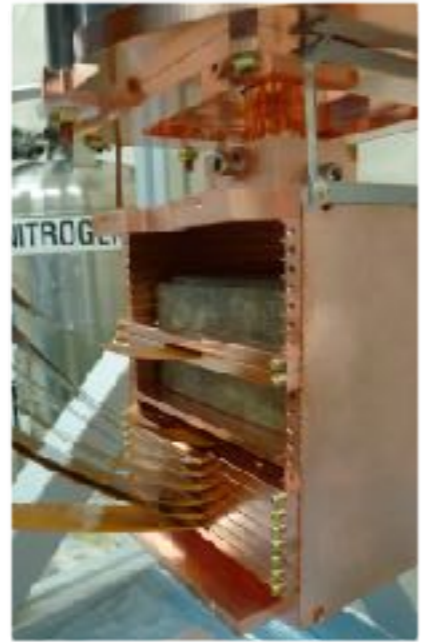


Detection directe de  
Matière noire:  
Bilan / perspective à 2 ans

15/04/2019

**DAMIC / DarkSide / Xenon**

# DAMIC AT SNOLAB



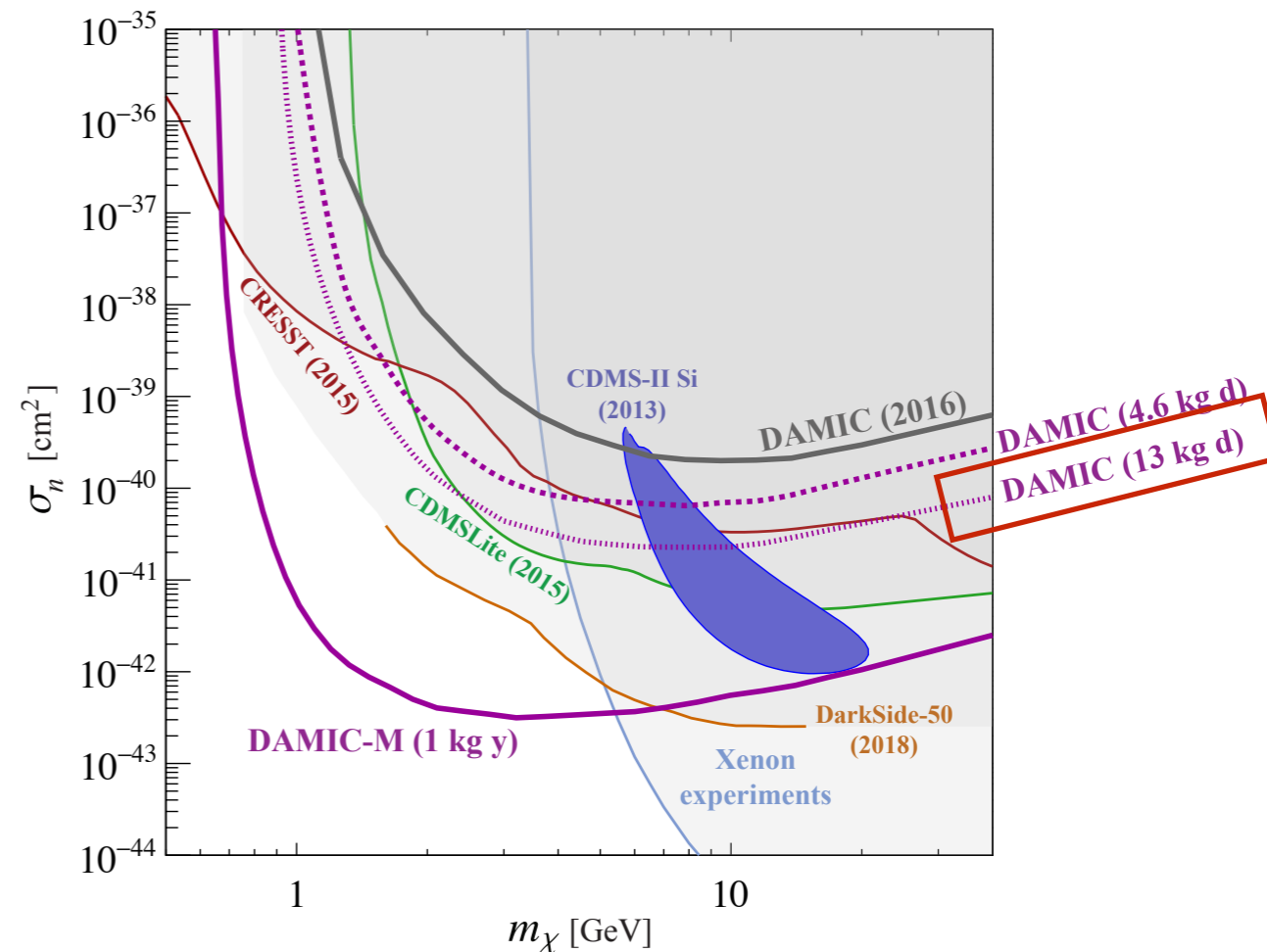
- ▶ **7 CCDs (40g) depuis 2017** (1 CCD entre deux écran de plomb archéologique et Cu electroformé)
- ▶ Temperature de **~140K**.
- ▶ Expositions de 8h et 24h
- ▶ **13 kg-day** collecté pour la recherche de DM (« binné » en 1x100)

## ▶ Exploitation a SNOLAB

- Limite WIMP (et autres)
- Preparation à DAMIC-M (mesure de courant de fuite et autres tests)

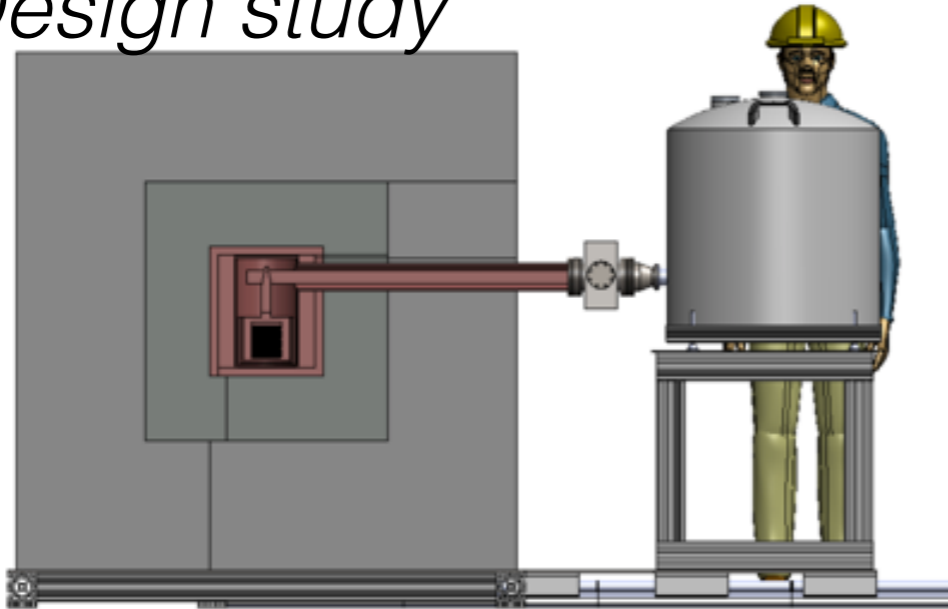
## ▶ Au LPNHE

- ▶ Simulations du fond radioactif: These de Joao
- ▶ Analyse de données recherche de WIMP: RG, Ariel

