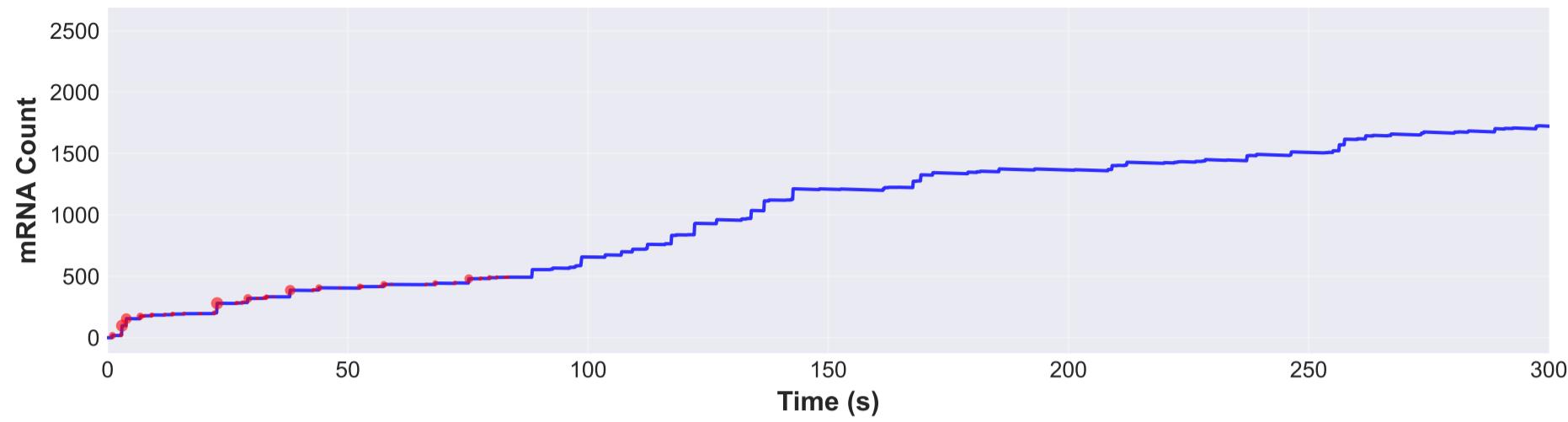
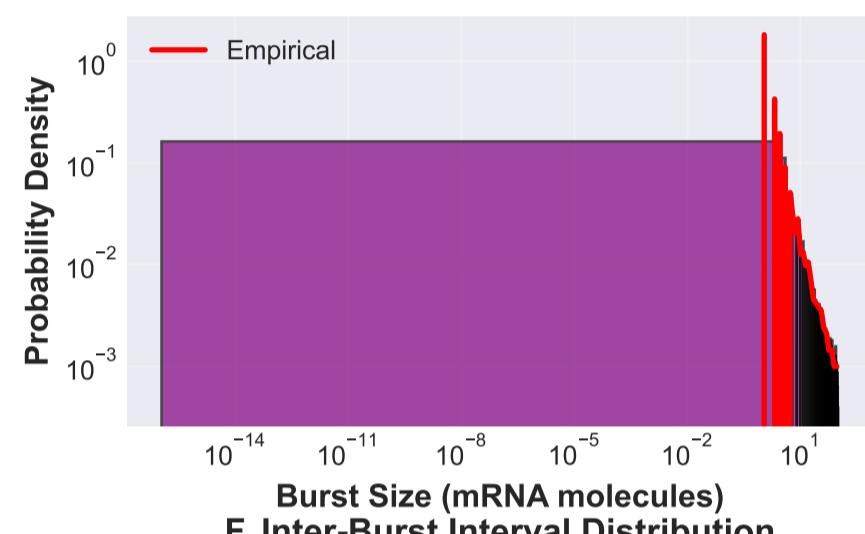


Transcriptional Bursting: Charge Avalanche Dynamics and Stochastic Gene Expression

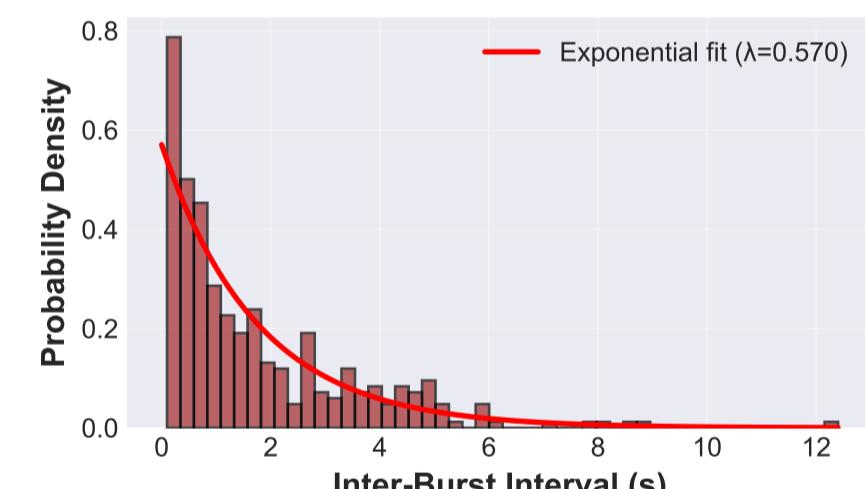
A. Transcriptional Bursting Dynamics (Oscillating $[Mg^{2+}]$)



