Chaos through the lens of quantum channels

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Motivation & Problem Statement

Key Challenges:

- Current limitation in field
- Gap in existing literature
- Unanswered scientific question[Physical Review E **76** 061127 (2007)]
- Technological barrier[Physical Review A **106** 042604 (2022)] [Physical Review Letters **110** 084101 (2013)]

Figure 1: Schematic showing the problem space (**taylor2005classical**, **taylor2005classical**)

Research Need:

- Why this matters now
- Potential impact (**jackson1999classical**, **jackson1999classical**)

Research Objectives

Primary Objective
Development of novel method/technique/theory for...

Specific Aims

1. **Aim 1:** Characterize/develop/model...
2. **Aim 2:** Implement/analyze/validate...
3. **Aim 3:** Demonstrate/compare/optimize...

Building upon previous work while addressing key limitations [Physical Review Letters **110** 084101 (2013)].

Theoretical Framework

Theorem (Key Theoretical Result)

$$\mathcal{H} = \int_{\Omega} \left[\frac{1}{2} \kappa (\nabla \phi)^2 + f(\phi) \right] \mathrm{d}V$$

Based on Landau theory[1]

Fundamental Equation

$$\frac{\partial \psi}{\partial t} = \mathcal{L}\psi + \mathcal{N}(\psi) + \eta(\vec{r}, t)$$

Extending previous formulations[2]

- Mathematical foundation following[3]
- Key assumptions and their validity
- Novel theoretical contribution

[1] **landau2013course**.
[2] **goldstein2002classical**.
[3] **arfken2013mathematical**.

Methodology

Experimental/Numerical Setup:

- Technique/equipment used[a]
- Parameters and conditions
- Validation approach[b]
- Statistical methods[c]

Innovative Aspects:

- New methodology developed
- Unique combination of techniques[d]

[a] **press2007numerical**.
[b] **allen2017computer**.
[c] **sivia2006data**.
[d] **frenkel2001understanding**.

Figure 2:
Experimental/computational setup[b]

[a] **landau2014guide**.
[b] **landau2014guide**.

Key Result 1: [Main Finding]

Figure 3: Primary result showing [key finding]

Observations:

- Clear trend/pattern
- Statistical significance[a]
- Comparison to expectation

Interpretation:

- Physical/biological meaning
- Surprising/unexpected aspect[b]

[a] **sivia2006data**.
[b] **griffiths2005introduction**.

Motivación con una figura

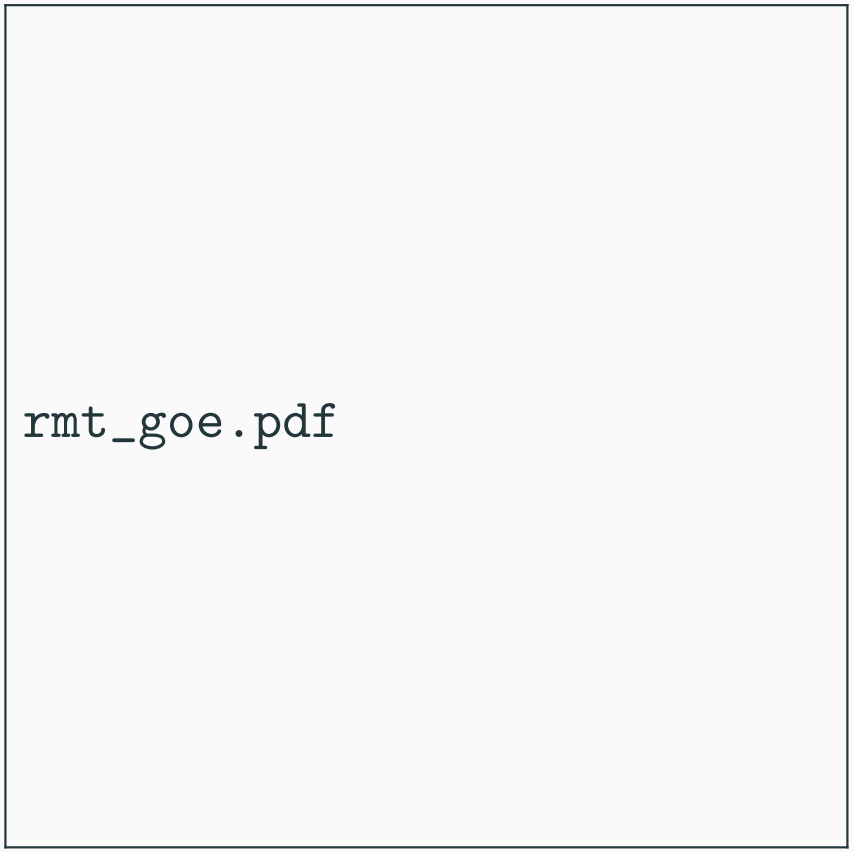
Canales cuánticos

- Describen ruido cuántico, mediciones generalizadas y la dinámica de sistemas cuánticos abiertos.
- Mapeos CPTP: completamente positivos y que preservan la traza de la matriz de densidad.
  - CP: $\mathcal{E} \otimes I_k \geq 0$
  - TP: $\mathrm{Tr}[\mathcal{E}(\rho)] = \mathrm{Tr}(\rho)$

Caos cuántico

Caos cuántico = RMT

[Physical Review Letters **110** 084101 (2013)] [Physical Review Letters **52** 1–4 (1984)] [Proceedings of the Royal Society of London. A. Mathematical and Physical Sciences **356** 375–394 (1997)]



Previous

[Physical Review E **103** L020201 (2021)] [Quantum Science and Technology **6** 045018 (2021)]

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Thank You

Questions?

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References available upon request