

FIRST SIDDHARTA-2 RUNS: LUMINOSITY MEASUREMENTS

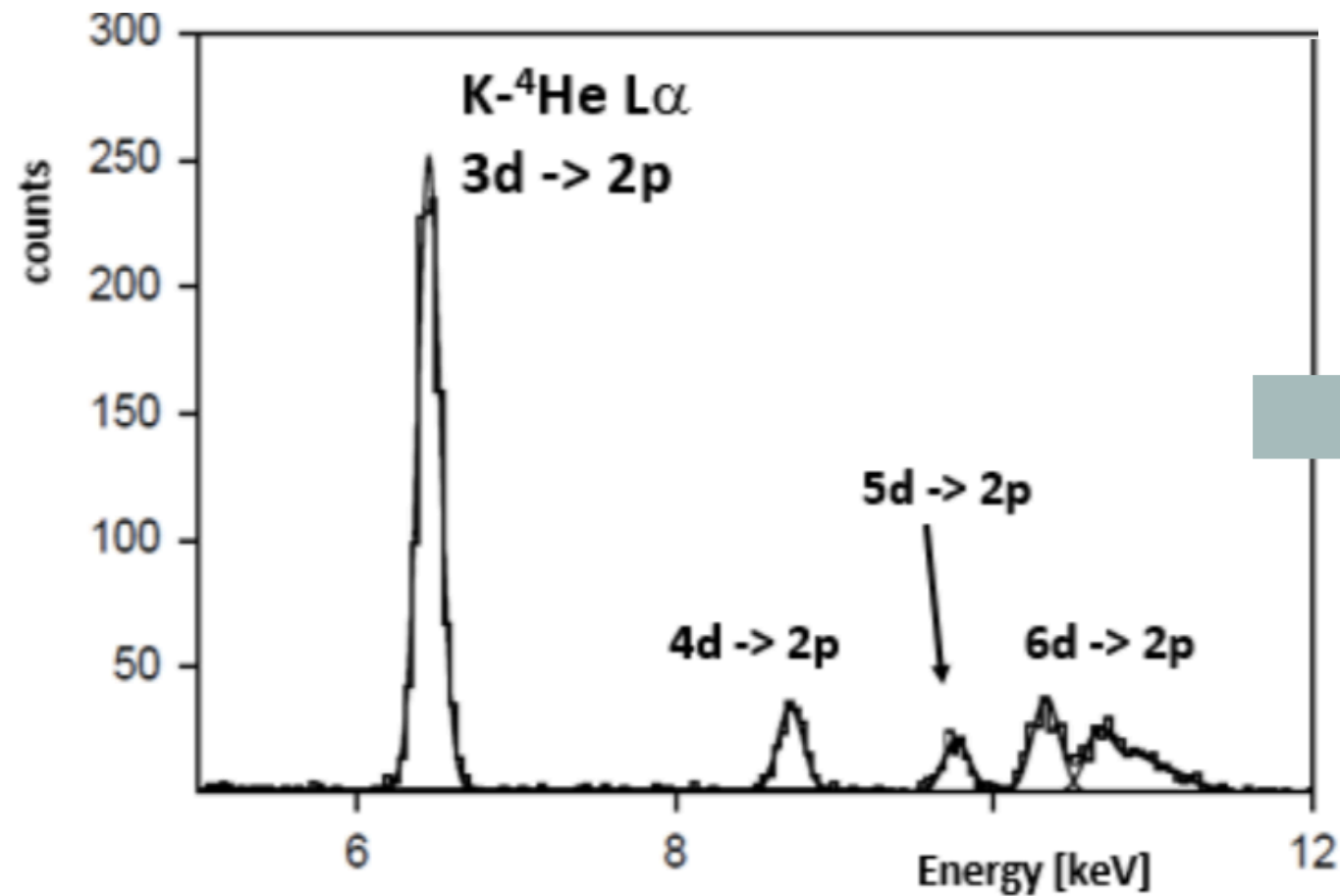
*Fabrizio Napolitano on behalf of the
SIDDHARTA-2 Collaboration*



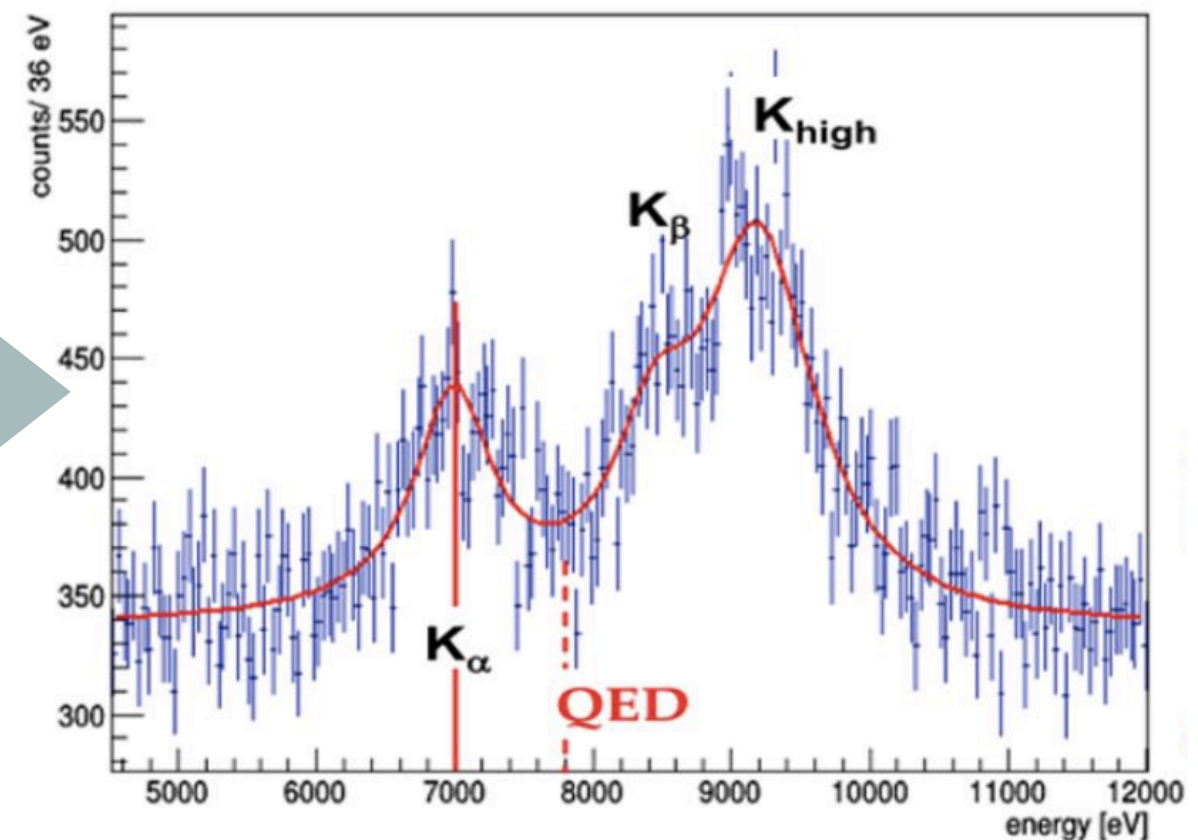
STRANU: Hot topics in strangeness and atomic physics 24-28/05/2021

From SIDDHARTINO to SIDDHARTA-2: SDDs and Luminosity

SIDDHARTINO: K-⁴He with 8 SDDs arrays and 50 pb⁻¹



SIDDHARTA-2: K-D with 48 SDDs arrays and 500 pb⁻¹

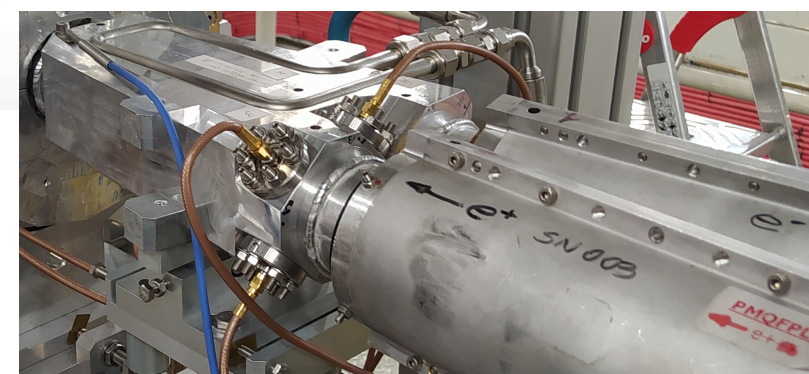
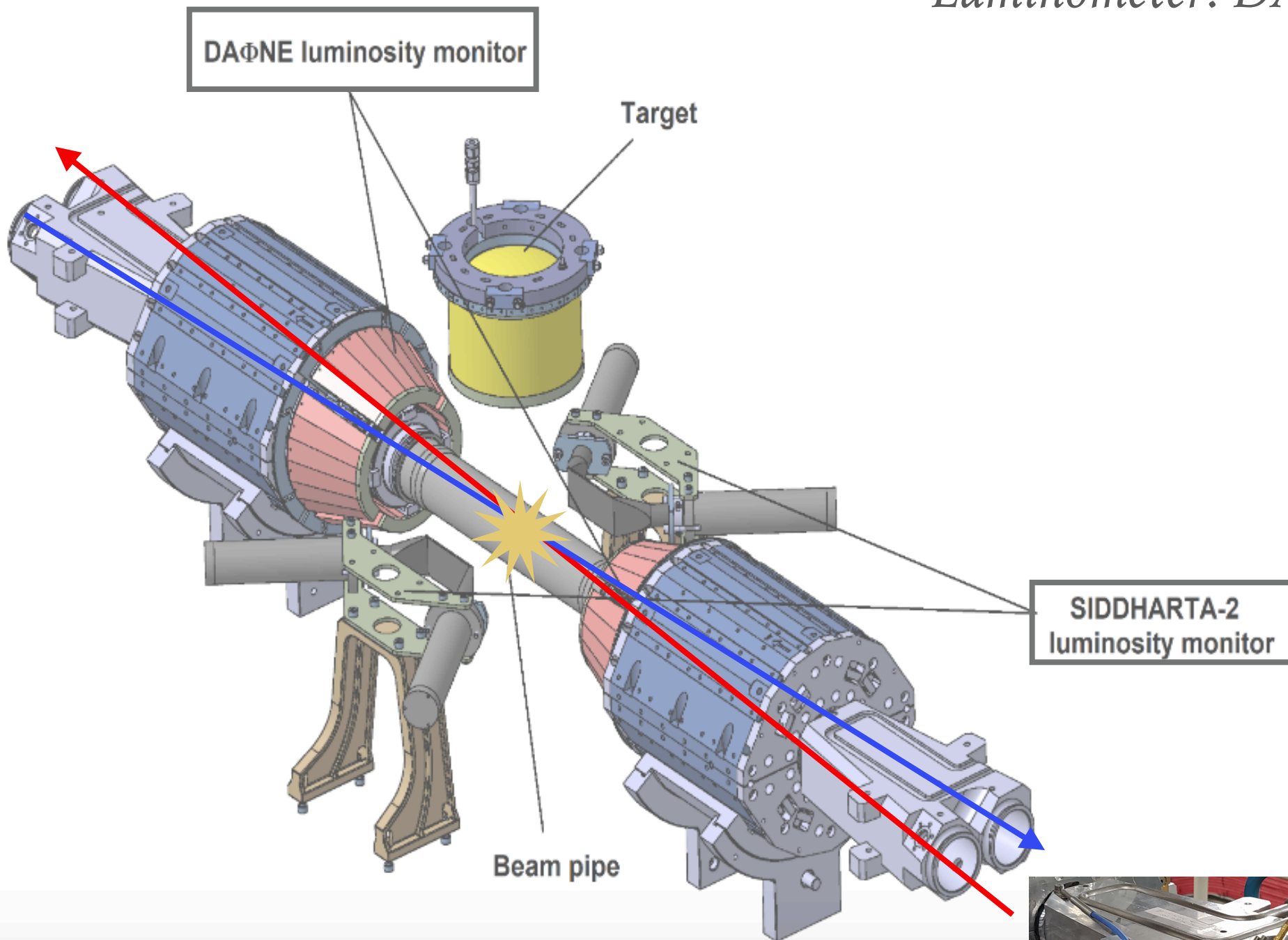


Low yield of Kaonic transitions require high integrated Luminosity

Need of a complementary Luminosity Detector

Skurzok M. et al, Characterization of the SIDDHARTA-2 luminosity monitor, JINST 2020

