

If Dirac Teaches Megumin Quantum Mechanics: A Courtroom Play

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Act 1. In the Warp Courtroom

Scene: The courtroom of Slaanesh in the Warp (from Warhammer 40k[10]). Megumin[8] is charged with vaporizing three Chaos Marines with her Explosion spell. She is aware of her actions but has not confessed in court.

Paul Dirac[7] appears as her defense attorney. He argues that, by the principle of quantum observation, guilt and innocence should be treated as a superposition until a measurement is made.

Co-defendant: Aqua[9] is present in the defendant's box due to sheer misfortune, still clueless about the situation.

Dirac:

If the universe follows the laws of quantum mechanics, Megumin, your state is not determined until it is observed. That is, your guilt $|G\rangle$ and innocence $|I\rangle$ are in superposition:

$$|\Psi\rangle = \alpha |G\rangle + \beta |I\rangle, \quad \text{with } |\alpha|^2 + |\beta|^2 = 1.$$

Quantum Interlude I: Quantization of Verdicts

Dirac (narration):

The verdict operator of the court is quantized as follows:

$$\hat{H}_{\text{Justice}} |G\rangle = +1 |G\rangle, \quad \hat{H}_{\text{Justice}} |I\rangle = 0 |I\rangle$$

This means verdicts are not emotional gradients, but discrete eigenvalues. One cannot define innocence without defining guilt. That is the quantum identity.

Act 2. The Interference of Guilt

Dirac:

If the phase is aligned, constructive interference appears:

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|G\rangle + |I\rangle),$$

and if the phase is opposite,

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|G\rangle - |I\rangle),$$

then destructive interference reduces the observable probability of guilt.

Interlude II: Uncertainty of Verdict and Sentence

Dirac (aside):

If the guilt operator \hat{G} and the sentence operator \hat{P} do not commute,

$$[\hat{G}, \hat{P}] \neq 0 \Rightarrow \Delta G \Delta P \geq \frac{\hbar}{2}$$

then a precise verdict implies uncertainty in sentencing, and vice versa.

Act 3. Collapse or Not Collapse

$$\hat{P}_G = |G\rangle \langle G|, \quad \hat{P}_I = |I\rangle \langle I|$$

Dirac:

If you consent to measurement, the wavefunction will collapse, and reality will choose a single branch.

Megumin:

...I accept the observation. Just as I always chose Explosion.

Act 4. Entanglement and Wigner's Friend

Judge Slaanesh:

Measurement result: $|I\rangle$. Not guilty.

Dirac:

Her guilt component vanished into orthogonality, and Aqua became entangled with the $|G\rangle$ state.

Dirac (internal monologue):

Even if Megumin knew she was guilty, unless she declares it, no external observation occurs. Hence, the wavefunction remains uncollapsed. This is the puzzle left by Wigner's friend.

Interlude III: State Reconstruction

Dirac (narration):

If the court reconstructs the density matrix ρ from testimonies,

$$\rho = \sum_{i,j} p_{ij} |i\rangle \langle j|,$$

then this is quantum state tomography. Truth is reconstructed from observation.

Act 5. ...

(Empty stage. The curtain falls.)

Note: An unobserved world is neither real nor unreal. The verdict in quantum court is always open, and the final question of physics remains:
Who observed it?

References

References

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