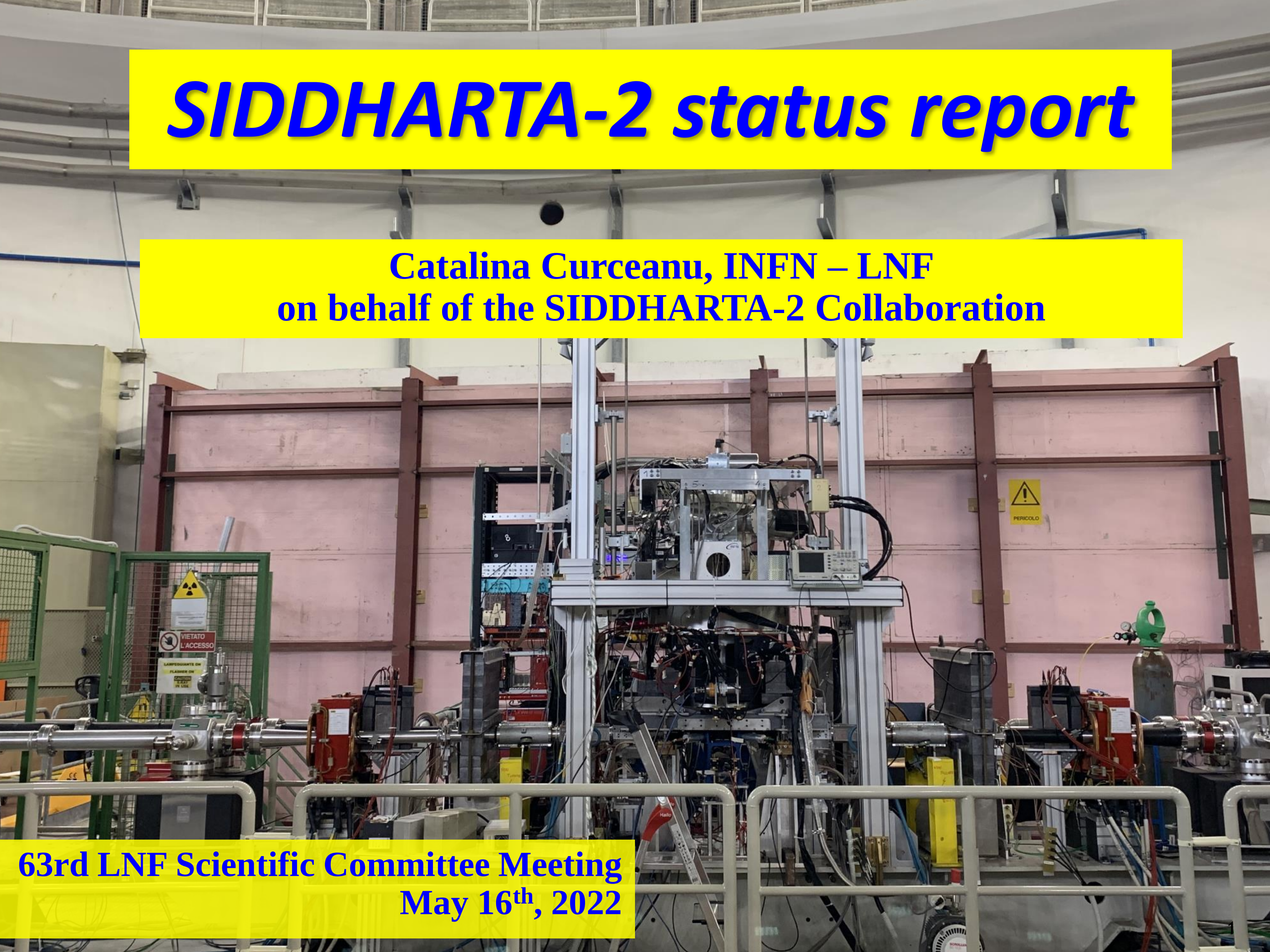
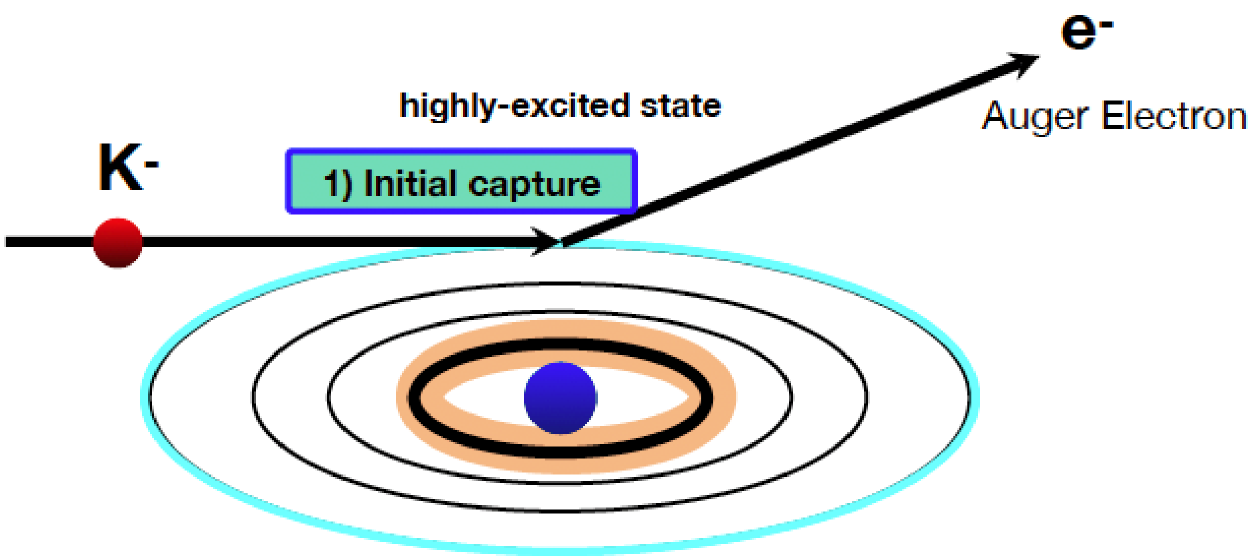
SIDDHARTA-2 status report

Catalina Curceanu, INFN – LNF
on behalf of the SIDDHARTA-2 Collaboration

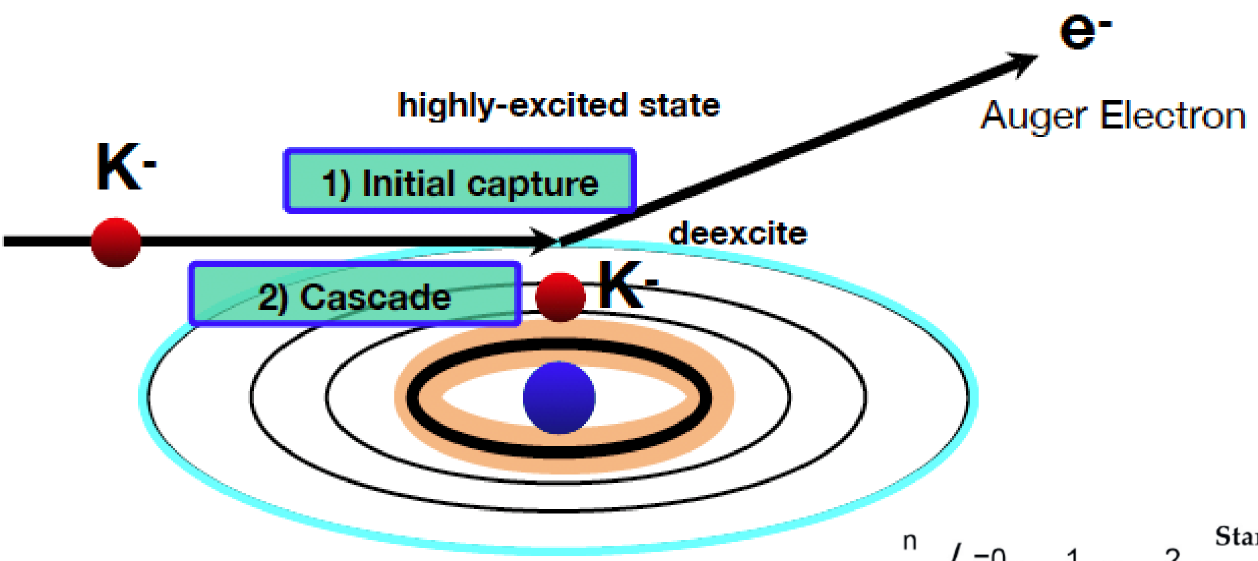


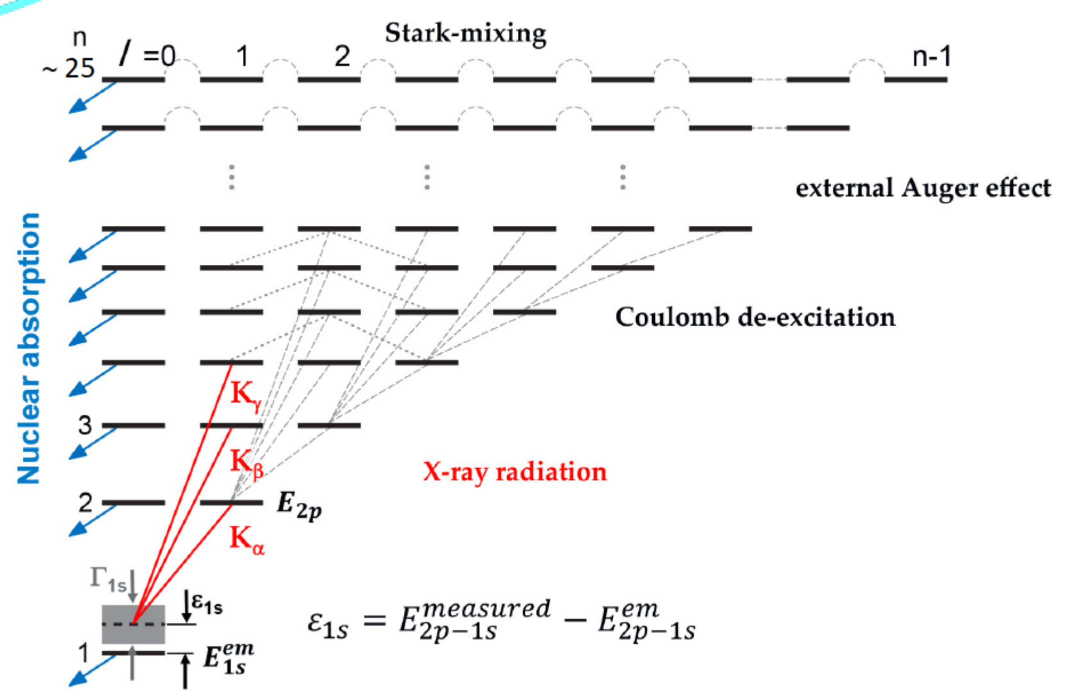
63rd LNF Scientific Committee Meeting
May 16th, 2022

Kaonic atom Formation



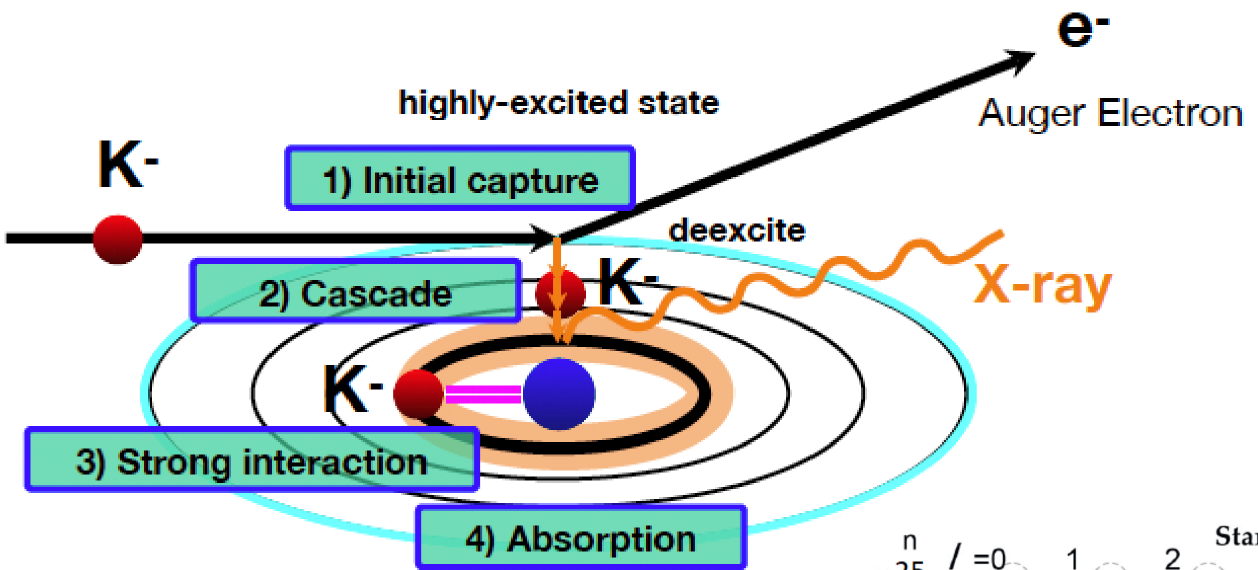
Kaonic atom Formation



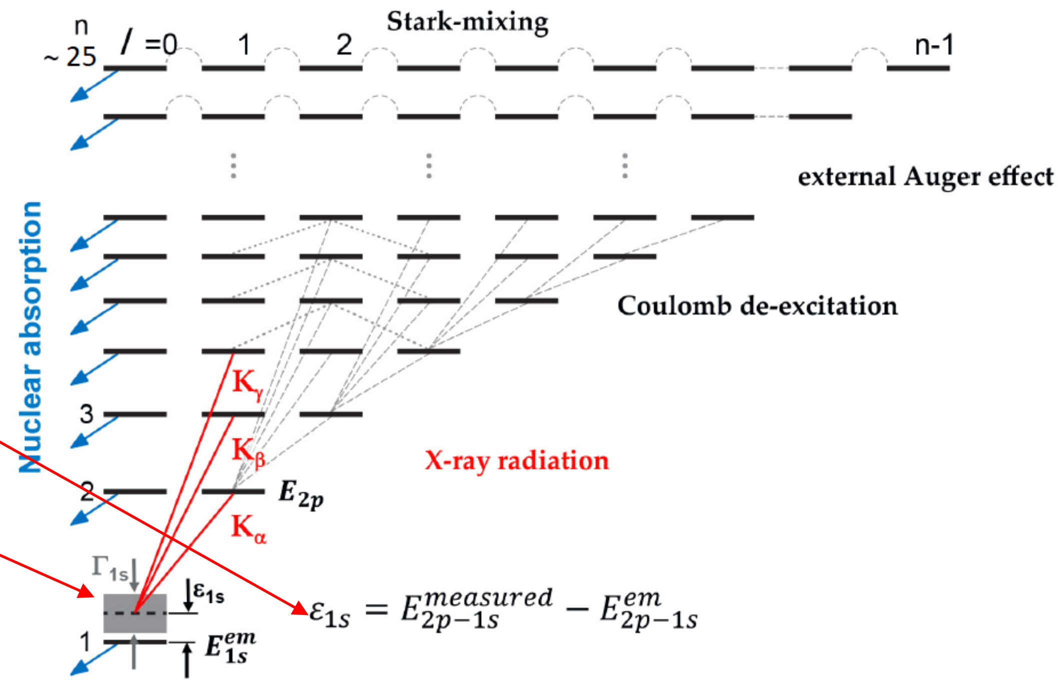


$$\varepsilon_{1s} = E_{2p-1s}^{measured} - E_{2p-1s}^{em}$$

Kaonic atoms and the QCD effects



Width Γ and shift ε obtained by measuring the X-rays emitted



SIDDHARTA-2 Collaboration

Silicon **D**rift **D**etectors for **H**adronic **A**tom **R**esearch by **T**iming **A**pplication

LNF-INFN, Frascati, Italy
SMI-ÖAW, Vienna, Austria
Politecnico di Milano, Italy
IFIN –HH, Bucharest, Romania
TUM, Munich, Germany
RIKEN, Japan
Univ. Tokyo, Japan
Victoria Univ., Canada
Univ. Zagreb, Croatia
Univ. Jagiellonian Krakow, Poland
ELPH, Tohoku University

SIDDHARTA-2 Scientific Goal

To perform the *first measurement ever of kaonic deuterium X-ray* transition to the ground state (1s-level) such as to determine its shift and width induced by the presence of the strong interaction.

SIDDHARTA-2 Scientific Goal

To perform the *first measurement ever of kaonic deuterium X-ray* transition to the ground state (1s-level) such as to determine its shift and width induced by the presence of the strong interaction.

Analysis of the combined measurements of kaonic deuterium and kaonic hydrogen

$$\varepsilon_{1s} - \frac{i}{2}\Gamma_{1s} = -2\alpha^3 \mu_c^2 a_{K^-p}\left(1 - 2\alpha\mu_c(\ln\alpha - 1)a_{K^-p}\right)$$

(μ_c reduced mass of the K⁻p system, α fine-structure constant)

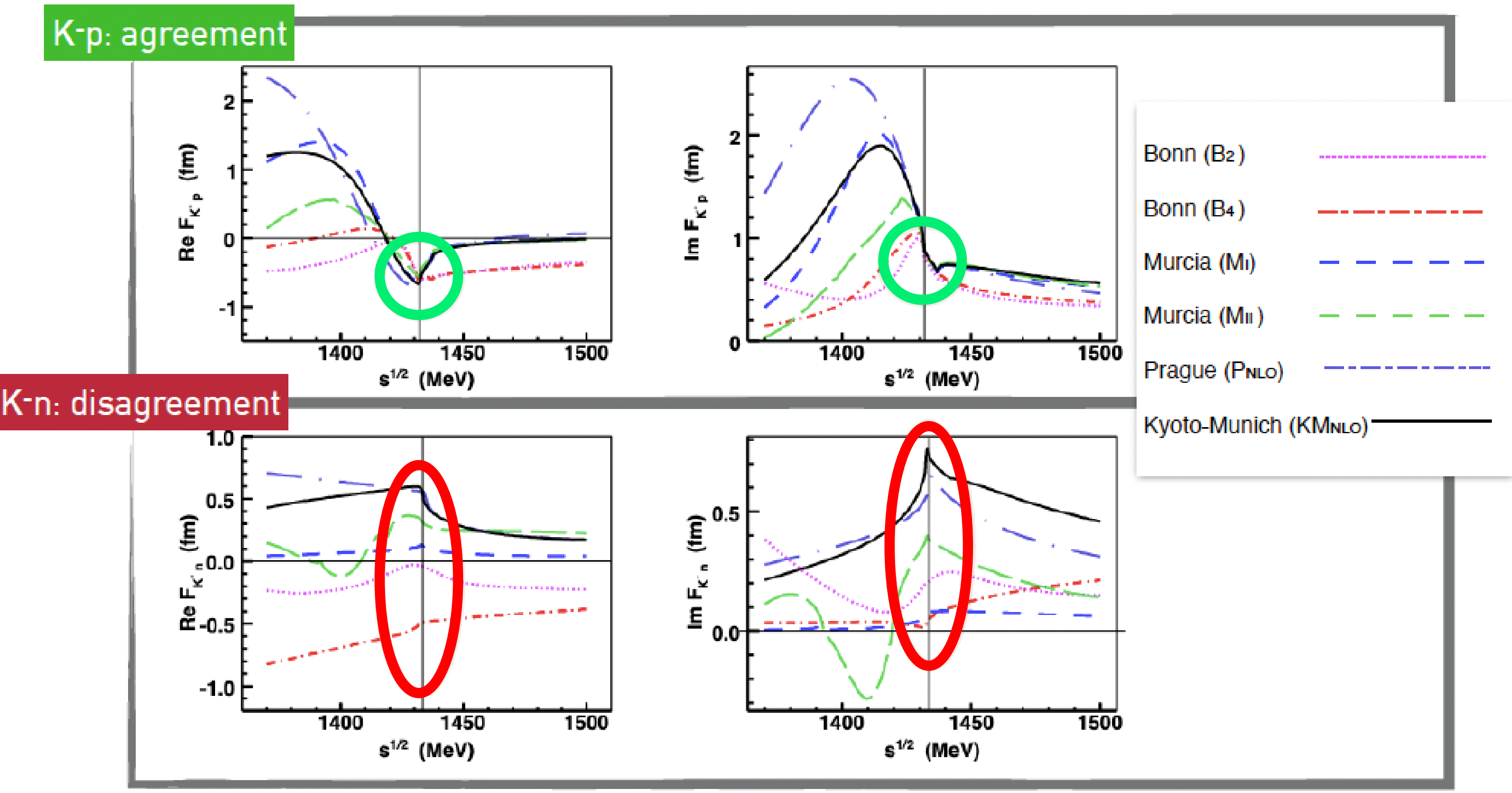
U.-G. Meißner, U.Raha, A.Rusetsky, Eur. phys. J. C35 (2004) 349
next-to-leading order, including isospin breaking

$$a_{K^-p} = \frac{1}{2}[a_0 + a_1]$$
$$a_{K^-n} = a_1$$

$$a_{K^-d} = \frac{k}{2}\left[a_{K^-p} + a_{K^-n}\right] + C = \frac{k}{4}[a_0 + 3a_1] + C$$
$$k = \frac{4[m_n + m_K]}{[2m_n + m_K]}$$

completely solve Isospin-dependent K-N scattering length

Kaonic atoms – scattering amplitudes



A. Cieplý, M. Mai, Ulf-G. Meißner, J. Smejkal, https://arxiv.org/abs/1603.02531v2

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- Publications since last SC
- 62nd SciCom recommendations
- SIDDHARTINO run outcomes
- Activities in DAΦNE – SIDDHARTA-2 installation and first results
- HPGe Detector: test run for kaonic lead (kaon mass)
- Future plans

Publications since last SC

1. D. Sirghi et al., A new kaonic helium measurement in gas by SIDDHARTINO at the DAΦNE collider, J.Phys.G 49 (2022) 5, 055106
2. F. Sirghi et al., Status and perspectives for low energy kaon-nucleon interaction studies at DAΦNE: from SIDDHARTA to SIDDHARTA-2, PoS PANIC2021 (2022) 200
3. 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, accepted.
4. A. Scordo et al, HAPG mosaic crystal Von Hamos spectrometer for high precision exotic atoms spectroscopy, PoS PANIC2021 (2022) 195.
5. F. Sgaramella et al., The SIDDHARTA-2 calibration method for high precision kaonic atoms X-ray spectroscopy measurements, e-Print: 2201.12101, submitted to Physica Scripta.
6. F. Napolitano et al., Kaonic Atoms at the DAΦNE Collider with the SIDDHARTA-2 Experiment, e-Print:2201.11525, submitted to Physica Scripta
7. Hexh Shi et al., Kaonic helium-4 L series X-rays yields in gas measured by SIDDHARTINO, under submission to Nuclear Physics A

Publications since last SC

8. C. Curceanu et al, Kaonic atoms measurements at the DAΦNE collider: the SIDDHARTA-2 experiment, EPJ Web Conf. 258 (2022) 07006
9. M. Tuechler et al, Main Features of the SIDDHARTA-2 Apparatus for Kaonic Deuterium X-Ray Measurements, EPJ Web Conf. 262 (2022) 01016.
10. K. Piscicchia et al., Low energy kaon-nuclei interaction studies at DAΦNE, EPJ Web Conf. 262 (2022) 01006.
11. M. Miliucci, Silicon drift detectors technology for high precision light Kaonic atoms spectroscopic measurements at the DAΦNE collider, AIP Conf.Proc. 2416 (2021) 1, 020009.
12. V. De Leo et al, Reflection efficiency and spectra resolutions ray-tracing simulations for the VOXES HAPG crystal based Von Hamos spectrometer, Condens.Mat. 7 (2021) 1, 1.
13. M. Miliucci, Silicon Drift Detectors' Spectroscopic Response during the SIDDHARTA-2 Kaonic Helium Run at the DAΦNE Collider, Condens.Mat. 6 (2021) 4, 47. .

