Columbia

RPI

Nikhef

Muenster

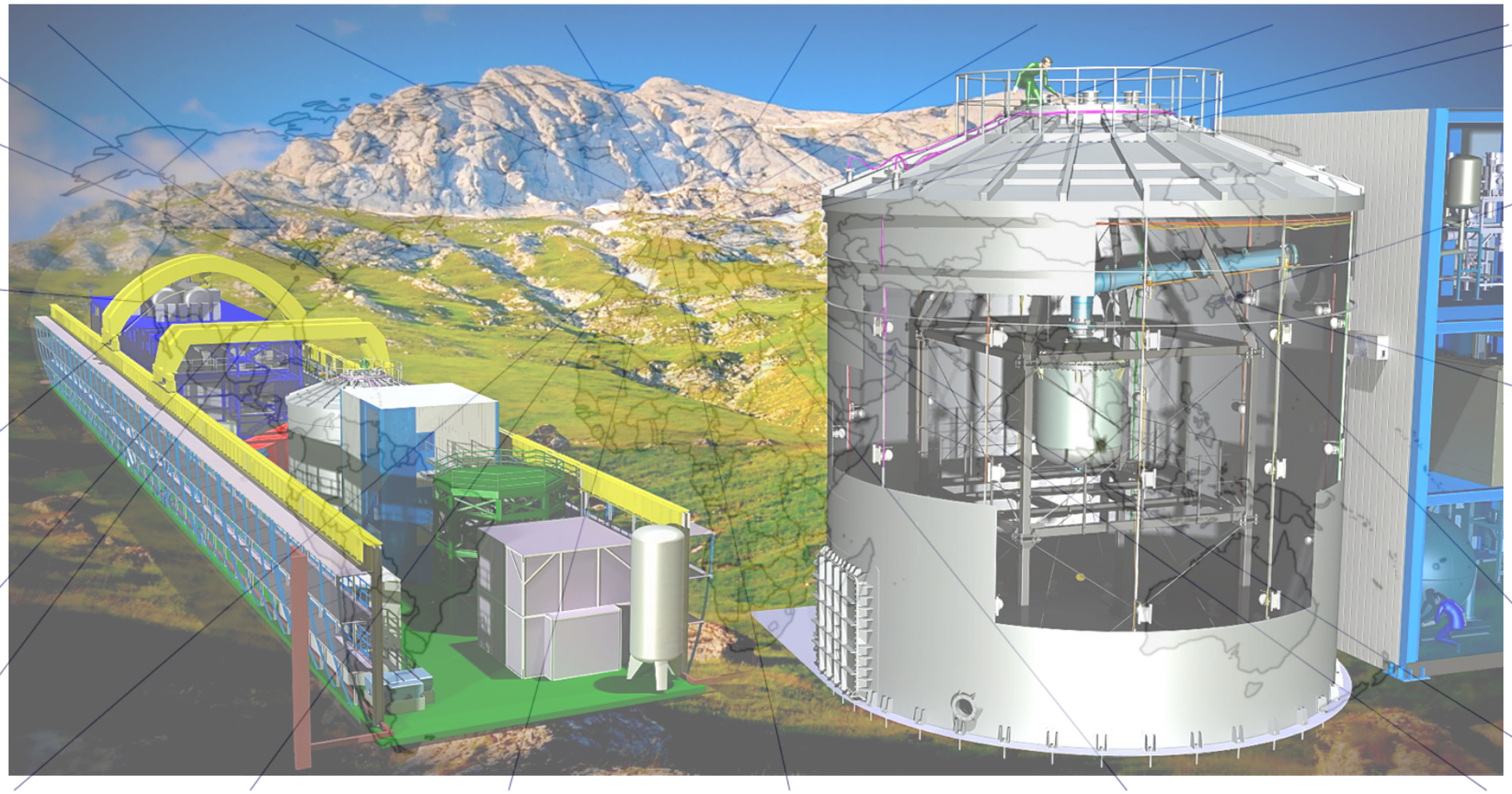
Stockholm

Mainz

MPIK

Freiburg

Zurich



Chicago

Tokyo

UCLA

Nagoya

UCSD

Kobe

Rice

Purdue

Coimbra

Subatech

LPNHE

LAL

Bologna

LNGS

Torino

Napoli

Weizmann

NYUAD

Analyzing the XENON1T Dark Matter Search Data

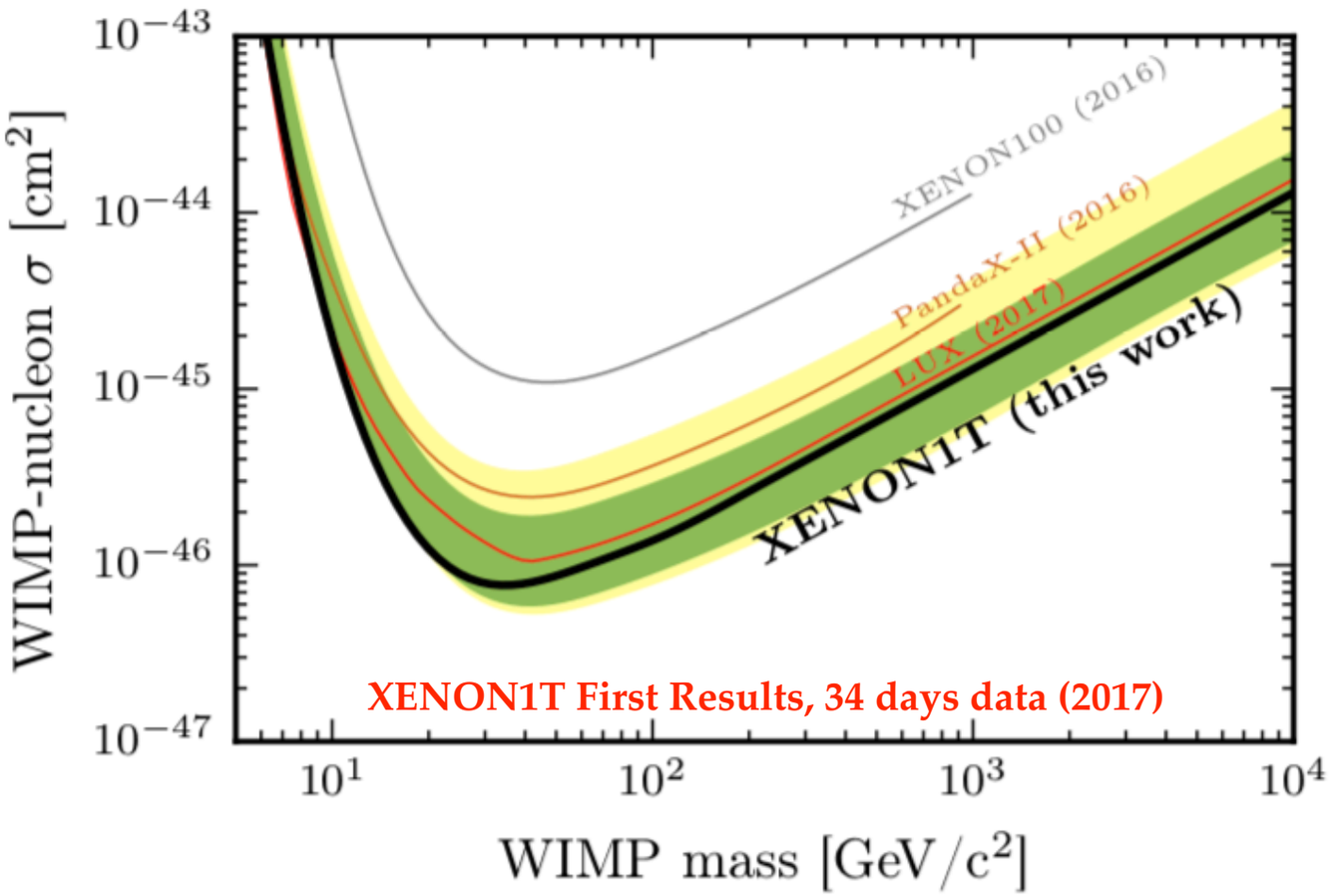
Kaixuan Ni, UC San Diego (on behalf of the XENON Collaboration)

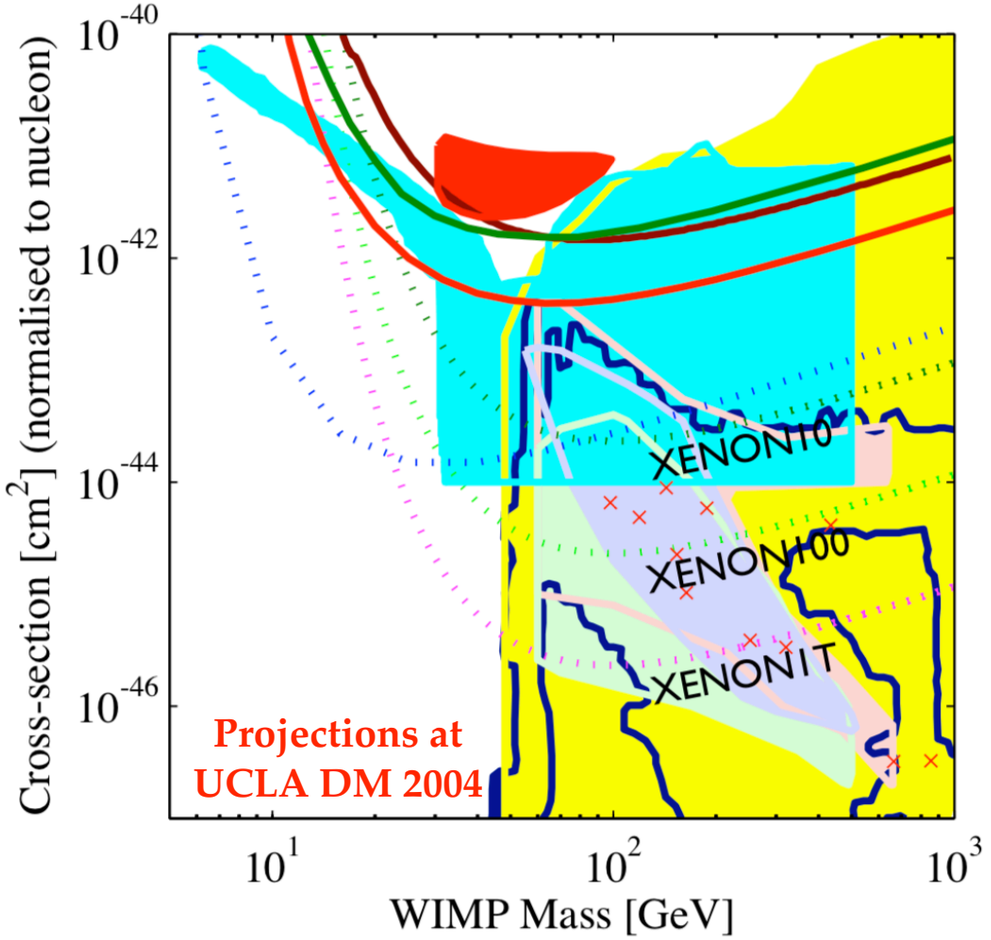
2/23/2018 UCLA Dark Matter 2018

What XENON1T has achieved…

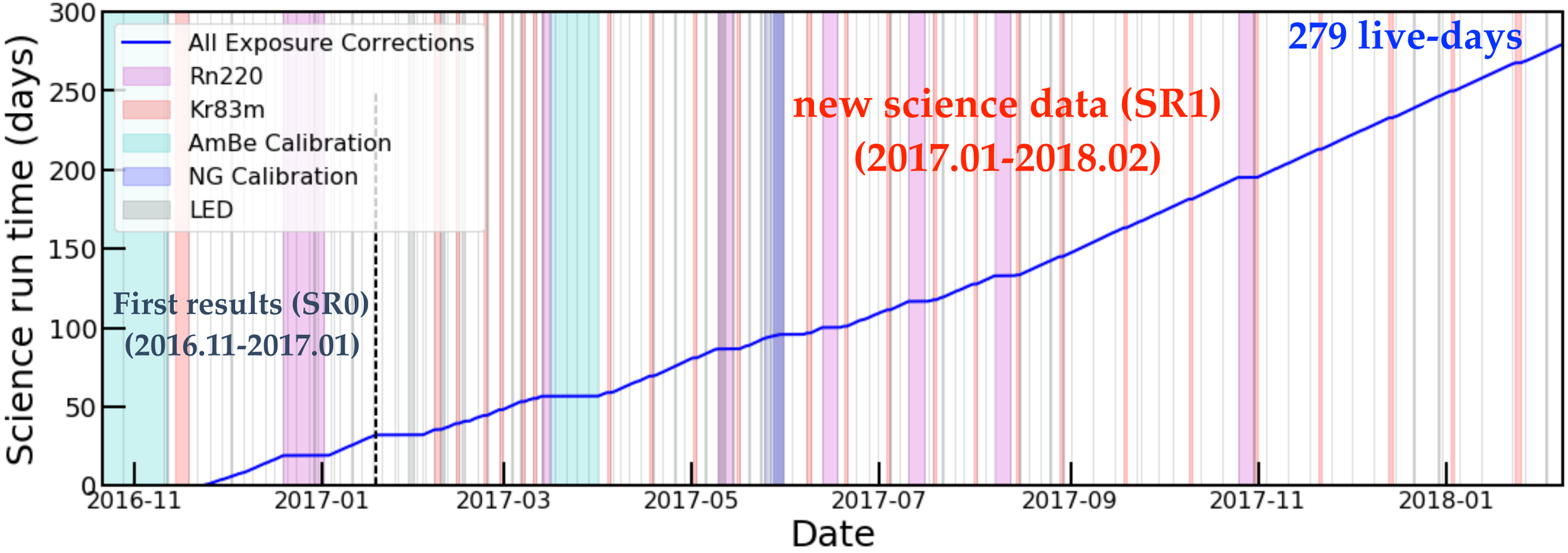
- Detector technique: two-phase xenon time projection chamber
- Active LXe target: 2.0 tonnes (the largest and most sensitive of its kind)

