

We may need one

D. Horváth^{a,b} S. Nagy^c I. Nándori^b and Z. Trócsányi^{b,c}

^aCenter of the Hungarian Academy of Sciences, Hungary

^bInstitute of Nuclear Research of the Hungarian Academy of Sciences, Hungary

*^cInstitute of Physics, University of Debrecen,
H-4010 Debrecen P.O.Box 105, Hungary*

E-mail: Zoltan.Trocsanyi@cern.ch

ABSTRACT: We summarize the literature ignited by the OPERA experiment claiming the observations of superluminal neutrinos...

ARXIV EPRINT: [arXiv:yymm.nnnn](https://arxiv.org/abs/yymm.nnnn)

Contents

1	Introduction	1
2	Possible flaws in the experiment	2
3	Contradictions with other observations	2
4	Explanations without new physics	2
5	Interpretations with new physics	2
6	Other	2
7	Conclusions	2
8	Acknowledgements	2

1 Introduction

Using INSPIRE, I found the following citations to Ref. [1]. I propose to make a rough scan how we can classify these papers into the scheme given in the four(+1) sections below, including some initial remarks.

I propose the following division.

For Dezsó: [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28]

For Sanyi: [29] [30] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55]

For Pista: [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82]

For Zoli: [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [96] [97] [98] [99] [100] [101] [102] [103] [104] [105] [106] [107]

- 2 Possible flaws in the experiment
- 3 Contradictions with other observations
- 4 Explanations without new physics
- 5 Interpretations with new physics
- 6 Other
- 7 Conclusions
- 8 Acknowledgements

This research was supported by the Hungarian Scientific Research Fund grant OTKA K-????? and by the TÁMOP 4.2.1./B-09/1/KONV-2010-0007 project. We are grateful to ...

References

- [1] **OPERA Collaboration** Collaboration, T. Adam *et. al.*, *Measurement of the neutrino velocity with the OPERA detector in the CNGS beam*, [arXiv:1109.4897](#). * Temporary entry *.
- [2] G. Cacciapaglia, A. Deandrea, and L. Panizzi, *Superluminal neutrinos in long baseline experiments and SN1987a*, [arXiv:1109.4980](#). * Temporary entry *.
- [3] G. Amelino-Camelia, G. Gubitosi, N. Loreti, F. Mercati, G. Rosati, *et. al.*, *OPERA-reassessing data on the energy dependence of the speed of neutrinos*, [arXiv:1109.5172](#).
- [4] G. Dvali and A. Vikman, *Price for Environmental Neutrino-Superluminality*, [arXiv:1109.5685](#).
- [5] D. Fargion and D. D'Armiento, *Inconsistence of super-luminal Opera neutrino speed with SN1987A neutrinos burst and with flavor neutrino mixing*, [arXiv:1109.5368](#).
- [6] J. Ciborowski and J. Rembielinski, *Comments on the recent velocity measurement of the muon neutrinos by the OPERA Collaboration*, [arXiv:1109.5599](#).
- [7] F. Klinkhamer, *Superluminal muon-neutrino velocity from a Fermi-point-splitting model of Lorentz violation*, [arXiv:1109.5671](#).
- [8] D. Autiero, P. Migliozzi, and A. Russo, *The neutrino velocity anomaly as an explanation of the missing observation of neutrinos in coincidence with GRB*, [arXiv:1109.5378](#). * Temporary entry *.
- [9] F. Tamburini and M. Laveder, *Apparent Lorentz violation with superluminal Majorana neutrinos at OPERA?*, [arXiv:1109.5445](#).
- [10] J. Alexandre, *Lifshitz-type Quantum Field Theories in Particle Physics*, [arXiv:1109.5629](#).
- [11] G. F. Giudice, S. Sibiryakov, and A. Strumia, *Interpreting OPERA results on superluminal neutrino*, [arXiv:1109.5682](#). * Temporary entry *.

