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REAL-TIME SUPERNOVA NEUTRINO TRIGGERS FOR

DARKSIDE-20K

NIKA SHALAMOVA ON BEHALF OF THE DARKSIDE-20K COLLABORATION / NEUTRINO 2026

WHEN THE NEUTRINOS ARRIVE, WE'LL KNOW

Neutrinos escape a collapsing star before light emerges from the stellar envelope, providing an early alert channel for the astronomical community.

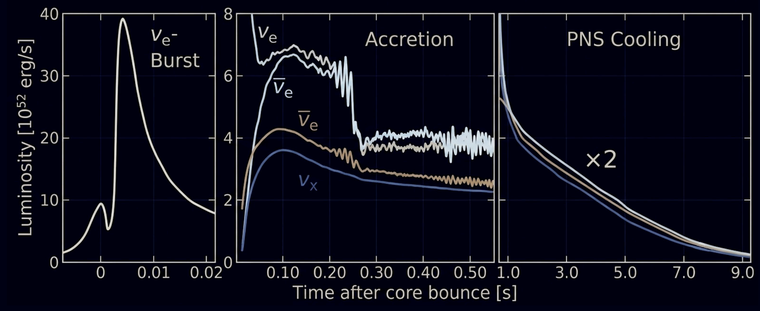
The DarkSide-20k experiment, a dual-phase liquid argon time projection chamber designed for dark matter searches, can detect this burst in real time.

To enable rapid detection, we are developing real-time machine-learning-based triggers that are supernova-model-agnostic and robust against evolving detector conditions.

REAL-TIME AUTOENCODER-BASED PIPELINE

Lightweight 2-layer autoencoder was trained on: only fast online-quality selection cuts,
simple features: photoelectrons in S2-only events and events occurring within a window after the current event

NEUTRINO LUMINOSITY



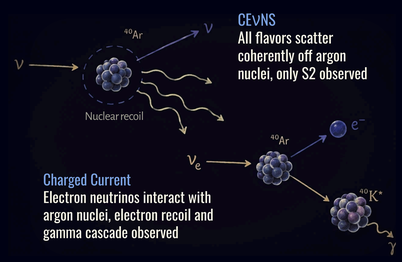
DARKSIDE-20K FOR SNe

Low-Energy Threshold
50 t ultra-radiopure underground Ar TPC; S2-only detection below the S1 threshold.

Two Detection Channels
Sensitive to both CEνNS and electron neutrino charged-current interactions

Underground
Deep beneath the surface for shielding, 650 t Outer Veto, 32 t Inner Veto

NEUTRINO DETECTION CHANNELS

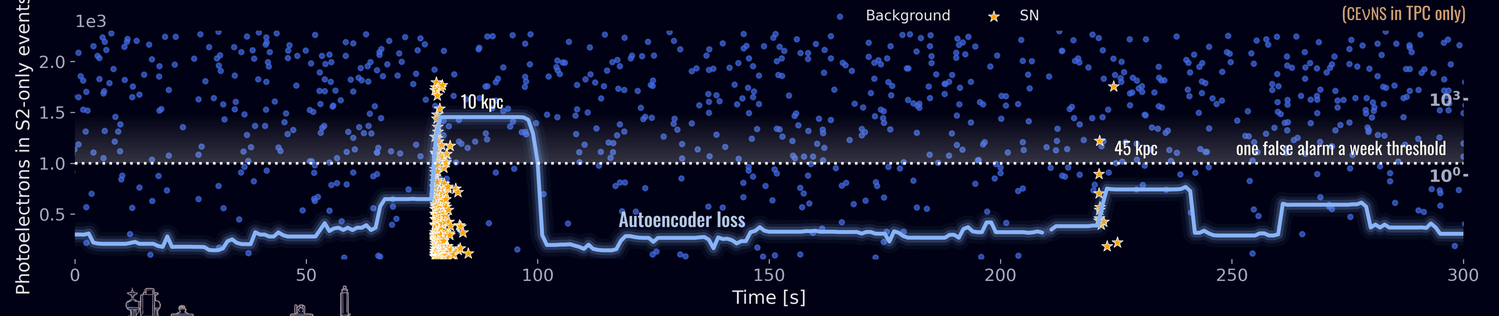


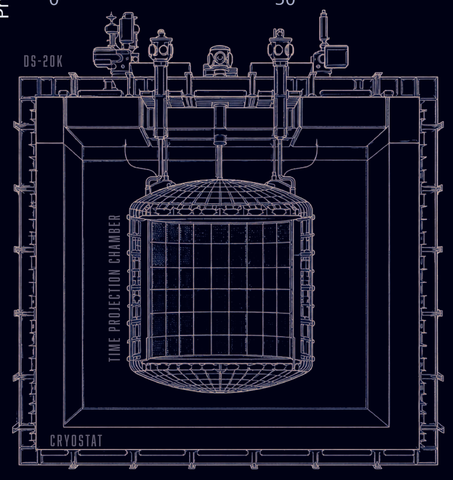
CEνNS
All flavors scatter coherently off argon nuclei, only S2 observed

Charged Current
Electron neutrinos interact with argon nuclei, electron recoil and gamma cascade observed

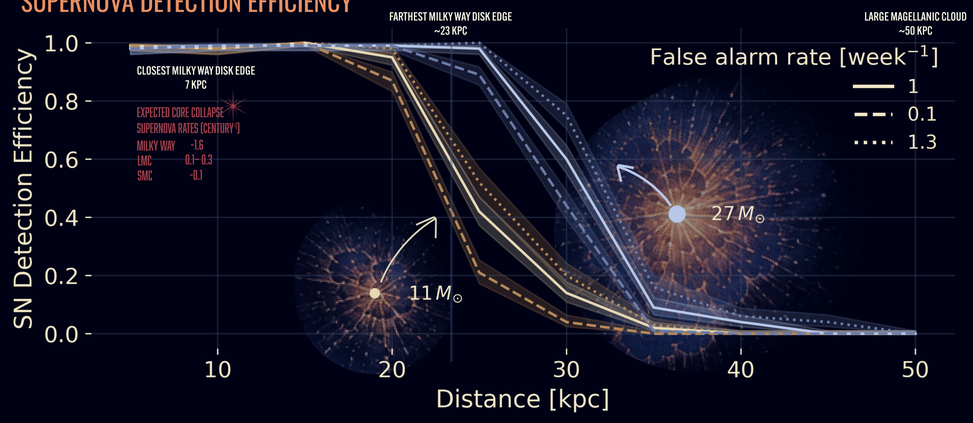
SUPERNOVA SIGNAL RESPONSE

(CEνNS in TPC only)





SUPERNOVA DETECTION EFFICIENCY



A SIMPLE PROOF-OF-CONCEPT AUTOENCODER ALREADY ACHIEVES SENSITIVITY ACROSS THE ENTIRE MILKY WAY DISK

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This research was supported by NSF PHY 2310091 and compute resources provided by Anvil at Purdue University through allocation PHY240334