Advanced Seminar: Stochastic models of gene expression and protein synthesis

Part A: Introduction

1. Introduction to nonequilibrium stochastic systems (14.11.19, Roberto)

N.G. van Kampen: Stochastic Processes in Physics and Chemistry (Elsevier, 2001)

R. Livi and P. Politi: Nonequilibrium Statistical Physics: A Modern Perspective (Cambridge University Press, 2017), Chapter 1

T. Chou, K. Mallick and R.K.P. Zia: Non-equilibrium statistical mechanics: From a paradigmatic model to biological transport. Rep. Prog. Phys. 74:116601 (2011)

2. Introduction to stochastic gene expression (21.11.19, Maurizio)

J. Paulsson: Models of stochastic gene expression. Physics of Life Reviews 2:157 (2005)

A. Raj, A. van Oudenaarden: Single-molecule approaches to stochastic gene expression. Annu. Rev. Biophys. 38:255 (2009)

3. Introduction to exclusion models of protein synthesis (28.11.19, Daniel)

R.K.P. Zia , J.J. Dong and B. Schmittmann: Modeling Translation in Protein Synthesis with TASEP: A Tutorial and Recent Developments. J. Stat. Phys. 144:405 (2011)

T. van der Haar: Mathematical and Computational Modelling of Ribosomal Movement and Protein Synthesis: an overview. Computational and Structural Biotechnology Journal 1:e201204002 (2012)

H. Zur and T. Tuller: Predictive biophysical modeling and understanding of the dynamics of mRNA translation and its evolution. Nucleic Acids Research 44:9031 (2016)

Part B: Transcription

4. Nonequilibrium models of gene expression (5.12.19, Arman)

T. Ahsendorf, F. Wong, R. Eils and J. Gunawardena: A framework for modelling gene regulation which accommodates non-equilibrium mechanisms. BMC Biology 12:102 (2014)

C. Li, F, Cesbron, M. Oehler, M. Brunner, T. Höfer: Frequency Modulation of Transcriptional Bursting Enables Sensitive and Rapid Gene Regulation. Cell Systems 6:409 (2018)

5. Elongation and termination in transcription (12.12.19, Johannes)

P.H. von Hippel and T.D. Yager: The elongation-termination decision in transcription. Science 255:809 (1992)

H. Yin, I. Artsimovitch, R. Landick and J. Gelles: Nonequilibrium mechanism of transcription termination from observations of single RNA polymerase molecules. PNAS 96:13124 (1999)

6. Nonequilibrium models and network inference (19.12.19, Denis)

J. Berg: Dynamics of gene expression and the regulatory inference problem. Europhysics Letters 82:28010 (2008)

U. Herbach, A. Bonnaffoux, T. Espinasse and O. Gandrillon: Inferring gene regulatory networks from single-cell data: a mechanistic approach. BMC Systems Biology 11:105 (2017)

Part C: Translation

7. TASEP with open boundaries (9.1.20, Torben)

C.T. MacDonald, J.H. Gibbs and A.C. Pipkin: Kinetics of Biopolymerization on Nucleic Acid Templates. Biopolymers 6:1 (1968)

B. Derrida, M.R. Evans, V. Hakim and V. Pasquier: Exact solution of a 1D asymmetric exclusion model using a matrix formulation. J. Phys. A 26:1493 (1993)

R.A. Blythe and M.R. Evans: Nonequilibrium steady states of matrix-product form: a solver's guide. J. Phys. A 40:R333 (2007)

8 . Ribosome profiling (16.1.20, Florian)

N.T. Ingolia, S. Ghaemmaghami, J.R.S. Newman and J.S. Weissman: Genome-Wide Analysis in Vivo of Translation with Nucleotide Resolution Using Ribosome Profiling. Science 324:218 (2009)

A. Diament, A. Feldman, E. Schochet, M. Kupiec, Y. Arava and T. Tuller: The extent of ribosome queuing in budding yeast. PLoS Comput. Biol. 14: e1005951 (2018)

9. Inhomogeneous TASEP (23.1.20, Sebastian)

J. Szavits-Nossan, M. Carmen Romano and L. Ciandrini: Power series solution of the inhomogeneous exclusion process. Phys. Rev. E 97:052139 (2018)

J. Szavits-Nossan, L. Ciandrini and M. Carmen Romano: Deciphering mRNA Sequence Determinants of Protein Production Rate. Phys. Rev. Lett. 120:128101 (2018)

J. Szavits-Nossan and L. Ciandrini: Accurate measures of translation efficiency and traffic using ribosome profiling. bioRxiv 2019 (http://dx.doi.org/10.1101/719302)

10. Ribosome recycling (30.1.20, Sarah)

E. Marshall, I. Stansfield and M. C. Romano: Ribosome recycling induces optimal translation rate at low ribosomal availability. J. R. Soc. Interface 11: 20140589 (2014)

L.D. Fernandes, A.P. S. de Moura and L. Ciandrini: Gene length as a regulator for ribosome recruitment and protein synthesis: theoretical insights. Sci. Rep. 7: 17409 (2017)

11. Ribosome dropoff and Langmuir kinetics (30.1.20, Yaren)

P. Bonnin, N. Kern, N.T. Young, I. Stansfield and M.C. Romano: Novel mRNA-specific effects of ribosome drop-off on translation rate and polysome profile. PloS Comp. Biol. 13:e1005555 (2017)

A. Parmeggiani, T. Franosch and E. Frey: Totally asymmetric simple exclusion process with Langmuir kinet-
ics. Phys. Rev. E 70:046101 (2004)