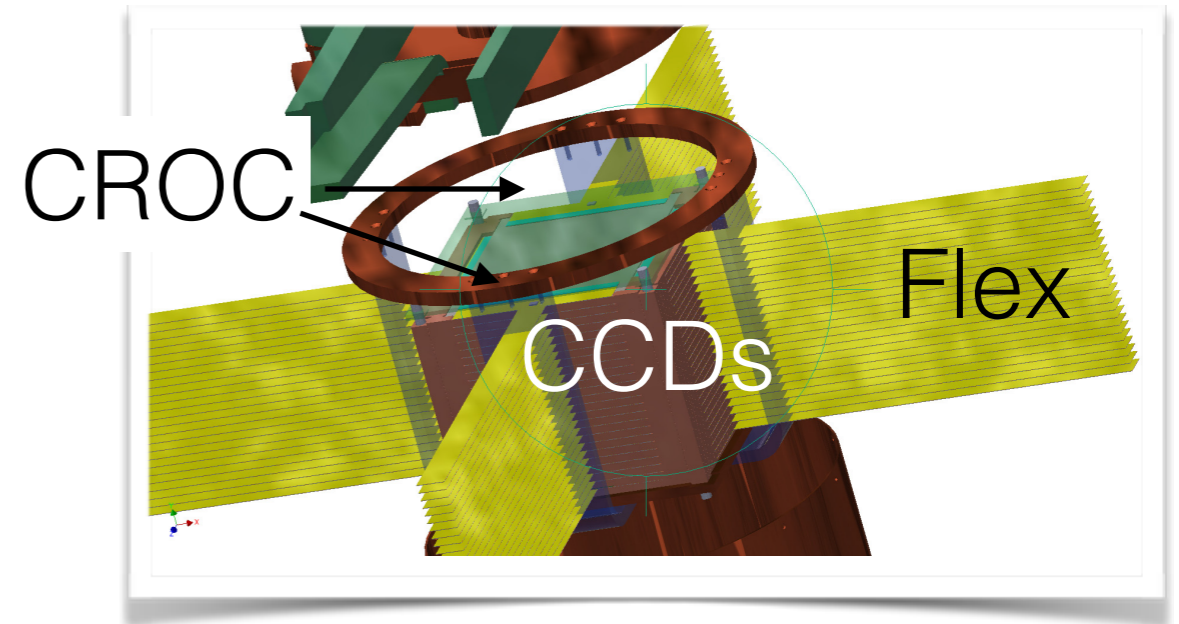


# DAMIC-M

## Design study



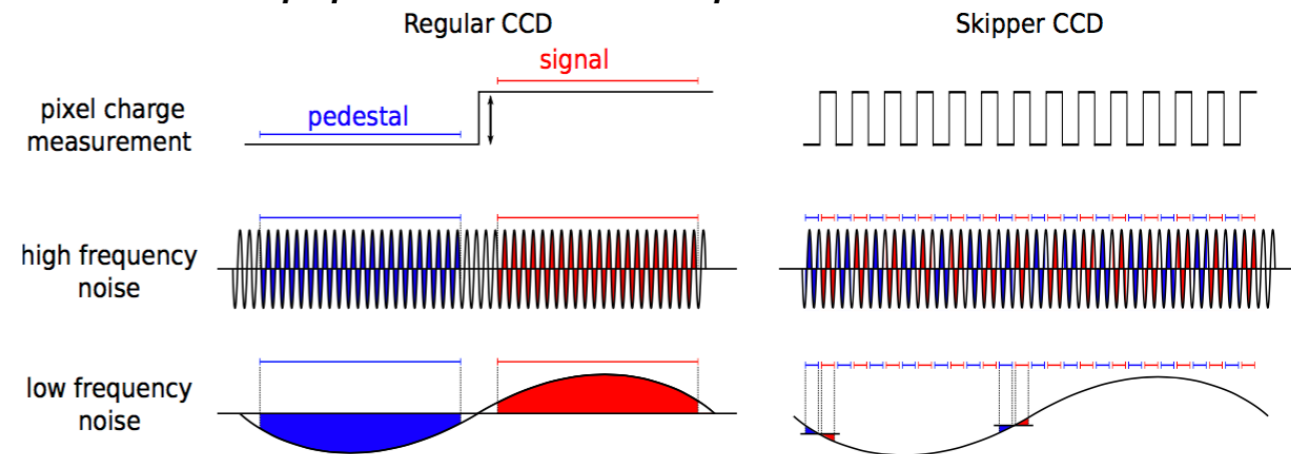
## Design



► ERC grant DAMIC-M (P. Privitera)  
(Unveiling the Hidden: A Search for Light Dark Matter with CCDs)

