MIMAC and SEDINE(News-G)at LSM

Directional Dark Matter Detection with MIMAC and non-directional with SEDINE(News-G)

Daniel Santos, Olivier Guillaudin and Ali Dastgeibi-Fard

LPSC-Grenoble

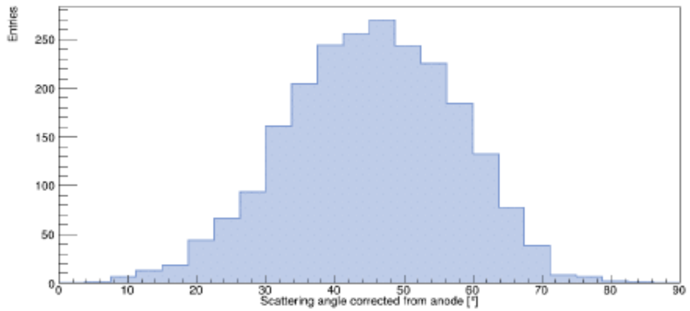
Bi-chamber-512 module

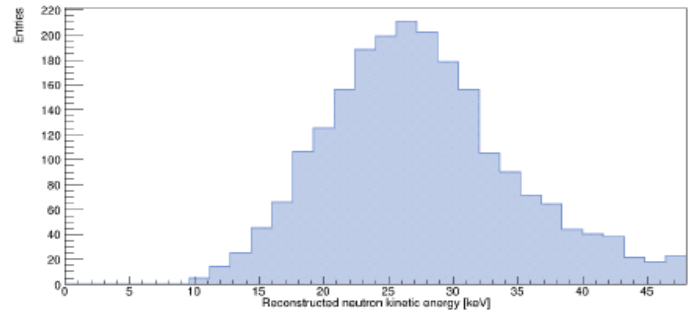
(with the Cathode Signal and the new low background 10 cm detectors)

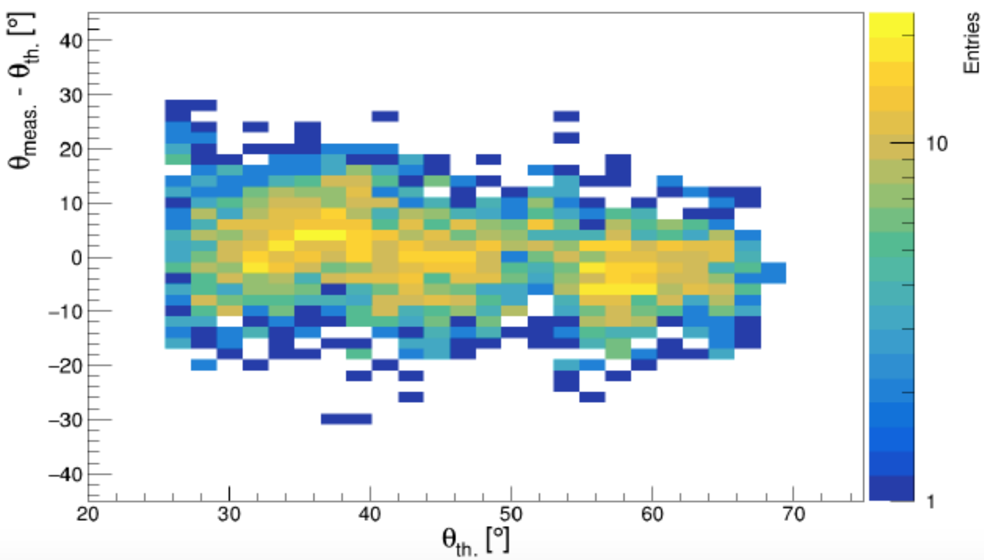
-working at 30 mbar (C_4H_{10}+50% CHF_3)
-Permanent circulating mode
-Remote controlled and commanded
- A calibration control per week

Proton recoil Angular Distribution produced by 27 keV neutrons in C_4H_{10} + 50% CHF_3 (30 mbar)

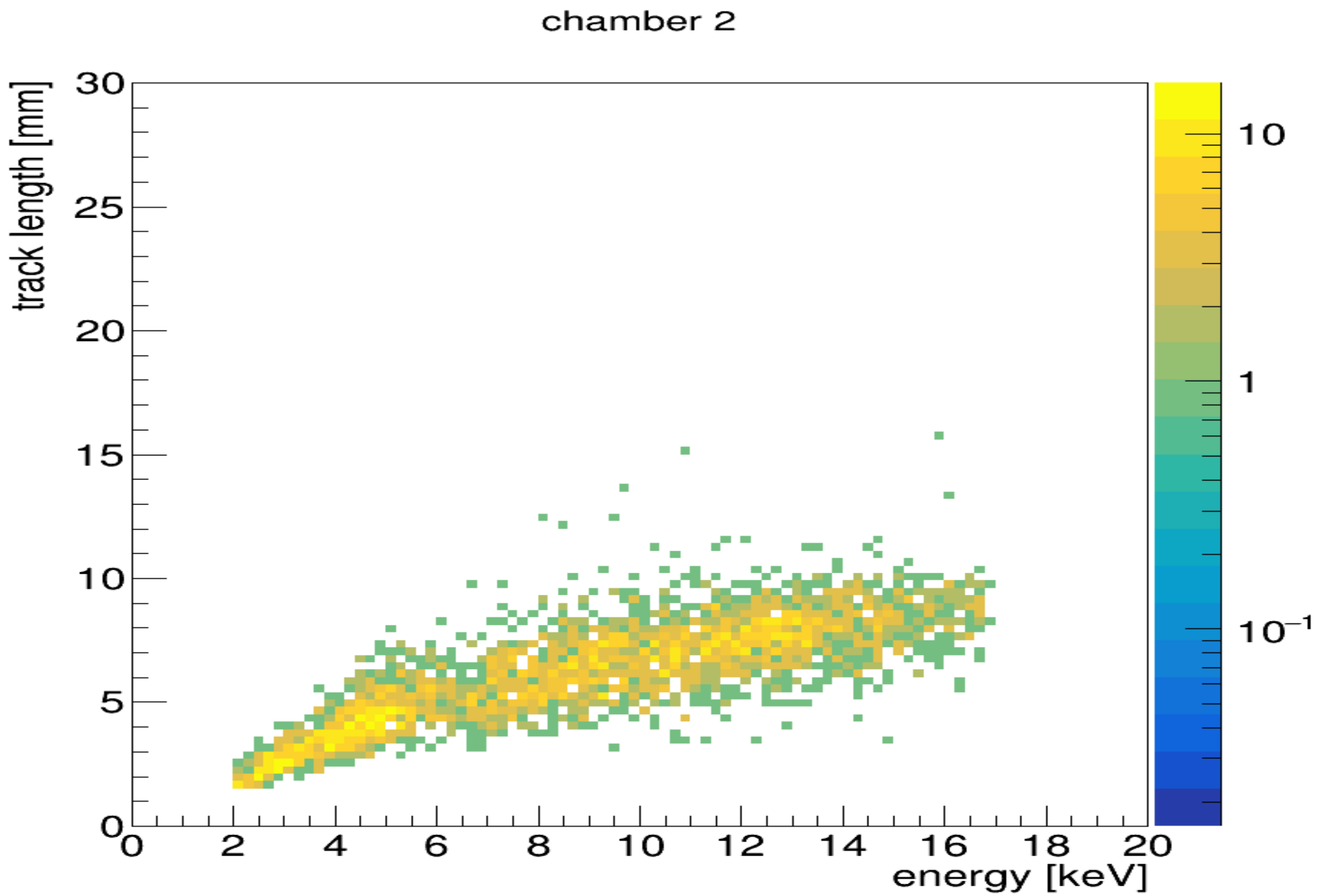
Cyprien Beaufort et al, https://arxiv.org/abs/2112.12469



