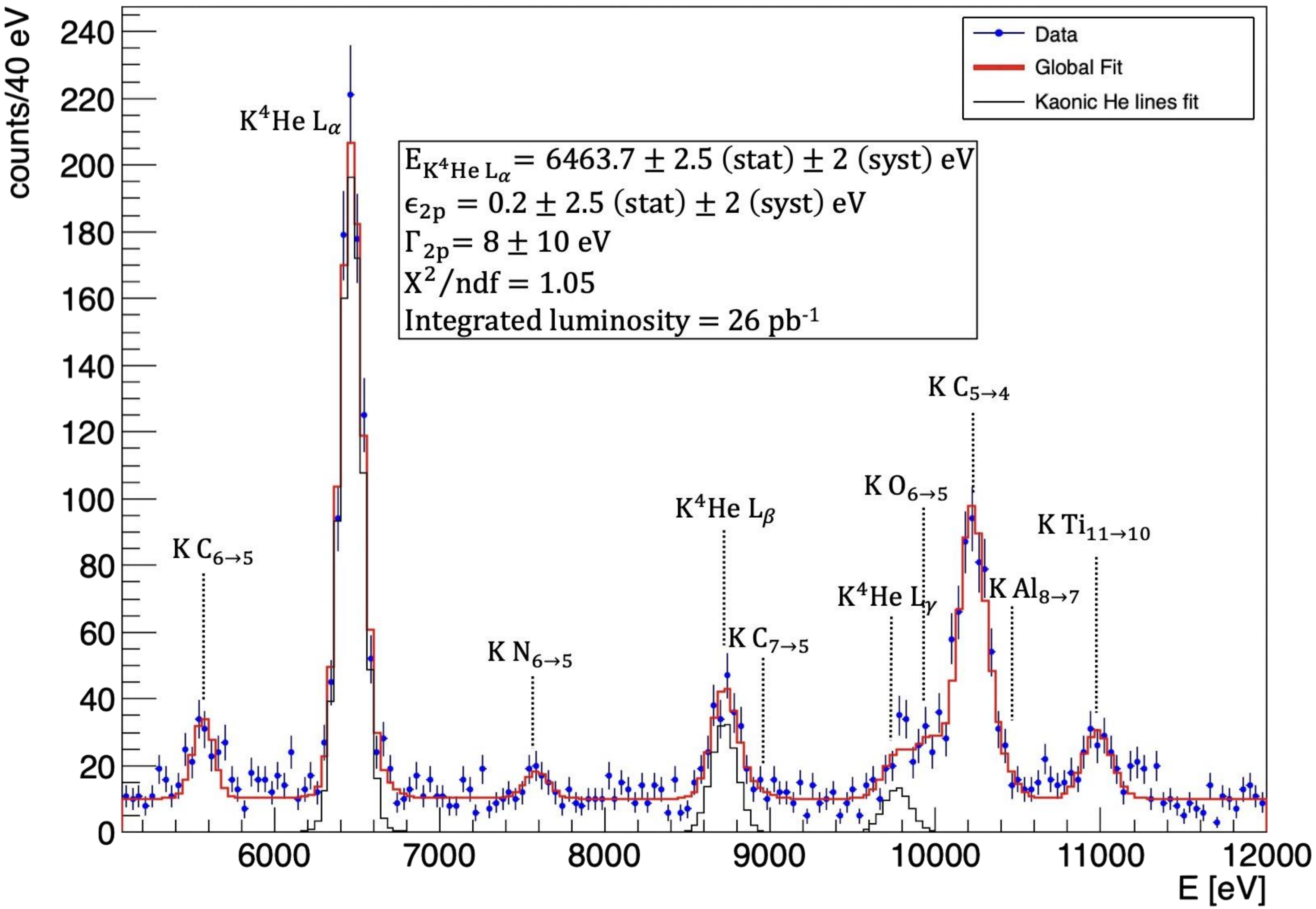


Kaon Trigger



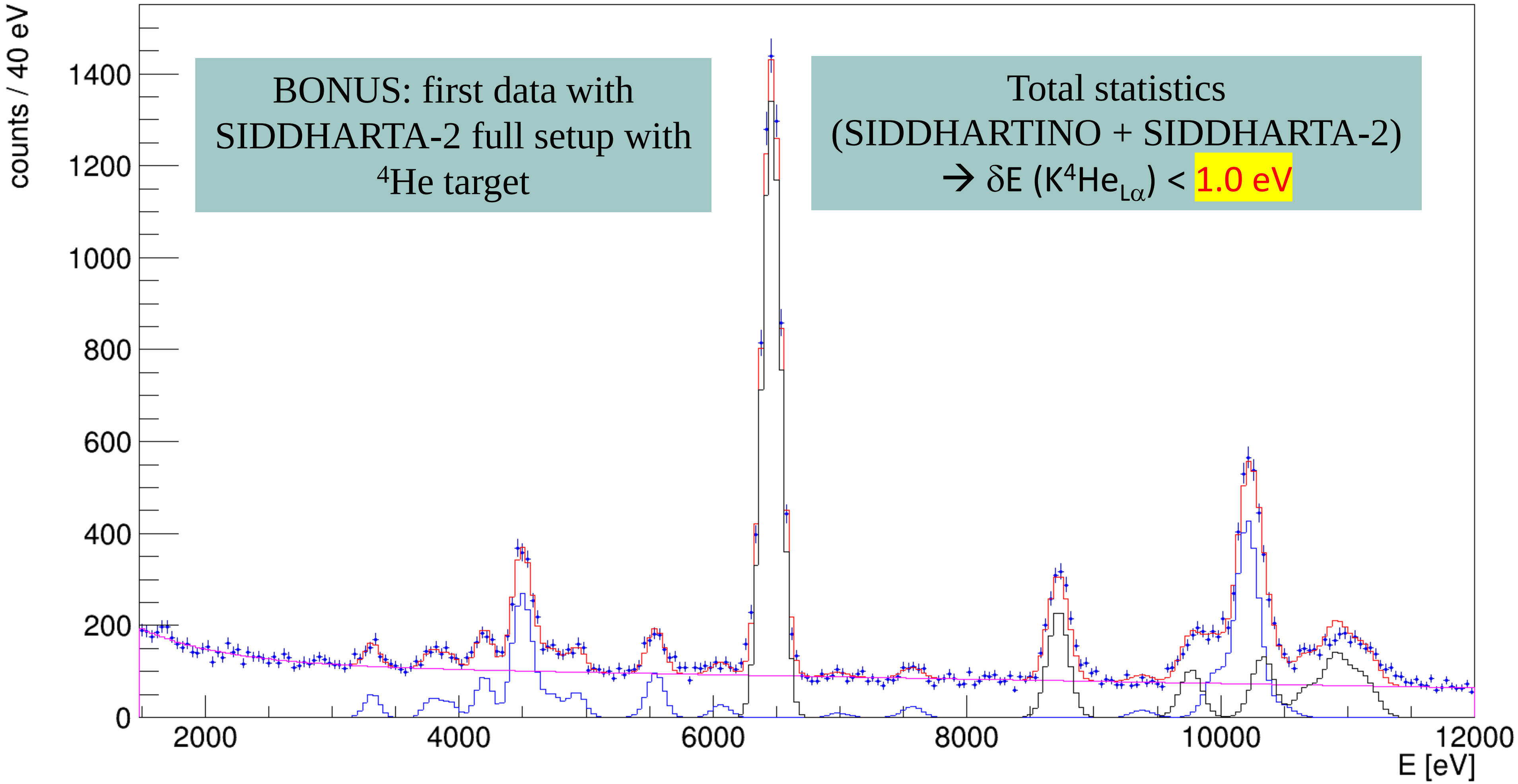


Kaonic ^{4}He $3d \rightarrow 2p$ data analyses:
Most precise measurement in gas!



Sirghi *et al* 2022 *J. Phys. G: Nucl. Part. Phys.*

Kaonic ^{4}He $3d \to 2p$ measurement (2021 and 2022)



Very preliminary: precision below 1 eV!

KHE4 YIELDS AT 2 DENSITIES: SUBMITTED NUCL PHYS A

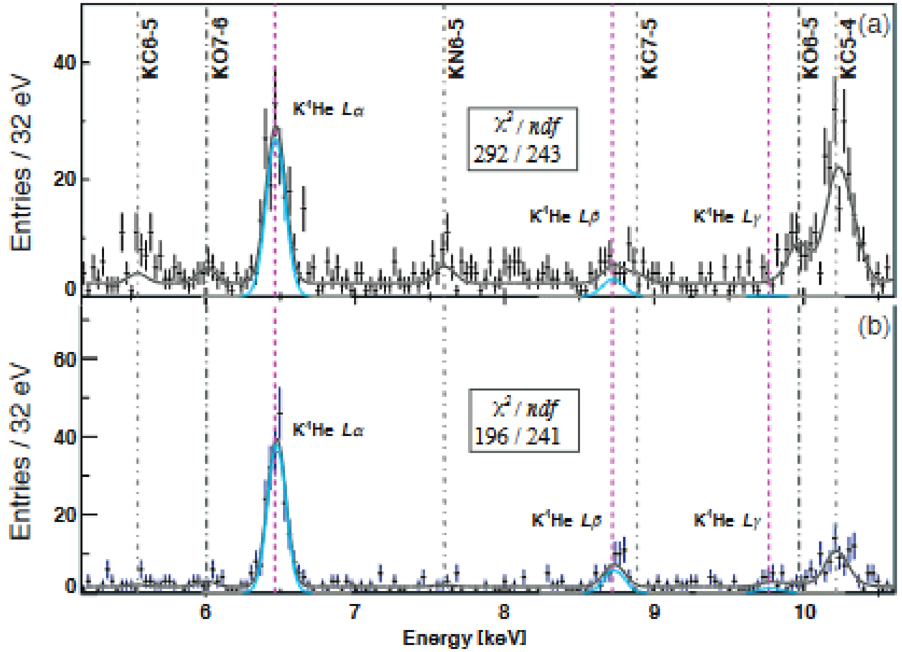


Figure 2: X-ray kaonic helium-4 spectra measured by SIDDHARTINO for: (a) 0.82 g/l target gas density; (b) 1.90 g/l target gas density. The kaonic helium-4 peaks L_α, L_β and L_γ are shown. Several kaonic atom X-ray lines produced in the Kapton foils are also shown: Kaonic Carbon 6 → 5, Kaonic Oxygen 7 → 6, Kaonic Nitrogen 6 → 5, Kaonic Carbon 7 → 5, Kaonic Oxigen 6 → 5, Kaonic Carbon 5 → 4 transitions. The solid line shows the fit function of the spectrum. The blue line shows the L series L_α, L_β and L_γ kaonic helium-4 components.