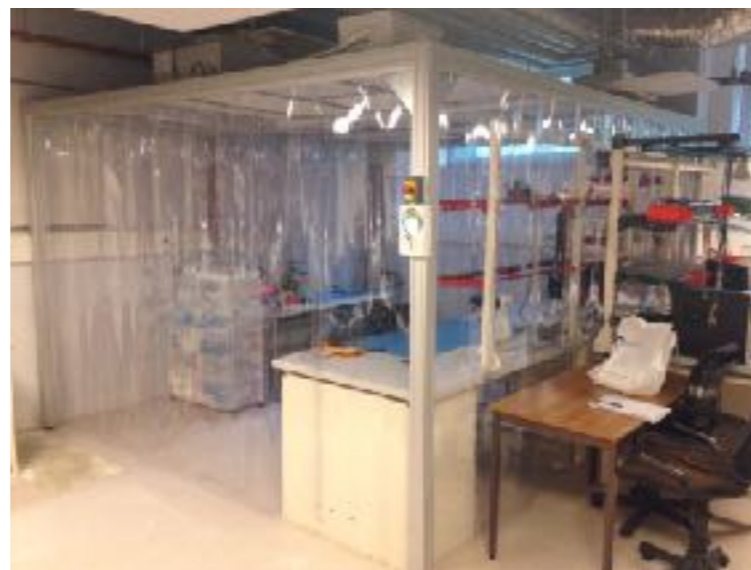
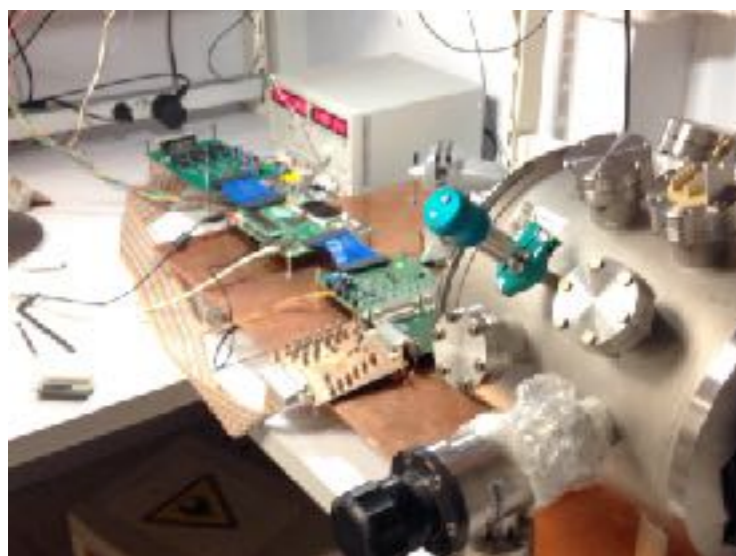
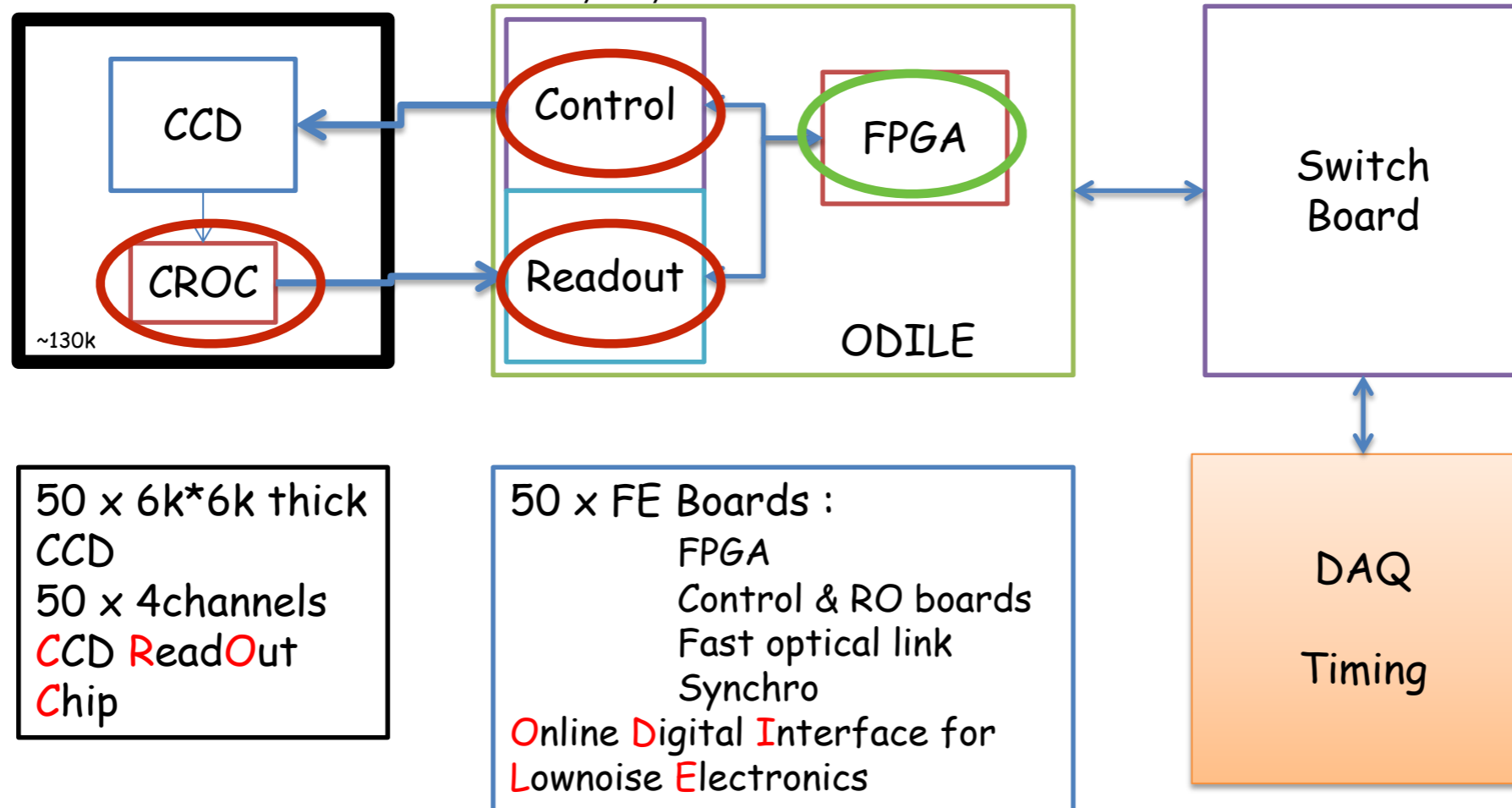
- à Modane
- 1kg detector
- level of background to a fraction of d.r.u.
- reduction of the readout noise to  $0.1e^-$

## Skipper CCD operation



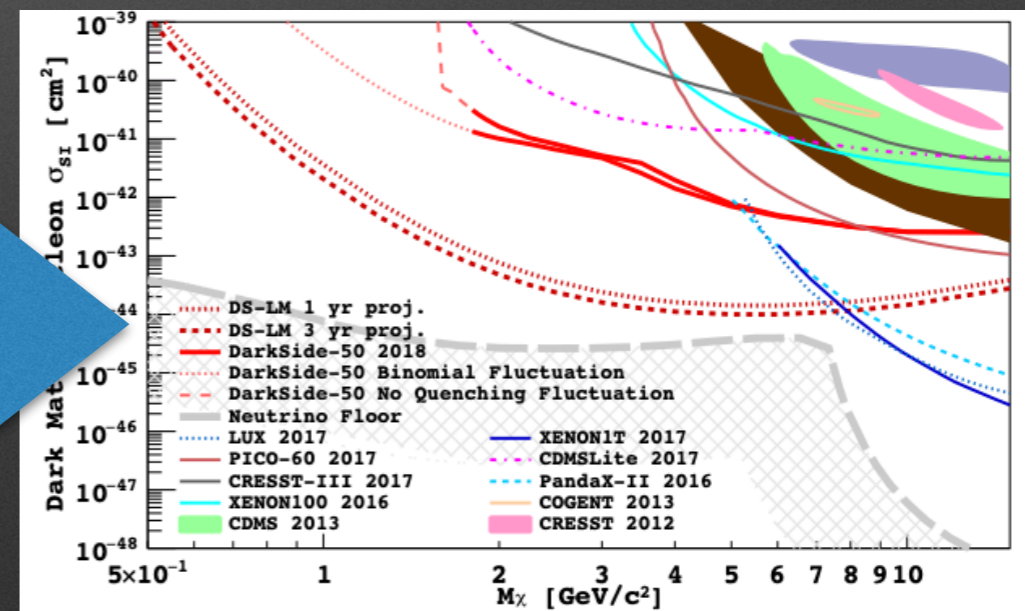
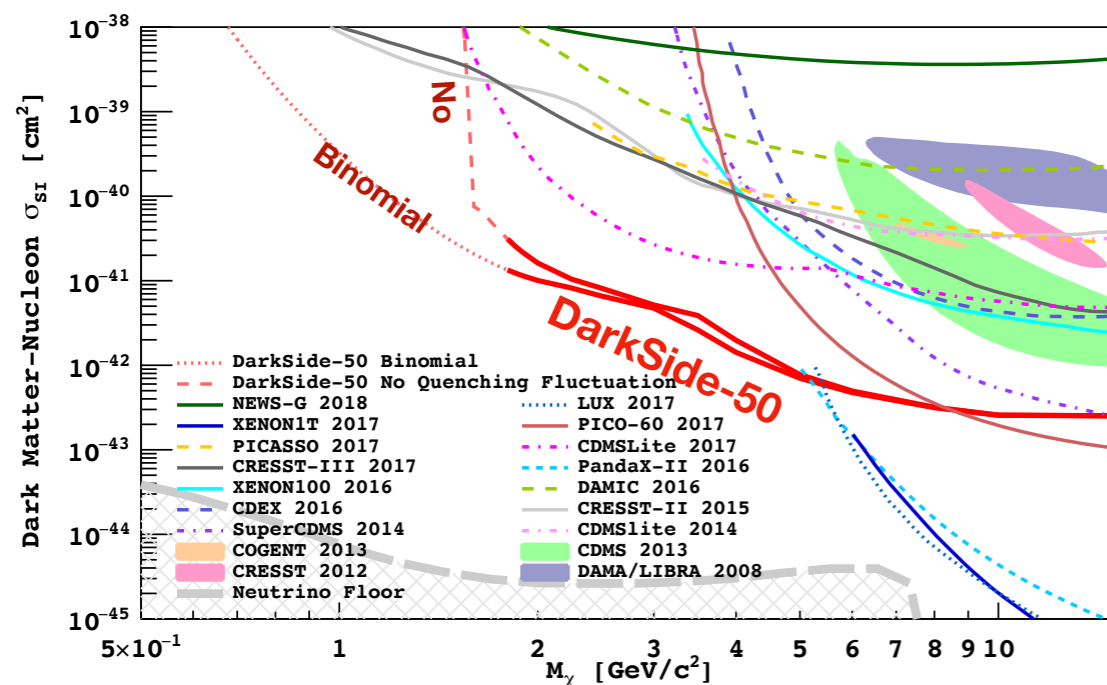
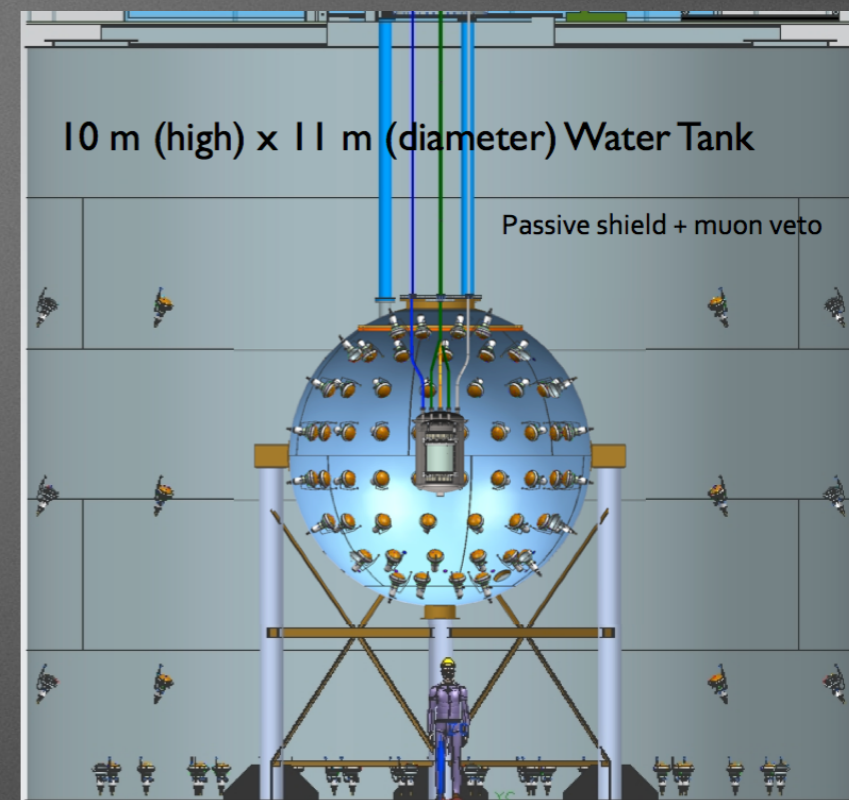
# DAMIC-M @ LPNHE