+ other 4 articles submitted awaiting reviews

Luca De Paolis: Best Poster award

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62nd LNF Scientific Committee Meeting

Recommendations SIDDHARTA

"The **SIDDHARTA-2 team should start taking data with the present luminosity**, while working carefully on optimizing their S/B ratio as much as possible, like they have been doing in the past. Given the present background and machine conditions, it is important to know what is **the minimum integrated luminosity** required to get sensible results for the kaonic deuterium measurement."

We address this question – data taking planned to be started end of May/early June 2022; need (probably) to go end of 2022 and/or through 2023 to get sensible results

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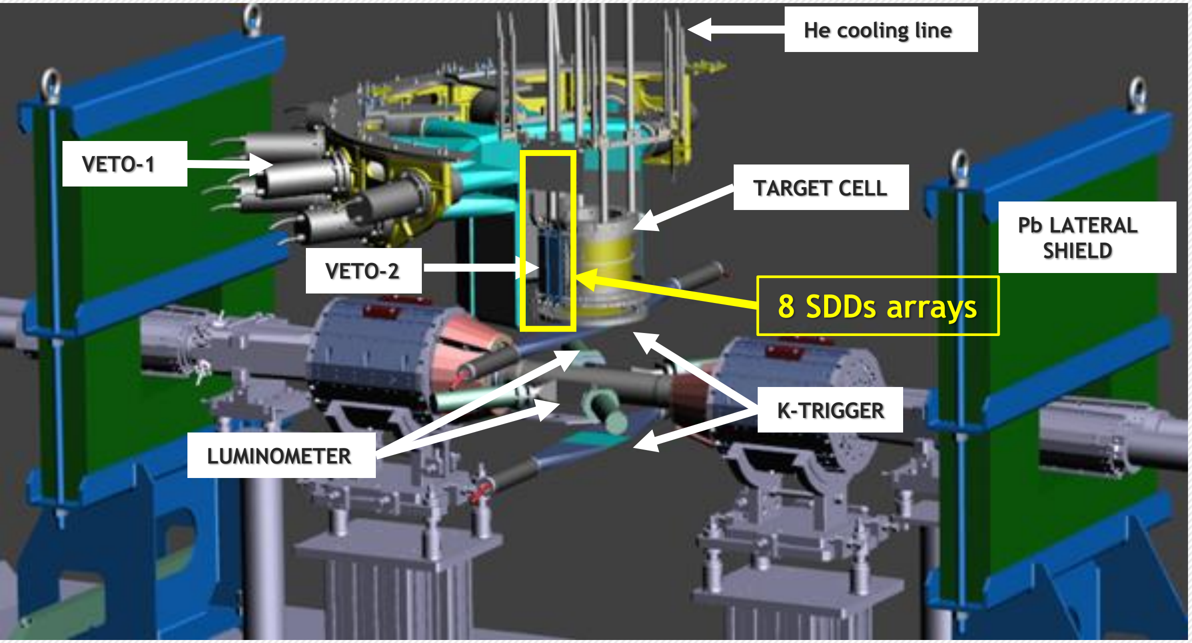
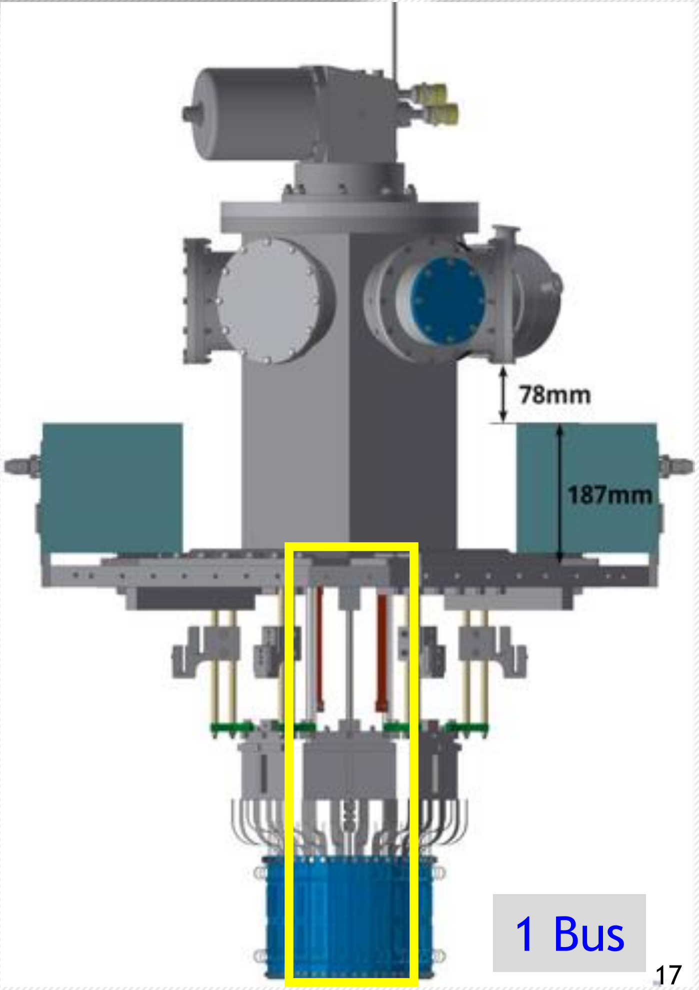
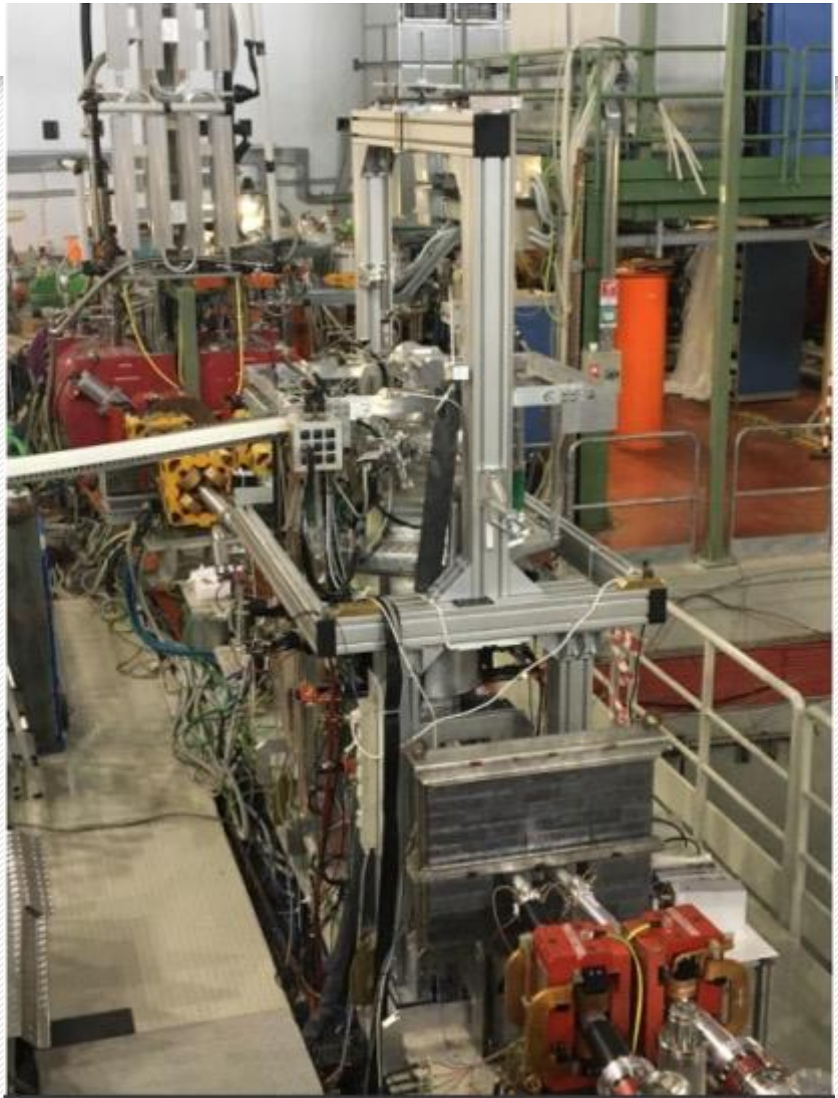
SIDDHARTINO run

Schematic representation of SIDDHARTINO setup





SIDDHARTINO setup (1/6 SDDs)



- Phase 1 with SIDDHARTINO:

during the commissioning of DAΦNE:

optimization with the SIDDHARTINO setup

for the K-^4He measurement

(with 8 SDD arrays)

Project timeline –shown at the last SciCom

61st LNF SciCom

2021, May

Software and hardware optimization back. reduction

SIDDHARTINO optimization run

2021, June

Different combinations of the degrader thickness and different gas density

SIDDHARTINO K-^{4}He run

2021, 24 June – 18 July

Analysis of the SIDDHARTINO data.
Start SIDDHARTA-2 Installation

Start SIDDHARTA-2 installation: mechanics

2021, August

Installation of SDD, veto and electronics.
Update of the DAQ….

SIDDHARTA-2 Installation and tests

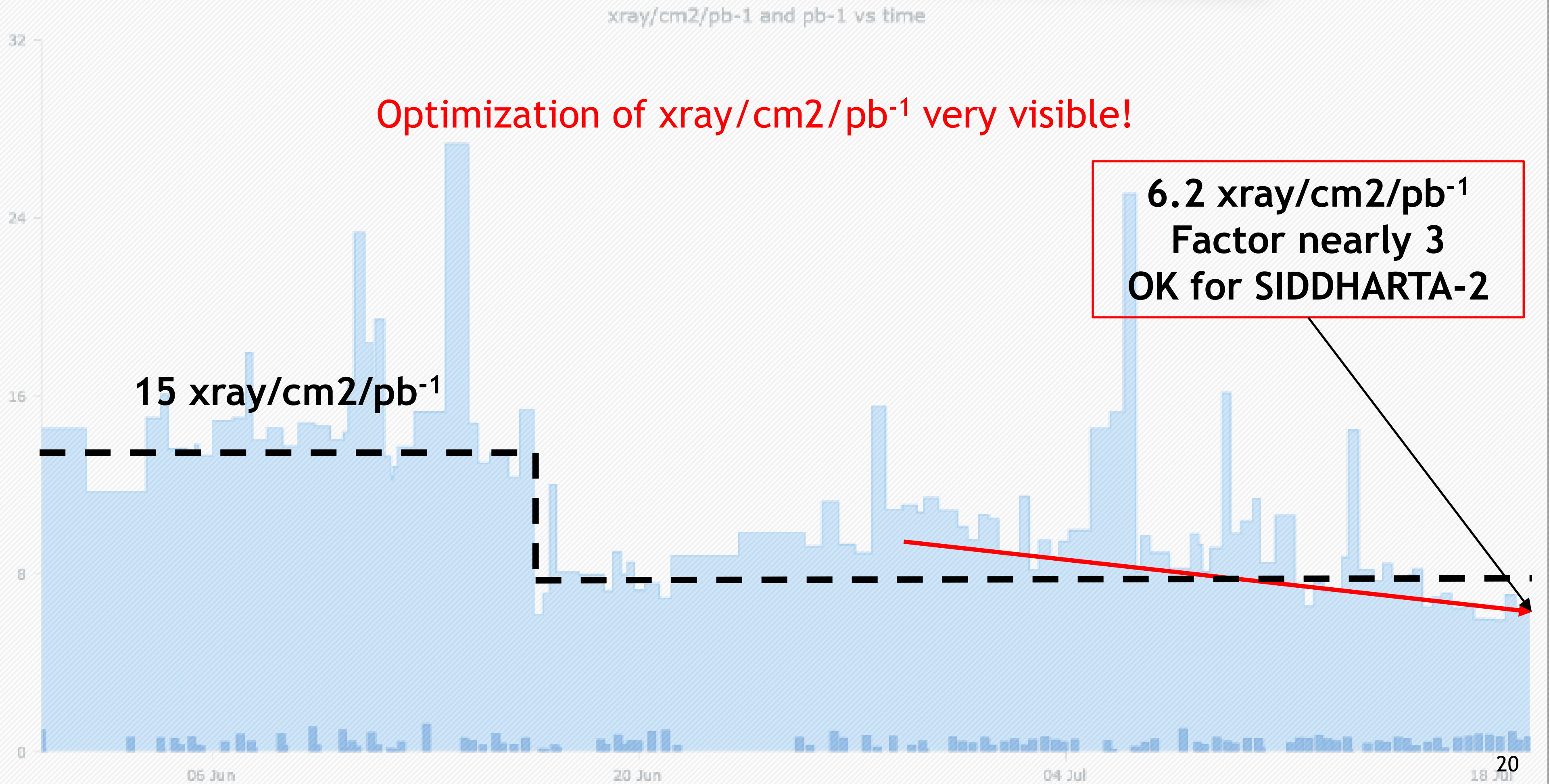
2021, September -October

Ready for run

62nd LNF SciCom

2021, November

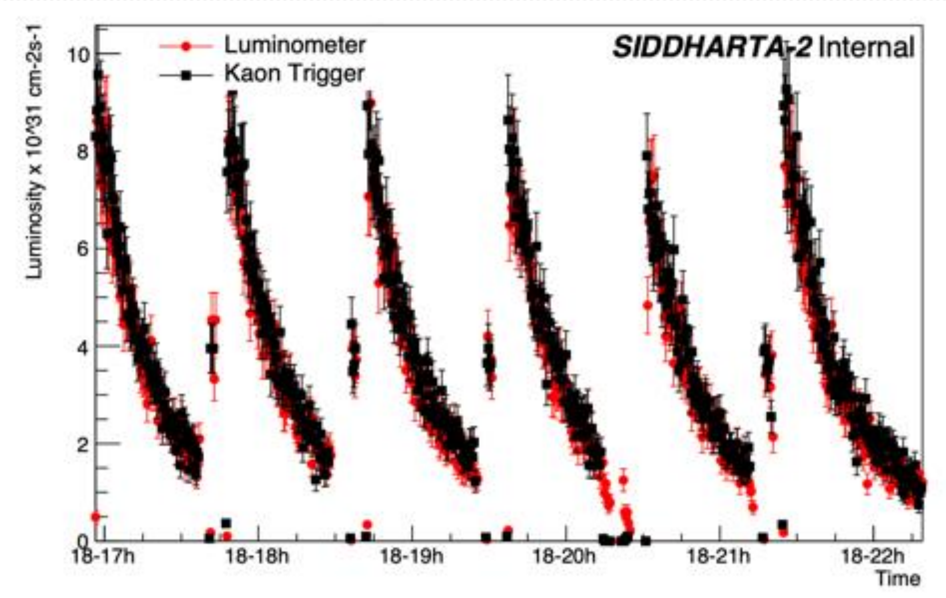
SIDDHARTINO - xray/cm2/pb^{-1}



SIDDHARTINO data - Integrated Luminosity

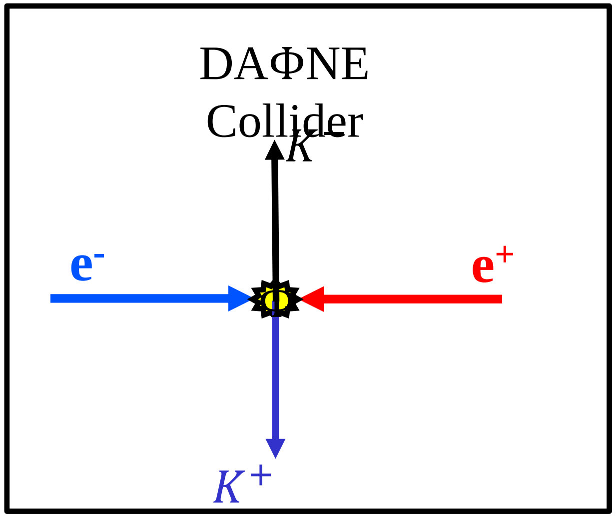
Total integrated luminosity: 54 pb^{-1}

- Optimization run: 24 pb^{-1}
  - Trigger, DAQ, SDD optimization
- Kaonic ^4He run: 30 pb^{-1}
  - Degrader optimization, low and high ^4He density measure



Kaon monitor and Luminometer measure at the end of SIDDHARTINO run

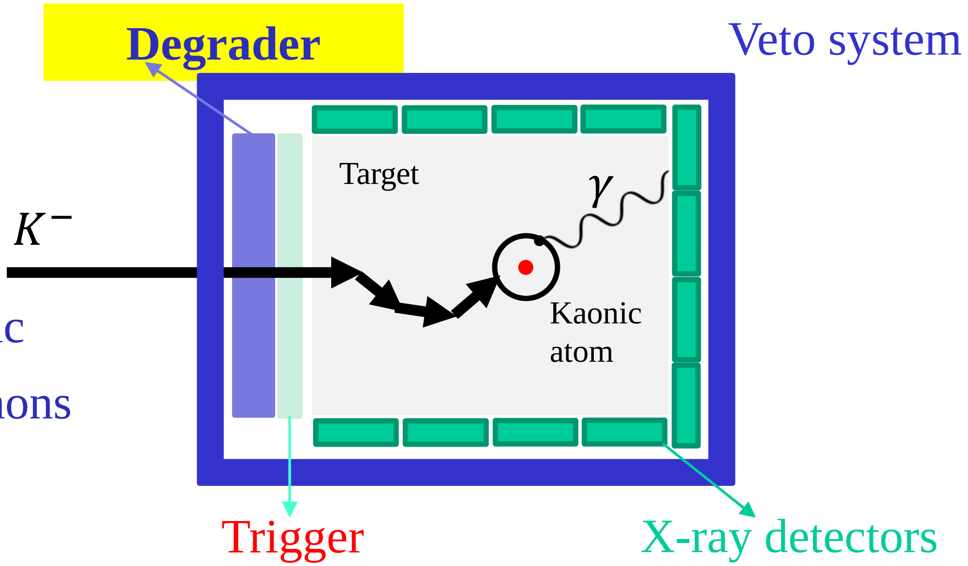
Experimental Principle



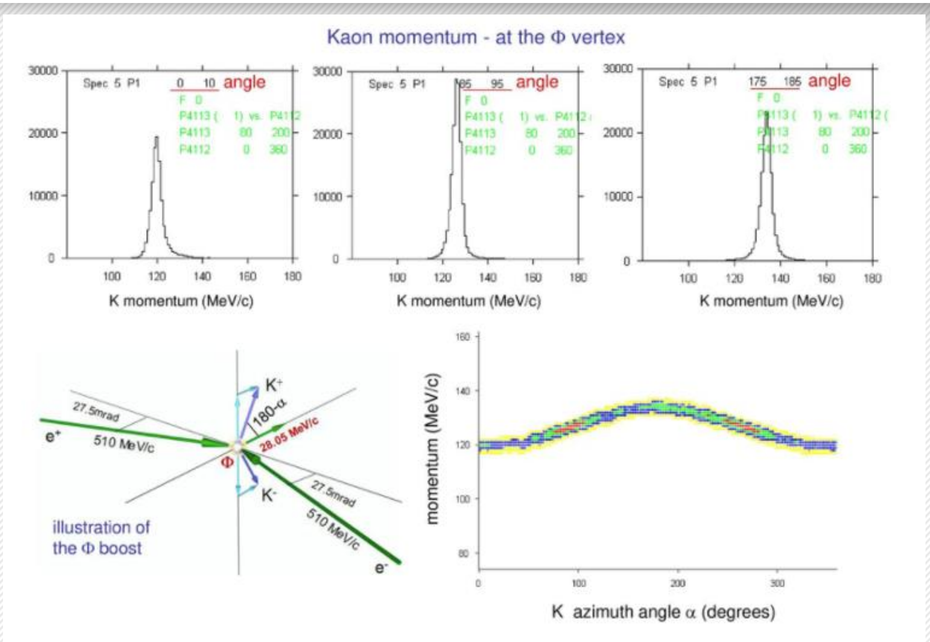
Monochromatic

Low energy kaons

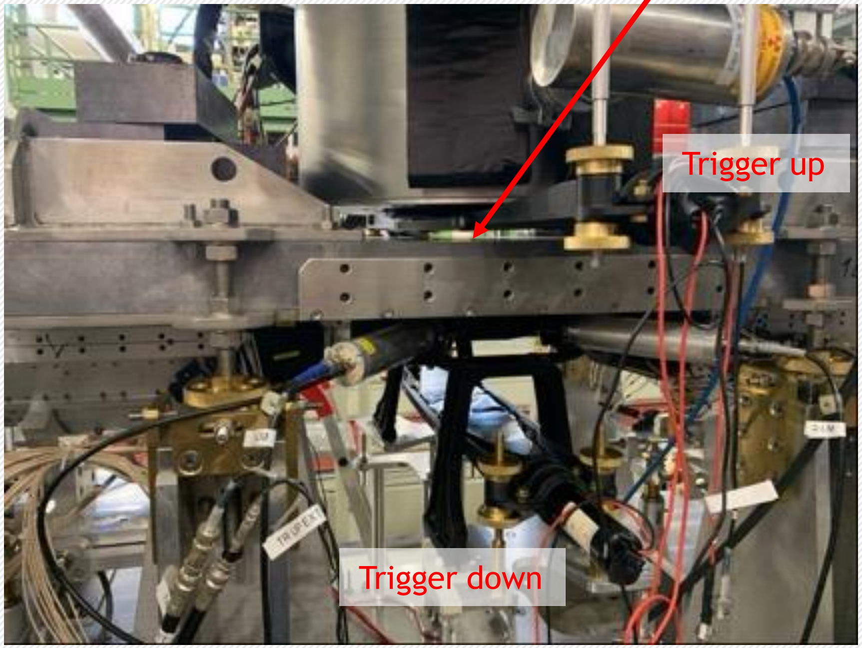
Solid angle



Degrader Optimization



the degrader is composed of mylar foil (micron) and is placed below the trigger up



Degrader thickness optimization is fundamental to maximize the number of stopped kaons in the target

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IOP Publishing
Journal of Physics G: Nuclear and Particle Physics
J. Phys. G: Nucl. Part. Phys. 49 (2022) 055106 (14pp)
https://doi.org/10.1088/1361-6471/ac5dac

A new kaonic helium measurement in gas by SIDDHARTINO at the DAΦNE collider*

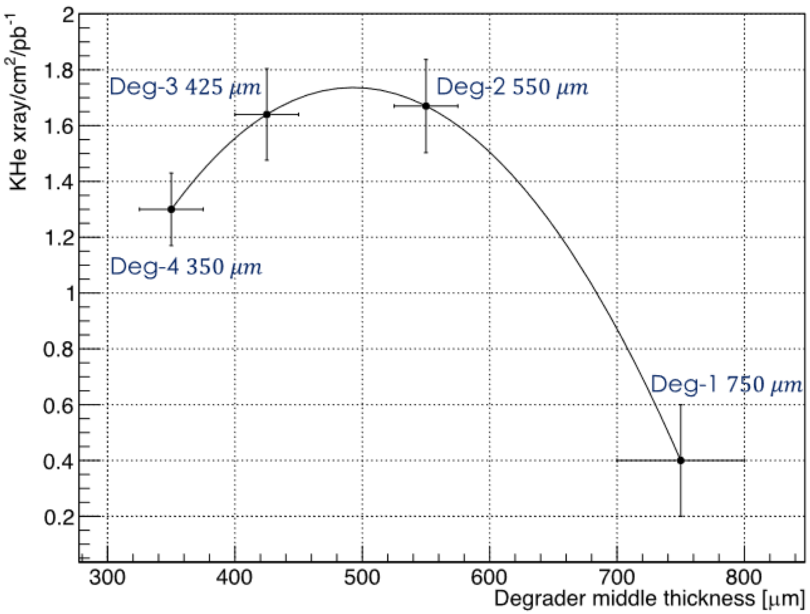

Figure 5. Degrader optimization curve: the horizontal axis is the central thickness and the vertical one the corresponding $K^4He(3d \rightarrow 2p)$ signal normalized by integrated luminosity and effective detection surface.