- Science data taking started: 2016.11 (tonne-scale LXe DM search started)
- First results (SR0): data 2016.11~2017.01
- Best limits on spin-independent interactions: 7.7×10^{-47} cm^2 at 35 GeV/c^2





The New XENON1T data and analysis improvements



- improved clustering algorithm for better pulse identification
- improved position reconstruction correcting the electric field distortion
- improved event selection, signal efficiency and background rejection
- improved signal corrections, leading to better energy resolutions
- improved modeling of ER and NR with high statistical calibration data
- improved background modeling, a larger fiducial volume

XENON1T data analysis: developing the foundational analysis techniques for DM Search with Xe

XENON1T
(real waveforms)

Geant4
+waveform
simulation

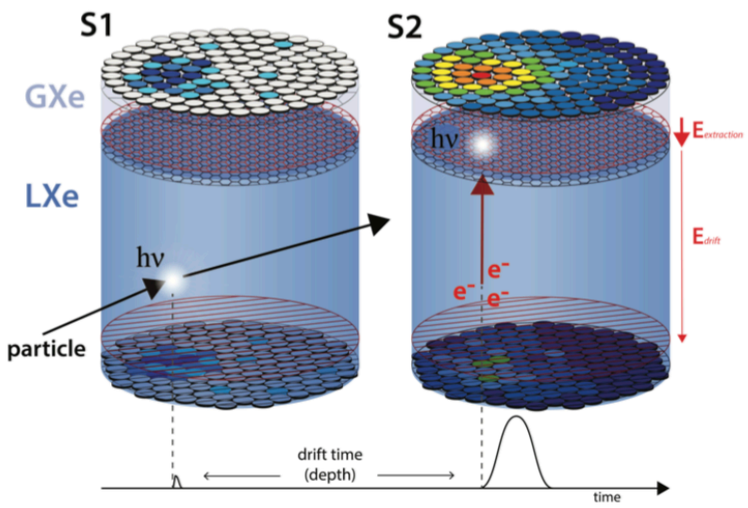
Raw data Processor
(PAX)
- pulse-finding
- pos reconstruction
- energy reconstruction
- S1, S2, etc.

Background analysis

Calibration analysis

Statistical interpretation

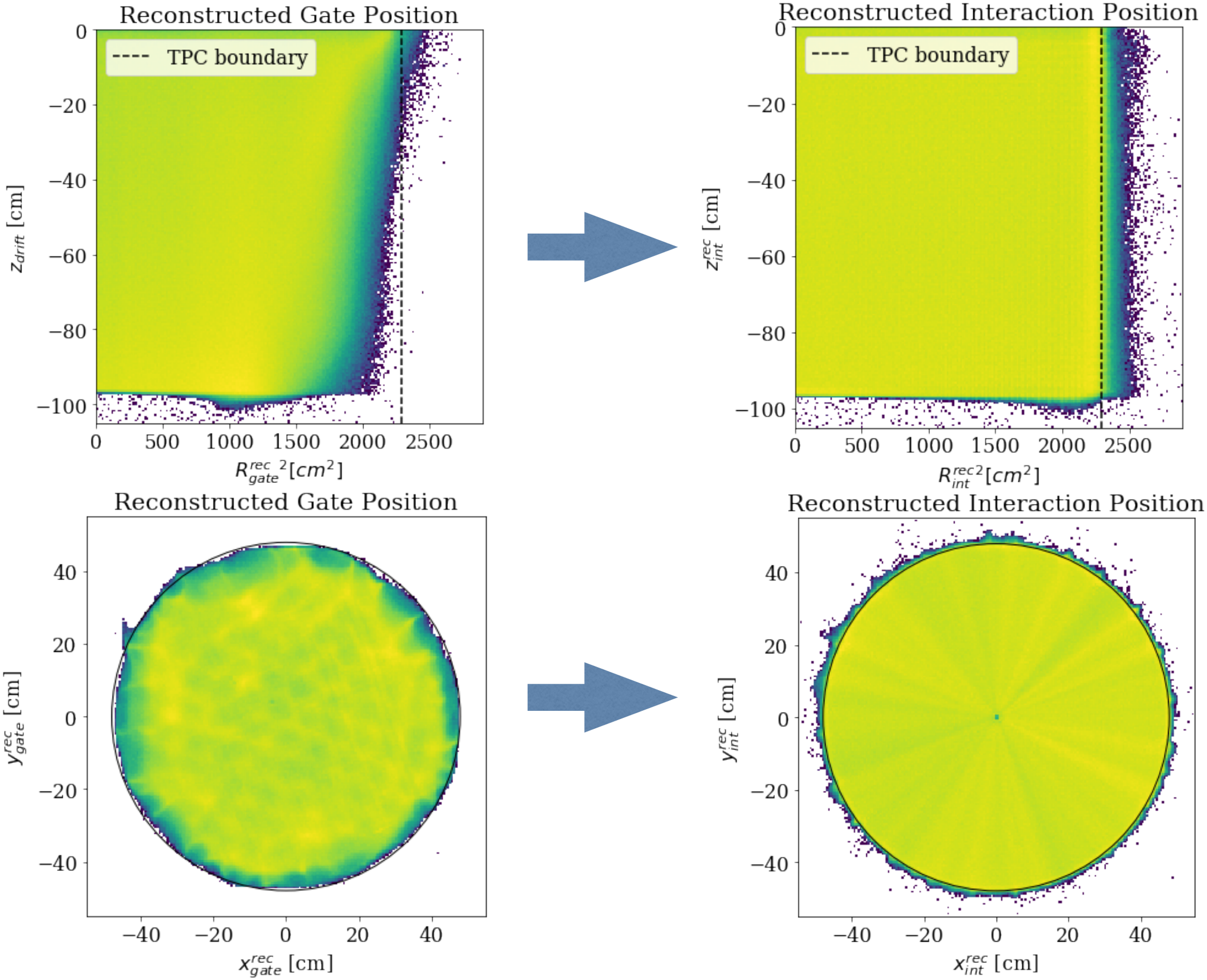
Physics Results



PAX
Processor for Analyzing XENON

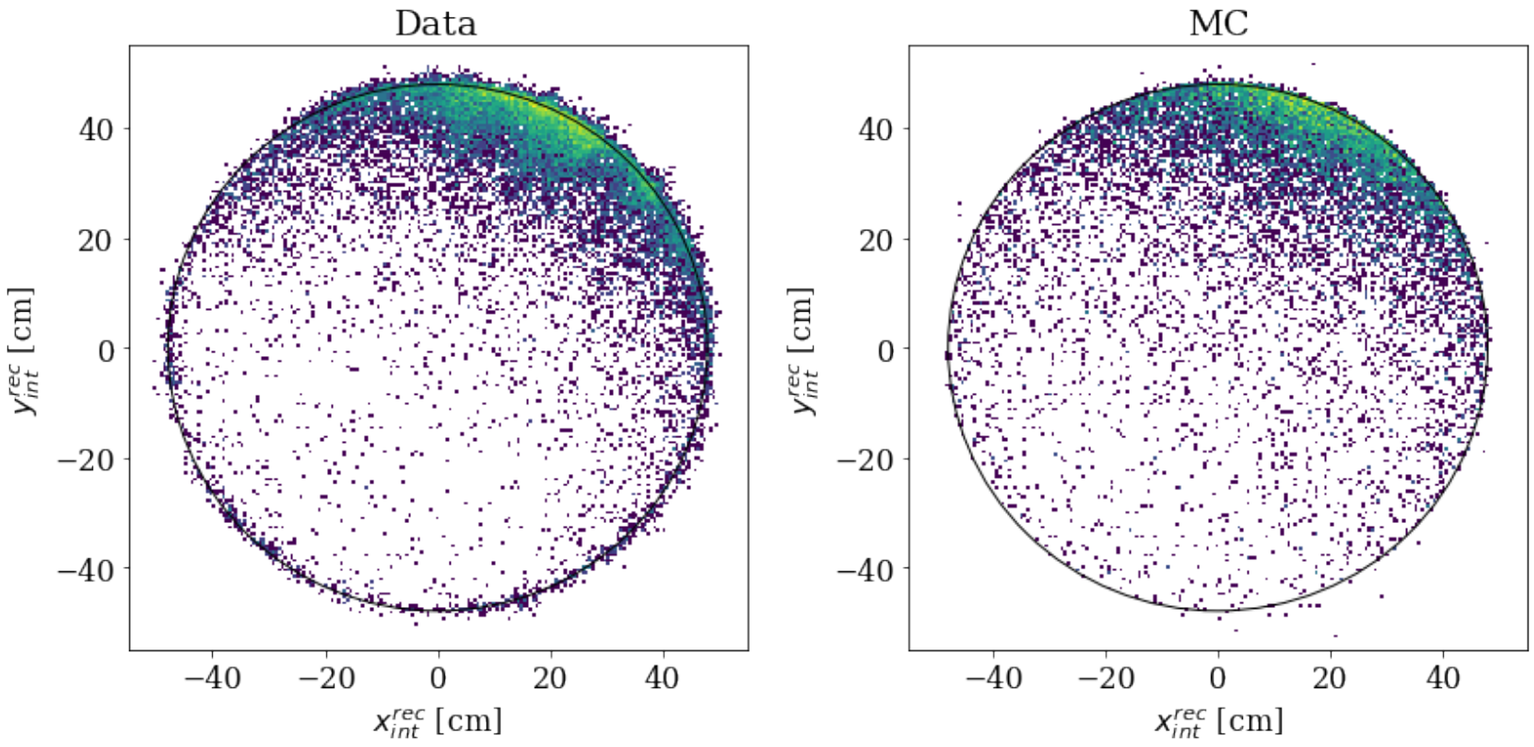
Developed by the XENON collaboration
Publicly available to the community
https://github.com/XENON1T/pax

Position reconstruction using Kr83m calibration events to account for instrumental effect