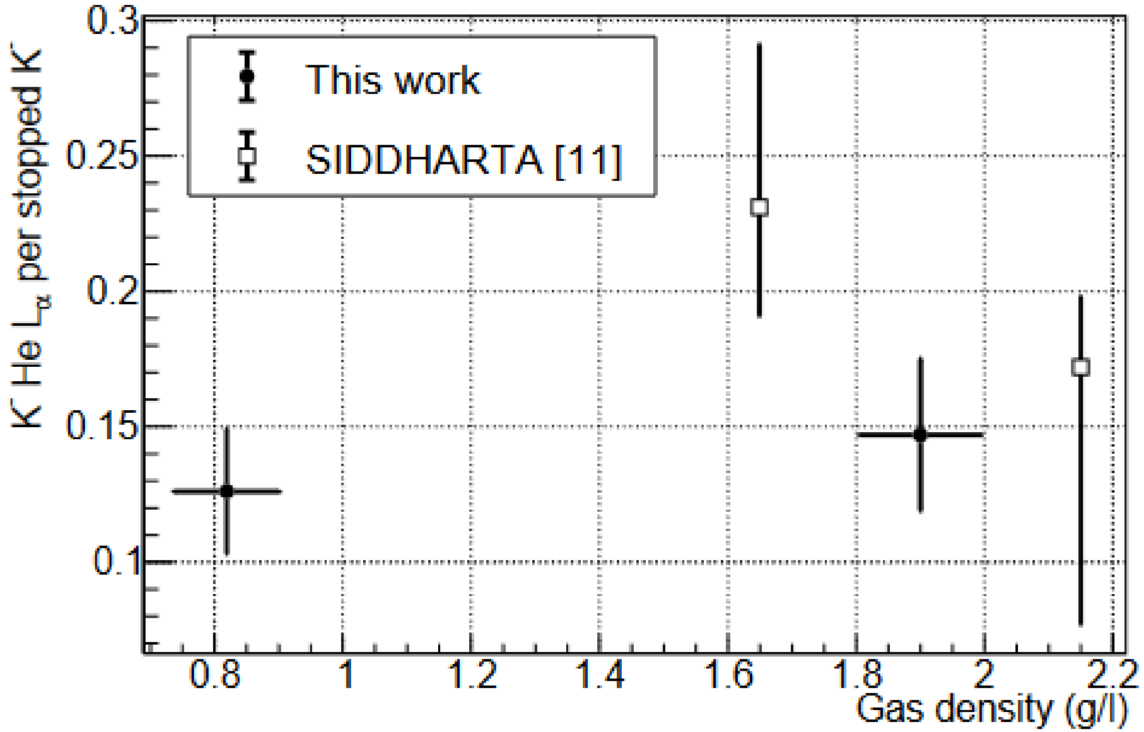


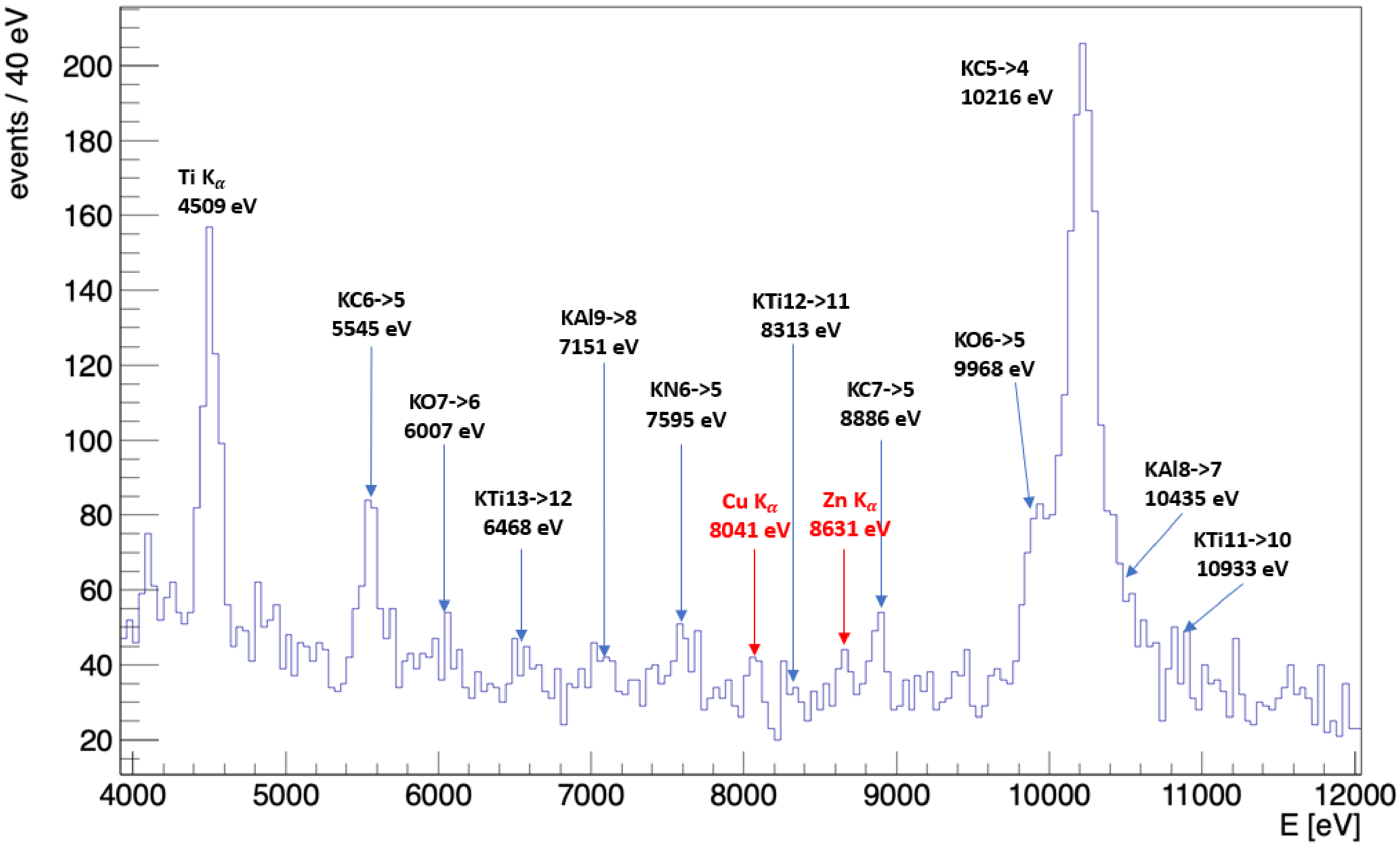
Figure 3: The L_α X-ray yield of K^- ^{4}He as function of the target density from all gaseous target measurements: this work (filled dots) and SIDDHARTA [16] (hollow squares).

