First Prediction of Momentum-Pair Creation in Stern-Gerlach

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… PAVIS is as opposite to pilot wave and hidden variable views as is possible.

Instead of particles, I only allow quantum equilibria. These are wave packets that cannot get smaller due a lack of sufficient spatial resolution capacity (lack of mass-energy), but also usually resist getting larger due to something I call *adiabatic bandwidth*. Energy carries information, and it is the bidirectional flow of information encoded into equilibrium adiabatic energy exchanges that keeps thermal matter simple, solid, and classical. Aharonov's and Gao's protected wave functions touch on this issue, but they focus on the energy aspect and do not directly address information flows. Alas, without the adiabatic bandwidth concept you cannot develop a complete theory of protected wave functions.

Entities above the various quantum equilibrium points reside in classical time and follow information-dominated causal physics. This is the domain of "world lines" in general relativity. However, in PAVIS world lines are finite in diameter, fuzzy, and only partially deterministic of the future. Thus in PAVIS general relativity is both approximate and emergent, not primal. Ahem. But PAVIS does provide a less infinity-plagued approach to resolving relationships between quantum theory and both relativities. SR becomes a deep set of PAVIS rules, and GR becomes the large-scale topology of the information fabric, which I like to call the Boltzmann fabric out of respect for that great and brilliant man.

Below the PAVIS quantum equilibrium points, which include atoms and nucleons, *there are no particles and no histories*. There is only "rule chemistry" in which *everything* is entangled and must eventually sum to null. That includes the universe as a whole, which in PAVIS has an antiverse partner that is hurtling the opposite direction in time. We remain fully entangled with it.

I am surprised how powerful PAVIS can be analytically.

For example, in PAVIS a Stern-Gerlach field *adds a momentum-pair creation rule* to the wave function of the atom. This does not instantiate the atom, but it does cause its wave function to expand transversely to encompass the new futures implied by the rule. For spin ½, impacting one lobe onto a mask absorbs, scrambles, and distributes its half-momentum into the fully classical instrument along some classically precise xyz angle. By conservation this forces the other entangled half of the pair to pick up all of the remaining rules and thus become a "real" wave packet, an observed atom. Delightfully, this event also *creates a history for the particle*, making it look as though the particle had been there all along, with exactly the spin orientation needed.

Schwinger was intensely annoyed by this decided-from-the-start history. Bohm in contrast used it as "proof" that there had been a particle there all along, and that the wave function had collapsed early. Only Feynman said "yes it's weird, but if you just follow the rules it works". Point to Feynman. Ironically, the very fact that such particles seem to have perfect and impossible trajectories from start to finish is proof that they stayed quantum, since only *quantum* rules can create entire histories — not just particles — when detection finally occurs.

Feynman was right: The wave function remains coherent, and remerger is possible.

Now someone out there just needs to test it.

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And speaking of testing, here's my first PAVIS experimental prediction:

If it is true that Stern-Gerlach (say for spin ½) works by adding one "momentum-pair excitation rule" to each atomic wave function that passes through it;

Then the excitation process will transfer *twice* as much energy to the wave function as will be found in the atom when it is finally detected.

The other half of the transferred energy will end up in the blocking mask… that's right, in the *blocking mask*.

Both the initial double-size energy transfer to the atom and the single-unit transfer to the mask will be fully classical events, and thus detectable by using sufficiently sensitive experimental setups.

I am not aware of any name for this rather novel mode of real-energy transfer, so I'll invent one: a *vacuum phonon*. That's not entirely accurate of course, since the "vacuum" must initially be occupied by a quite real wave function. But once the momentum has been transferred into the blocking mask, all of the other properties (rules) of the atomic bundle will default to some other spatially distant lobe, where they will form a localized atom. Thus after the momentum has been transferred, there will be nothing left behind but empty space: a vacuum phonon.

The concept of a vacuum phonon is… well, a rather fascinating possibility, yes? Note that despite its similarity to phonons it is not a quasiparticle, since it can be conveyed from a single fundamental particle in the vacuum. Also, it has quantum numbers that do not correspond to any other fundamental particle. Put those two features together and, oddly enough, it classifies as an addition to the Standard Model Zoo, one that is very low-energy and accessible to almost any laboratory, even if it is hard to detect.