Herve Lebbolo: reunion du vendredi 25/03/2019

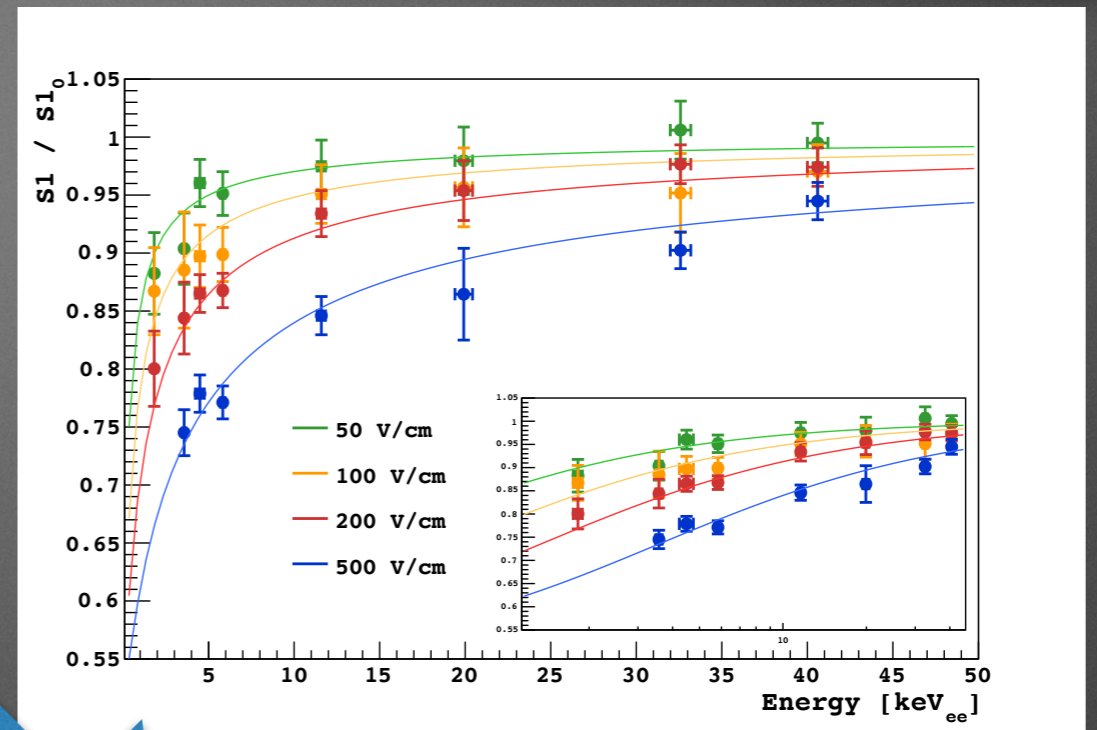
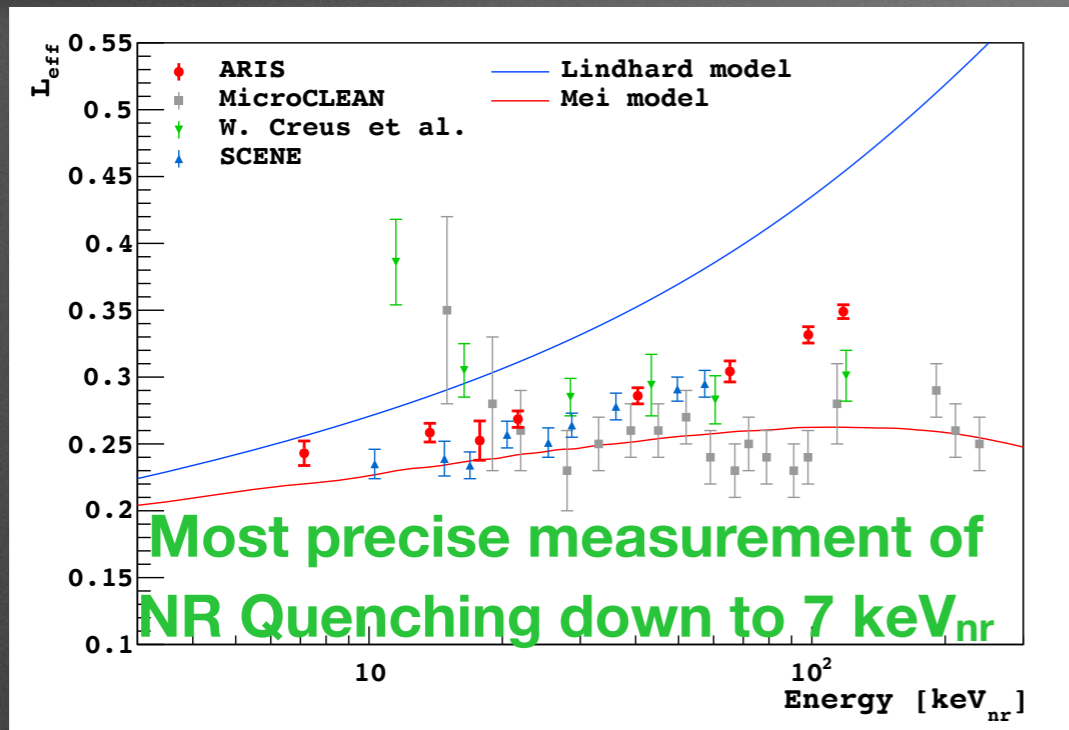


