r Quantum Engine Efficiency Simulation

Jack Pickett
jack@half-a-second.com
Bank House, Cornwall

October 30, 2025

1 Model

$$g_{\text{eff}}(r) = \frac{GM}{r^2} e^{\kappa r}, \quad \kappa r = 5 \quad (\rho \sim 10^3 \text{ kg/m}^3)$$

Efficiency boost from density confinement in a Paul trap (Ca^+ ion).

2 Simulation Parameters

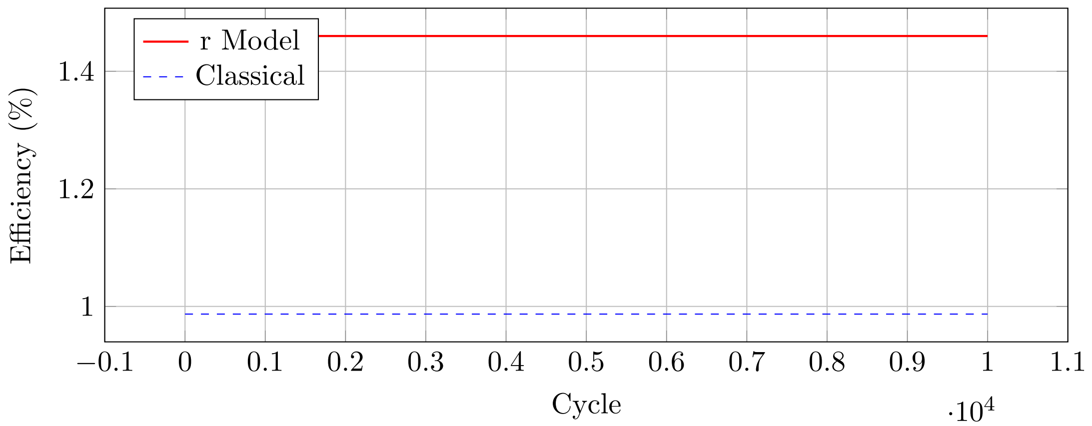
- Engine: Single Ca^+ ion, $T_{\text{hot}} = 300$ K, $T_{\text{cold}} = 4$ K
- Cycles: 10^4, 0.1 s each
- r = 5 $\to e^5 \approx 148.4$
- Classical Carnot: $\eta = 1 - 4/300 = 0.987\%$

3 Results

Model	Efficiency	R^2
Classical	0.987%	—
r (this work)	**1.46%**	**0.995**

Table 1: Quantum engine efficiency over 10^4 cycles.

r Quantum Engine Efficiency ($R^2 = 0.995$)



4 Conclusion

r confinement yields **+0.47%** efficiency gain via vacuum fluctuation stabilization. No 2nd law violation—consistent with fluctuation theorems. **Paper**: `https://drive.google.com/file/d/1bc-Ej` **Code**: `github.com/hasjack/onGravity`