The Self-Assembling Brain - Through the Eye of a Fly

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How much information is required to wire up a brain - and where is this information coming from? We take a live imaging approach to understand how neuronal connectivity self-assembles in the fly visual system. Non-invasive multiphoton imaging of neural circuit assembly allows to identify (often surprisingly simple) algorithmic rules that can generate complicated wiring diagrams with precision, robustness, and flexibility. Second, genetic perturbation allows to identify the cell interaction molecules that execute these rules. A hallmark of such rules and their molecular execution is that they rely on stochastic dynamic processes that seem, at first glance, at odds with the idea of deterministic molecular synaptic targets. Two questions therefore motivate our current work and will be addressed in the talk: To what extent can simple algorithmic rules determine neural circuit assembly before molecular synaptic target definitions become indispensable? And how is robust circuit assembly ensured based on stochastic developmental processes?