SIDDHARTA-2 K-d measurement

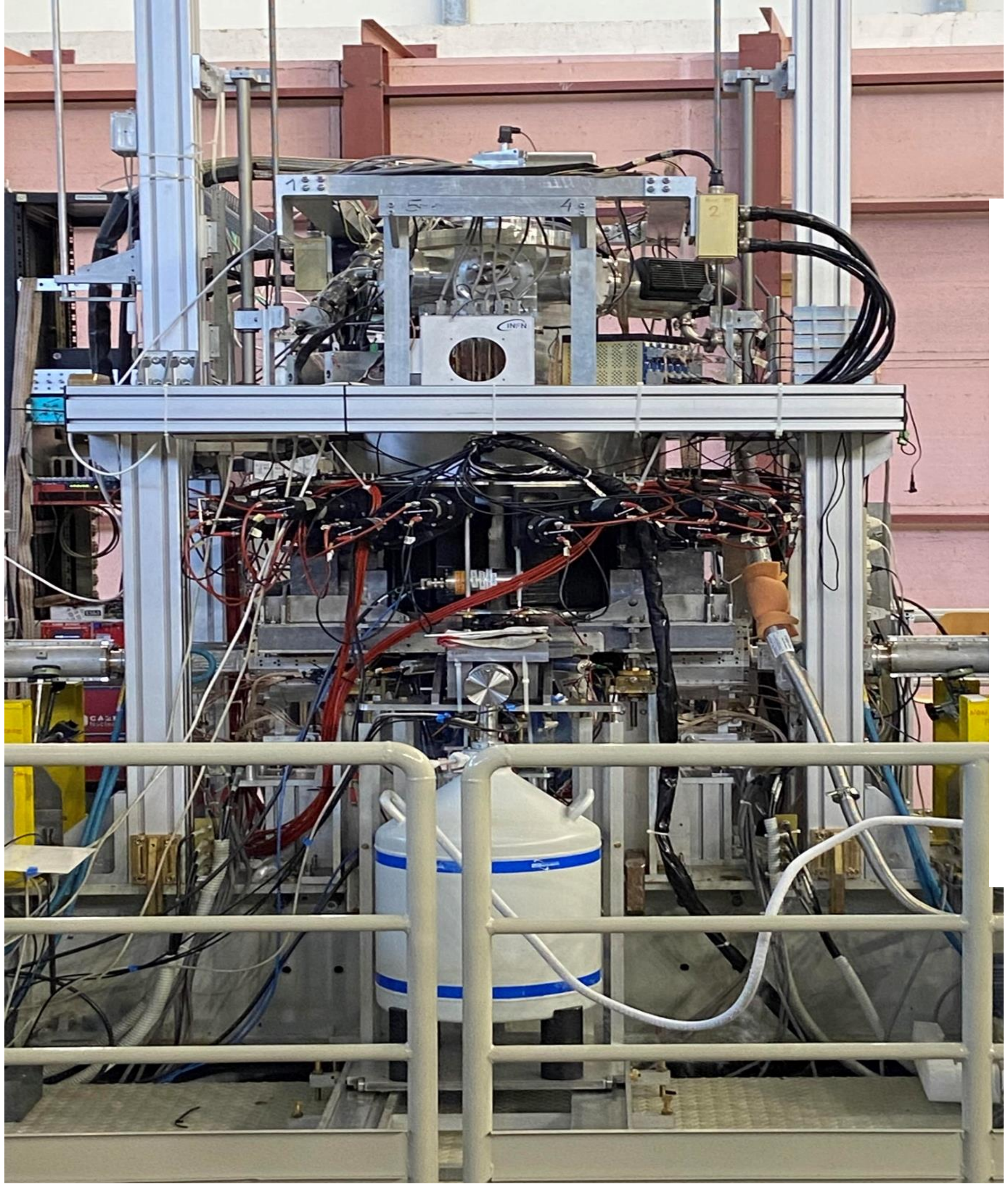
SIDDHARTA-2 KD 1.1%

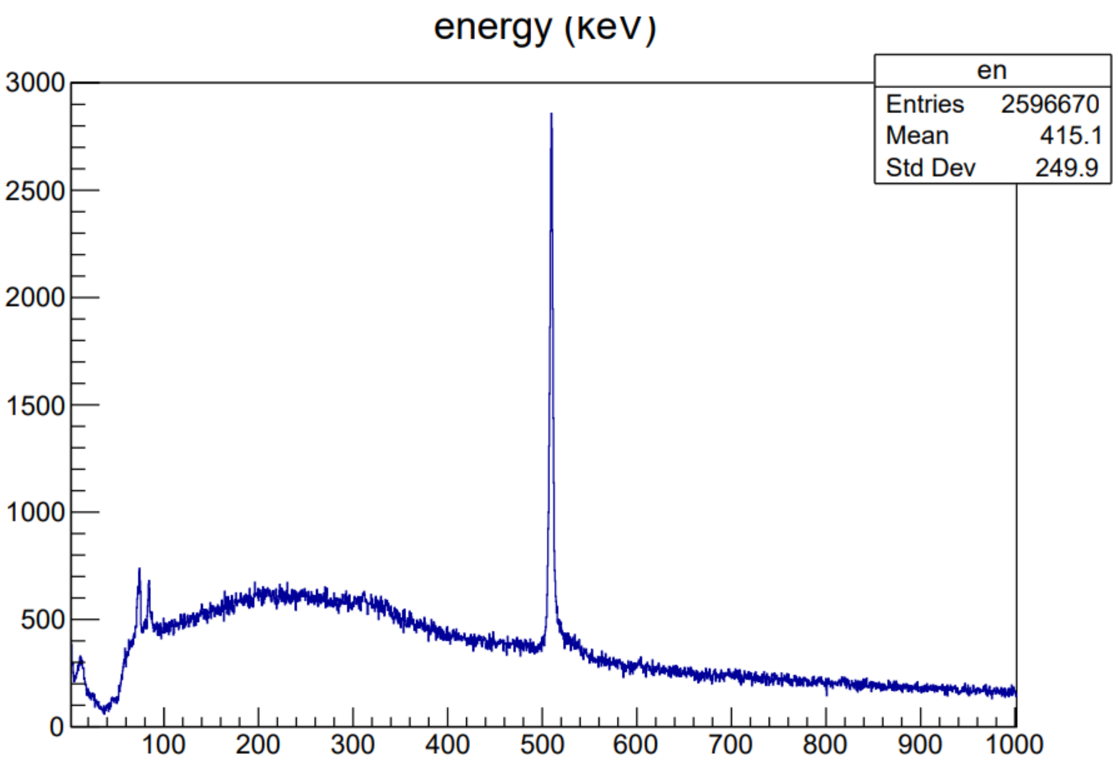
Date: 03/06/2022 to 24/06/2022 (run from ID 166 to ID 305)
Degrader: deg_rot1_475um
N° SDDs: 98 (bus1 + bus4)
L (lumi) = 30.248 pb^{-1}

Very preliminary
First spectrum with deuterium target



HPGe
(Zagreb)




energy (keV)
en
Entries 2596670
Mean 415.1
Std Dev 249.9
3000
2500
2000
1500
1000
500
0
100
200
300
400
500
600
700
800
900
1000

SIDDHARTA-2 plans

Phase 2
SIDDHARTA-2

Setup with all the SDDs (48 SDD arrays) and the *kaonic deuterium measurement* for a run of 800 pb^{-1}

Action plan for Kd measurement:

- First run of test with SIDDHARTA-2 setup
(about 30 pb^{-1} integrated) - 2022
- Second/Third run with optimized shielding, readout electronics and other necessary optimizations; (for other 750 pb^{-1} integrated) – **2023/4**

Test runs for other kaonic atoms measurements (HPGE, CdZnTe…)

PUBLICATIONS 2021-2022

1. R. Del Grande et al (AMADEUS Collaboration), On the K− Absorptions in Light Nuclei by AMADEUS, Few Body Syst. 62 (2021) 1, 7.
2. M. Miliucci et al, Low-energy Kaon Nucleon/Nuclei Studies at DAΦNE: the SIDDHARTA-2 Experiment, Acta Phys. Polon. Supp. 4 (2021) 49.
3. M. Miliucci et al., Silicon Drift Detectors system for high precision light kaonic atoms spectroscopy, Meas. Sci. Technol. 32 (2021).
4. M. Miliucci et al., Low energy kaon-nuclei interaction at DAΦNE:The SIDDHARTA-2 experiment, Il Nuovo Cimento 44 C (2021).
Selected communication at 106° SIF Congress (best presentation: Marco Miliucci) for with publication on Rivista de il Nuovo Cimento.
5. C. Curceanu et al, Kaonic Atoms Measurements at DAΦNE: SIDDHARTA-2 and Future Perspectives, Few Body Syst. 62, 4 (2021).
6. M. Miliucci et al., Silicon Drift Detectors spectroscopic response during the SIDDHARTA-2 Kaonic Helium run at the DAΦNE collider, arXiv:2111.01572, submitted to Condensed Matter.
7. M. Miliucci et al., HIGH PRECISION KAONIC ATOMS X-RAY SPECTROSCOPY AT THE DAΦNE COLLIDER: THE SIDDHARTA-2 EXPERIMENT (submitted to RAP Conference Proceedings)

PUBLICATIONS 2021-2022

8 M. Miliucci et al., Silicon Drift Detectors Technology for High Precision Light Kaonic Atoms Spectroscopic Measurements at the DAΦNE Collider, in print on AIP-CP.

9. Kaonic atoms measurements at the DAΦNE collider: the SIDDHARTA-2 experiment, C. Curceanu et al., EPJ Web Conf. 258 (2022) 07006

10. A new kaonic helium measurement in gas by SIDDHARTINO at the DAΦNE collider, D. Sirghi et al., J.Phys.G 49 (2022) 5, 055106

11. The SIDDHARTA-2 calibration method for high precision kaonic atoms X-ray spectroscopy measurements, F. Sgaramella et al., e-Print: 2202.01535, accepted in Physica Scripta)

12. Kaonic Atoms at the DAΦ\PhiΦNE Collider with the SIDDHARTA-2 Experiment, F. Napolitano et al., e-Print: 2201.11525, Phys. Scr. (2022) 97 084006

13. Paper KHe yields submitted to Nuclear Physics A

14. A. Khreptak et al., Studies of the linearity and stability of Silicon Drift Detectors for kaonic atoms X-ray spectroscopy, submitted to Acta Phys. Pol. B, e-Print: 2208.14991

15. A. Scordo et al, First tests of the full SIDDHARTA-2 experimental apparatus with a 4 He gaseous target, accepted in Acta Phys. Pol. B, e-Print: 2208.03422

16. M. Miliucci et al., Large area silicon drift detectors system for high precision timed x-ray spectroscopy, Measur.Sci.Tech. 33 (2022) 9, 095502.

