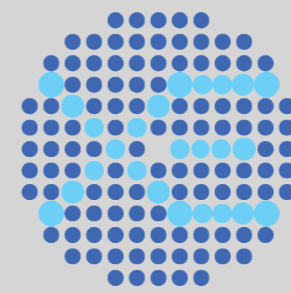




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XENON

Accidental coincidence background in XENONnT

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On behalf of the XENON Collaboration

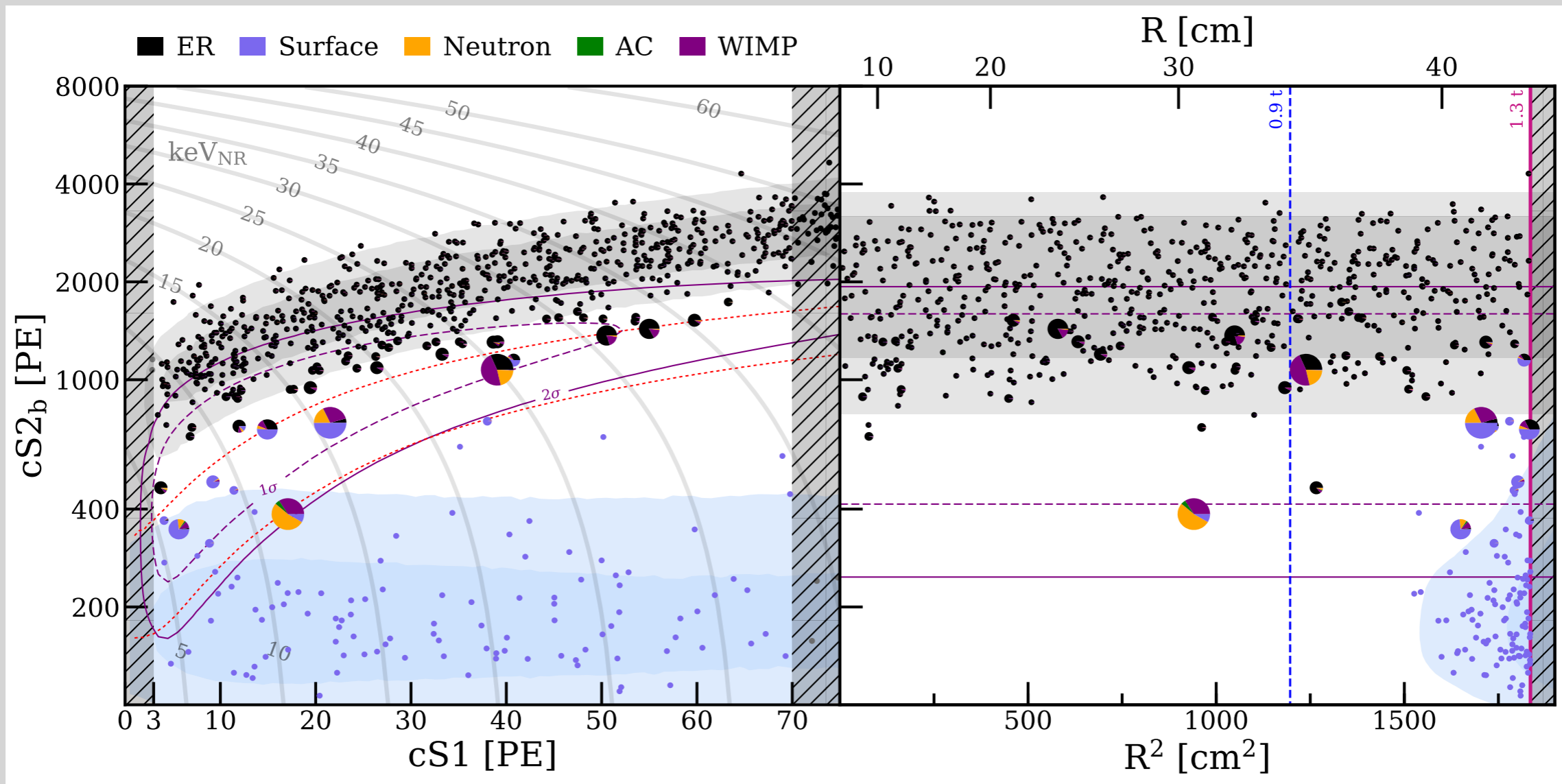


Current progress

- New techniques removing intrinsic background
- Blinded analysis of the first science data
- No ER excess found



