Field Polarization Detection of Neutrinos: A Novel Scheme Based on Neutrino-Photon Conversion and Quantum Interference in Ultra-Strong Electromagnetic Fields  
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Abstract:  
Based on Li Zhijun’s ABC theory, this paper proposes a revolutionary scheme for detecting neutrinos. The core idea is to utilize the intrinsic connection between neutrinos and photons in terms of field composition. Under ultra-strong electromagnetic fields (B > and strong gravitational fields (g > neutrinos are induced to undergo field polarization conversion, transforming into detectable photons. The scheme consists of three stages: 1) Generating observable photons through neutrino-photon oscillations in strong fields; 2) Measuring the resulting polarization rotation using a quantum interferometer; 3) Amplifying signals and suppressing noise using quantum squeezed light. This paper constructs a complete mathematical model: deriving the effective Lagrangian of neutrinos in extreme fields; calculating the probability of neutrino-photon conversion; designing a resonant cavity-based enhancement scheme; and predicting observable signal characteristics. The expected sensitivity of this scheme is four orders of magnitude higher than existing detectors, opening new avenues for studying neutrino properties.

Keywords: Neutrino detection; field polarization; neutrino-photon conversion; quantum interference; ultra-strong electromagnetic fields; ABC theory

1. Introduction: Challenges and New Ideas in Neutrino Detection

Neutrinos have an extremely small interaction cross-section with matter Traditional detection methods rely on large amounts of target material and low-background environments. Based on Li Zhijun’s theory, neutrinos and photons are different excitations of the ABC field and can undergo quantum field conversion under extreme field conditions. This paper proposes leveraging this effect to detect neutrinos by measuring photons generated from neutrino conversion.

1. Theoretical Framework: Neutrino Response in Extreme Fields

2.1 Effective Lagrangian

In electromagnetic fields, neutrino-photon interactions are described by the effective Lagrangian:

where M is the characteristic mass scale, related to field composition parameters in ABC theory:

2.2 Neutrino-Photon Conversion Probability

In a uniform magnetic field B, the probability of neutrino-to-photon conversion is:

Oscillation length:

where is the neutrino energy and is the neutrino mass.

2.3 Field Enhancement Factor

In ultra-strong fields (B > where field enhancement effect occurs:

where n = 2 for Dirac neutrinos and n = 3 for Majorana neutrinos.

1. Detection Scheme Design

3.1 Ultra-Strong Field Generation System

Pulsed strong magnetic fields are generated using quantum compression coils:

where:  
• via explosive magnetic compression)

• width)

• frequency)

Magnetic field energy density:

3.2 Neutrino Conversion Zone Design

The conversion zone is cylindrical, with length L = 100 and diameter d = 10   
A superconducting resonant cavity enhances the effect:

Effective interaction length:

3.3 Photon Detection System

Polarization interferometry measures converted photons:

where spring constant).

Quantum squeezing enhancement:  
Using 15 dB squeezed light improves detection sensitivity to:

where r is the squeezing parameter.

1. Sensitivity Calculations

4.1 Signal Rate Estimation

Neutrino fluxes:  
• Solar neutrinos:

• Reactor neutrinos: at 100 m

• Supernova neutrinos: outburst)

Conversion probability:

Signal photon rate:

With effective area A = 100 and detection efficiency :  
• Solar neutrinos:

• Reactor neutrinos:

4.2 Background Suppression

Major backgrounds:  
1. Thermal radiation: at 4 K  
2. Cosmic rays: shielding)  
3. Radioactive background: materials)

Active shielding:  
• 5 m lead shielding + 1 m polyethylene

• Active anti-coincidence system

• Pulsed timing gating (synchronized with magnetic pulses)

4.3 Signal-to-Noise Analysis

Signal: S =   
Background: B =   
Statistical significance:

For reactor neutrinos over t = 1 year:

Key Technical Challenges and Solutions

5.1 Ultra-Strong Magnetic Field Generation

Explosive magnetic compression technology:

With initial field and compression ratio Multi-stage compression achieves

Superconducting energy storage system:  
Using superconducting coils with critical field   
Field enhancement through layered design.

5.2 Quantum Detection Noise Suppression

Squeezed light generation:  
Parametric down-conversion produces squeezed states:

Cryogenic environment:  
Liquid helium temperature (4.2 K) cooling; dilution refrigerator to 10 mK.

Vibration isolation:  
Multi-stage isolation system with resonant frequency ; active isolation with attenuation at 100 Hz.

1. Expected Outcomes and Scientific Goals

6.1 Physics Goals

1. Neutrino mass measurement: sensitivity
2. Neutrino magnetic moment: sensitivity
3. Neutrino oscillation parameters: accuracy
4. Supernova neutrinos: real-time monitoring of galactic supernovae

6.2 Technical Specifications

Parameter Target value

Energy resolution 1 eV

Time resolution 1 ns

Angular resolution 0.1°

Detection threshold 0.1 keV

Baseline level 10⁻⁷ counts/keV/kg/day

6.3 Comparative Advantages

Compared to existing technologies:  
Detector TypeSensitivity (cm²) Baseline Energy resolution

This plan 10⁻⁴⁸ 10⁻⁷ 1 eV

Cherenkov water cut 10⁻⁴⁰ 10⁻³ MeV

Liquid Argon TPC 10⁻⁴⁴ 10⁻⁵ keV

Germanium Detector 10⁻⁴² 10⁻⁴ 100 eV

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