

Istituto Nazionale Fisica Nucleare - Laboratori Nazionali di Frascati



Istituto Nazionale di Fisica Nucleare

**STRANU**

**Hot topics in strangeness nuclear and atomic**

**physics**

**24-28 / 05/ 2021**



Istituto Nazionale di Fisica Nucleare

# SIDDHARTINO:

# first step towards SIDDHARTA-2

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*On behalf of SIDDHARTA-2 Collaboration*

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# SIDDHARTA – 2

## Silicon Drift Detectors for Hadronic Atom Research by Timing Application

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

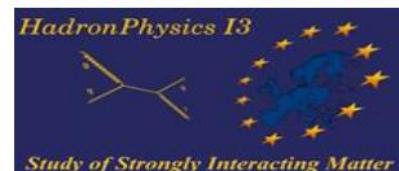
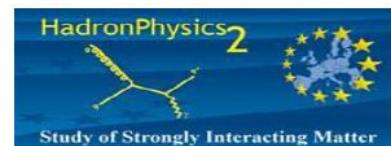
Univ. Zagreb, Croatia

Univ. Jagiellonian Krakow, Poland

ELPH, Tohoku University

STRONG-2020

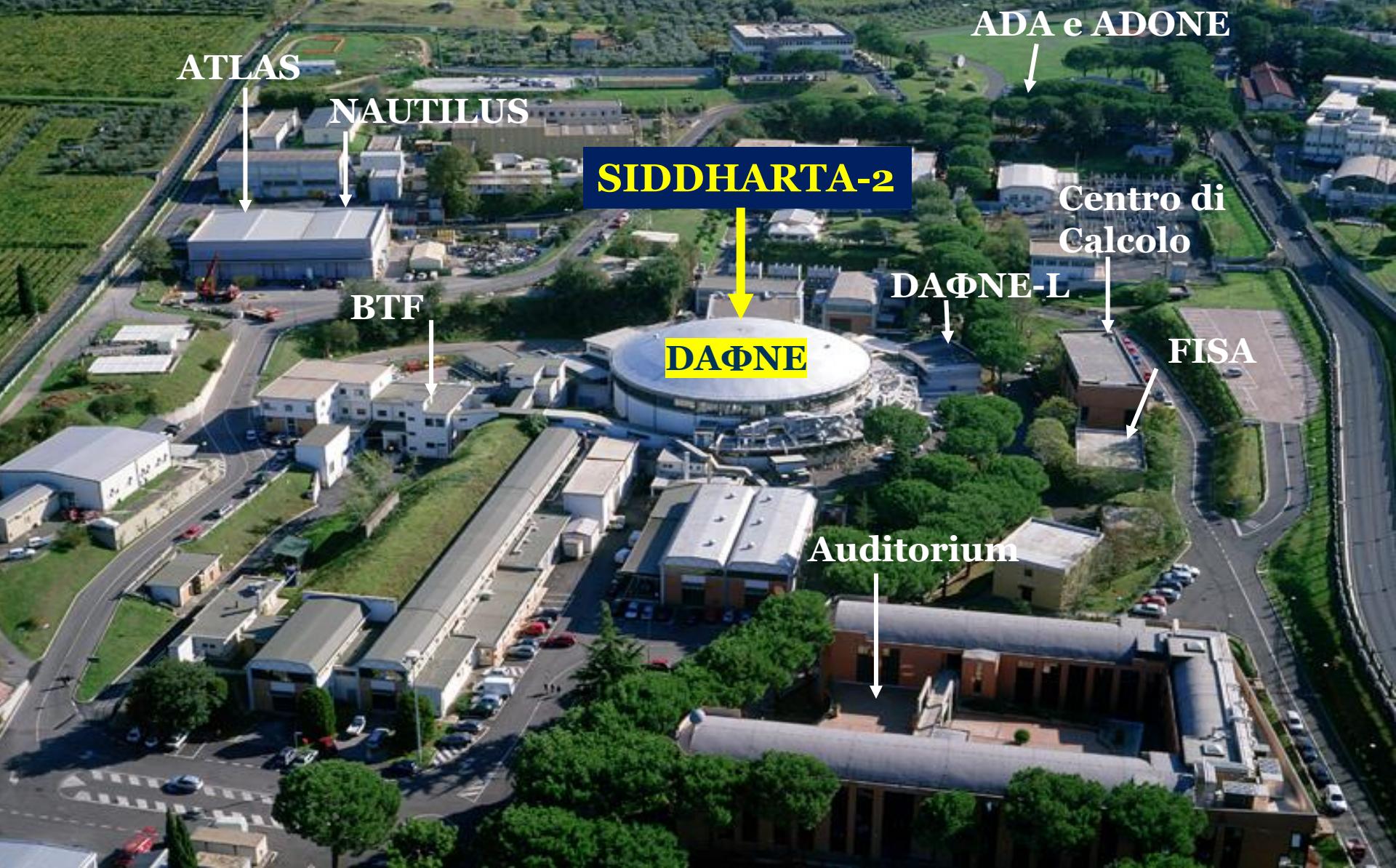
Croatian Science Foundation,  
research project 8570



**FWF** Der Wissenschaftsfonds.

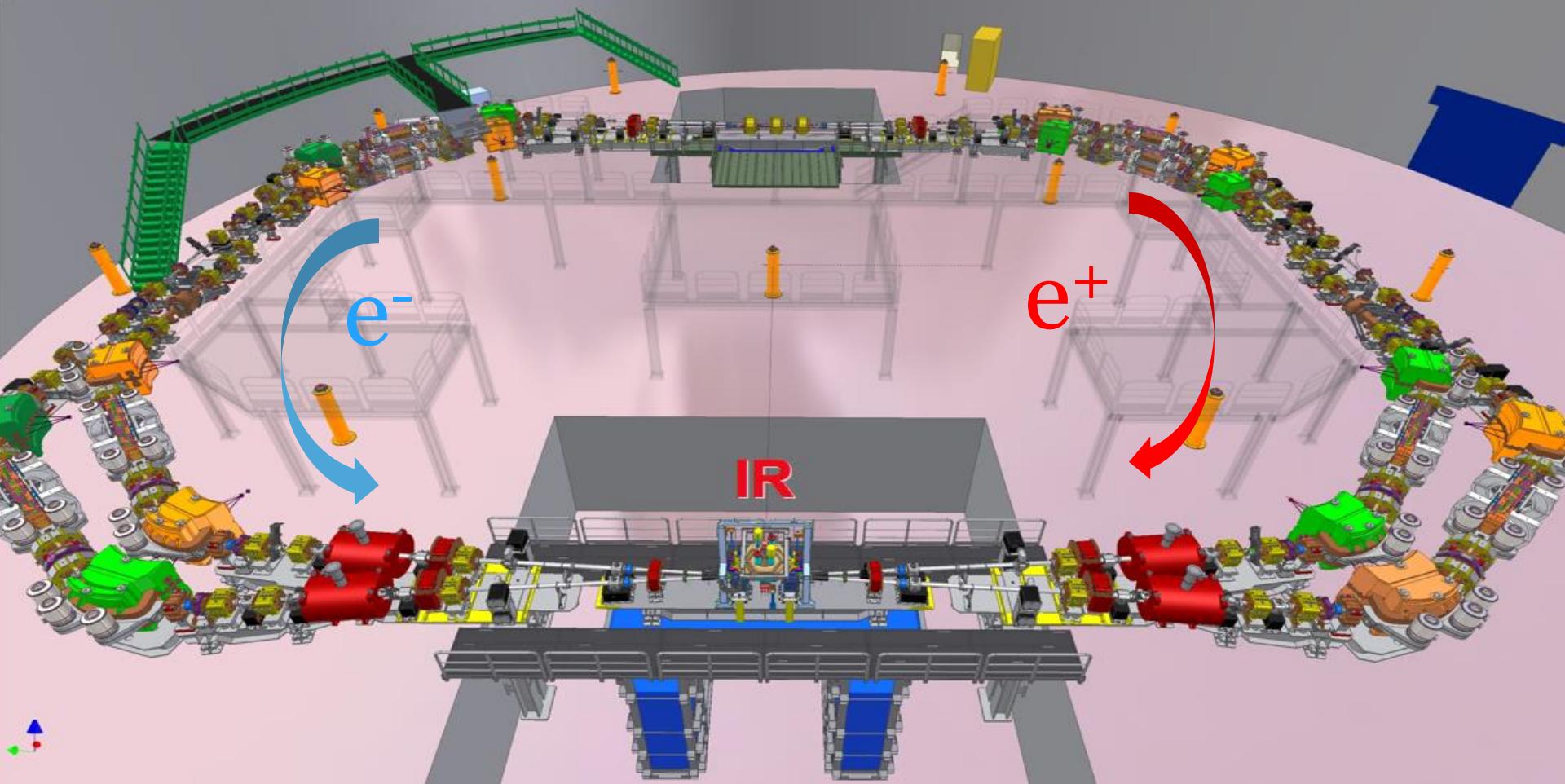
 **Farnesina**  
Ministero degli Affari Esteri  
e della Cooperazione Internazionale