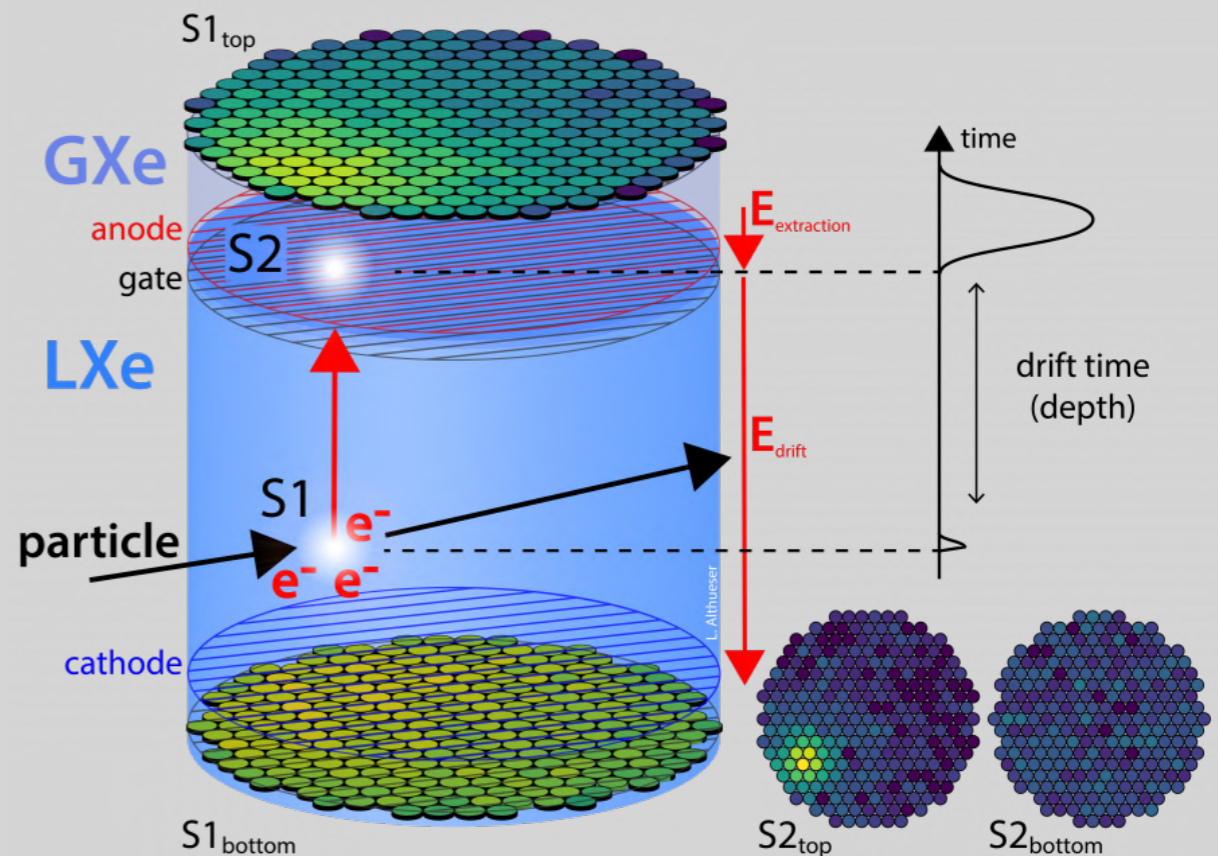
Backgrounds in LXe TPC



From XENON1T 1tXy result

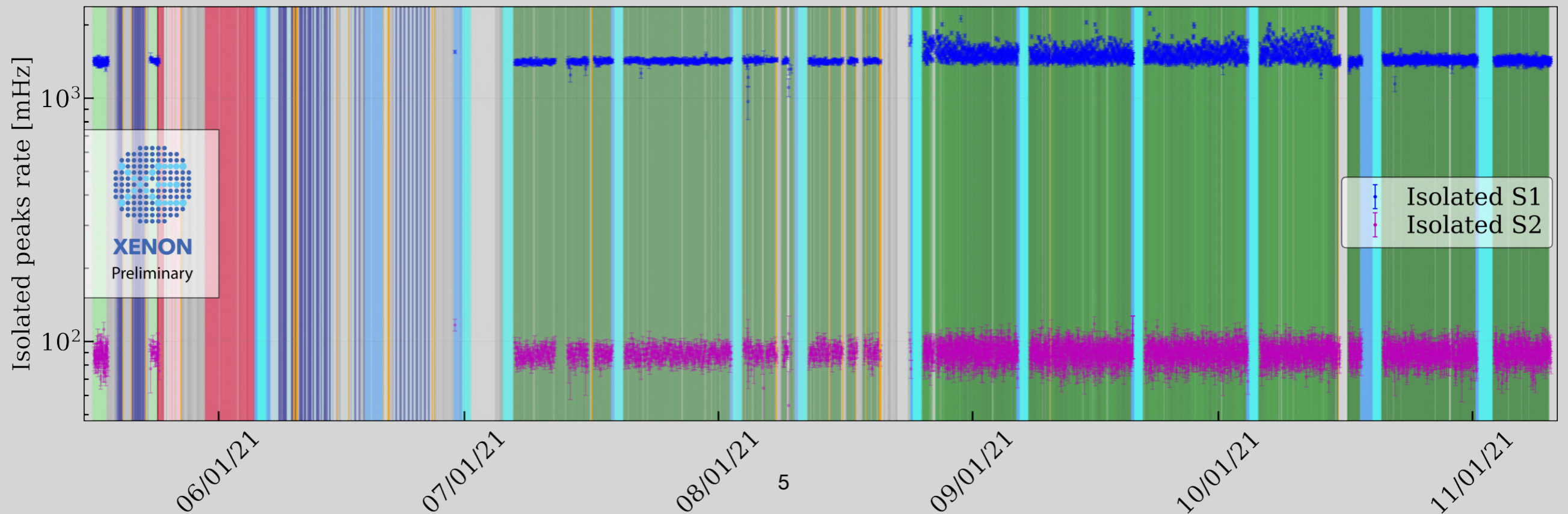
Accidental coincidence

- AC background is random pairing of isolated S1 and S2
- Isolated peaks have no causal connection to preceding events
- Drift time of AC obeys uniform distribution