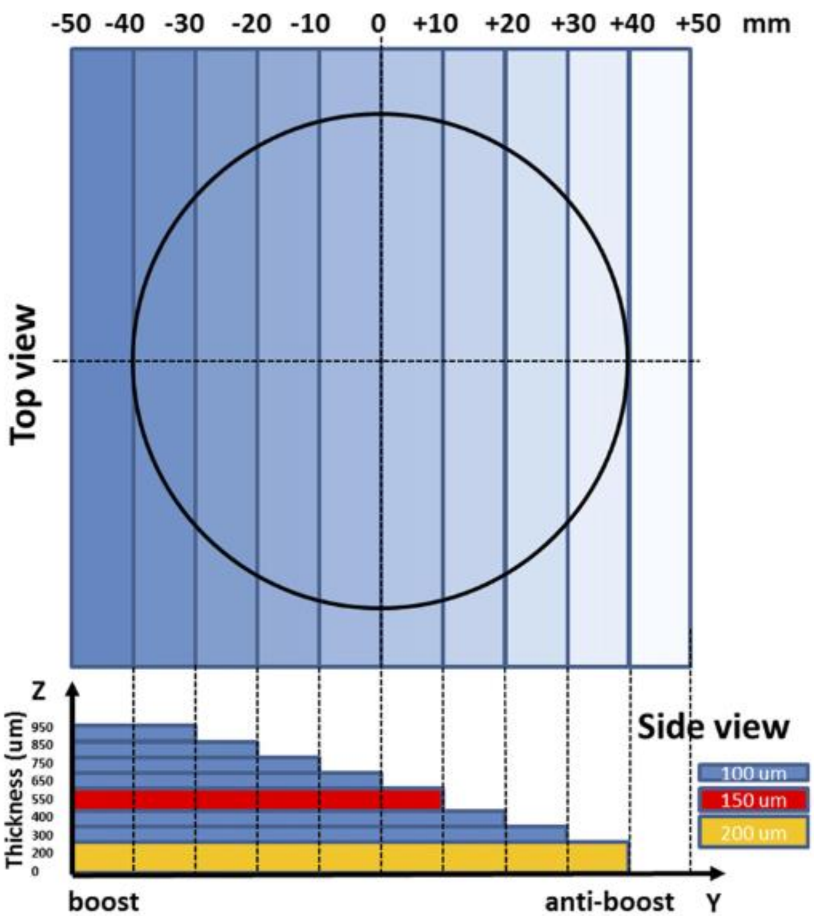

Figure 6. Nearest to optimal configuration of the Mylar degrader: the circle represents the size of the entrance window of the vacuum chamber; direction '*Y*' points to the outer side of the DAΦNE ring, corresponding to the anti-boost side for kaons. The degrader has eight steps to compensate for the boost effect, with thicknesses shown in the lower part of the figure.

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Journal of Physics G: Nuclear and Particle Physics
J. Phys. G: Nucl. Part. Phys. 49 (2022) 055106 (14pp)
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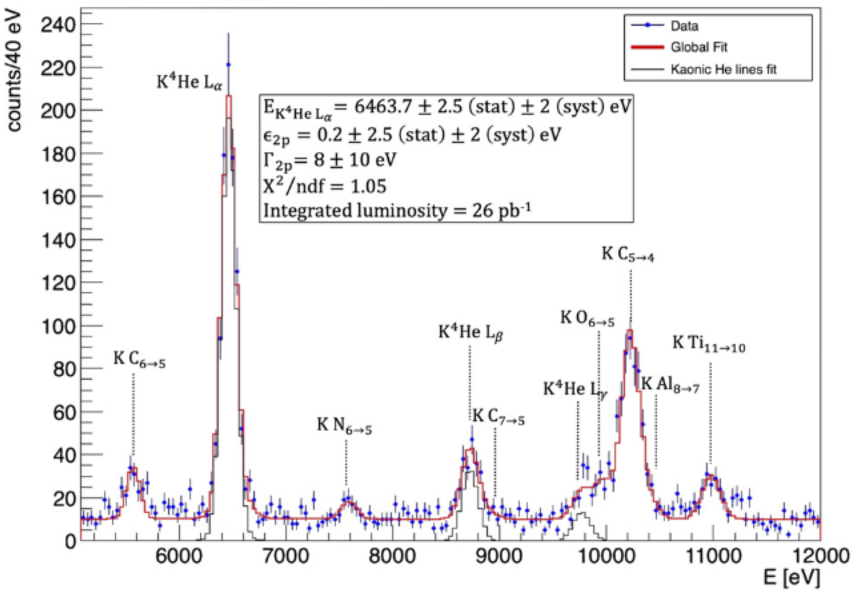

Figure 7. Fit (red line) of the K^4He energy spectrum. The $L\alpha$ peak is seen together with the $L\beta$ and $L\gamma$ ones (black lines). The peaks labeled as KN, KC, KAl, KTi (dotted lines) are the kaonic atoms lines produced by the kaons stopped in the Kapton ($C_{22}H_{10}O_5N_2$) walls of the target cell and in other parts of the setup (see text for details).

$$\epsilon_{2p} = E_{exp} - E_{e.m} = 0.2 \pm 2.5(stat) \pm 2.0(syst)\ eV$$

$$\Gamma_{2p} = 8 \pm 10\ eV\ (stat).$$

The most precise KHe measurement in gas

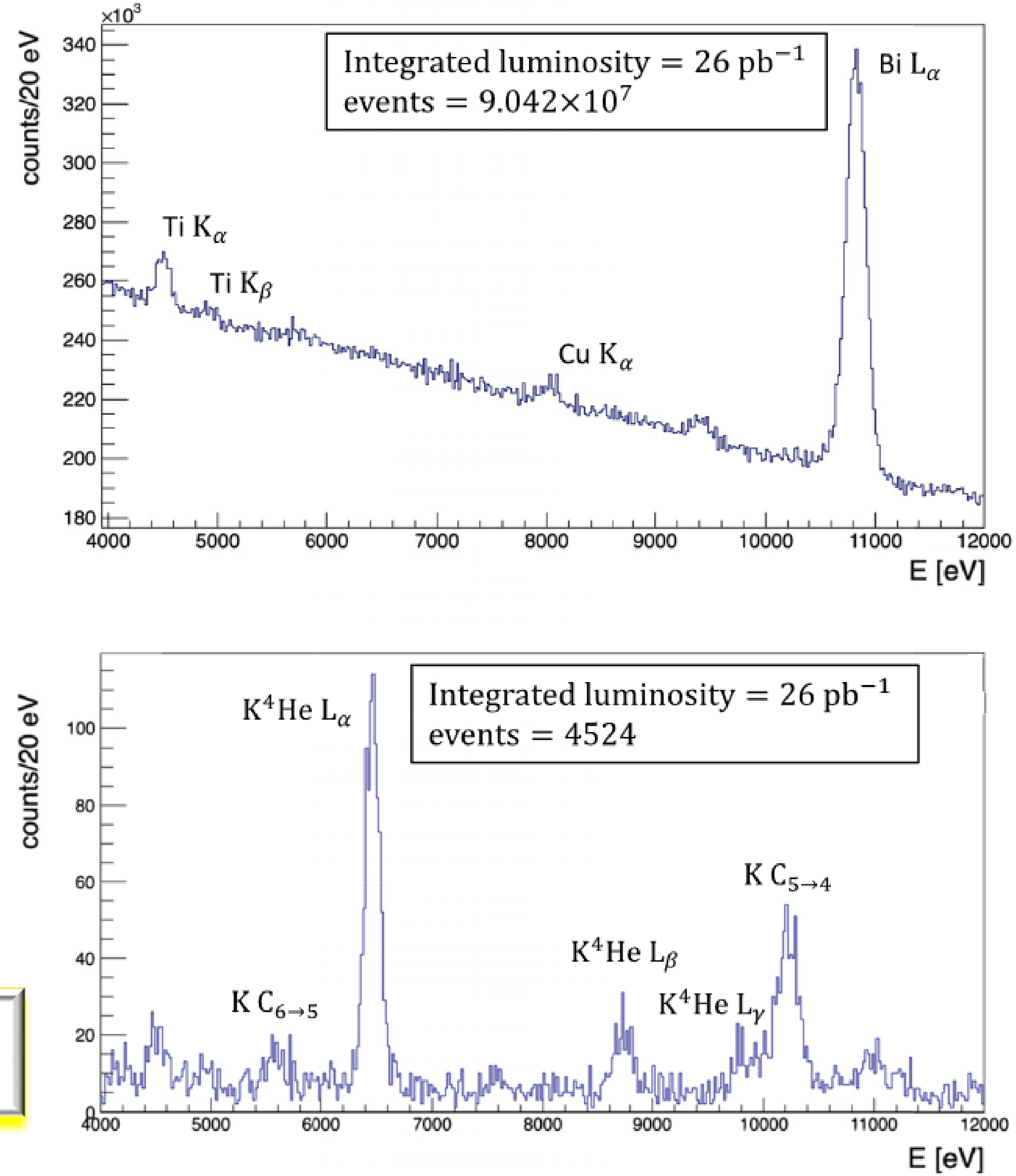

Figure 4. Spectra without (top) and with (bottom) KT selections, from which the $\simeq 10^5$ rejection factor can be obtained (bottom). See text for details.

Kaonic helium-4 L series X-rays yields in gas measured by SIDDHARTINO

Kaonic atoms cascade processes (yields)

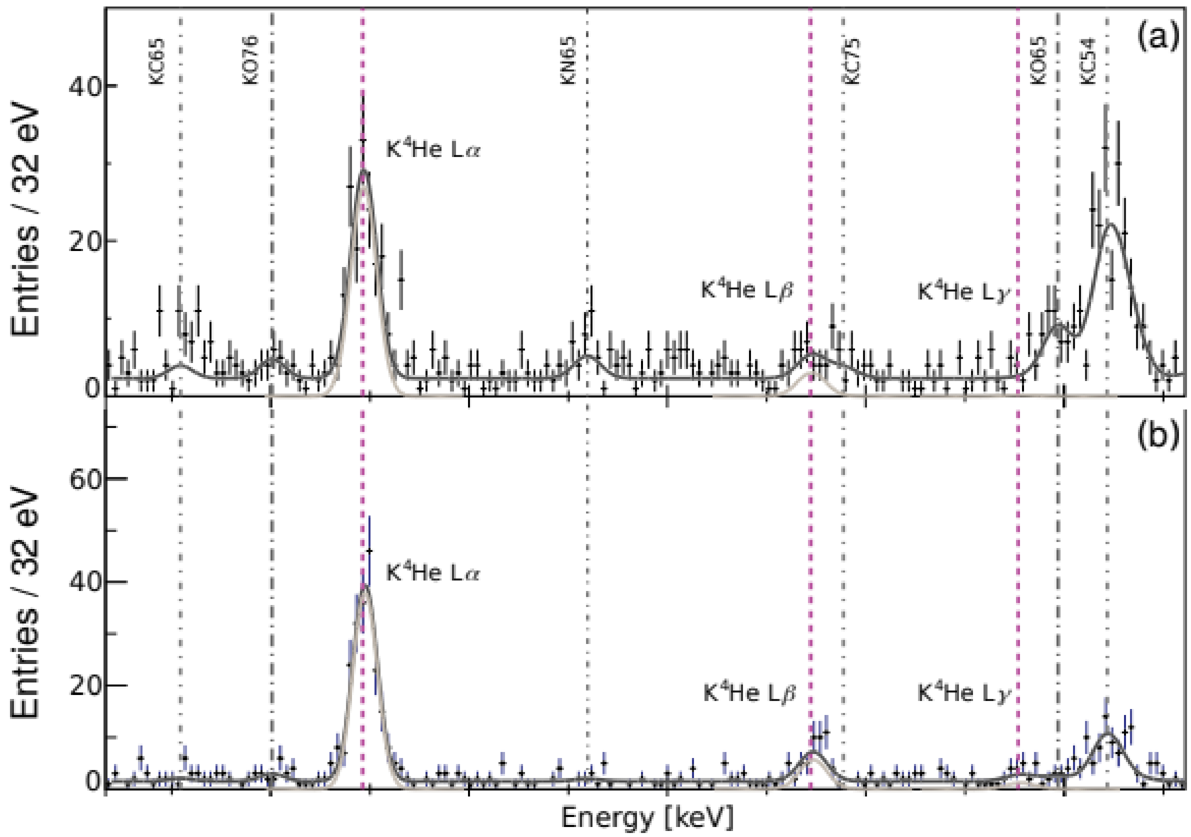

Figure 2. X-ray kaonic helium-4 spectra measured by SIDDHARTINO for: (a) 0.9 g/l target gas density, corresponding to 4.3 pb^{-1} integrated luminosity; (b) 1.9 g/l target gas density, corresponding to 9.5 pb^{-1} integrated luminosity.

Kaonic helium-4 L series X-rays yields in gas measured by SIDDHARTINO

Kaonic atoms cascade processes (yields) for Nucl Phys A

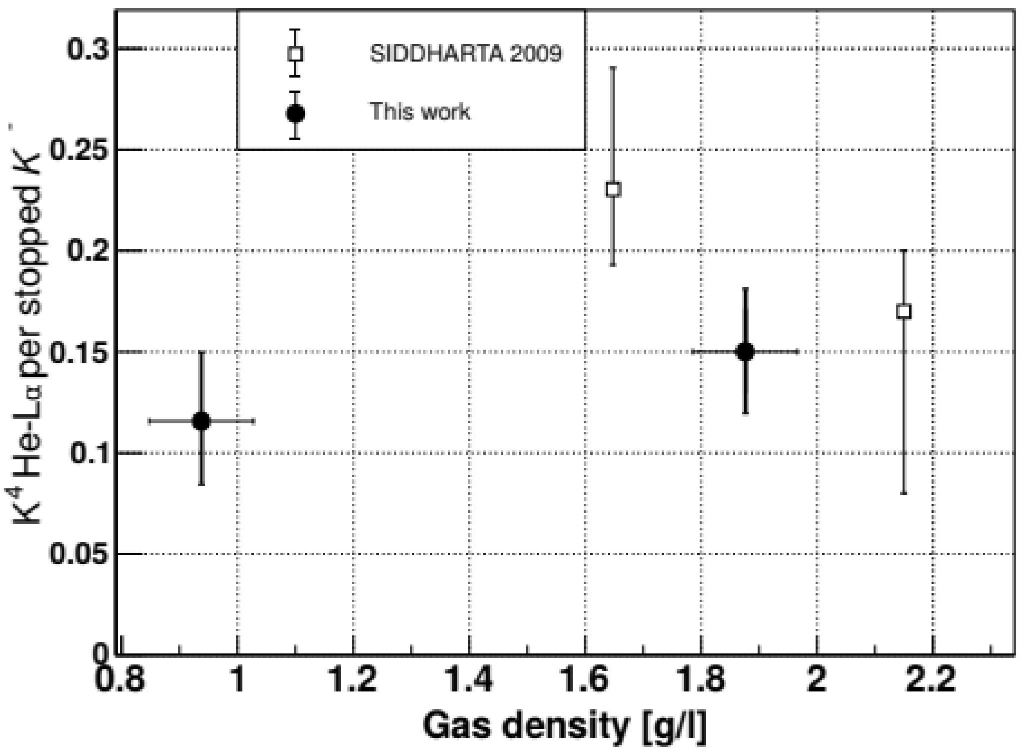

Figure 3. The L_α X-ray yield of $K^{-}\,{}^{4}He$ as function of the X-rays target density from all gaseous target measurement: this work (filled dots) and SIDDHARTA experiment [13] (hollow dots).

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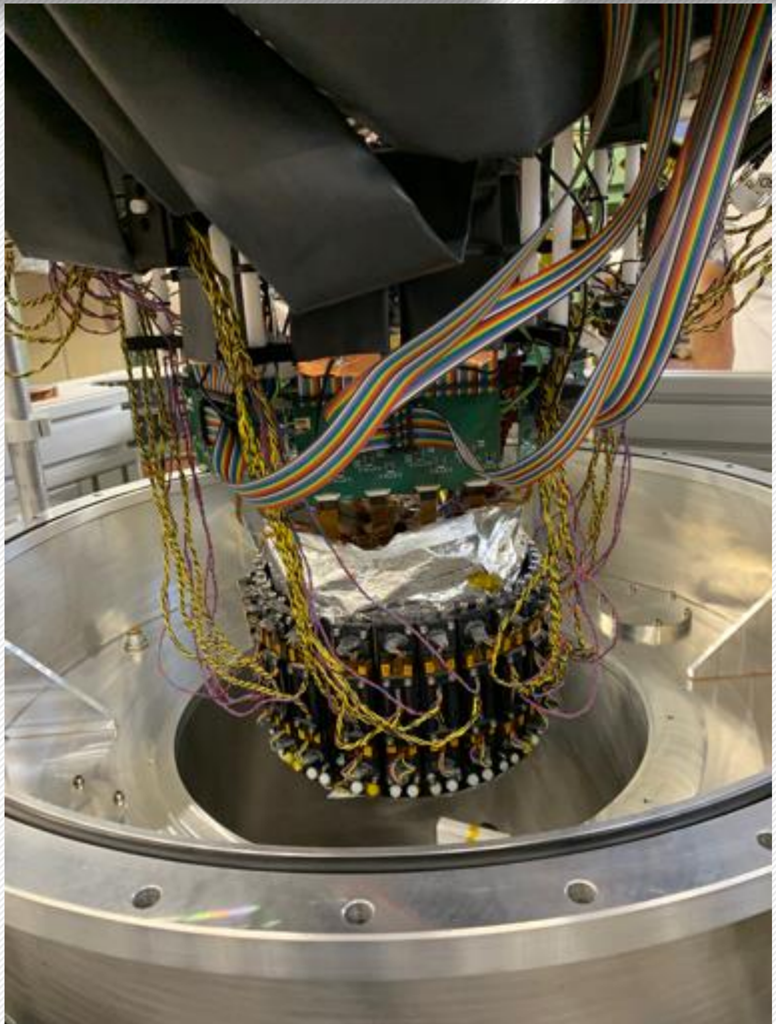
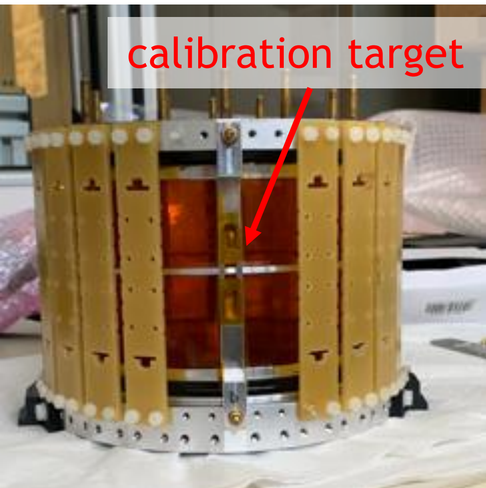
Installation of SIDDHARTA-2

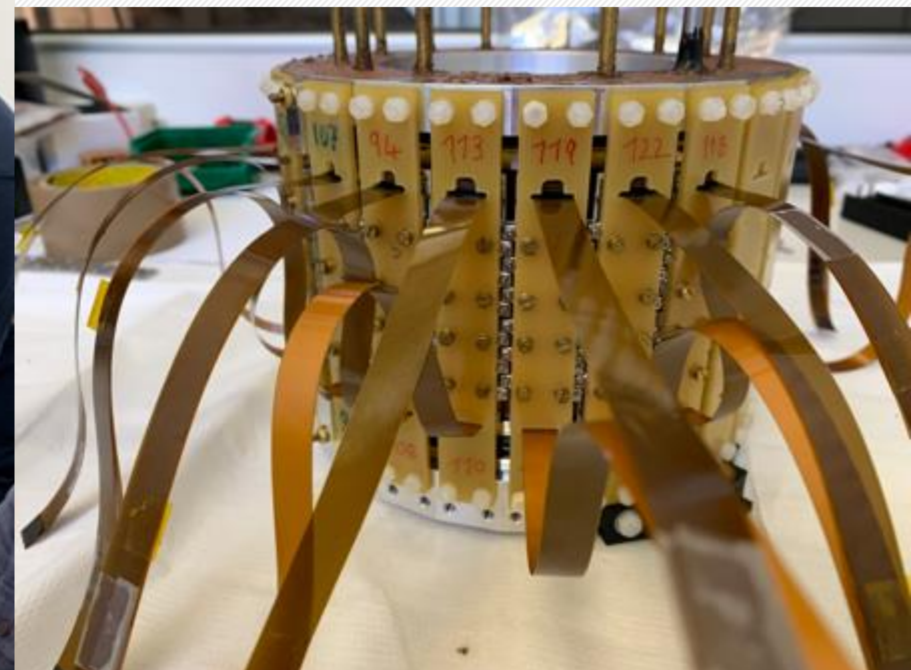
- **SDD detectors installation**
- **Veto-2 installation**
- **Front-end electronic installation**
- **Veto-1 installation**