# Laboratori Nazionali di Frascati (LNF-INFN)

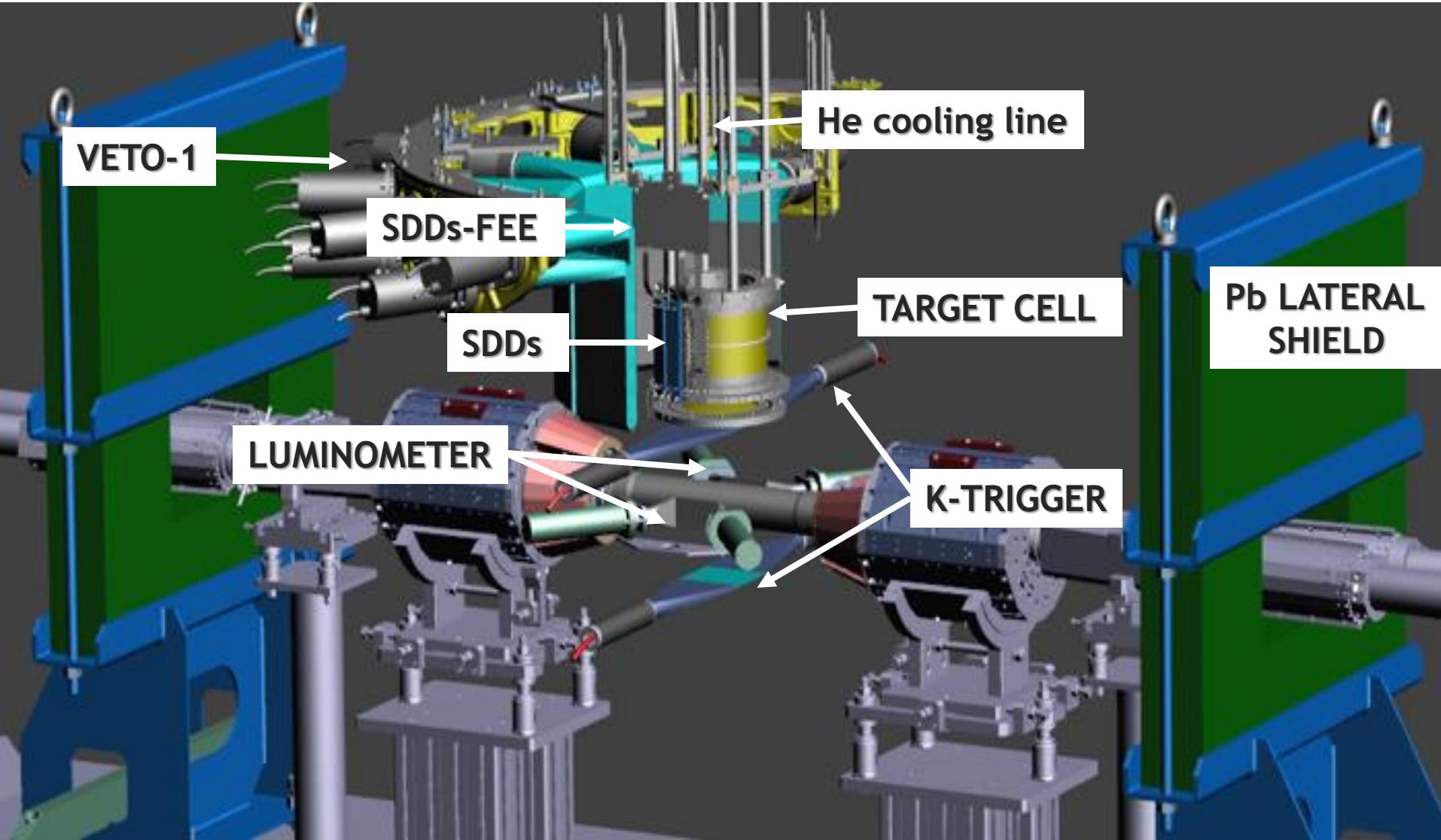


# Laboratori Nazionali di Frascati (LNF-INFN)

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

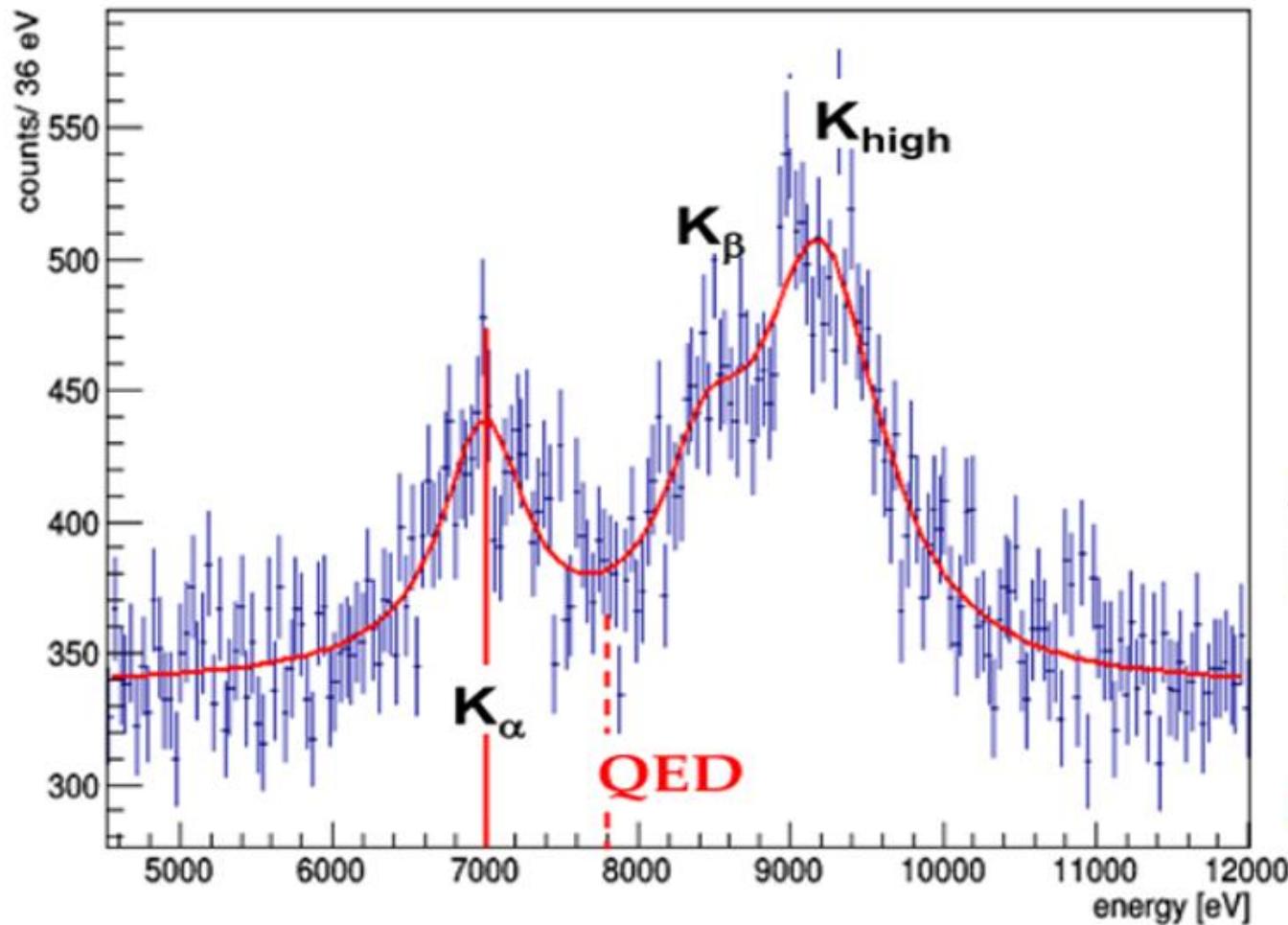


# SIDDHARTA-2 experimental apparatus



# SIDDHARTA-2 MC Kaonic deuterium

KD yield < 0.1 %



$$\int L = 800 \text{ pb}^{-1}$$

density: 3% (LHD)  
detector area: 246 cm<sup>2</sup>



$$\epsilon = -800 \pm 30 \text{ eV}$$
$$\Gamma = 750 \pm 75 \text{ eV}$$



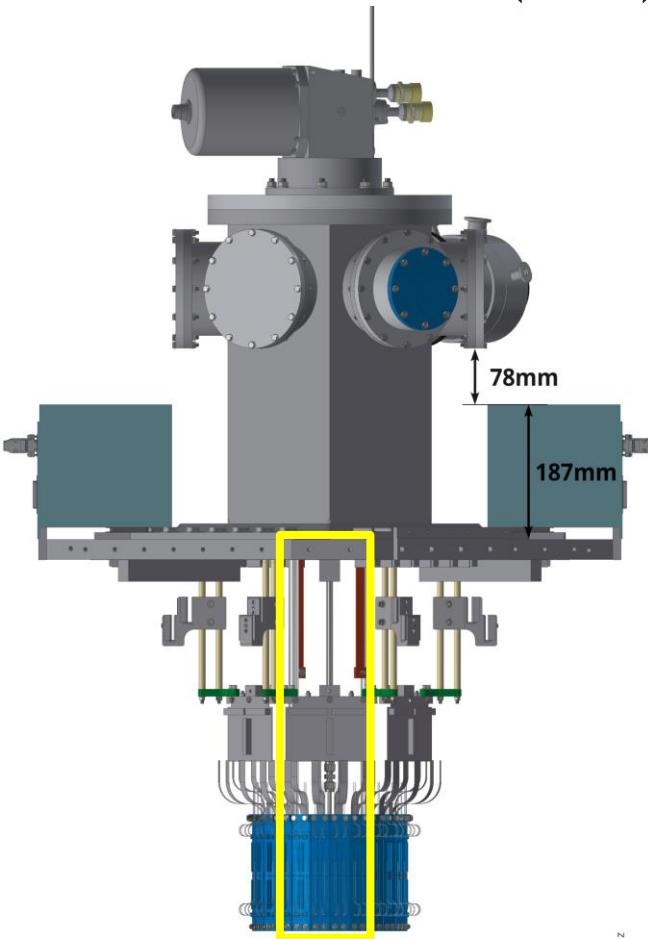
Same precision as SIDDHARTA,  
which gave the most precise  
measurement of KH so far

# SIDDHARTINO installation (April 2019)



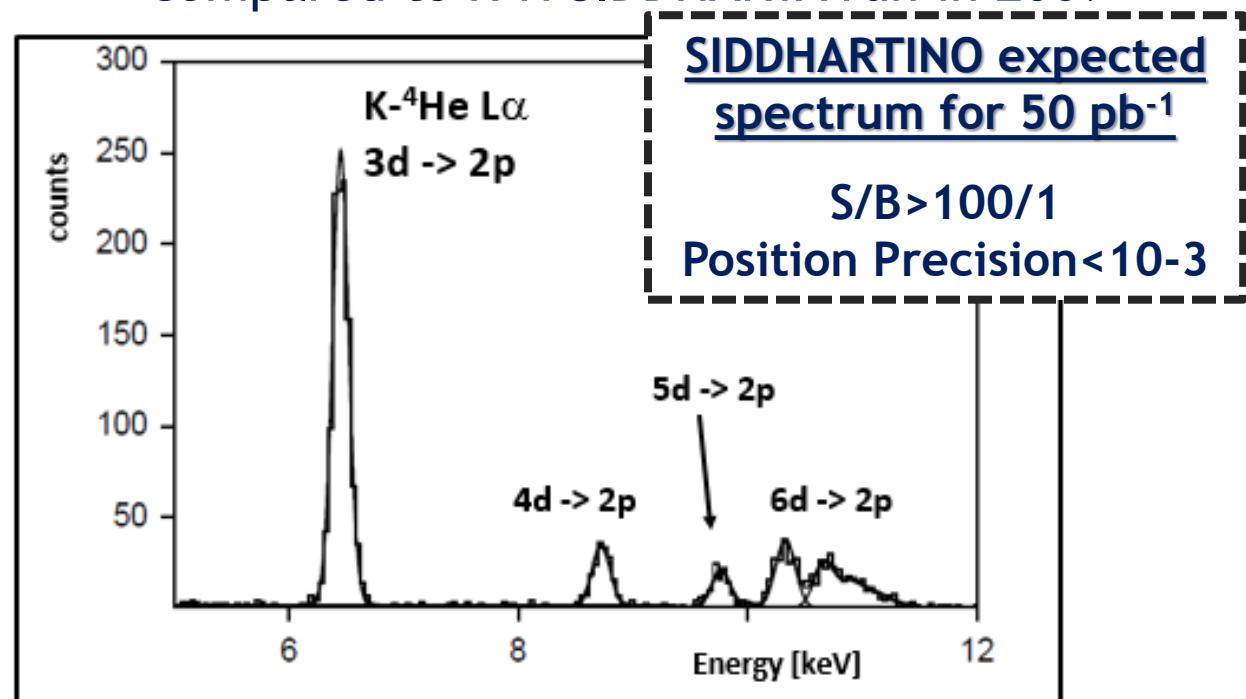
# SIDDHARTINO - aim

1/6 of SIDDHARTA-2 (SDDs)