# DarkSide-50 → 1 ton detector

- \*LAr dual phase TPC
- \*50 kg detector
- \*World best limit in the low mass region
- \*1 ton prototype being constructed at CERN as part of DS-20k → plans to bring it at LNGS to improve Low Mass sensitivity



# Measurements at IPNO



\*Measurements performed with ARIS in 2016

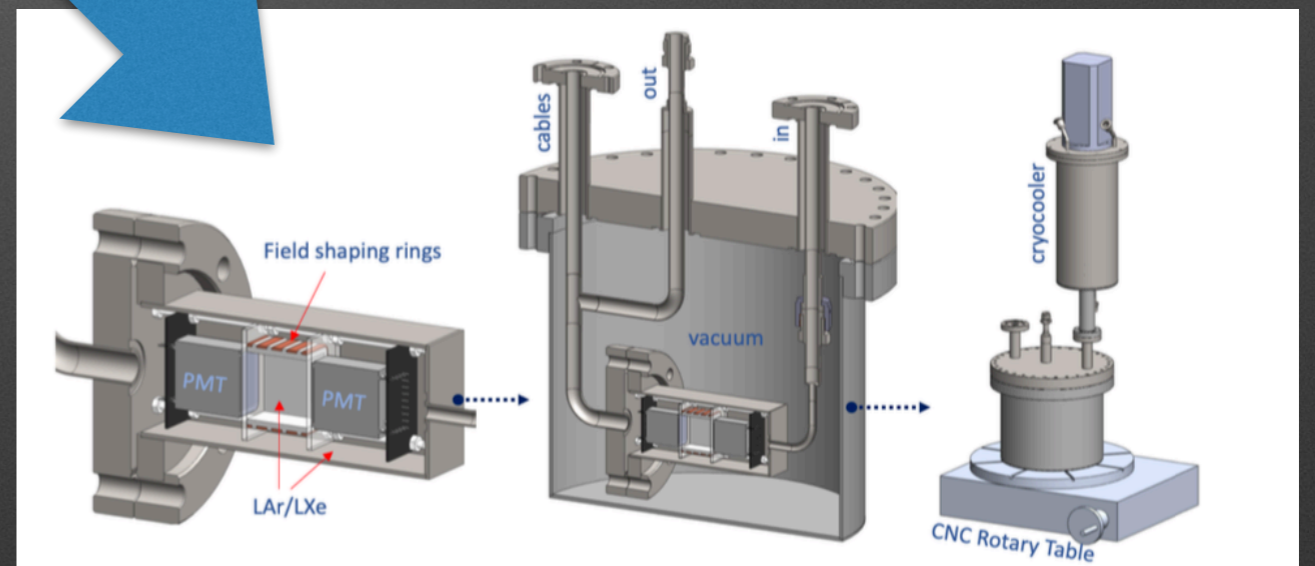
\*Fundamental for the low mass measurement of DarkSide-50

\*Submitted an ANR in 2018 and again in 2019 to perform measurements at IPNO

\*Do measurements also with Xenon

\*Go to lower energies than ARIS → important for low mass

\*Directionality



S1 only

Rotation system to measure S1 for different recoil directions with respect to electric field