Isolated peaks

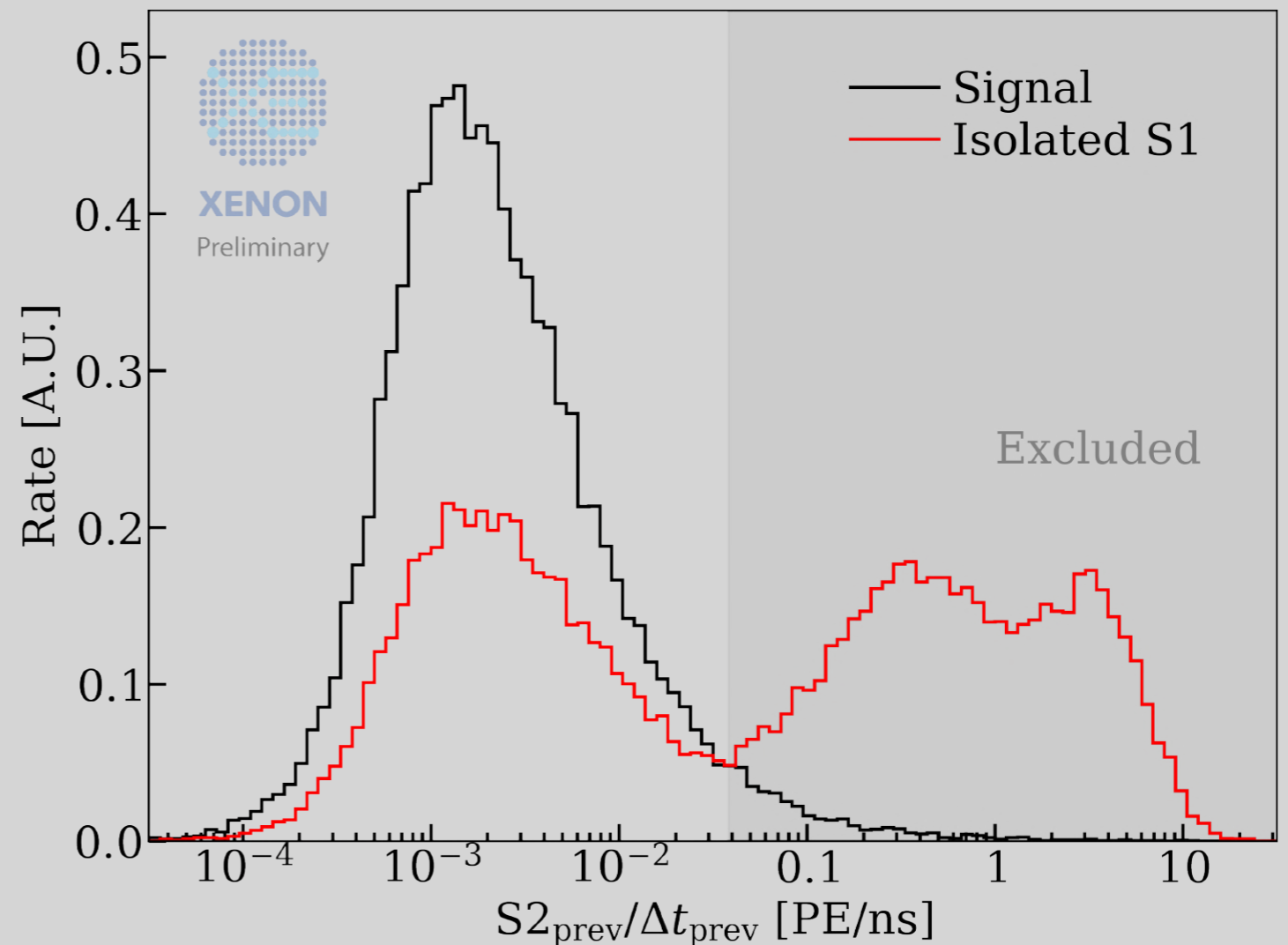
- Isolated S1(3 fold):
 - lone hits pile-up
 - single electrons misclassification...
- Isolated S2:
 - Delayed extraction due to low extraction efficiency...



