Executive Summary: The Quantum Principles Challenge

The **Quantum Principles (QP) Challenge** is an international scientific initiative aimed at replicating a key experimental result that reveals how quantum systems transition to classical behavior depending on measurement duration. The challenge centers on reproducing a specific current-voltage (IV) curve measured on a single-molecule junction at ambient conditions. Short measurement times (0.64 ms) yield quantum signatures, while long measurement times (20 ms) produce classical responses.

Scientific Significance

The experiment highlights a potentially fundamental principle: **the temporal resolution of a measurement directly influences the observed physical regime**. Replicating this result would contribute meaningfully to ongoing discussions about quantum measurement, decoherence, and system–observer interactions.

Scope and Feasibility

The required setup — a bending beam assembly (BBA) integrated into a mechanically controlled break junction (MCB) system — is technically accessible to most university workshops and nanoscience labs. Key advantages:

- **Ambient-condition operation** (no cryogenics)
- **Commercially available materials**
- **Reproducible fabrication protocol**
- **Modest financial cost** relative to typical quantum experiments

The primary investment is **team effort**, not equipment.

Organizational Benefits

Participation offers:

- A **focused, time-bounded project** ideal for cross-disciplinary collaboration
- A **high-visibility opportunity** for smaller institutions
- A **motivational framework** for students, PhD candidates, and early-career researchers
- A chance to **publish a landmark** result with lasting impact

The challenge can be executed alongside normal research activities, with teams typically dividing into fabrication, electronics, measurement, analysis, and coordination groups.

Support and Incentives

- Documented and direct guidance is available for participating teams
- A limited number of high-quality BBAs are provided to new groups
- The first team to publish a successful replication in a peer-reviewed journal is recognized as the winner. The corresponding data is to be made public on platforms such as Zenodo or OSF.
- The challenge founder will visit the winning institution to give an engaging seminar
- The winning team receives a $10.000 replication grant

Conclusion

The QP Challenge represents a **low-risk, high-reward** opportunity to contribute to foundational physics while strengthening internal collaboration and visibility. With modest resources and a coordinated team, institutions can meaningfully participate and potentially lead a significant scientific development.