- [12] S. S. Gubser, *Superluminal neutrinos and extra dimensions: Constraints from the null energy condition*, [arXiv:1109.5687](#).
- [13] K. Svozil, *Neutrino dispersion relation changes due to radiative corrections as the origin of faster-than-light-in-vacuum propagation in a medium*, [arXiv:1109.5411](#).
- [14] K. Cahill, *Fast Light, Fast Neutrinos?*, [arXiv:1109.5357](#).
- [15] F. Cardone, R. Mignani, and A. Petrucci, *Neutrinos superluminality and Local Lorentz Invariance*, [arXiv:1109.5289](#).
- [16] R. B. Mann and U. Sarkar, *Superluminal neutrinos at the OPERA?*, [arXiv:1109.5749](#). * Temporary entry *.
- [17] R. Alicki, *A possible statistical mechanism of anomalous neutrino velocity in OPERA experiment?*, [arXiv:1109.5727](#). * Temporary entry *.
- [18] C. Pfeifer and M. N. Wohlfarth, *Beyond the speed of light on Finsler spacetimes*, [arXiv:1109.6005](#).
- [19] M. Li and T. Wang, *Mass-dependent Lorentz Violation and Neutrino Velocity*, [arXiv:1109.5924](#).
- [20] A. Drago, I. Masina, G. Pagliara, and R. Tripiccione, *The Hypothesis of Superluminal Neutrinos: comparing OPERA with other Data*, [arXiv:1109.5917](#).
- [21] C. R. Contaldi, *The OPERA neutrino velocity result and the synchronisation of clocks*, [arXiv:1109.6160](#). * Temporary entry *.
- [22] V. Oikonomou, *The 2d Gross-Neveu Model for Pseudovector Fermions and Tachyonic Mass Generation*, [arXiv:1109.6170](#). * Temporary entry *.
- [23] R. Konoplya, *Superluminal neutrinos and the tachyon's stability in the rotating Universe*, [arXiv:1109.6215](#). * Temporary entry *.
- [24] L. Iorio, *Environmental fifth-force hypothesis for the OPERA superluminal neutrino phenomenology: constraints from orbital motions around the Earth*, [arXiv:1109.6249](#). * Temporary entry *.
- [25] M. Anacleto, F. Brito, and E. Passos, *Supersonic Velocities in Noncommutative Acoustic Black Holes*, [arXiv:1109.6298](#). * Temporary entry *.
- [26] A. Kehagias, *Relativistic Superluminal Neutrinos*, [arXiv:1109.6312](#). * Temporary entry *.
- [27] J. Alexandre, J. Ellis, and N. E. Mavromatos, *On the Possibility of Superluminal Neutrino Propagation*, [arXiv:1109.6296](#).
- [28] J. Magueijo, *Neutrino oscillations and superluminal propagation, in OPERA or otherwise*, [arXiv:1109.6055](#). * Temporary entry *.
- [29] S. Hannestad and M. S. Sloth, *Apparent faster than light propagation from light sterile neutrinos*, [arXiv:1109.6282](#). * Temporary entry *.
- [30] L. Gonzalez-Mestres, *Comments on the recent result of the 'Measurement of the neutrino velocity with the OPERA detector in the CNGS beam'*, [arXiv:1109.6308](#).
- [31] V. Pankovic, *Is OPERA Neutrino Superluminal Propagation similar to Gain-Assisted Superluminal Light Propagation*, [arXiv:1109.6121](#).
- [32] R. Garattini and G. Mandanici, *Particle propagation and effective space-time in Gravity's Rainbow*, [arXiv:1109.6563](#).