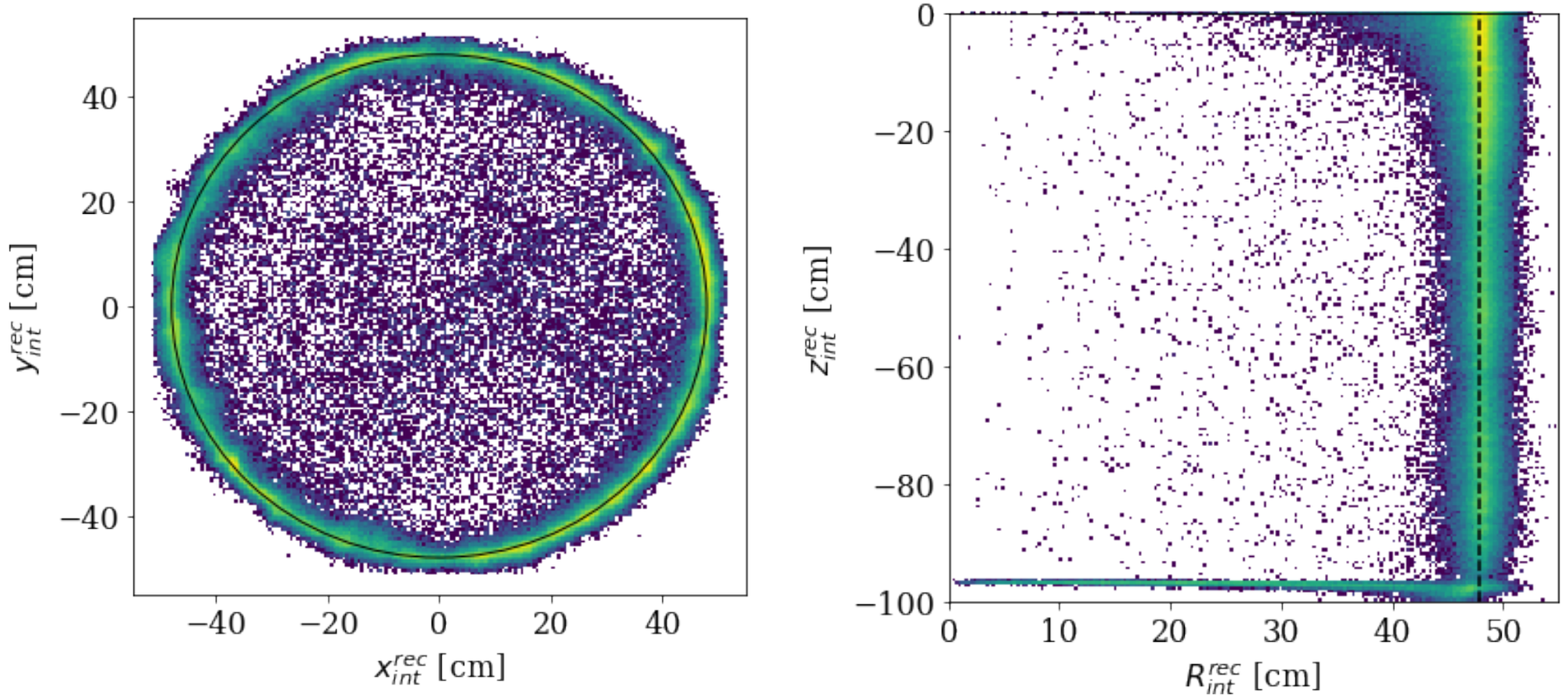


Reconstructed interaction position distribution matches well with MC

neutron calibration

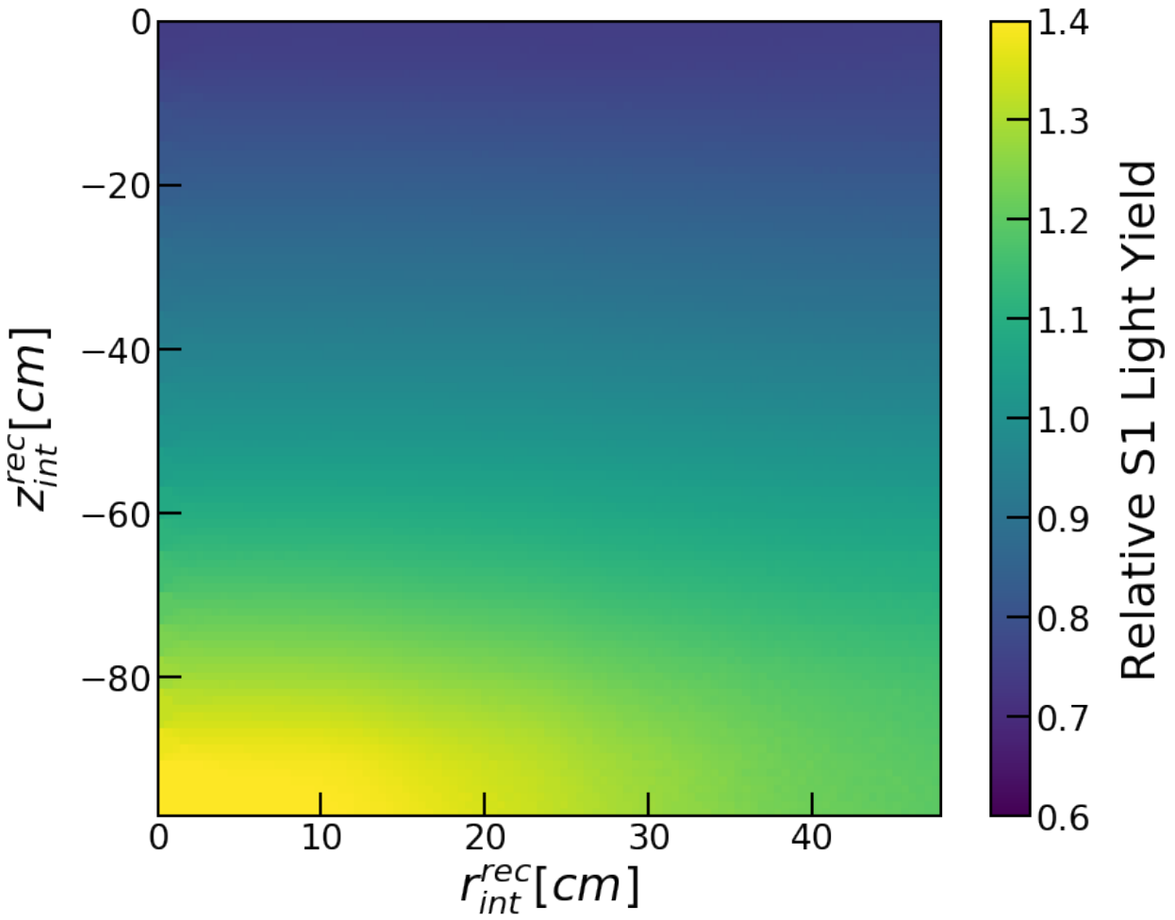


Reconstructed interaction position distribution for background events

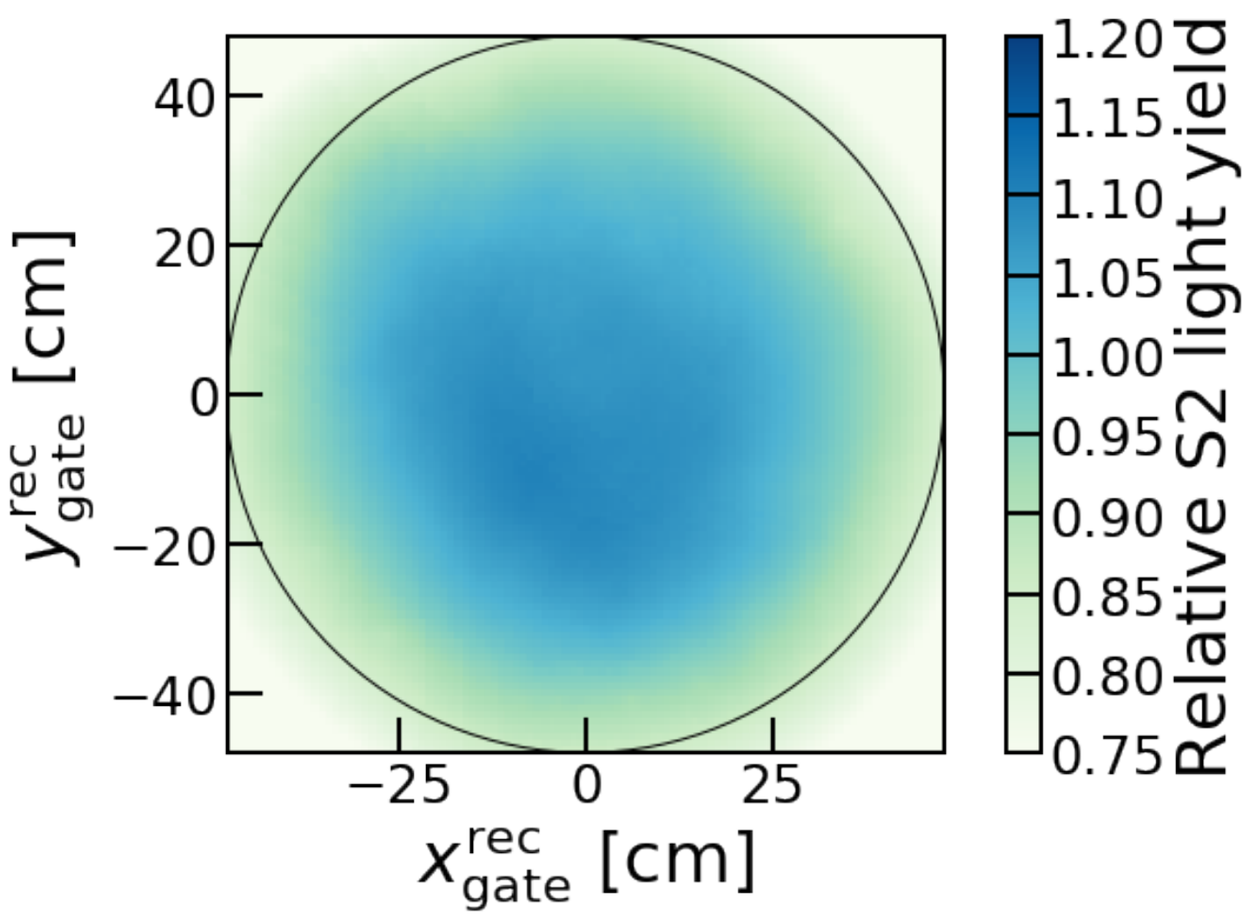


Position dependence of S1 and S2 signals are corrected using Kr83m calibration

S1 light yield



S2 bottom vs observed XY position

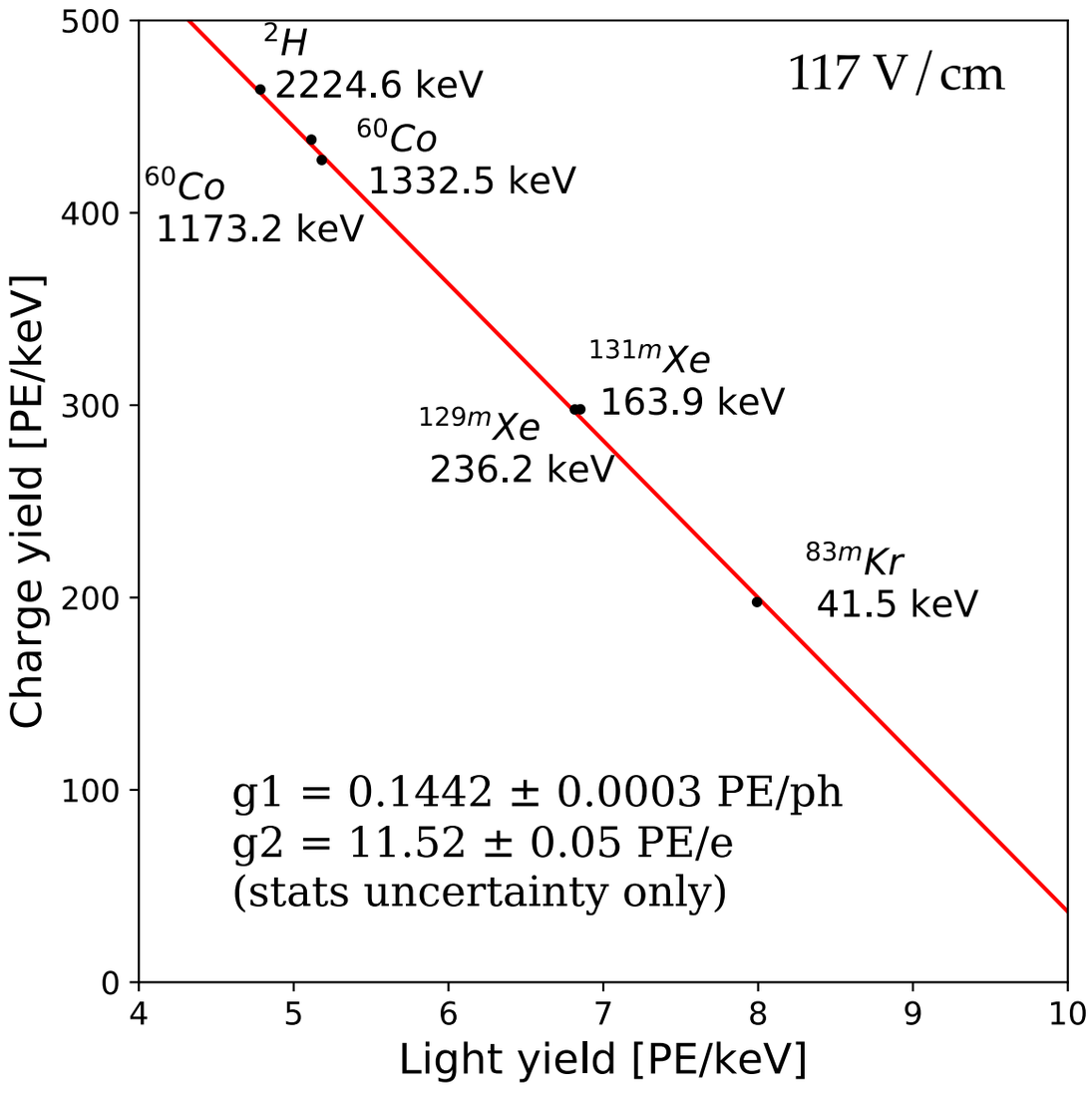


S2's z dependence is corrected according to the measured electron lifetime.