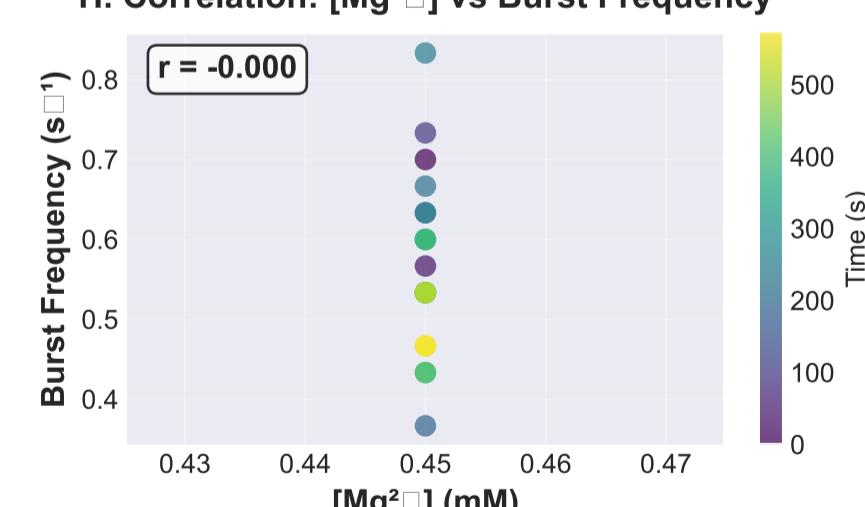
C. Burst Size Distribution



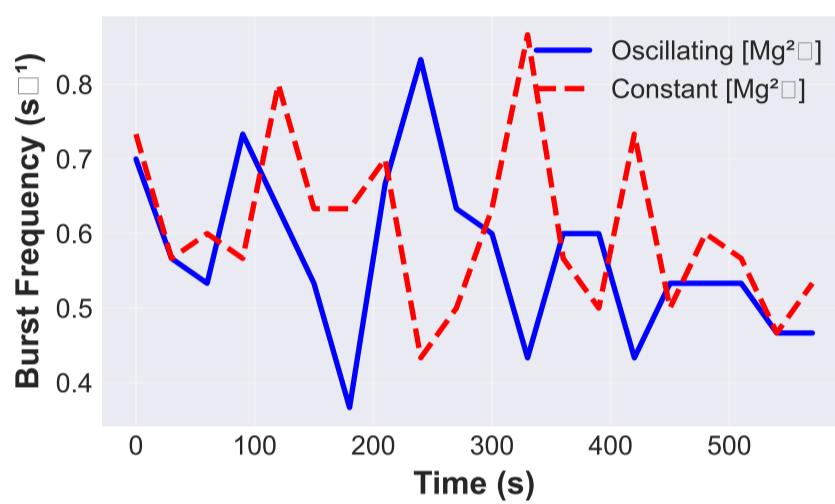
F. Inter-Burst Interval Distribution



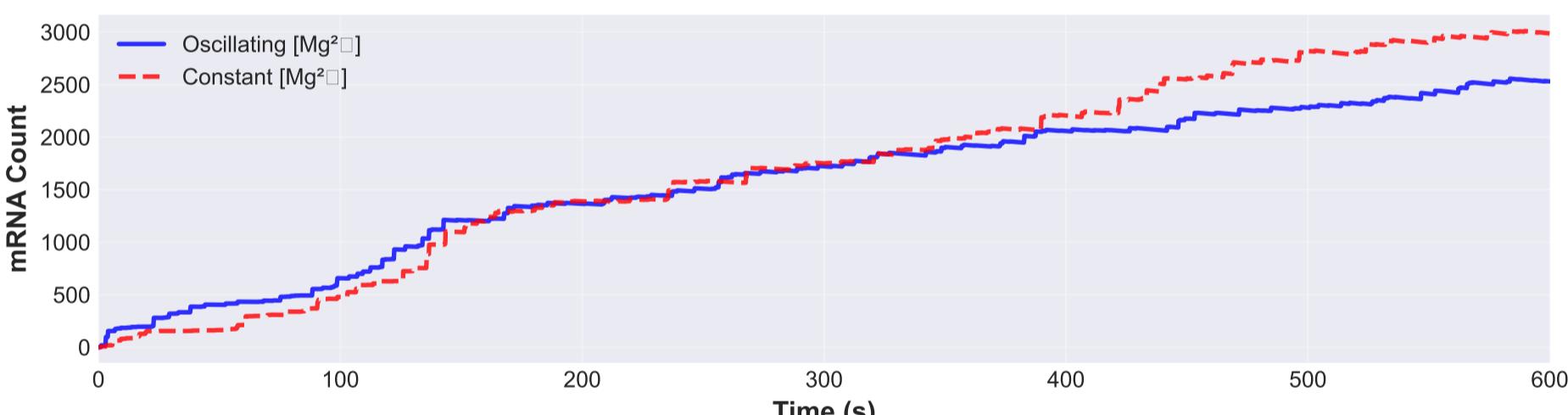
H. Correlation: $[Mg^{2+}]$ vs Burst Frequency