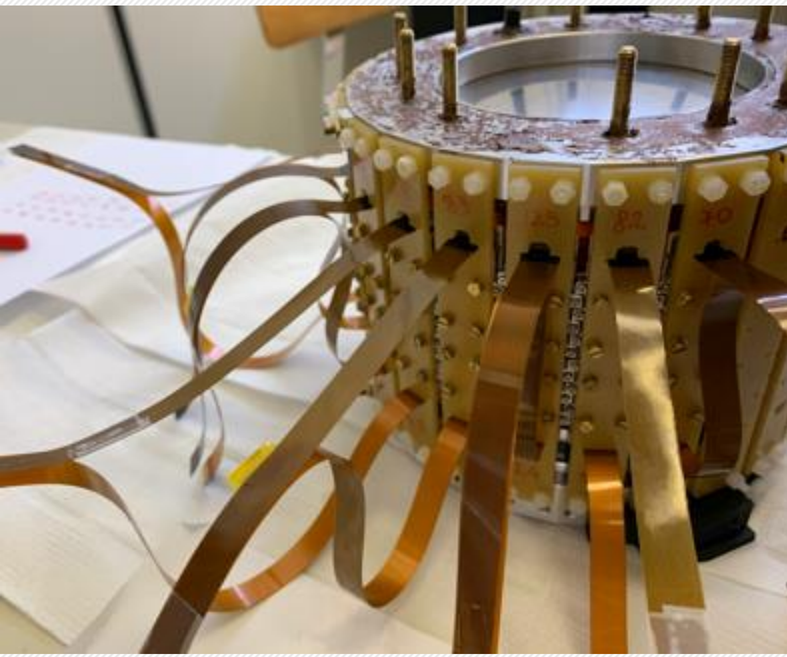
SDD installation



SDD installed around the target

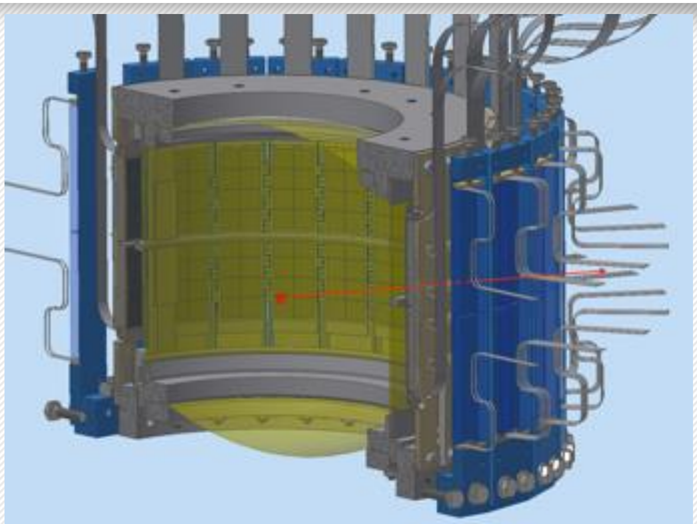


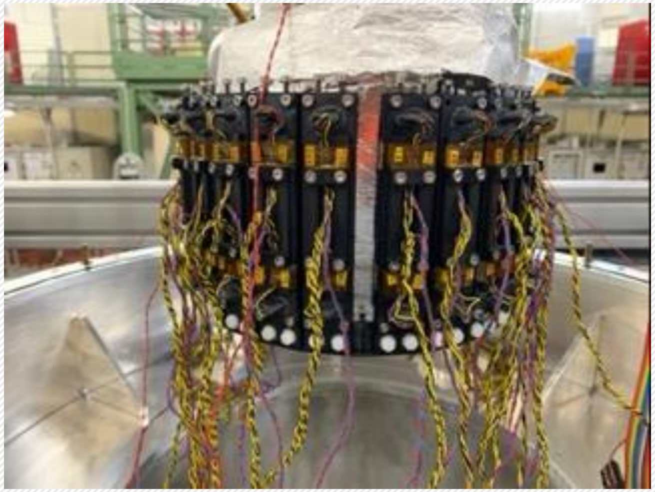
SDD installation



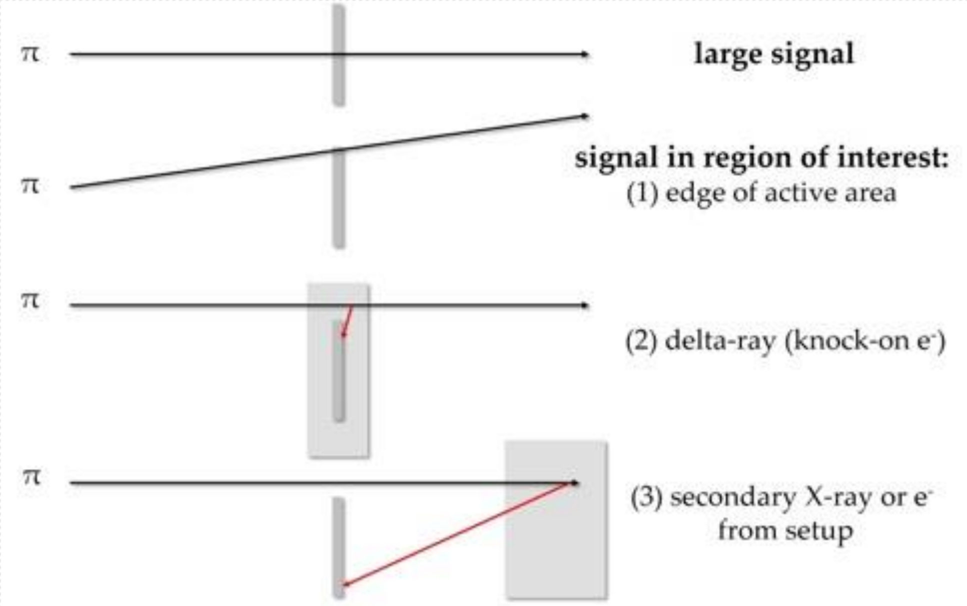
Wrap for thermal isolation

Veto-2 installation





Working principle of veto-2 system

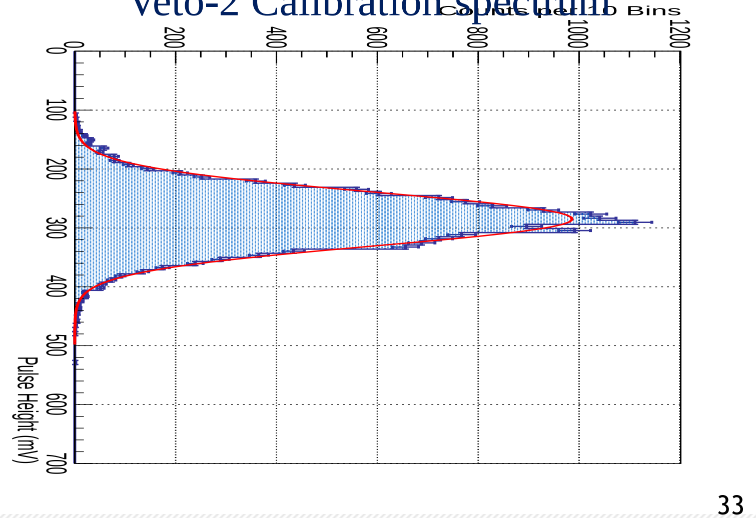


Veto-2 installation

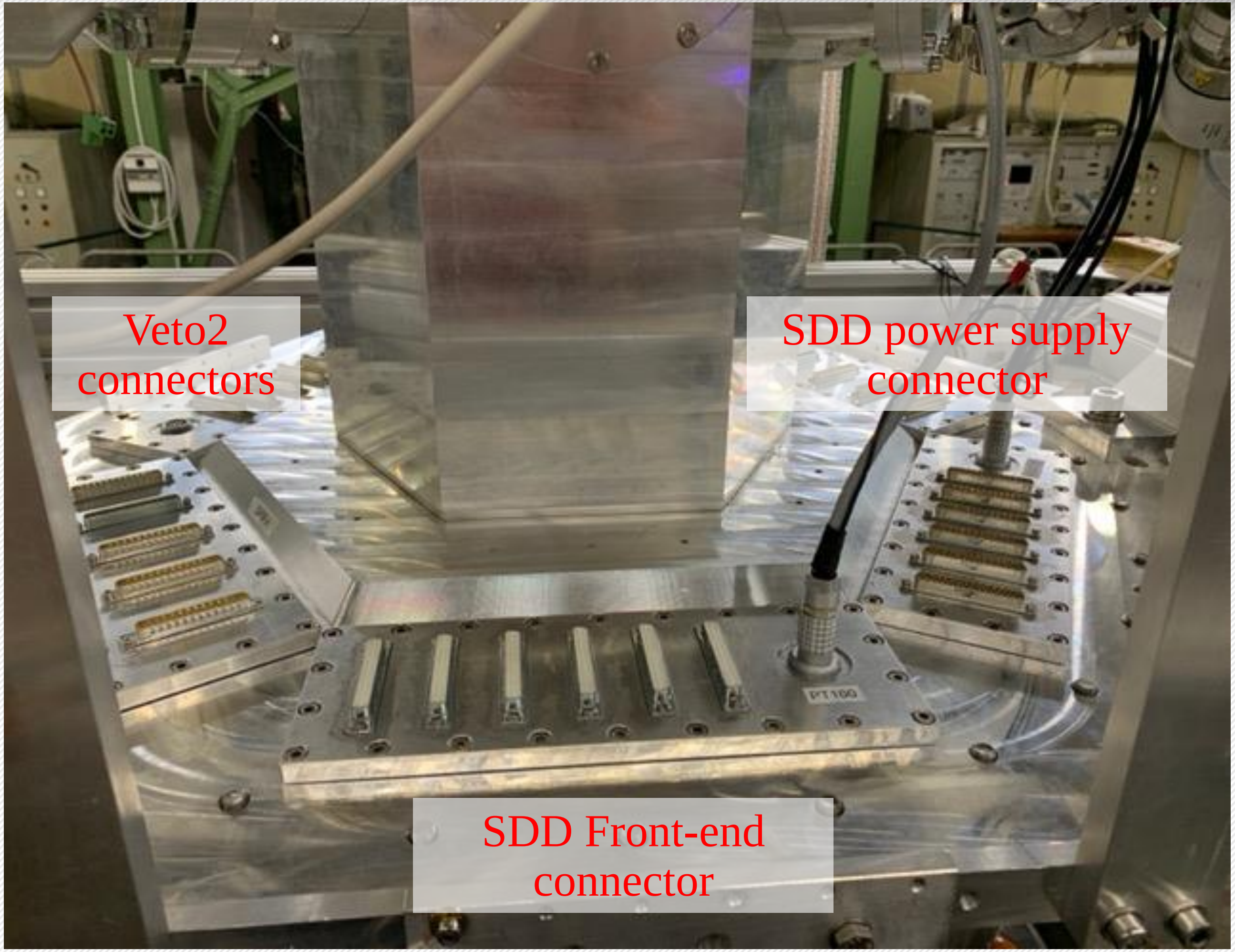
- The installation of veto 2 has been completed and the correct operation of each unit has been verified
- Each veto-2 unit is equipped with an LED that will allow to calibrate and verify the correct functioning of the system with and without beams

Veto-2 single unit

Veto-2 Calibration spectrum



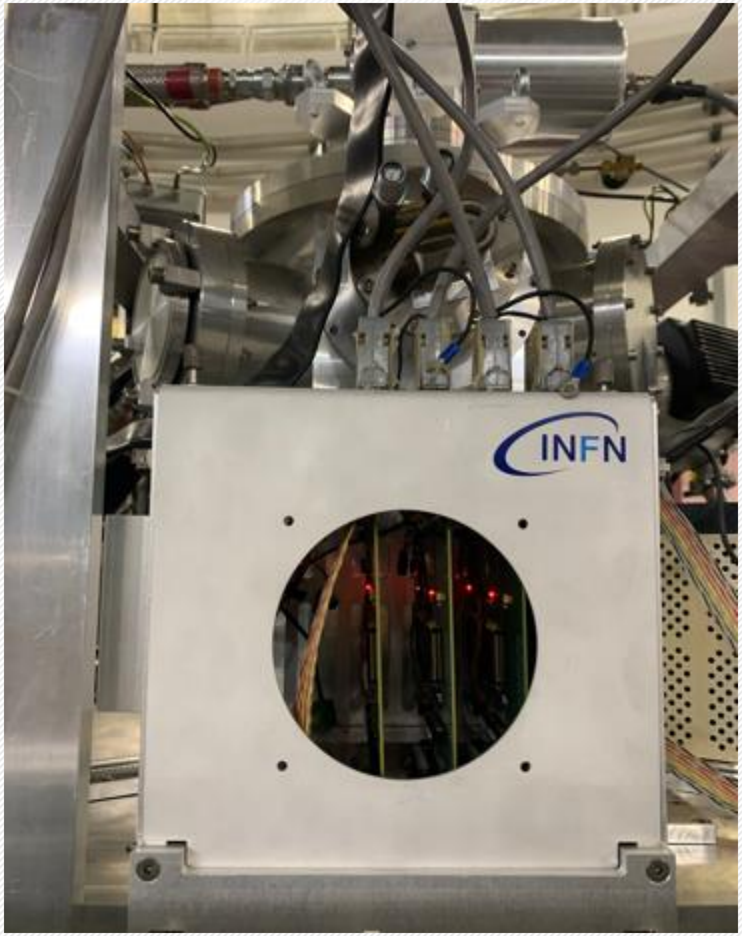
Front-end electronics installation



SIDDHARTA-2 setup before the installation of electronic components

Front-end electronics installation

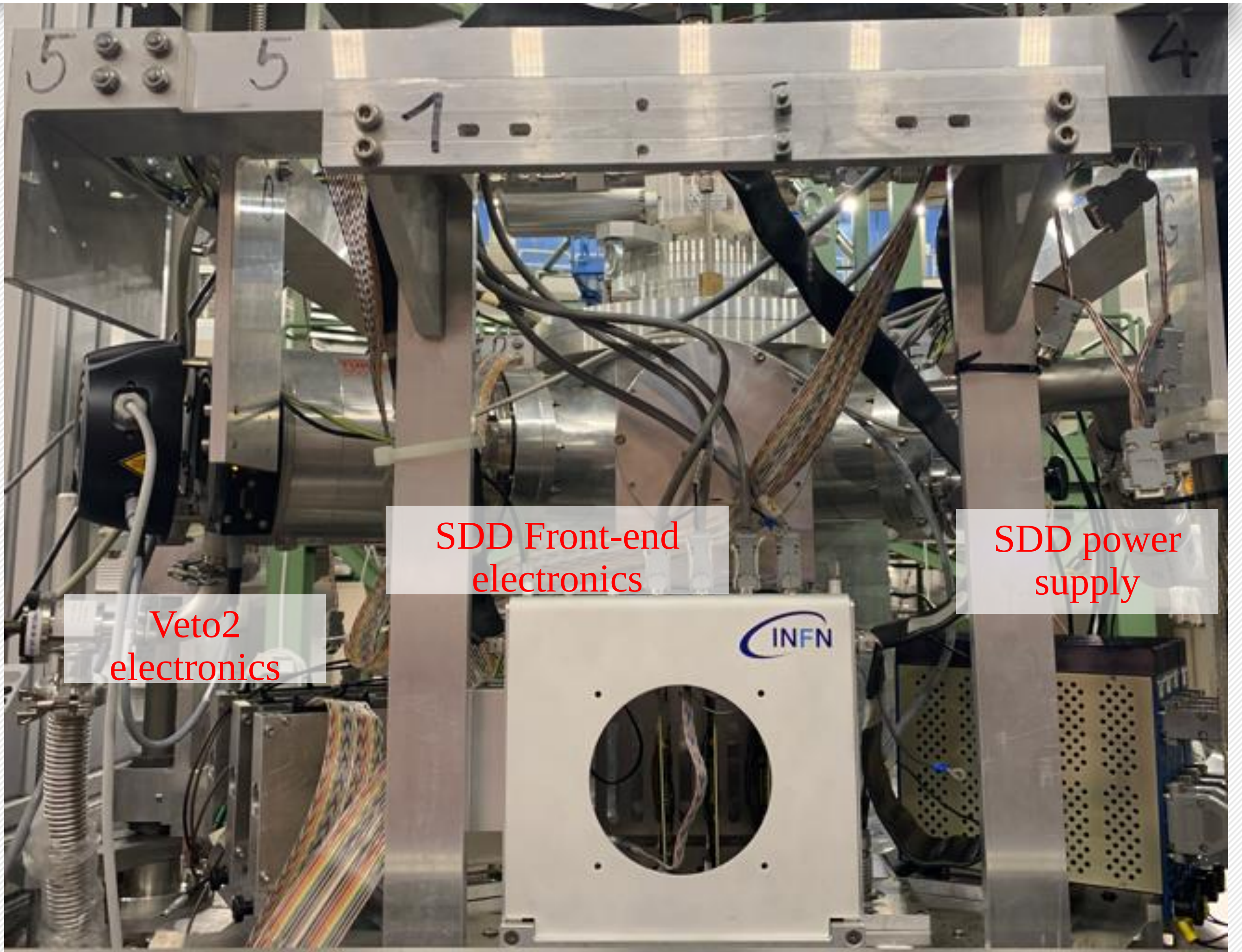
Electronic Box



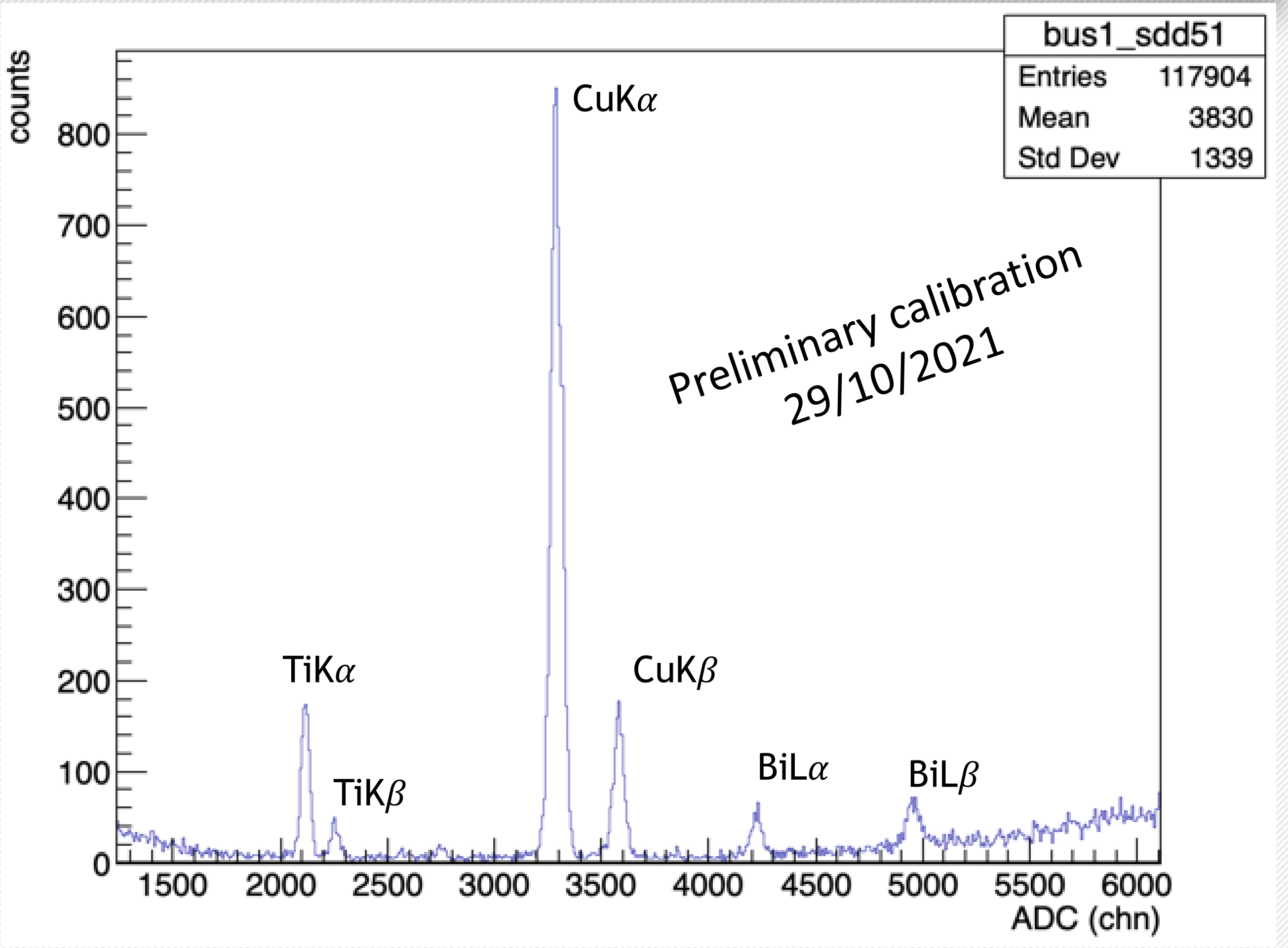
SDD Front-end electronics

Veto-2
Front-end electronics

Front-end electronics installation

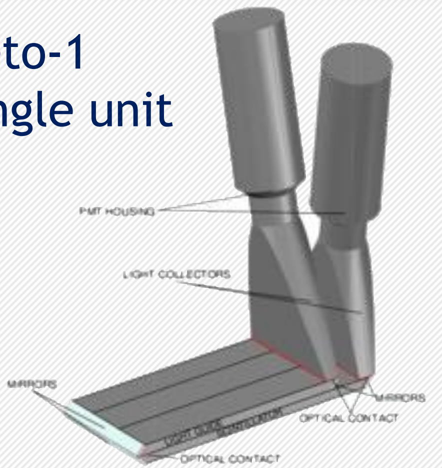


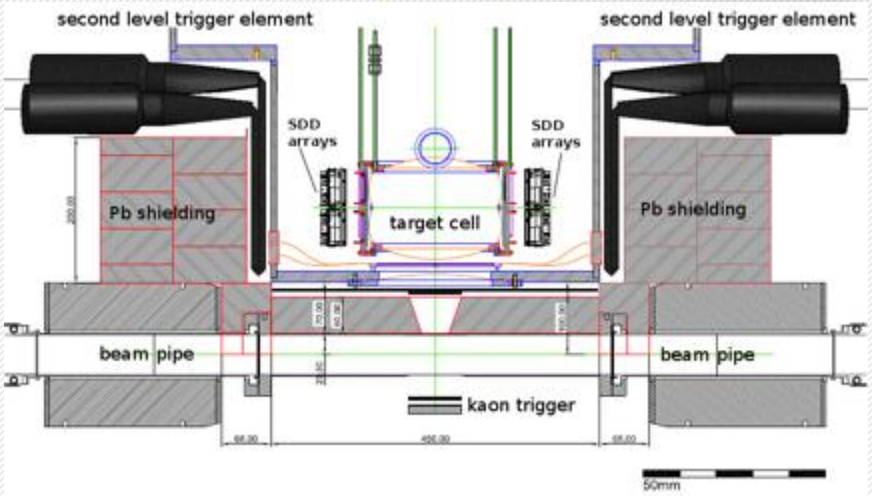
SDD calibration spectrum acquired with SIDDHARTA-2



