Realizing Two of Einstein's Dreams:
Unifying Gravity and Light,
and Why Quantum Mechanics is Weird

doug <sweetser@alum.mit.edu>

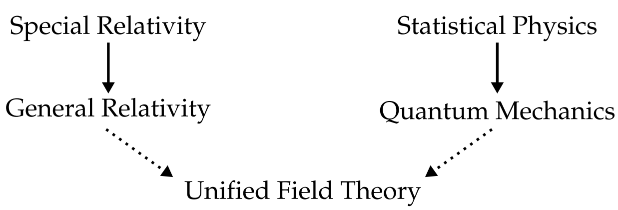
Abstract

Einstein dreamed of unifying gravity with light. His work branched from general relativity. I will do a simple thought experiment to show that if Nature is as logically consistent as she appears to be, then the equation that governs how two electrical charges with opposite signs attract must apply to two possitive mass charges.

Einstein was bothered by why quantum mechanics had to be the way it is. This deep riddle is resolve by a deep merger: Newton's calculus applied correctly to events in spacetime using quaternions. The double limit definition of a quaternion derivative on a quaternion manifold splits into two classes. In one ordering of the limits, one ends up with a directional derivative along the real axis. This maintains classical causality. In the other ordering of limit processes, one can only define a normed derivative. There is no time-ordered list of events. Instead, there is a sum over all possible histories that contribute to make up a normed derivative.

Einstein's Dream

1. Unify Gravity and light.
2. Explain why quantum mechanics is weird.



Goldielock's Unified Field Theory

1. Newton's Rank 0 theory of gravity is great!

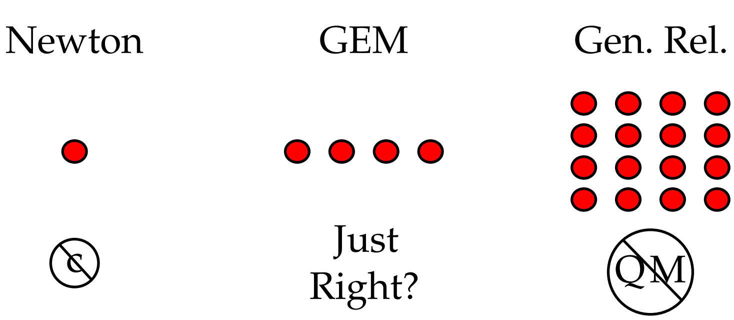
   DEADLY FLAW: Inconsistent with special relativity.

2. General relativity's Rank 2 theory is better!

   DEADLY FLAW: Cannot be quantized.

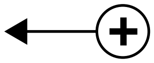
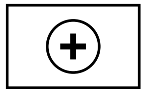
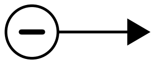
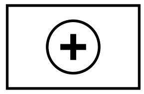
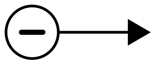
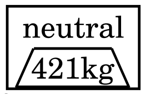
3. Ergo, a rank 1 theory should be just right!

   DEADLY FLAW: Very destructive to current work.



Attractive 4-Vector Field Equations

The same manifestly covariant law should apply in different situations:

Case	Probe	Source	Field Eq.	Charges
1.			$J_q = \Box^2 A$	Repel
2.			$-J_q = \Box^2 A$	Attract
3.		 $e^2 = G\, m_e\, 421$	$-J_m = \Box^2 A$	Attract

Rank 1 Theory Dismissals

1. Objection: Cannot have an attractive 4-force equation with $+m$.

   Answer: it is the sign of m relative to $\nabla^2\phi$ that matters.

