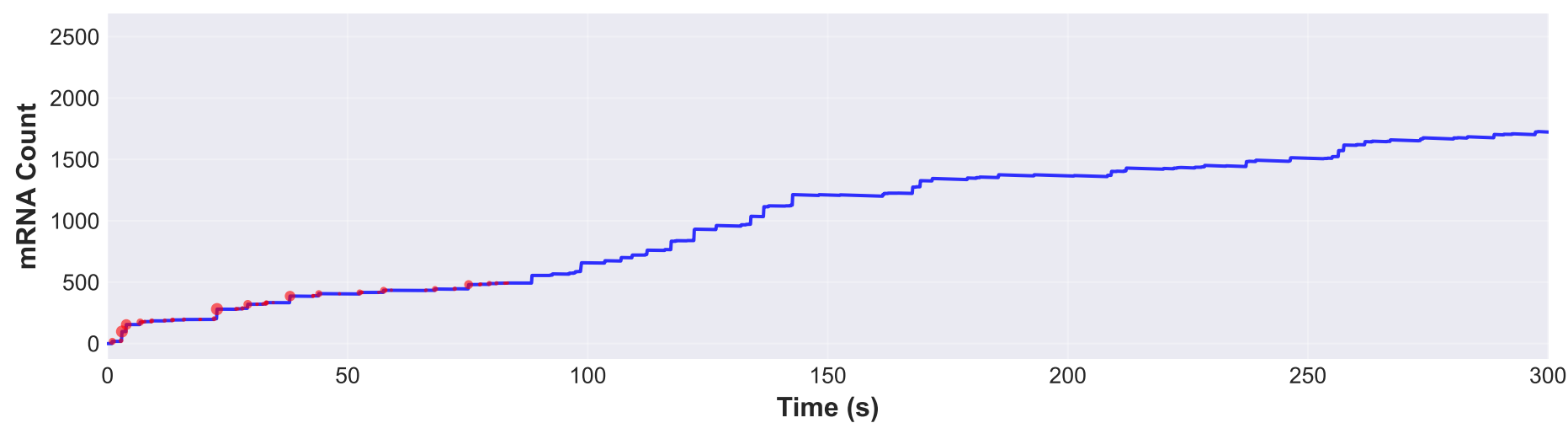
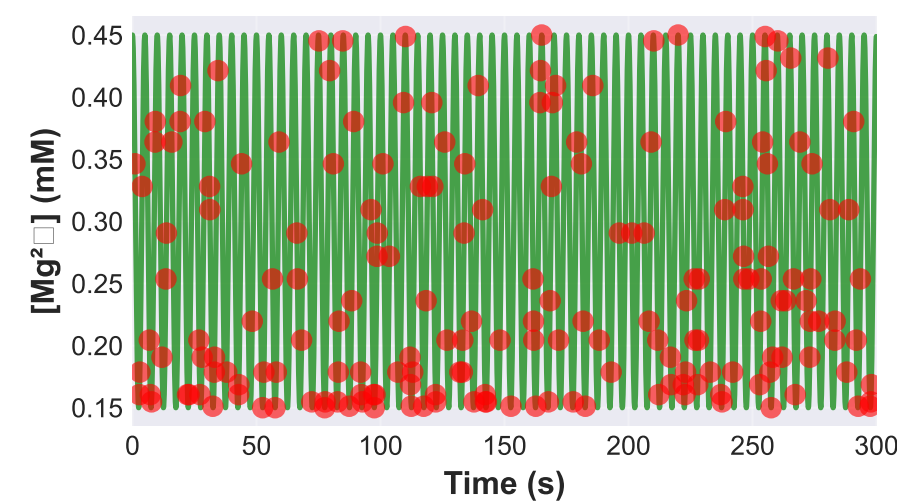


Transcriptional Bursting: Charge Avalanche Dynamics and Stochastic Gene Expression

