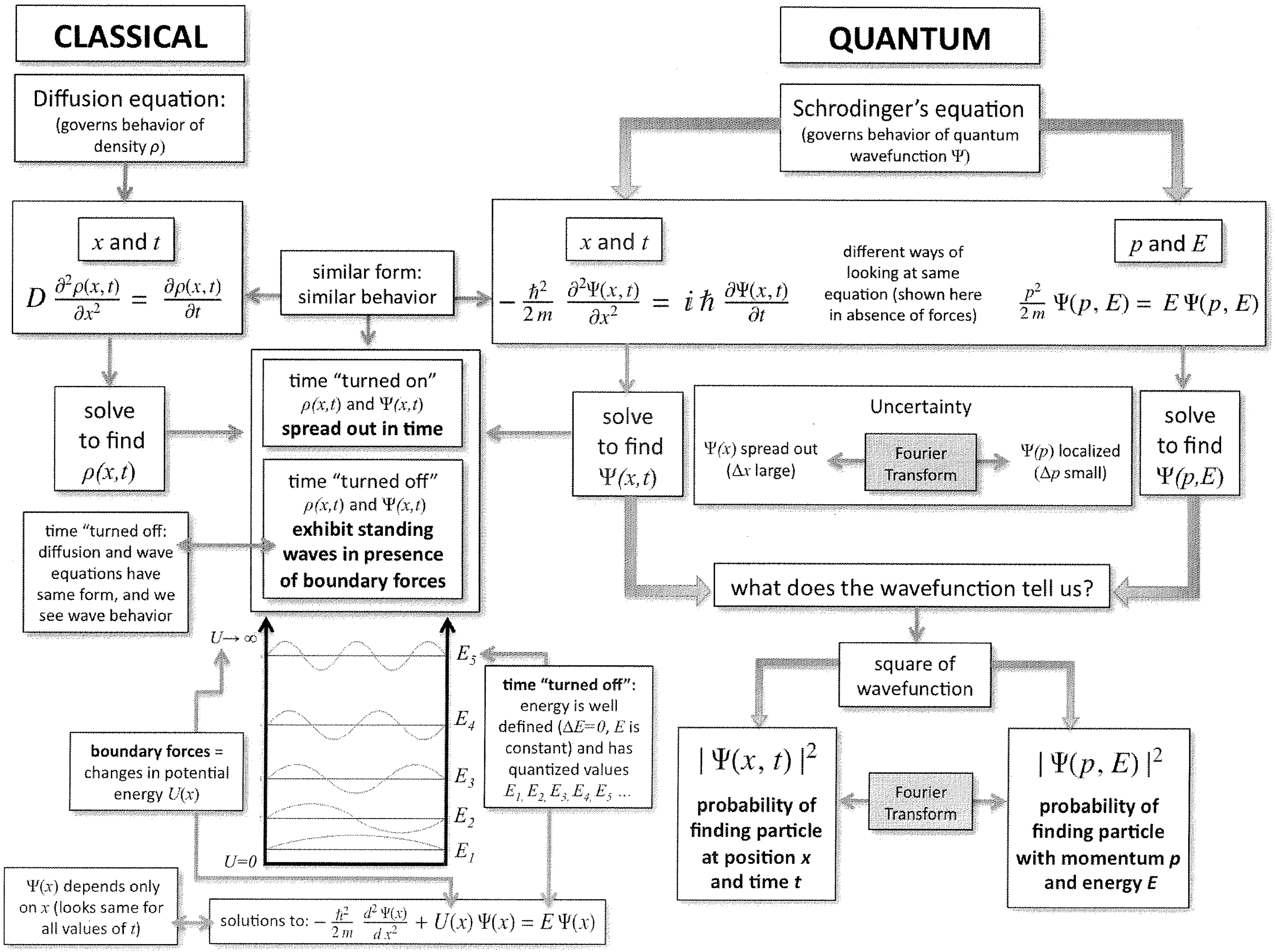
CLASSICAL
QUANTUM
Diffusion equation: (governs behavior of density ρ)
Schrodinger's equation (governs behavior of quantum wavefunction Ψ)
x and t
$D \frac{\partial^2 \rho(x,t)}{\partial x^2} = \frac{\partial \rho(x,t)}{\partial t}$
similar form: similar behavior
x and t
$-\frac{\hbar^2}{2m} \frac{\partial^2 \Psi(x,t)}{\partial x^2} = i\hbar \frac{\partial \Psi(x,t)}{\partial t}$
different ways of looking at same equation (shown here in absence of forces)
p and E
$\frac{p^2}{2m} \Psi(p,E) = E\,\Psi(p,E)$
solve to find ρ(x,t)
time "turned on" ρ(x,t) and Ψ(x,t) spread out in time
time "turned off" ρ(x,t) and Ψ(x,t) exhibit standing waves in presence of boundary forces
solve to find Ψ(x,t)
Uncertainty
Ψ(x) spread out (Δx large)
Fourier Transform
Ψ(p) localized (Δp small)
solve to find Ψ(p,E)
time "turned off: diffusion and wave equations have same form, and we see wave behavior
what does the wavefunction tell us?
U→ ∞
E5
E4
E3
E2
E1
U=0
time "turned off": energy is well defined (ΔE=0, E is constant) and has quantized values E1, E2, E3, E4, E5 ...
square of wavefunction
boundary forces = changes in potential energy U(x)
|Ψ(x, t)|²
probability of finding particle at position x and time t
Fourier Transform
|Ψ(p, E)|²
probability of finding particle with momentum p and energy E
Ψ(x) depends only on x (looks same for all values of t)
solutions to: $-\frac{\hbar^2}{2m}\frac{d^2\Psi(x)}{dx^2} + U(x)\Psi(x) = E\,\Psi(x)$