Stochastic models of stem cell differentiation

There has been a long-running discussion amongst stem cell biologists over stochastic versus instructive models of stem cell dynamics. In this talk I will discuss the background to this problem and show some recent data from differentiation of pluripotent stem cells toward neural progenitors which favours the stochastic perspective. Based on this data I will outline a model of stem cell differentiation that uses ideas from statistical mechanics to distinguish between observable cell states and unobserved internal molecular configurations, and so provides a framework to learn cell identities from single cell expression data. I will summarise with some suggested areas for further work that may benefit from increased collaboration between experimentalists, physicists and mathematicians.