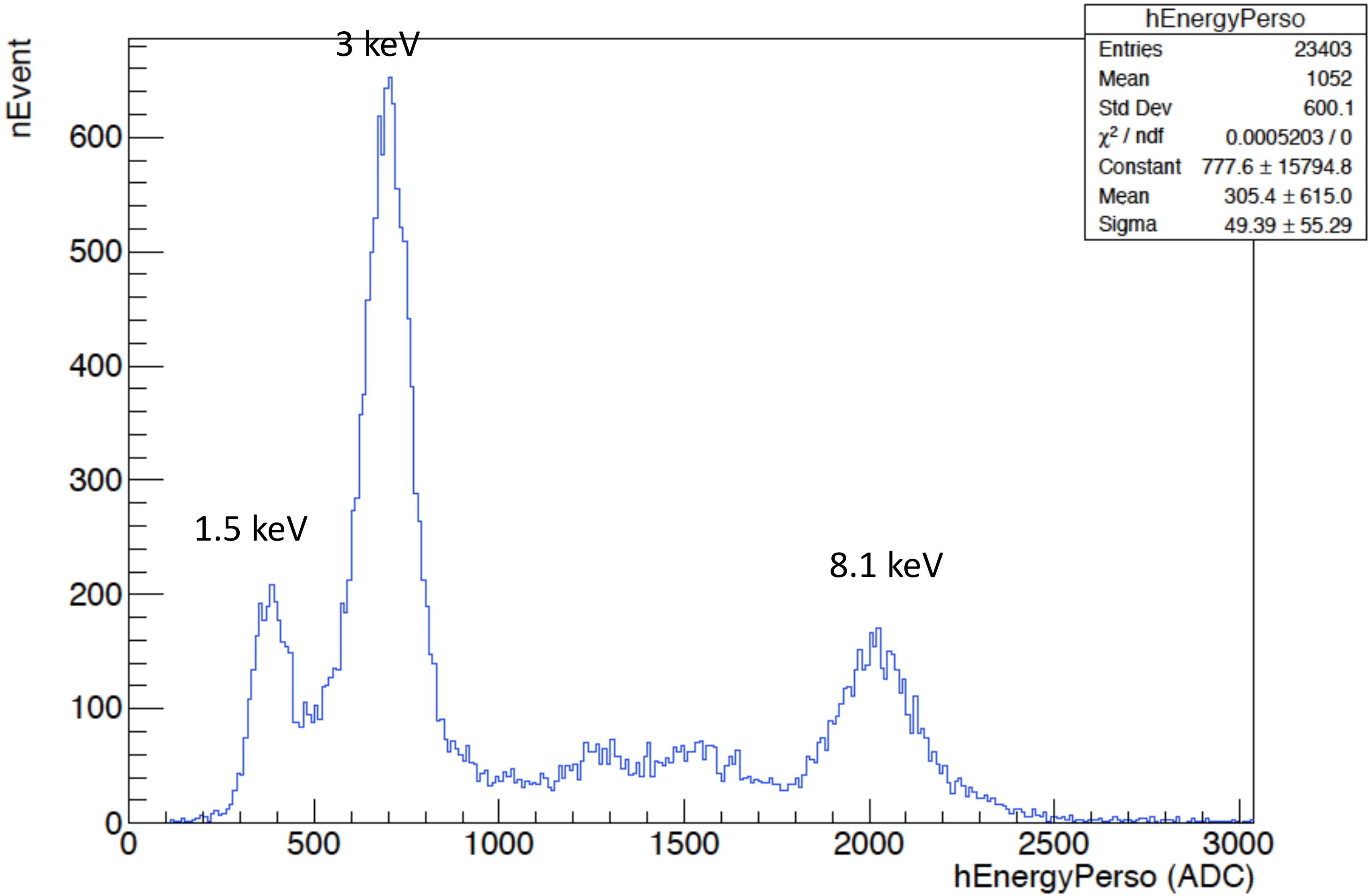




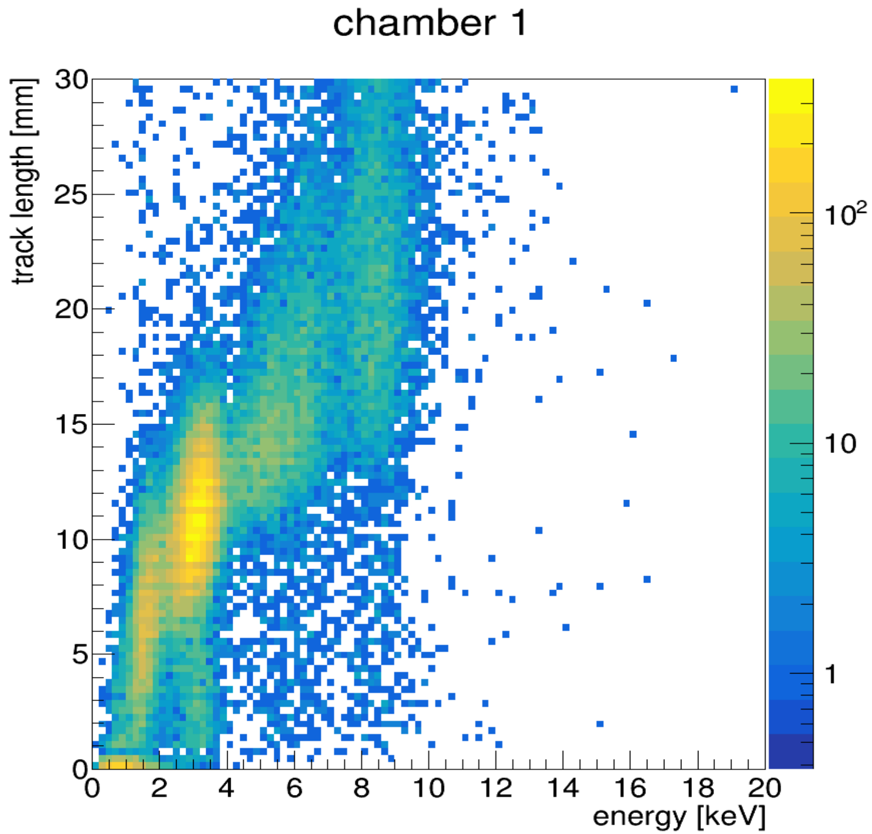
Proton recoil track lengths produced by a mono-energetic neutron field of 27 keV as a function of their ionization energy