- [33] A. Nicolaidis, *Neutrino Shortcuts in Spacetime*, [arXiv:1109.6354](#). * Temporary entry *.
- [34] A. G. Cohen and S. L. Glashow, *New Constraints on Neutrino Velocities*, [arXiv:1109.6562](#). * Temporary entry *.
- [35] F. Klinkhamer and G. Volovik, *Superluminal neutrino and spontaneous breaking of Lorentz invariance*, [arXiv:1109.6624](#). * Temporary entry *.
- [36] M. Matone, *Superluminal Neutrinos and a Curious Phenomenon in the Relativistic Quantum Hamilton-Jacobi Equation*, [arXiv:1109.6631](#).
- [37] S. Gardner, *Superluminal Neutrinos without Revolution*, [arXiv:1109.6520](#). * Temporary entry *.
- [38] L. Gonzalez-Mestres, *Astrophysical consequences of the OPERA superluminal neutrino*, [arXiv:1109.6630](#). * Temporary entry *.
- [39] E. Ciuffoli, J. Evslin, J. Liu, and X. Zhang, *OPERA and a Neutrino Dark Energy Model*, [arXiv:1109.6641](#). * Temporary entry *.
- [40] X.-J. Bi, P.-F. Yin, Z.-H. Yu, and Q. Yuan, *Constraints and tests of the OPERA superluminal neutrinos*, [arXiv:1109.6667](#). * Temporary entry *.
- [41] P. Wang, H. Wu, and H. Yang, *Superluminal neutrinos and domain walls*, [arXiv:1109.6930](#).
- [42] G. Henri, *A simple explanation of OPERA results without strange physics*, [arXiv:1110.0239](#). * Temporary entry *.
- [43] R. Cowsik, S. Nussinov, and U. Sarkar, *Superluminal Neutrinos at OPERA Confront Pion Decay Kinematics*, [arXiv:1110.0241](#). * Temporary entry *.
- [44] R. Torrealba, *Using an Einstein's idea to explain OPERA faster than light neutrinos*, [arXiv:1110.0243](#). * Temporary entry *.
- [45] N. Dass, *OPERA, SN1987a and energy dependence of superluminal neutrino velocity*, [arXiv:1110.0351](#).
- [46] W. Winter, *How large is the fraction of superluminal neutrinos at OPERA?*, [arXiv:1110.0424](#). * Temporary entry *.
- [47] M. M. Anber and J. F. Donoghue, *Limiting velocities as running parameters and superluminal neutrinos*, [arXiv:1110.0132](#). * Temporary entry *.
- [48] J. Franklin, *Superluminal neutrinos*, [arXiv:1110.0234](#). * Temporary entry *.
- [49] S.-Y. Li, *OPERA Collaboration have observed phase speed of neutrino wave function*, [arXiv:1110.0302](#). * Temporary entry *.
- [50] J. Carmona and J. Cortes, *Constraints from Neutrino Decay on Superluminal Velocities*, [arXiv:1110.0430](#). * Temporary entry *.
- [51] P. Wang, H. Wu, and H. Yang, *Superluminal Neutrinos and Monopoles*, [arXiv:1110.0449](#).
- [52] T. Li and D. V. Nanopoulos, *Background Dependent Lorentz Violation from String Theory*, [arXiv:1110.0451](#). * Temporary entry *.
- [53] I. Y. Aref'eva and I. V. Volovich, *Superluminal Dark Neutrinos*, [arXiv:1110.0456](#). * Temporary entry *.
- [54] E. N. Saridakis, *Superluminal neutrinos in Horava-Lifshitz gravity*, [arXiv:1110.0697](#).