Furthermore, vacuum phonons would forever give lie to the idea that blocking masks "do nothing" when they create or destroy wave functions in quantum interference experiments. In the PAVIS interpretation all paths are used, just with severely asymmetric bundling rules that result in one path getting "almost nothing", just tiny blip of momentum, and some other path getting "almost everything", such as the full atom minus that blip of energy. But *both* paths would get real-energy particles that are both detectable and manipulatable. Fascinating…

If either (or both) vacuum phonons and double-momentum quantized energy excitations of atoms in Stern Gerlach can be experimentally validated, it would provide a powerful incentive to reinterpret pretty much all of quantum mechanics in terms of *rules*, as opposed to particles. It would also show the relevance of at least some aspects of the PAVIS model. Finally, it would profoundly change the tenor of quantum interference experiments. Blocking masks would never again be viewed as "inert" components. Instead, they would become active, sensitive, and customizable components of the interference process. This would surely enable new directions for manipulation and testing in a wide range of quantum experiments.

And finally, as a minor side effect, it would add a new particle, the vacuum phonon, to the Standard Model… and do so at a really, *really* good price.

Terry Bollinger at 3:01 PM EDT on August 03, 2020:
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Since I put the vacuum phonon "wild hypothesis" out while thinking in real time, here is an important update with some interesting experimental implications:

At least for the case of a spin 1 atom, say a silver atom, with spin 0 along the z axis (which I'm pretty sure is identical to saying it has a specific, superclassical spin in the xy plane), the specific type of rule excitation that the SG adds to the silver atom wave function is a *virtual photon pair rule*. Each virtual photon is circularly polarized and oriented up or down along the z axis, which when mixed (rule chemistry) with the atomic bundle imparts both momentum and +1z or -1z spin to the two SG lobes. Since in rule chemistry the photon pair gets bundled ("absorbed") by the equally quantum atomic rule bundle, the virtual photons only modify the evolution of the evolution of the atomic bundle. Thus the virtual photons do not radiate at light speed, at least for as long as they remain in the bundle.

Here's the critical predictive part: ***if*** the silver atom is detected at a particular location and time in the upper +1z lobe, ***then*** the lower z lobe should both dissipate and "emit from empty space" a -1 spin circular polarized photon headed in the z-down direction. The energy and frequency of this photon will be defined by the transverse momentum of the atom in the +z direction.

Thus it will look exactly as if the atom had been excited sufficiently by the SG to emit a downward photon, which in turn gives it both upward momentum and z axis positive spin. The only difference, really, is that the photon will be emitted from a region of space macroscopically distant from where the atom was found.

So alas, after accounting for the spin pairing that is also part of the problem, it looks like the PAVIS rule excitation hypothesis does *not* for a silver atom produce a spin-0 pure-momentum particle that is not in the Standard Model. But it *does* postulate emission of a photon from a nominally empty region of space in which there is no atom to emit it. If there is a name for this prediction of photon emission from a region of space where the atom is not, I am unaware of it.

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... one apt name might be *emissive ventriloquism*, or "photon casting": The emission of a photon from a lobe of an atomic wave function that is distant in space from the lobe in which the atom is eventually detected.

This interpretation sounds less radical, since it is at least akin to known peculiar wave function separations such as Sin-Itiro Tomonaga's theory of spin-charge separation in condensed matter.

However, please make no mistake: If you entertain as plausible my silly idea that atomic wave functions can be raised to excited energy states *and remain coherent*, via linear addition of "virtual pair rules" whose properties other than energy sum to zero; then you must also entertain as plausible a clear and experimentally disprovable violation of standard quantum interpretation.

The violation is this: If you block or mask one path of a coherent atomic wave function, then for every case in which that path does *not* detect an atom, a sufficiently sensitive set of detectors should instead observe a transverse photon whose momentum precisely cancels the transverse momentum needed to shift the atom to the path where it *was* found.