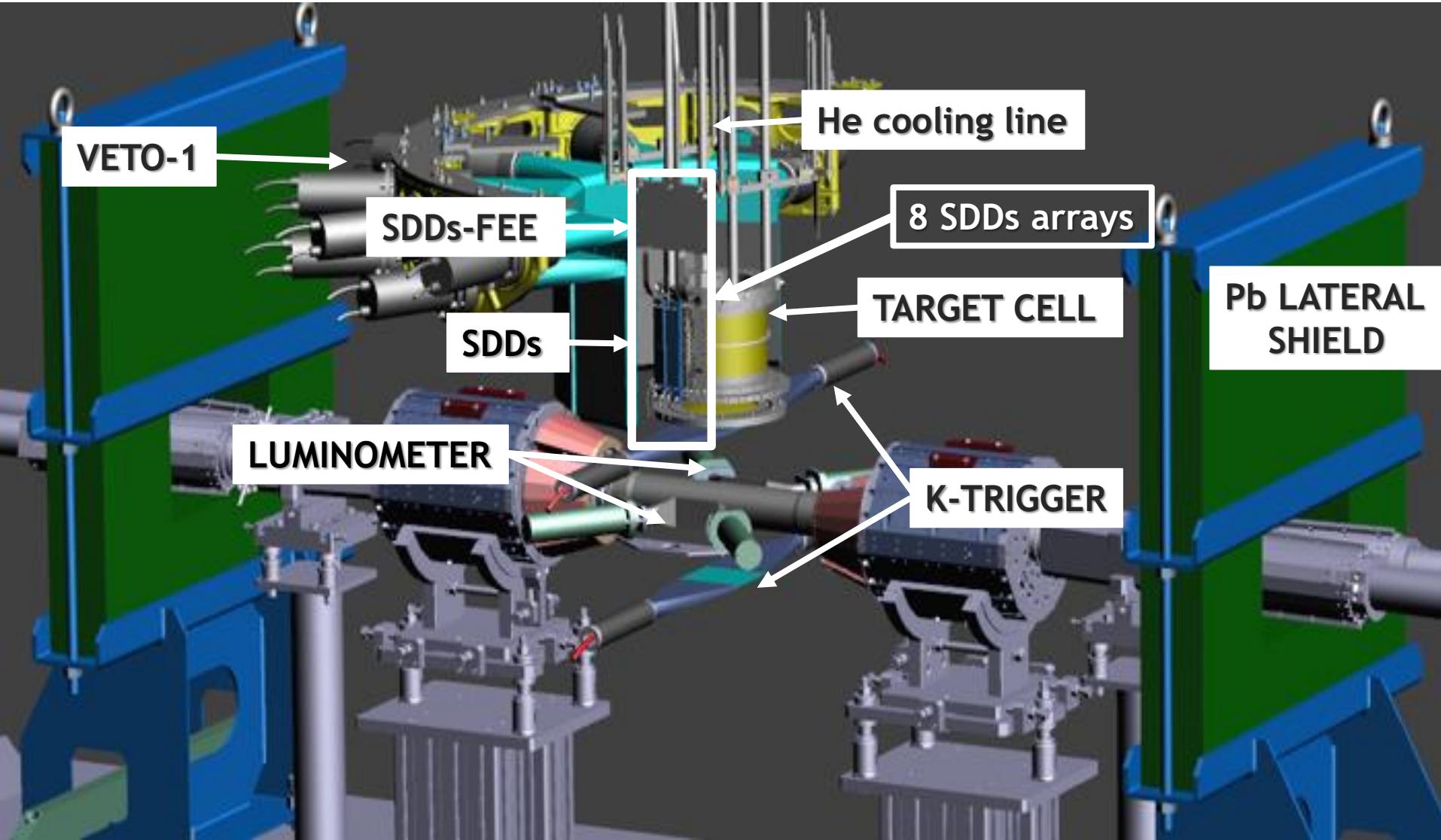
Evaluation of the machine background  
during the DAΦNE beams commissioning phase  
in preparation for the K-d run

Measurement of  $K^-{}^4He$   $3d \rightarrow 2p$  transition to be  
compared to K-H SIDDHARTA run in 2009



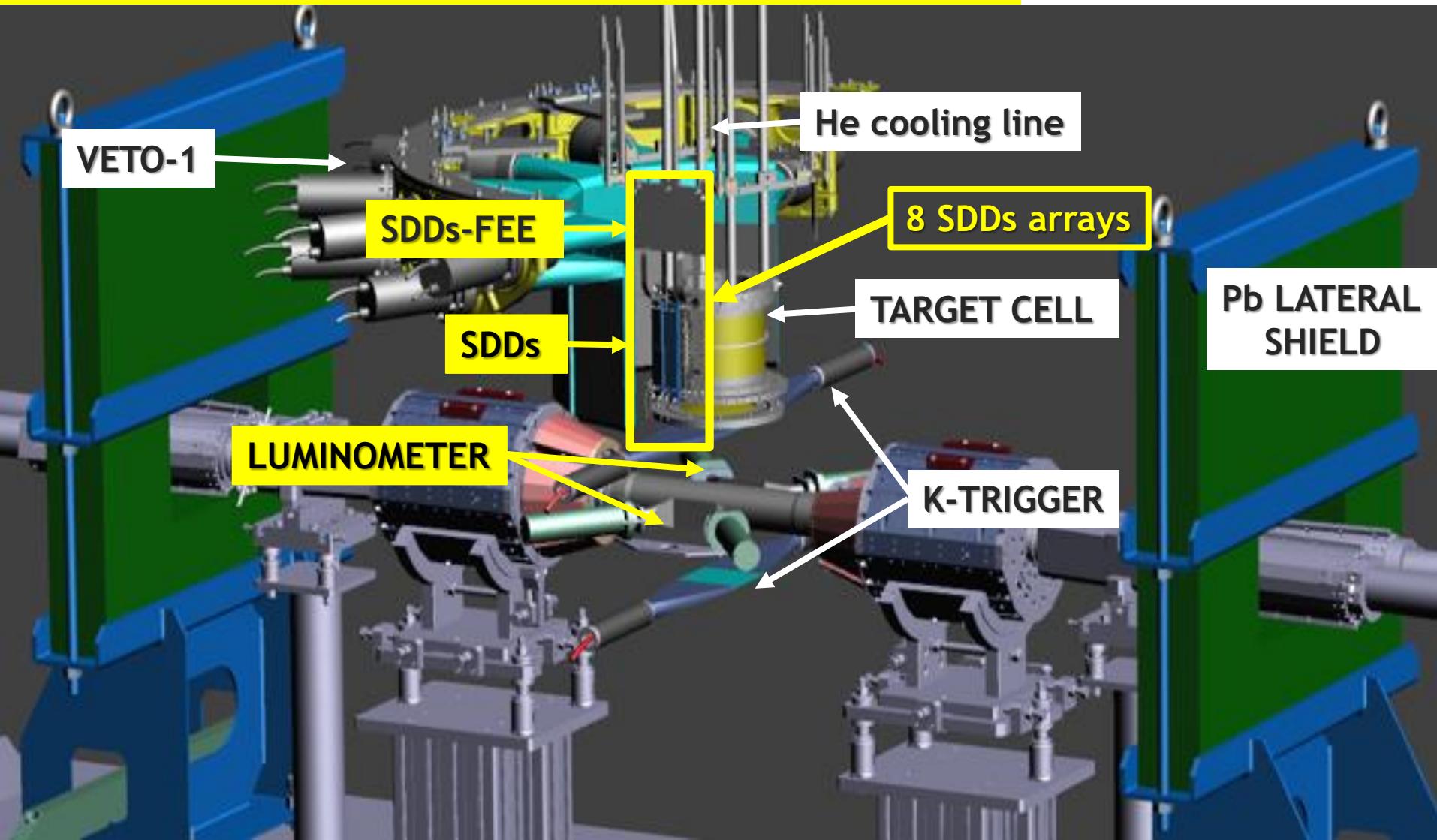
SIDDHARTA-2 single BUS

# SIDDHARTINO

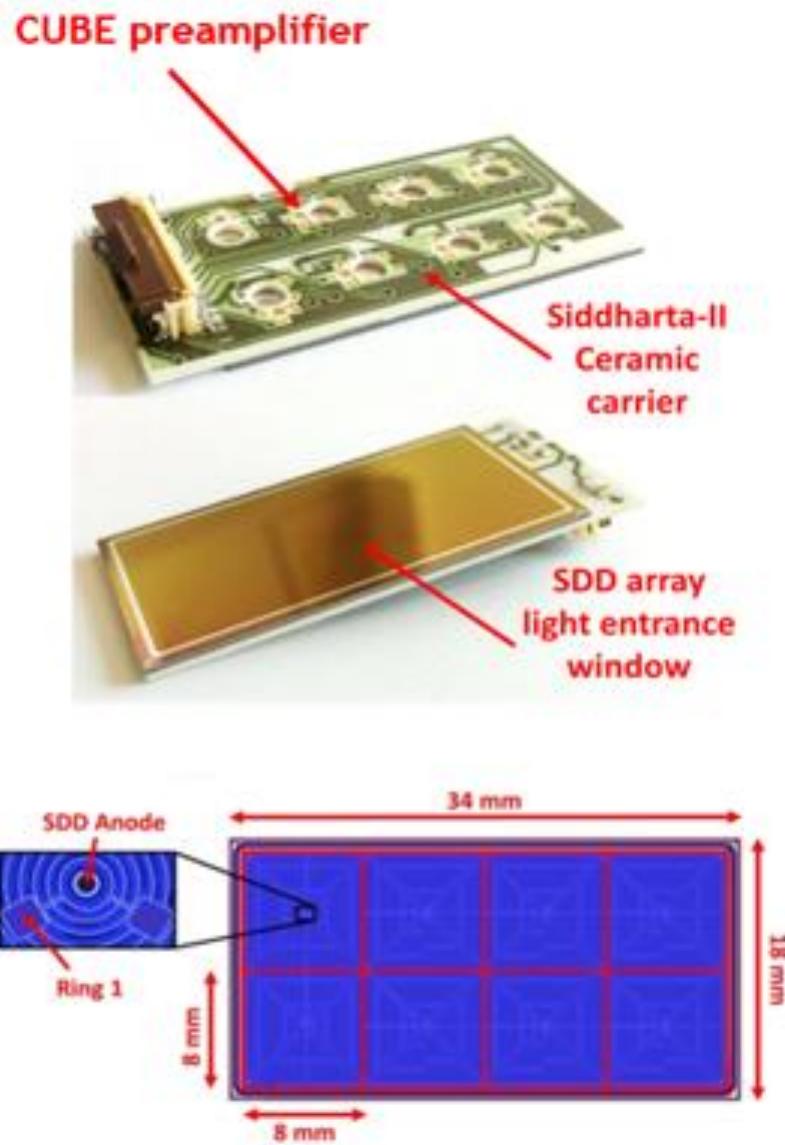


# SIDDHARTINO

- Refined optimization during DAΦNE B.C.P.