Veto-1 system installation

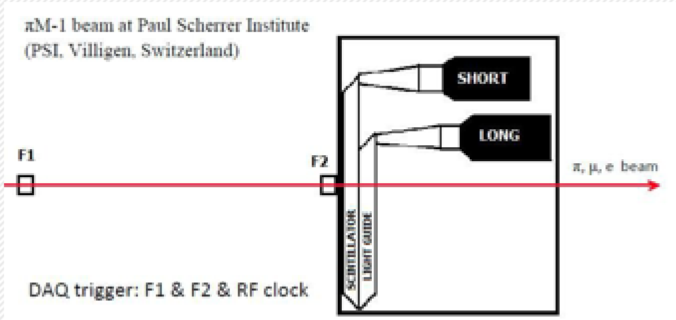
Veto-1 single unit





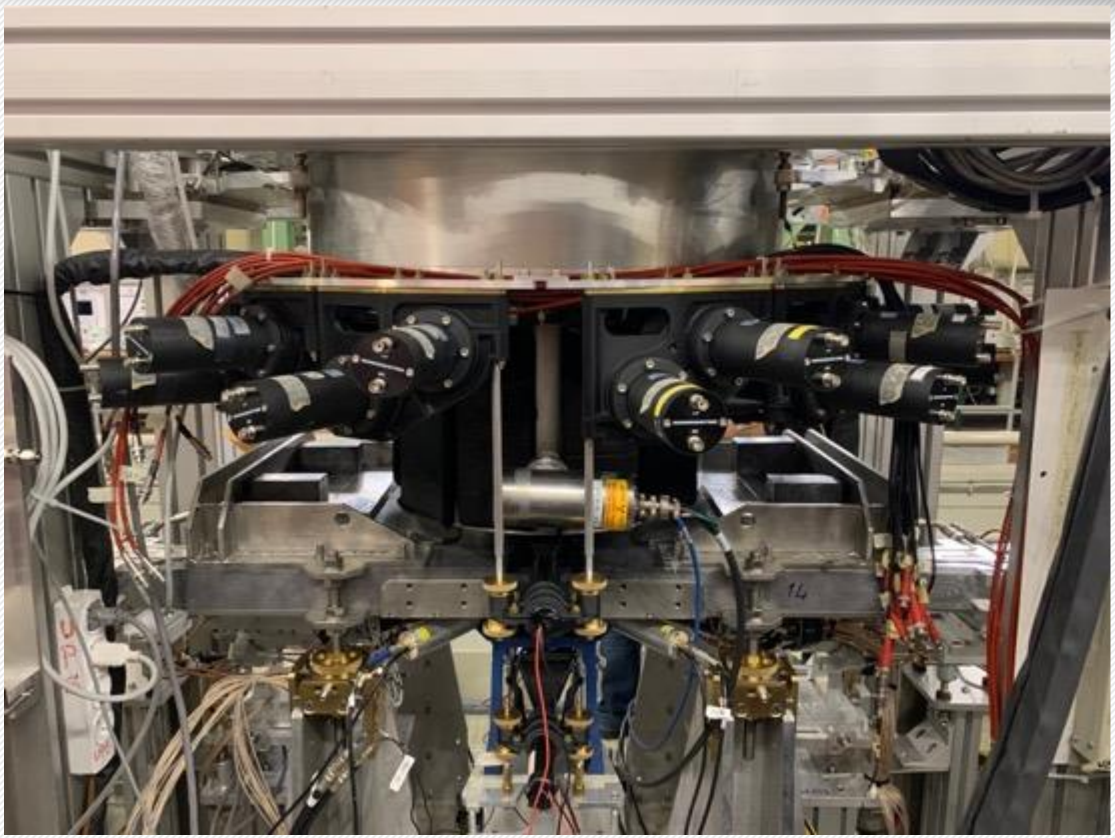
Drawing of the veto-1 elements placed around the vacuum chamber

Working principle of veto-1 system



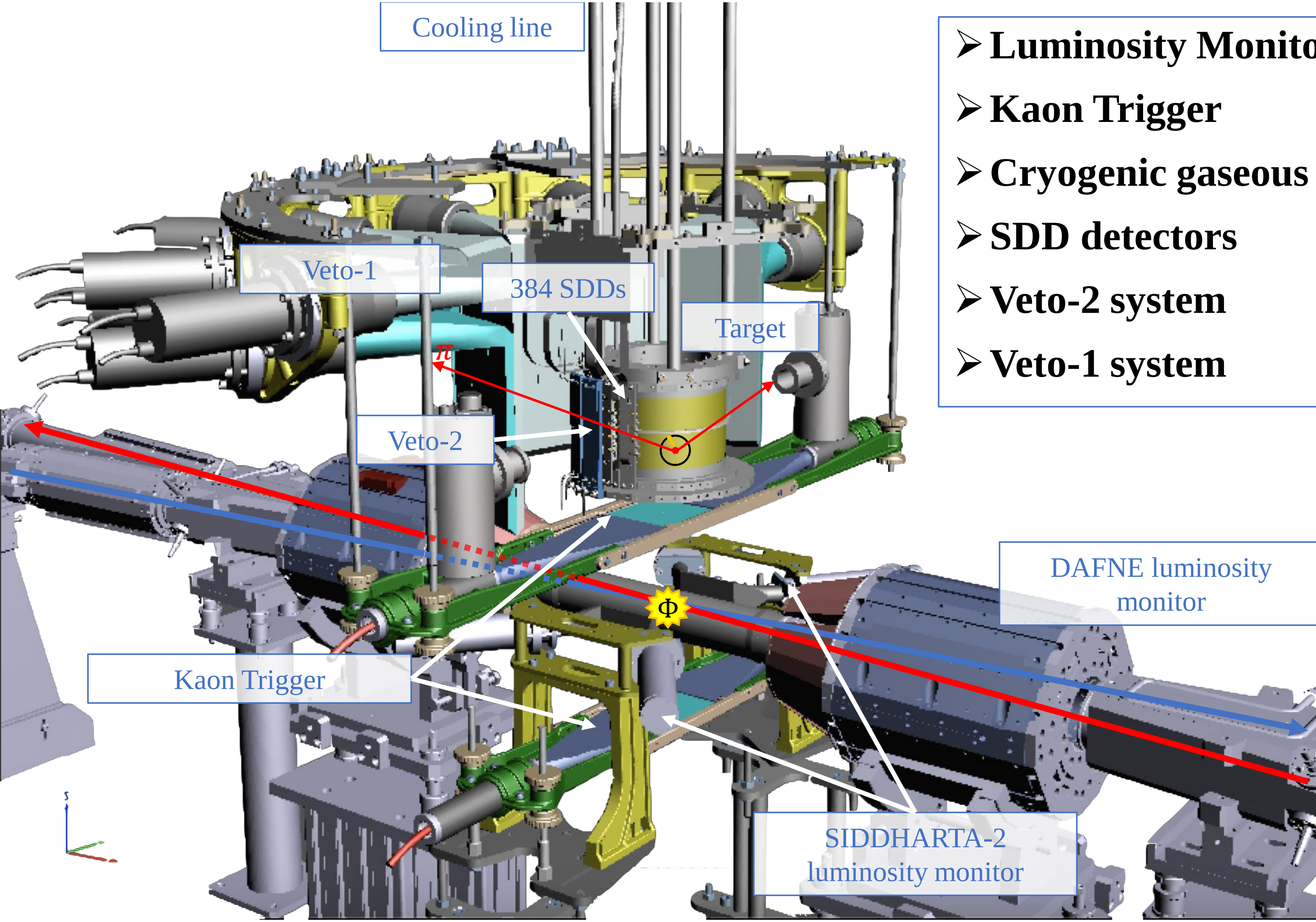
M. Bazzi et al, 2013 *JINST* **8** T11003

Veto-1 system installation



Veto-1 system installed

SIDDHARTA-2 setup



- **Luminosity Monitor**
- **Kaon Trigger**
- **Cryogenic gaseous target**
- **SDD detectors**
- **Veto-2 system**
- **Veto-1 system**

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

Project timeline

62nd LNF SciCom

2022, Nov.

SDD calibration
DAQ
optimization

SIDDHARTA-2

debug

2021, Nov. – December.

Change of cryo lines
Installation and calib of HPGe

SIDDHARTA-2

Optimization

(while awaiting for DAFNE)

HPGE activitty

January – 7th April 2022

Debog of system with beam (trigger and luminometer)

Start SIDDHARTA-2 debug with beam

7 – 13 April

2022

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

SIDDHARTA-2 KHe run

and HPGe debug

while commissioning

7 April – **63rd SciCom**

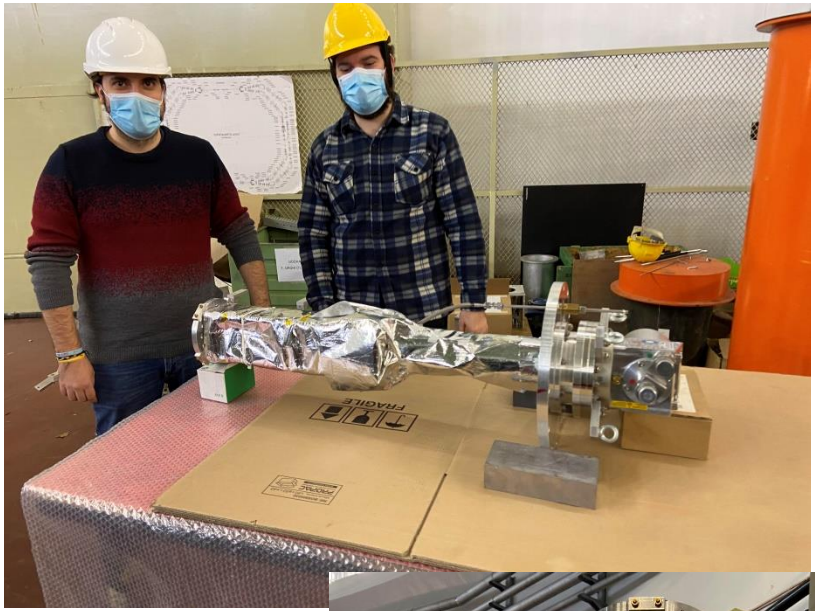
Ready for Kd run (DAFNE optimization continued)

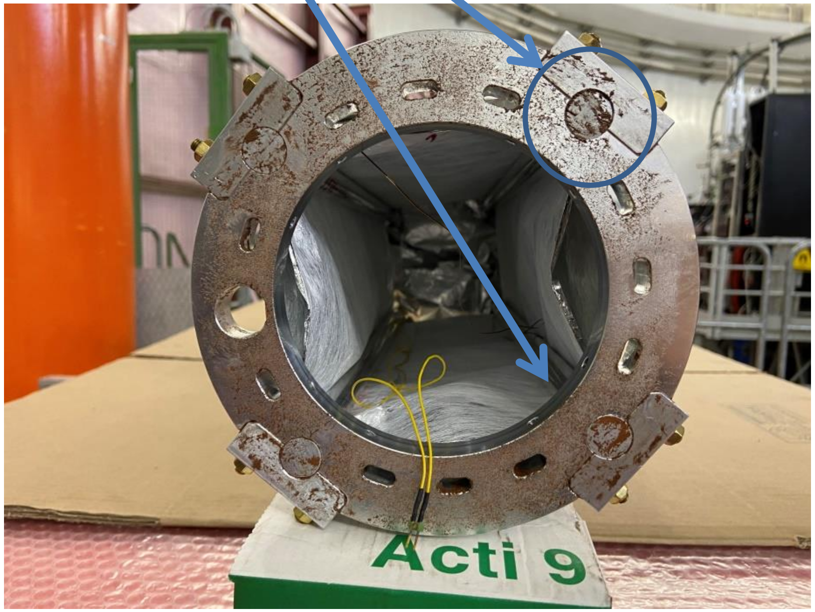
Kd run

end May/early June till July (as long as possible)

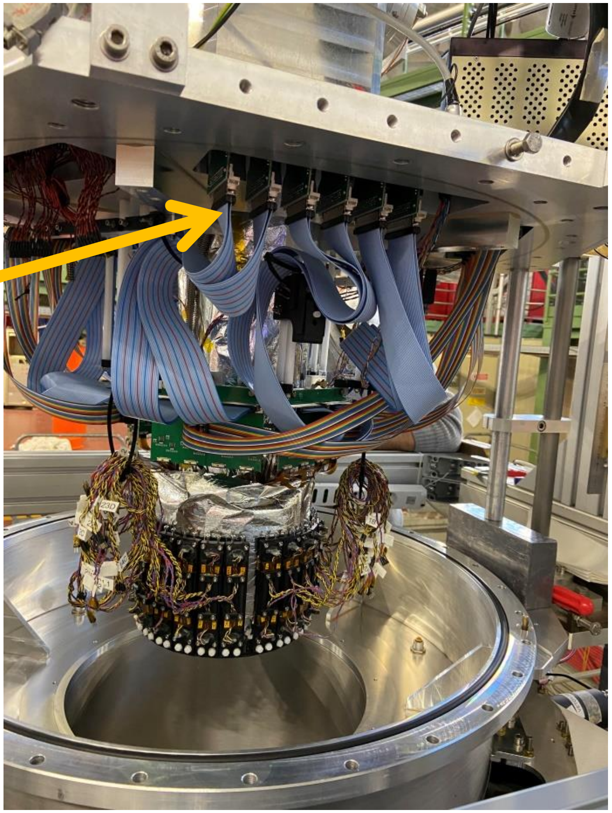
HPGe run

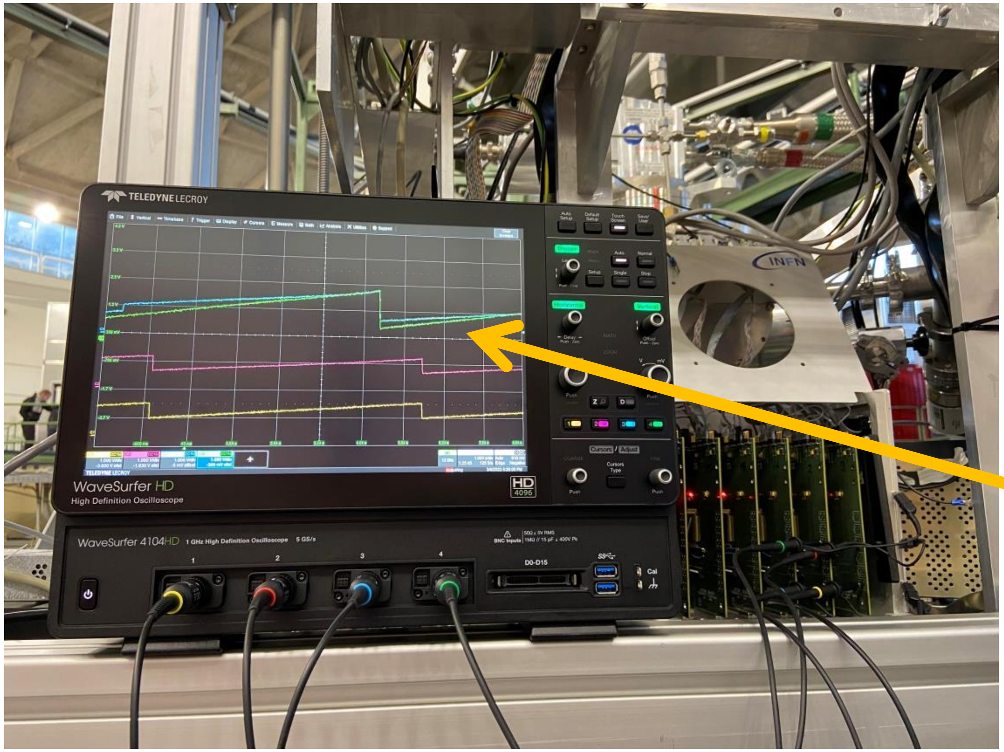
Early 2022
Cooling improvement
Replace the Al bars from
the cooling head and the target





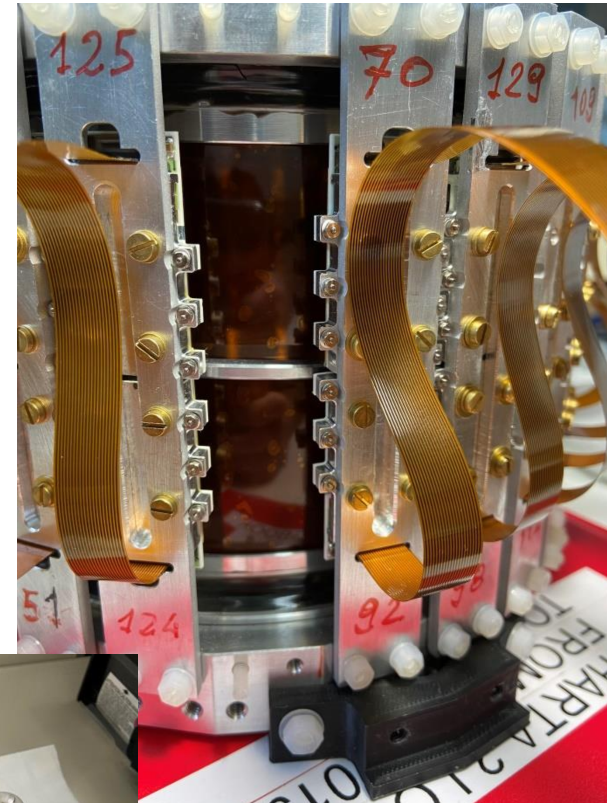
Early 2022
Internal cabling to SFERA ASIC
(high density SCSI type connectors)