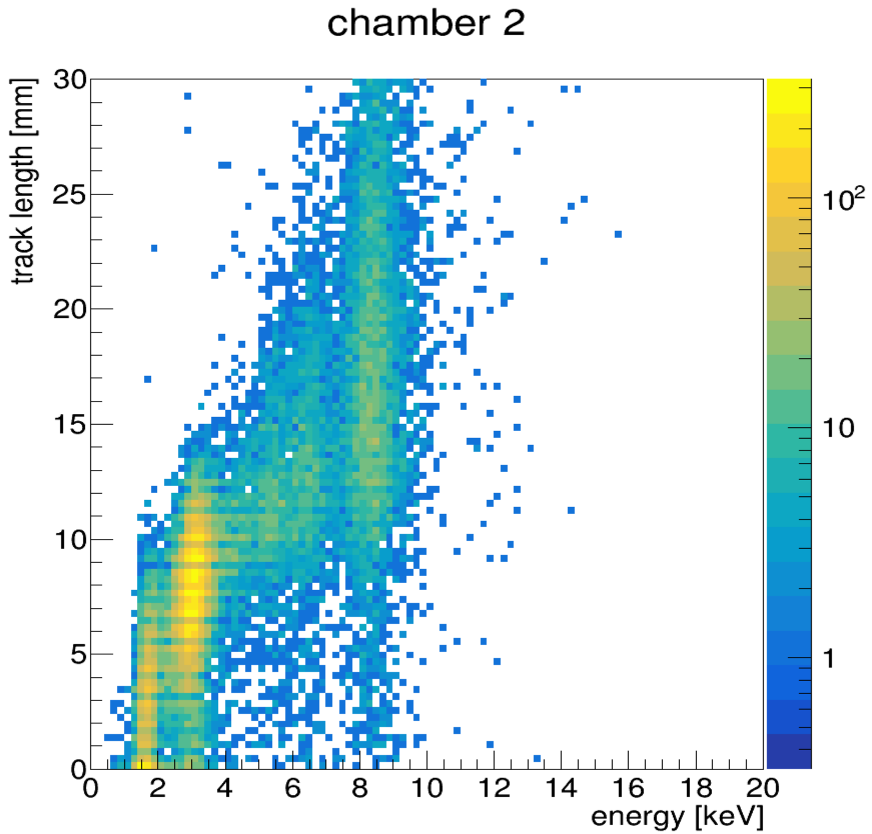


X-ray Calibration of the new detector Bi-chamber Module at 500 V, 3000V drift

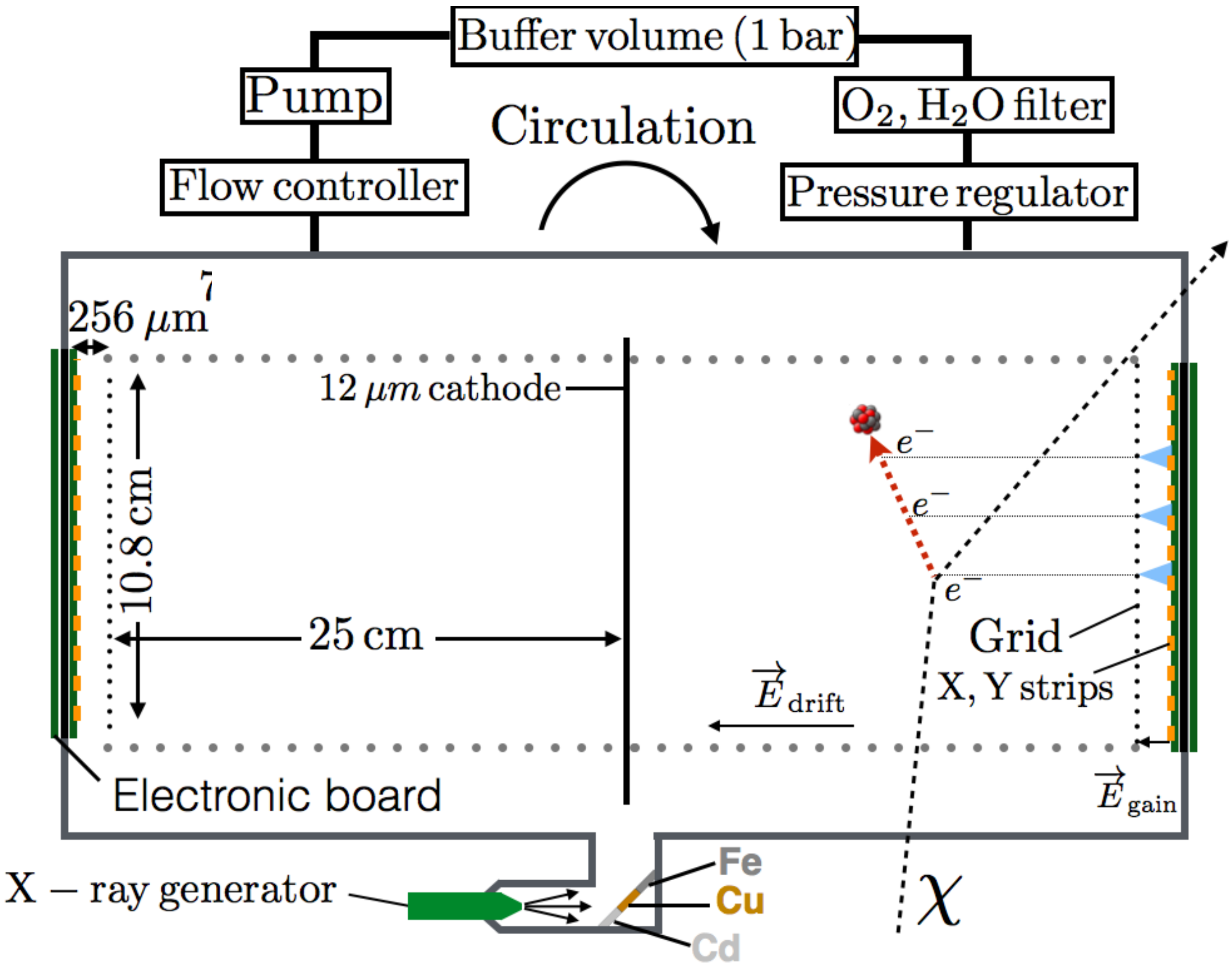


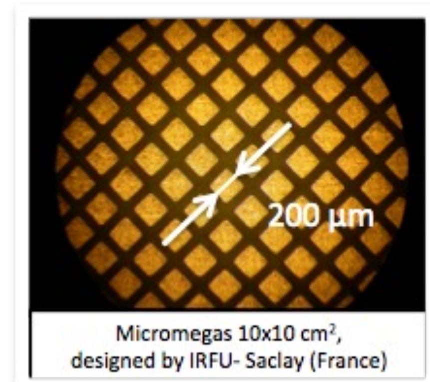
Electron track lengths produced by X-rays as a function of their energy





