Fusion versus endocytosis: the stochastic entry of enveloped viruses

TOM CHOU, UCLA — Viral infection requires the binding of receptors on
the target cell membrane to glycoproteins, or “spikes,” on the virus membrane. Fu-
sion peptides that make up part of these spikes on the viral membrane may then be
triggered by pH changes or binding of additional coreceptors. Thus, binding of virus
envelope proteins to cell surface receptors not only initiates the viral adhesion and
the wrapping process necessary for internalization, but also starts the direct fusion
process. Both fusion and internalization may be viable pathways for some viruses,
under appropriate conditions. We develop a stochastic model for viral entry that
incorporates both receptor mediated fusion and endocytosis. The relative probabili-
ties of fusion and endocytosis of a virus particle initially nonspecifically adsorbed on
the host cell membrane are computed as functions of receptor concentration, binding
strength, and number of spikes. We find the parameter regimes where each pathway
is expected to arise and discuss possible experimental tuning of these parameters.