Quantum Mechanics (QM) from Special Relativity (SR)
The RoadMap to the SRQM Interpretation of Quantum Mechanics
A Study in Physical 4-Vectors and Lorentz Invariants

A physical derivation of Quantum Mechanics (QM) using only the assumptions of Special Relativity (SR) as a starting point...
Quantum Mechanics is not only totally compatible with Special Relativity, QM is derivable from SR!
This is the "SRQM Interpretation of Quantum Mechanics", or alternately, the "[SR→QM] Interpretation of Quantum Mechanics",
as well as a Study in Physical 4-Vectors and Lorentz Invariants.
A thesis by John B. Wilson.

Roadmap from Special Relativity to Quantum Mechanics: (The Short Version)

Start with SR Physical 4-Vectors:
4-Position $\mathbf{R} = (ct,\mathbf{r})$
4-Velocity $\mathbf{U} = \gamma(c,\mathbf{u})$
4-Momentum $\mathbf{P} = (E/c,\mathbf{p}) = (mc,\mathbf{p})$
4-WaveVector $\mathbf{K} = (\omega/c,\mathbf{k})$
4-Gradient $\partial = (\partial_t/c,-\nabla)$

Note the following relations between SR 4-Vectors:
$\mathbf{U} = d\mathbf{R}/d\tau$
$\mathbf{P} = m_o\mathbf{U}$
$\mathbf{K} = (1/\hbar)\mathbf{P} = (\omega_o/c^2)\mathbf{U}$
$\partial = -i\mathbf{K}$

Form a chain of SR Lorentz Invariant Scalar Equations, based on those relations:
$\mathbf{R}\cdot\mathbf{R} = (c\tau)^2$
$\mathbf{U}\cdot\mathbf{U} = (c)^2$
$\mathbf{P}\cdot\mathbf{P} = (m_oc)^2$
$\mathbf{K}\cdot\mathbf{K} = (m_oc/\hbar)^2 = (\omega_o/c)^2$
$\partial\cdot\partial = (-im_oc/\hbar)^2 = -(m_oc/\hbar)^2 = -(\omega_o/c)^2$

The last is the Klein-Gordon Equation, the Relativistic Quantum Wave Equation for Spin-0 Particles.
The Schrödinger Equation, and hence Quantum Mechanics, is just the low-velocity ($|\mathbf{v}| << c$) limiting-case.
This is (RQM) = Relativistic Quantum Mechanics, derived from only:
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5 of the Standard SR 4-Vectors.
4 really simple empirical relations between them.
1 SR rule for forming Lorentz Scalar Invariants, ie. the Minkowski Metric which gives the Lorentz Scalar Product.

As one of my physics professors (Dr. Valk - GA Tech Physics) used to say:
"Once you have the Schrödinger Equation, you have Quantum Mechanics."

I would modify this just a bit:
"Once you have the Klein-Gordon Equation, you have Relativistic Quantum Mechanics.
The Schrödinger Equation, and hence Quantum Mechanics, is just the low-velocity ($|\mathbf{v}| << c$) limiting-case.
Likewise, Classical Mechanics is just the 'mixed wave' or 'non-phase aligned' limiting-case of Quantum Mechanics,
in which the divergence of a momentum state is very small compared to the magnitude-squared of the momentum state.
In other words, the limiting-case for which changing the state by a few quanta has a neglible effect on the overall state."
The Hamilton-Jacobi non-quantum limit $\{\hbar|\nabla\cdot\mathbf{p}| << (\mathbf{p}\cdot\mathbf{p})\}$ see Goldstein, Classical Mechanics, pg. 491