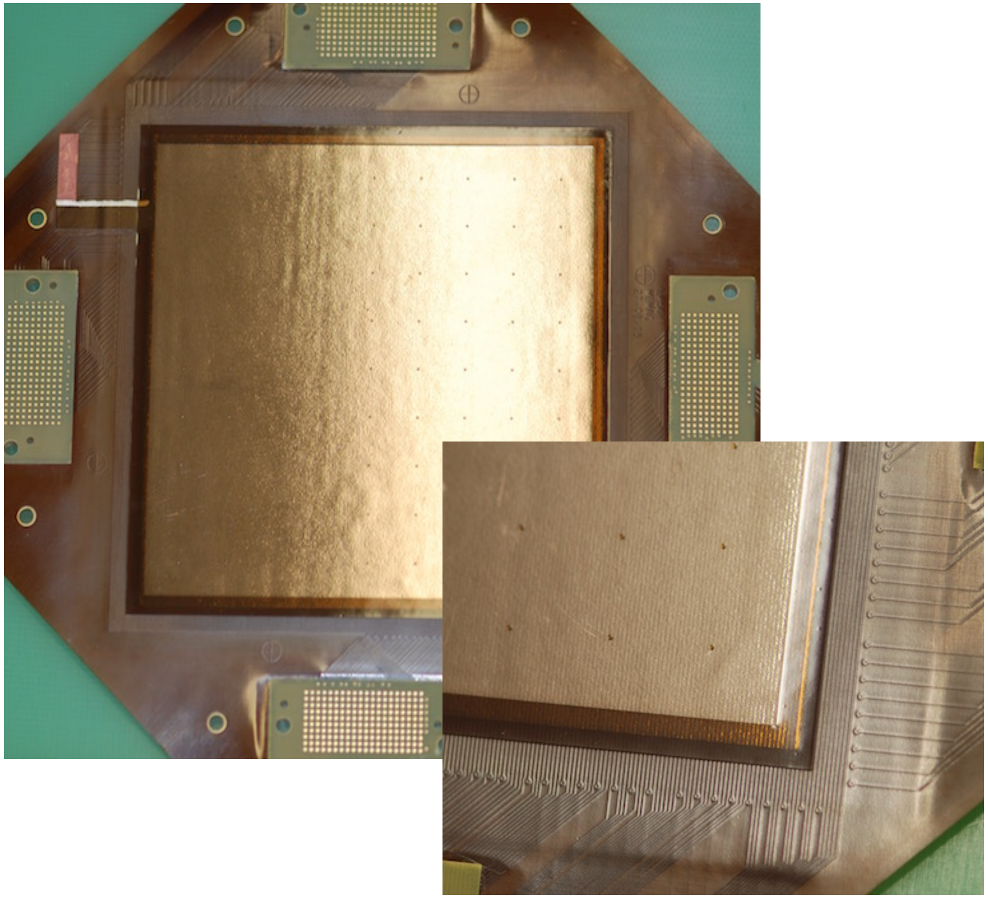
MIMAC-bi-chamber module prototype

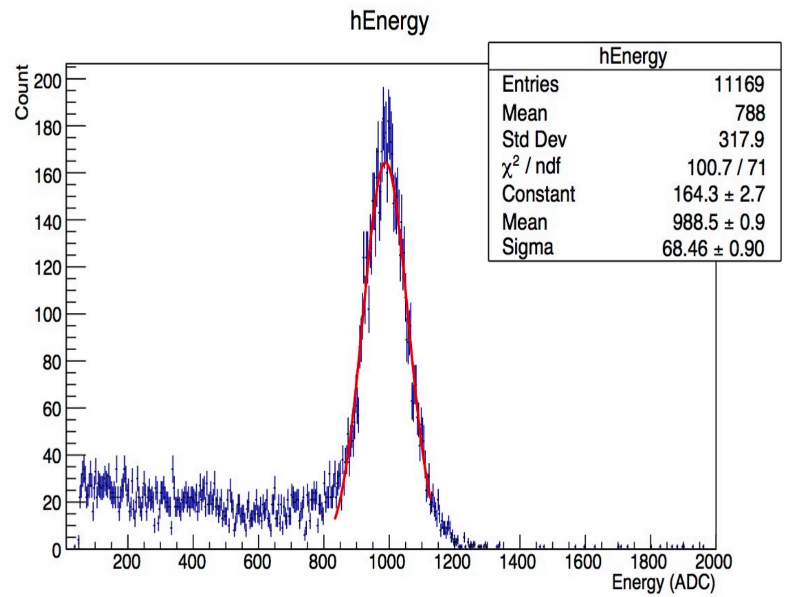




MIMAC Target: ^{1}H, ^{12}C, ^{19}F

New MIMAC low background detector





Gaz : MIMAC 50 mbar
HT grille : -560 V
Drift field : -150 V/cm

Kapton micromegas readout
Piralux Pilar

16,3 % FWHM (6 keV)
Gain ~25 000
Energy threshold <1 keV

Cathode Signal to place a 3D-track

- The cathode signal is produced by the primary electrons. It is produced before the anode signal produced by the avalanche.

C. Couturier, Q. Riffard, N. Sauzet, O. Guillaudin, F. Naraghi, and D. Santos.

Journal of Instrumentation, 12(2017):P11020,.