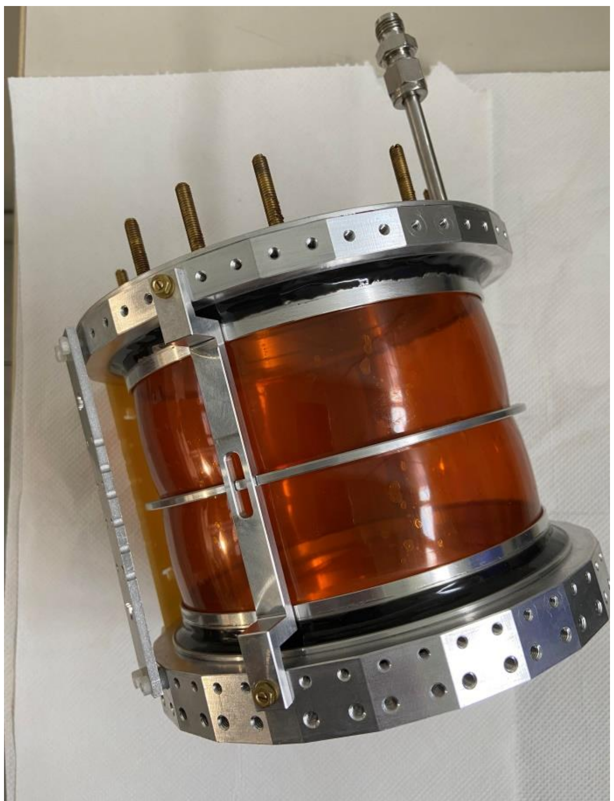




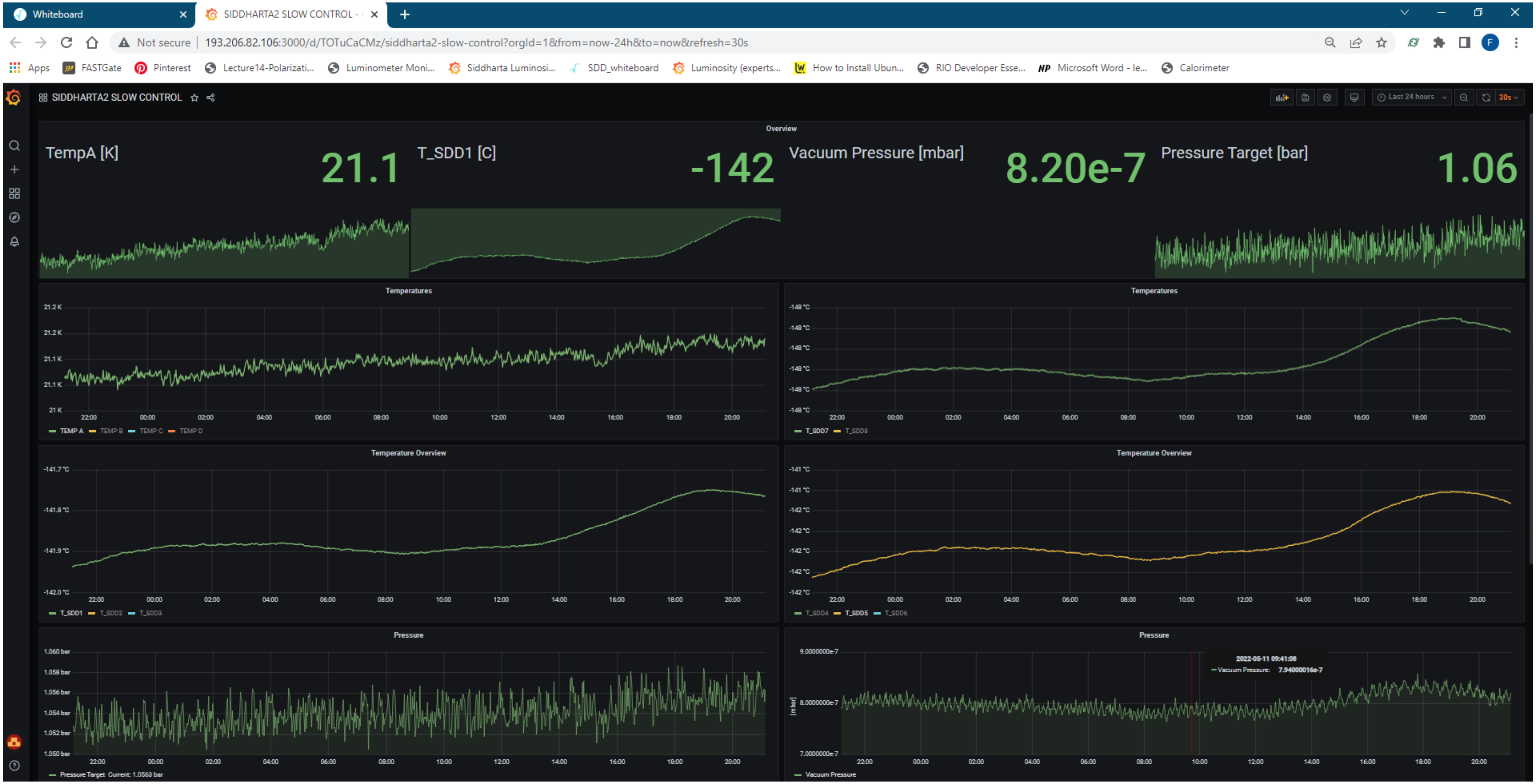
Output signals from
CUBE preamplifier

Early 2022
Replace:
non working SDD arrays
AL finger support for better cooling



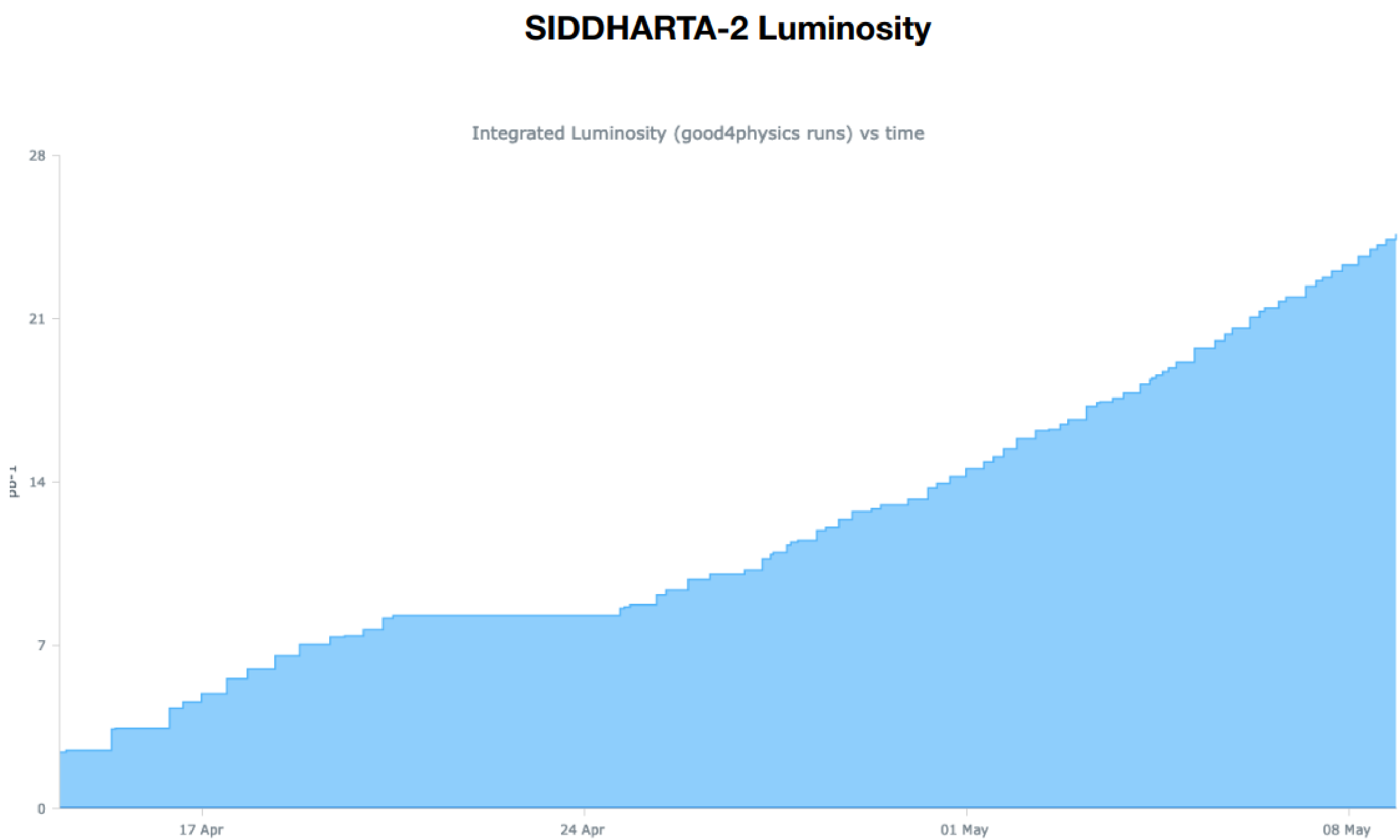


Online monitoring for setup parameters



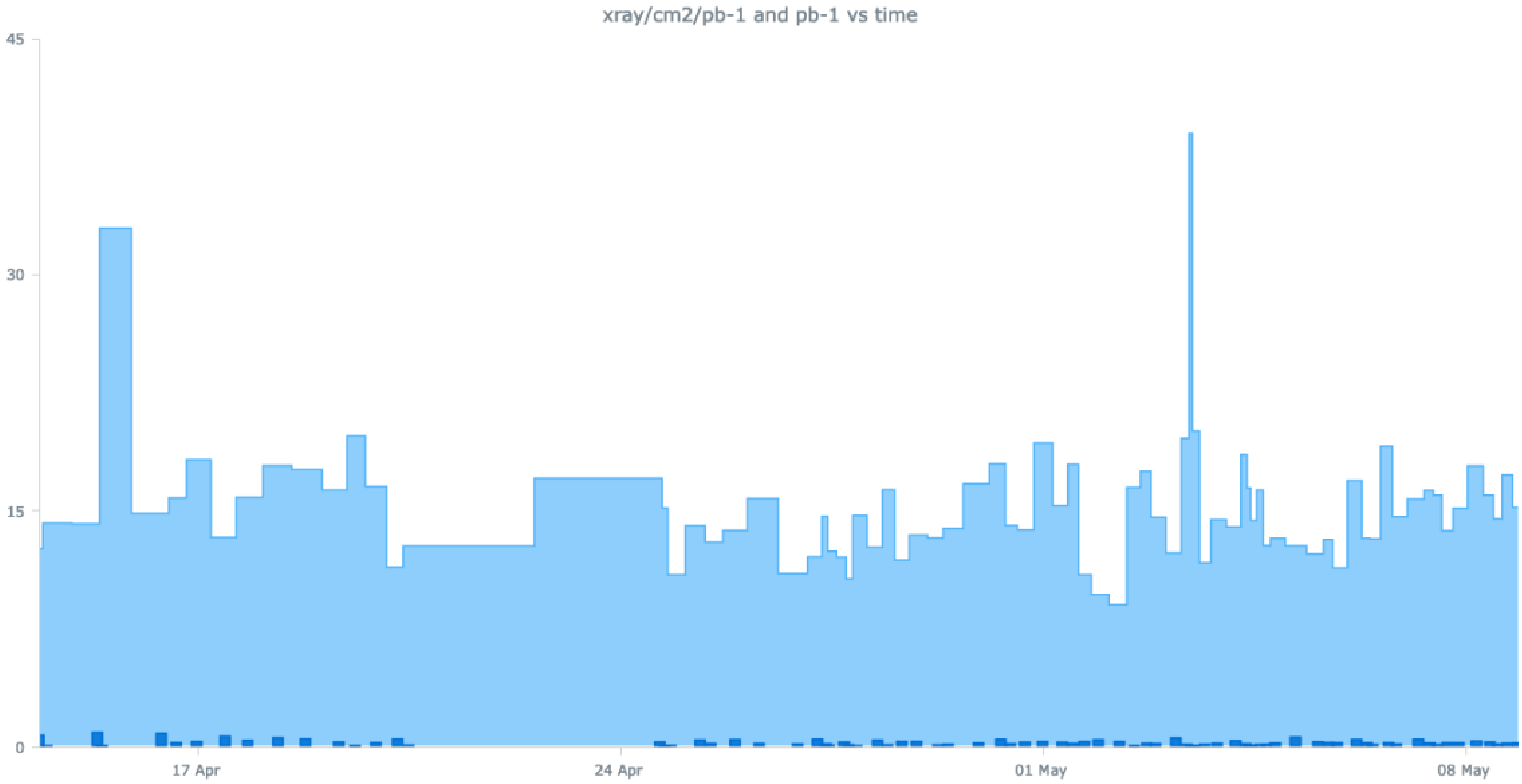
SIDDHARTA-2: Run History April – May 2022

SIDDHARTA-2: Run History April – May 2022



SIDDHARTA-2 has recorded 25 pb^{-1} of data good for physics in 2022

SIDDHARTA-2: Run History April – May 2022



The background in 2022 is around 15 x 10^4 X-ray/cm^2/pb-1
(It was 6 x 10^4 X-ray/cm^2/pb-1 in SIDDHARTINO)

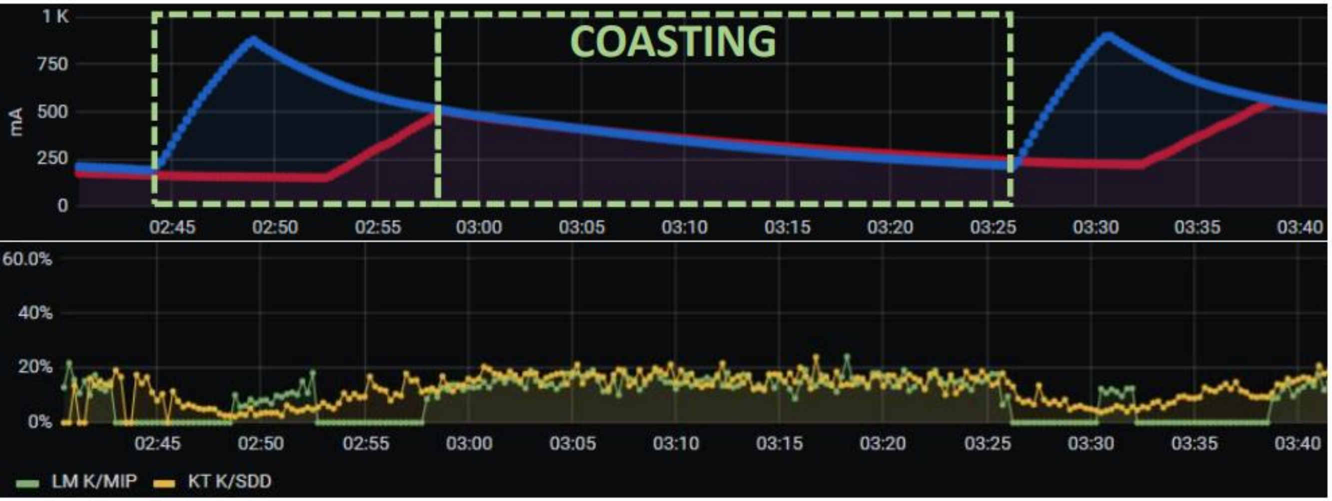
SIDDHARTA-2: Run History April – May 2022 (ex 1 May)

SIDDHARTA-2 Info shared with Dafne

Optimization of working regime

Run Period: 02.00 11/05/2022 – 12.00 11/05/2022

Integrated Luminosity: 0.67 pb^{-1} (0.067 pb^{-1}/hr)



Ie: 850 – 180 mA

Ip: 500 – 180 mA

INJECT INTERVAL ≈ 18 min

COAST INTERVAL ≈ 30 min

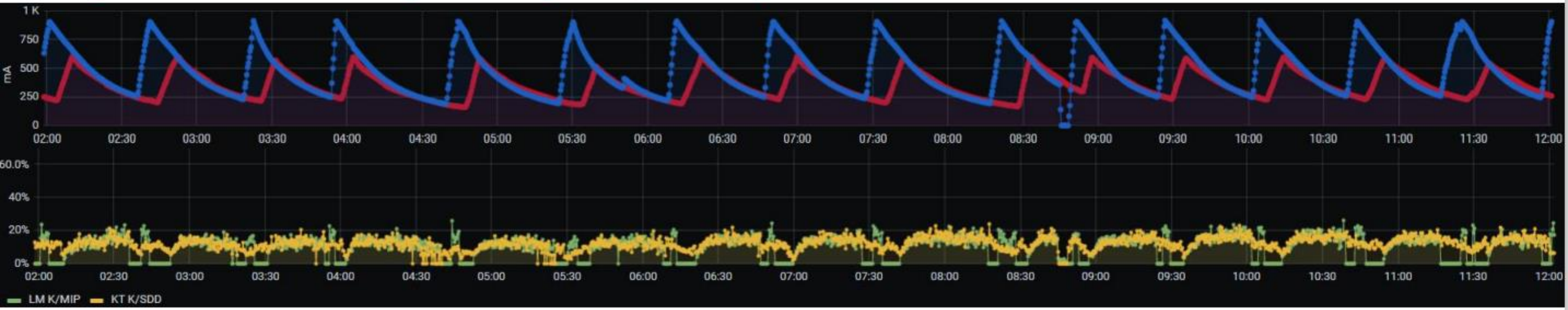
K/MIP (coast) ≈ 14 %

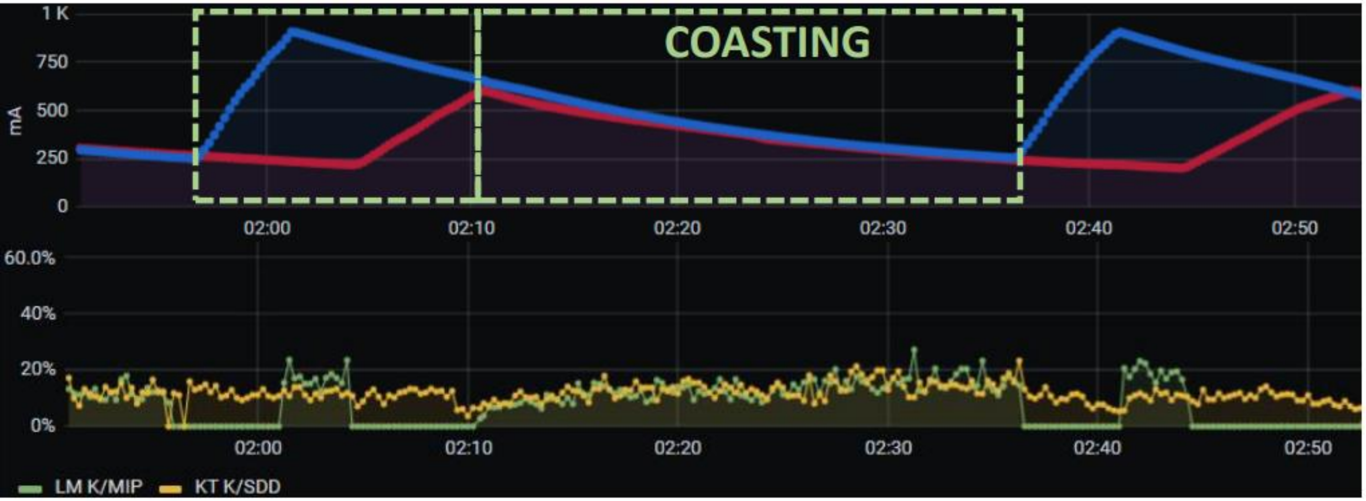
K/SDD (coast) ≈ 14 %

Optimization of working regime

Run Period: 02.00 12/05/2022 – 12.00 12/05/2022

Integrated Luminosity: 0.95 pb^{-1} (0.095 pb^{-1}/hr)





Ie: 900 – 220 mA

Ip: 580 – 220 mA

INJECT INTERVAL ≈ 13 min

COAST INTERVAL ≈ 28 min

K/MIP (coast) ≈ 14 %

K/SDD (coast) ≈ 14 %

Optimization of working regime

Run Period:
02.00 11/05/2022 – 12.00 11/05/2022

Integrated Luminosity: 0.67 pb^{-1}
Ie: 850 – 180 mA
Ip: 580 – 180 mA

INJECT INTERVAL ≈ 18 min
COAST INTERVAL ≈ 30 min

K/MIP (coast) ≈ 14 %
K/SDD (coast) ≈ 14 %

Run Period:
02.00 12/05/2022 – 12.00 12/05/2022

Integrated Luminosity: 0.95 pb^{-1}
Ie: 900 – 220 mA
Ip: 600 – 220 mA

INJECT INTERVAL ≈ 13 min
COAST INTERVAL ≈ 28 min

K/MIP (coast) ≈ 14 %
K/SDD (coast) ≈ 14 %

Mean injection interval -30%
Mean coasting interval -6%
Overall integrated luminosity +42%

SIDDHARTA-2 KHe 1.4%

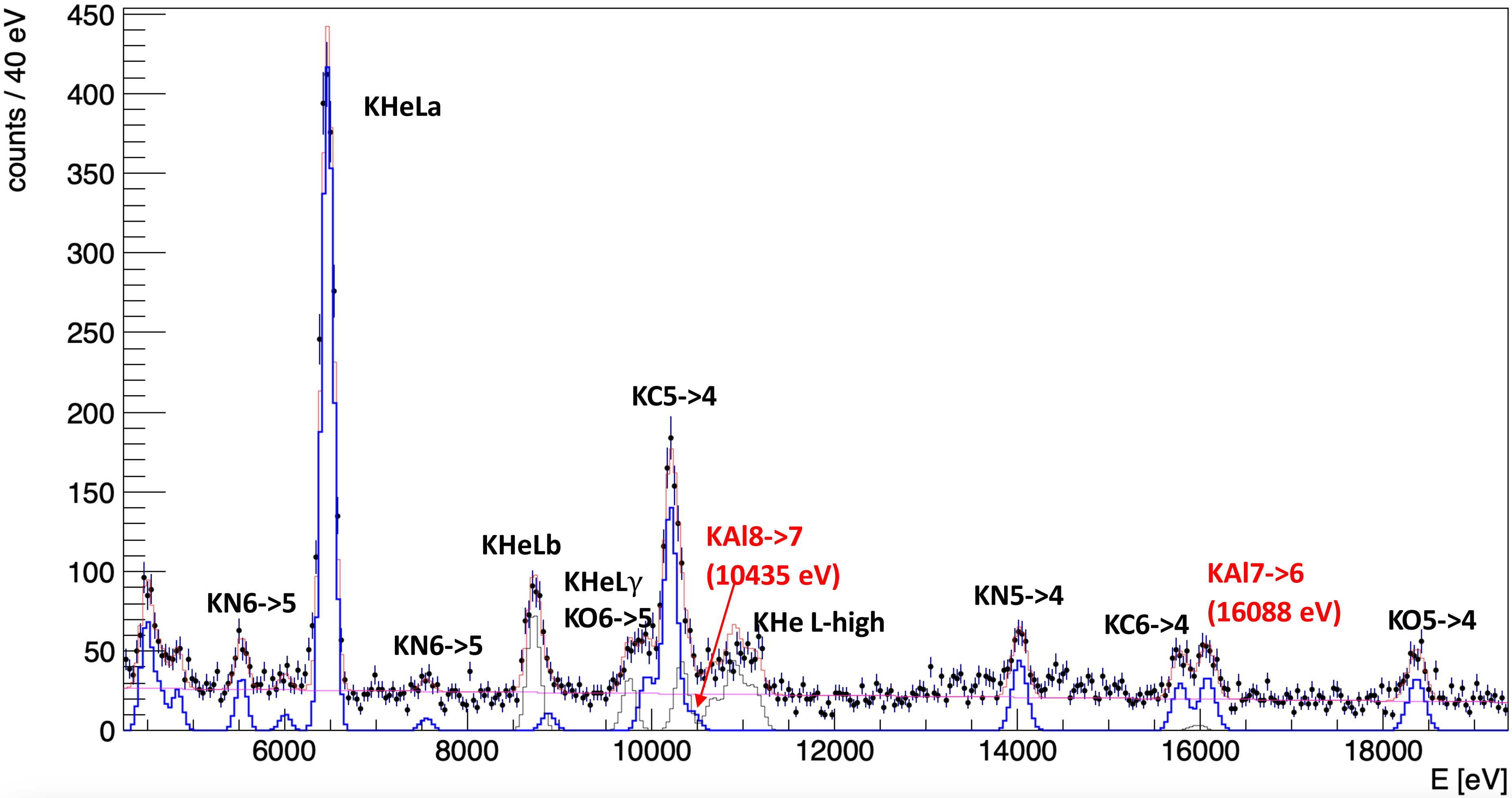
Degraders: 475um (new) + 600 um

N° SDDs: 319

bkg function: pol1

L= 12.06 pb^{-1}

	$E_{e.m.}$ [eV]	E_{exp} [eV]	Amp	events
KHe 3->2	6463.5	6462.5 $\pm$ 2.0	416 $\pm$ 9	1705 $\pm$ 83
KAl 8->7	10435.1	10460 $\pm$ 40	12 $\pm$ 4	55 $\pm$ 20
KAl 7->6	16088.3	16082.5 $\pm$ 14	33 $\pm$ 3	183 $\pm$ 23



SIDDHARTA-2 KHe 1.4%

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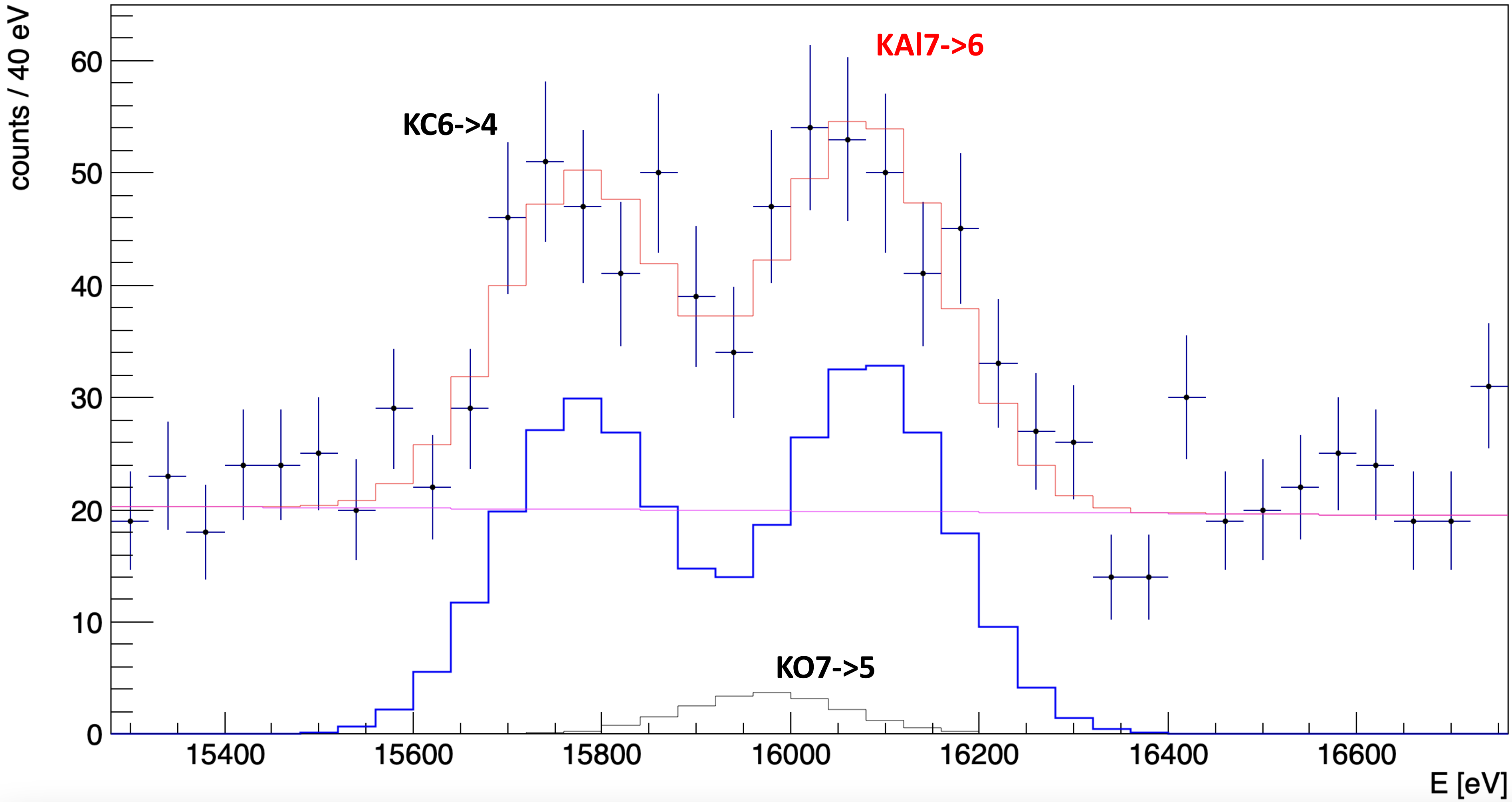
KAl 8->7	10435.1	10460 ± 40	12 ± 4	55 ± 20
KAl 7->6	**16088.3**	**16082.5 ± 14**	**33 ± 3**	**183 ± 23**



SIDDHARTA-2: first scientific outcomes:

- An improved Khe measurement with higher precision
- The most precise kaonic aluminium measurement

Plan to prepare 1-2 new articles!