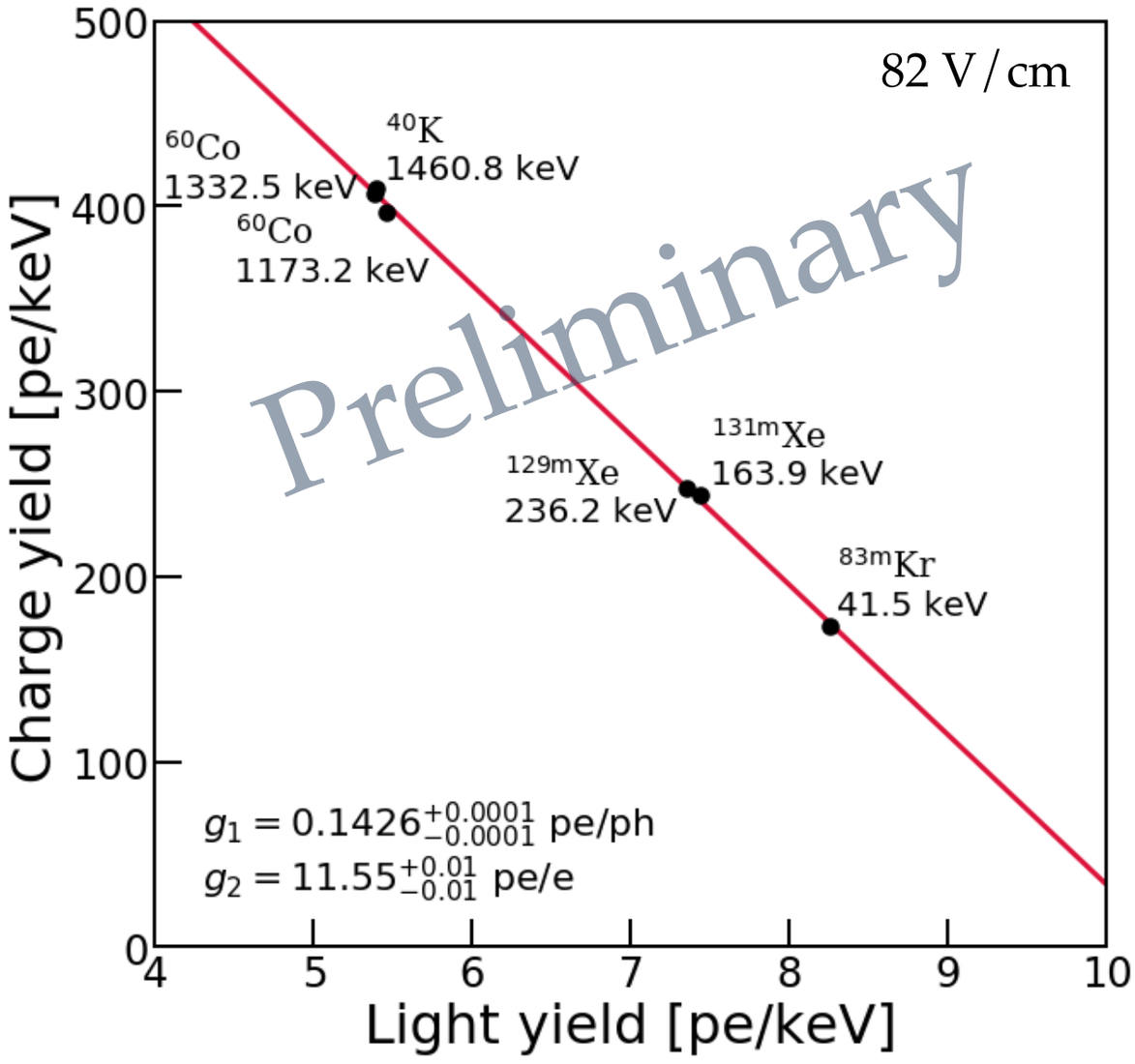
Energy calibration and g1, g2 values

$$E = (n_{ph} + n_e) \cdot W = (\frac{S1}{g1} + \frac{S2}{g2}) \cdot W$$

First Science Run (SR0)

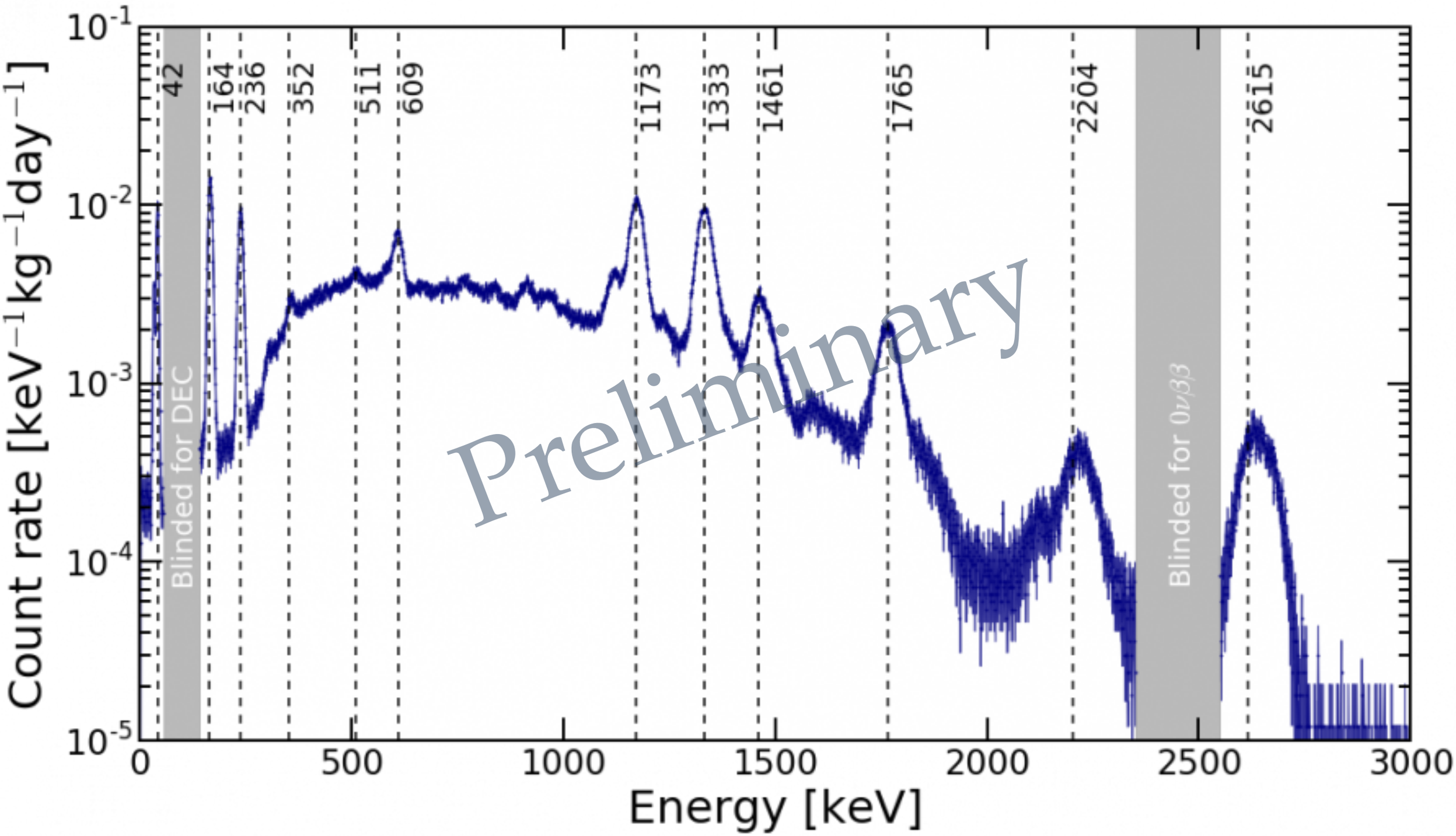


New Science Data (SR1)



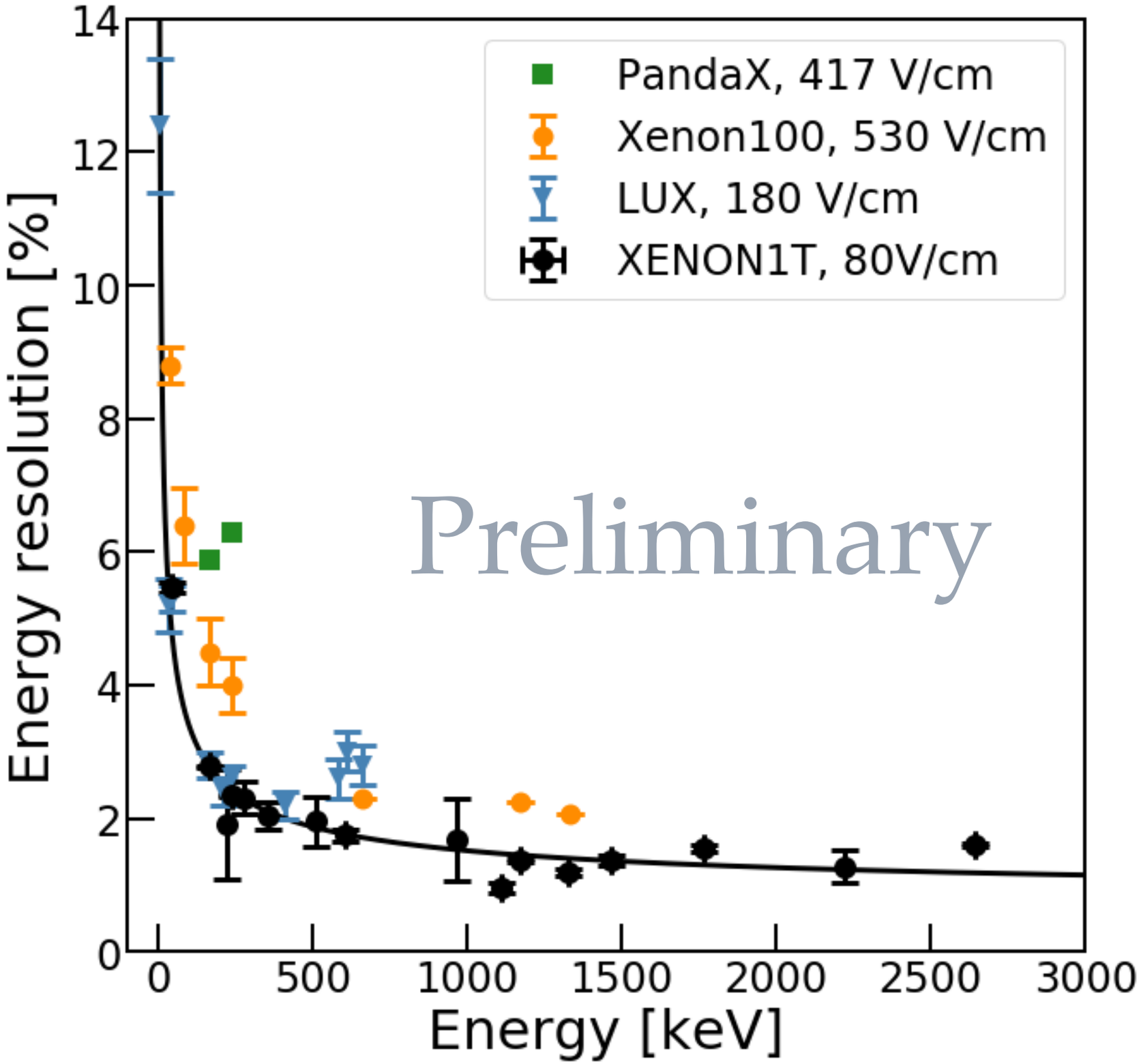
Excellent energy resolution achieved in XENON1T

