Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Precision matters for position decoding in the early fly embryo
MARIELA D PETKOVA, Harvard University, GASPER TKACIK, IST Austria, ERIC F WIESCHAUS, WILLIAM BIALEK, THOMAS GREGOR, Princeton University — Genetic networks can determine cell fates in multicellular organisms with precision that often reaches the physical limits of the system. However, it is unclear how the organism uses this precision and whether it has biological content. Here we address this question in the developing flyembryo, in which a genetic network of patterning genes reaches 1% precision in positioning cells along the embryo axis. The network consists of three interconnected layers: an input layer of maternal gradients, a processing layer of gap genes, and an output layer of pair-rule genes with seven-striped patterns. From measurements of gap gene protein expression in hundreds of wild-type embryos we construct a "decoder", which is a look-up table that determines cellular positions from the concentration means, variances and covariances. When we apply the decoder to measurements in mutant embryos lacking various combinations of the maternal inputs, we predict quantitative changes in the output layer such as missing, altered or displaced stripes. We confirm these predictions by measuring pair-rule expression in the mutant embryos. Our results thereby show that the precision of the patterning network is biologically meaningful and a necessary feature for decoding cell positions in the early fly embryo.

Mariela Petkova
Harvard University

Date submitted: 06 Nov 2015 Electronic form version 1.4