RICOCHET, COHERENT, MINER AND CONNIE COMPARISON

Source, Distance, Power, Flux, Background, Purpose

COHERENT	MINER	CONNIE	Ricochet
SNS Stopped Pions (Oak Ridge) <20 meters Not compared, higher neutrino energies (do not compare neutrino flux from pion decay) Purpose: Search for coherent neutrino scattering	Reactor at Texas A&M 2 meters 1 MW $4 \times 10^{11} v\text{'s}\ cm^{-2}s^{-1}$ $\sim 100\ keV^{-1}kg^{-1}day^{-}$ (Simulation) Purpose: to observe coherent neutrino scattering and search for sterile neutrinos	Reactor at Angra dos Reis 30 meters 3.8 GW $6 \times 10^{12} v's\ cm^{-2}s^{-1}$ $3000\ keV^{-1}kg^{-1}day^{-1}$ Purpose: Search for coherent neutrino scattering	Chooz Reactor ~400 meters 8.54 GW (comes from two reactors) $8 \times 10^{10}\ v's\ cm^{-2}s^{-1}$ $1.5\ keV^{-1}kg^{-1}day^{-1}$ (From Chooz and EDELWEISS) Purpose: Search for sterile neutrino via coherent neutrino scattering

Technology

COHERENT	MINER	CONNIE	Ricochet
NaI and CSI crystals Germanium Detectors Liquid Argon	CDMS (Cryogenic Dark Matter Search) style germanium detectors High density concrete, copper foil, steel	Array of charged coupled devices (CCDs) Prototype – four 8 Mpix CCDs, mass of ~1 g, area of 6cm by 3 cm	Multiple Bolometric devices Germanium semi-conductors Metallic zinc super-conductors $CaWO_4$ cyrstals Using Helium3 to detect the background neutrons

Ideally Suited For

COHERENT	MINER	CONNIE	Ricochet
Discovery of coherent neutrino scattering Core Collapse supernova neutrino detection Better understand the atmospheric and solar neutrinos energy ranges.	Searching for sterile neutrinos	Close-proximity nuclear monitoring Discovery of coherent neutrino scattering	Pushing low energy technology for neutrino physics and dark matter searches Nuclear reactor monitoring Possible extensions to new physics and sterile neutrino searches

Advantages

COHERENT	MINER	CONNIE	Ricochet
Unique time signature (Difference from reactors) Higher recoil energies allow for detection with low threshold detectors Pulsation allows for a reduced background Uses established technology Operating for 2 years	Control over power cycle The movable distance makes MINER ideal for searching for sterile neutrinos	Very low thresholds achieved (25 eV) Compact footprint Distance to reactor is variable They have run a prototype on site	Utilizing multiple dark matter technologies, such as EDELWEISS, CRESST and superconducing metals Demonstrated low thresholds (<200 eV) No source correlated backgrounds (from low uranium and thorium contamination) Overburden (140 mwe) and large water shielding Utilizing existing Double Chooz infrastructure Strong international cooperation (US, France, Germany) Potential dark matter / dark forces sensitivity

Disadvantages

COHERENT	MINER	CONNIE	Ricochet
Cannot successfully detect lower energy neutrinos (like those that come from reactors) There are backgrounds from neutrino induced events (Neutrino induced Neutrons {NIN})	There are a lot of beam-correlated backgrounds to account and correct for (neutrons, muons, gamma rays)	Small mass target mass (5-50 g) High background Only two of the four CCDs were high enough quality to detect background in the prototype	Difficult to decipher between neutrino events and backgrounds, such as neutron radiation Competitors detectors have more advanced timelines Backgrounds: need to reach backgrounds near levels of EDELWEISS (demonstrated, but always challenging)

Sites used for information

- https://sites.duke.edu/coherent/files/2015/09/Coherent_PositionPaper.pdf
- https://arxiv.org/pdf/1609.02066.pdf
- http://iopscience.iop.org/article/10.1088/1742-6596/718/4/042009
- https://arxiv.org/pdf/1608.01565.pdf
- https://dspace.mit.edu/bitstream/handle/1721.1/105649/963850265-MIT.pdf?sequence=1