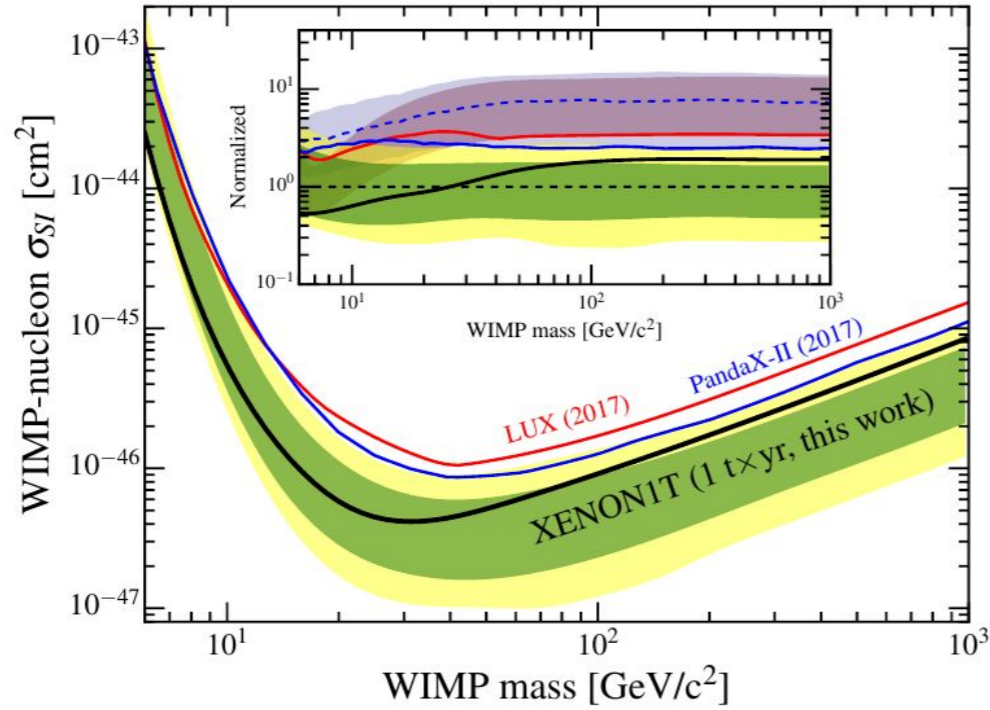
**XENON Project  
@LPNHE**

**Xe**

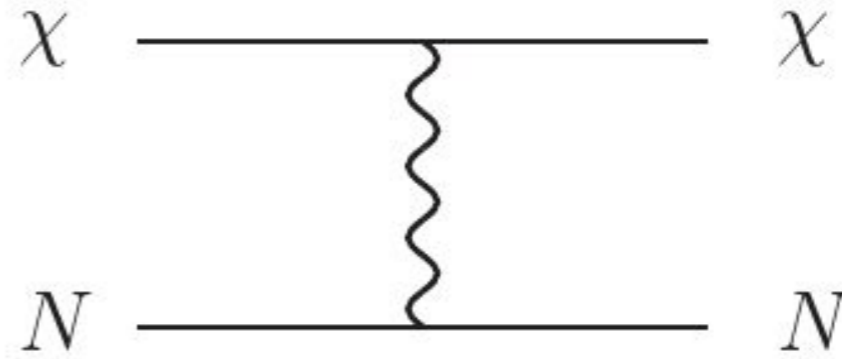
**XENON  
Dark Matter Project**

# Limites d'exclusions (resultats 2018-2019)

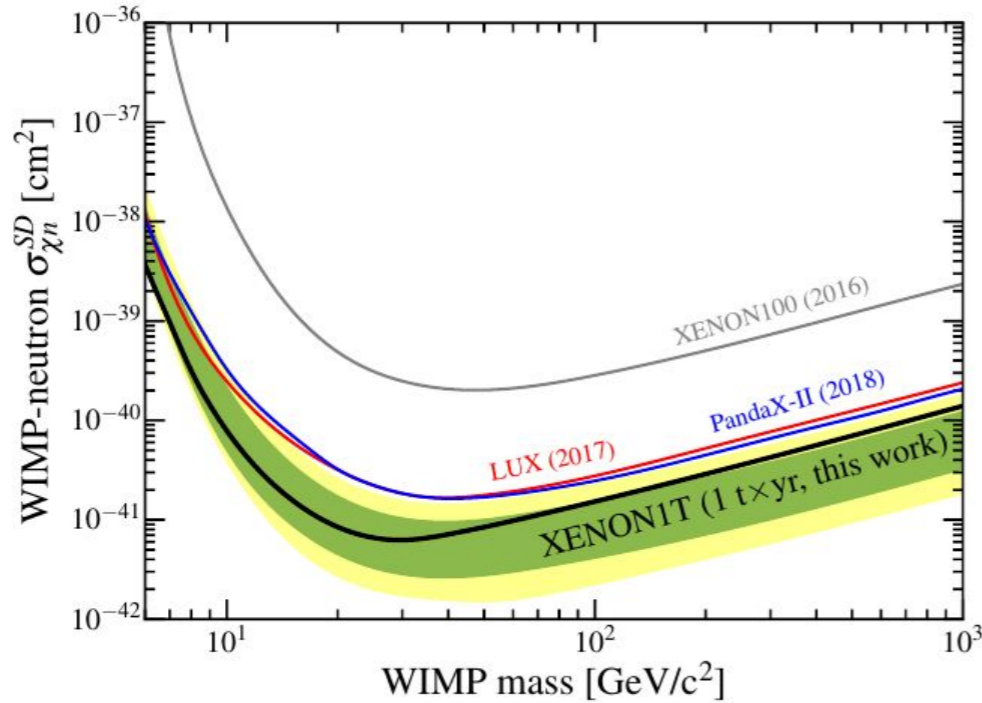
## SPIN INDEPENDENT



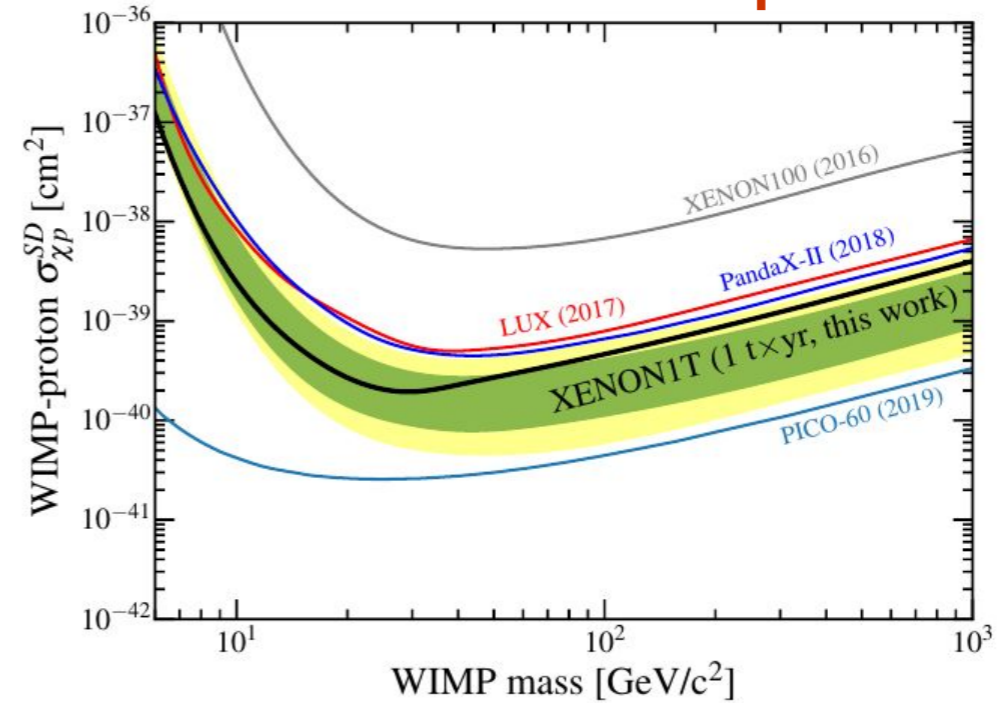
SI: *Phys. Rev. Lett.* 121, 111302, [arXiv:1805.12562](https://arxiv.org/abs/1805.12562)  
SD: Accepted by *Phys. Rev. Lett.*, [arXiv:1902.03234](https://arxiv.org/abs/1902.03234)



## SPIN DEPENDENT - neutron



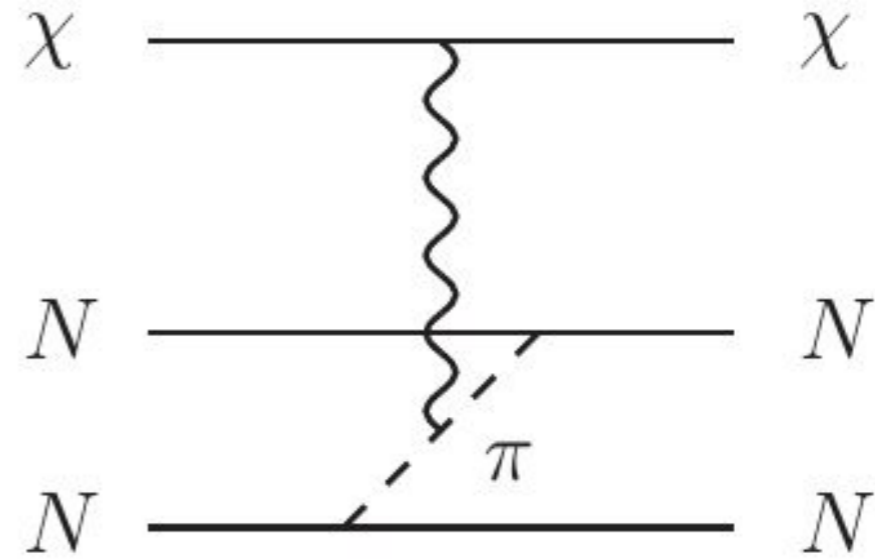
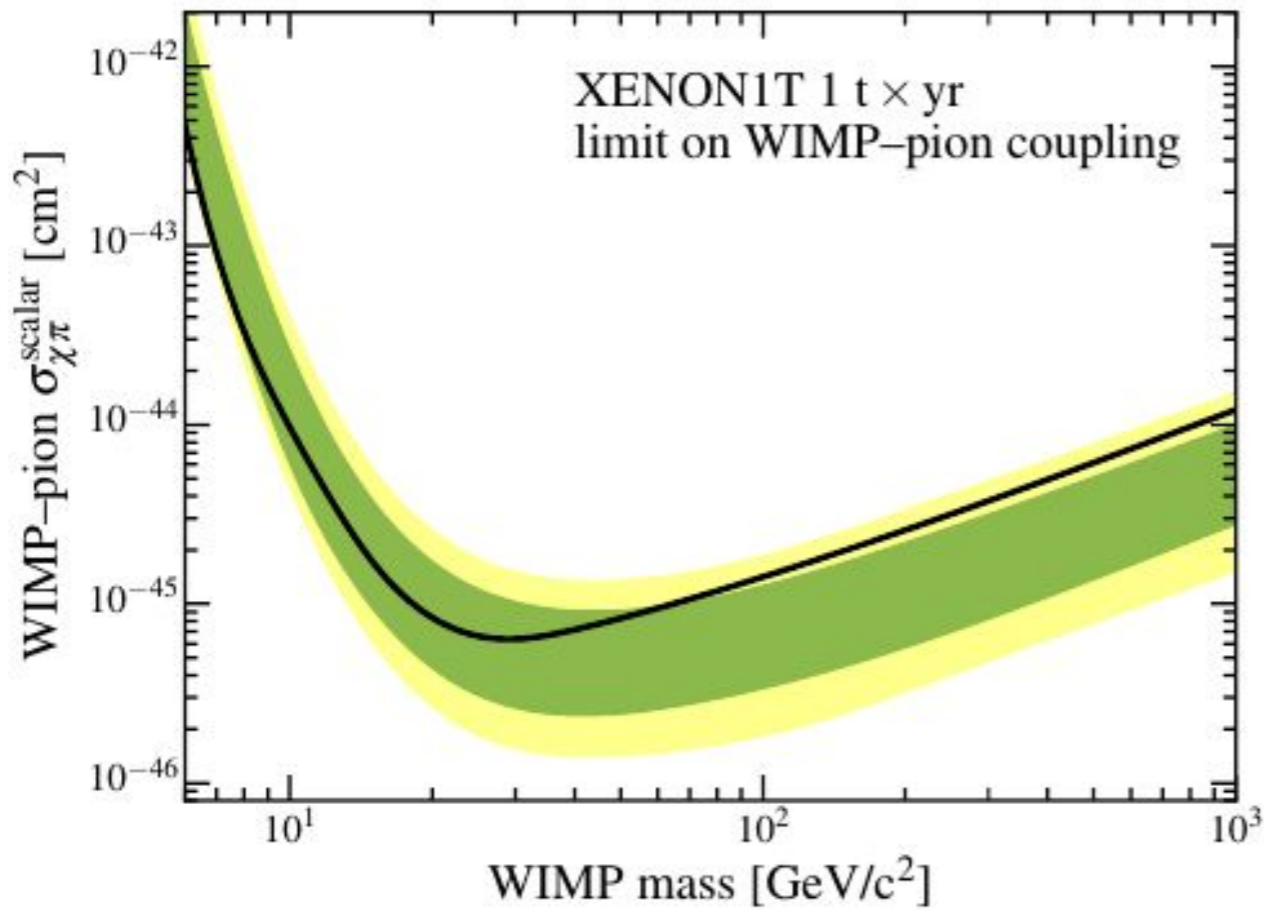
## SPIN DEPENDENT - proton





