Fordyce Davidson, University of Dundee, Scotland, UK
Nicola Stanley-Wall, University of Dundee, Scotland, UK

Selective Heterogeneity in Exoprotease Production by *Bacillus subtilis.*

Bacteria have elaborate signalling mechanisms to ensure a behavioural response that is most likely to enhance survival in a changing environment. It is becoming increasingly apparent that as part of this response, bacteria are capable of cell differentiation and can generate multiple, mutually exclusive co-existing cell states. These cell states are often associated with multicellular processes that bring benefit to the community as a whole but which may be, paradoxically, disadvantageous to an individual subpopulation. How this process of cell differentiation is controlled is intriguing and remains a largely open question. In this talk, we consider an important aspect of cell differentiation that is known to occur in the Gram-positive bacterium *Bacillus subtilis*: we investigate the role of two master regulators DegU and Spo0A in the control of extra-cellular protease (EPS) production. EPS is required to adhere the cells together and in mutant EPS$^-$ strains, the biofilm visibly lacks structural integrity. Recent work in this area focussed the on role of DegU in this process and suggested that transient effects in protein production were the drivers of cell-response heterogeneity. Here, we provide a complementary analysis of this regulatory system that investigates the roles of both DegU and Spo0A in extra-cellular protease production. In doing so, we present a mechanism for bimodality, or system heterogeneity, without the need for a bistable switch in the underlying regulatory network. Moreover, our analysis leads us to conclude that this heterogeneity is in fact a persistent, stable feature. Our results suggest that system response is divided into three zones: low and high signal levels induce a unimodal or undifferentiated response from the cell population with all cells OFF and ON, respectively for exoprotease production. However, for intermediate levels of signal, a heterogeneous response is predicted with a spread of activity levels, representing typical "bet-hedging" behaviour.