Shadow

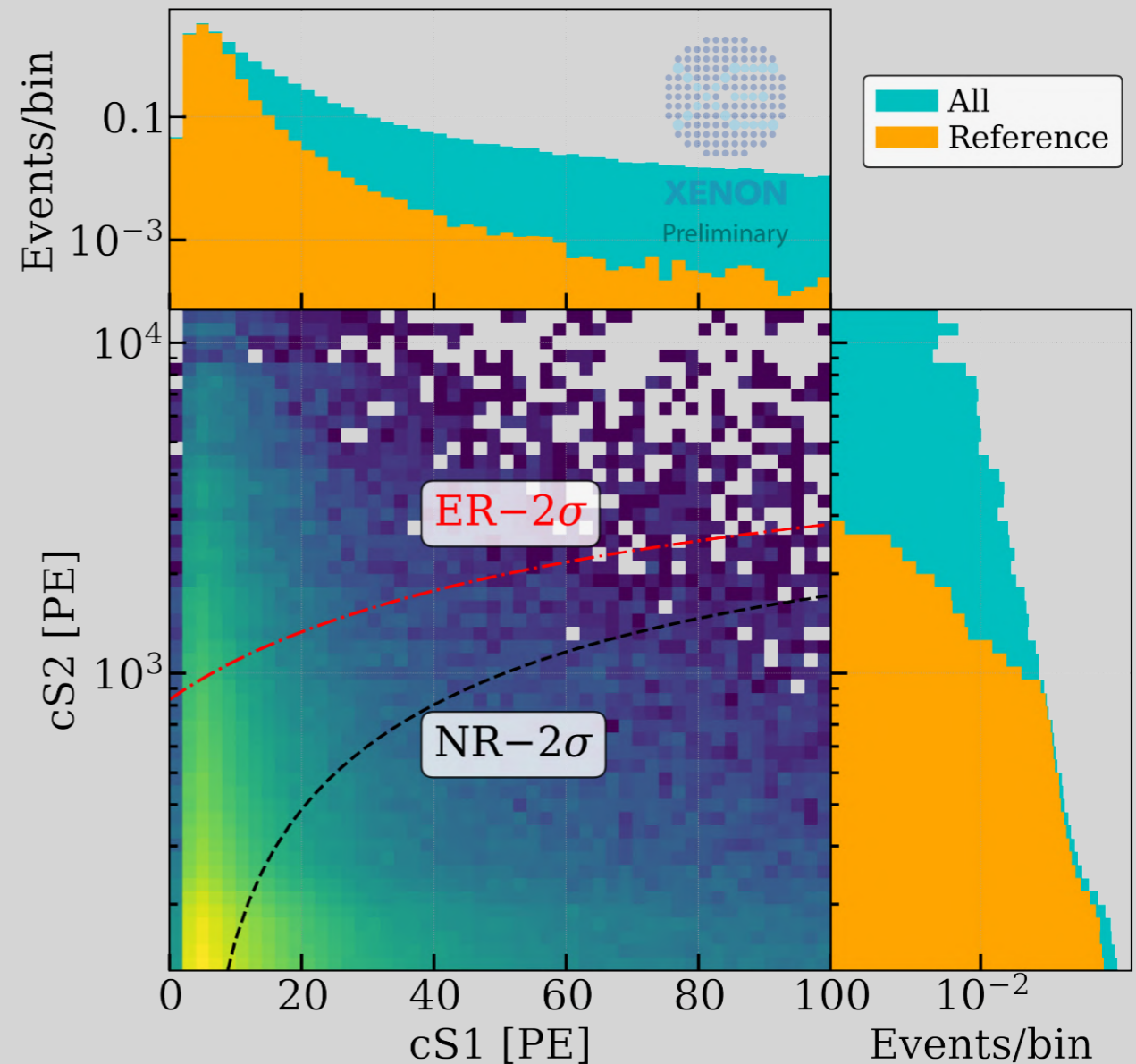
Cut suppressing isolated peaks

- Preceding event can produce lone hits and single electrons
- Reveal time and position correlation between preceding events and following isolated peaks
- Suppress isolated peaks by a factor of 2, with ~10% signal loss



Synthesis of AC

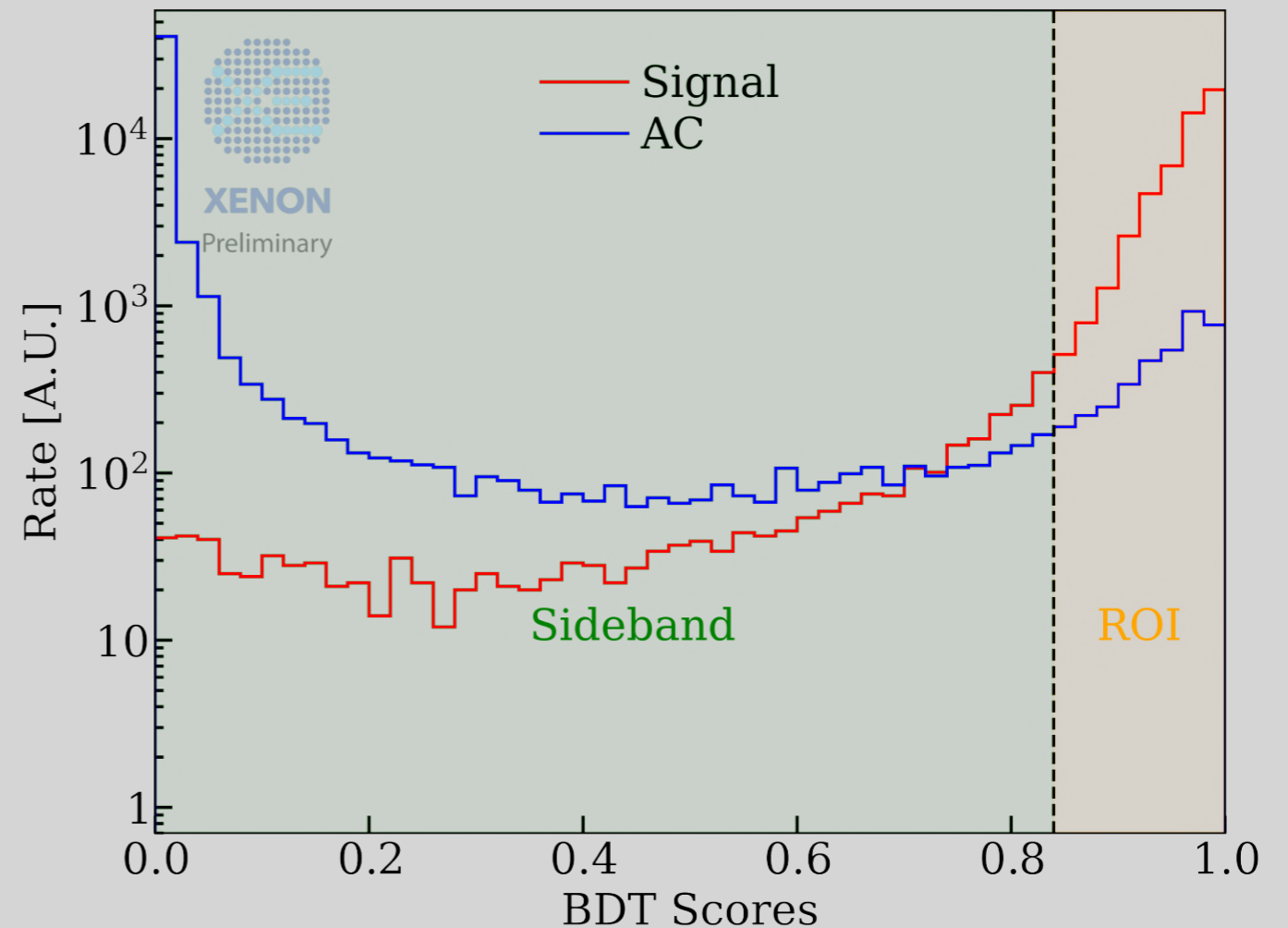
- Data driven
- Sampling isolated S1 and S2 from real data
- Assign random drift time between them and apply all events selections