$$E = (n_{ph} + n_e) \cdot W = (\frac{S1}{g1} + \frac{S2}{g2}) \cdot W$$



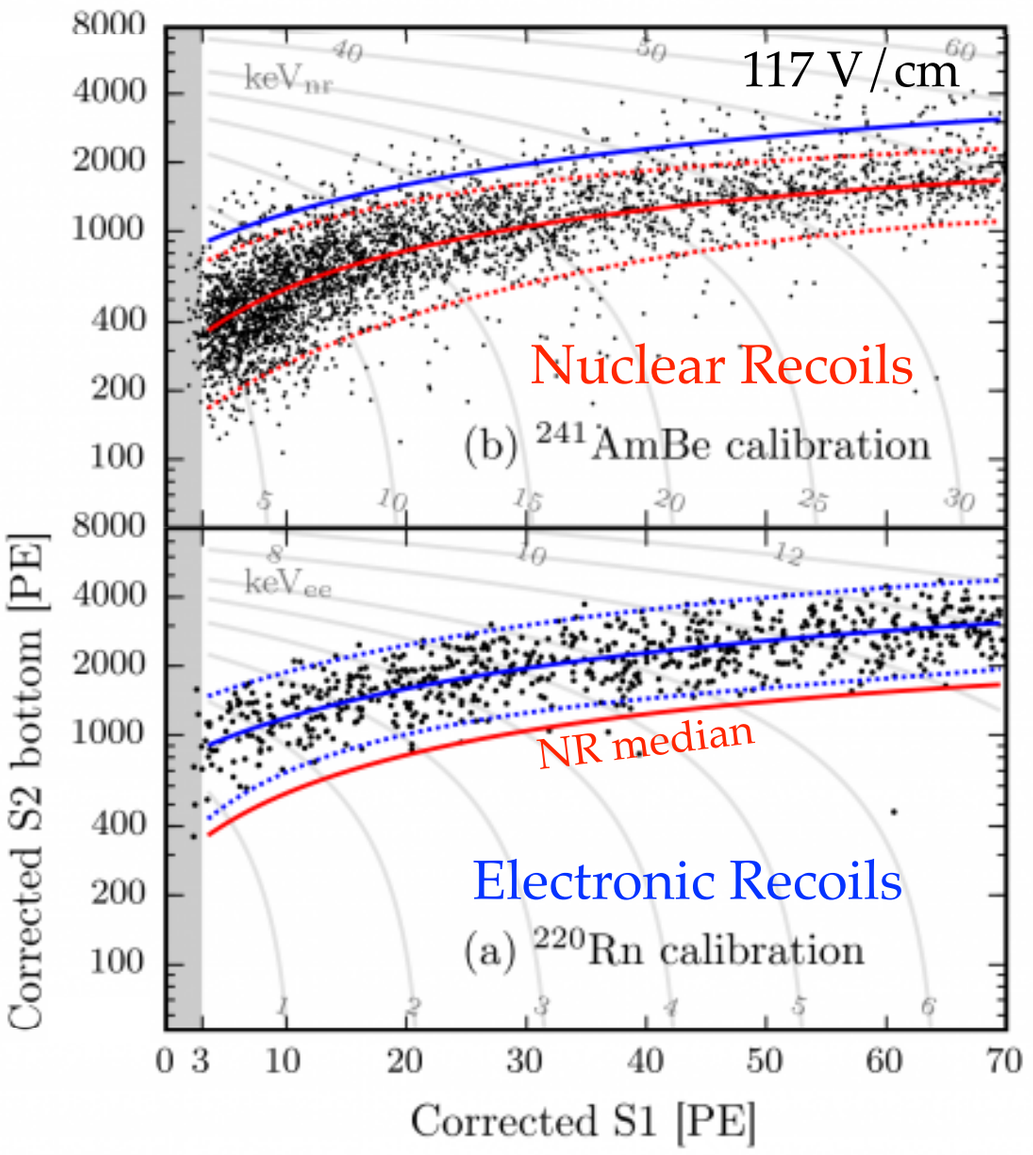
Excellent energy resolution achieved in XENON1T

σ/E



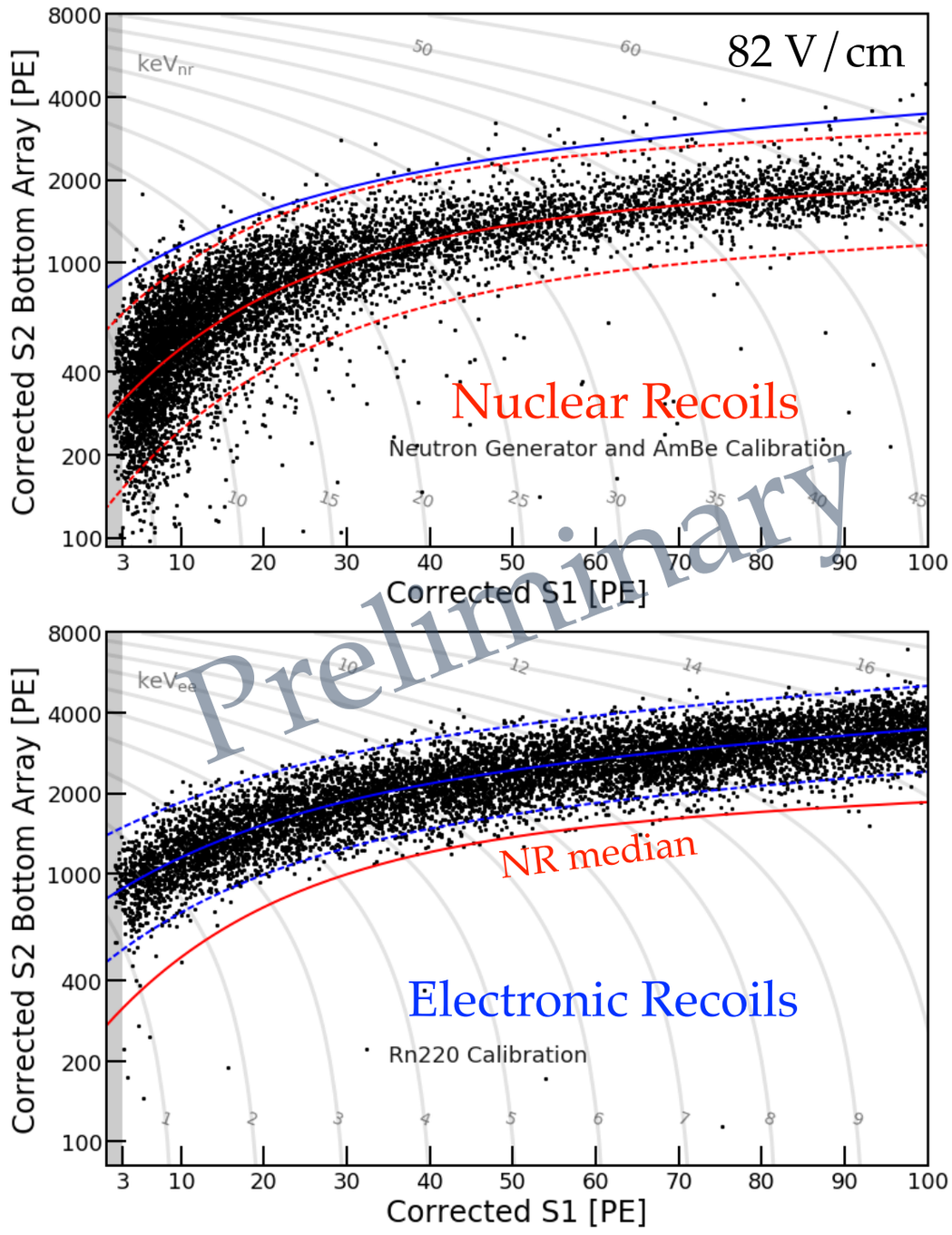
Low energy responses from Rn220 & neutron calibration data

First Results (SR0)



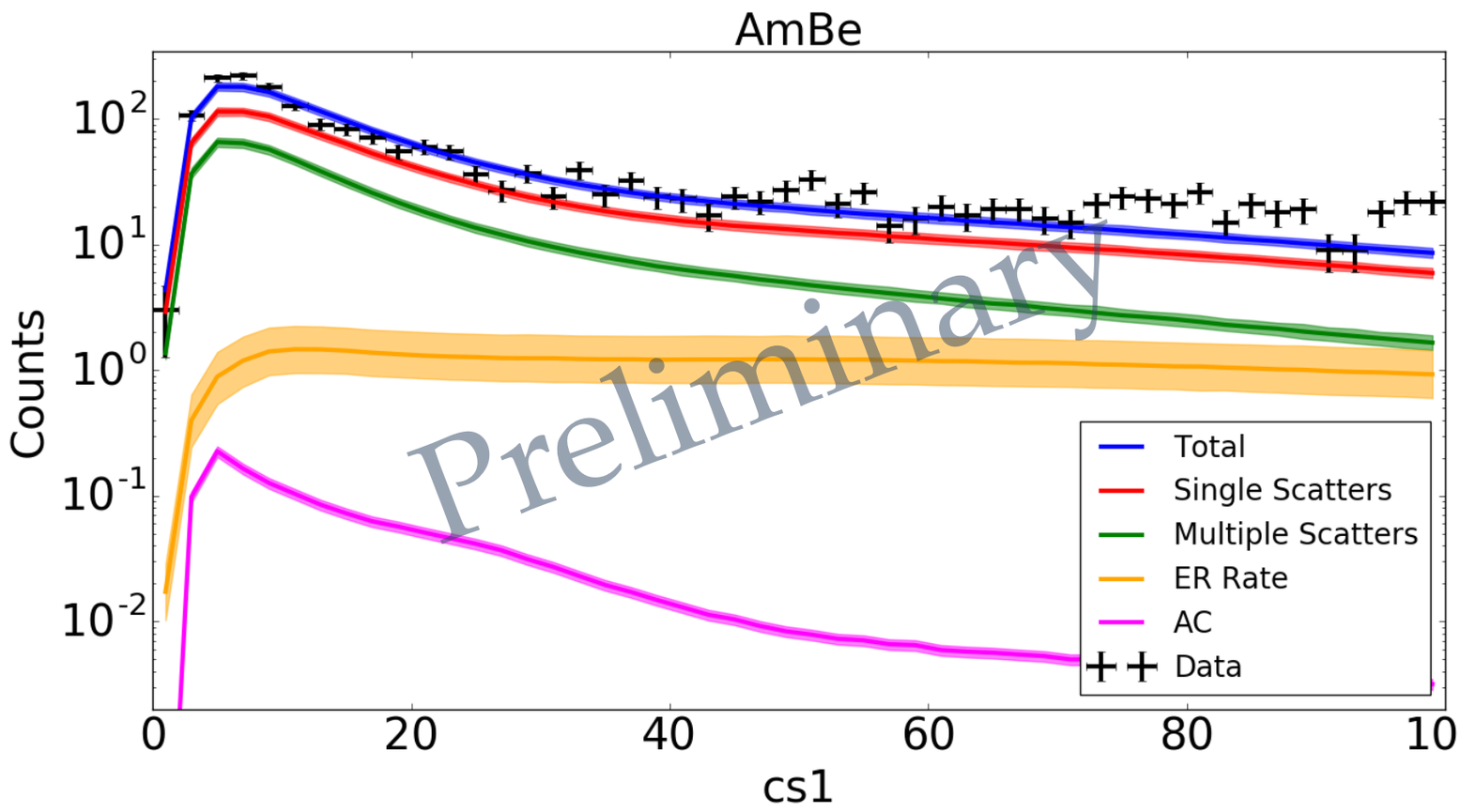
ER rejection: (99.7+/-0.2)% with 47.7%
NR acceptance within [-2σ, median]

