Neutrinos via Charm Decays in Astrophysical Sources

by

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Abstract

Abbreviations

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1 Introduction

first zeroth test.[1–3]

second zeroth test.[1,2]

third zeroth test[1,3]

test.[4]

first test [1–3]

second test [1, 2]

third test [1, 3]

[5]

[4]

[6]

$(2.998 \pm 0.001) \times 10^{10}\,\mathrm{cm\,s^{-1}}$

$\pm \times + - \cdot 6.626 \times 10^{-27}\,\mathrm{erg\,s}$

$4.803 \times 10^{-10}\,\mathrm{esu}$

$10^{14}\,\mathrm{G}$

1.4×10^{0} 1.4×10^{0}

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6} \tag{1}$$

$\sqrt{1-\beta^2}$

$\alpha\beta\gamma\delta\eta\zeta\xi\chi\varphi\phi\vartheta\theta\mu\nu\rho$

2 Background

2.1 Particle Physics

The interaction and classification of elementary particles is currently most accurately described by the *Standard Model* (SM) of particle physics. From combining and generalizing the properties of *Quantum Mechanics* (QM) and *Special Relativity* (SR) emerges *Quantum Field Theory* (QFT) as the mathematical framework formalizing this construct. Certain features intrinsic to the SM require formulating additional gauge symmetries. Excitations occuring in the associated fields then correspond to various particles, of which the following paragraphs provide a brief overview. Since this work mainly deals with the statistical behavior of large quantities instead of individual particle probabilistics, a more detailed explanation is omitted.

Fundamental to the SM is a unitary $U(1) \times SU(2) \times SU(3)$ symmetry group, the generators of which can be understood as representations of bosonic field quanta with the physical role of mediating interactions between fermionic spinor fields. Commutation relations identical to regular QM have to be be fulfilled. Therefore, bosons must commute and have integer spin whereas fermions must anticommute and have half integer spin.

Carriers of the strong force arise from SU(3) and are referred to as gluons. They couple to and possess themselves color charges, enabling color changing and self interaction. The only type of elementary fermions with non vanishing color charge are quarks, which exist in flavors of up and down, charm and strange, top and bottom, as well as the corresponding antiparticles. Appropriately, *Quantum Chromodynamics* (QCD) is the name given to the QFT governing any interaction involving color charge.

Weak, Electromagnetic, Electroweak, Higgs

Parity Violation, Mixing

Limits, Dark Matter, Dark Energy, Neutrino Oscillation, Quantum Gravity

General Relativity

Hadrons

Confinement, Asymptotic Freedom, Residual Nuclear Force, Decays

Leptons

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Acknowledgements

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Bibliography

1. J. A. Carpio, K. Murase, M. H. Reno, I. Sarcevic, A. Stasto, *Physical Review D* **102**, ISSN: 2470-0029, DOI: 10.1103/PhysRevD.102.103001, arXiv: 2007.07945 [astro-ph.HE] (2020).
2. C. Alvarez, A. Carramiñana, *Astronomy & Astrophysics* **414**, 651–658, ISSN: 1432-0746, DOI: 10.1051/0004-6361:20031627, arXiv: astro-ph/0311267 (2004).
3. J. D. Jackson, *Classical Electrodynamics* (Wiley, New York, NY, Third Edition, 1999), ISBN: 9780471309321.
4. J. Li, A. Spitkovsky, A. Tchekhovskoy, *The Astrophysical Journal* **746**, 60, DOI: 10.1088/0004-637X/746/1/60, arXiv: 1107.0979 [astro-ph.HE] (2012).
5. C. Thompson, R. C. Duncan, *The Astrophysical Journal* **408**, 194, DOI: 10.1086/172580 (1993).
6. B. Haskell, A. Sedrakian, in *Astrophysics and Space Science Library* (Springer International Publishing, 2018), Chapter 8, 401–454, ISBN: 9783319976167, ISSN: 2214-7985, arXiv: 1709.10340 [astro-ph.HE].

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