- [55] D. Lust and M. Petropoulos, *Comment on superluminality in general relativity*, [arXiv:1110.0813](#). * Temporary entry *.
- [56] B. Broda, *An OPERA inspired classical model reproducing superluminal velocities*, [arXiv:1110.0644](#). * Temporary entry *.
- [57] R. Ehrlich, *Resolution of 8 inconsistencies with the OPERA result on superluminal neutrinos, and the best way to check it*, [arXiv:1110.0736](#). * Temporary entry *.
- [58] G. Amelino-Camelia, L. Freidel, J. Kowalski-Glikman, and L. Smolin, *OPERA neutrinos and relativity*, [arXiv:1110.0521](#). * Temporary entry *.
- [59] R. Brustein and D. Semikoz, *Apparent superluminal neutrino propagation caused by nonlinear coherent interactions in matter*, [arXiv:1110.0762](#). * Temporary entry *.
- [60] L. Maccione, S. Liberati, and D. M. Mattingly, *Violations of Lorentz invariance in the neutrino sector after OPERA*, [arXiv:1110.0783](#). * Temporary entry *.
- [61] H. Davoudiasl and T. G. Rizzo, *Testing the OPERA Superluminal Neutrino Anomaly at the LHC*, [arXiv:1110.0821](#). * Temporary entry *.
- [62] C. Unnikrishnan, *Thermal expansion of the earth and the speed of neutrinos*, [arXiv:1110.0755](#).
- [63] S. Nojiri and S. D. Odintsov, *Could the dynamical Lorentz symmetry breaking induce the superluminal neutrinos?*, [arXiv:1110.0889](#).
- [64] J. Goldberg, *Comment on Jerrold Franklin, Superluminal neutrinos*, [arXiv:1110.0234v1](#), [arXiv:1110.0970](#). * Temporary entry *.
- [65] D. V. Naumov and V. A. Naumov, *Neutrino Velocity Anomalies: A Resolution without a Revolution*, [arXiv:1110.0989](#). * Temporary entry *.
- [66] I. Oda and H. Taira, *Superluminal Neutrinos from Gauge Field*, [arXiv:1110.0931](#). * Temporary entry *.
- [67] X.-Y. Wu, X.-J. Liu, N. Ba, B.-J. Zhang, and Y. Wang, *Analysis OPERA superluminal muonic neutrino experiment*, [arXiv:1110.0882](#).
- [68] B. G. Sidharth, *Very High Energy Considerations*, [arXiv:1110.0929](#).
- [69] G. Kraniotis, *Exact deflection of a Neutral-Tachyon in the Kerr's Gravitational field*, [arXiv:1110.1223](#). * Temporary entry *.
- [70] P. A. Sanchez, M. Anabitarte, and M. Bellini, *Dirac equation for massive neutrinos in a Schwarzschild-de Sitter spacetime from a 5D vacuum*, [arXiv:1110.1300](#). * Temporary entry *.
- [71] D. Ahluwalia, S. Horvath, and D. Schritt, *Probing neutrino masses with neutrino-speed experiments*, [arXiv:1110.1162](#).
- [72] A. Mecozzi and M. Bellini, *Superluminal group velocity of neutrinos*, [arXiv:1110.1253](#). * Temporary entry *.
- [73] S.-S. Xue, *Do high-energy neutrinos travel faster than photons in a discrete space-time?*, [arXiv:1110.1317](#). * Temporary entry *.
- [74] J. Moffat, *Bimetric Relativity and the Opera Neutrino Experiment*, [arXiv:1110.1330](#). * Temporary entry *.
- [75] E. Canessa, *OPERA neutrinos and superluminal helical motion*, [arXiv:1110.0245](#).