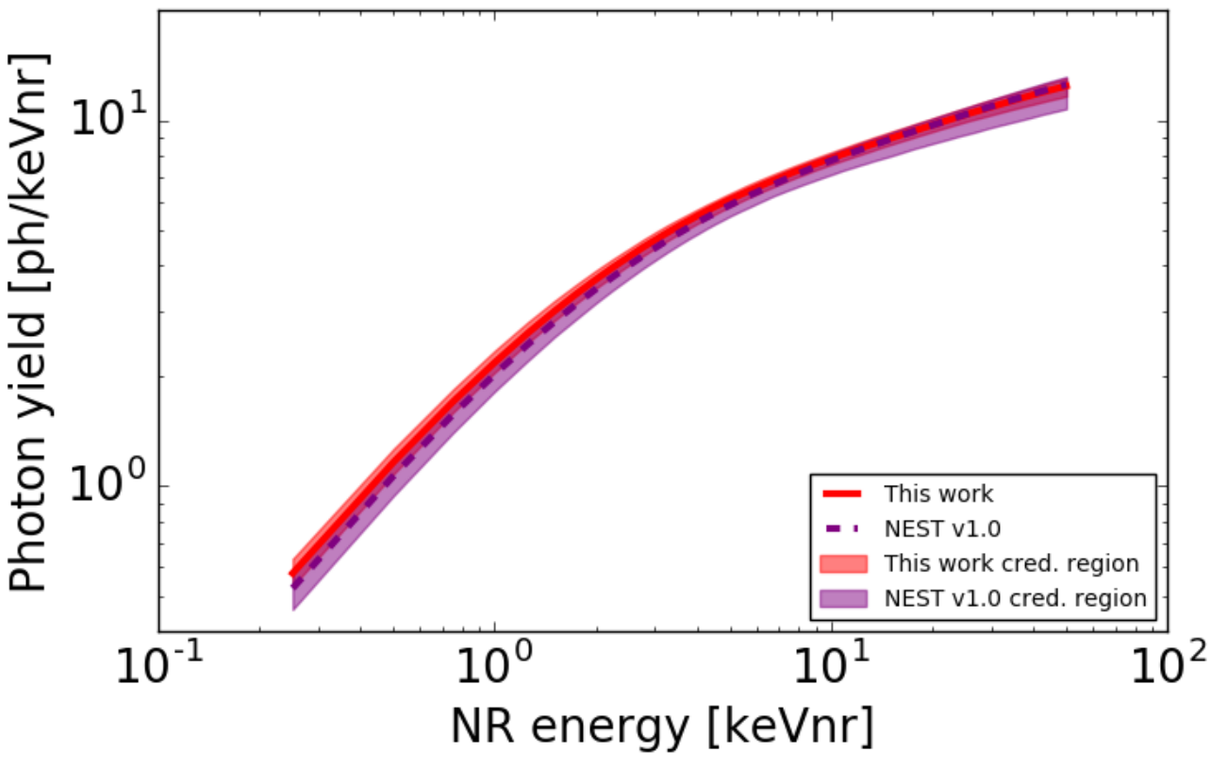
New Data (SR1)

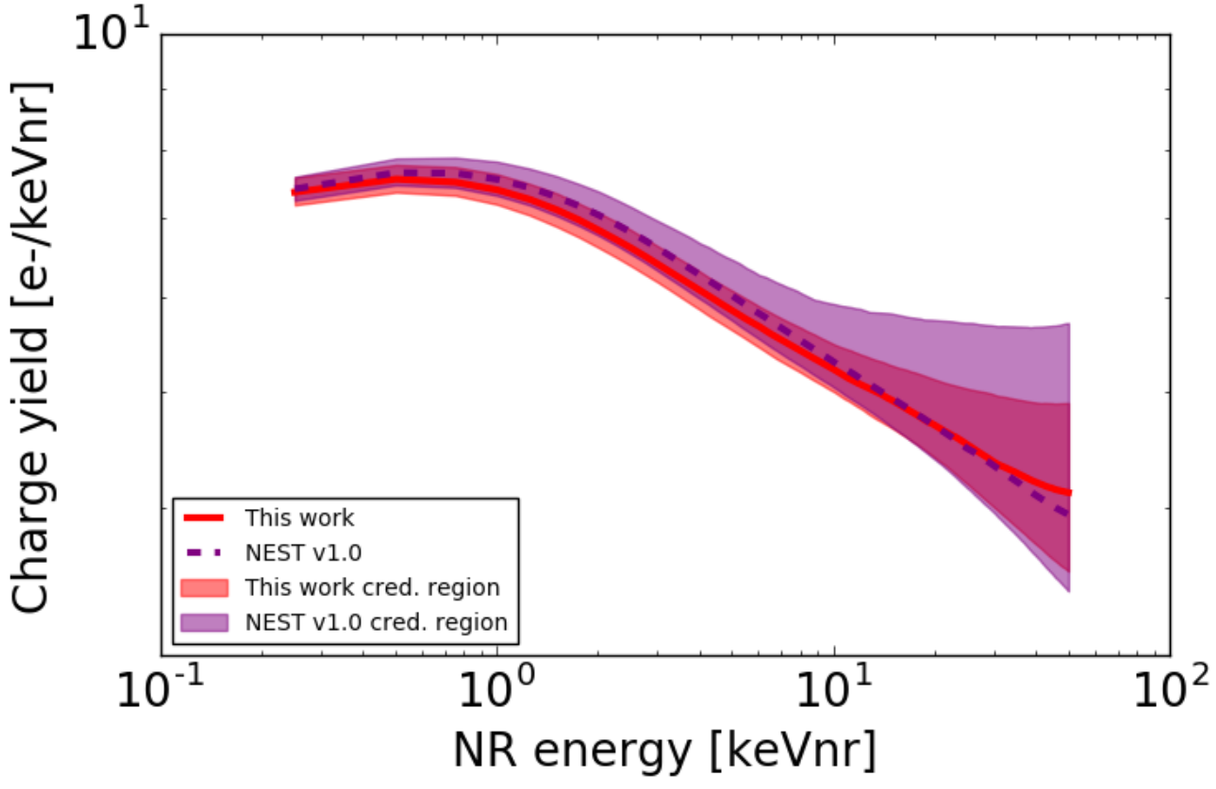


ER rejection: (99.82+/-0.05)%

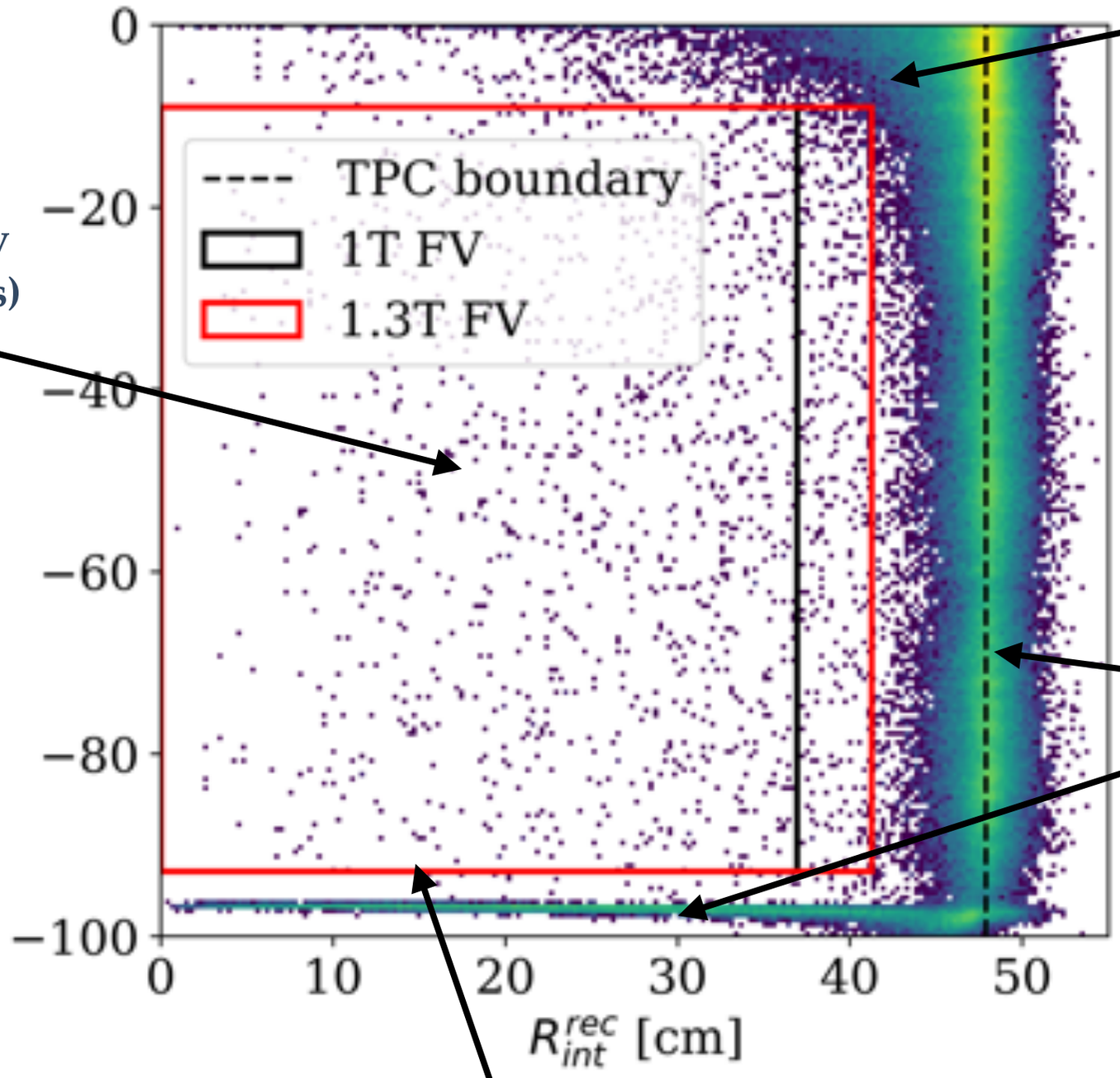
Nuclear recoil light/charge yields are consistent with the global model