PUBLICATIONS 2021-2022

17. M. Miliucci et al., High precision Kaonic Deuterium measurement at the DAΦNE collider: the SIDDHARTA-2 experiment and the SIDDHARTINO run, Rev.Mex.Fis.Suppl. 3 (2022) 3, 0308081

18. F. Sirghi et al., Status and perspectives for low energy kaon-nucleon interaction studies at DAΦ\PhiΦNE: from SIDDHARTA to SIDDHARTA-2, PoS PANIC2021 (2022) 200.

+ other 3 articles in preparation

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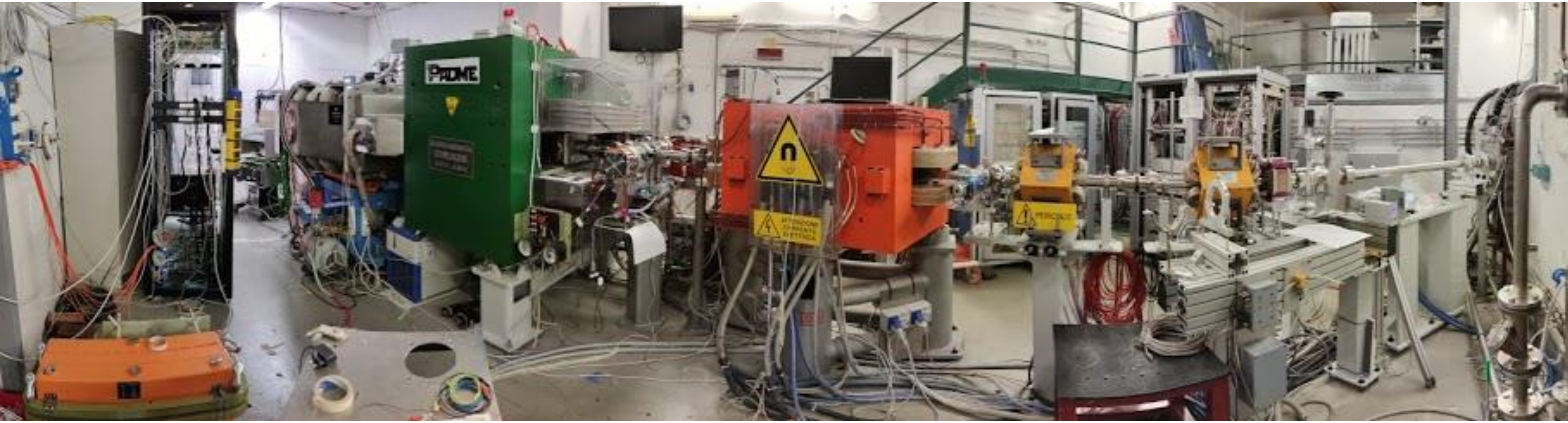
Laboratori Nazionali di Frascati

STRONG 2020



THE PADME EXPERIMENT @ LNF

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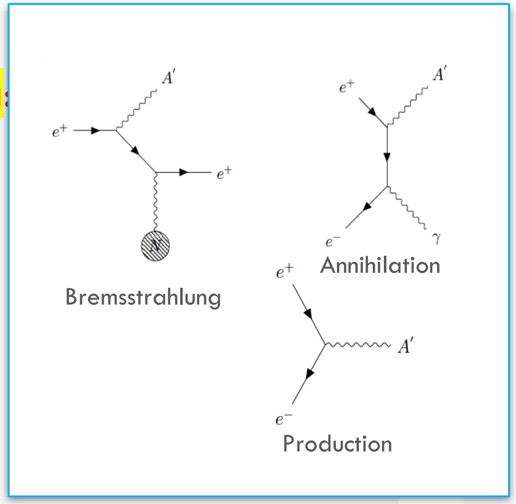
DARK PHOTON PRODUCTION

A Dark Photon (A') can be produced using e^+ via:

- Bremsstrahlung: $e^+N \rightarrow e^+NA'$
- Annihilation associate production: $e^+e^- \rightarrow \gamma A'$
- Annihilation direct production: $e^+e^- \rightarrow A'$



For the A' decay two options are possible:

- No dark matter particles lighter than the A':
  - $A' \rightarrow e^+e^-$, $\mu^+\mu^-$, hadrons, **"visible"** decays
  - For $M_{A'}$<210 MeV A' only decays to e^+e^- with BR(e^+e^-)=1
- Dark matter particles χ with $2M_\chi < M_{A'}$
  - A' will dominantly decay into pure DM
  - BR(l^+l^-) suppressed by factor ε^2
  - $A' \rightarrow \chi\chi \sim 1$. These are the so called **"invisible"** decays

PADME aims to produce A' via the reaction:

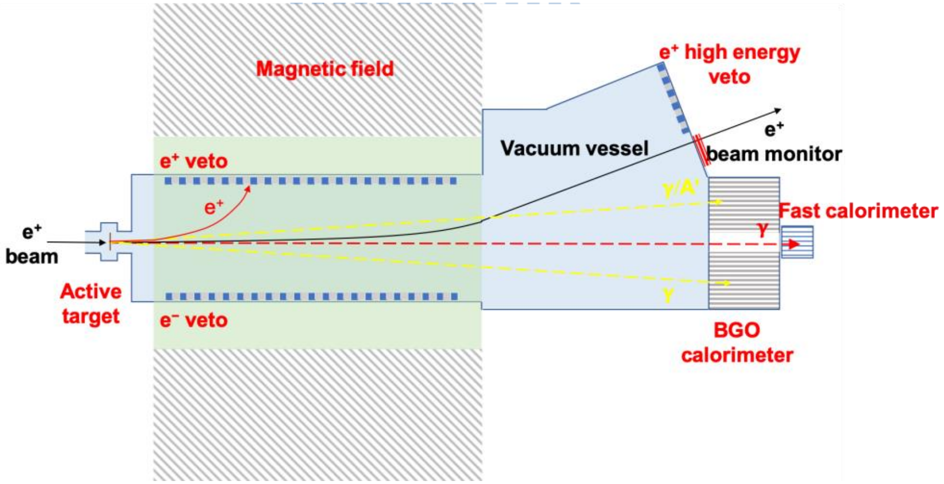
$$e^+e^- \rightarrow A'\gamma$$

This technique allows to identify the A' even if it is stable or decays into dark sector particles $\chi\bar{\chi}$.

Know e^+ beam **momentum and position**, measuring the recoil photon **position** and **energy**

$$M^2{}_{miss} = (\bar{P}_{e^+} + \bar{P}_{e^-} - \bar{P}_\gamma)^2$$

Only a minimal assumption: A' couples to leptons



ACTIVITY 2021 – 2022

- Analysis of data sets
  - Data processing and detectors calibration
    - Considering different beam **energy** (550, 490, 430 MeV), bunch **length** (150, 280 ns) and **beam profile**
  - Published commissioning paper and MC beam line paper [JINST 17 (2022) 08, P08032, JHEP 09 (2022) 233]
  - $e^+e^- \rightarrow \gamma\gamma$ cross-section measurement (presented @ Moriond, paper in preparation)
  - Preliminary selection of $e^+e^- \rightarrow \gamma + \text{invisible}$
- Plans for 2022 data taking devoted to the search of the hypothetic X_{17} boson
    - with resonant production at $\sqrt{s} \cong 17\ \text{MeV}/c^2$
    - In the **visible decay** $e^+e^- \rightarrow X_{17} \rightarrow e^+e^-$
  - Studies performed on event collected in 2020 and MC simulations
  - **Detector upgrade** (different from original tailored to invisible)

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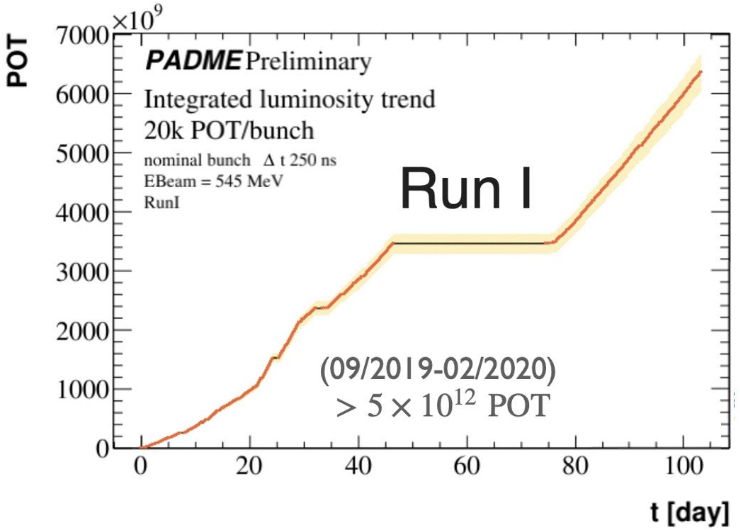
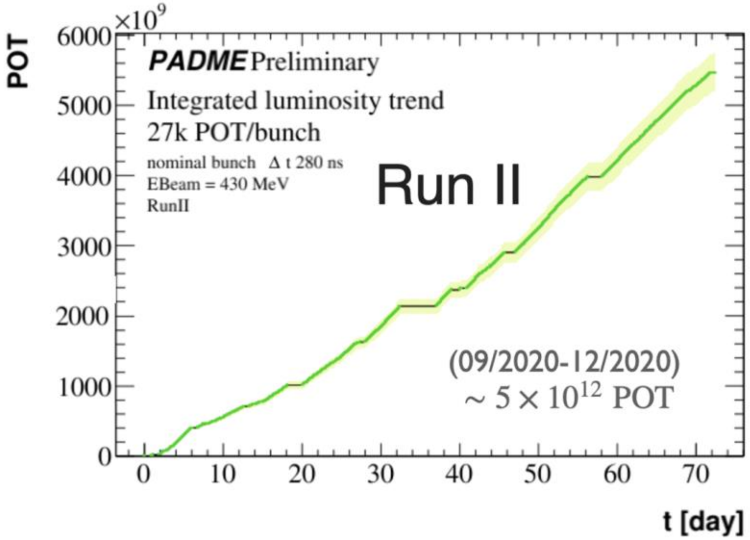
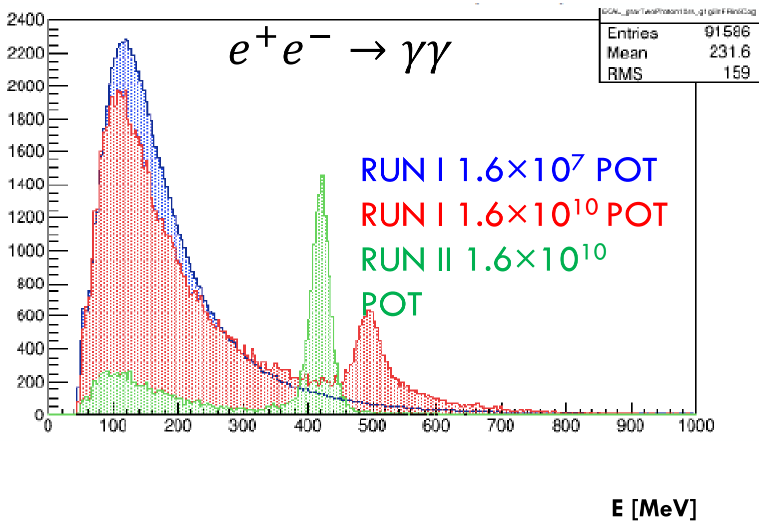
PADME DATA