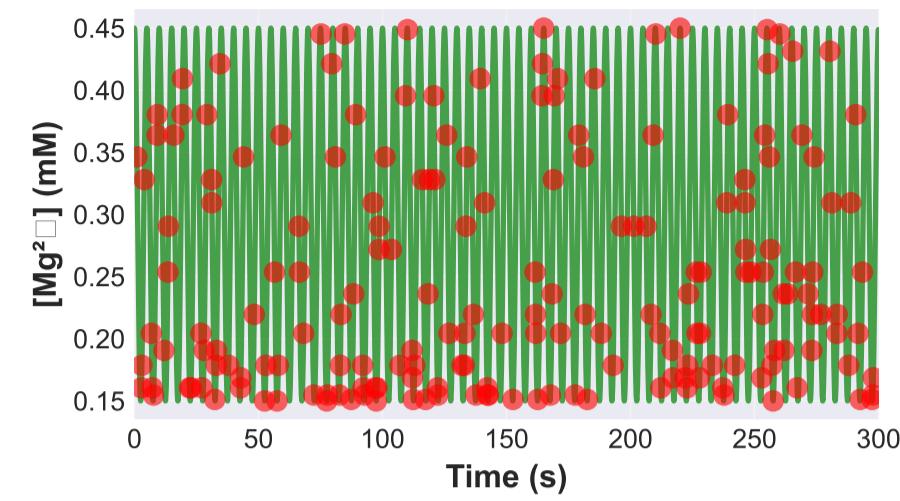
D. Time-Varying Burst Frequency



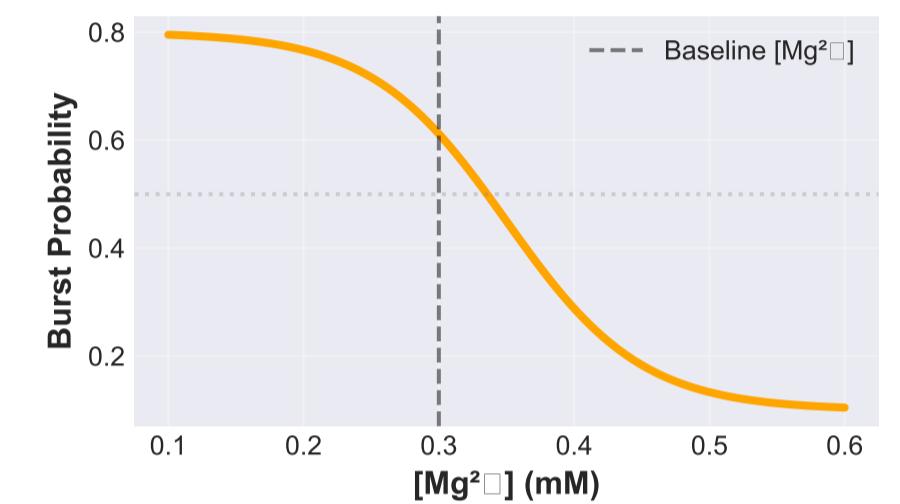
G. mRNA Dynamics: Oscillating vs Constant $[Mg^{2+}]$



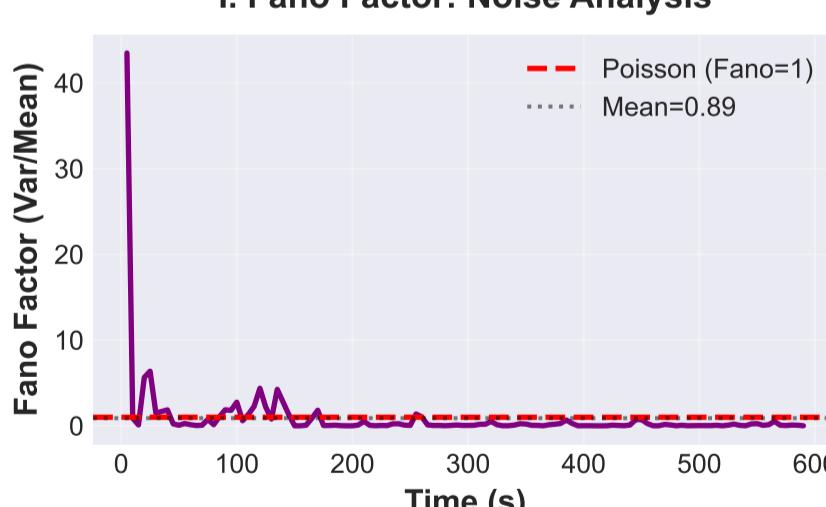
B. Burst Events vs $[Mg^{2+}]$



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



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