Low Energy Background (signal region blinded) in XENON1T



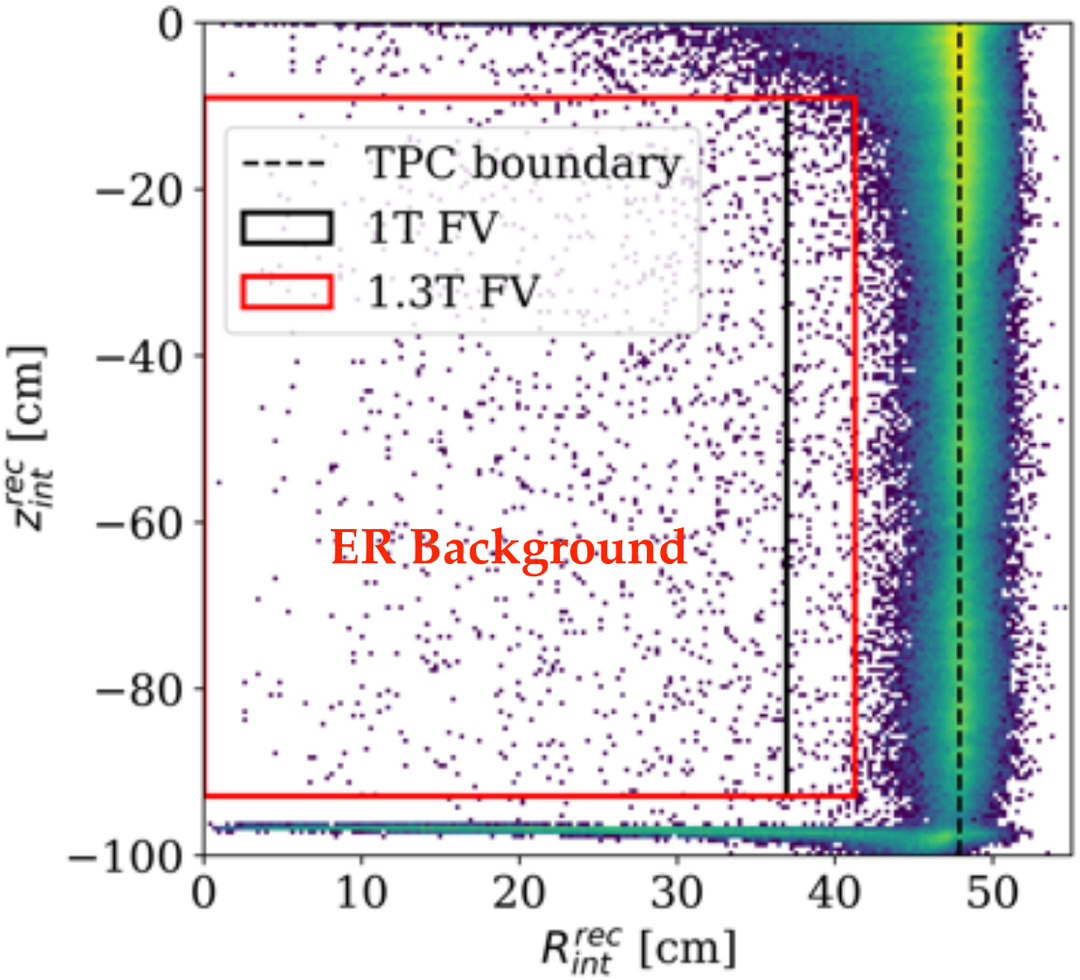
Electronic Recoils (external gammas)

Electronic Recoils (mostly Rn222-progeny Pb214, Kr85 beta decays)

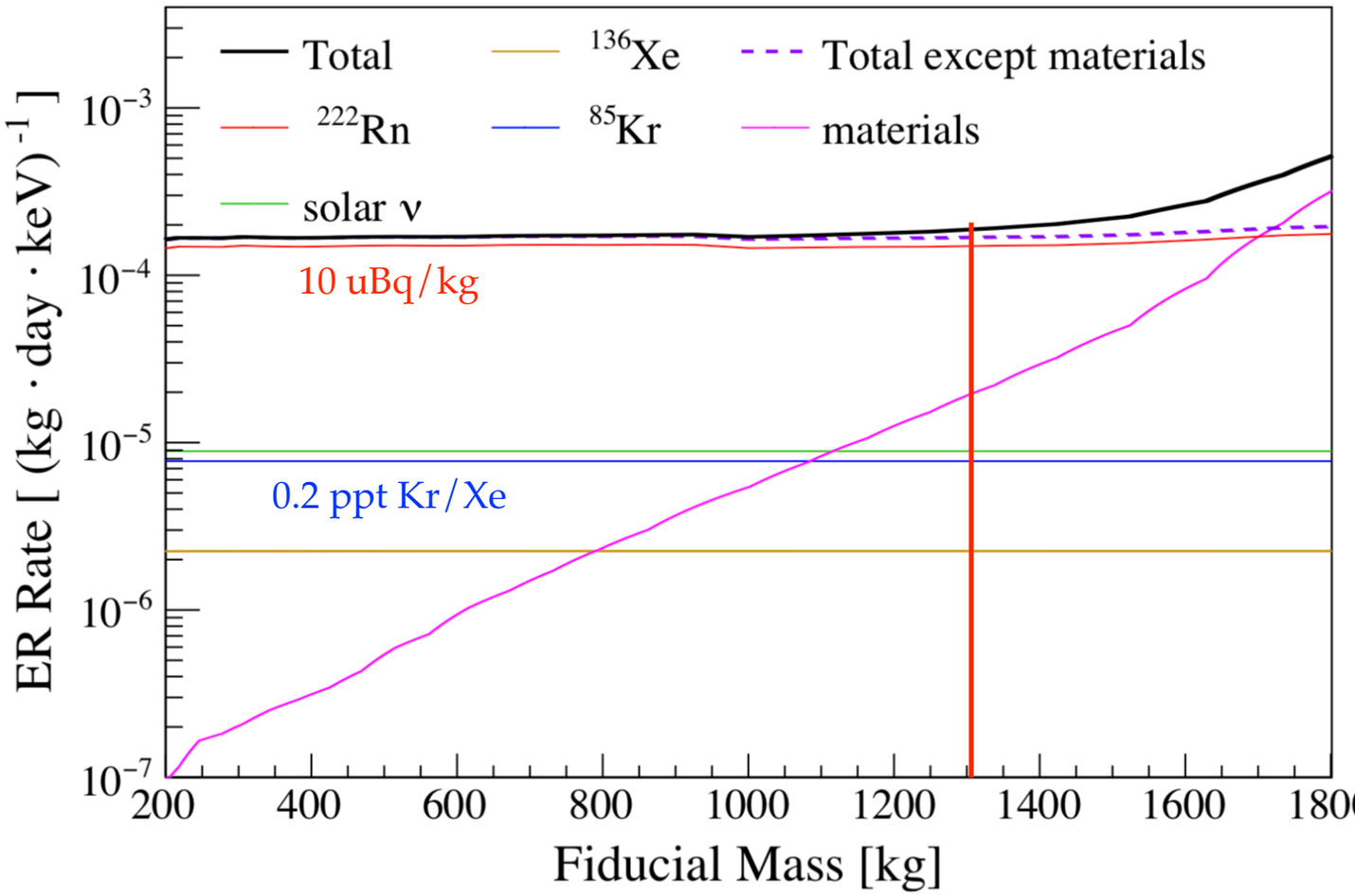
Surface events

Toy Fiducial Volumes

Low energy Electron Recoils (ER) Background



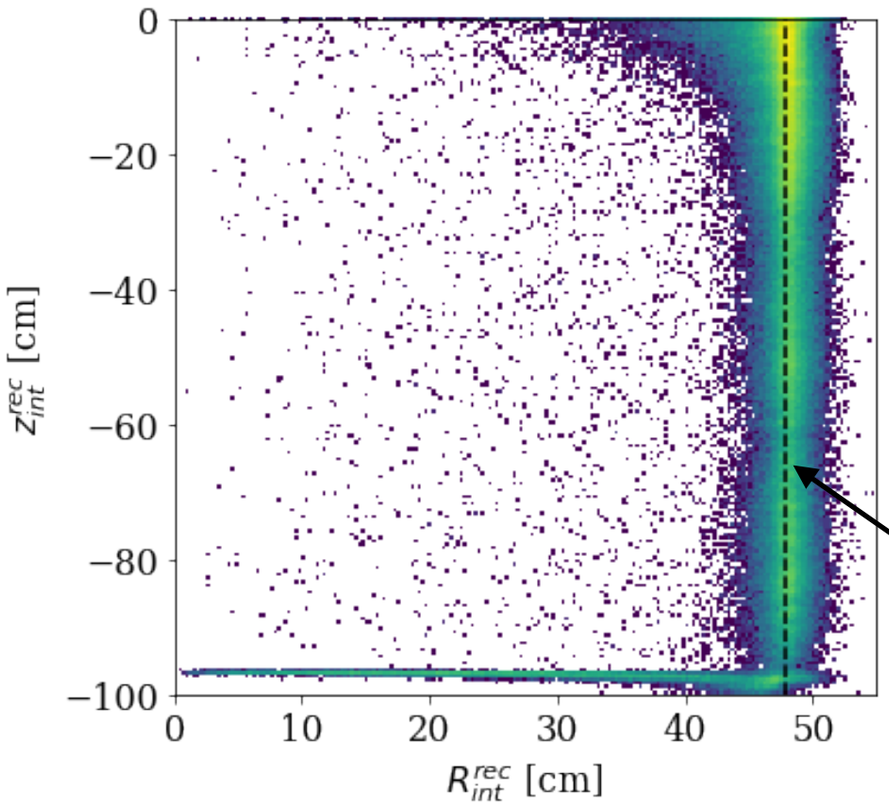
MC prediction, arXiv:1512.07501

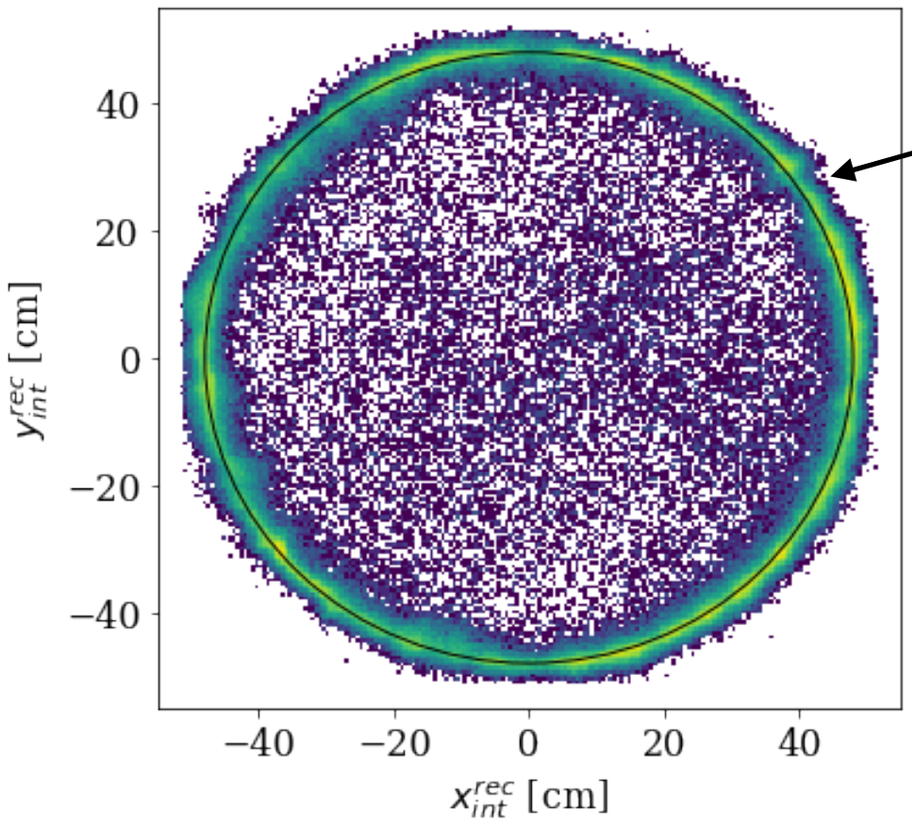


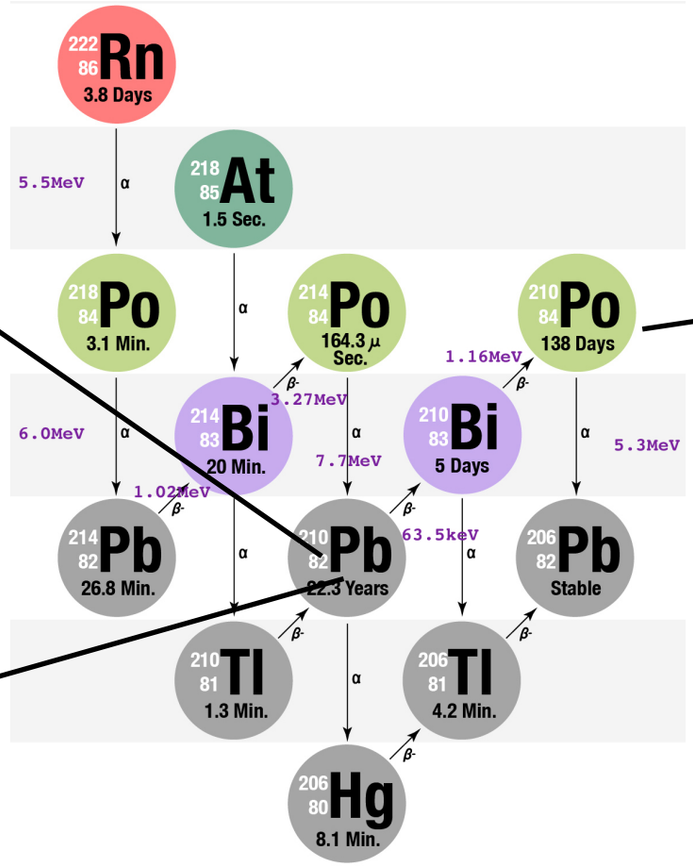
Measured ER background is very consistent with the prediction!