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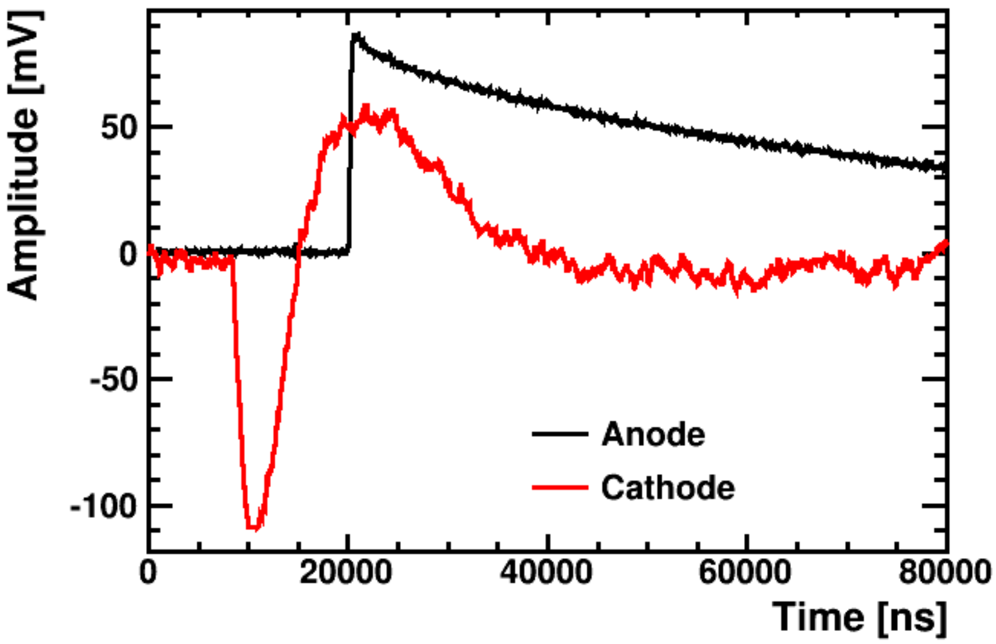
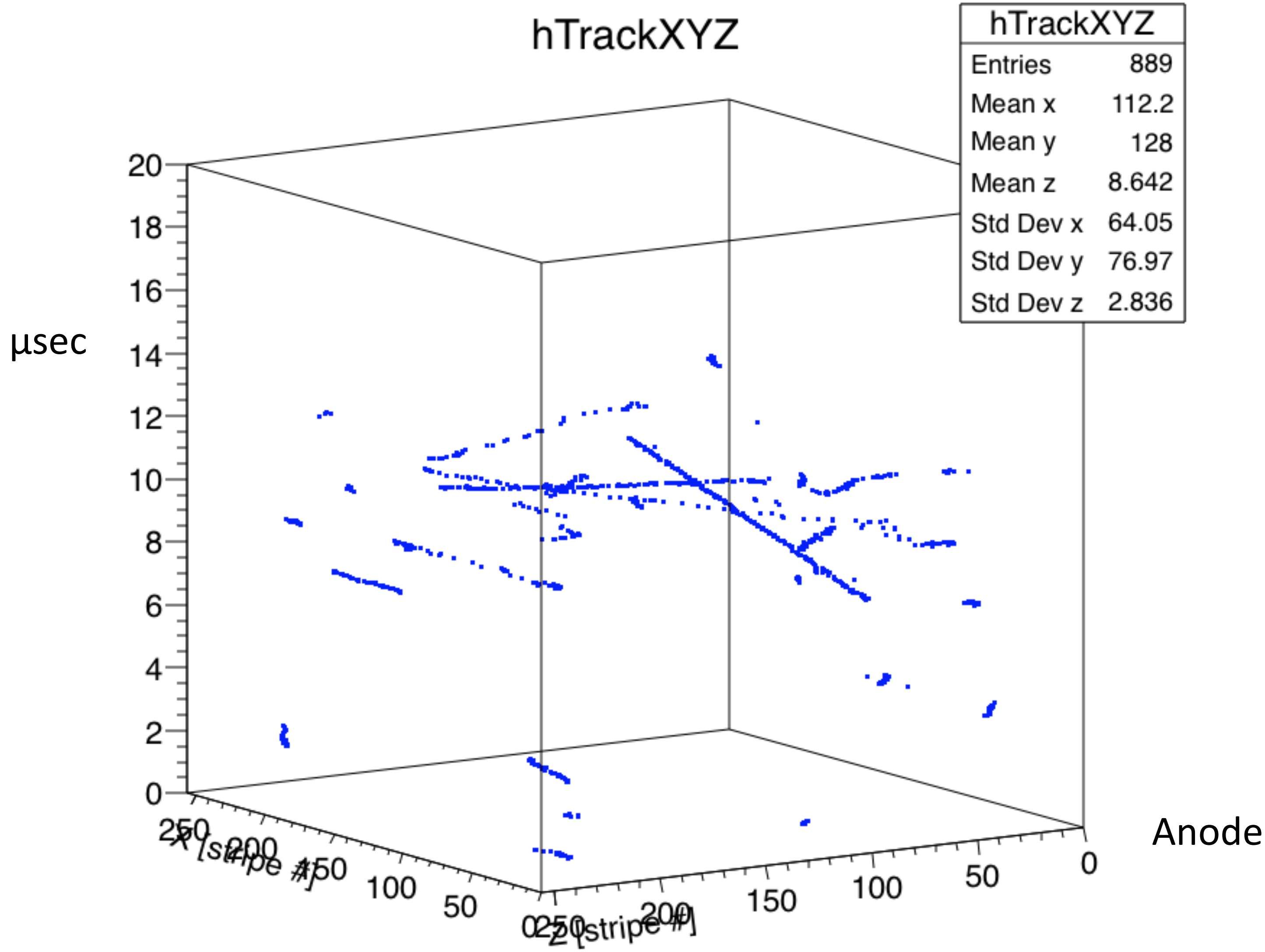


Measurement in a MIMAC chamber of an alpha passing through the active volume parallel to the cathode at 10 cm distance.

