NEW PICTURE

SCHRODINGER'S EQUATION

$$\hat{H} |\psi(t)\rangle = i\hbar \frac{\partial}{\partial t} |\psi(t)\rangle$$

$$-\frac{\hbar^2}{2m} \frac{\partial^2 \psi(x,t)}{\partial x^2} + V(x) \psi(x,t) = i\hbar \frac{\partial \psi(x,t)}{\partial t}$$

2nd DERIVATIVE
IN SPACE

1st DERIVATIVE
IN TIME

RELATIVITY TELLS US
SPACE + TIME ARE ~ EQUIVALENT

⇒ OPTION #1
2nd DERIVATIVE FOR BOTH

• SCHRODINGER REALIZED THIS
• "HAD" ANOTHER EQUATION FIRST !!!
NOW KNOWN AS

KLEIN — GORDON EQUATION
"IT HAD ISSUES"   — ENERGY
                    — PROBABILITY
                    DISAGREEMENT W/ LAB DATA

⇒ OPTION #2
1st DERIVATES FOR $t, \overline{x}$

✩ DIRAC EQUATION ✩

WHAT ELSE DOES SPECIAL RELATIVITY
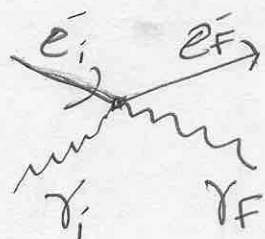MAKE US THINK ABOUT

$E = mc^2$

CONCEPTUALLY   ⟵— ✗ TRY NOT TO
TRANSFORMATION   THINK ABOUT MASS
                            TOO MUCH NOW
CREATION
                            LIGHT PHOTONS MASSLESS
ANNIHILATION

"SINGLE PARTICLE"

$$H |\psi\rangle = i\hbar \frac{\partial |\psi\rangle}{\partial t}$$

"INTERACTIONS IN LIFE CAN BE MESSY"

e_i^- e_F^-

γ_i γ_F

BANG   BANG

VERY STYLIZED !

MULTI WAVEFUNCTION SYSTEM

$|\psi_S\rangle \longrightarrow |\psi_{1S} \psi_{2S} \psi_{3S} \dots\rangle \longrightarrow$ $\hat{\phi}$

NEW   A (FIELD)
VIEW   OPERATOR
MODERN
TIMES

1st NEW VIEW
QED = QUANTUM ELECTRODYNAMICS
       ∼ QUANTUM + SPECIAL RELATIVITY
"FERMIONS CAN EMIT AND ABSORB VIRTUAL PHOTONS"
    e^-