# Limites d'exclusion : couplage WIMP-pion

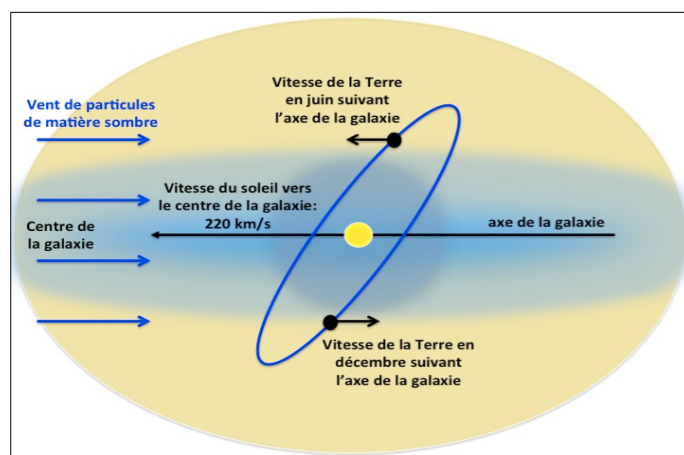
*Phys. Rev. Lett. 122, 071301, arXiv:1811.12482*



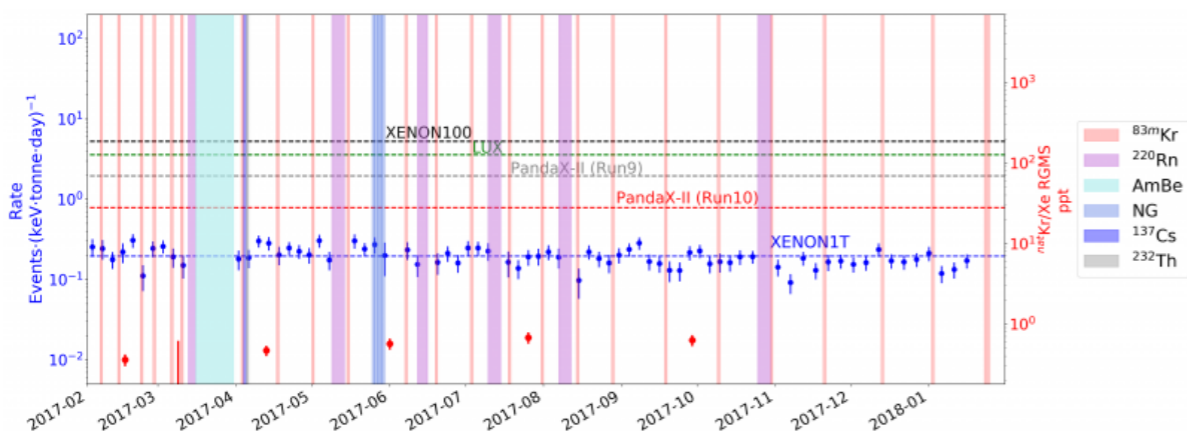
$$\frac{dR}{dE_r} = \frac{2\rho_0\sigma_{\chi\pi}^{\text{scalar}}}{m_\chi\mu_\pi^2} \times |\mathcal{F}_\pi(q^2)|^2 \times \int_{v_{\min}(E_r)}^{\infty} \frac{f(\mathbf{v}, t)}{v} d^3v$$

## Modulation annuel

**Objectif:** etude des événements de recul électronique (qui est un bruit de fond pour l'analyse standard) à la recherche d'un possible signal de modulation annuel

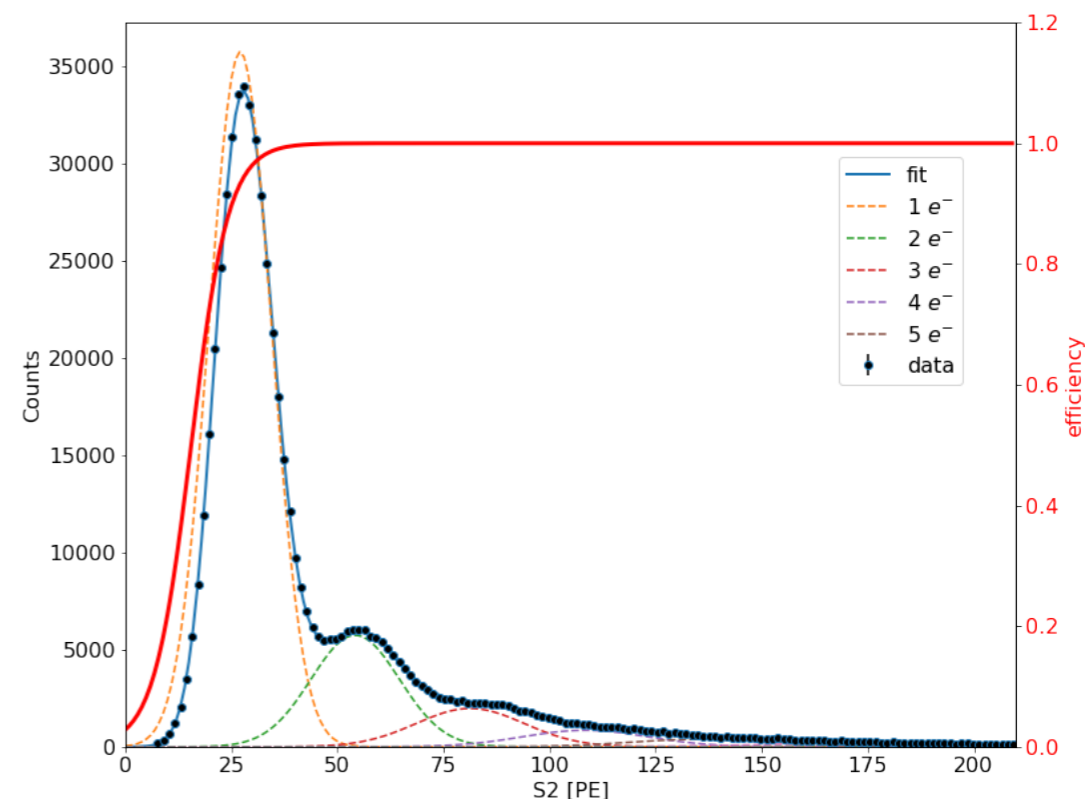


Exemple de bruit de fond électronique à faible énergie (0-25 keV)