3D event-localization in MIMAC by means of the cathode-signal

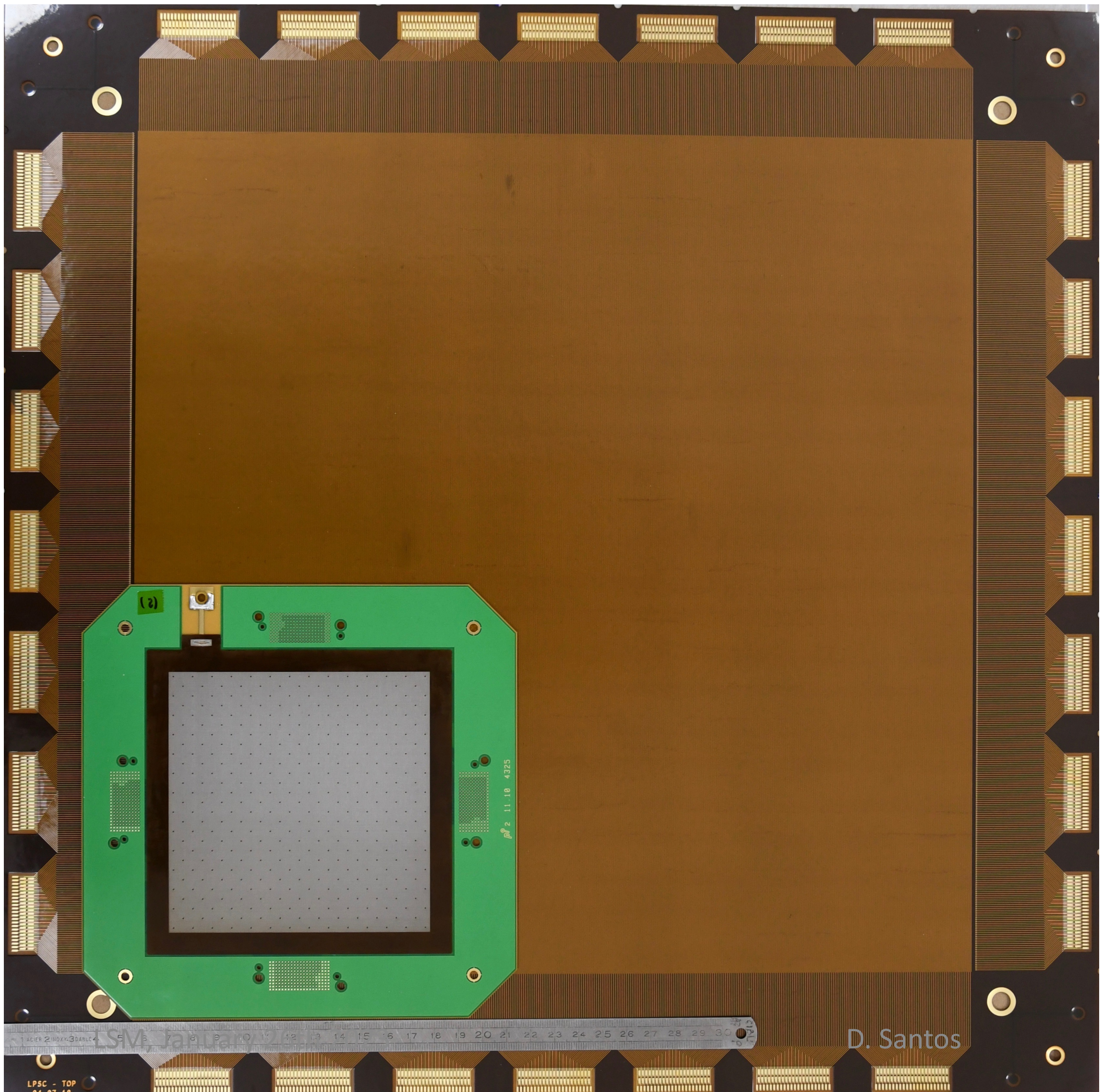


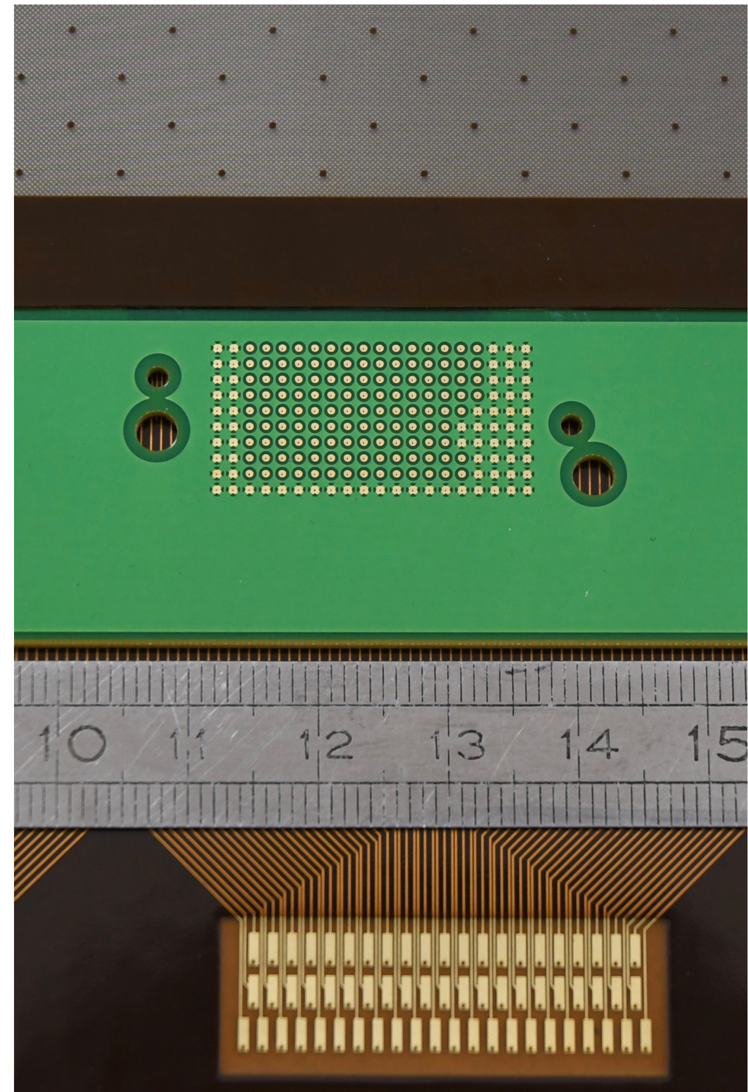
MIMAC-512

Bi-chamber 512

- Installation in progress (starting next week)
- 3 months without shielding
- Shielded with the former Sedine shielding (6 months, up to the installation of the new bi-chamber 1792)

The new 35 cm “new technology” MIMAC detector compared to the old one





New MIMAC Bi-chamber module 35x35x25 cm^3

- Installation at Modane on November 2023 with the same gas system than the 10 cm Bi-chamber module

  Run background without lead shielding (1 month)

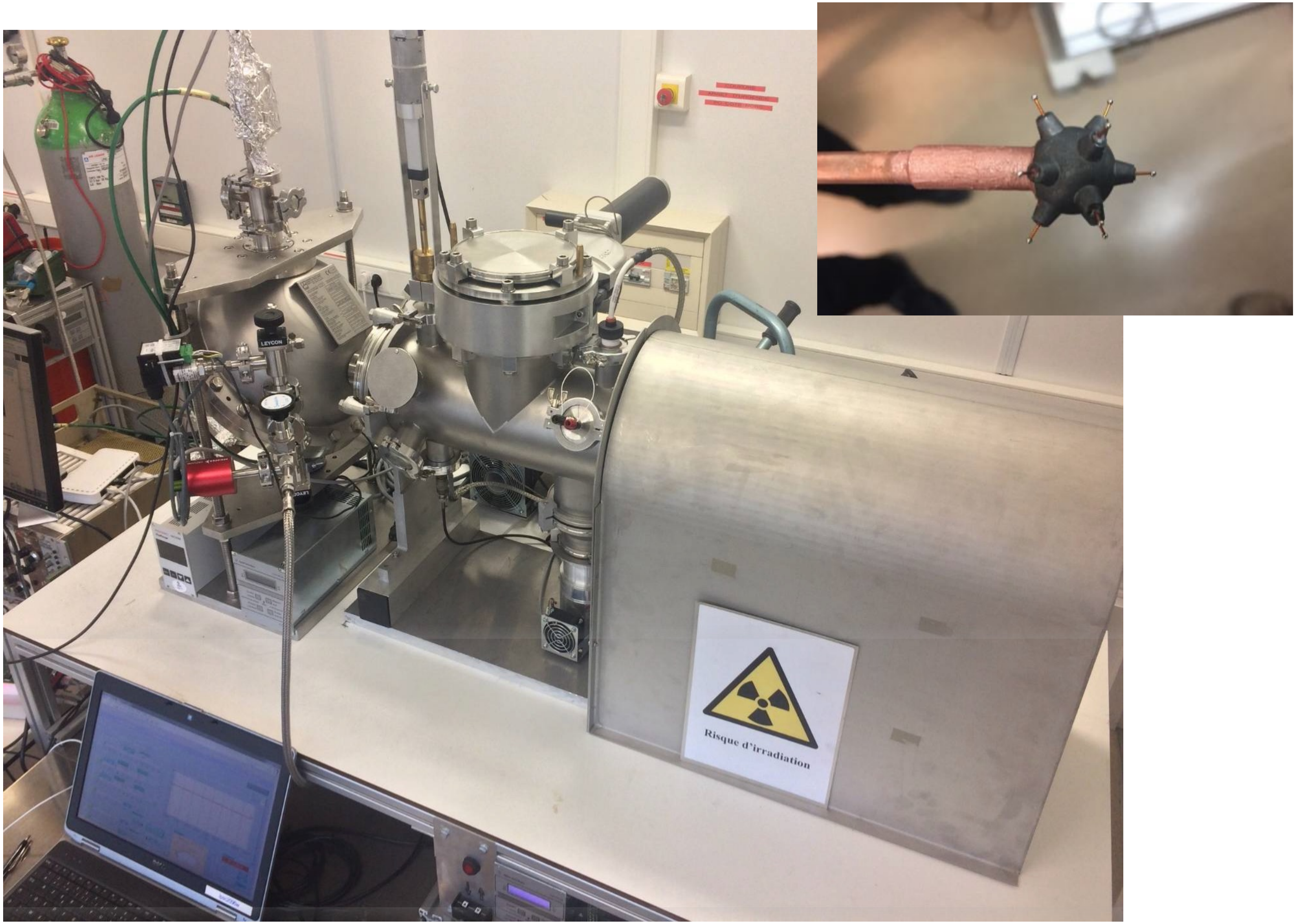
- Lead shielding installation (Janvier 2024)