*Two different processes and two different
Luminometer: DAFNE and SIDDHARTA-2*

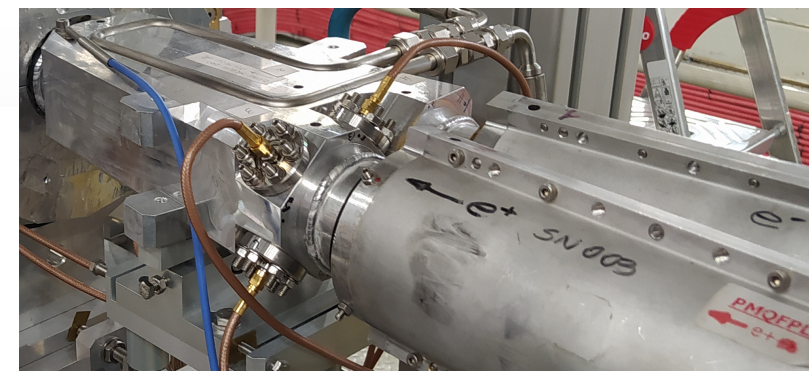
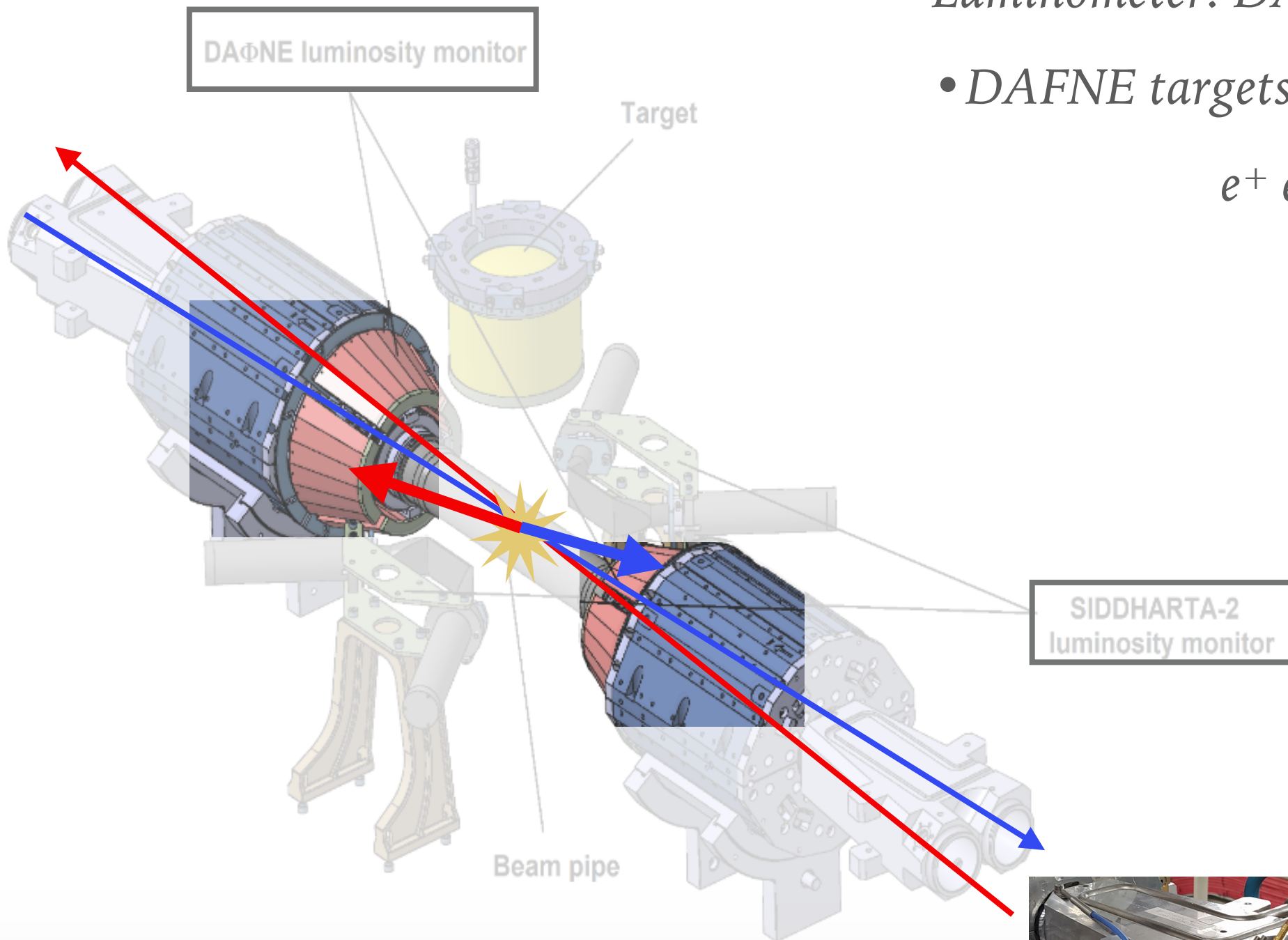


Skurzok M. et al, Characterization of the SIDDHARTA-2 luminosity monitor, JINST 2020

*Two different processes and two different
Luminometer: DAFNE and SIDDHARTA-2*

- *DAFNE targets BAHBAH scattering*

$$e^+ e^- \rightarrow e^+ e^-$$



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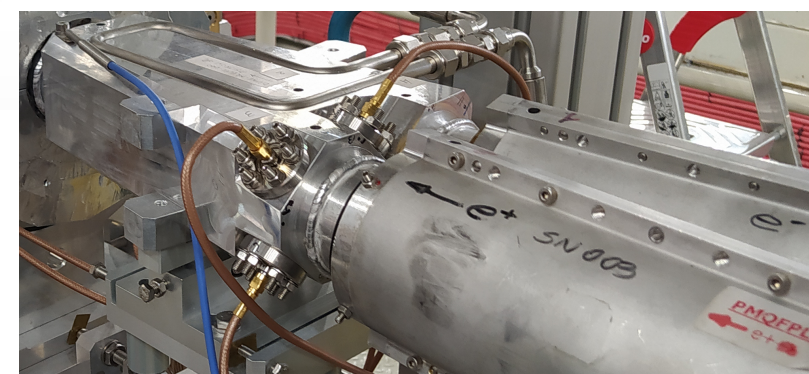
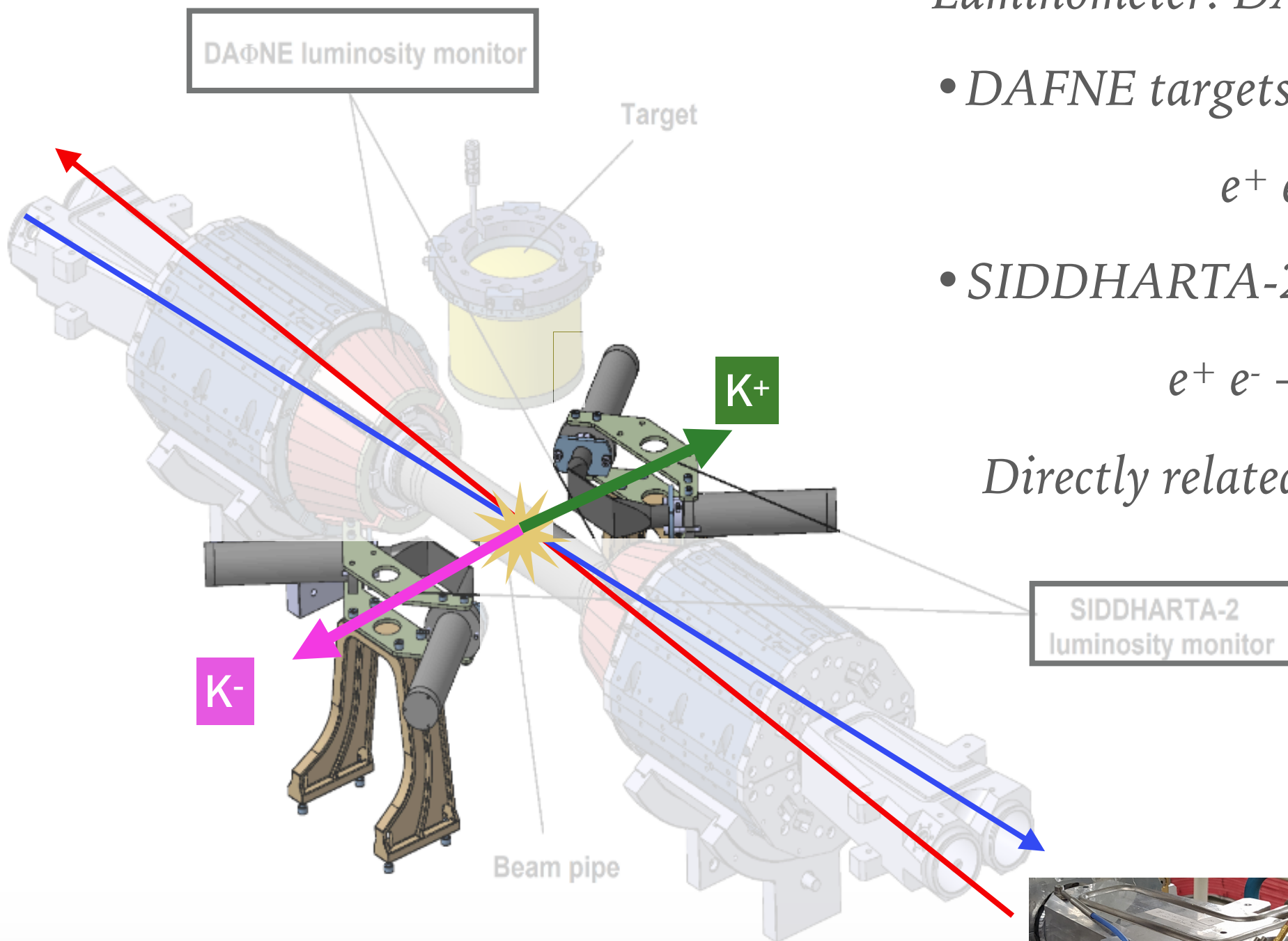
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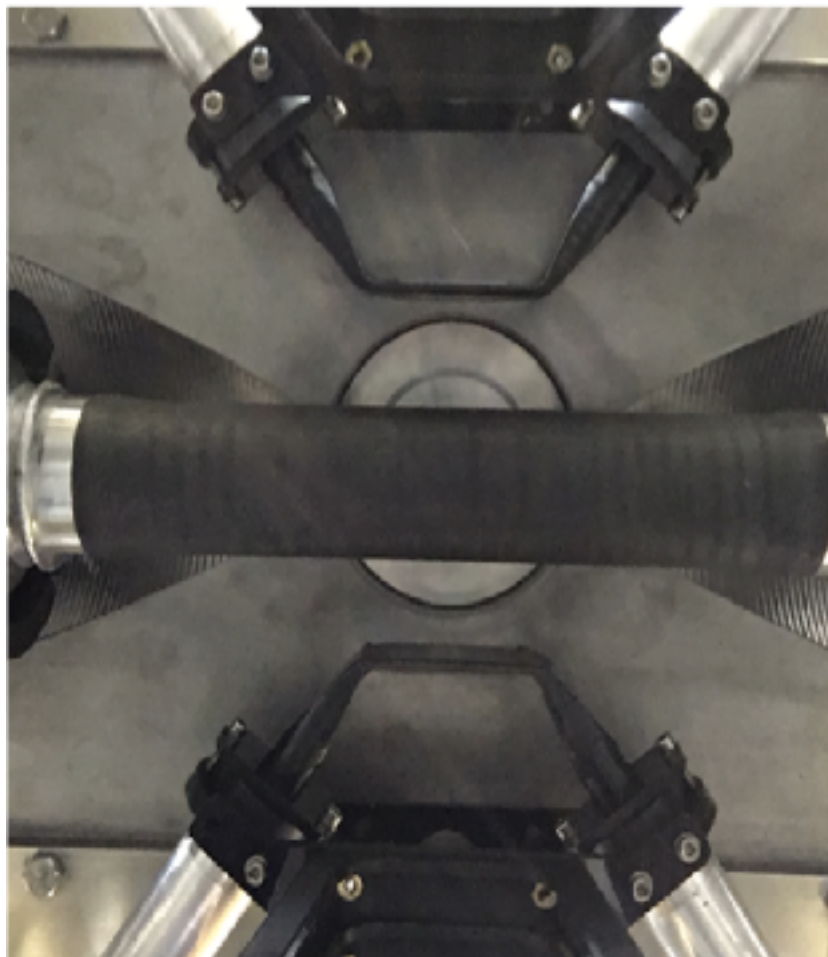
- *SIDDHARTA-2 targets Kaons production*

$$e^+ e^- \rightarrow \phi \rightarrow K^+ K^-$$

Directly related to our measurement!