- Run II wrt Run I
  - Similar statistics, approximately 1/2 of minimal goal (10^{13} particles-on-target)
  - Slightly lower beam momentum in Run II, 430 MeV$/c$, wrt to Run I, 490 MeV$/c$
  - **Improved vacuum separation** between experiment and beamline (thinner Mylar window placed upstream)
  - Less beam-induced background with primary wrt secondary beam
- Run III expected in winter 2022.
  - Beam commissioning ongoing (started Jul. 2022)

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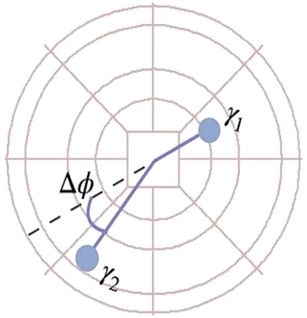
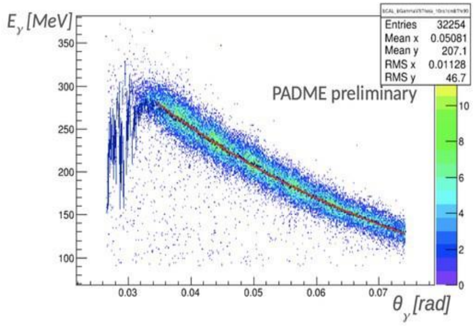
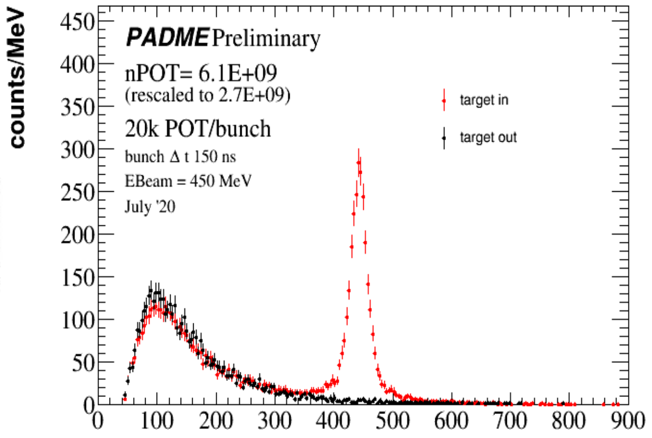
$E^+E^- \longrightarrow \Gamma\Gamma$ CROSS SECTION

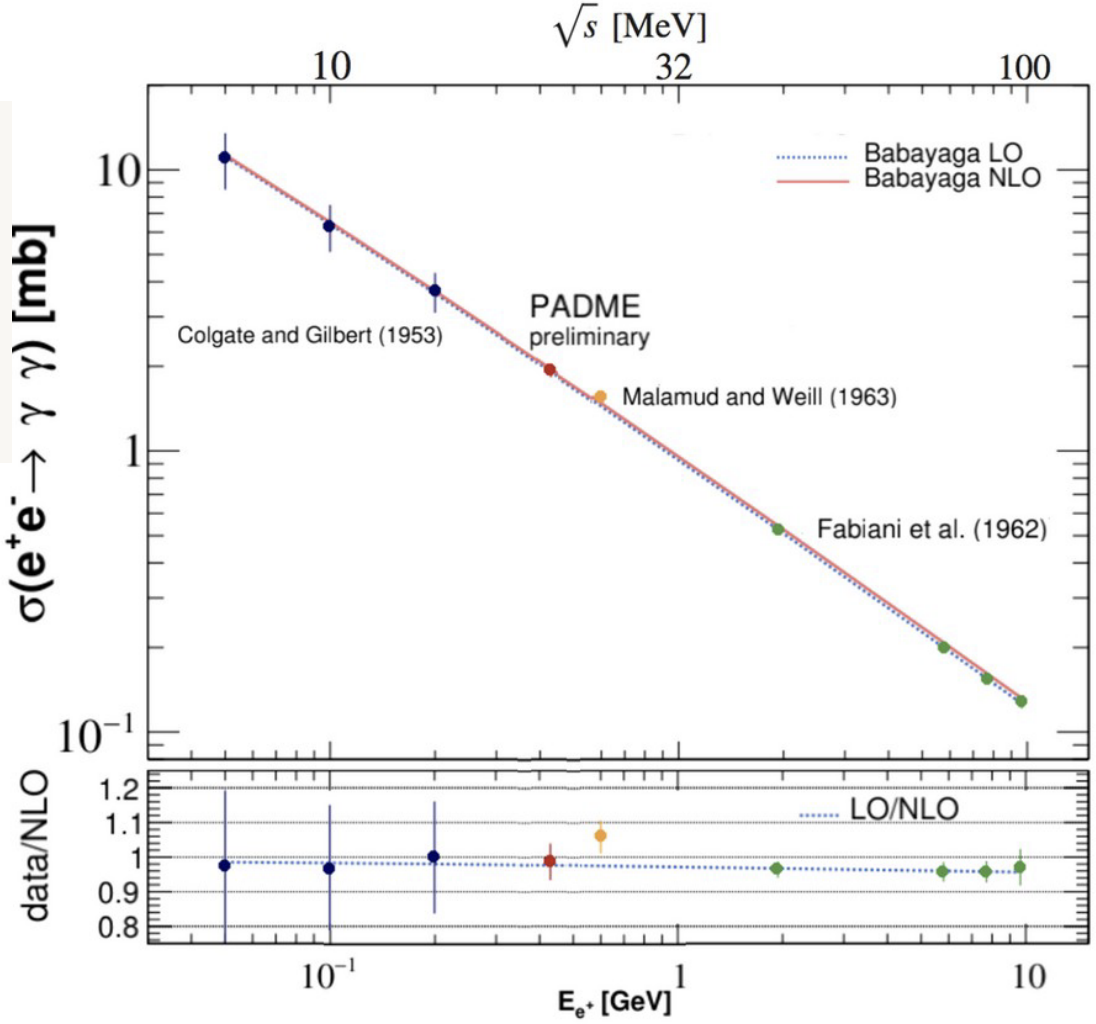
$e^+e^- \longrightarrow \gamma\gamma$ cross section

- Below 0.6 GeV known only with 20% accuracy
- Can be sensitive to sub-GeV new physics since available measurement $e^+e^- \rightarrow non - charged\ particles$
- Used 10% of Run II sample
- Tag-and-probe method on two back-to- back clusters. Exploit energy-angle correlation.









