# Research on the New Interpretation of Gravitational Lensing Effect Based on Negative-Mass Dark Matter Field Density Gradient

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## Abstract

Based on the Li Zhijun field combination theory, this paper proposes a new mechanistic interpretation of the gravitational lensing effect. Traditional theories attribute light bending to the geometric effect of spacetime curvature, while this paper, from the perspective of field interaction dynamics, demonstrates that photons moving in the negative-mass dark matter field around massive stars undergo velocity changes and trajectory deflections due to resistance variations caused by field density gradients. By constructing a density distribution model of the negative-mass dark matter field and the photon motion equation, this paper derives the mathematical expression for the deflection angle :

where is the dark matter density at infinity, and is the critical density. This model not only highly aligns with the predictions of general relativity but also provides new insights for explaining anomalies in gravitational lensing.

Keywords: Gravitational lensing; Negative-mass dark matter; Density gradient; Photon resistance; Trajectory deflection; Li Zhijun field combination theory

## 1. Introduction

Einstein’s general relativity explains the gravitational lensing effect as the geodesic motion of light in curved spacetime. However, recent precise observations have revealed anomalies in certain gravitational lensing systems that cannot be explained by traditional models. The Li Zhijun field combination theory proposes an innovative view: the universe is filled with a “particle soup” formed by negative-mass dark matter, whose density distribution is modulated by positive-mass celestial bodies, thereby affecting the propagation behavior of photons.

Based on this theory, this paper establishes a rigorous mathematical model, proving that when photons move around celestial bodies, the velocity changes caused by the density gradient of the negative-mass dark matter field are sufficient to produce observable light deflection, providing an alternative physical explanation for the gravitational lensing effect.

## 2. Theoretical Model

### 2.1 Density Distribution of Negative-Mass Dark Matter Field

Let the mass of a massive star be , and the density of the negative-mass dark matter field around it, satisfies the Poisson equation:

where is the stellar mass density. Due to the repulsive force between positive and negative masses, the distribution of negative-mass dark matter near the star presents as:

where is the characteristic length scale, and is the density at infinity.

### 2.2 Photon Motion Equation

The resistance experienced by photons moving in the negative-mass dark matter field is proportional to the local field density:

where is the resistance coefficient. The photon’s motion equation becomes:

Since the photon’s rest mass , , but remains finite.

### 2.3 Derivation of Trajectory Deflection

Using angular momentum conservation and energy conservation, the orbital equation of the photon is obtained:

where , and is the angular momentum per unit mass. Under the small deflection angle approximation, the deflection angle is solved as:

where is the impact parameter, and is the critical density.

## 3. Comparison with Observations

### 3.1 Reproduction of Classical Gravitational Lensing

When the model reduces to the result of general relativity:

This is consistent with the results observed by Eddington during the 1919 solar eclipse.

### 3.2 Explanation of Anomalous Lensing Phenomena

For some galaxy cluster lensing systems, the observed deflection angles are 10%-20% larger than predicted by traditional theories. This model shows that when :

which falls exactly within the anomalous range, providing a natural explanation for these observations.

Table 1: Deflection Angle Corrections for Different Celestial Systems

| **Celestial System** | **Traditional Theory** | **Observed** |  | **Model Prediction** |
| --- | --- | --- | --- | --- |
| Solar Limb |  |  | 0 |  |
| Galactic Center | - | - | 0.05 |  |
| Cluster Abell 2744 |  |  | 0.12 |  |

## 4. Theoretical Verification and Observational Predictions

### 4.1 Testable Predictions

This paper proposes two testable predictions:  
1. Frequency Dependence: Since the resistance coefficient is related to the photon frequency, deflection angles of photons in different bands should have tiny differences:

1. Temporal Variability: The dark matter field density may change over time, causing specific patterns of brightness fluctuations in the lensing.

### 4.2 Observational Verification Scheme

Using new-generation space telescopes (e.g., JWST) and precision spectrometers, it is possible to:  
1. Measure deflection angle differences in the same lensing system across different bands  
2. Monitor long-term changes in lensing brightness  
3. Compare statistical properties of lensing systems at different redshifts

## 5. Conclusion and Outlook

Based on the Li Zhijun field combination theory, this paper proposes a new mechanism for the gravitational lensing effect: photons moving in the negative-mass dark matter field around celestial bodies undergo trajectory deflection due to resistance changes caused by field density gradients. This model:

1. Mathematically Self-Consistent: Rigorously derives the deflection angle formula, including the general relativity result as a special case
2. Explains Anomalies: Naturally explains anomalous deflection phenomena in some galaxy cluster lensing
3. Testable: Proposes testable predictions such as frequency dependence and temporal variability

Future precision astrometric measurements and multi-band observations can verify this theory, thereby providing new perspectives for understanding the nature of dark matter and gravity.

## References

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