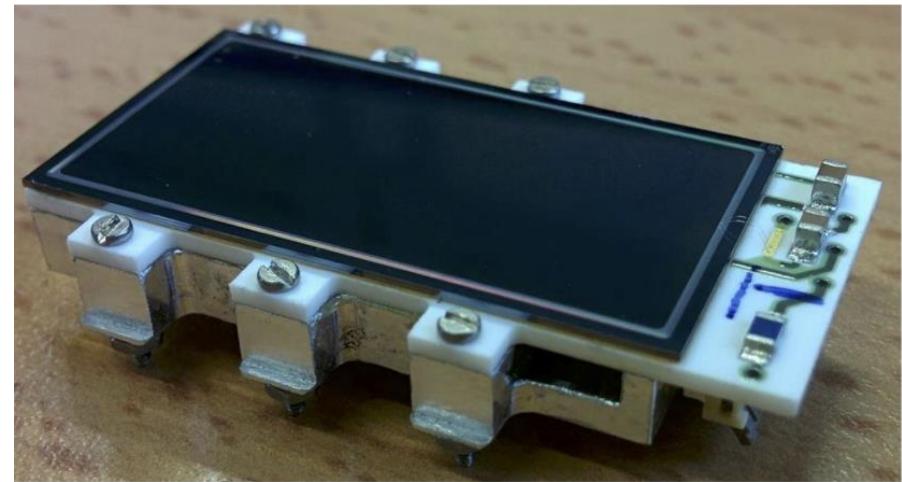


# SDDs ENERGY RESPONSE



New technology of SDDs  
(LNF-INFN, PoliMi, FBK)  
for the high precision K-d measurement

8 SDD units ( $0.64 \text{ cm}^2$ ) for a device total active area of  $5.12 \text{ cm}^2$



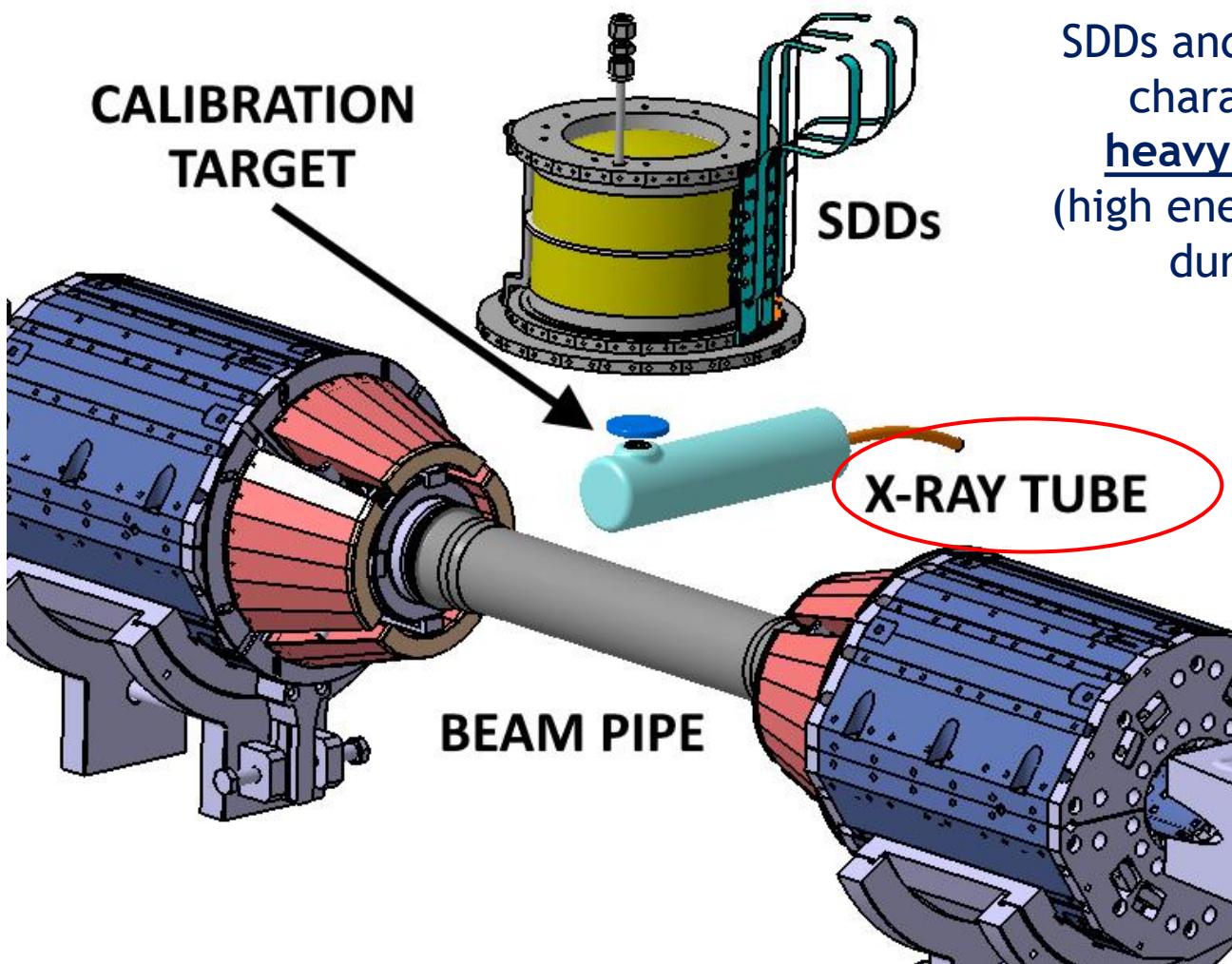
For details on laboratory optimization  
F. Sgaramella talk at 11.25

# SDDs ENERGY RESPONSE



SDDs arrays  
head-to-head

# SDDs ENERGY RESPONSE



SDDs and DAQ analog/digital chain  
characterization in machine  
**heavy background conditions**  
(high energy particle and radiation)  
during the DAΦNE B.C.P

Multi-element target  
Ti-Fe-Cu-Br-Sr  
to include the  
**SIDDHARTA-2 energy range**

# SDDs ENERGY RESPONSE

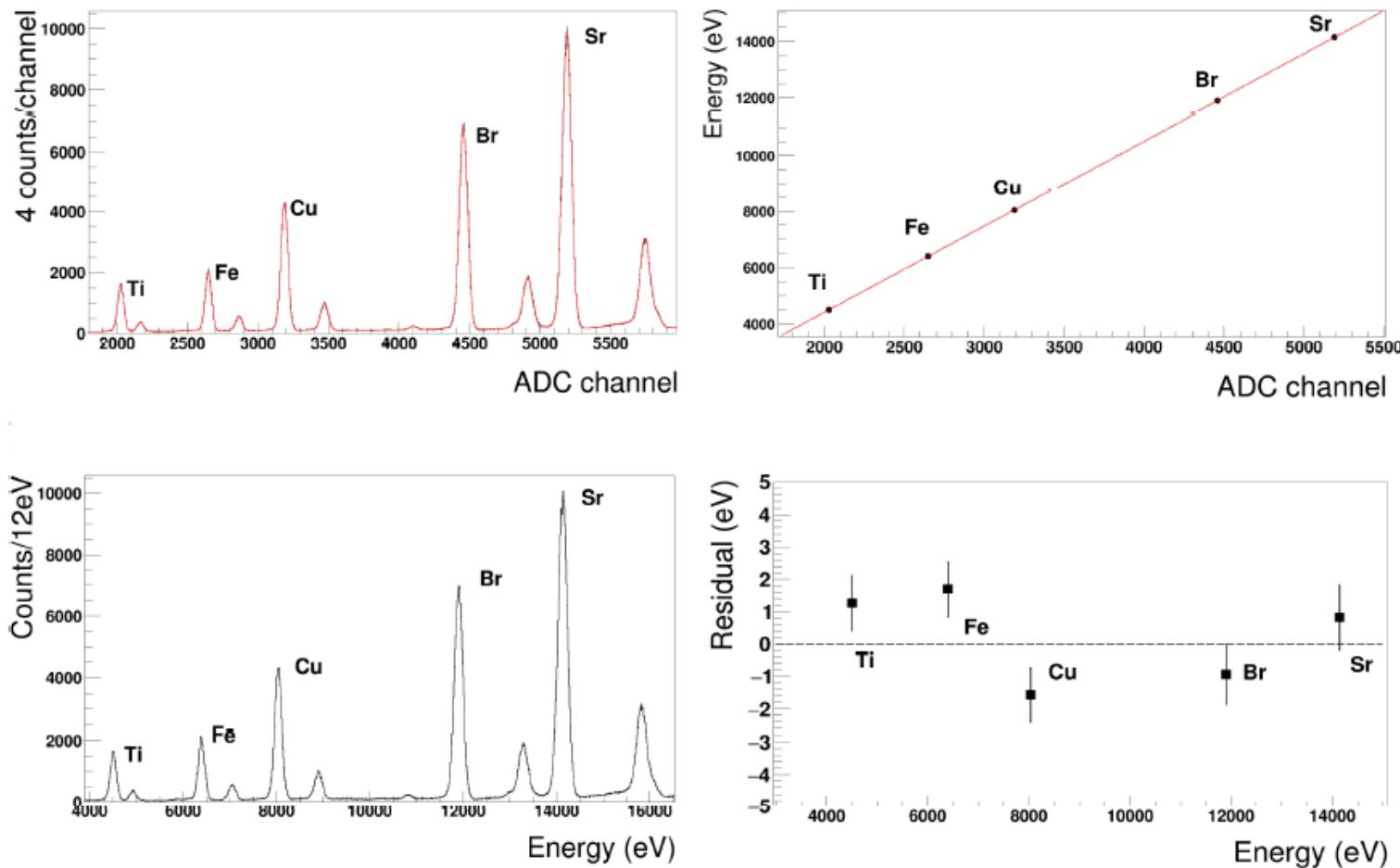
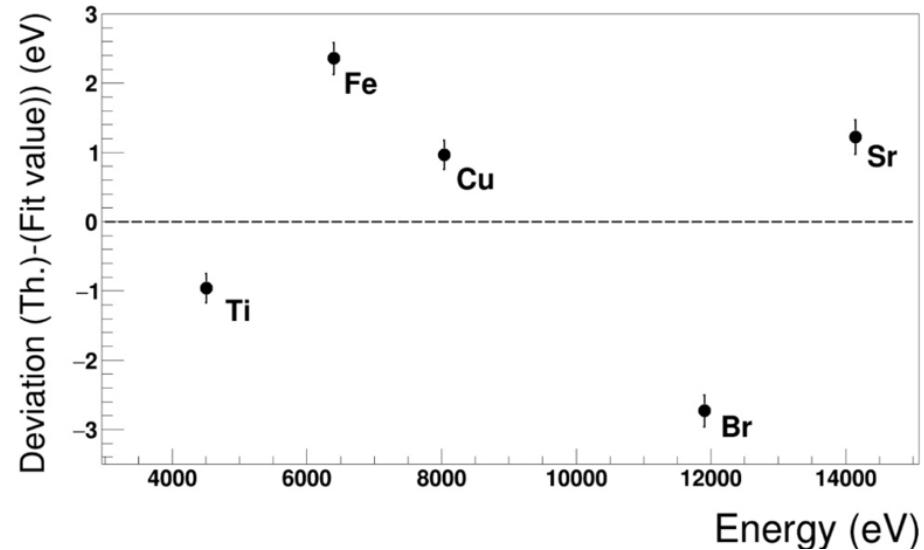
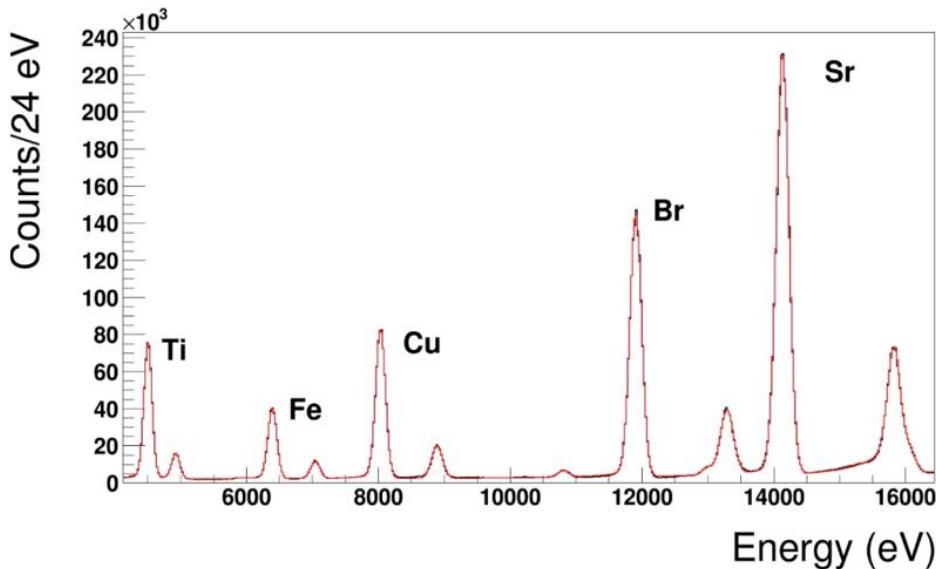