- 1st Physics Run: February 24- June 24

NEWS-G (Sedine) at LSM

A. Dastgheibi-Fard, F. Vazquez de Sola, P. Lautridou and D. Santos
on behalf of NEWS-G collaboration

S30 coupled to COMIMAC



Ionization Quenching Factor Measurements with COMIMAC
(NEWS-G collaboration, arXiv 2201.09566, published in ERJ-C)

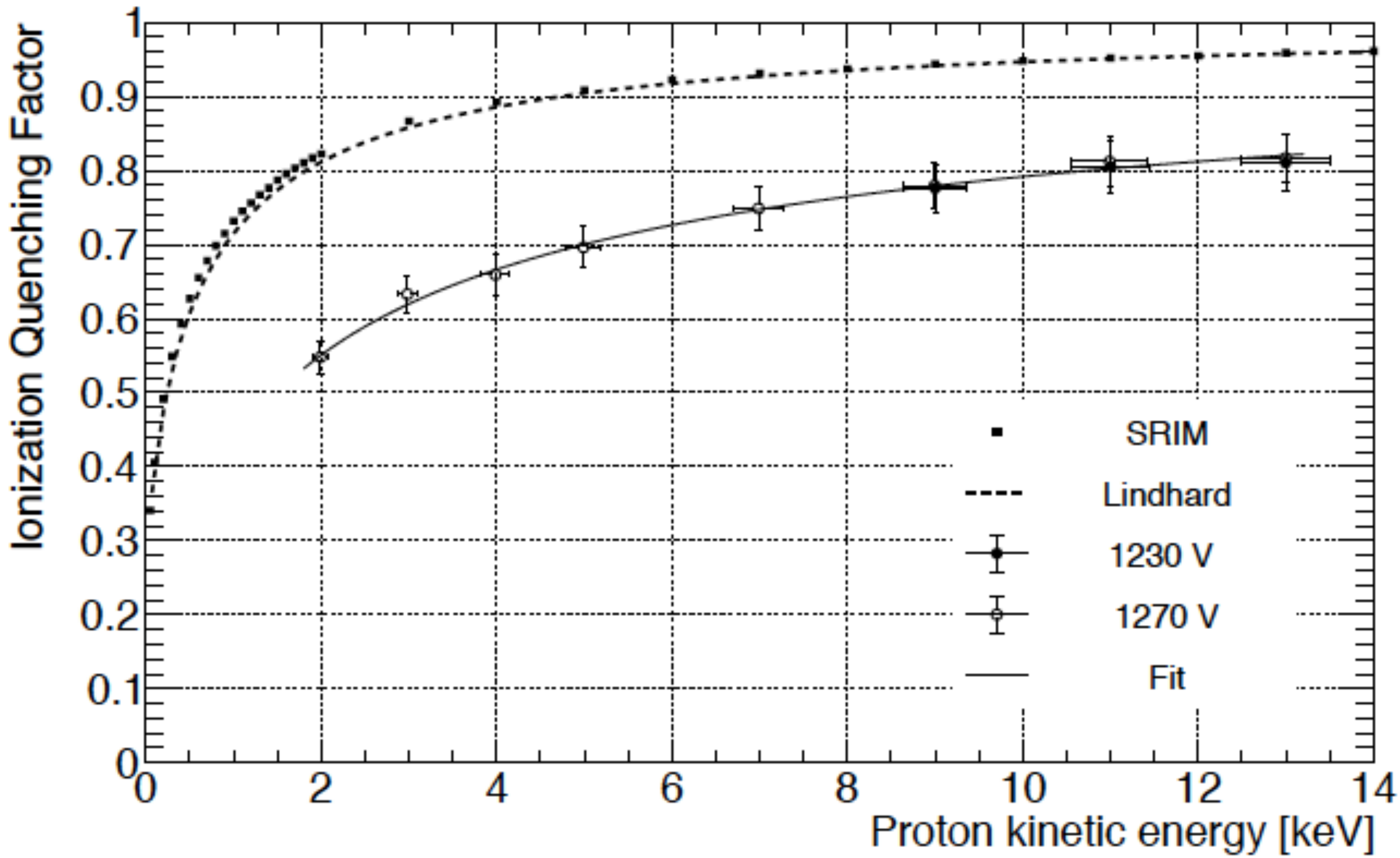
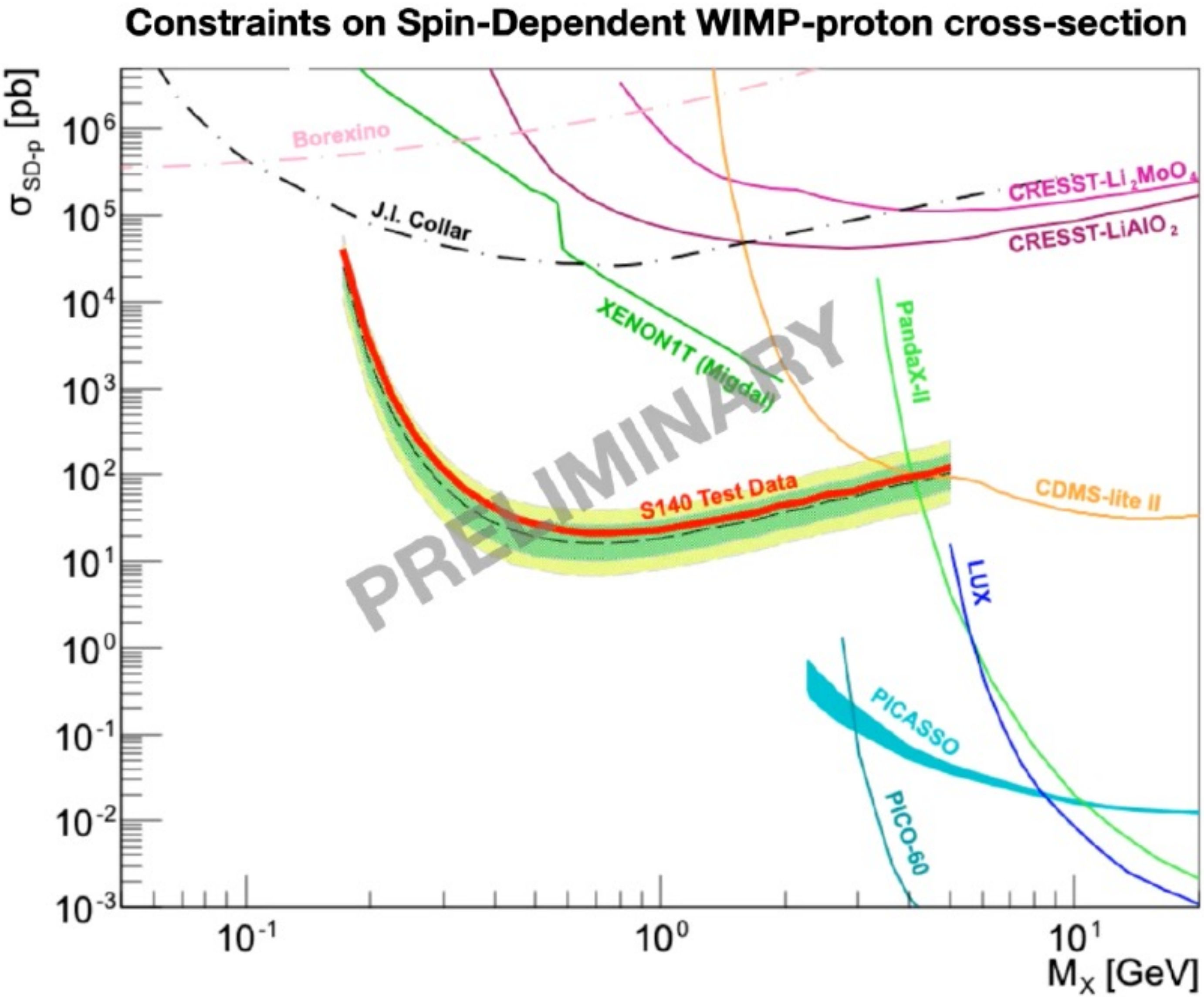