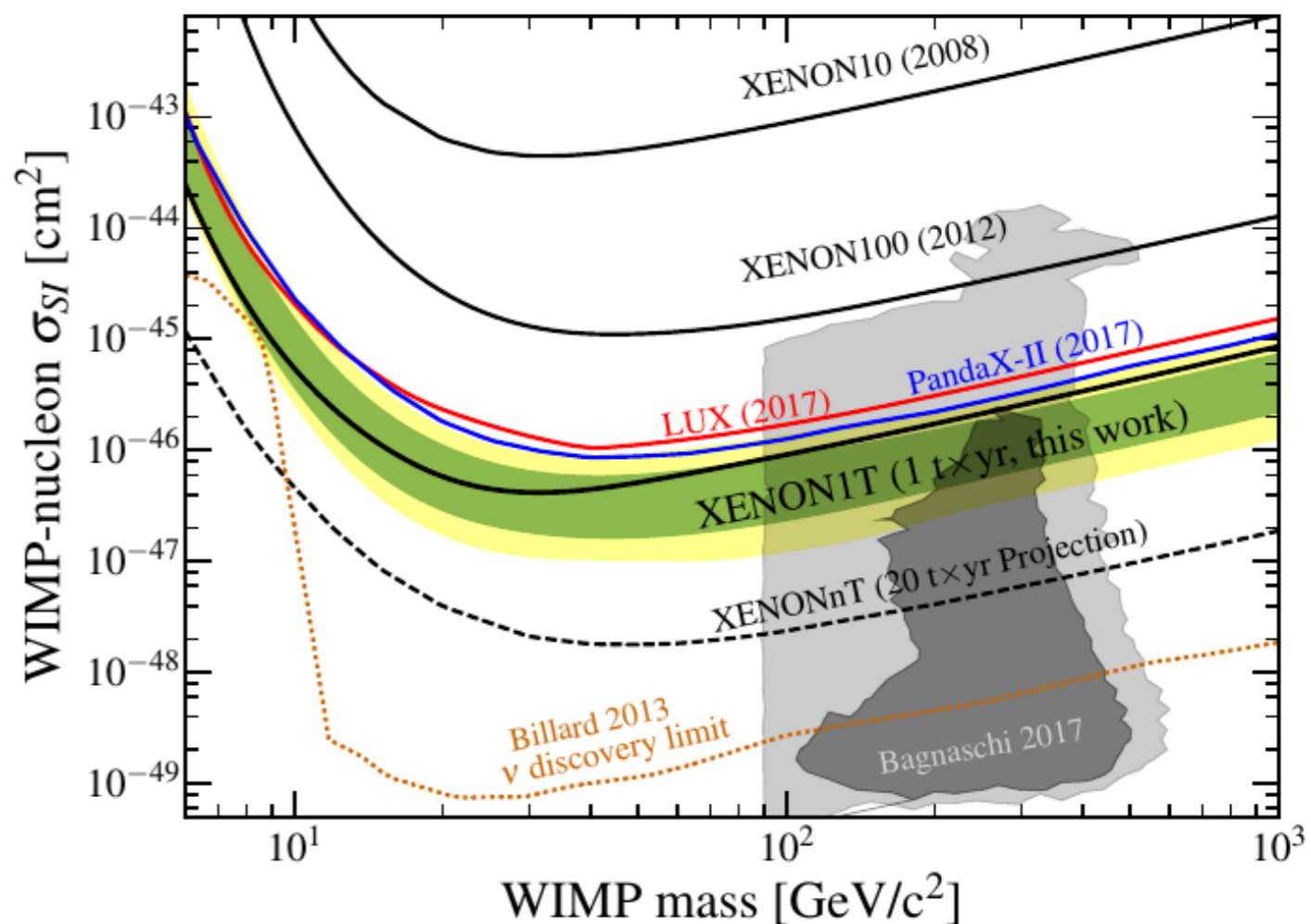
## Electrons solitaires

**Objectif:** le spectre à faible énergie du signal de ionization (S2) est dominé par des électrons solitaires. C'est indispensable avoir un modèle de ce bruit de fond pour la recherche de WIMP à faible masse. C'est aussi utile pour caractériser le détecteur



# Construction de XENONnT

- ▶ Rapid upgrade to 8.2 t total mass, 6 t in the TPC
- ▶ Most sub-systems in place from XENON1T
- ▶ New inner cryostat, new TPC, 476 PMTs (most of these tested & screened)
- ▶ Neutron veto, Rn removal tower, additional storage system
- ▶ Installation at LNGS scheduled to start in late 2018, commissioning in 2019



Aprile et al., Eur. Phys. J. C (2017) 77: 881. *XENON1T sub-systems*  
 Aprile et al., JCAP 77 (2016), 358. *online Rn-removal*  
 Aprile et al., Eur. Phys. J. C (2017) 77: 275. *online Kr-removal*  
 Aprile et al., JCAP 4 (2016), 27. *sensitivity*

## ReStoX2 : Le systeme de recuperation et stockage pour XENONnT

Coordinateurs:

Luca Scotto Lavina (LPNHE)

Julien Masbou (Subatech)

Exchangeur de chaleur:

Financé par le CNRS/IN2P3 et  
DIM-ACAV+ (Region Ile-de-France)

Matériel: acier

13 plaques rectangulaires refroidis par LN<sub>2</sub>

Dimensions: 0.95m x 0.95m x 4m

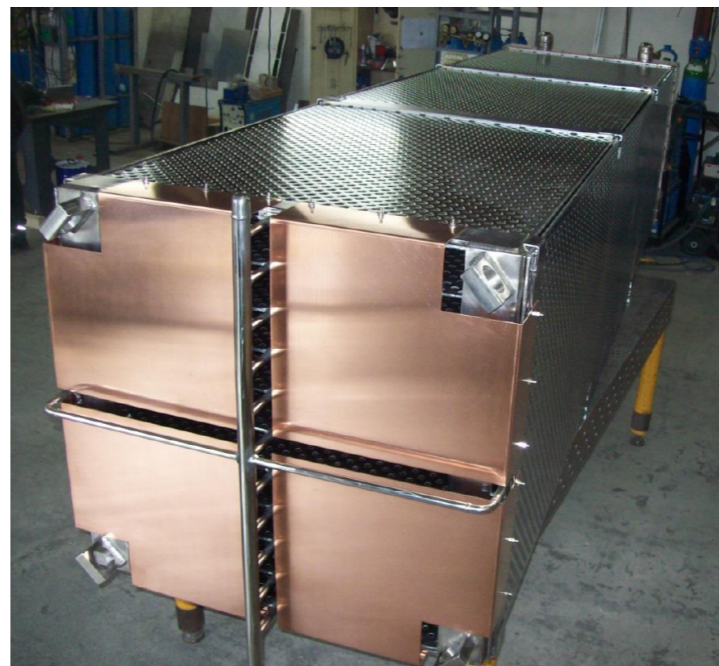
Surface d'échange: ~100 m<sup>2</sup>

Pression max: 71.5 bar

T de service: de -196° à +50° C

Recuperation rapide avec cristallisation du xenon (1 ton/heure attendue)

Heat exchanger



ReStoX2 installed in LNGS