Figure 4: Typical example of a SDDs system unit energy response analysis.

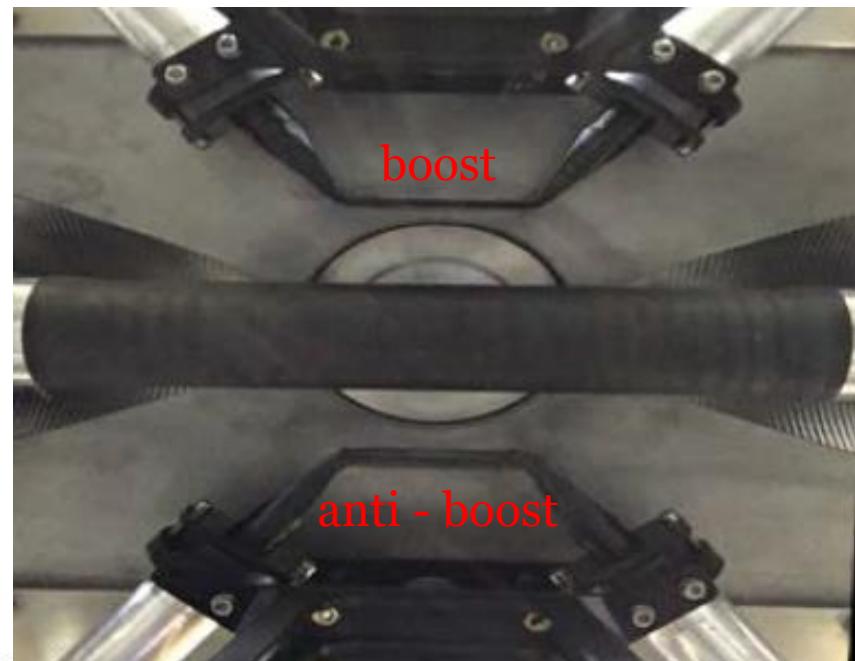
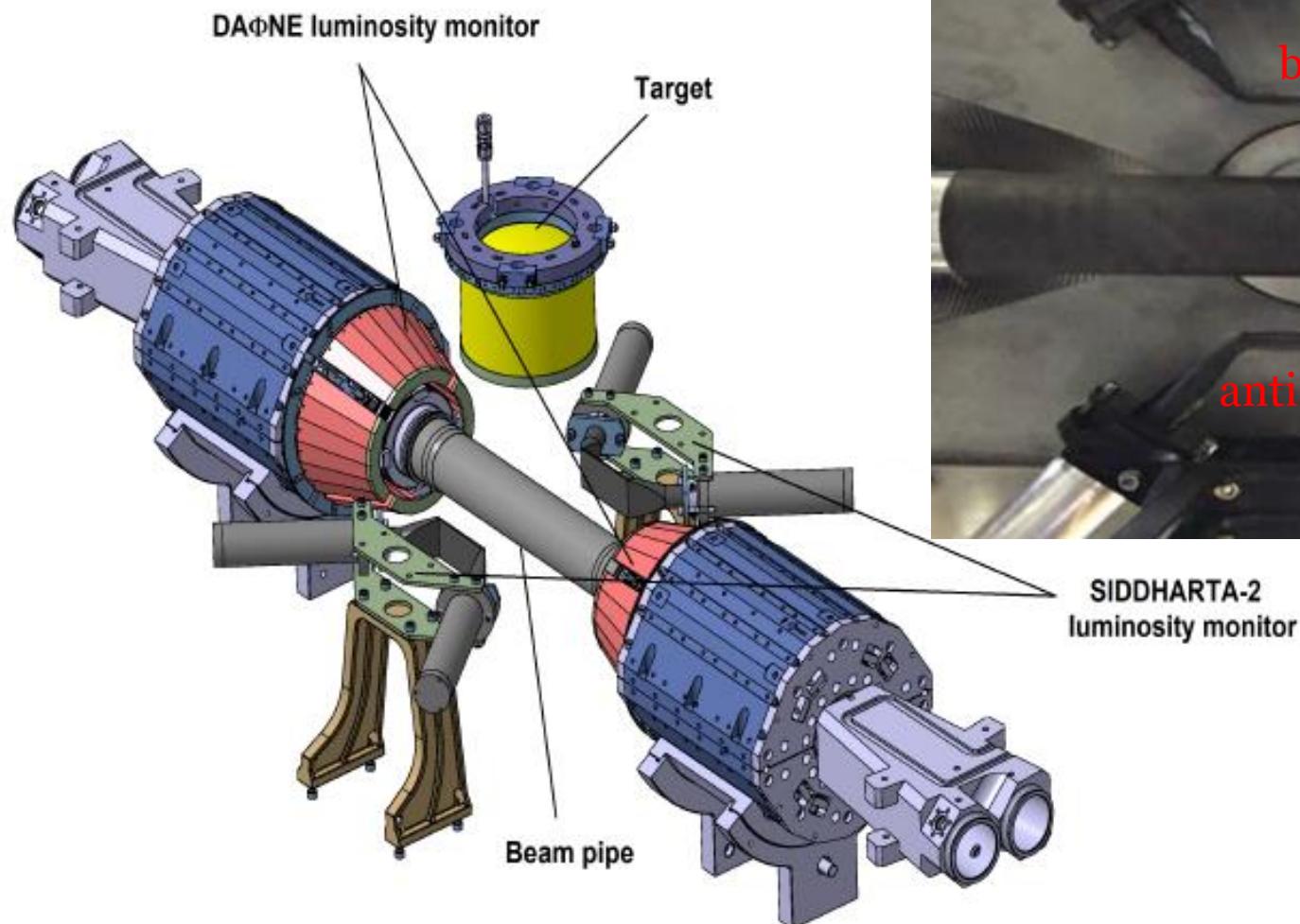
# SDDs ENERGY RESPONSE



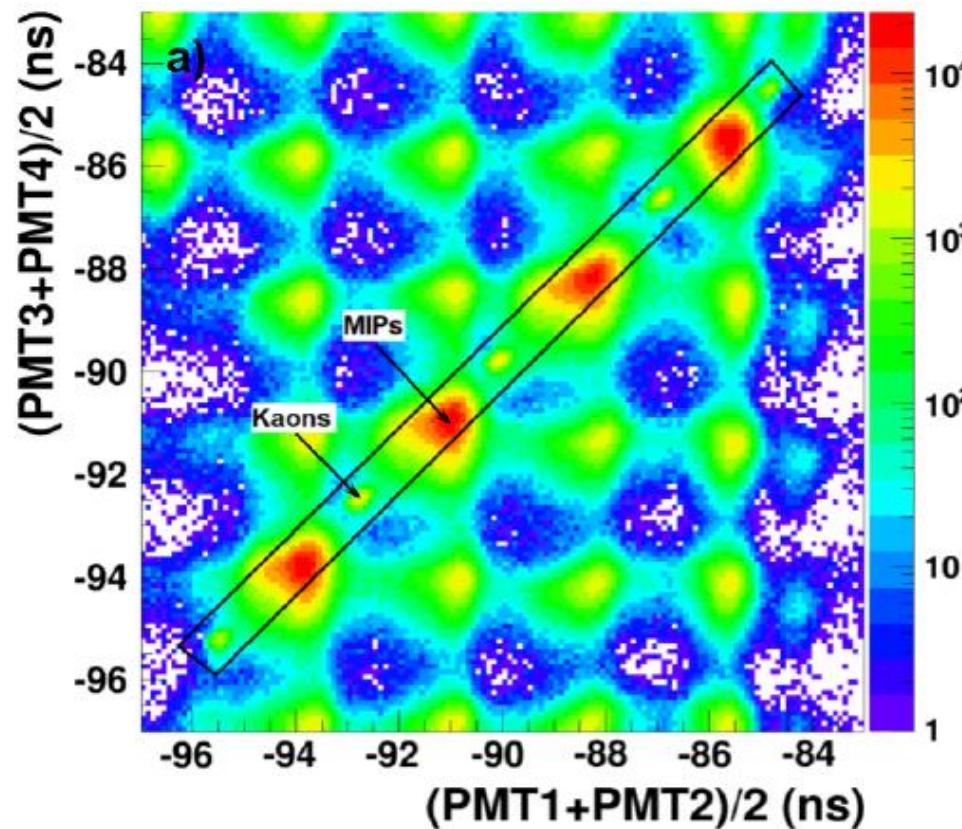
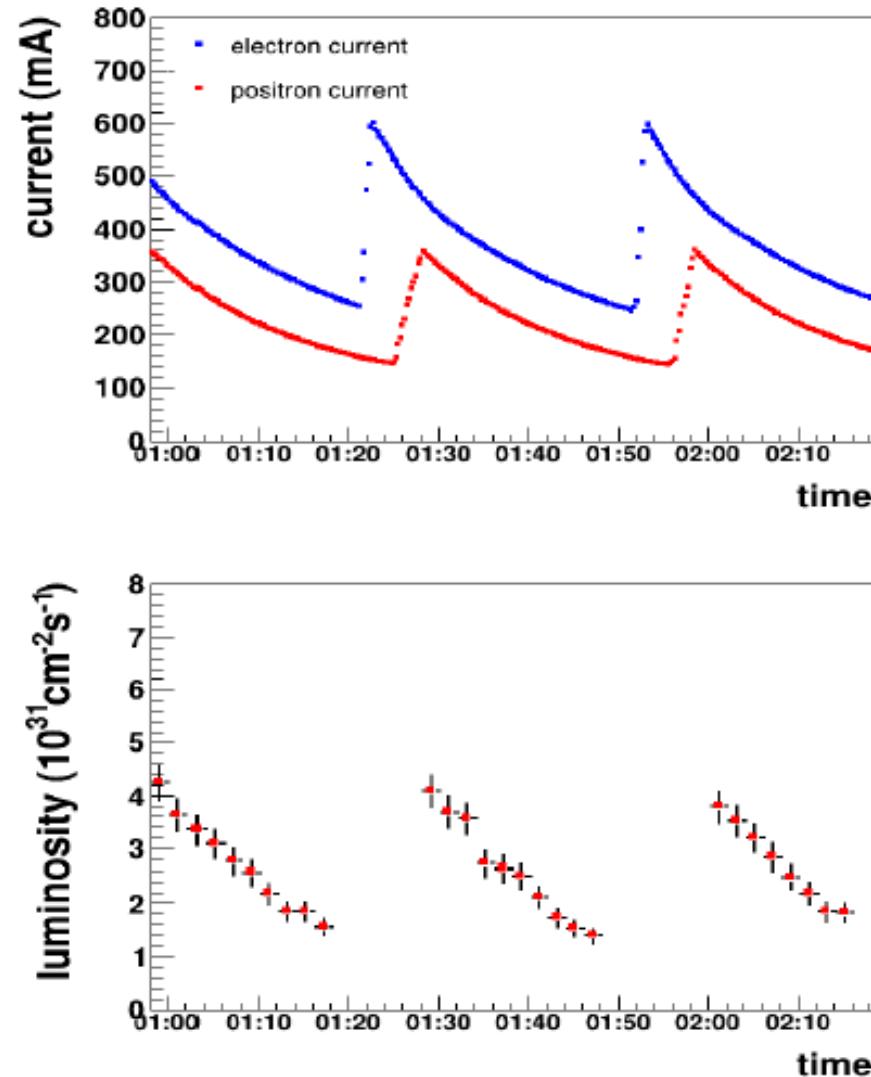
**Sum of 15 calibrated units**

