In this talk we study nonlinear mathematical models describing the intracellular time dynamics of viral RNA accumulation for positive-sense single-stranded RNA viruses. Our models consider different replication modes ranging between two extremes represented by the geometric replication (GR) and the linear stamping machine replication (SMR). We first analyse a model that quantitatively reproduced experimental data for the accumulation dynamics of both polarities of turnip mosaic potyvirus RNAs. We identify a non-degenerate transcritical bifurcation governing the extinction of both strands depending on three key parameters: the mode of replication ($\alpha$), the replication rate ($r$) and the degradation rate ($\delta$) of viral strands. Our results indicate that the bifurcation associated with a generically takes place when the replication mode is closer to the SMR, thus suggesting that GR may provide viral strands with an increased robustness against degradation. This transcritical bifurcation, which is responsible for the switching from an active to an absorbing regime, suggests a smooth (i.e. second-order), absorbing-state phase transition. Finally, we also analyse a simplified model that only incorporates asymmetry in replication tied to differential replication modes.

Related publications: