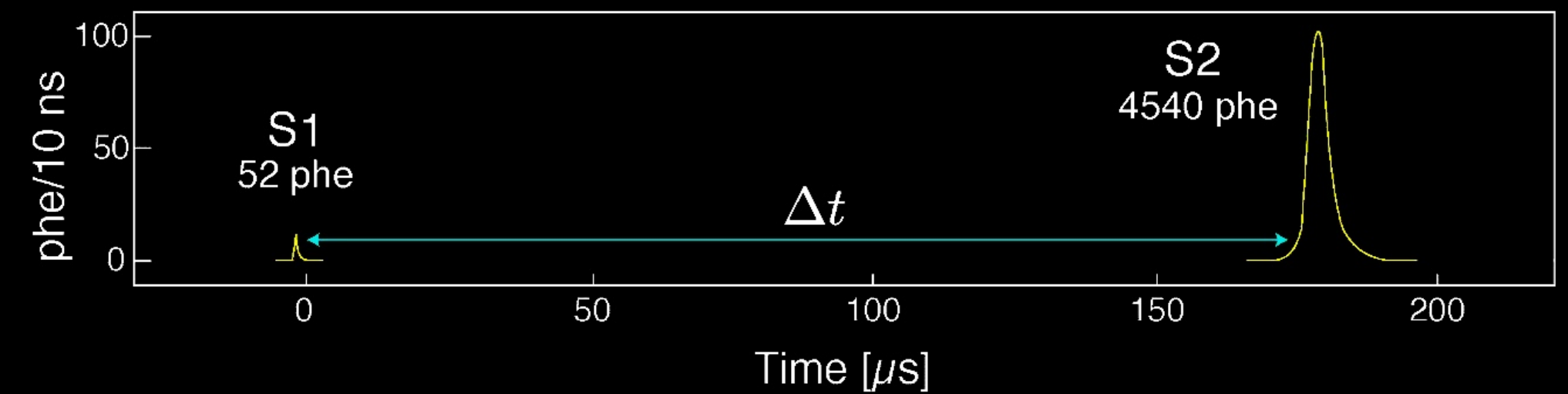
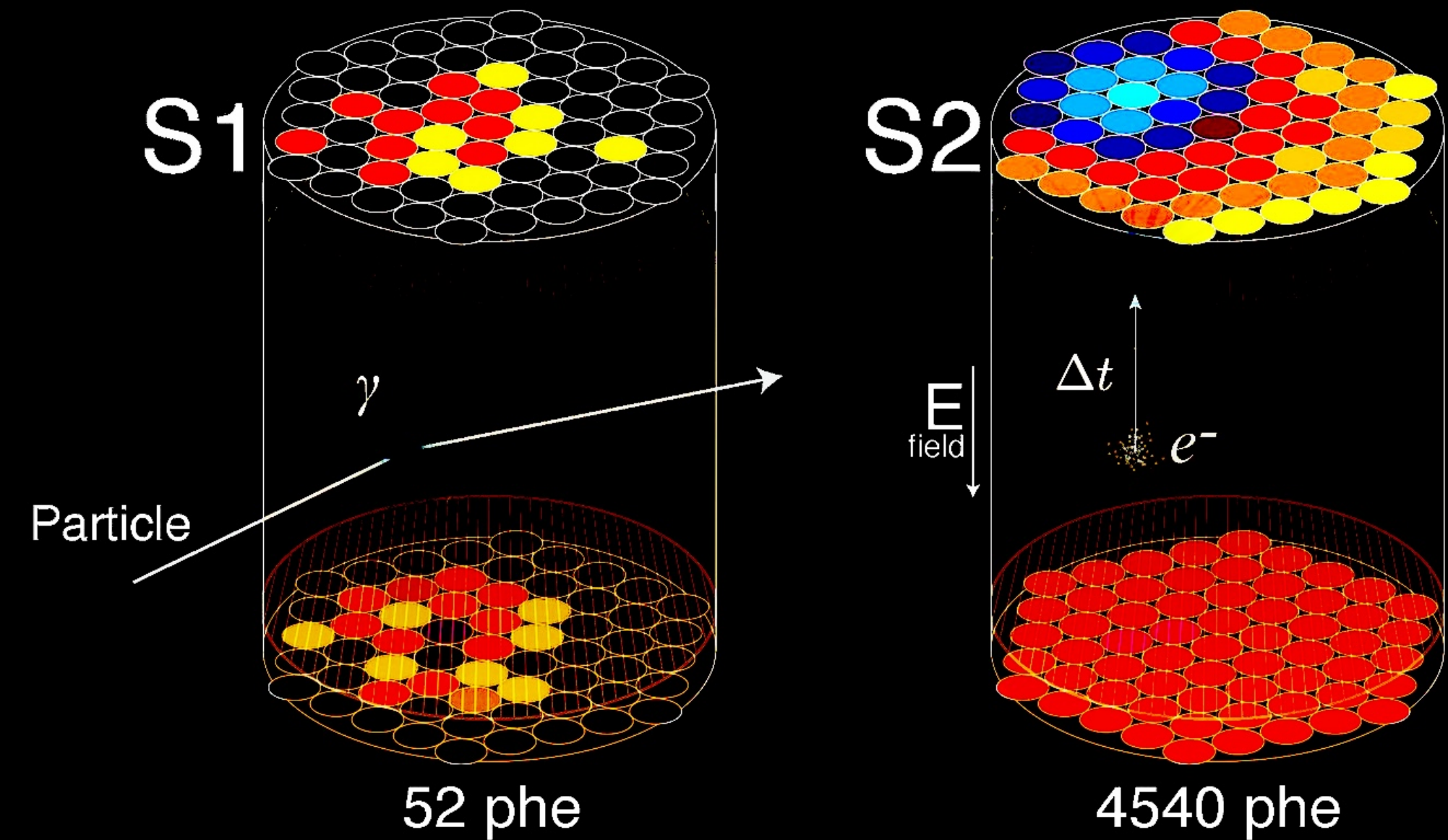
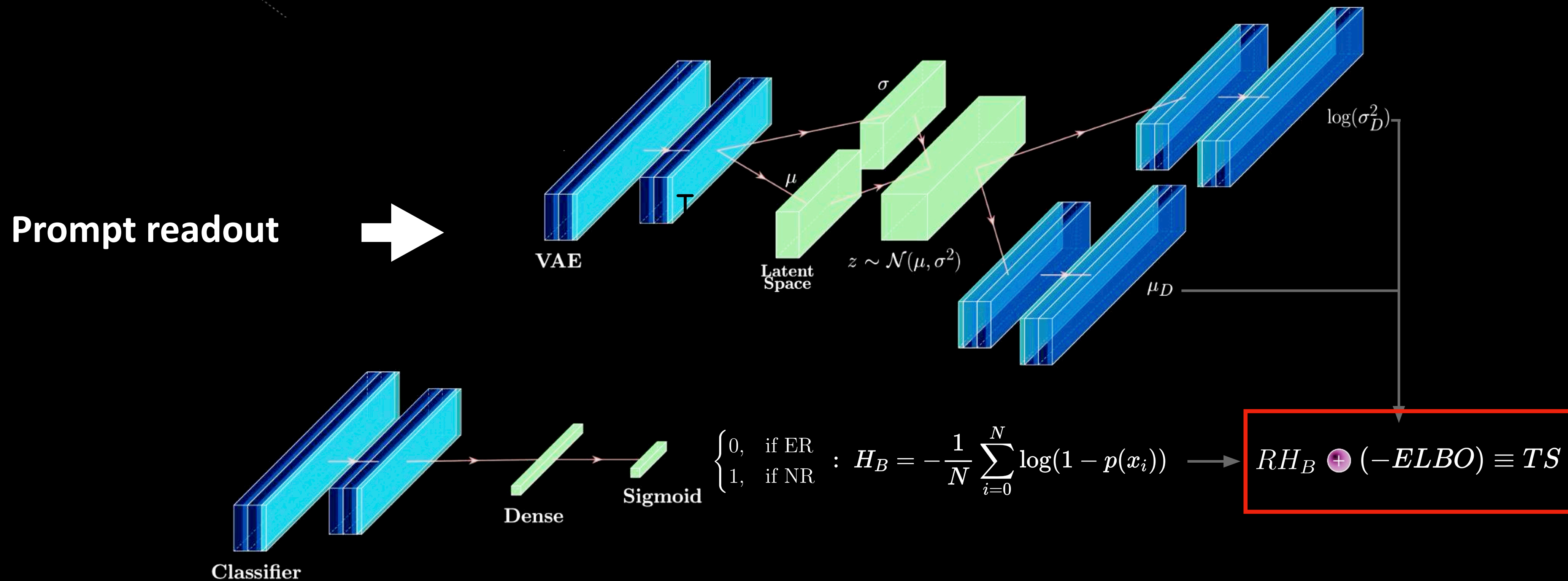