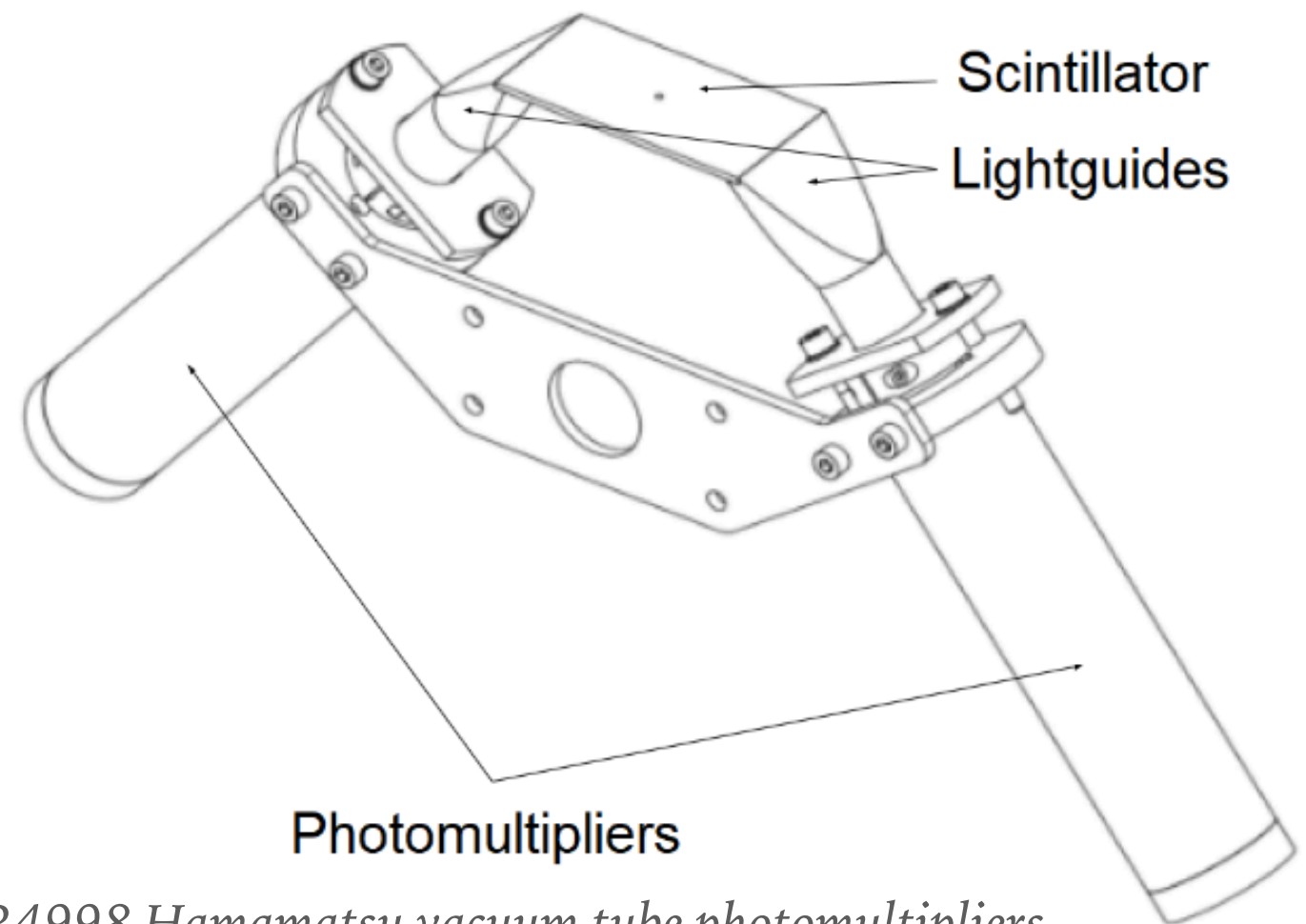


The SIDDHARTA-2 Luminometer has been designed and constructed in collaboration with the Jagiellonian University in Kraków, Poland.



Geometry is constrained by the SIDDHARTA-2 setup

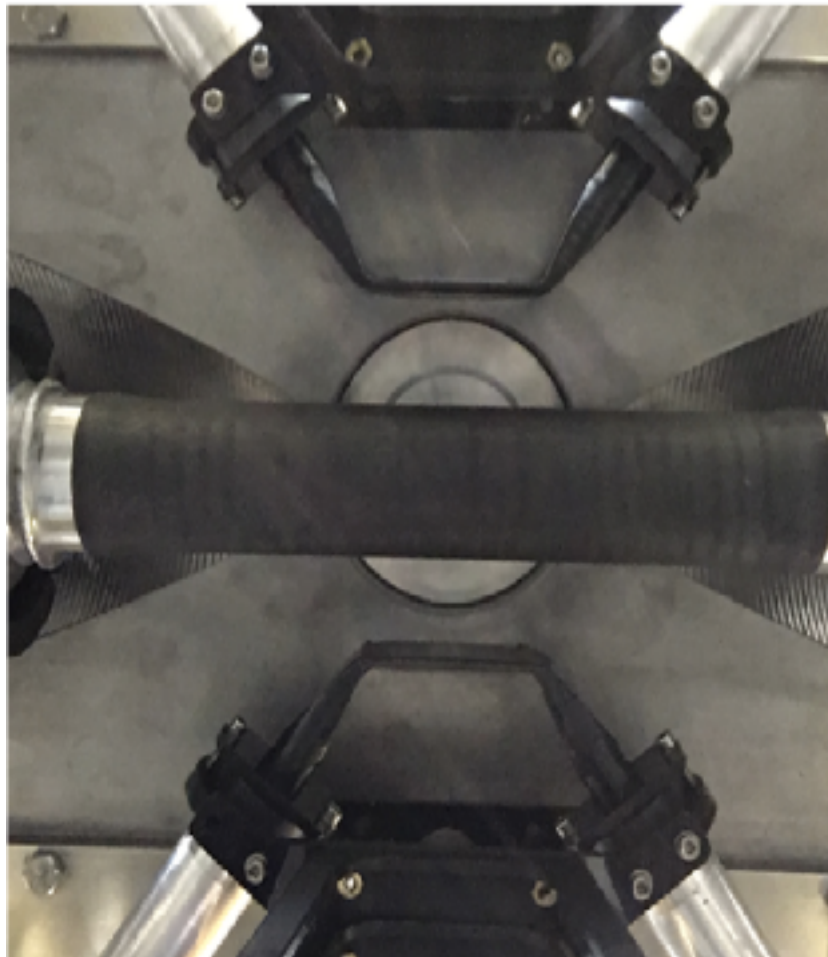
(80×40×2) mm³ Scionix BC-408 organic scintillator



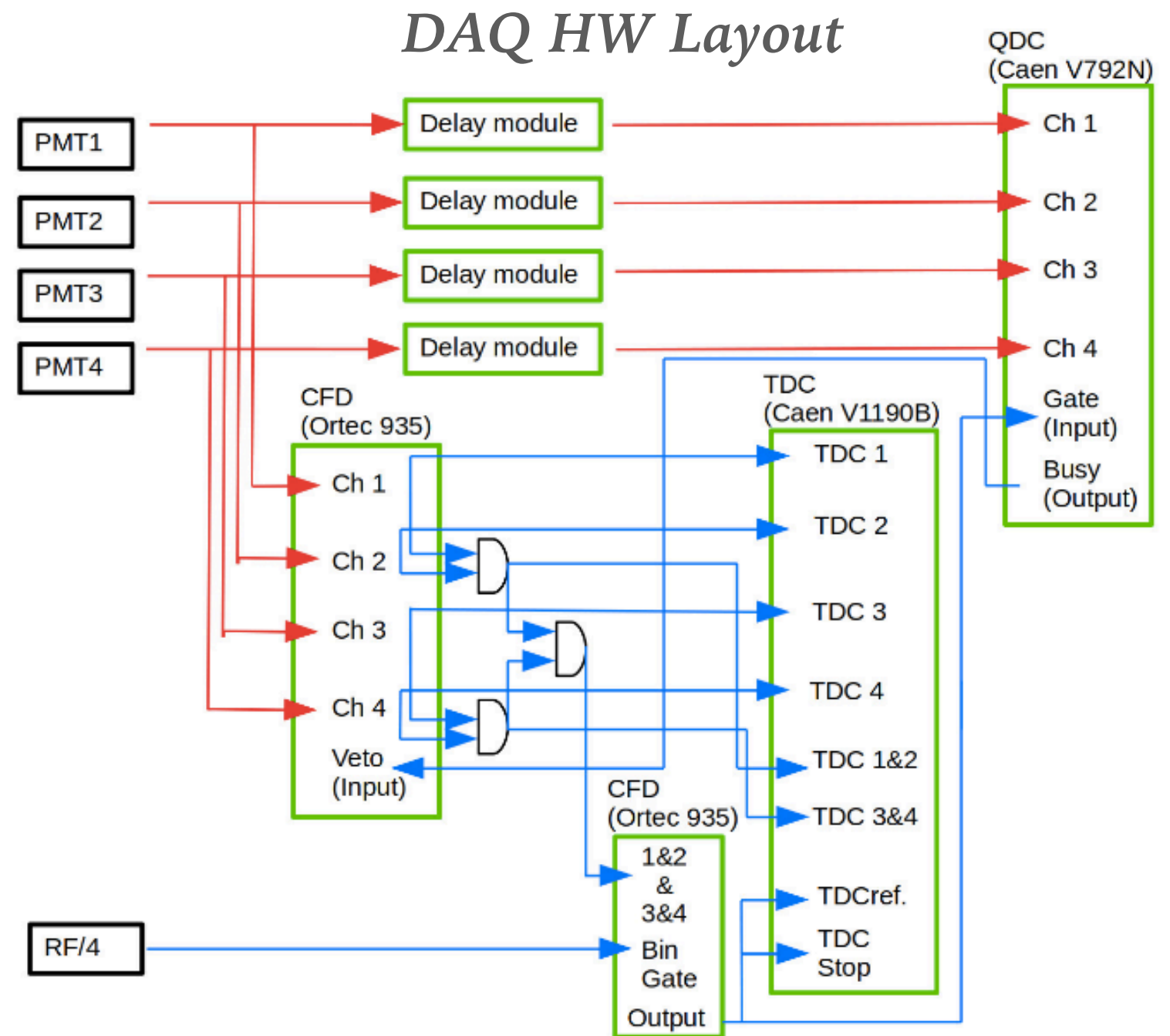
R4998 Hamamatsu vacuum tube photomultipliers

The Luminometer was tested with ⁹⁰Sr source prior to installation showing >95% efficiency for (relatively) low energy beta rays.

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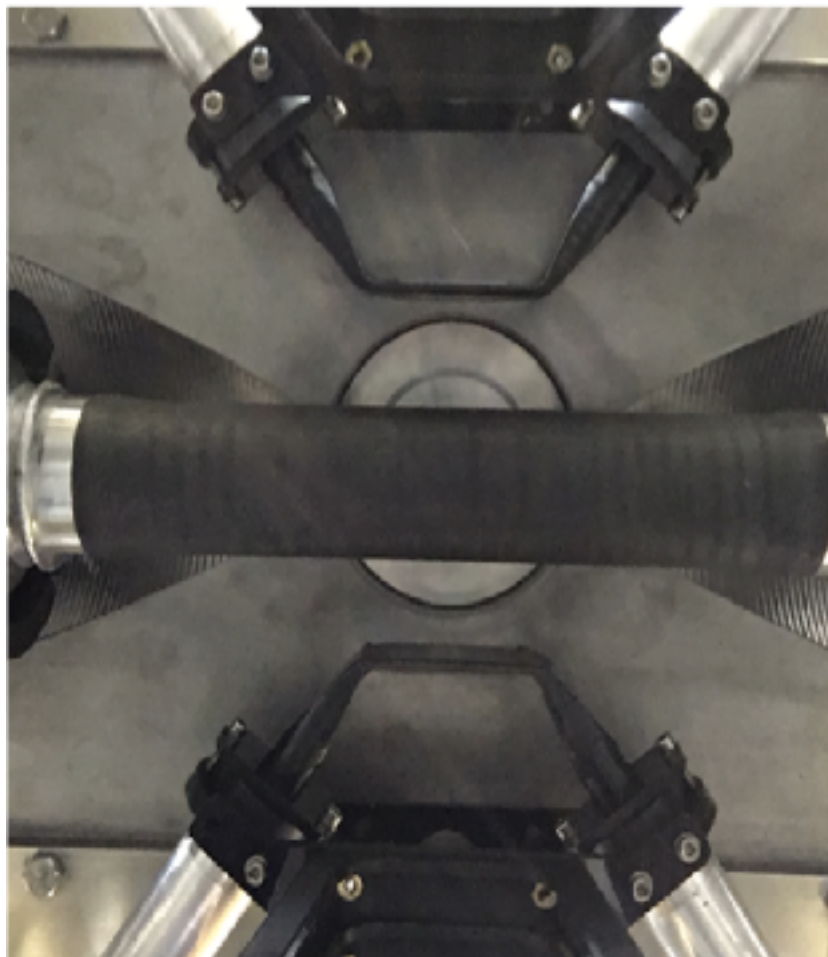