- Linear response
  - > Residuals within  $\pm 3$  eV (4-12 keV range)
  - >  $\Delta E/E < 10^{-3}$  (4-12 keV range)
- FWHM Fe Ka line =  $157 \pm 2$  eV (@ 150 K)

# LUMINOMETER



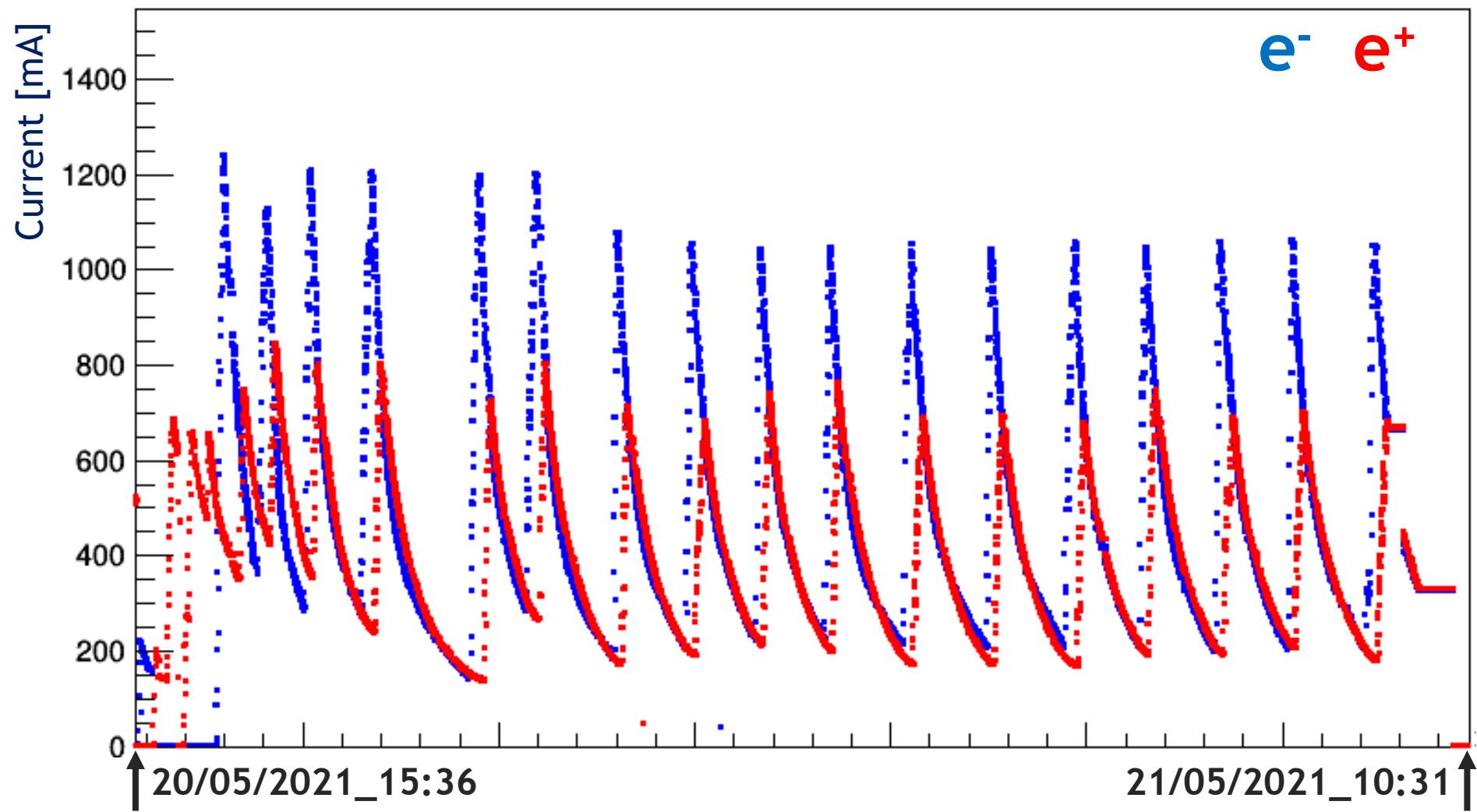
# LUMINOMETER



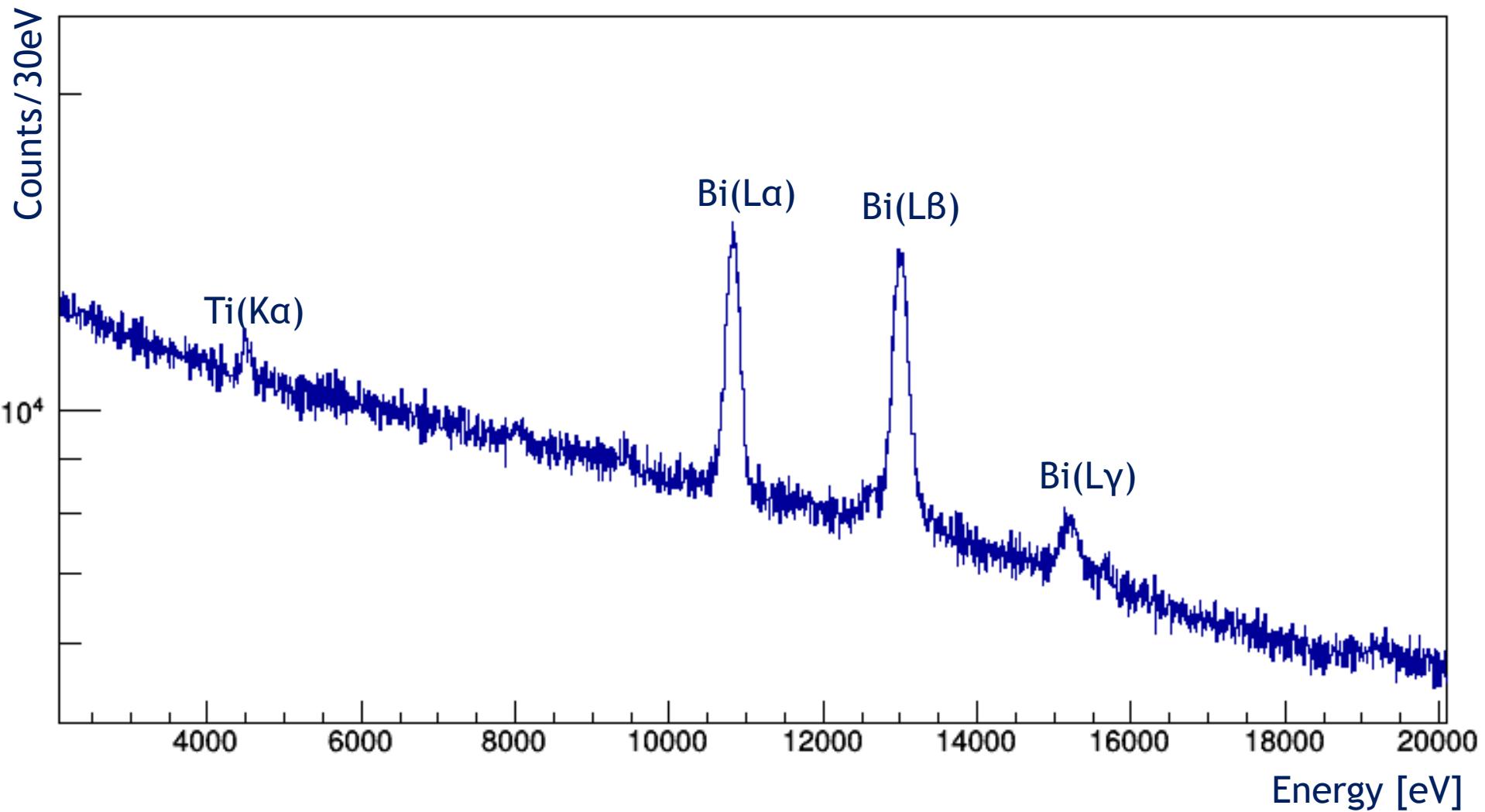
optimization and present status:  
F. Napolitano talk at 11.50