Anomaly detection for dark matter direct detection

Aim: Use event-by-event prompt readout to train anomaly detector



$$ELBO = \underbrace{\frac{1}{2}\beta \sum_{j=1}^{L-\text{Space}} \left(1 + \log((\sigma_j)^2) - (\mu_j)^2 - (\sigma_j)^2\right)}_{\text{KL Divergence}} + \frac{1}{L} \sum_{l=1}^{\text{Batch}} \log \mathcal{N}(\mathbf{x}^{(l)} | \boldsymbol{\mu}_D^{(l)}, \log \boldsymbol{\sigma}_D^{2(l)}).$$

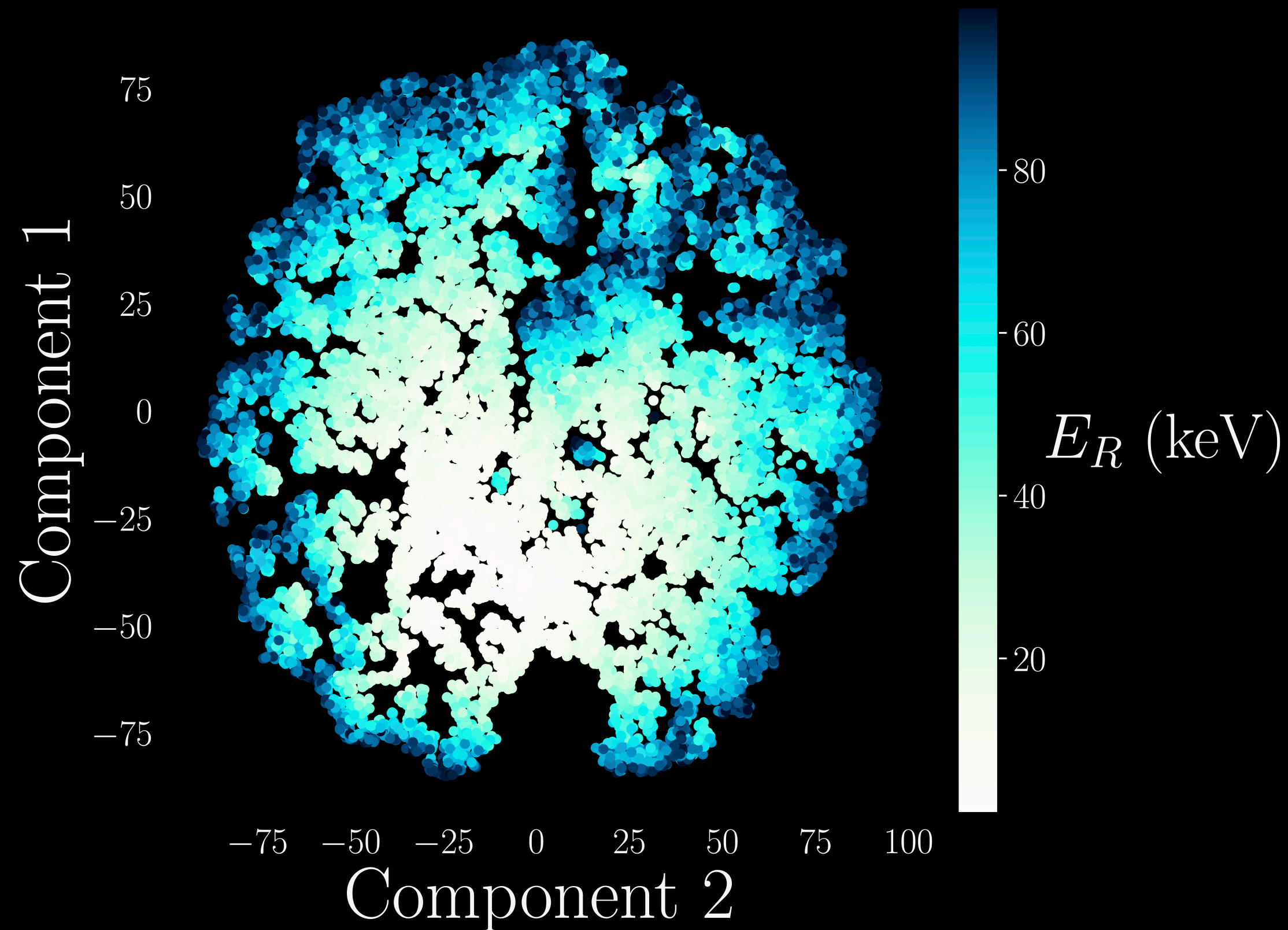


Semi-supervised pipeline: Combined anomaly function leverages discrete nature of detector events

Non-background events → Higher TS

What we get...

VAE learns event energy...



Establish 1D two-sample test

- No nuisance parameters
- Spectral info encoded
- No dependence on high level summary statistics (cS1/cS2)
- Trivially implement calibration data directly
- Likelihood free and model independent