$\sigma(e^+e^- \rightarrow \gamma\gamma(\gamma)) = 1.930 \pm 0.029(\text{stat}) \pm 0.099(\text{syst})$ mb

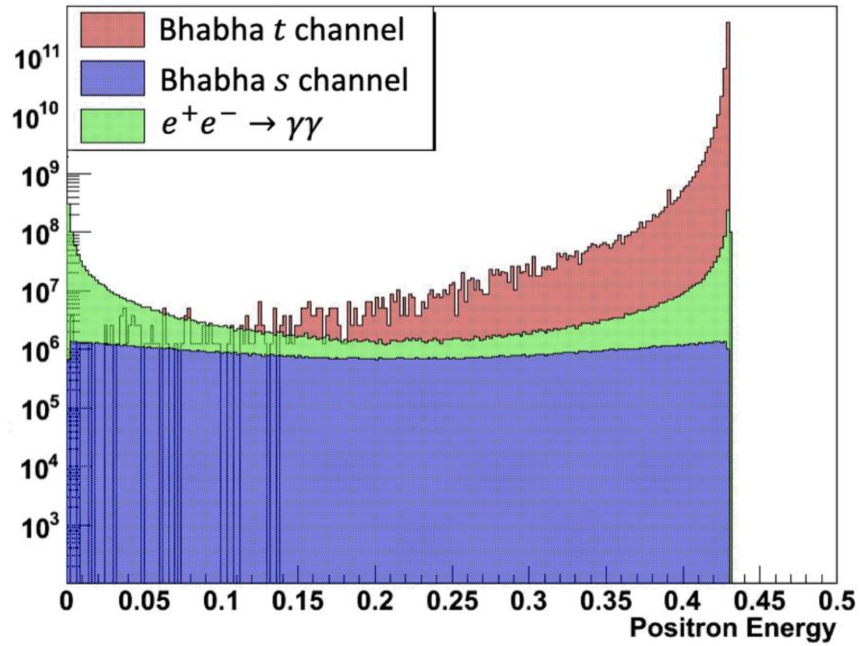
PADME X_{17} SETUP

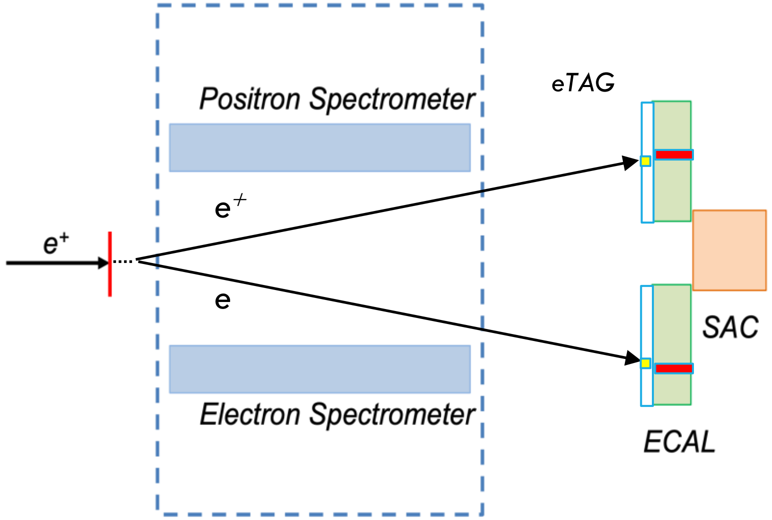
PADME veto spectrometer cannot be used to constrain e^+e^- vertices **not coming from the production target.**

Idea: identify $e^+e^- \rightarrow e^+e^-$ using the BGO calorimeter, as for $\gamma\gamma$ events.

- Whit **magnet off** the e^+e^- will reach ECal
  - Precise measurement (3%) of electron-positron pair momentum and angles;
  - Reconstruction of invariant mass of the pairs (small pile-up).
- To identify clusters from photons or electrons in ECal
  - New detector: Electron tagger (**ETag**) plastic scintillator slabs with same ECal vertical size.

Background contributions





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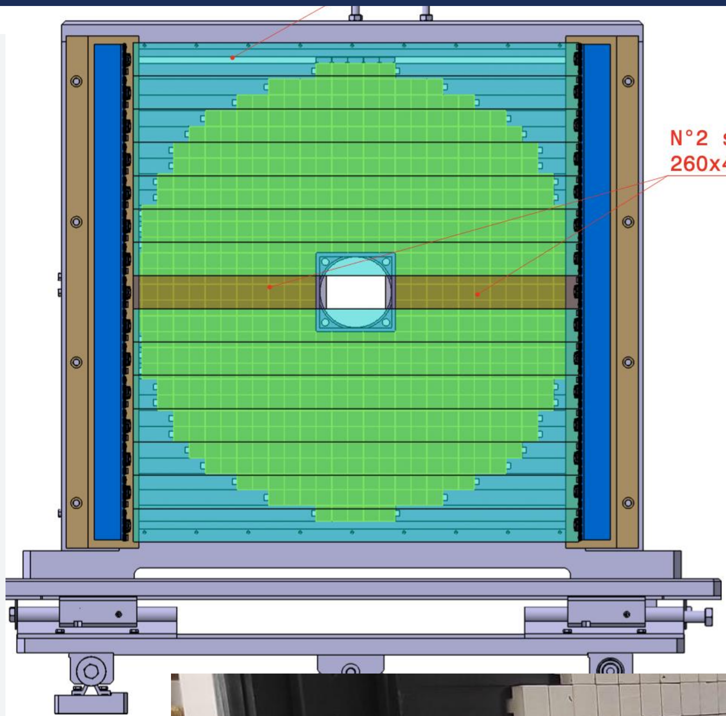
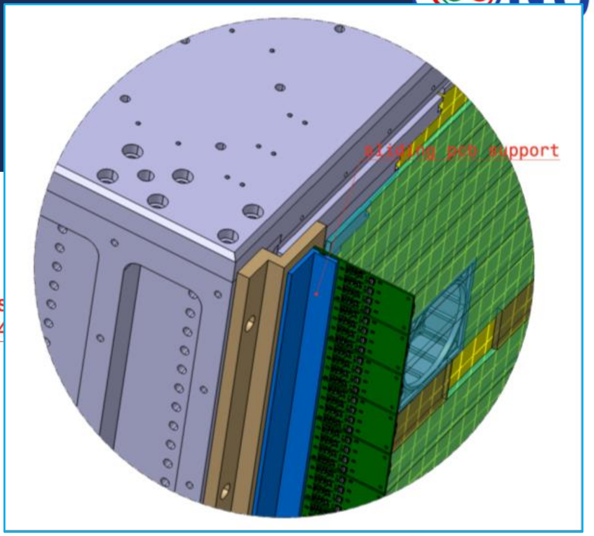
PADME NEW DETECTOR: ETAGGER

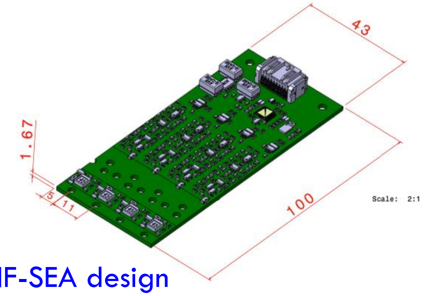
The new **eTagger** has been designed and assembled (2021-2022):

- 16 scintillators BC408 (600x45x5 mm^3);
- readout with 4 SiPMs (Hamamatsu S13360) on both sides. Same electronic cards developed for the veto detectors;
- Mechanical structure attached to the Ecal frame.

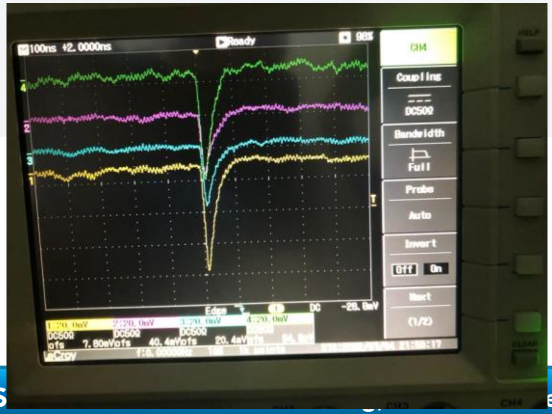
Commissioning took place Jul. 2022







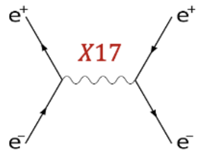
LNF-SEA design



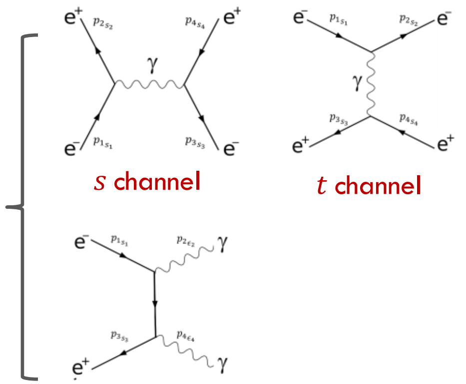
X17 STUDY @ PADME

- Same ATOMKI observables: 2 leptons in the final state, but **different production**
- Expected cross section enhancement from **resonant production** in e^+e^- annihilations at E_{e^+}~**283 MeV**
- Main backgrounds:
  - **Bhabha scattering,** both from the s channel and t channel
  - Two clusters in the calorimeter of course also produced in $\gamma\gamma$ events

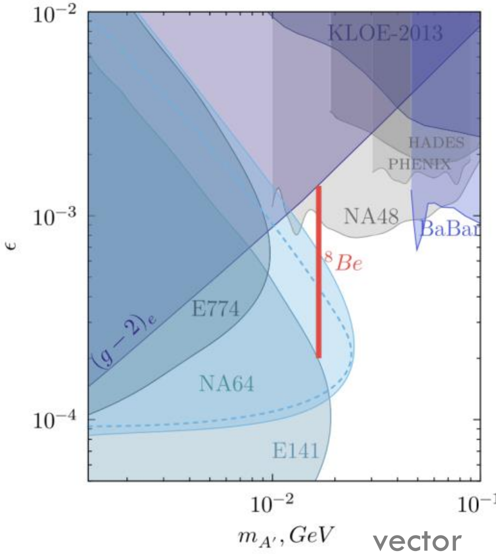
Signal



Background

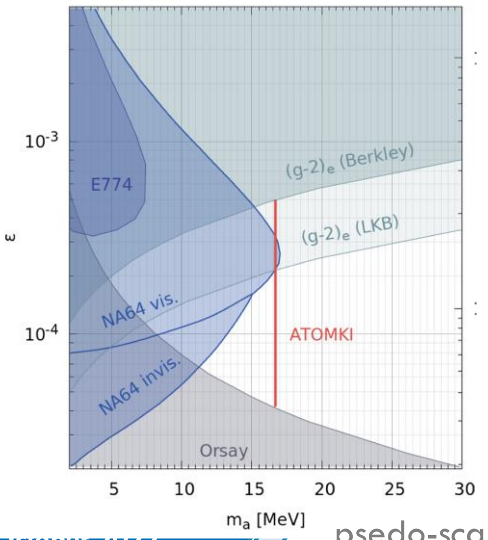


Phys. Rev. D **101,** 071101 (R) (2020)



vector

Phys. Rev. D **104,** L111102 (2021)