# SIDDHARTINO run

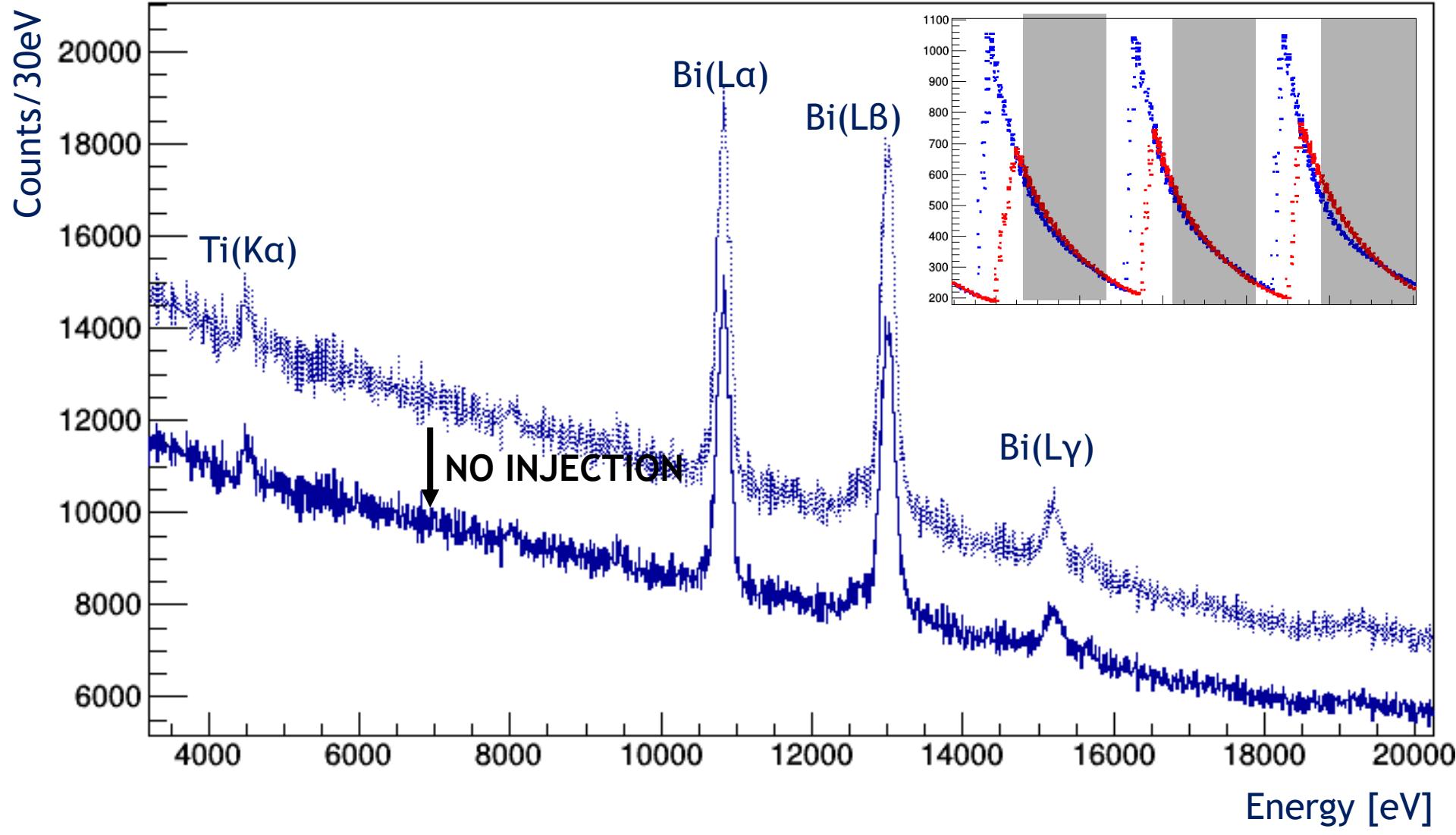
DAΦNE in Collision mode.