Contents

- Publications since last SC
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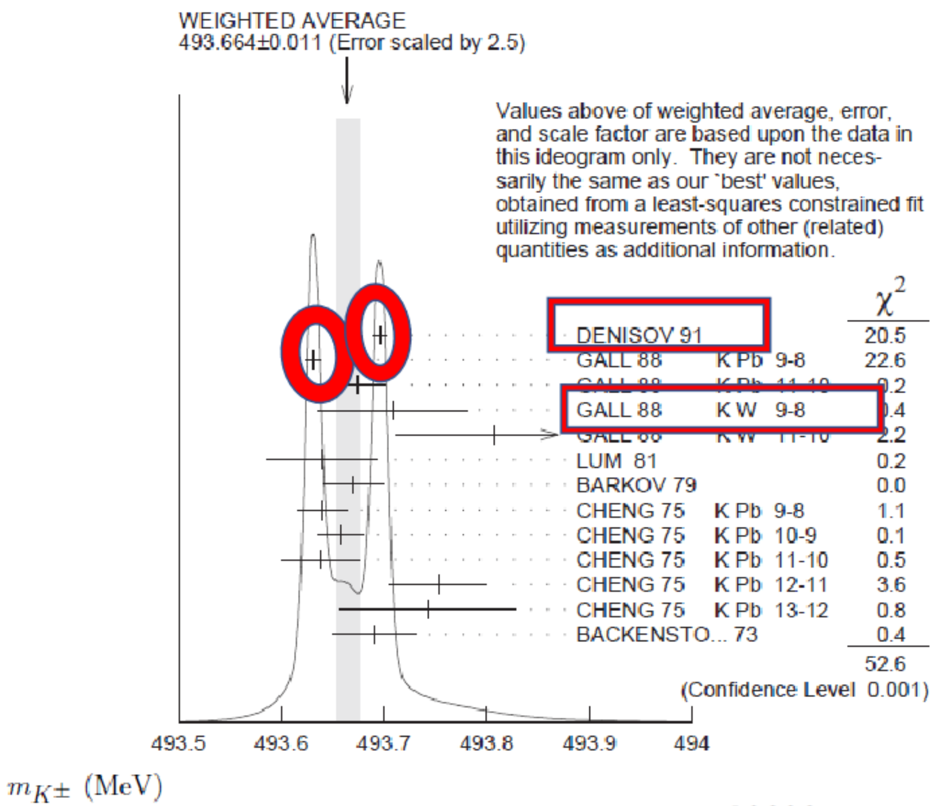
- HPGe Detector: test run for kaonic lead (kaon mass)
- Future plans

Charged kaon mass puzzle:

Previous measurements, motivation

PDG 2020:



PDG2020

m_K=493.679 ± 0.013 MeV

The main disagreement is between the two most recent and precise measurements (x-ray energies from kaonic atoms):

m_K=493.696±0.007 MeV

A.S. Denisov et al. JEPT Lett. 54 (1991)558

K^- ^{12}C, crystal diffraction spectrometer

(6.3 eV at 22.1 keV), 4f-3d

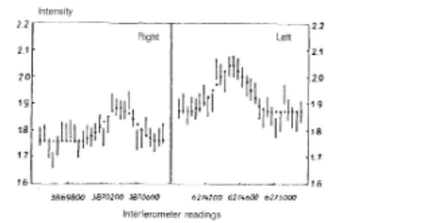


FIG. 1. Right and left reflections of the 4f-3d transition of the $K^- - ^{12}C$ atom. The interferometer readings are plotted along the abscissa; the detector count rate per 10^{12} protons is plotted along the ordinate. The vertical lines are the experimental values with the corresponding error; the heavy points are the results of a fit.

m_K=493.636±0.011 MeV

K.P. Gall et al. Phys. Rev. Lett. 60 (1988)186

K^- Pb, K^- W; HPGe detector (1 keV), **K^-Pb (9 -> 8),**

K^-Pb (11 -> 10), K^-W (9 -> 8), K^-W (11 -> 10),

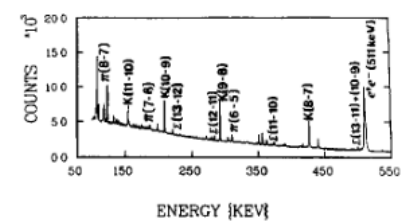
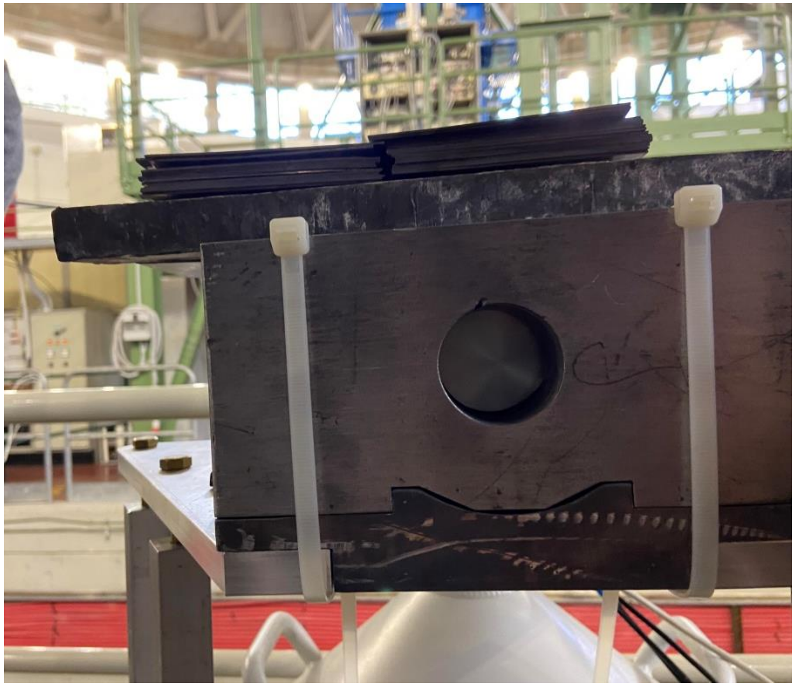
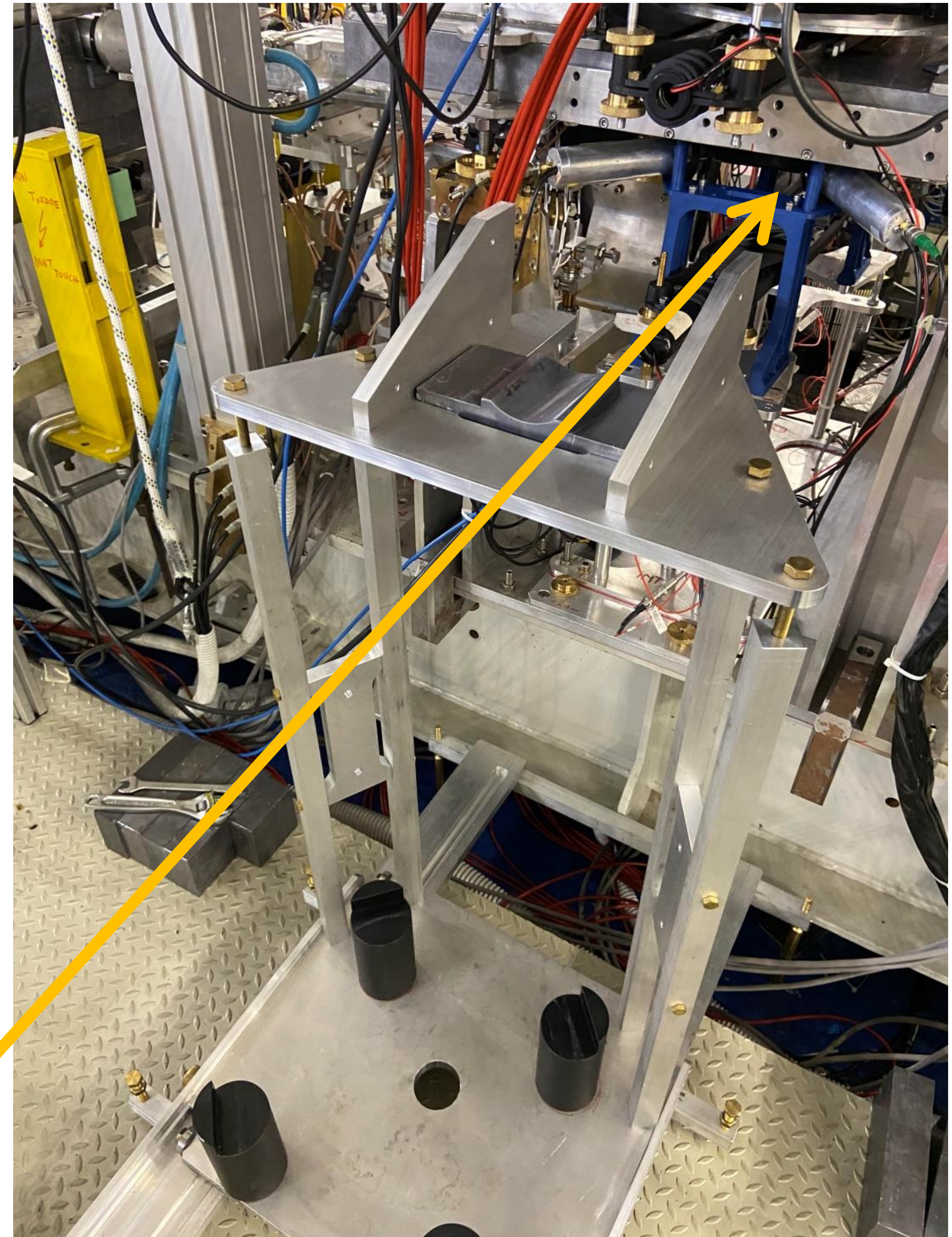


FIG. 1. Untagged Pb x-ray spectrum showing intense kaonic x-ray transitions.

Average m_K=493.679 ± 0.006 MeV S=2.4

Installation of HpGe structures and preliminary shielding

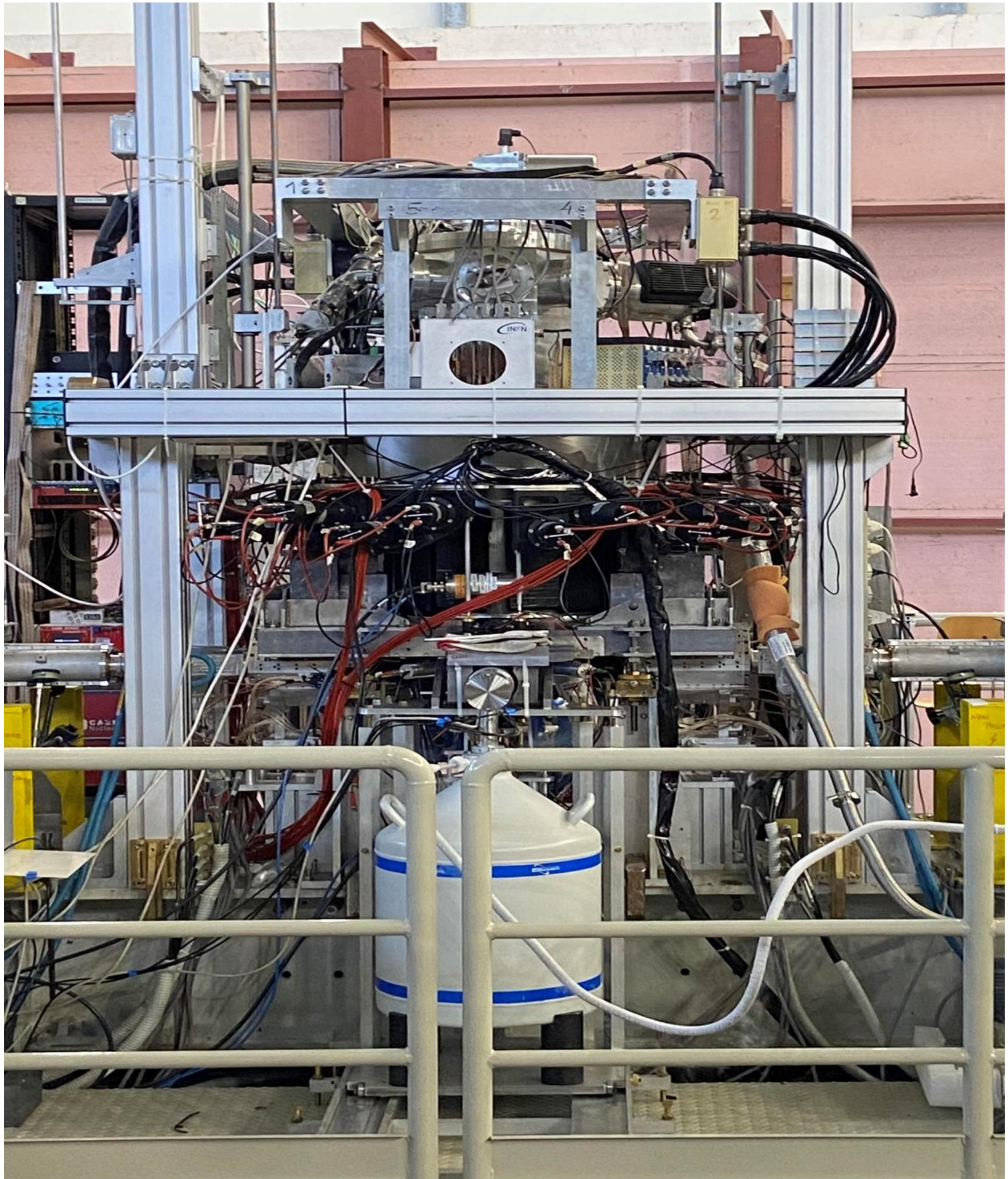




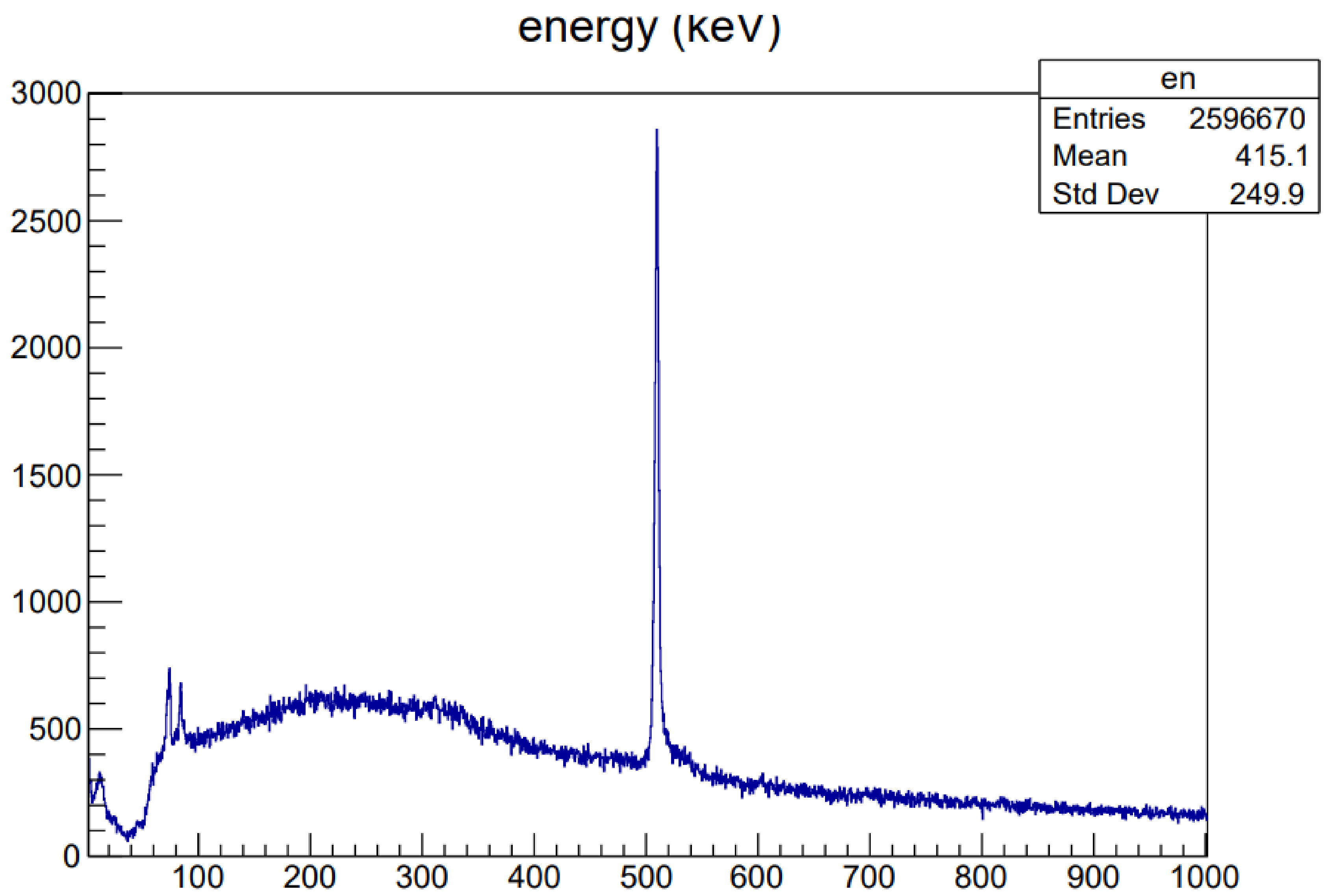
Pb target support behind luminomiter

Ge refilling
establish procedure to
be done each 7-10 days

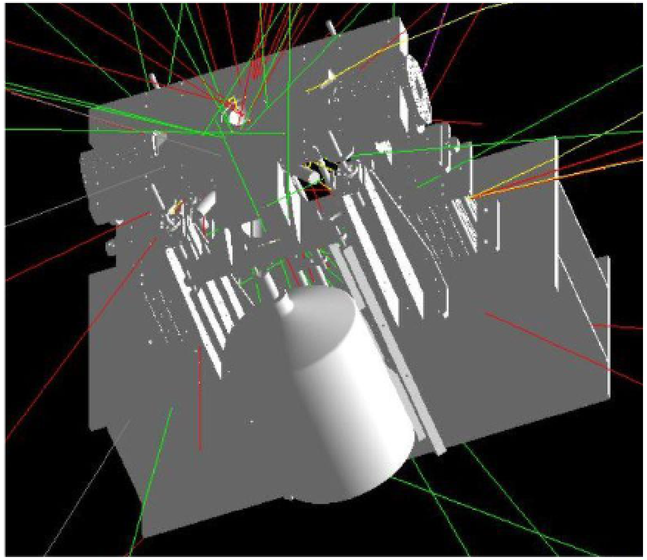
Present status



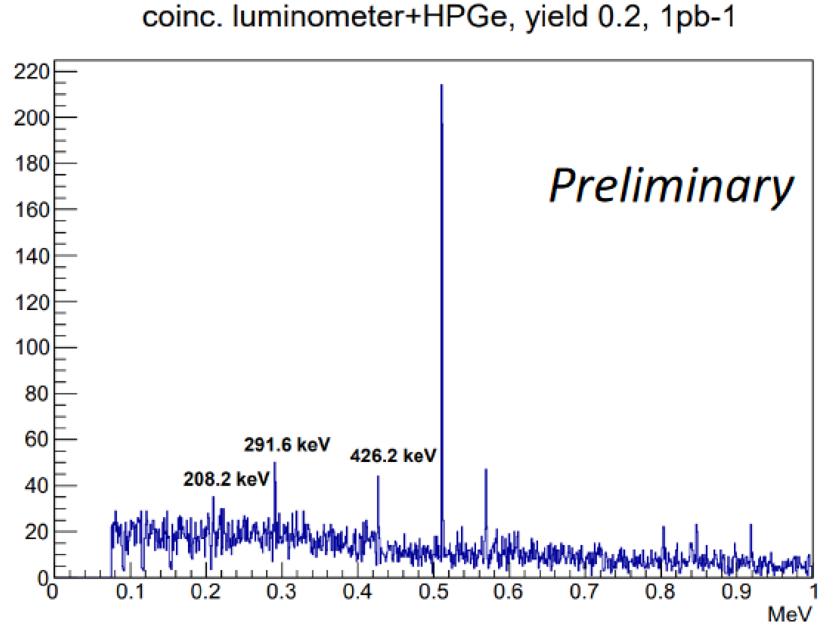
First HPGe spectrum (we plan a technical paper)



GEANT4 full simulation



Kaons are generated uniformly in 4π
Only hadronic background., no background from e+e- beams
Front shielding of HPGe detector should be optimized



Approx. 50 events (291.6 keV) / pb^{-1},
12 pb^{-1} /day -> approx. 600 events/day.

~9.000 events -> 10 keV precision (15 days)
~25.000 events-> 5 keV precision (40 days)

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Project timeline - future

SIDDHARTA-2 Kd run: run 1 (requested 300 pb^{-1} – **100 pb^{-1}** ?)
run 2/3 (700 pb^{-1}) with optimized components

Start of the data taking
kaonic deuterium
SIDDHARTA-2 run

SIDDHARTA-2
setup ready
End May 2022

Start Run
SIDDHARTA-2
and
HPGe parasitic test

From end May –
early June 2022

DAΦNE summer
shutdown

middle July 2022

Continue the run
SIDDHARTA-2
Kd
HPGe

as soon as possible!

SIDDHARTA-2 K-d measurement

achievable precision

*Kaonic deuterium run in **2022/3***

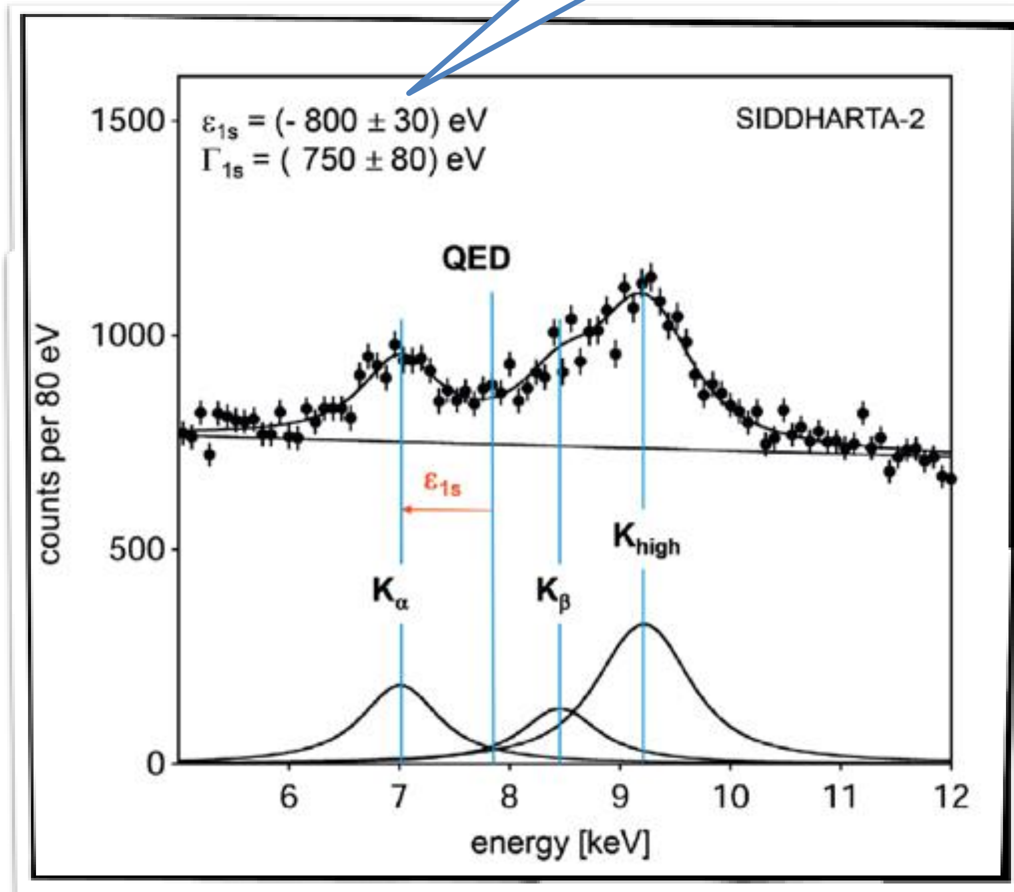
*Monte Carlo for an integrated luminosity of **800 pb^{-1}***

to perform the first measurement of the strong interaction induced energy shift and width of the kaonic deuterium ground state (similar precision as K-p) !