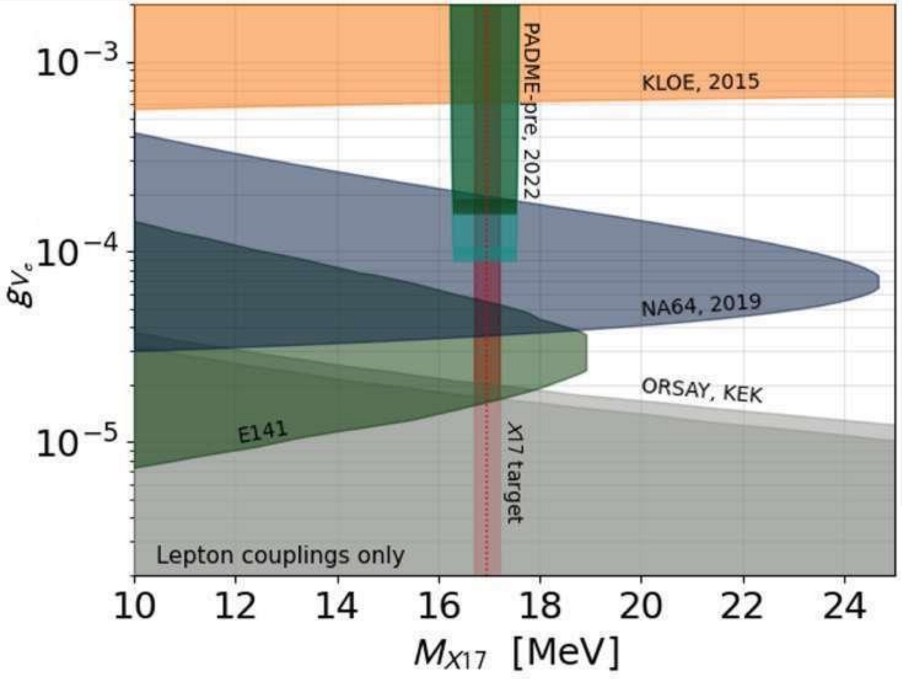
psedo-scalar

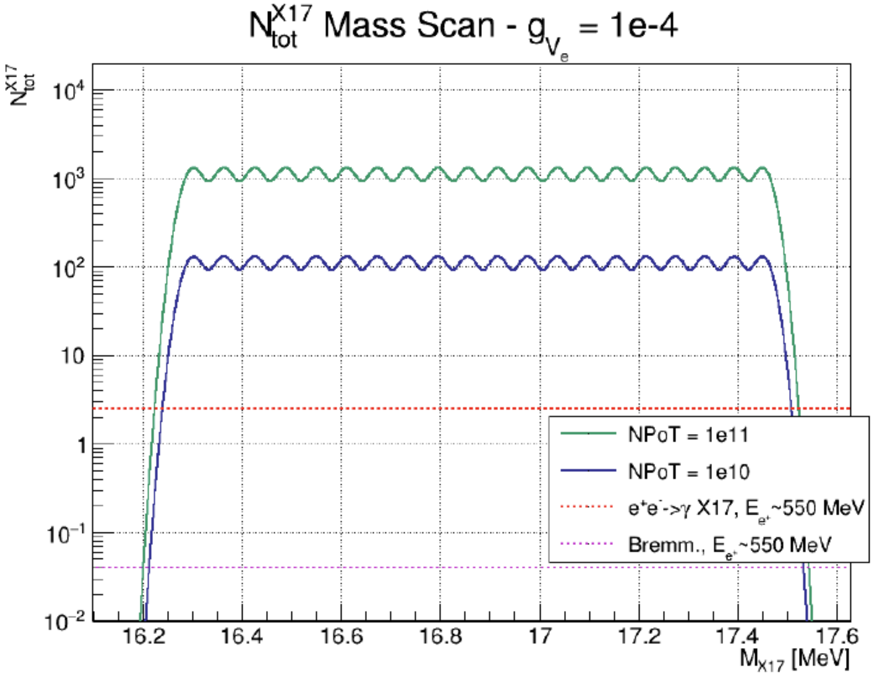
The nature of the X17 anomaly is not uniquely defined. Different interpretations consider a **vector** or **pseudo-scalar** particle of 17 MeV/c^2

EXPECTED RESULTS

X17 mass is known with limited precision (~ 0.2 MeV$/c^2$) the PADME strategy to search a signal is:

- explore a mass interval centred around 17 MeV$/c^2$ varing E_{e^+} almost continuously ($\sim$ 2 MeV) in the range 260-300 MeV.





Number of X17 expected at PADME for each of the 21 points of the energy scan.

Experimentally

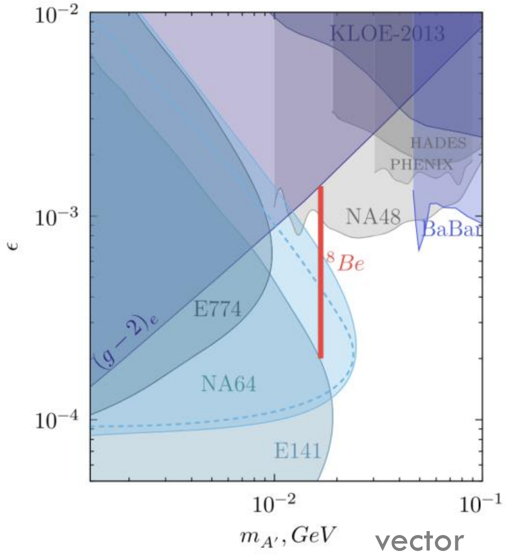
$$N^X \propto \frac{N_{meas}(e^+e^-) - N_{calc}(e^+e^-)}{N_{PoT}}$$

for each energy point

PROSPECTS FOR 2023

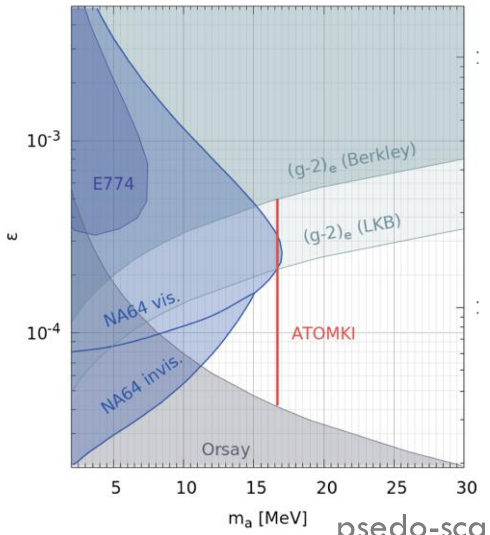
- According to phenomenological estimates Run III should allow PADME to close the gap for the X_{17} **vector hypothesis**
- Due to weaker constraints from NA64 for the **pseudo-scalar case** will be harder to close the gap
- At the end of 2022 will be understood which is the real sensitivity of the experiment to both scenarios
- In 2023 the LNF accelerator schedule foresees DAFNE operation for Siddhartha-2
- **However, PADME will be ready for any possible beam availability to improve/complete the X_{17} exclusion limits**
- To reach design sensitivity on *A'* existence, still 5×10^{12} particles-on-target are needed

Phys. Rev. D **101**, 071101 (R) (2020)



vector

Phys. Rev. D **104**, L111102 (2021)