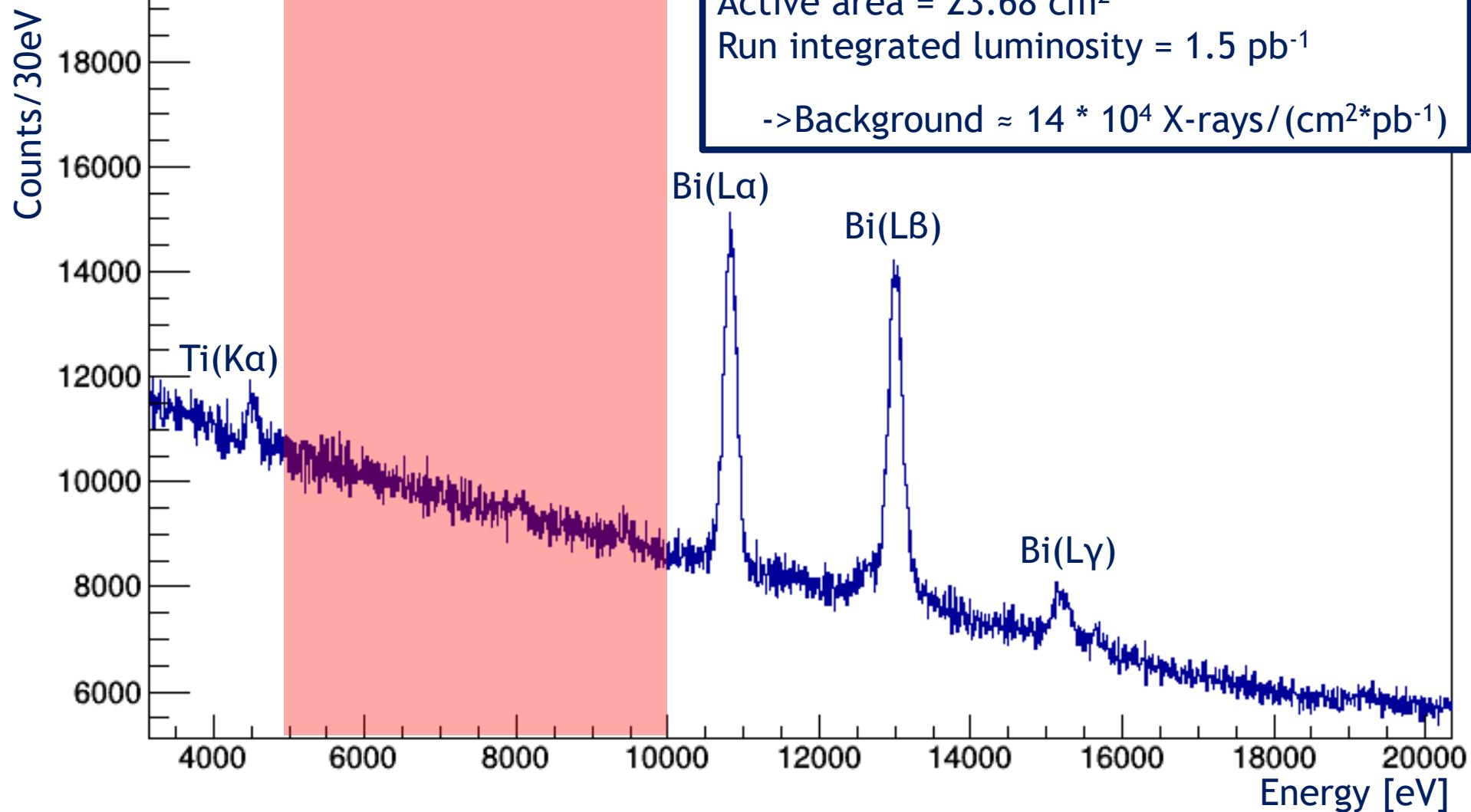
# SIDDHARTINO run



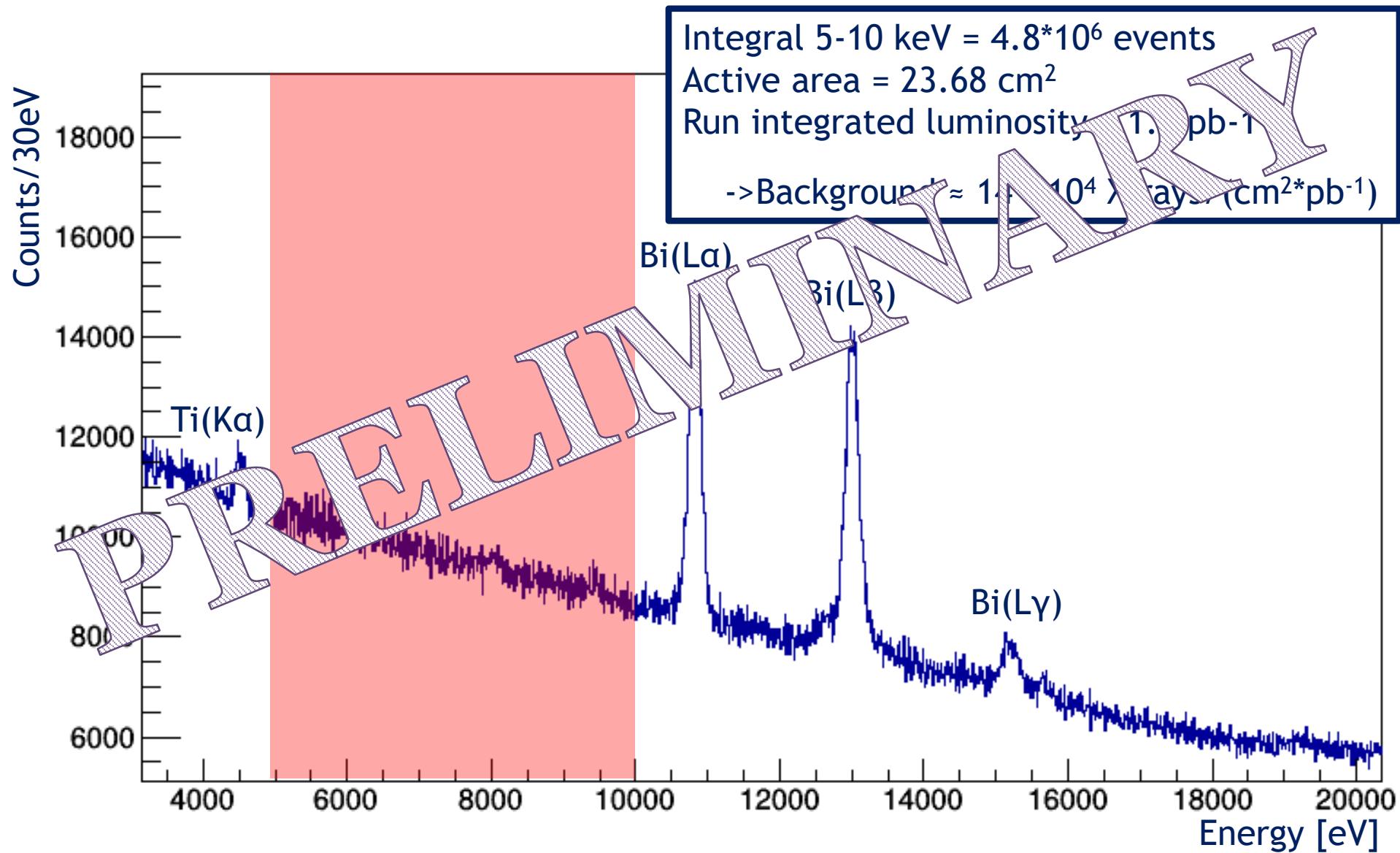
# SIDDHARTINO run



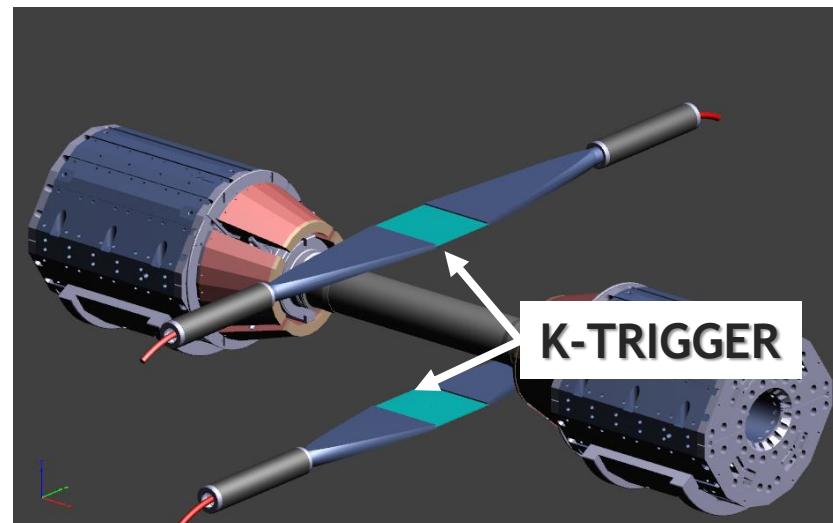
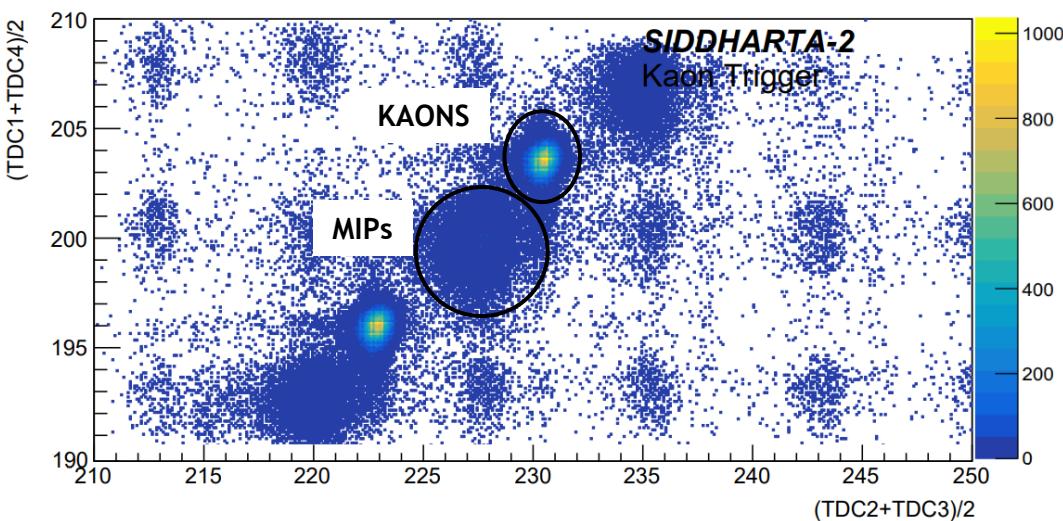
# SIDDHARTINO run



# SIDDHARTINO run



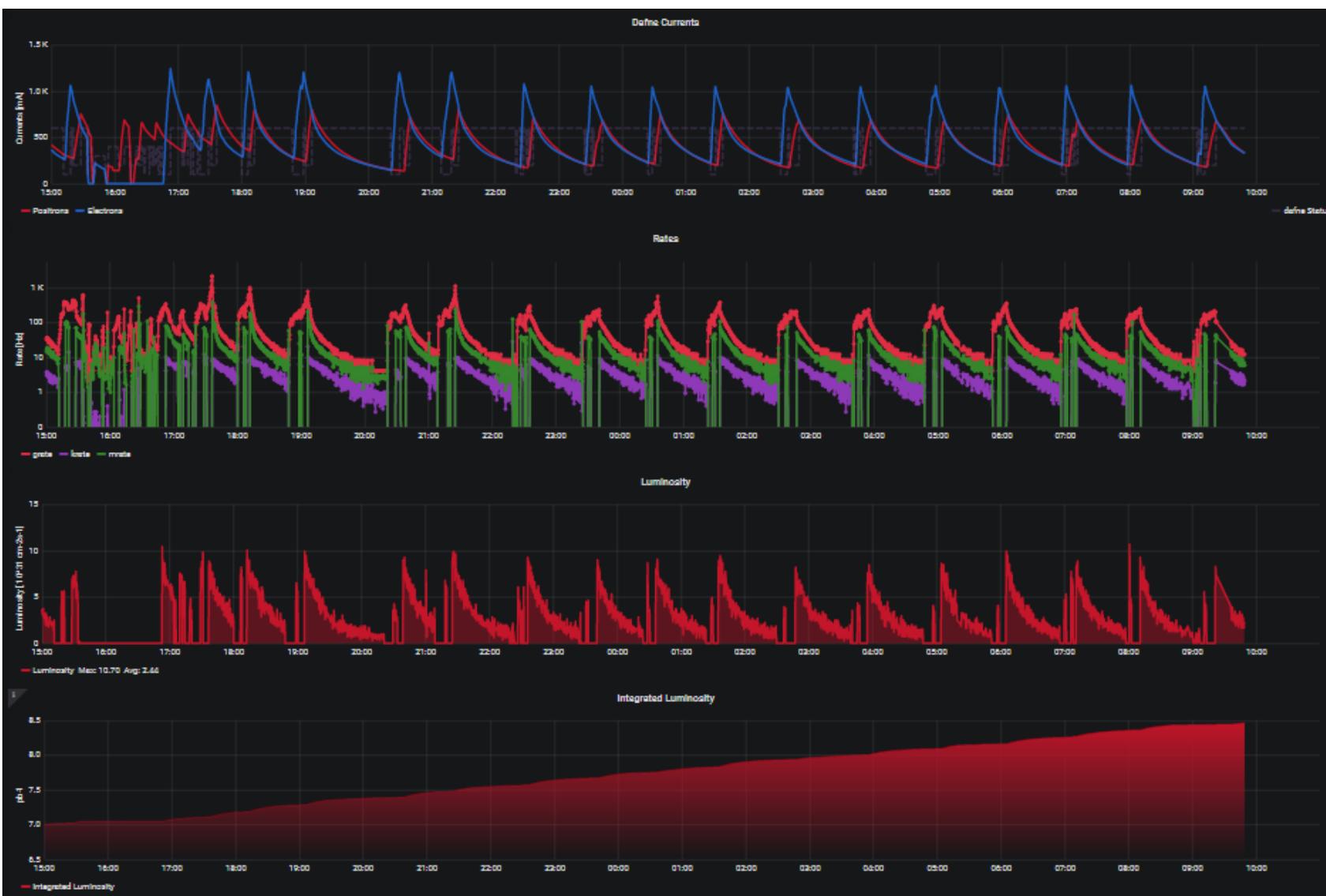
# ...Kaon Trigger is coming



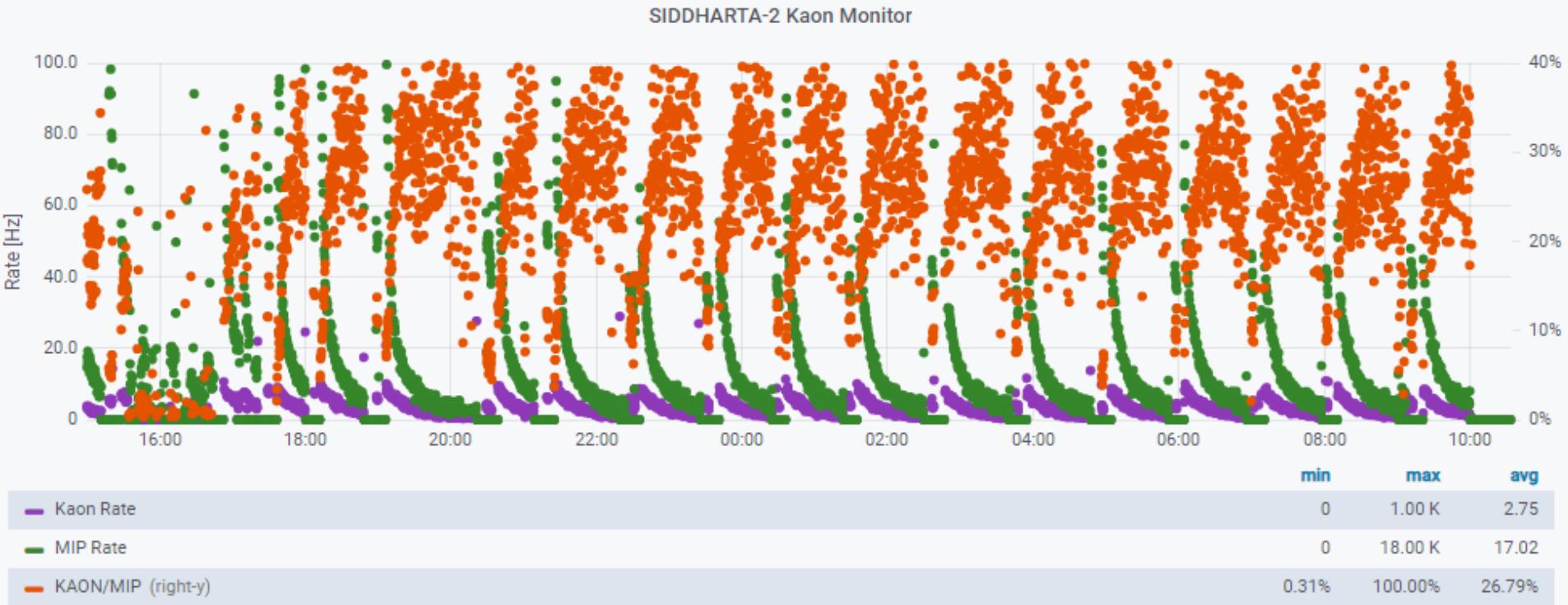
Tested and implemented in the SIDDHARTINO DAQ

**Background rejection factor given by the K Trigger and SDDs timing response is estimated to be at the level of  $10^{-5}$  (based on the SIDDHARTA run)**

# SIDDHARTA-2 on-line status



# From SIDDHARTA-2 to DAΦNE



On-line feedback from SIDDHARTA-2 to DAΦNE,  
fundamental during the beam commissioning phase for  
the machine parameter tuning

# Conclusions

- SIDDHARTINO experimental apparatus is fully working and taking data during the DAΦNE beam commissioning phase;
- Refined optimization of SDDs analog/digital DAQ chain and luminosity monitor in the heavy background of the collider (*published papers*), to be used as key tools during the machine optimization phase;
- Continuous on-line monitoring of beams outcomes quality and feedbacks to the Collider will help to improve the efficiency on beams optimization process;
- As soon as beam optimization will be achieved, let's move to SIDDHARTA-2 with the K-d measurement, and...

# Future plans

- Kaonic Helium  
2p  $\rightarrow$  1s transition
- Other Kaonic atoms  
Pioneering technology of 1mm thick SDDs
- Kaon mass:
  - High precision X-ray spectrometer with HAPG crystals  
(VOXES)
  - High purity Germanium Detectors  
(GEKA)

# THANK YOU



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Fine della presentazione. Fare clic per uscire.