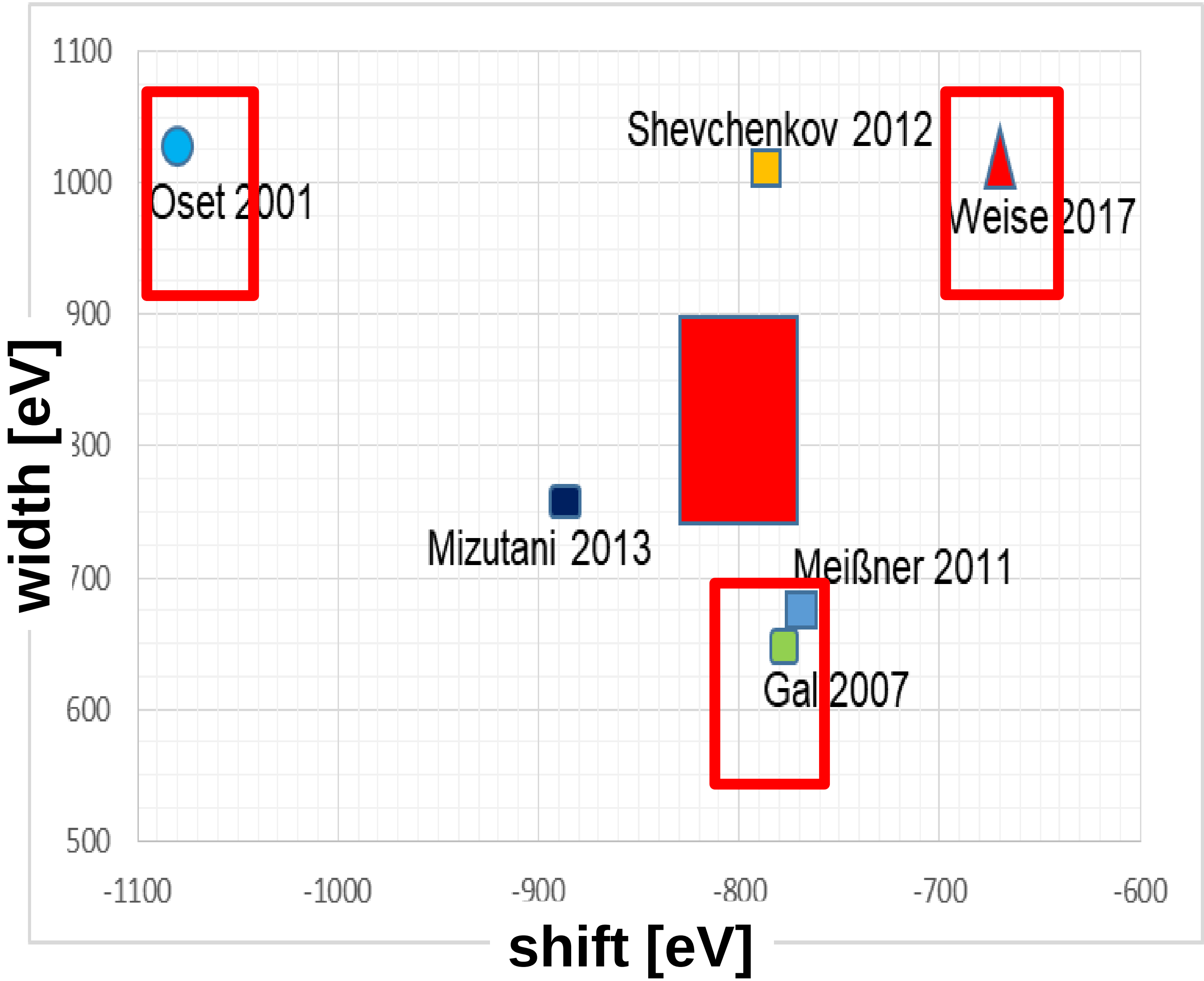
When significative?

Depends on yield (unknown)

Not less than 500 pb $^{-1}$



SIDDHARTA-2 kaonic deuterium at DAΦNE



SIDDHARTA-2 K-d measurement

SIDDHARTA-2

SIDDHARTA-2 setup ready for Kaonic deuterium first ever measurement: Plans and requests

- Optimization of veto systems integration: end May 2022

- First run with SIDDHARTA-2 setup originally planned for about 300 pb^{-1} integrated luminosity; we now realistically can envisage ia first run to start **June 2022 (till July tbd)** – 100 pb^{-1}?

- Second and Third (?) runs with optimized shielding, readout electronics and other necessary optimizations; (for remaining integrated luminosity, i.e. about 700 pb^{-1}) **– as soon as possible**

"Fundamental physics with exotic atoms and radiation detectors" Symposium

FQXi Foundational Questions Institute — INFN-LNF – 25-26/11/2021 – Aula Salvini — STRONG-2020

25–26 Nov 2021
Laboratori Nazionali di Frascati
Europe/Rome timezone

Enter your search term

- Overview
- Programme
- Registration
- Book of Abstracts
- Participant List
- Zoom link
- Internet access

Support

- alessandro.scordo@lnf.i...
- napolitano.fabrizio@lnf.i...
- alessandra.tamborrinoor...

Overview

The aim of the symposium is to discuss future perspectives in exotic atoms research and related radiation detectors, as tools for fundamental physics studies.

Symposium - Nuclear E2 resonance effects in kaonic molybdenum isotopes

8 April 2022
Laboratori Nazionali di Frascati
Europe/Rome timezone

Enter your search term

- Overview
- Timetable
- Contributions List
- Speakers List
- Registration
- Participants List

Dr. Luca De Paolis

Luca.DePaolis@lnf.infn.it

06 94032409

The nuclear E2 resonance effect occurs when atomic de-excitation energy is closely matched by nuclear excitation energy. It produces an attenuation of some of the atomic x-ray lines from resonant versus normal isotope targets. In some kaonic molybdenum isotopes (94, 96, 98, 100) the nuclear E2 resonance effect is expected. In 1975, the nuclear E2 resonance effect was measured in kaonic molybdenum 98 by G. L. Goldfrey, G- K. Lum and C. E. Wiegand at Lawrence Berkeley Laboratory. The experiment took 25 hours of data, not enough to provide a conclusive result. The nuclear E2 resonance effect in kaonic molybdenum isotopes could be measured in DAΦNE with germanium detectors.
Its measurement could provide important information about strong kaon-nucleus interaction and nuclear deformations.

Conclusions

- Despite the difficult period, we have been able to follow our plan and Sci Com recom. and perform our activities along the schedule @SC62
- In particular we: performed the most precise KHe measurement in gas and the measurement of yields at lowest density
- 17 articles were published/submitted since the last Sci Com - important scientific outcome, 2 are in preparation
- We are ready and very motivated to start the SIDDHARTA-2 planned first Kd measurement as soon as possible
- We put forward proposal for solid targets measurements with SIDDHARTA-2 setup for 100-150 pb^{-1} after Kd run - @SC62 as well as future measurements proposal

Kaonic Atoms to Investigate Global Symmetry Breaking Symmetry 12 (2020) 4, 547

Part. and Nuclear physics
QCD @ low-energy limit
Chiral symmetry, Lattice

The modern era of light kaonic atom experiments Rev.Mod.Phys. 91 (2019) 2, 025006

Fundamental physics New Physics

Kaonic atoms

Kaon-nuclei interactions
(scattering and nuclear interactions)

On self-gravitating strange dark matter halos around galaxies Phys.Rev.D 102 (2020) 8, 083015

Dark Matter studies

The equation of state of dense matter: Stiff, soft, or both? Astron.Nachr. 340 (2019) 1-3, 189

Astrophysics
EOS Neutron Stars

Part of the SIDDHARTA-2 collaboration

Thank you!


Special thanks to the accelerator,
research and technical divisions,
and in particular to
the DAΦNE staff and
to the LNF Director

spares

SIDDHARTA-2 KHe 1.4%

Degraders: 475um (new) + 600 um

N° SDDs: 319

bkg function: pol1

$L = 12.06\ pb^{-1}$

	$E_{e.m.}$ [eV]	E_{exp} [eV]	Amp	events
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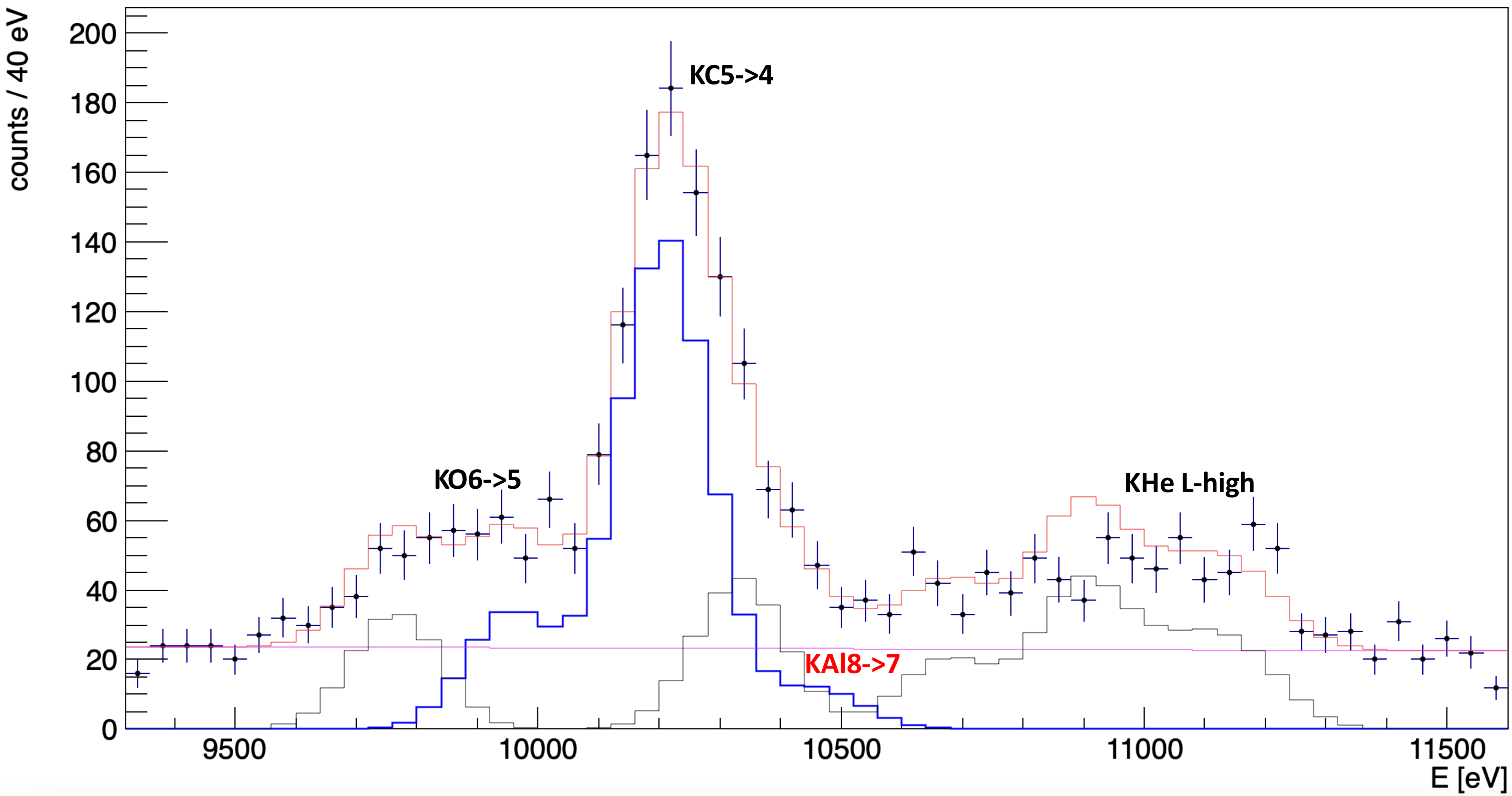
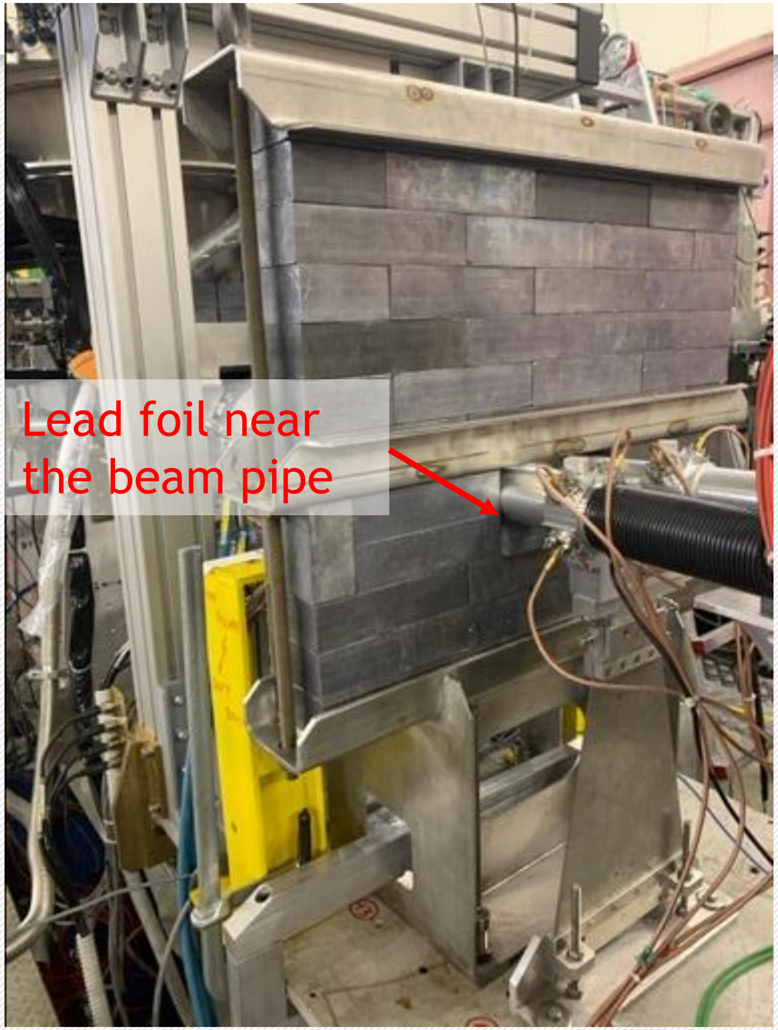
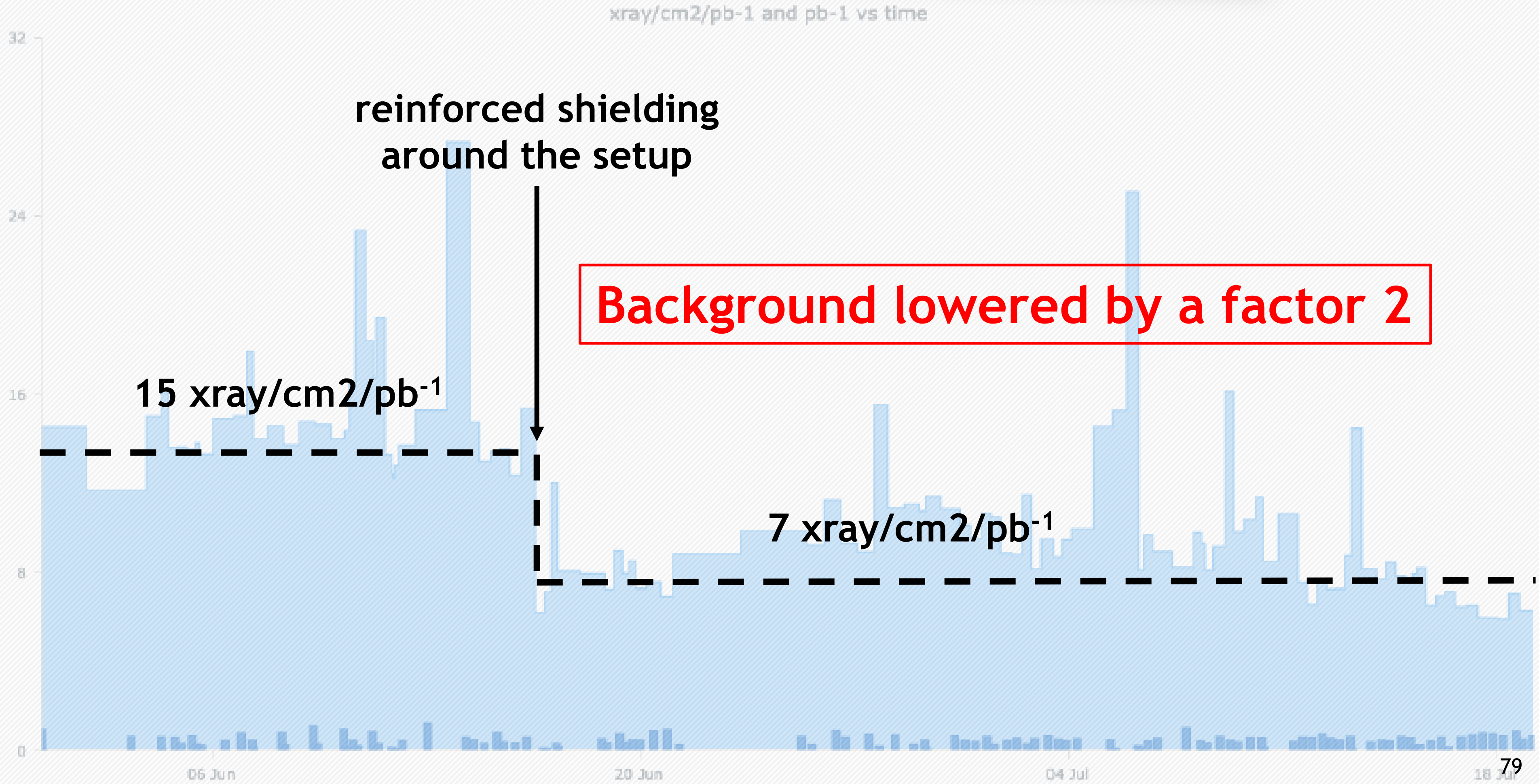


Back. reduction: reinforced shielding around the setup



SIDDHARTINO - xray/cm2/pb^{-1}

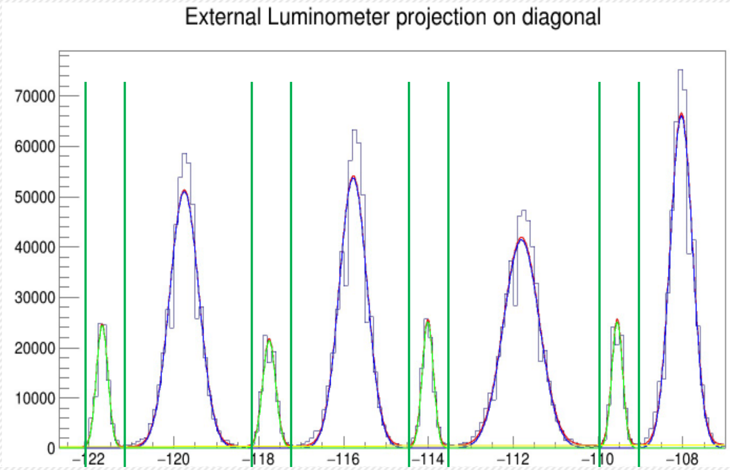


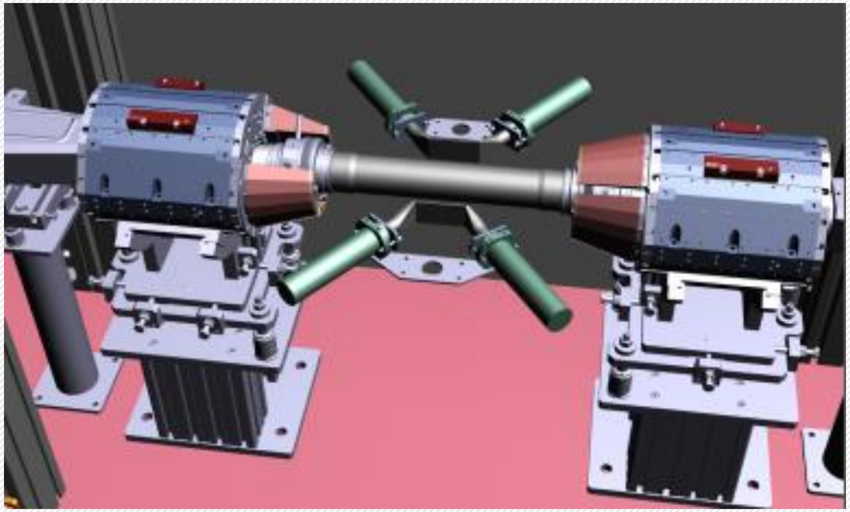
Luminosity measurement to monitor also background

- **Luminosity detector:**

- SIDDHARTA-2 luminometer used for back: kaons/MIPS

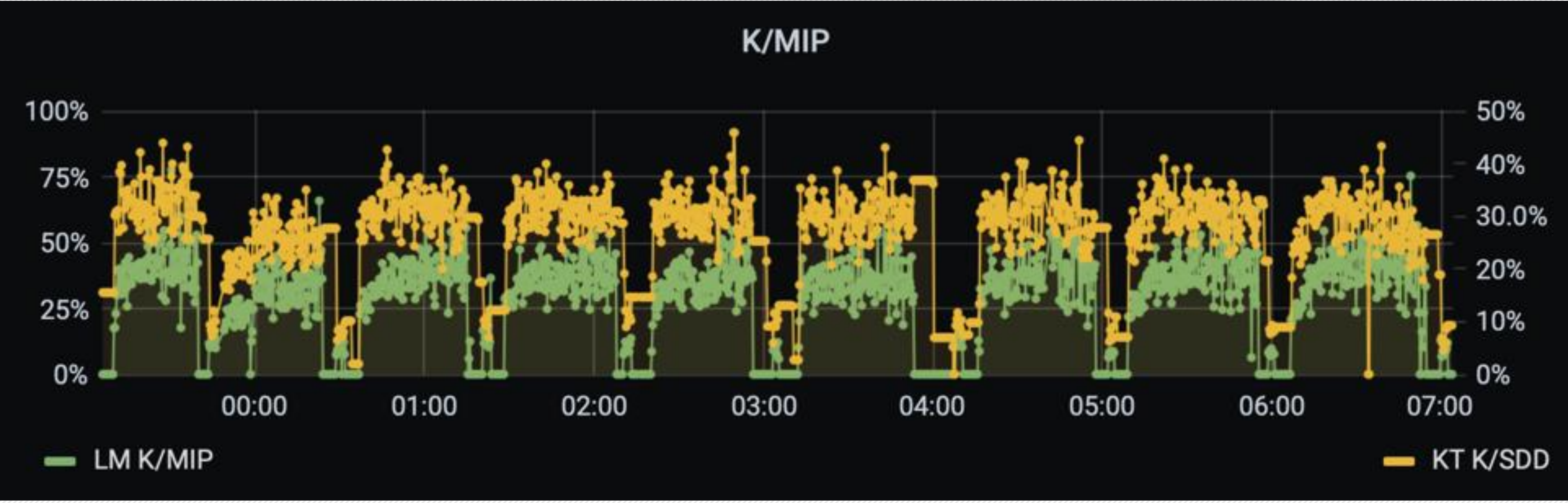
- luminosity delivery





Back to plastic scintillators in coincidence with RF/4 signal

Background levels monitor



Background levels were monitored online by a counter based on Kaon/Mip rate and a second based on Kaon/SDD rate.

Shared with the DAΦNE staff to optimize the background