- [76] S. I. Vacaru, *Super-Luminal Effects for Finsler Branes as a Way to Preserve the Paradigm of Relativity Theories*, [arXiv:1110.0675](#).
- [77] S. Tanimura, *Apparent Superluminal Muon-neutrino Velocity as a Manifestation of Weak Value*, [arXiv:1110.1790](#). * Temporary entry *.
- [78] Z. Lingli and B.-Q. Ma, *Lorentz Violation of the Photon Sector in Two Models*, [arXiv:1110.1850](#). * Temporary entry *.
- [79] I. Masina and F. Sannino, *Dark Medium Modified Dispersion Relations*, [arXiv:1110.1853](#).
- [80] A. E. Faraggi, *OPERA data and The Equivalence Postulate of Quantum Mechanics*, [arXiv:1110.1857](#). * Temporary entry *.
- [81] M. G. Ivanov, *Superluminal motion and Lorentzian symmetry breaking and repairing in two-metric theories*, [arXiv:1110.1875](#). * Temporary entry *.
- [82] C.-Y. Zhu, H. Fan, and S.-P. Ding, *Dirac equation for superluminal neutrinos and mass matrix*, [arXiv:1110.1943](#). * Temporary entry *.
- [83] B. Altschul, *Consequences of Neutrino Lorentz Violation For Leptonic Meson Decays*, [arXiv:1110.2123](#). * Temporary entry *.
- [84] F. Klinkhamer, *Superluminal neutrino, flavor, and relativity*, [arXiv:1110.2146](#). * Temporary entry *.
- [85] A. Stebbins, *Probing Superluminal Neutrinos Via Refraction*, [arXiv:1110.2170](#). * Temporary entry *.
- [86] E. de Oliveira, J. Rodrigues, W.A., and J. Vaz, J., *Superluminal Neutrinos from OPERA Experiment and Weyl Equation*, [arXiv:1110.2219](#). * Temporary entry *.
- [87] S. Sahu and B. Zhang, *Superluminal Neutrinos in a Pseudoscalar Potential*, [arXiv:1110.2236](#). * Temporary entry *.
- [88] D. Bernard, *Comment on : 'Neutrino Velocity Anomalies: A Resolution without a Revolution'*, [arXiv:1110.2321](#). * Temporary entry *.
- [89] T. R. Morris, *Superluminal group velocity through maximal neutrino oscillations*, [arXiv:1110.2463](#). * Temporary entry *.
- [90] B. A. Berg and P. Hoeflich, *Two exercises about neutrino departure times at CERN*, [arXiv:1110.2814](#). * Temporary entry *.
- [91] O. Besida, *Three errors in the article: 'The OPERA neutrino velocity result and the synchronisation of clocks, '*, [arXiv:1110.2909](#). * Temporary entry *.
- [92] R. A. van Elburg, *Time-of-flight between a Source and a Detector observed from a Satellite*, [arXiv:1110.2685](#).
- [93] T. R. Morris, *Off-shell OPERA neutrinos*, [arXiv:1110.3266](#). * Temporary entry *.
- [94] M. De Sanctis, *Wave packet distortion and superluminal neutrinos*, [arXiv:1110.3071](#). * Temporary entry *.
- [95] N. E. Mavromatos, *Neutrinos and the Universe*, [arXiv:1110.3729](#). * Temporary entry *.
- [96] T. Li and D. V. Nanopoulos, *Background Dependent Lorentz Violation: Natural Solutions to the Theoretical Challenges of the OPERA Experiment*, [arXiv:1110.3451](#). * Temporary entry *.

- [97] **ICARUS Collaboration** Collaboration, *et. al.*, *A search for the analogue to Cherenkov radiation by high energy neutrinos at superluminal speeds in ICARUS*, [arXiv:1110.3763](#). * Temporary entry *.
- [98] A. Palazzo, *A potential issue for the OPERA neutrino velocity measurement*, [arXiv:1110.3783](#). * Temporary entry *.
- [99] J. Alfaro, *Superluminal neutrinos and the Standard Model*, [arXiv:1110.3540](#). * Temporary entry *.
- [100] F. Giacomini and P. S. Lottini, *Could the OPERA setup send a bit of information faster than light?*, [arXiv:1110.3642](#). * Temporary entry *.
- [101] U. Jentschura and B. Wundt, *Symmetries of the Tachyonic Dirac Equation*, [arXiv:1110.4171](#). * Temporary entry *.
- [102] N. Qin and B.-Q. Ma, *Superluminal Neutrinos in the Minimal Standard Model Extension*, [arXiv:1110.4443](#). * Temporary entry *.
- [103] F. Villante and F. Vissani, *On the generality of the Cohen and Glashow constraints on the neutrino velocity*, [arXiv:1110.4591](#). * Temporary entry *.
- [104] J. Bramante, *Sterile Neutrino Production Through a Matter Effect Enhancement at Long Baselines*, [arXiv:1110.4871](#). * Temporary entry *.
- [105] J. Ellis, H.-T. Janka, N. E. Mavromatos, A. S. Sakharov, and E. K. Sarkisyan, *Probing Lorentz Violation in Neutrino Propagation from a Core-Collapse Supernova*, [arXiv:1110.4848](#). * Temporary entry *.
- [106] M. H. van Putten, *Narrowing of the neutrino light curve in the OPERA experiment*, [arXiv:1110.4781](#). * Temporary entry *.
- [107] M. Pavsic, *Extra Time Like Dimensions, Superluminal Motion, and Dark Matter*, [arXiv:1110.4754](#). * Temporary entry *.