   Electric current density is less due to inertial mass density.

   $$\rho_q - \rho_m = \frac{\partial^2\phi}{\partial t} - \nabla^2\phi + \frac{\partial}{\partial t}\Gamma^0{}_{\omega 0} A^\omega - \nabla^i \Gamma^0{}_{\omega i} A^\omega$$

2. Objection: Background is fixed.

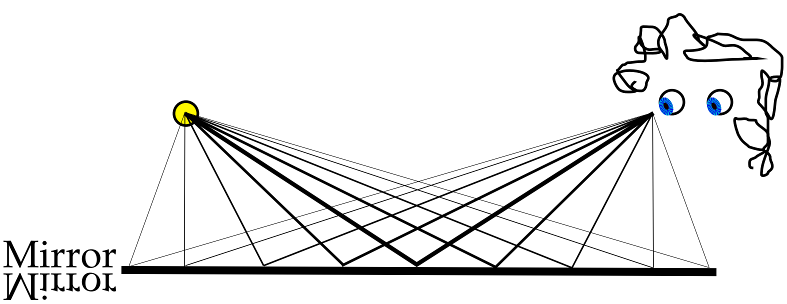
   Answer: Look at differential equation above:

   the connection Γ is in a diff. eq., so the metric is flexible.

Change in Quantum Mechanics

1. Add up every possible way.
2. If you look, particles go one particular way.
3. Causality is NOT the classical $A \longrightarrow B \longrightarrow C$

   Causality is the sum of all possible histories.



Change in Spacetime

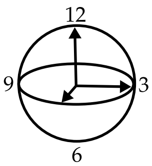
- Newtonian change $\longrightarrow$ calculus

- Einstein's spacetime $\longrightarrow$ quaternions

Problem: No calculus of quaternions

so the description of change in spacetime is incomplete.

$\triangle t$ $\triangle x$ $\triangle y$ $\triangle z$ **versus** $\triangle$



Dual Limit $\frac{d\phi}{dq}$ Definition

Changes in space goes to zero first, then changes in time go to zero OR the reverse.

1. $\boldsymbol{dR \rightarrow 0}$, then, $\boldsymbol{dt \rightarrow 0}$

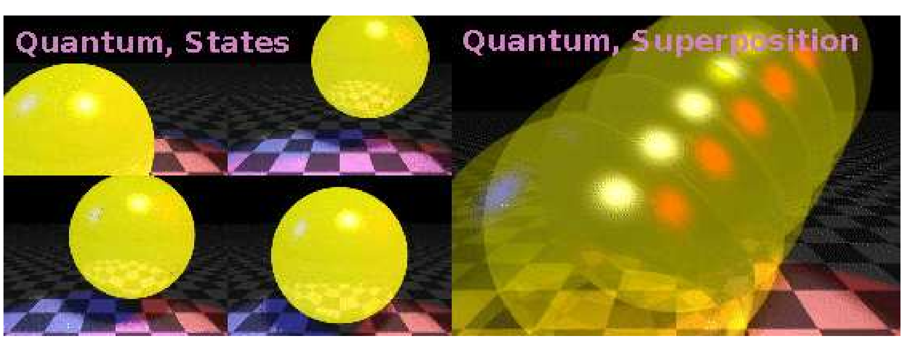
   - Classical Physics.
   - Causality is $A \longrightarrow B \longrightarrow C$.
   - Effectively a directional derivative:

   $$\boldsymbol{\frac{d\phi}{dq} = \lim_{\Delta d \rightarrow 0} \left(\lim_{\Delta d \rightarrow \Delta d + \Delta d^{\star}} \frac{f(q + \Delta d) - f(q)}{\Delta d} \right)}$$

2. $dt \rightarrow 0$, then, $dR \rightarrow 0$

   - Quantum mechanics.
   - Causality is the sum of all possible histories.
   - Effectively a normed derivative:

   $$\left| \frac{d\phi}{dq} \right| = \lim_{\Delta d \rightarrow 0} \left(\lim_{\Delta d \rightarrow \Delta d - \Delta d^{\star}} \frac{f(q + \Delta d) - f(q)}{\Delta d} \right)$$



GEM Dream

1. Unify Gravity and light with a rank 1 field equation.
2. A timelike directional derivative for classical physics, a spacelike normed derivative for quantum mechanics.