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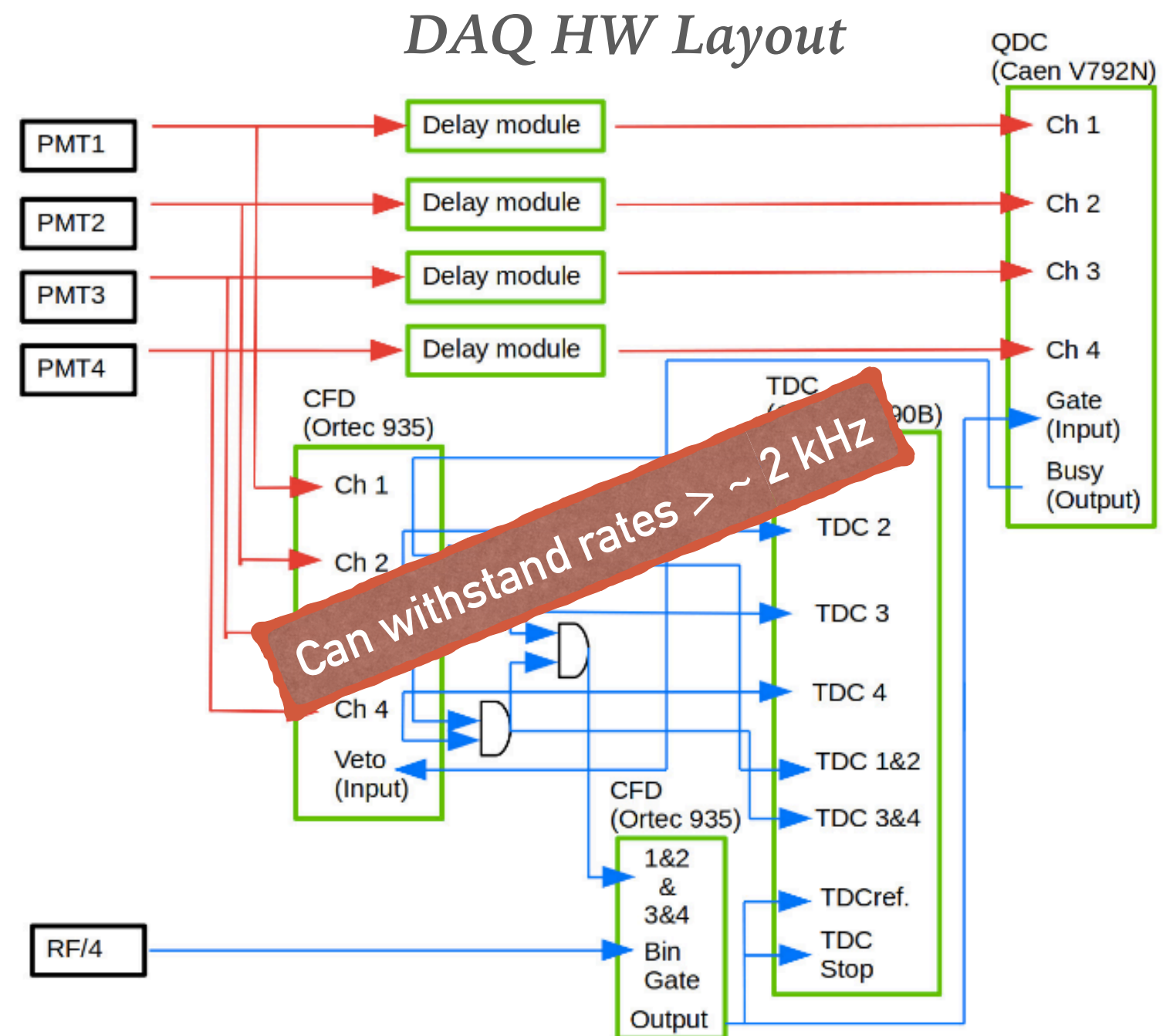


The Luminometer was tested with ^{90}Sr source prior to installation showing $>95\%$ efficiency for (relatively) low energy beta rays.

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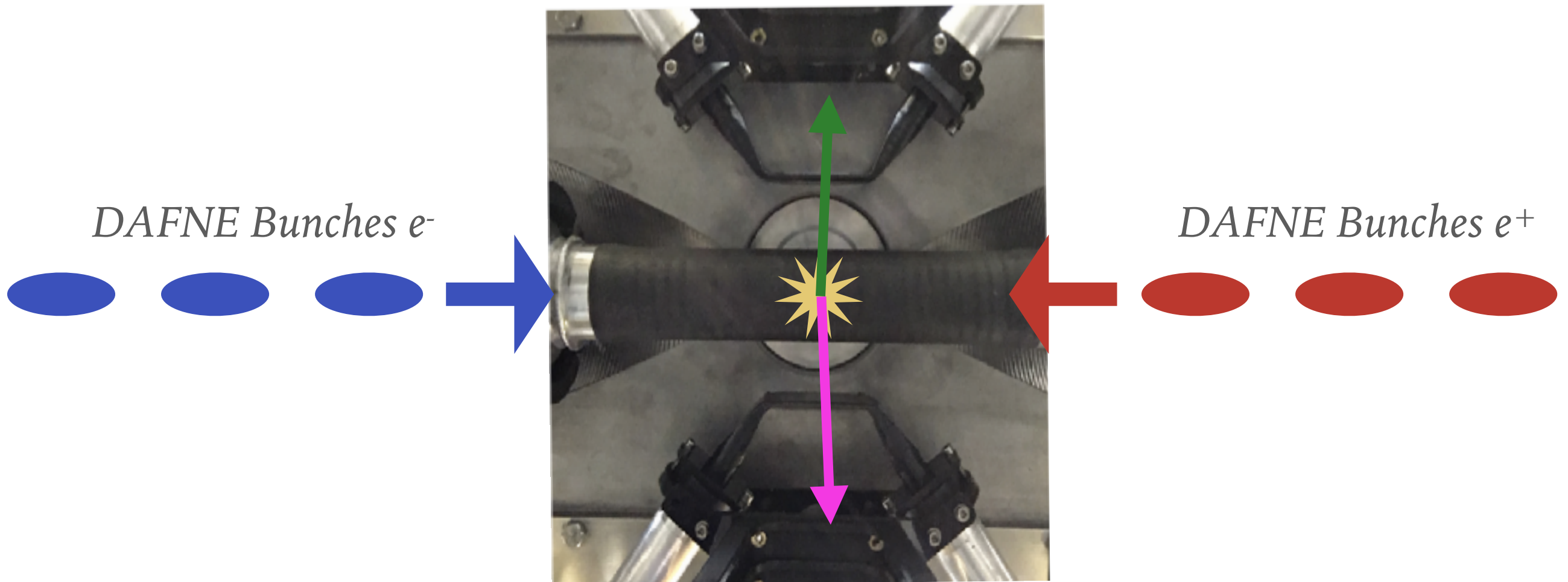


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The Luminometer was tested with ^{90}Sr source prior to installation showing $>95\%$ efficiency for (relatively) low energy beta rays.

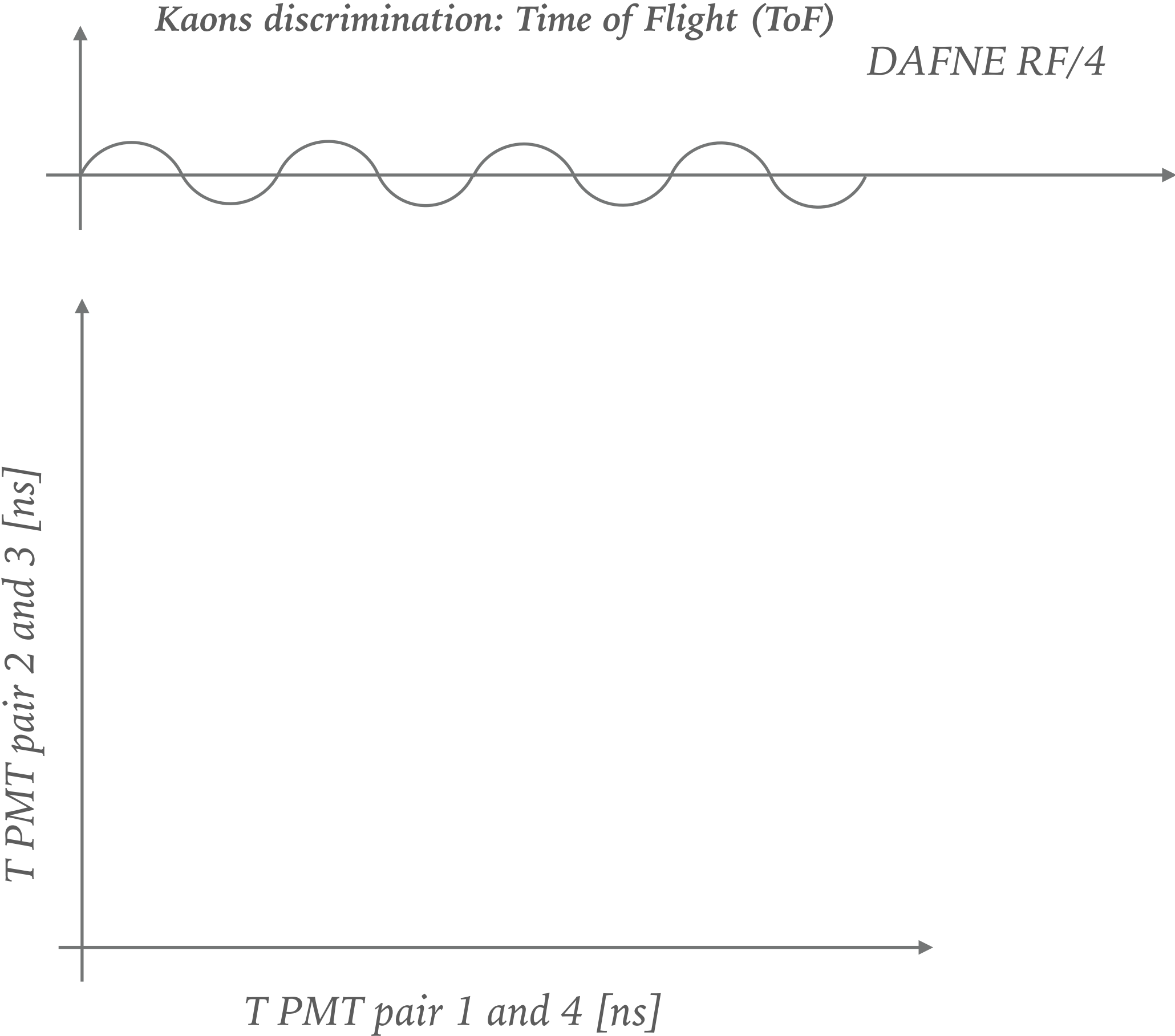
Kaons discrimination: Time of Flight (ToF)

