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BOOK REVIEW

QUANTUM RELATIVITY: A SYNTHESIS OF THE IDEAS OF EINSTEIN AND HEISENBERG

By David Finkelstein

Alvin Miller, “David Finkelstein's Postmodern Quantum Æther,” book review: Quantum Relativity: A Synthesis of the Ideas of Einstein and Heisenberg, David Finkelstein, 577 pages with appendices and index, 1994, Springer, $89.

This book is the author' s (massive) magnum opus and crowns a brilliant career. During this time, he has rubbed shoulders with many of the notables of modern physics (e.g., von Neumann, Bohm and others), and posterity will place him in the same league. So, he’s been there and done that. But along the way, he has always been willing to express his own, sometimes maverick, views. As the editor of the International Journal of Theoretical Physics ($795 for an annual subscription!), he does not demand political correctness (adherence to SM – the Standard Model). For example, early papers by Harold Aspden and a number of his own have been published there.

This book is a postmodern program to push modern physics (SM) to its extremes and thereby overcome it and move beyond. The explicit objective is replacement of the SM. He lists the various field theory models and rejects each in turn without explanation. One quantum chromo-dynamic model rejected uses lattice cells in phase space constructed out of the vacuum with creation/annihilation operators. Recently attempts have been made to place solitons on these lattices, all seemingly pertinent to Finkelstein's model. Incidentally, papers in the SM have speculated on when and what effects the present (metastable) false vacuum will make the final phase transition to the actual zero value ground state. The upshot is that all the parameters such as temperature and stress aren’t known, so that this could happen a minute from now.

The author has demonstrated an early and growing interest in the vacuum as time went by. In 1969 he published an influential paper that was one of the earliest on solitons, leading to instatons, Higgs particles, Witten strings, etc. Edward Witten himself said of the paper that it "probably represented the first use of what would now be called vacua in quantum field theory." In a 1987 paper Finkelstein commented "**the structure of the vacuum is the central problem of physics today**; the fusion of the theories of gravity and the quantum is a subproblem."

The model is constructed of what the author labels chronons in fermionic pairs that form quasibosons and condense (Bose-Einstein supercondensate) into space time vectors to form an off diagonal (diamond) hyper-crystalline order. Chronons are postulated to be about the size of Planck time which then determines lattice spacing. Here ordinary "**particles such as electrons are comparatively huge light blimps with internal structure**." The space time vectors are placed at the lattice vertices of Feynman style diagrams ("Feynman checkerboards with whiskers"). These are sited in complex valued phase cell space (discrete hyper-dimensional Hilbert space). If you’re still following, the metric is potentially indefinite and fluctuating, and there is no absolute space nor instantaneous time. And the model has no underlying manifold, although, by construction it still retains causality and locality. The universe is seen as blinking into and out of existence frequently as space time and the constituting lattice are formed.

To represent interactions, this mathematical set logic lattice is subjected to vacuum defects. An analogy

with solid state crystallography, as in Burger's dislocation theory of disinclination, torsion, etc., is used to produce all particles and forces (weak, strong, EM and inertia and gravity). Again, in analogy to solid state, the coherent mode method can be used to place harmonic oscillators in the lattice to represent solitons, kernels, vortices, etc., and derive the mass spectra energy levels. After construction is completed, the lattice can bemapped to Minkowski space to embed the tiling there. From this point, the final mapping can be made to produce a subquantal hyper-crystalline lattice in the real four-dimensional laboratory frame world.

One of Finkelstein's mottos is from Huckleberry Finn, "I don't hold much with mathematics." He is adept at keeping the necessary formalism to the minimum that will do justice to the model. Certainly his model is substantially less complicated than the SM, where field theory now resembles nothing so much as the gyres and epicycles prior to Copernicus. An example of minimal use technique is Finkelstein's employment of the Rubik's cube toy to generate the group theory rotation symmetries for the hypercube. One big mathematical surprise is the indication of octahedral instead of cubic lattice structure giving a hyper diamond with off-diagonal order.

Here the power of geometry and topology as tools is demonstrated. Even Newton had geometric effects – witness the Coriolis force. Modern physics has become a mathematical playground for all the various geometric entities now known, with topology as active agent. A viable aether theory must not reject these questions out of hand. Finkelstein is pioneering these applications and reaping unique physical insights as a reward.

Integrated into the book are a number of succinct, intelligent discussions of metaphysics. Such discussions are now a requirement in order to cope with the turmoil in modern physics. With respect to the æther, he is thoroughly conversant with the classical version (noting particularly Sommerfield) and its contemporary revival. Interestingly, Descartes in the fifteenth century already postulated vortices in his fluid æther. In the famous Newton (point particles in the empty Void) versus Leibniz debate (contiguous monads), Finkelstein sides with Leibniz and the concept of extension. Space is full - the plenum. Without wandering into theology, the concept is a benevolent, beneficent universe. Finkelstein has published elsewhere on process theology and similar topics.

In spite of the lengthy convoluted route through mathematical spaces, the hyper-crystalline lattice that eventually falls out is markedly similar to classical æther models. But there are a number of significant distinctions instantly made. This is not a hidden variable theory. There is no underlying continuum into which the æther is to be placed, contrary to Newtonian physics. In compliance with the fundamental postmodern prescription, no absolute, preferred frame is granted the æther. The biggest advance over the classical model is that now for the first time the mathematical formalism has been developed that will permit the determination of the complete structure and dynamics of the lattice æther.

But this is also the source of the greatest disappointment with the book. It is admittedly only a work in progress. Results so far achieved are tantalizing but sparse. Dynamic predictions will have to await new papers or perhaps a second edition update. Finkelstein conducts lively workshops on Quantum Topology and Quantum Logic at the Georgia Tech. School of Physics that should generate added details. As it stands, the lattice is really only discussed in the last chapter of the book. The author doesn't elaborate the relation of his model to the classical æther or to the SM, in spite of similarities in all the models. There is no discussion of the features to be expected for the lattice in the real world space-time.

The book is not recommended for neophytes or those totally allergic to math. The index appears to be computer generated and not comprehensive. The book is pricey, although certainly packed with original ideas for that price. It represents a tentative, cutting edge effort to open physics to a radical, new frontier,

as opposed to attempts to regress to an era that probably can’t be recaptured. Understood in this way, the book will amply reward those intrepid enough to explore it.