Fig. 9: Ionization Quenching Factor for protons in 100 mbar of methane. The measurements at 1230 V and 1270 V are respectively presented with black dots and white dots. Comparisons with SRIM and with the Lindhard theory are also shown.

S140 at Modane during 15 days at 135 mbar CH_4



Presented by F. Vazquez de Sola on October 19th 2022

Possible New runs with SEDINE in EDELWEISS shielding

- **Runs**
  - CH4 (safety proceeding) + Achinos 11 balls

- **Edelweiss Shielding**

Poly	30 cm	=>	40 cm
Lead	15 cm	=>	25cm (including the Roman lead)

Sedine (in the EDW III shielding)

- Sedine, the first low background detector made with 5N Copper (purity of 99.999%)
- To profit of the work done on NEWS-G (S140) at Modane and Snolab understanding the background and signals in the sphere.
- To profit of the possibility to run an experiment with CH_4 at pressure less than 800 mbar (5.9 times the pressure of S140 run at Modane) and having the IQF measured at Grenoble
- To profit of the Edelweiss shielding at least 3 months starting as soon as possible !!

We'll get a nice opportunity to improve the exploration at

low Wimp masses…even better than present limits

MIMAC (MIcro-tpc MAtrix of Chambers)

LPSC (Grenoble) : D. Santos, C. Beaufort (CDD), F.Naraghi , O. Guillaudin, N. Sauzet,

- Electronics : **G. Bosson (r), J. Bouvier (r), J.L. Bouly, L.Gallin-Martel, F. Rarbi, Cairo Caplan (CDD)**
- Data Acquisition: **T. Descombes**
- COMIMAC (quenching) **: J-F. Muraz**

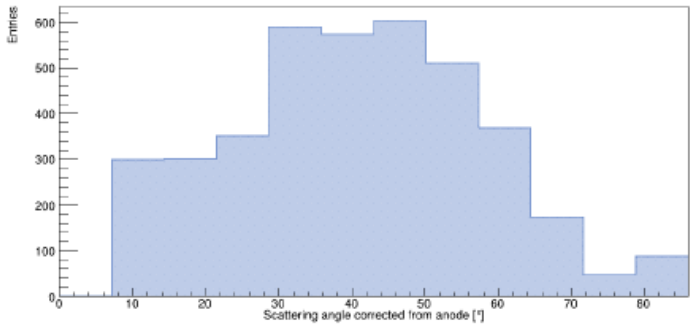
CCPM (Marseille): J. Busto, C. Tao

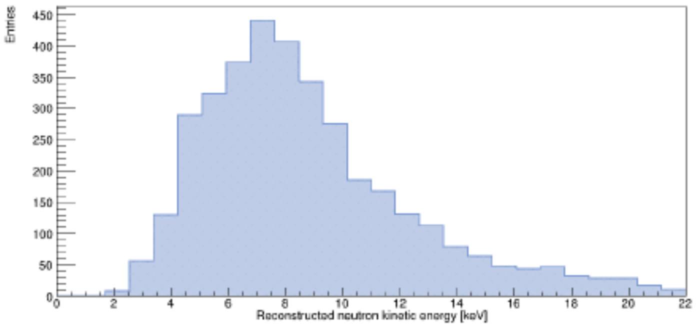
IRSN- LMDN (Cadarache): M. Petit, T. Vinchon (spectroscopie neutronique métrologique)

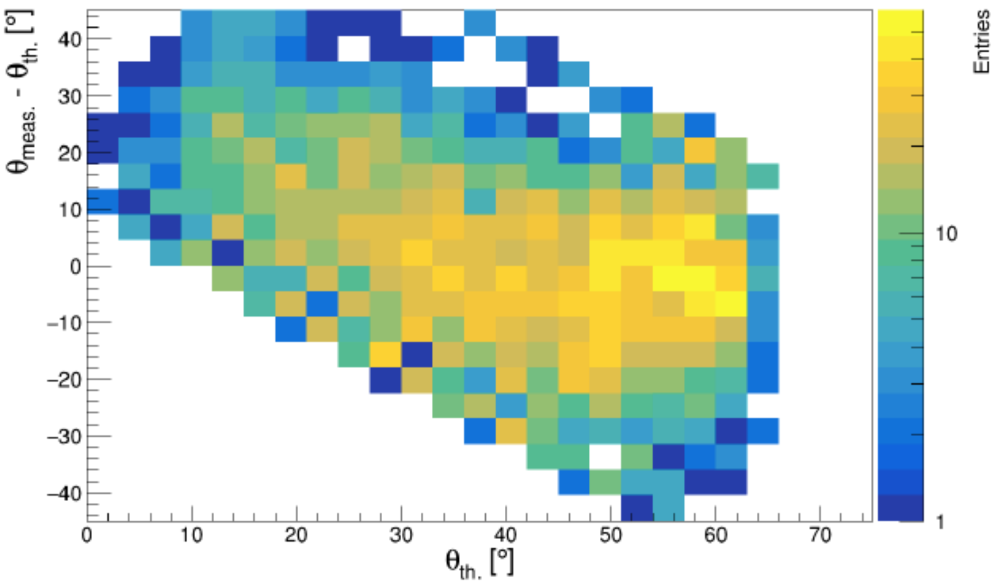
Prototype hosted in **IHEP (Beijing-China)**: **ZhiminWang , Changgen Yang**

Proton recoil Angular Distribution produced by 8 keV neutrons

Cyprien Beaufort et al.,arxiv.org/2112.12469







What does it mean to perform a directional detection of nuclear recoils?

If you wonder about your detector is able to perform a directional detection …

- You have to put your detector in a mono-chromatic neutron field knowing where is the source.
- You try to get the energy of the mono-energetic neutron field detecting each nuclear recoil with its angle with respect to the neutron direction producing such recoil !
- If you are interested in the low energy range (keV range) you can choose a 27 or even 8 keV mono-chromatic neutron field…