psedo-scalar

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

PADME CONFERENCE PRESENTATIONS 2020 – 2022

35 conference contributions

XVIII Vulcano Workshop on Frontier Objects in Astrophysics and Particle Physics (FOAPP), Elba, 25 Sep. - 1 Oct. 2022	PADME results and perspectives	P. Valente
Congresso Nazionale Società Italiana di Fisica, Milano, 12 - 16 Sep. 2022	Il detector di PADME alla ricerca del fotone oscuro	F. Pinna
Congresso Nazionale Società Italiana di Fisica, Milano, 12 - 16 Sep. 2022	Ricerca di X17 con fasci di positroni ad LNF	E. Long
Congresso Nazionale Società Italiana di Fisica, Milano, 12 - 16 Sep. 2022	Ricerche di materia oscura nell'esperimento PADME	T. Spadaro
The 28th International Nuclear Physics Conference (INPC 2022), Cape Town, 11 - 16 Sep. 2022	The study of the X17 anomaly with the PADME experiment	P. Gianotti
11th International Conference of the Balkan Physical Union (BPU11), Belgrade, 28 Aug. - 1 Sep. 2022	The PADME experiment at LNF-INFN	V. Kozhuharov
14th International Conference on Identification of Dark Matter (IDM2022), Vienna, 18 -22 Jul. 2022	Dark sector studies with the PADME experiment	E. Long
XLI International Conference on High Energy Physics (ICHEP2022), Bologna, 6 - 13 Jul. 2022	Dark sector studies with the PADME experiment	P. Valente
19th International Conference on Calorimetry in Particle Physics (CALOR2022), Brighton, 16 - 20 May 2022	Using artificial intelligence in the reconstruction of signals from the PADME electromagnetic calorimeter	K. Stoimenova
5th Inter-experiment Machine Learning Workshop, CERN, 9 - 13 May, 2022	Application of artificial intelligence in the reconstruction of signals from the PADME electromagnetic calorimeter	K. Stoimenova
Moriond International Conference on Electroweak Interactions & Unified Theories, La Thuille, 12 - 19 Mar. 2022	PADME Positron Annihilation into Dark Matter Experiment	I. Oceano
Workshop Shedding light on X17, Rome, 6 - 8 Sep. 2021	Searching X17 with positrons at PADME	V. Kozhuharov
22nd Particles and Nuclei International Conference (PANIC2021), hosted by LIP, Faculty of Sciences of the University of Lisbon and held online, 5 - 10 Sep. 2021	The PADME Scientific Program	P. Gianotti
22nd Particles and Nuclei International Conference (PANIC2021), hosted by LIP, Faculty of Sciences of the University of Lisbon and held online, 5 - 10 Sep. 2021	The Padme Detector	F. Pinna
10th International Conference on New Frontiers in Physics (ICNFP 2021), Crete, Greece, 23 Aug. - 7 Oct. 2021	Search for feebly interactive particles: the PADME experiment	D. Domenici
Workshop on Standard Model and Beyond, 30 Aug. - 8 Sep. 2021, Online conference	Searching for light dark matter with the PADME experiment	I. Oceano
17th International Conference on Topics in Astroparticle and Underground Physics, hosted by IFIC Valencia and held online, 26 Aug. - 3 Sep. 2021	Searching for Dark Matter with the PADME experiment	I. Oceano
EPS-HEP 2021, Online conference, Jul. 26-30, 2021	Search for a Dark Photon with the PADME experiment	S. Spagnolo
Workshop Sustainable HEP, CERN, 28 - 30 Jun. 2021	The remote monitor and control systems of the PADME experiment at the DAΦNE BTF	E. Leonardi
WE-Haraeus-Seminar, Mainz, 9 Jun. 2021	Searching light dark matter particles in positrons annihilations	P. Valente
Invisibles21 Workshop, Madrid, 31 May 2021 - 4 Jun. 2021	Searching for the Dark Photon at the PADME Experiment	E. Long
Fifth Technology and Instrumentation in Particle Physics conference (TIPP2021), TRIUMF, 24 - 28 May 2021	The PADME charged particle spectrometer	I. Oceano
Fifth Technology and Instrumentation in Particle Physics conference (TIPP2021), TRIUMF, 24 - 28 May 2021	The PADME calorimeter	C. Taruggi
XIV International Conference on Interconnections between Particle Physics and Cosmology, Norman USA, 17 - 21 May 2021	The PADME experiment	E. Long
Beyond Standard Model: From Theory to Experiment (BSM- 2021), 29 Mar. 2 Apr. 2021	Searching for a dark photon signal with PADME	F. Oliva
First National Forum on Contemporary Space Research, Sofia, Bulgaria, 21 - 22 Oct. 2020	The PADME Experiment and Dark Matter Studies	R. Simeonov
Congresso Nazionale Società Italiana di Fisica, 14 - 18 Sep. 2020	Simulazione ed Elaborazione di Segnali nei Veto di PADME	E. Long
Congresso Nazionale Società Italiana di Fisica, 14 - 18 Sep. 2020	Ricerca di nuova fisica attraverso lo studio di eventi multileptonici a Padme	G. Martelli
Congresso Nazionale Società Italiana di Fisica, 14 - 18 Sep. 2020	L'esperimento PADME	B. Sciascia
9th International Conference on New Frontiers in Physics (ICNFP 2020), Crete, 4 Sep. 2 Oct. 2020	The Physics program of the PADME Experiment	F. Oliva
9th International Conference on New Frontiers in Physics (ICNFP 2020), Crete, 4 Sep. 2 Oct. 2020	The Padme detector	C. Taruggi
International Conference Instrumentation for Colliding Beam Physics (INSTR-20), Novosibirsk, 24 - 28 Feb. 2020	The PADME detector at LNF	D. Domenici
ASI Seminar, 6 Feb. 2020	Searching for light dark matter portals	F. Giacchino
Excited QCD 2020, Krynica Zdroj, Poland, 3 - 7 Feb. 2020	The Physics Program of the PADME Experiment	P. Gianotti
58th International Winter Meeting on Nuclear Physics, Bormio, 20-24 Jan. 2020	The PADME experiment	I. Oceano

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PADME PAPERS 2020 – 2022

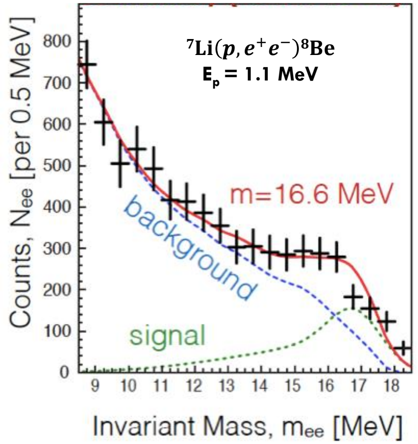
K. Dimitrova	Using Artificial Intelligence in the Reconstruction of Signals from the PADME Electromagnetic Calorimeter	Instruments 2022, 6, 46. https://doi.org/10.3390/instruments6040046
P. Albicocco et al.	Commissioning of the PADME experiment with a positron beam	JINST 17 (2022) 08, P08032, ArXiv:2205.03430 [physics.ins-det]
F. Bossi et al.	The PADME beam line Monte Carlo simulation	JHEP 09 (2022) 233, ArXiv:2204.05616 [hep-ex]
S. Spagnolo	Search for a Dark Photon with the PADME experiment	PoS EPS-HEP2021 (2022) 186
P. Gianotti	The PADME scientific program	PoS PANIC2021 (2022) 043
F. Pinna	The PADME detector	PoS PANIC2021 (2022) 079
A. P. Caricato et al.	The physics program of the PADME experiment	Phys. Scripta 97 no.2 (2022) 024003
G. Georgiev	Offline noise calibration of the CAEN V1742 ADCs at the PADME experiment	J.Phys.Conf.Ser. 2255 (2021) 012008
I. Oceano	Searching for Dark Matter with the PADME experiment	J.Phys.Conf.Ser. 2156 (2021) 012058
R. Simeonov	The PADME Experiment andDark Matter Searches	Bulgarian Jou. Phys. vo. 47 (2021) 62-69
D. Domenici	The PADME experiment at LNF	JINST 15 (2020) no.10, C10015
P. Albicocco et al.	Characterisation and performance of the PADME electromagnetic calorimeter	JINST 15 (2020) no.10, T10003
I. Oceano	The performance of the diamond active target of the PADME experiment	JINST 15 (2020) C04045
G. Piperno	First results on the performance of the PADME electromagnetic calorimeter	JINST 15 (2020) C05008
F. Oliva	Performance of the charged particle detectors of the PADME experiment	JINST 15 (2020) C06017

15 papers

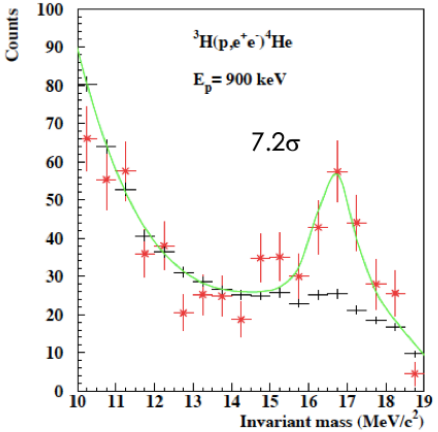
THE ^{8}BE ANOMALY

The study of de-excitation of light nuclei via IPC pointed out an anomaly in the decay of ^{8}Be and ^{4}He.

$m_X = 16.7 \pm 0.35(stat) \pm 0.5(sys) MeV$ $m_X = 16.90 \pm 0.12(stat) \pm 0.21(sys) MeV$

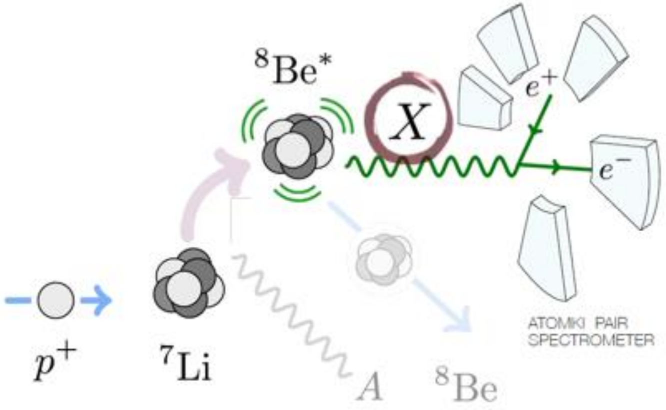


Phys. Rev. Lett. **116,** 042501 (2016)



Phys. Rev. C **104,** 044003 (2021)

Is the *X* a signal of a dark matter particle?



E. Nardi *et al.*, **"Resonant production of dark photons in positron beam dump experiments"** Phys.Rev. D**97** (2018) no.9, 095004

By setting the e$^+$ beam at ~283 MeV PADME has the unique opportunity to have a resonant production of the X_{17}.
Several uncertainties:

- resonance width (0.5 eV);
- Bhabha scattering background;
- optimal target.