The majority of fungi are microscopic moulds (filamentous fungi) that grow by means of tip growing tubular ‘cells’ called hyphae. Most filamentous fungi form complex, interconnected, networks of fungal hyphae and these networks are generated by the fusion of genetically identical hyphae or cell protrusions. The interconnected state allows the fungal colony to function as a coordinated individual by the sharing and exchange of nutrients, water, signalling molecules, nuclei and other organelles (Read et al., 2010). During colony initiation in the fungal model *Neurospora crassa*, germinating asexual spores (conidia) form specialized hyphae called germ tubes that are involved in colony establishment. They also develop specialized cell protrusions termed conidial anastomosis tubes (CATs) that generate fused networks of spore germlings. My group is using the CAT system in *N. crassa* as a model to study self-signalling and self-fusion between cells in filamentous fungi (Read et al., 2012). I will show how we are combining the live-cell imaging of proteins with mutant analyses to study the cell biology and mechanistic basis of CAT induction, chemotropism and fusion (e.g. Lichius et al., 2014). Prolific cell fusion continues as the fungal colony develops and matures. I will finish my presentation by showing with time-lapse imaging how the complex coenocytic (supracellular), hyphal network formed in the mature colony facilitates the long distance and highly dynamic movement of nuclei and other organelles.