GBDT

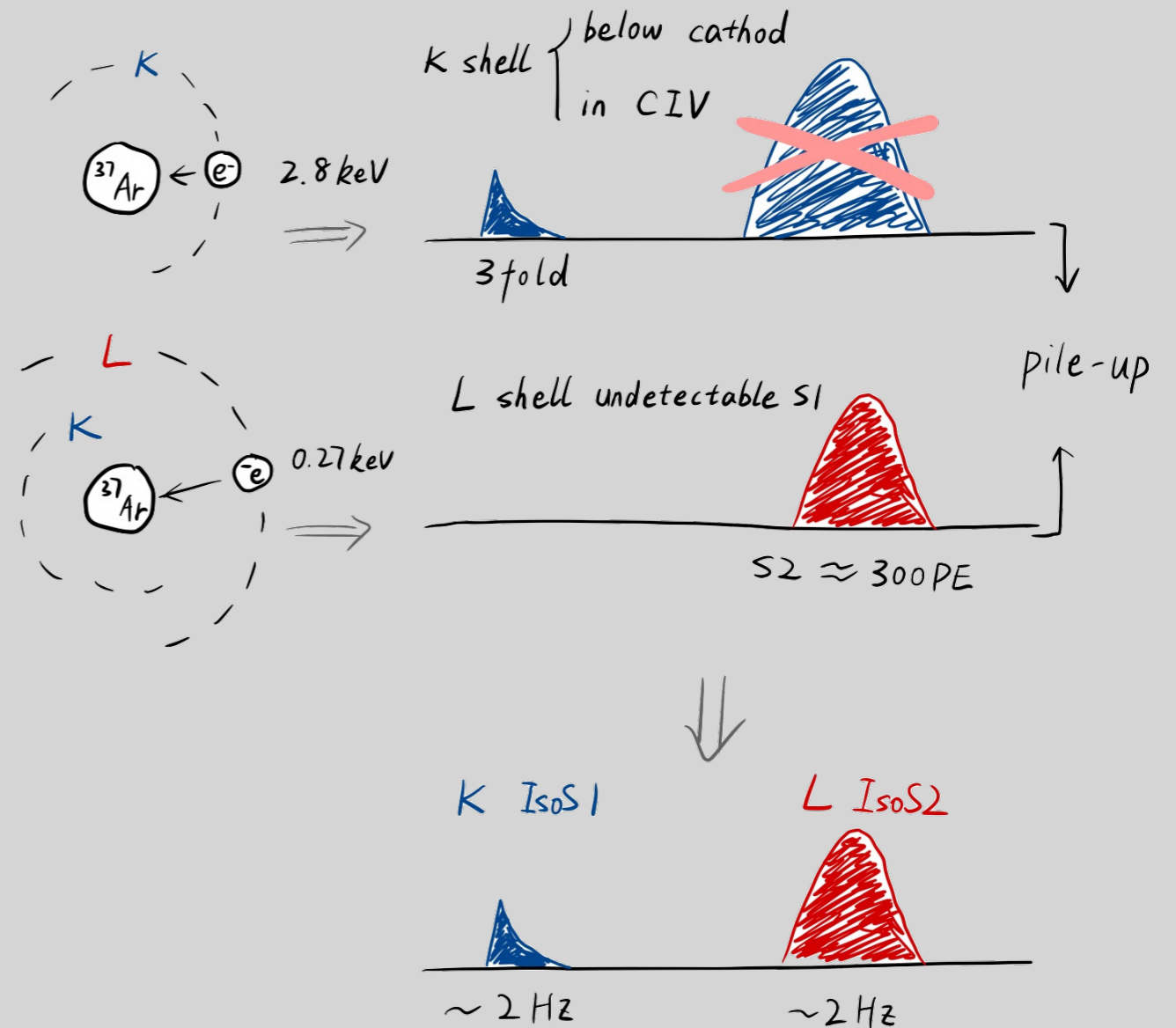
Suppress AC using S2 diffusion model

- Gradient-boosted decision trees
- Features for discrimination
 - Drift length
 - S2 width parameters
 - S2 area
- Suppress AC by ~ 10 with less than 10% signal loss