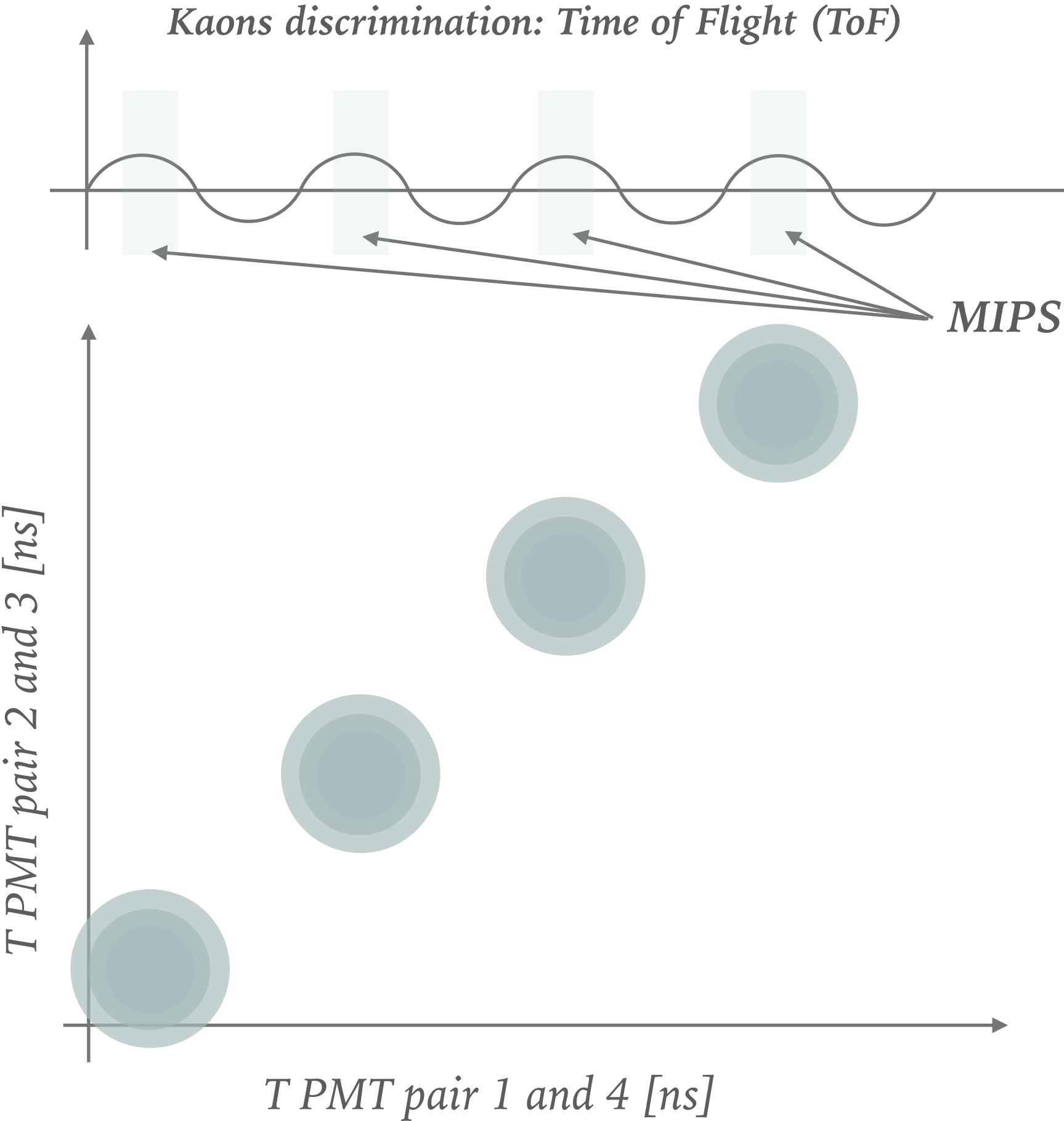


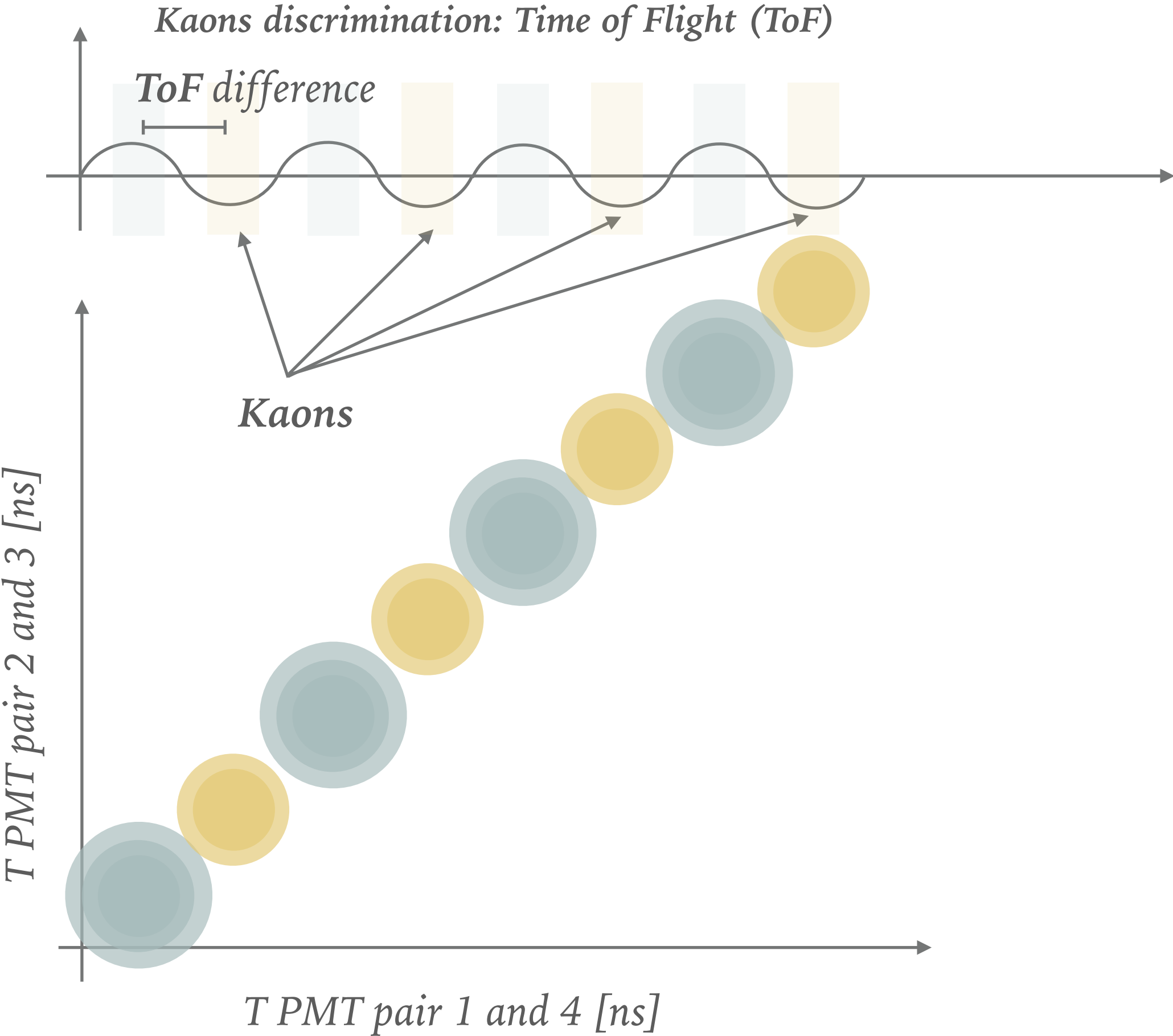
The ToF is different for Kaons, $m(K) \sim 500 \text{ MeV}/c^2$ and light particles originating from beam-beam and beam-environment interaction (MIPs).

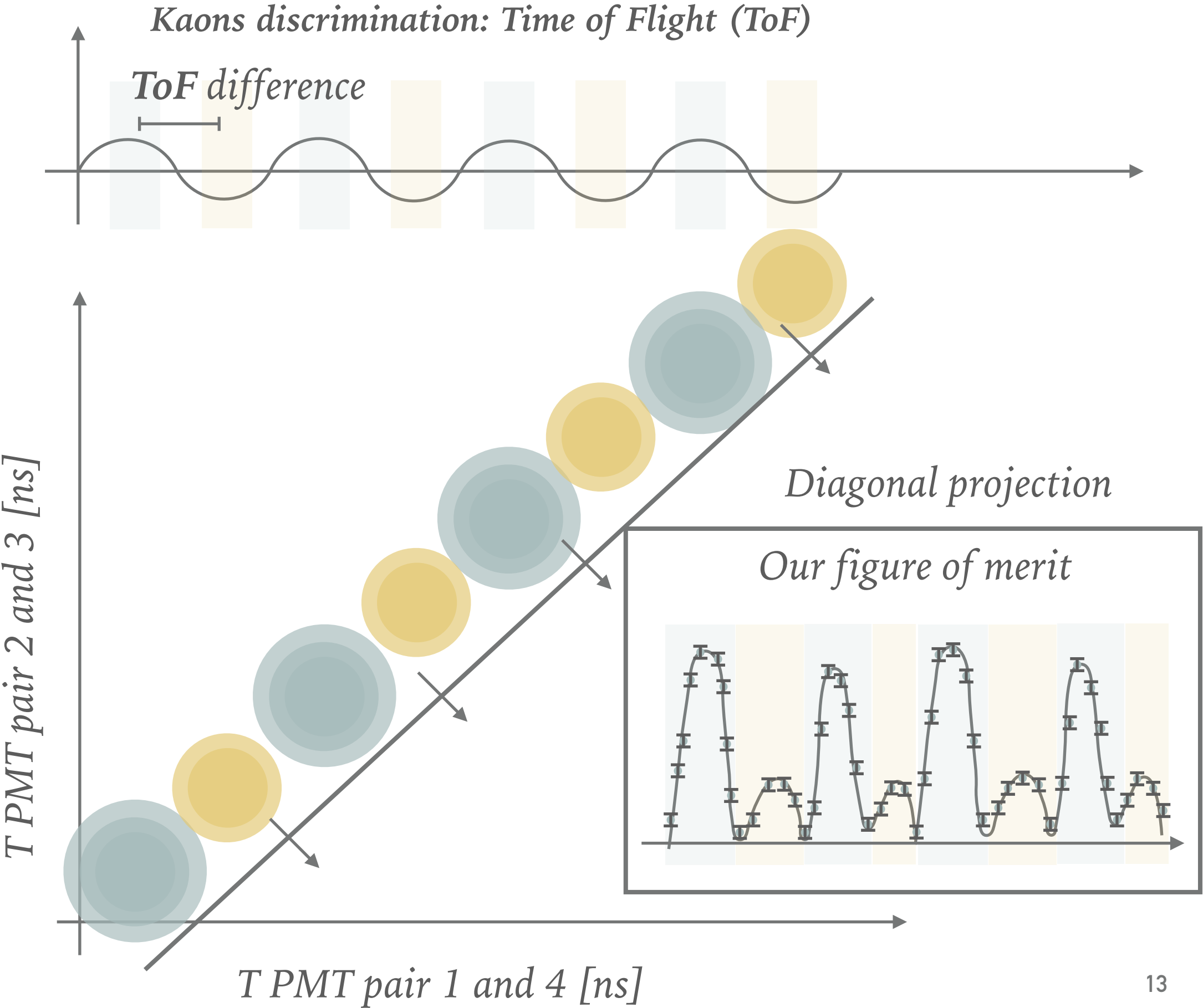
Can efficiently discriminate by ToF Kaons and MIPs!

Use the DAFNE RadioFrequency of 368.7 MHz divided by 4 (RF/4)