See full development: http://www.scirealm.org/SRQM-RoadMap.html
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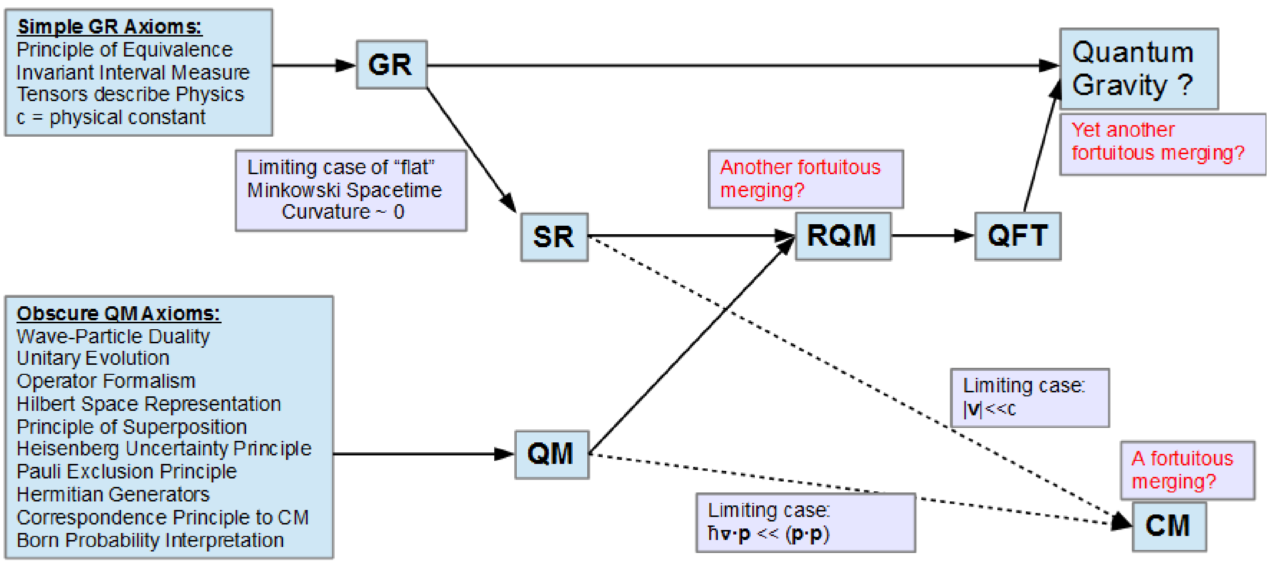
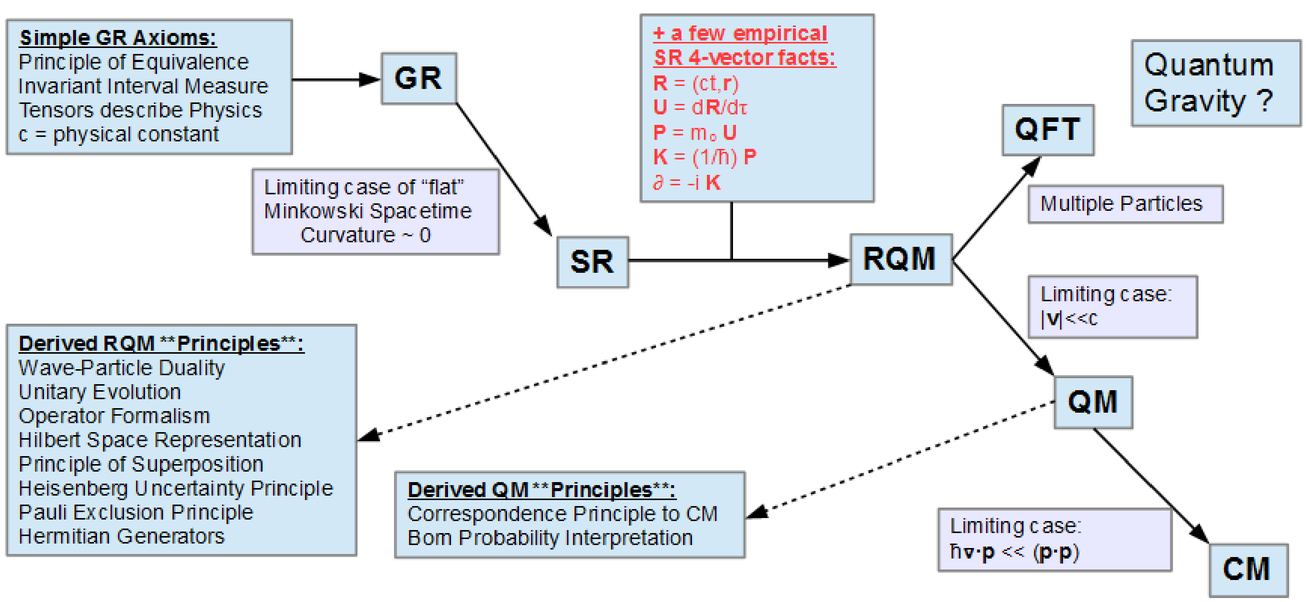
This changes the paradigm of how we think GR, SR, RQM, QM, and CM all fit together…

This is the old paradigm…



This is the new paradigm, based on the SRQM interpretation.



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