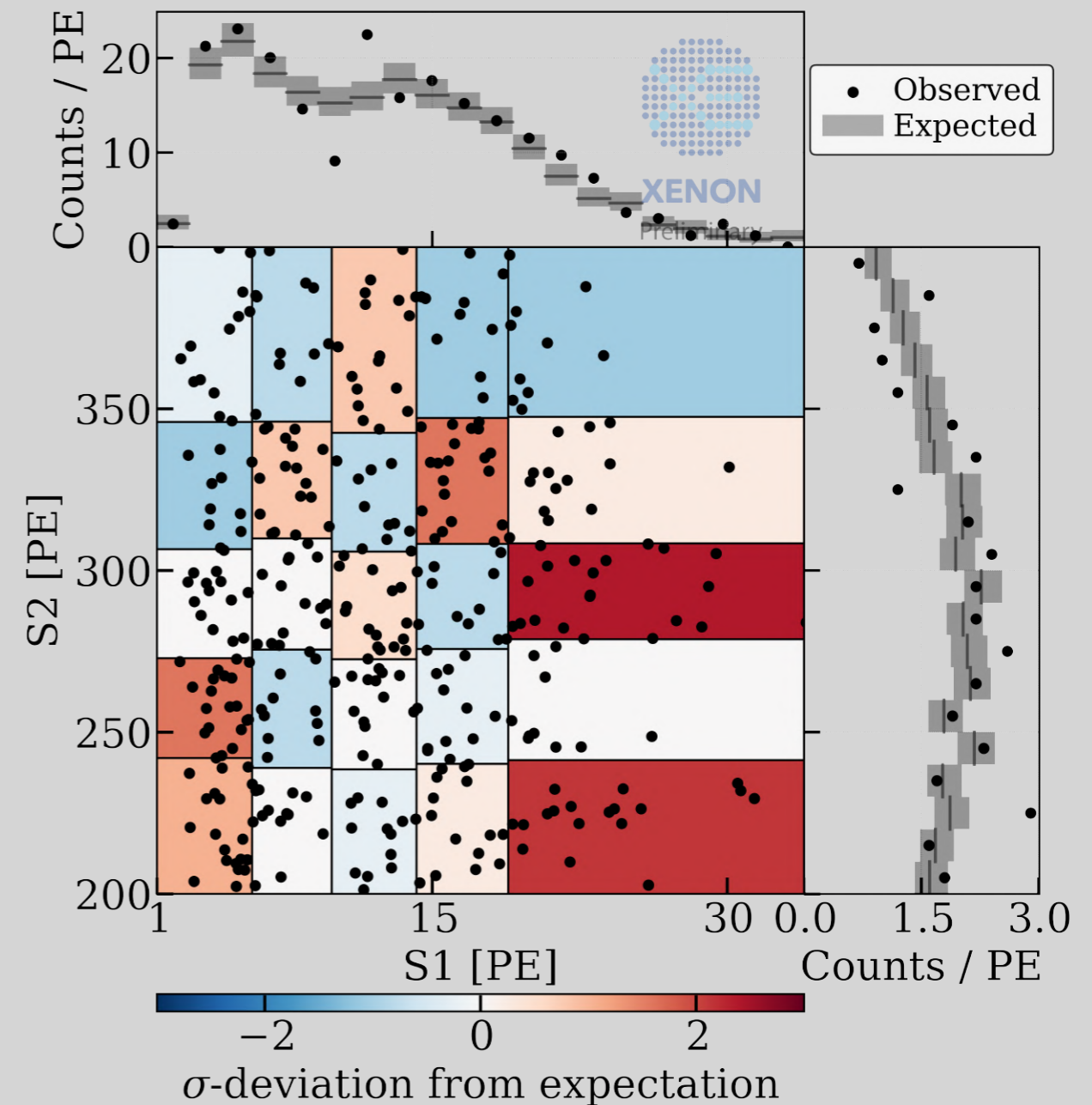
Model validation in Ar37

- AC in Ar37
 - S1: K shell event with no S2
 - S2: L shell event
- Predict AC in Ar37 calibration data and compare it with observation



