WEBSIGHTS | NOVEMBER 01 2024

# *Particle Physics with Don Lincoln and News about Neutrinos ⊘*

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*Phys. Teach.* 62, 702 (2024) https://doi.org/10.1119/10.0032489



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### websights

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#### Early Quantum Mechanics—Dr. Jorge S. Diaz's JK<sup>0</sup> YouTube channel:

https://www.youtube.com/@jkzero/videos https://en.wikipedia.org/wiki/2020\_Beirut\_explosion https://tinyurl.com/WS-DiazSG https://twww.youtube.com/@Kathy\_Loves\_Physics https://tinyurl.com/WS-DiazFineStr https://tinyurl.com/WS-DiazCP https://tinyurl.com/WS-DiazFH https://tinyurl.com/WS-PSSCfh

Dr. Diaz is an industrial physicist interested in explosions, shockwaves, and the history of modern physics. He first came to my attention while reading about the physics of the (roughly 0.5-kiloton TNT equivalent) August 2020 Beirut chemical explosion. His 25-odd YouTube videos include presentations on the physics of explosions (blast waves, including faster-than-sound shock waves evolving to acoustic waves), and on early atomic and quantum physics. I found Diaz's most recent video on the Stern-Gerlach experiment to be compelling and invigorating storytelling together with an insightful scholarly exposition of the physics, at a level appropriate for undergraduate physics majors. Diaz's engaging storytelling is at the level of high school physics pedagogue Kathy Joseph, but includes mathematics more appropriate for advanced freshmen and upper-division physics majors. Diaz's videos create a richly illustrated story, adding archival analyses of the literature and related images, including portraits, technical diagrams, schematics, and mathematics, of a kind only possible for a German-speaking mathematical physicist. For instance, Sommerfeld's many mathematical contributions to early quantum mechanics near and during the (first world) war years are reexamined from German sources.

Dr. Diaz's videos include context, interpretations, and historical, mathematical, and technical presentations on much of early quantum mechanics, including the fine structure constant, the Franck–Hertz experiment, the correspondence principle and so forth. I would have found these videos very helpful before my undergraduate modern physics lab, especially the Franck–Hertz (F–H) experiment. Diaz's F–H video also excerpts the excellent 1960 PSSC Physics film from Reed College, which I had never seen before (Franck himself speaks in that film), and includes references to commercial fluorescent tubes.

If you have students interested in learning about QM history, including Bohr period and adjacent mathematics (or just getting ready to do the F–H experiment), this is a compelling YouTube channel. DOI: 10.1119/10.0032488

### • Particle Physics with Don Lincoln and News about Neutrinos

https://en.wikipedia.org/wiki/Don\_Lincoln https://tinyurl.com/WS-LincolnFermiLab https://tinyurl.com/WS-DL-HB1 https://tinyurl.com/WS-DL-HB10y https://tinyurl.com/WS-FermiNeutrino https://neutrinophysics.fnal.gov/ https://tinyurl.com/WS-DL-neutrinos

Last month's issue of The Physics Teacher included an excellent paper by Prof. Lincoln on quark-gluon plasma (QGP, aka "melted protons"), and since I am teaching an evening course for high school teachers on particle and nuclear physics, we had a field day with his papers and videos last week. Lincoln has published over 140 YouTube videos, mostly about particle physics for Fermilab, with many on the Higgs boson. His first video on the topic is over 13 years old, predating the discovery of that particle, and you can watch the field (and Don) age and develop in his several subsequent videos, including a video made just this year on the race to find the Higgs, and another from 2022 celebrating 10 years of Higgs physics. Given the long continuing public interest in particle physics, physics pedagogues may want to watch a few of Lincoln's videos. He has a 9-year-old QGP video worth watching in there as well.

Also in the news from Fermilab: the Short-Baseline Near Detector (SBND) is now online and detecting neutrinos with 112 tons of cryogenic liquid argon. These are generated in intense beams, making Fermilab the lead neutrino experimental physics site in the world. Of course, Prof. Lincoln has multiple videos on neutrinos and neutrino oscillations, including an introductory video created during the pandemic. DOI: 10.1119/10.0032489

## • Implications of Negative Energy by Dr. Katerina Visnjic

#### https://tinyurl.com/WS-NegE https://www.youtube.com/@Physics4Life/videos

Explicitly discussing the different interpretation of the presence of a negative sign in front of vector and scalar quantities is particularly important in introductory mechanics when ending kinematics and encountering kinetic and potential energies. I believe that students tend to overgeneralize their new vector understandings, and then struggle with energy problems that are not deliberately cooked to avoid this issue, particularly with bound gravitational and electrostatic energy. Princeton lecturer Dr. Visnjic does an insightful and worthy job of addressing this issue.