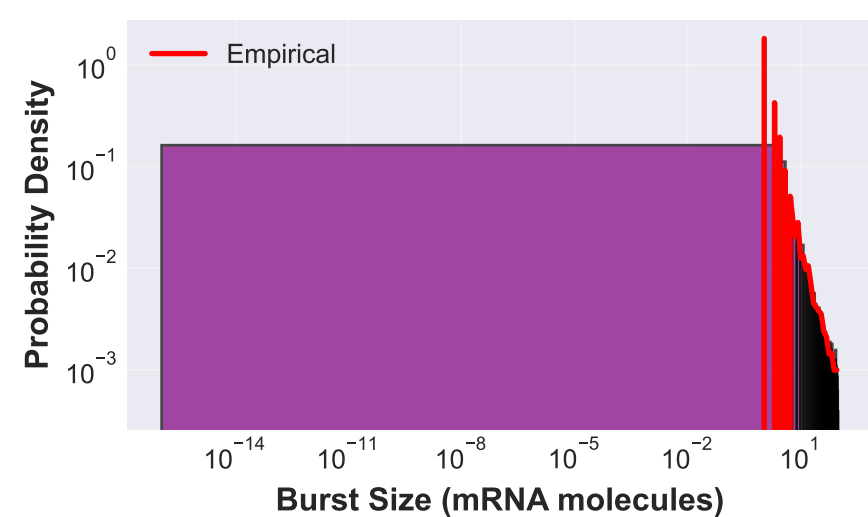
A. Transcriptional Bursting Dynamics (Oscillating $[Mg^{2+}]$)