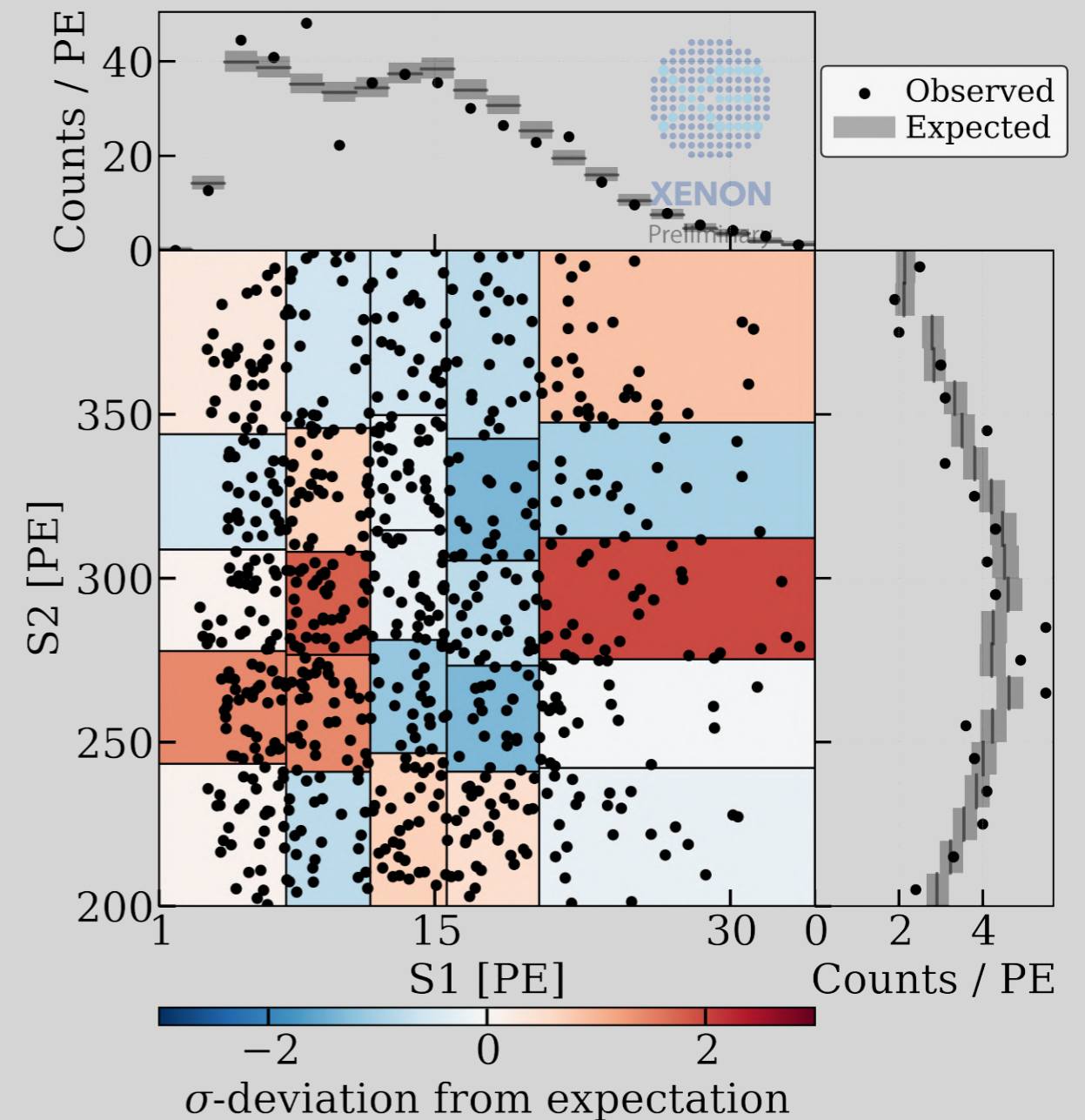
Validation in Ar37 Sideband

- Prediction / Observation = 348.7 / 366
- Validation passed with good p-values
 - 1D validations in S1, S2, R, Z space
 - 2D validation in (S1, S2) space



Validation in Ar37 ROI

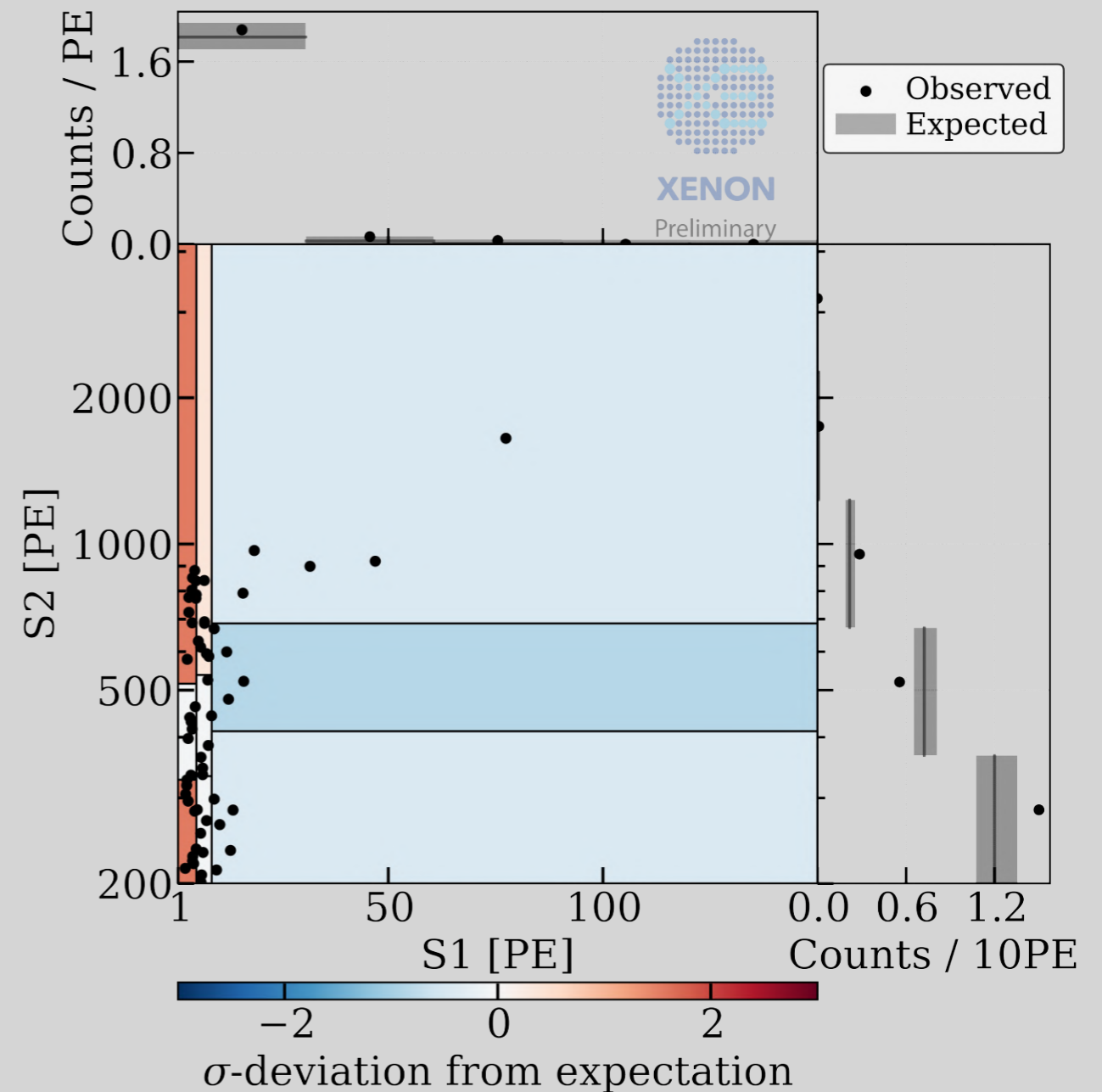
- Prediction / Observation = 731.6 / 733
- Validation all passed with good p-values
- Combined fit gives at most ~5% sys. error on absolute rate