Surface Background

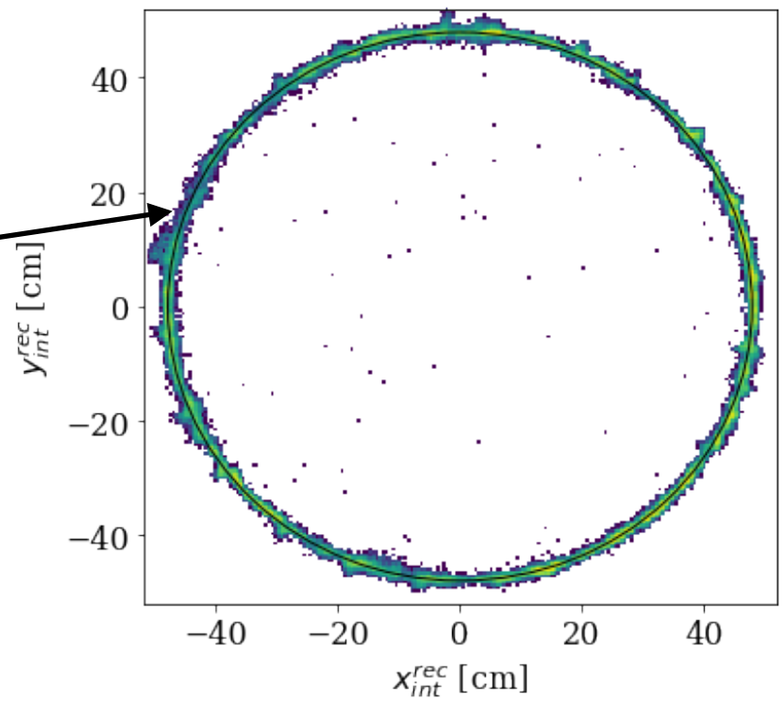
low energy



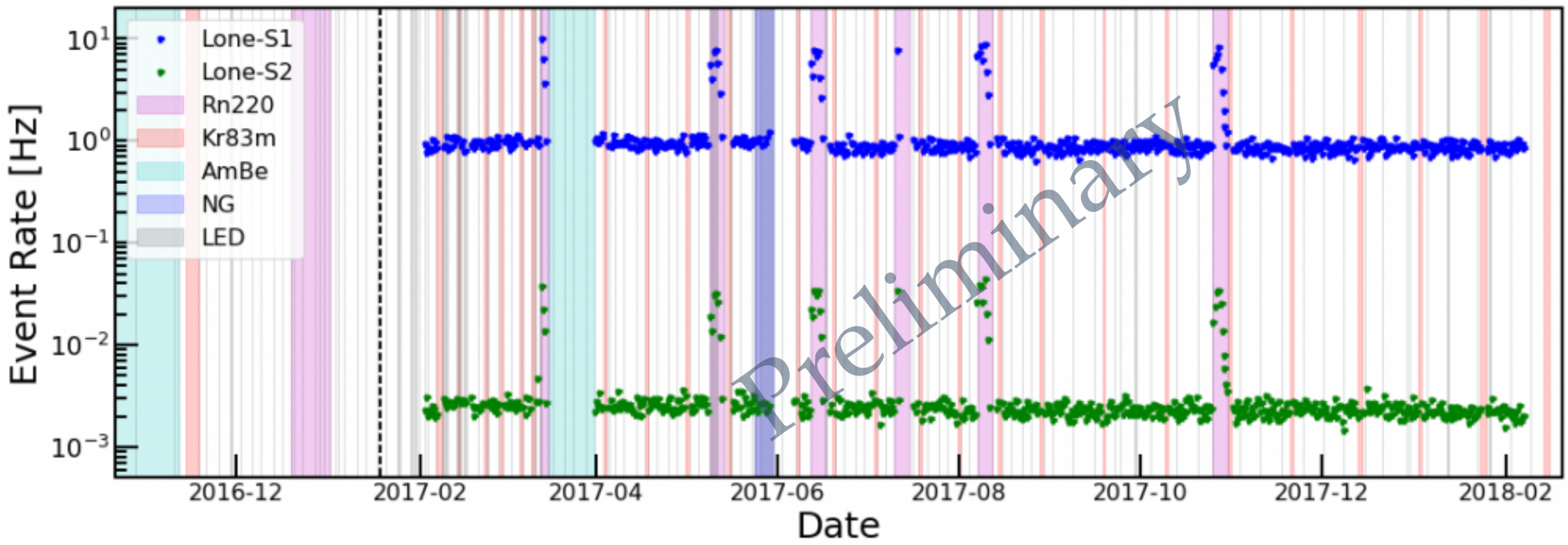


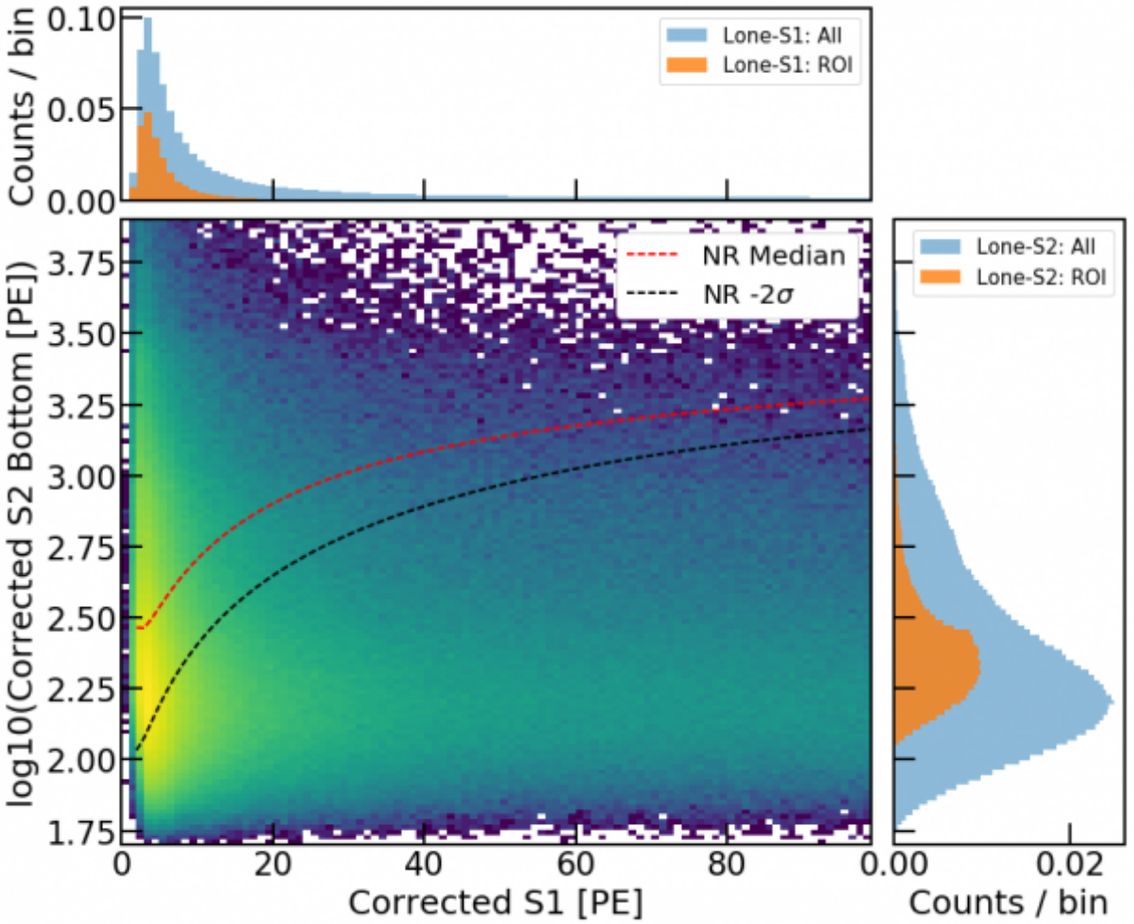


5.3 MeV alpha



Accidental Coincidence (AC) Background

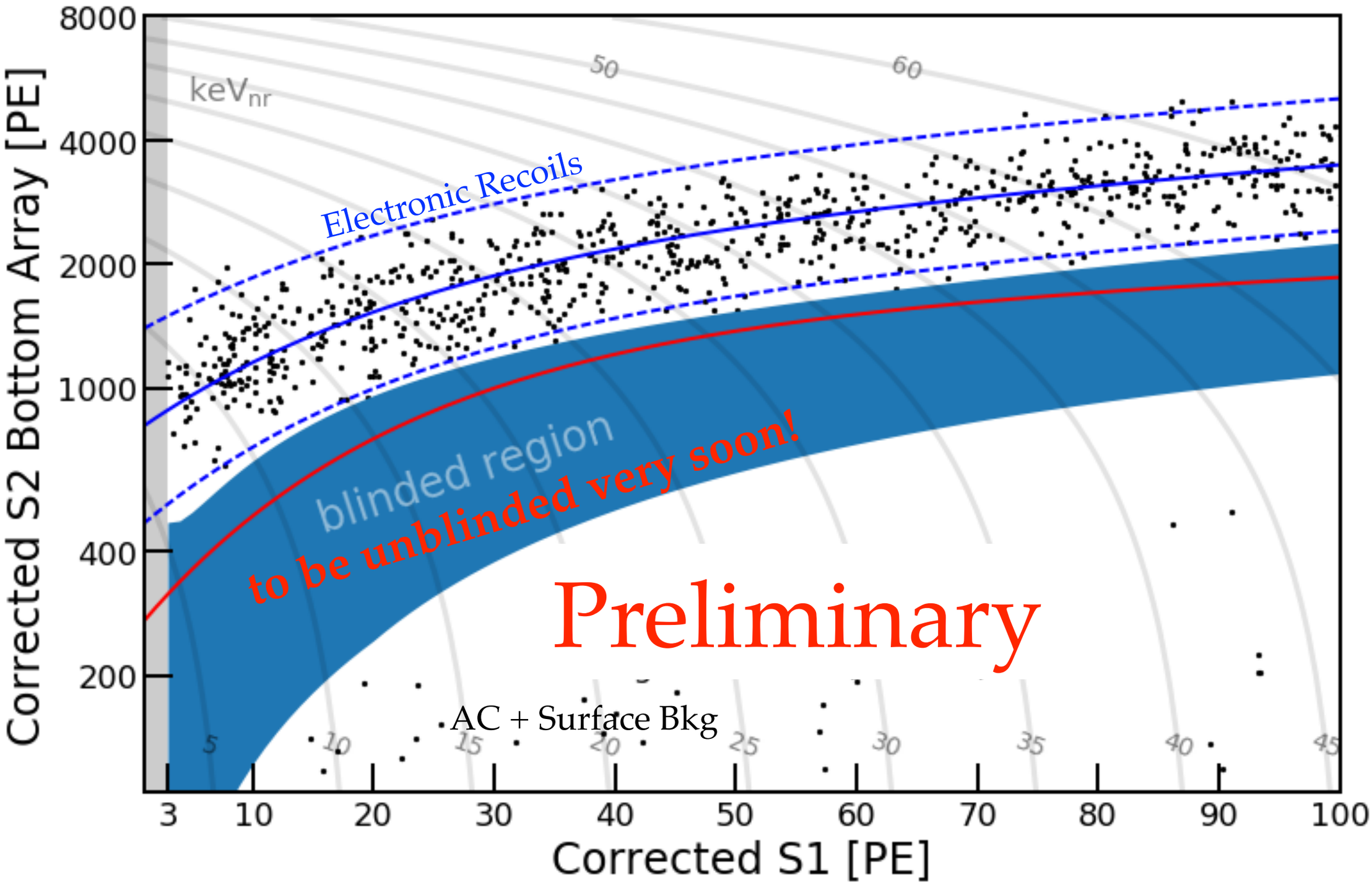




Other sub-dominant background components:

- Radiogenic neutrons
- Coherent neutrino-nucleus scattering (CNNS)

SR1 Dark Matter Search Data in **1.3-ton x 247 live-days**



Stay tuned for the expected most exciting DM search results of 2018!

http://www.xenon1t.org/ **Twitter: @Xenon1T**