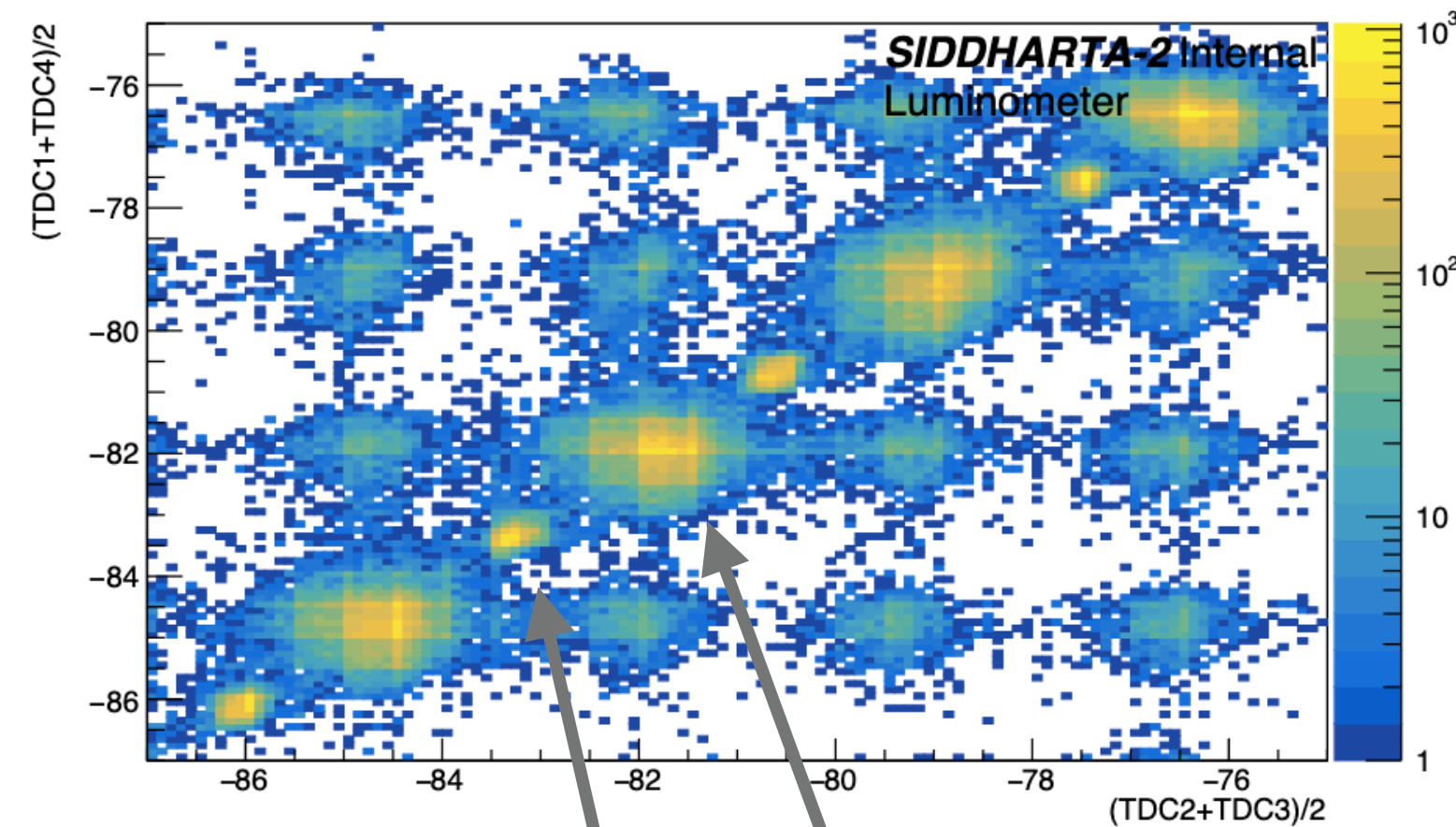








First Look into Luminometer Data

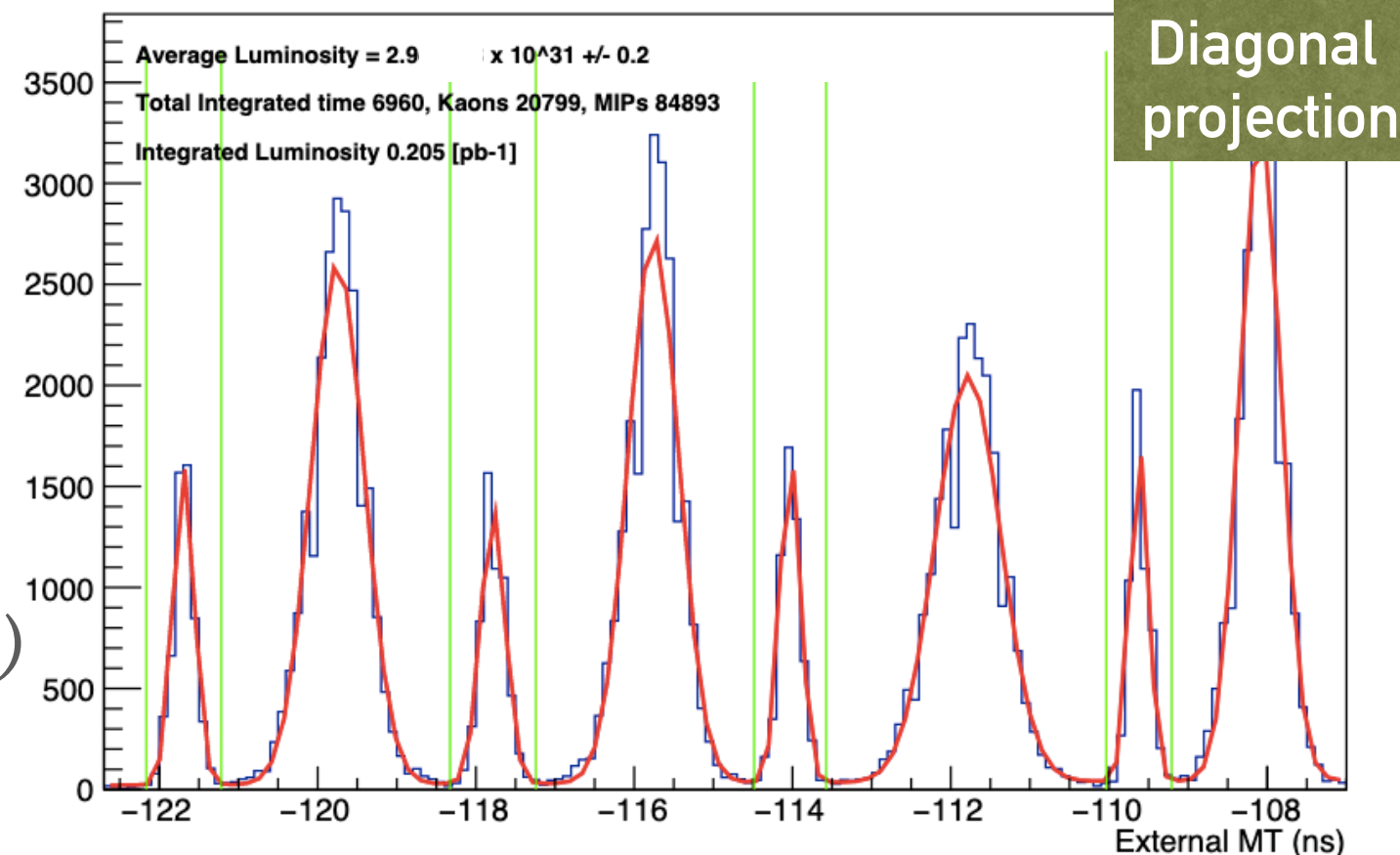


Run from 25/05/2021

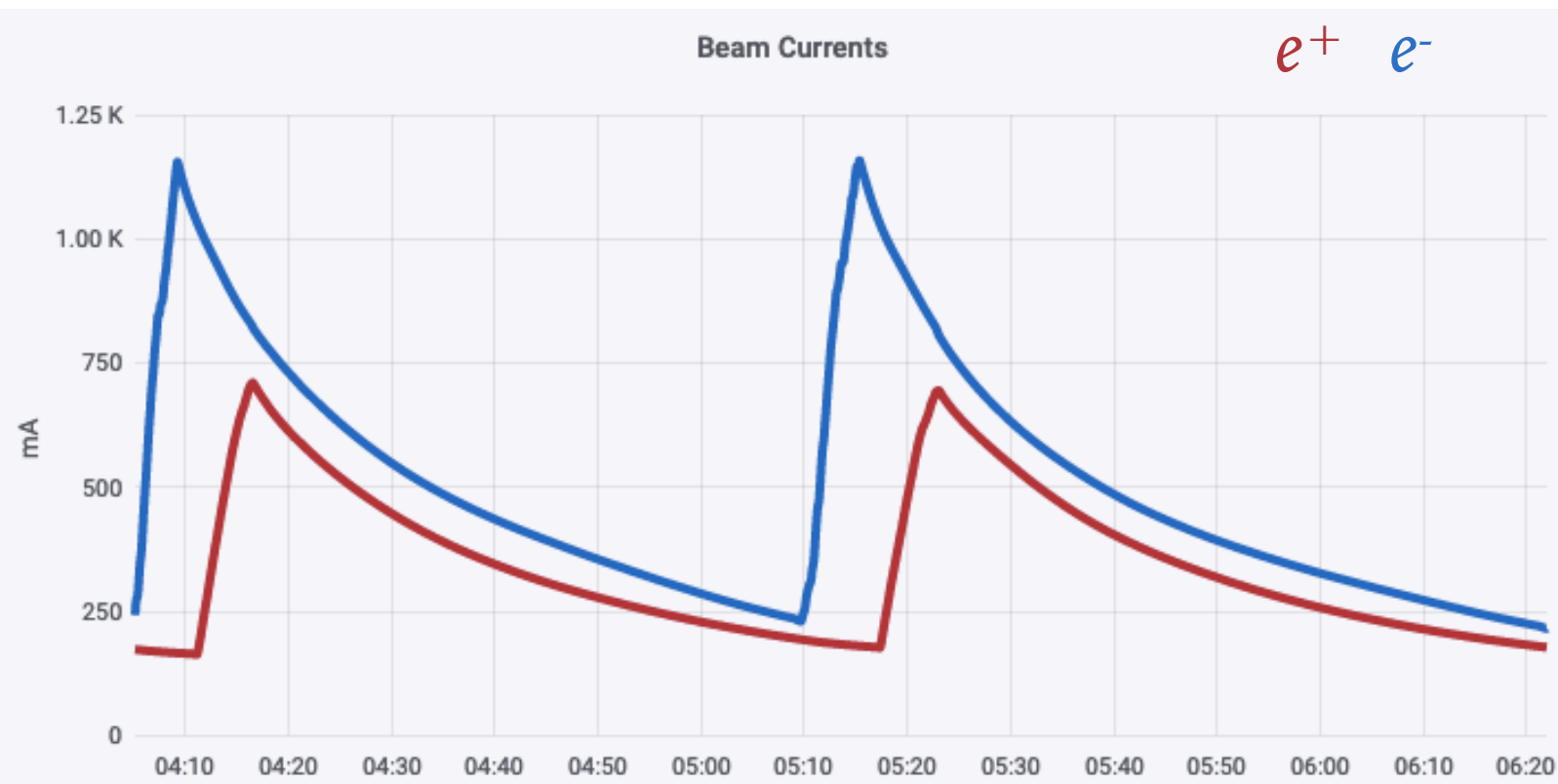
Get the luminosity counting kaons:

$$L = \frac{N_K}{t_{DAQ} \cdot \sigma_{e^+e^- \rightarrow \phi} \cdot BR_{\phi \rightarrow K^+K^-}}$$

N_K can be extracted with fit (offline)
or with cuts (online)