Validation in Sideband

Sideband in science data

- Prediction / Observation = 55.1 / 59
- Last validation of model before unblinding
- Apply 5% uncertainty on WIMP analysis



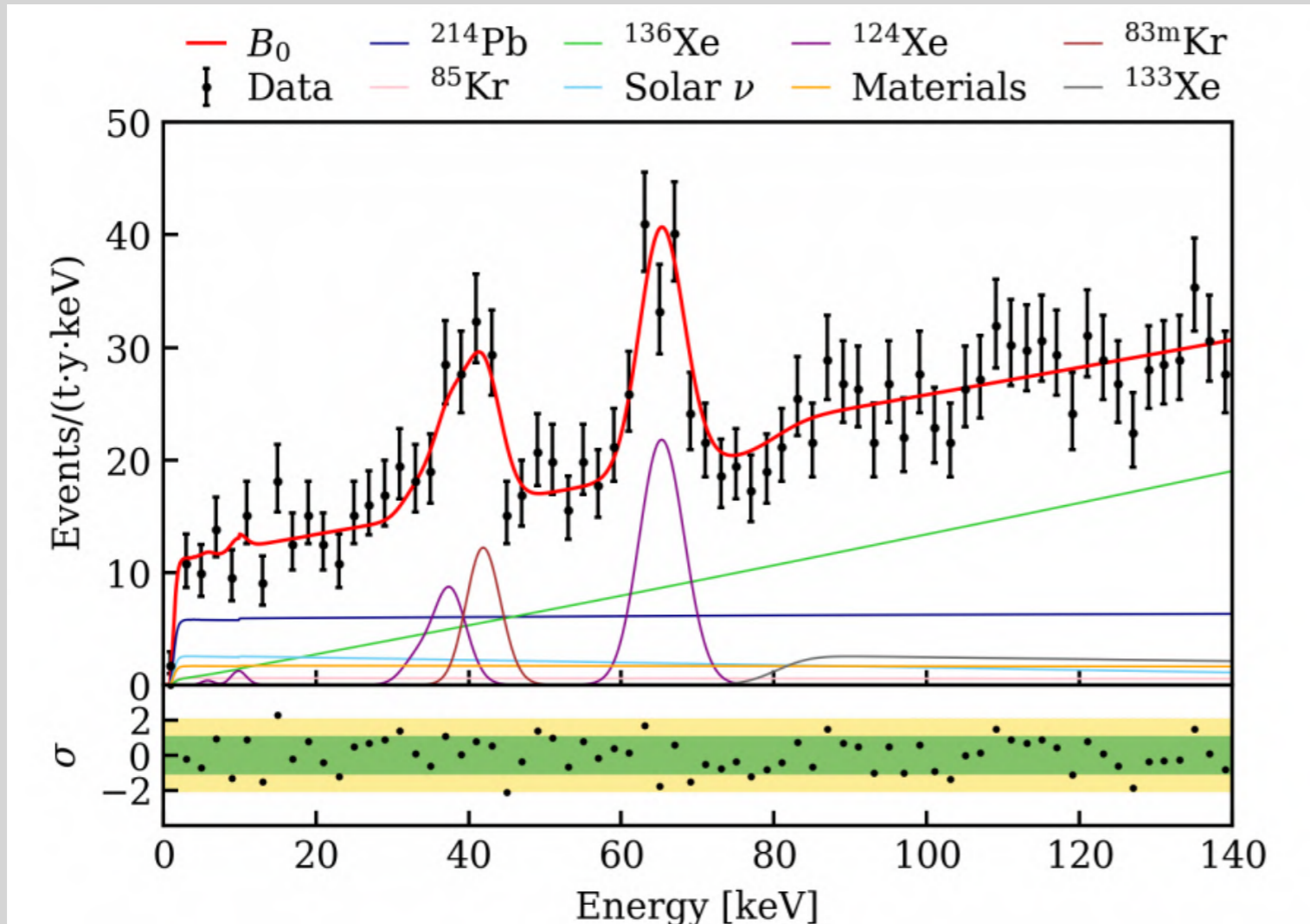
Summary

On AC background study in nT SR0

- AC background rate is high in XENONnT first science run.
- We designed model for AC background.
- AC model stands the test in several datasets: Ar37, Sideband in science data.
- Systematic error is constrained to be $\sim 5\%$ (unprecedented precision).

Electronic recoil

Backup



^{214}Pb	980 ± 120
^{85}Kr	91 ± 58
Materials	267 ± 51
^{136}Xe	1523 ± 54
Solar neutrino	298 ± 29
^{124}Xe	256 ± 28
AC	0.71 ± 0.03
^{133}Xe	163 ± 63
$^{83\text{m}}\text{Kr}$	80 ± 16