Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Optimal strategies for timekeeping in cells ANDREW MUGLER, Columbia University, Physics, ALEKSANDRA WALCZAK, Princeton University, PCTS, CHRIS WIGGINS, Columbia University, APAM, C2B2 — Intracellular "clocks" are constrained by the fact that the molecules which oscillate in number to keep time also intrinsically fluctuate in number. Information theory provides natural measures of the reliability with which the oscillatory signal can be extracted from this intrinsic "noise" and propagated to other species in the cell. For a simple stochastic clock model, in which a chemical species driven by oscillatory production regulates via copy number a second species, we compute the mutual information between time and copy number for both the regulating and regulated species. The latter requires the full time-dependent joint probability distribution over copy counts, for which we solve accurately and efficiently via eigenfunction expansion. The simplicity of the model permits powerful analytic predictions such as scalings of information with driving frequency and copy number. The efficiency of the computation permits numerical optimization of information over model parameters, revealing, e.g., that different regulation functions are optimal in different biologically relevant regimes.

Andrew Mugler
Columbia University, Physics

Date submitted: 21 Dec 2009 Electronic form version 1.4