First Look into Luminometer Data

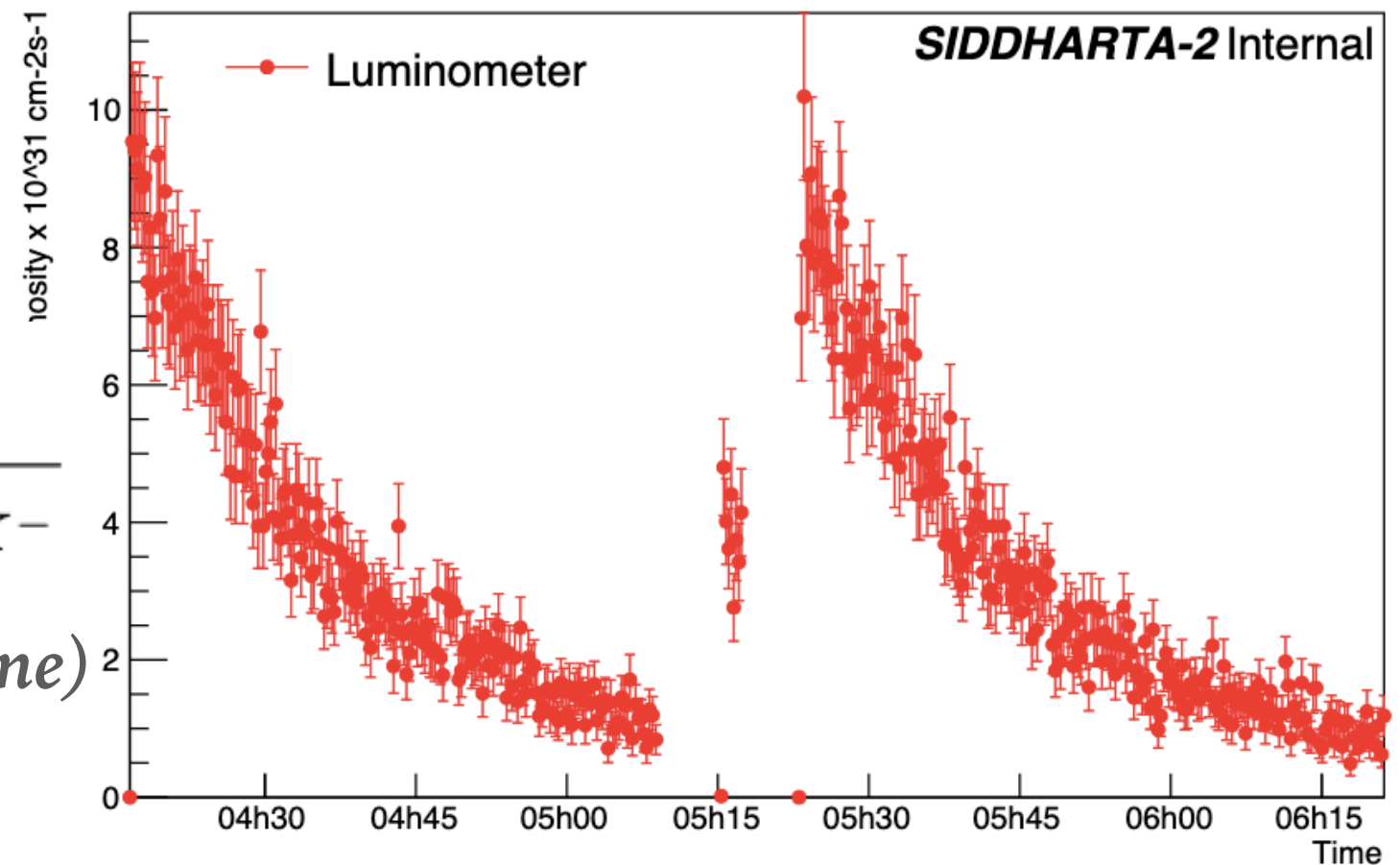


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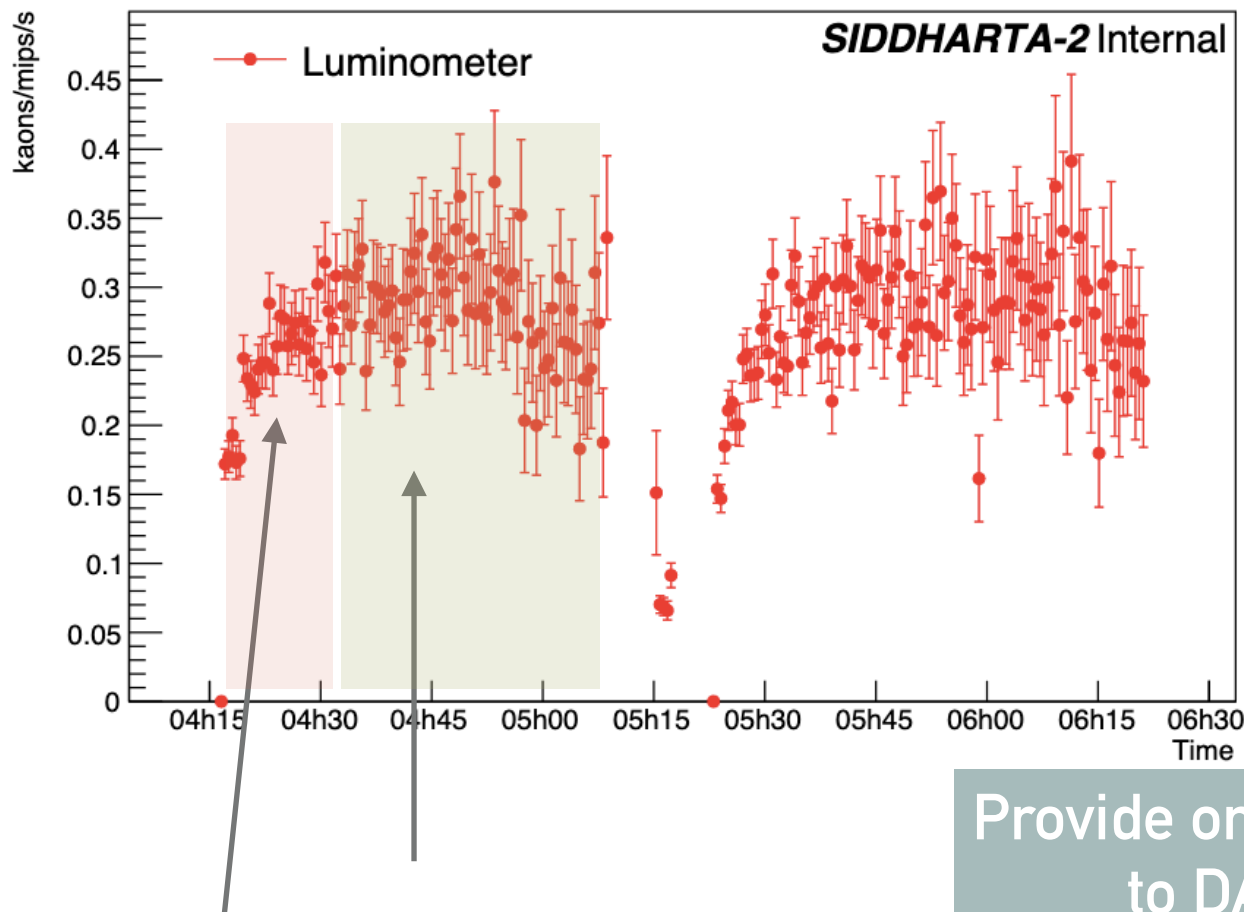
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Luminometer as beam quality detector

SIDDHARTA-2 Luminometer can provide real time information to DAFNE collider.

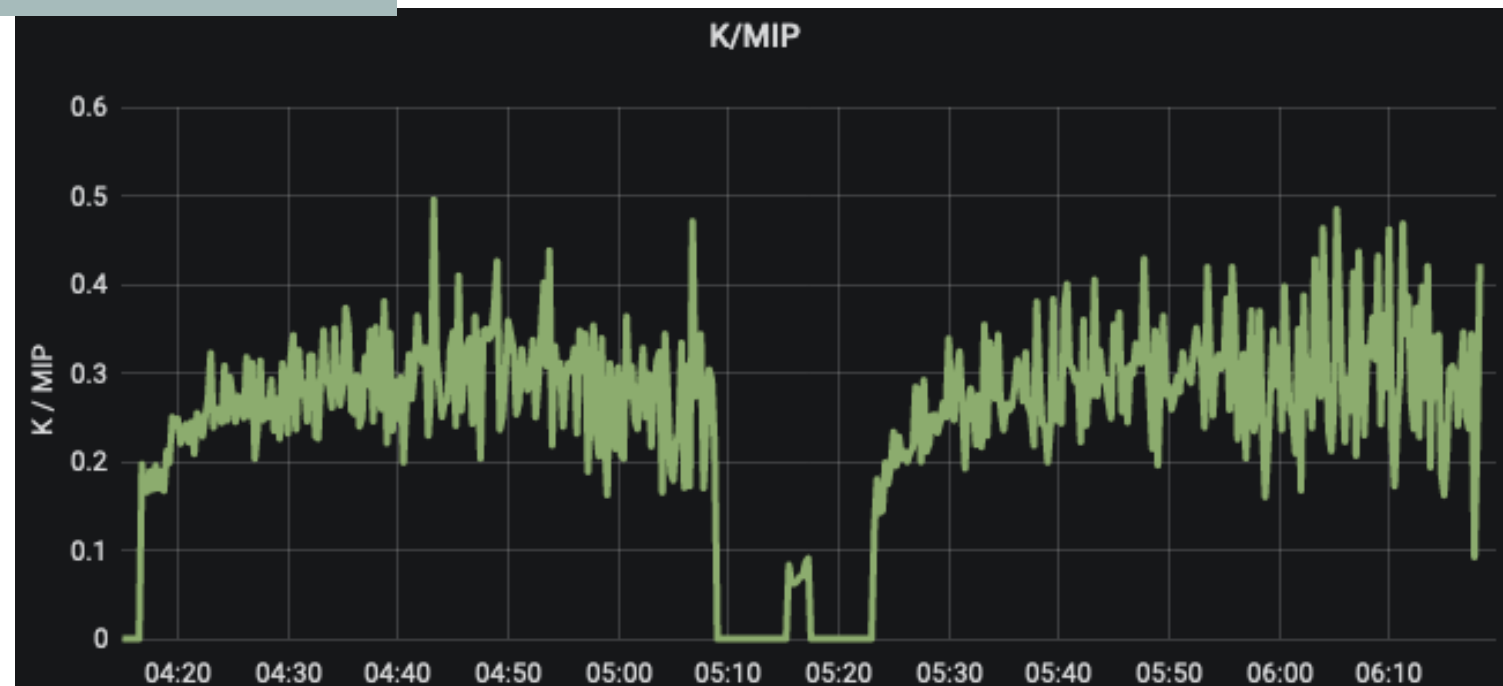
K/MIP is an useful quantity as it relates with the background seen by the SDDs