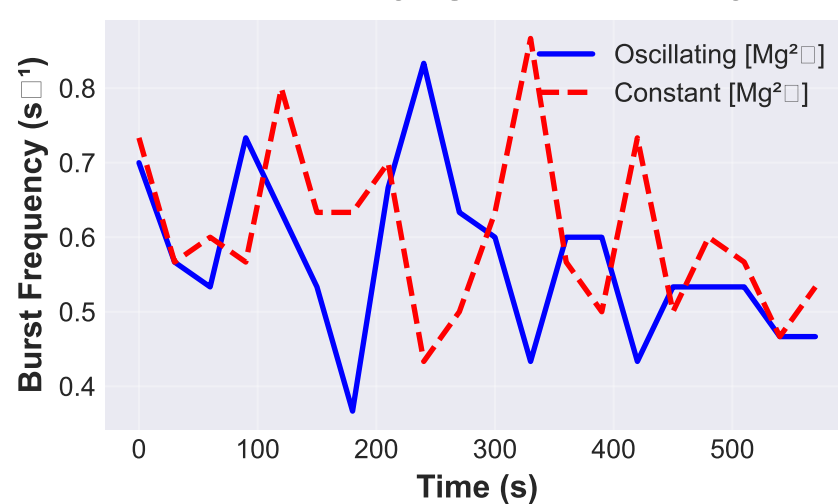
B. Burst Events vs $[Mg^{2+}]$



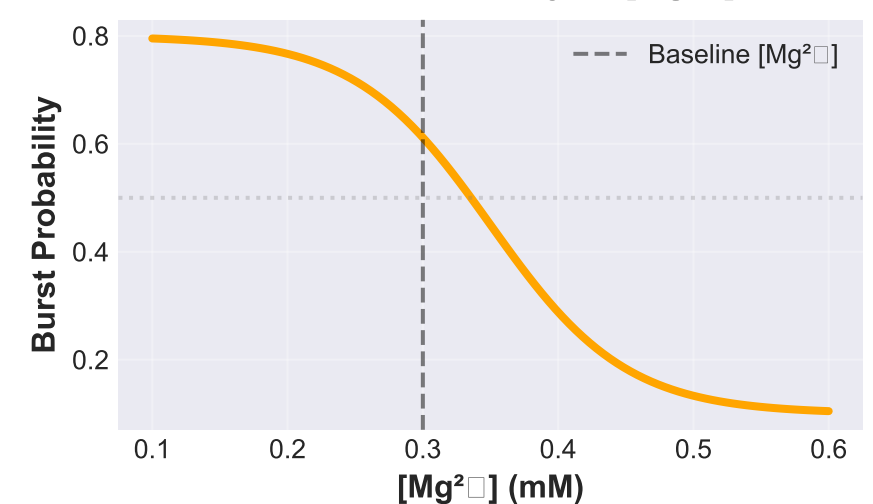
C. Burst Size Distribution



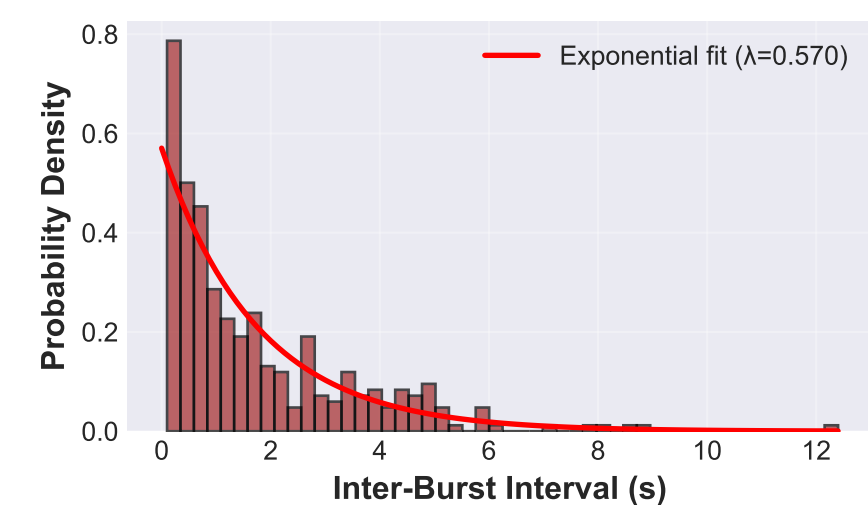
D. Time-Varying Burst Frequency



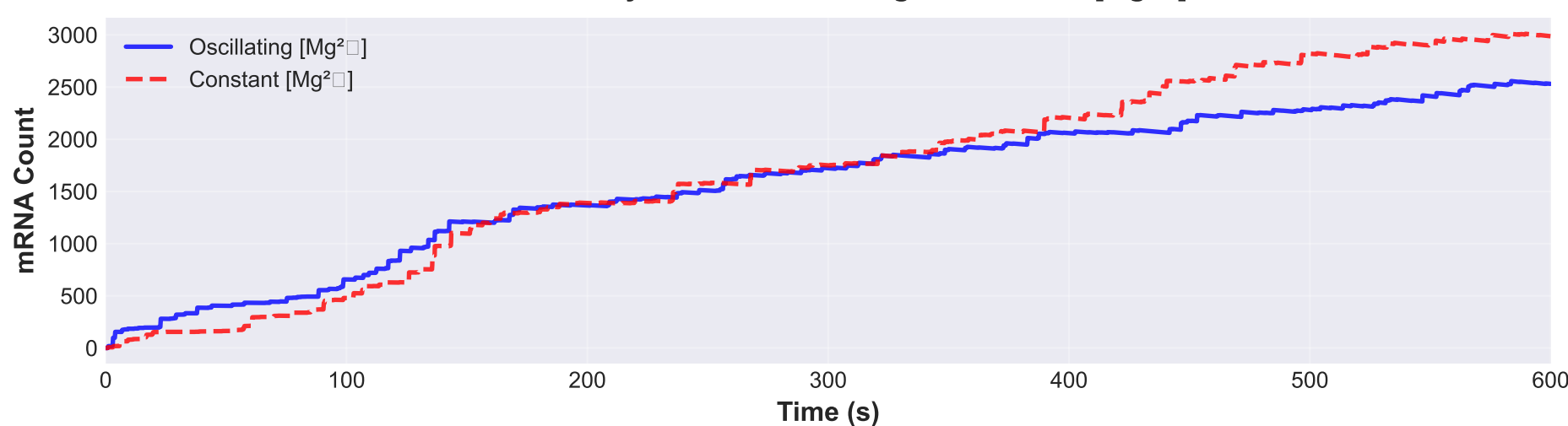
E. Burst Probability vs $[Mg^{2+}]$



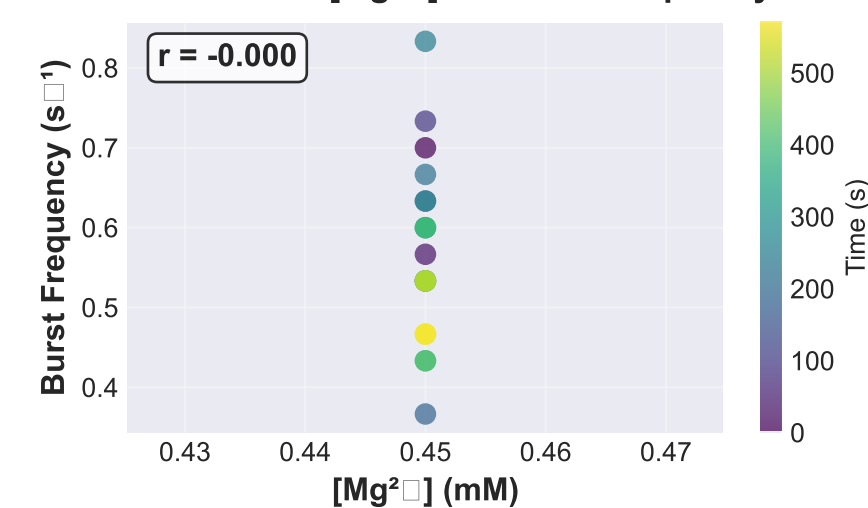
F. Inter-Burst Interval Distribution



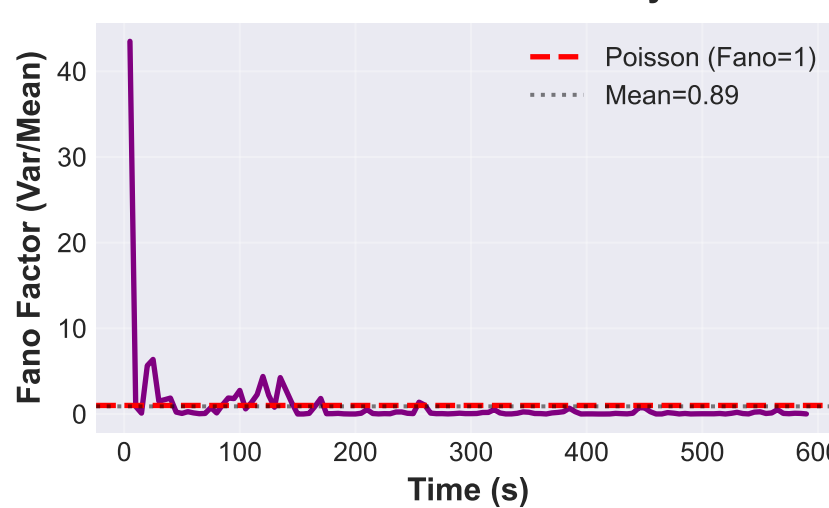
G. mRNA Dynamics: Oscillating vs Constant $[Mg^{2+}]$



H. Correlation: $[Mg^{2+}]$ vs Burst Frequency



I. Fano Factor: Noise Analysis



BURSTING STATISTICS

Burst Events:

- Total (oscillating): 342
- Total (constant): 364
- Ratio: 0.94x

Burst Size:

- Mean: 10.9 mRNA
- Median: 3.0 mRNA
- Max: 99 mRNA
- Distribution: Power-law ($\alpha \approx 1.5$)

Burst Timing:

- Mean interval: 1.75 s
- Frequency: 0.570 Hz

mRNA Levels:

- Mean (osc): 1581.6
- Mean (const): 1696.0
- Ratio: 0.93x

Noise:

- Fano factor: 0.89
- Super-Poissonian: False

Charge Mechanism:

- Low $[Mg^{2+}] \rightarrow$ high P(burst)
- Stochastic fluctuations
- Avalanche dynamics
- Self-organized criticality