Provide online K/MIP to DAFNE

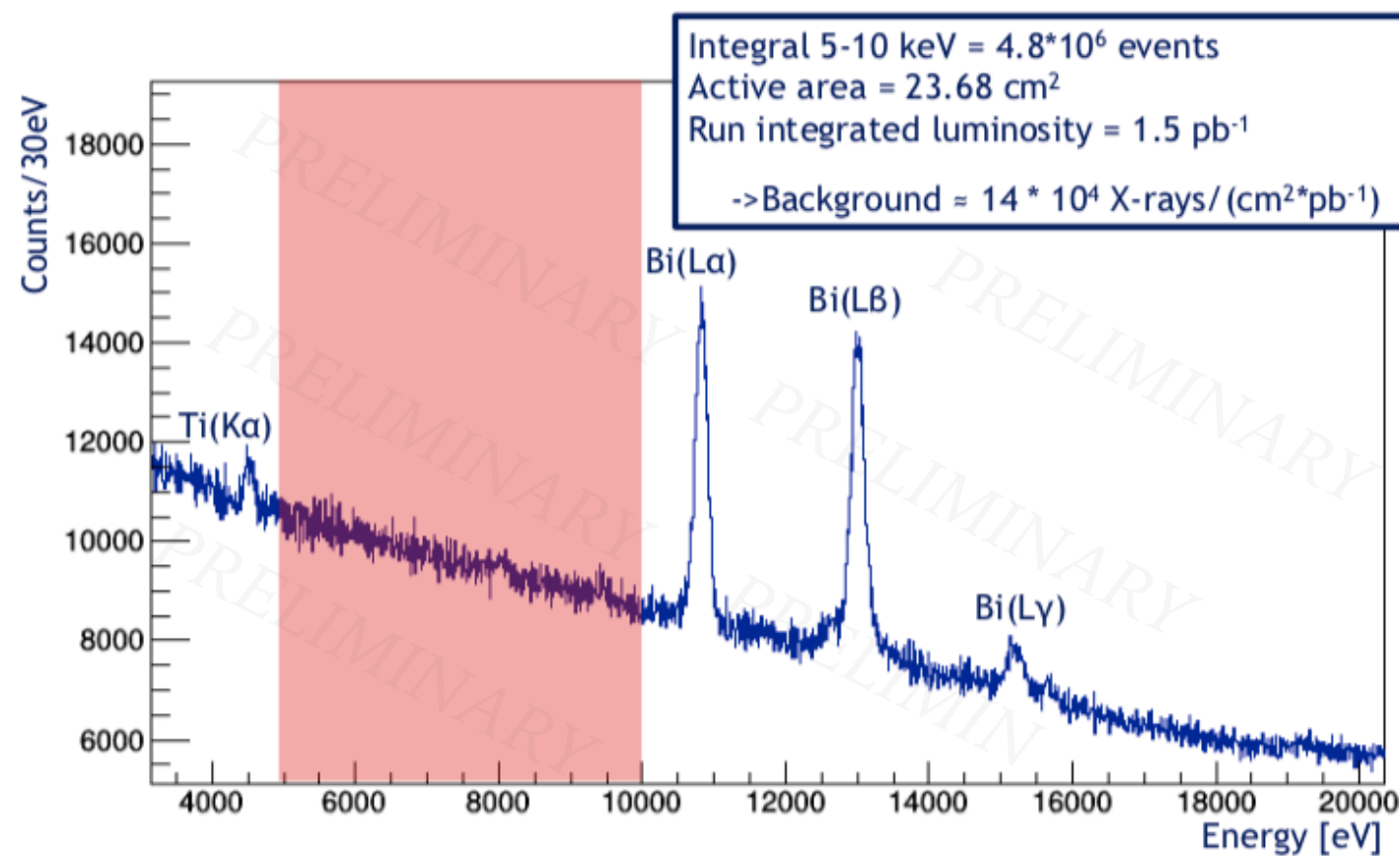
Star of fill - higher background

End of collision - moderate bkg

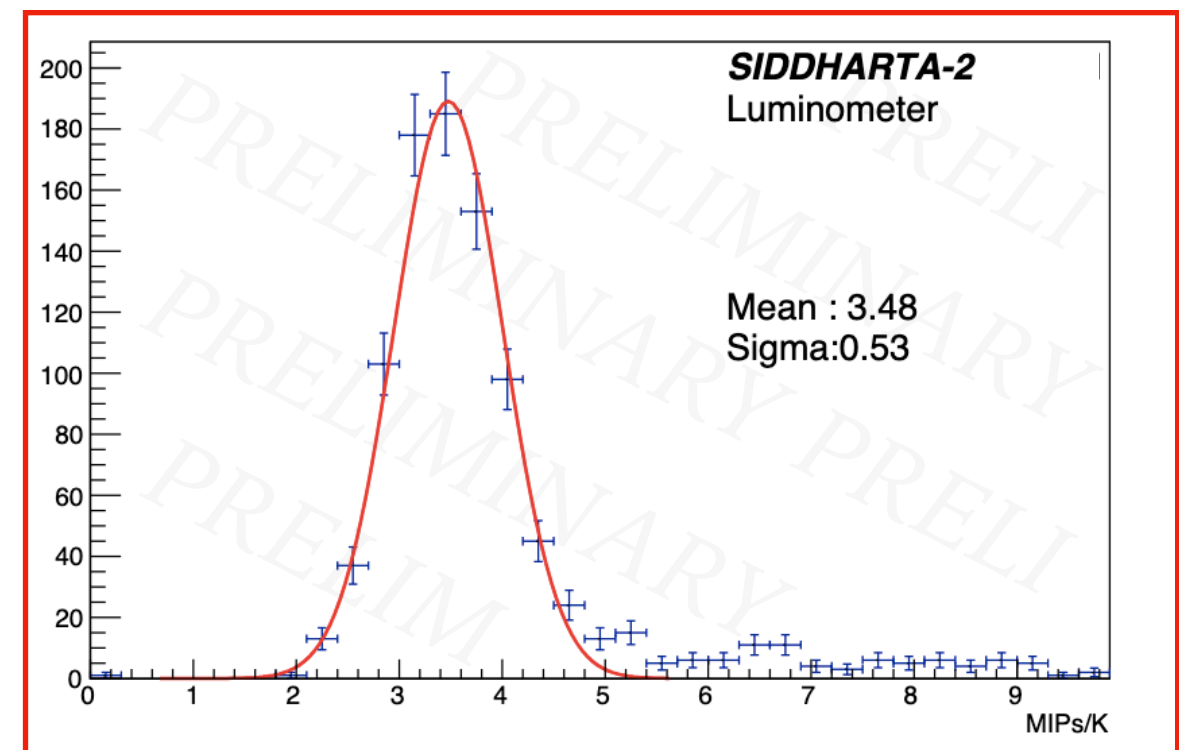


Luminometer as beam quality detector

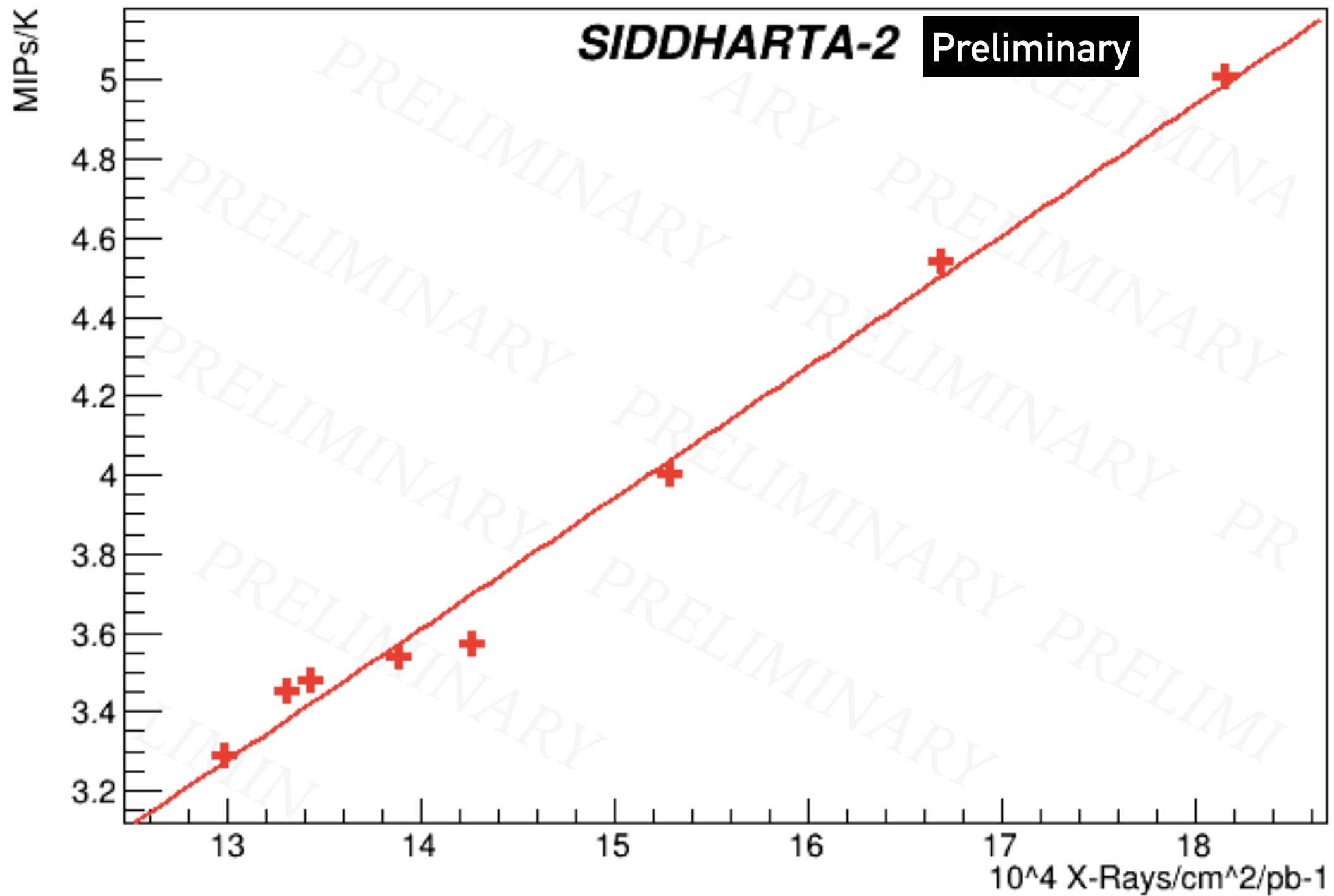
SIDDHARTINO run



Luminometer MIP/K



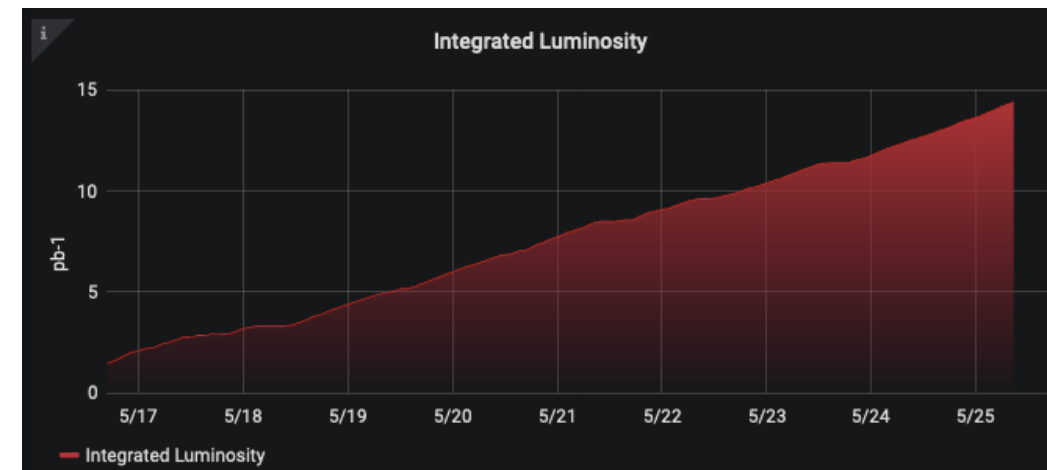
Does the SDDs background correlate with the Luminometer background?

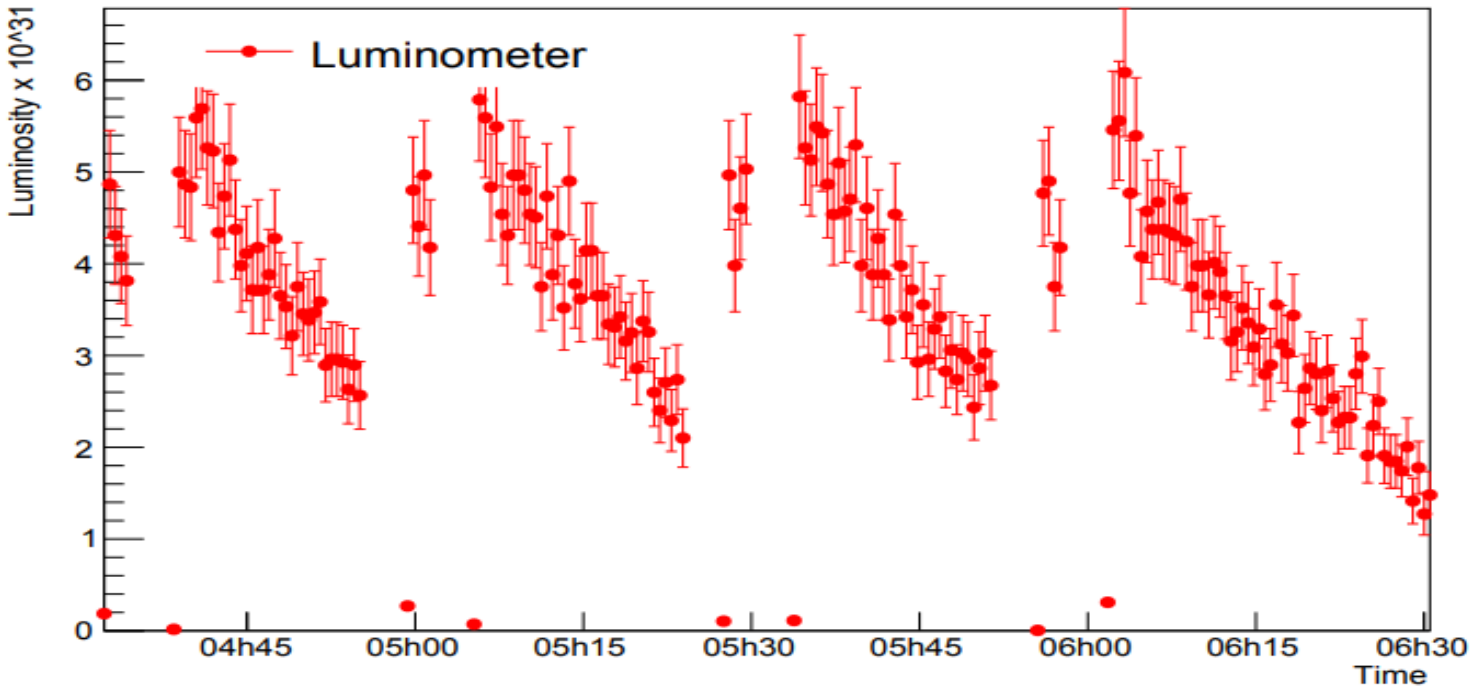
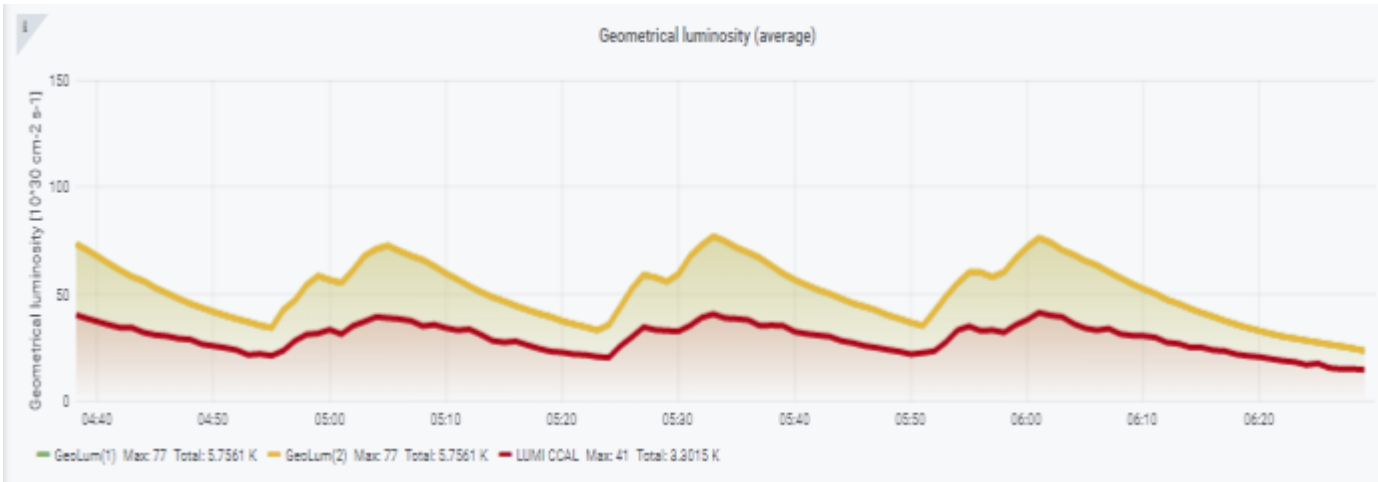
Luminometer as beam quality detector

Luminometer demonstrated tool to control beam background at DAFNE

CONCLUSIONS

- Luminosity monitoring key ingredient for SIDDHARTA-2 Physics programme:
 - Luminosity evaluation - complementary with DAFNE Luminometer
 - Background control and real-time feedback to collider
- SIDDHARTA-2 Luminometer is on-line and operational since start of DAFNE operations
- BIG THANKS to DAFNE staff for allowing SIDDHARTA-2 evaluating the experimental conditions! → Looking forward to higher luminosities!





Luminosity
23 April 2021

SIDDHARTA-2
vs.
DAFNE