It's just a phase: Structural characterization of liquid-liquid phase separation of EARLY FLOWERING 3 and its role in temperature sensing in plants

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How plants sense temperature is a fundamental question in plant biology and of growing importance due to global warming. Plants are able to reprogram their developmental and reproductive pathways in response to small changes in ambient temperature, which has led to alterations in plant phenology in both wild and domesticated species. A key protein implicated in plant thermosensing is EARLY FLOWERING 3 (ELF3). ELF3 acts as a scaffold, interacting with different transcription factors to regulate a host of target genes important for plant morphology and flowering time. The activity of ELF3 is highly sensitive to temperature changes, although the mechanism of this has been unclear. We have recently shown that ELF3 contains a prion-like domain (PrLD), which is required for temperature response. This domain acts as a driver of liquid-liquid phase separation (LLPS) in vitro and in vivo. Our recent studies focus on the structural basis of ELF3 LLPS and how temperature effects this phenomenon. We have used a combination of structural techniques including small angle scattering (SAS) and X-ray diffraction as well as atomic force, electron and fluorescence microscopies to probe LLPS dynamics and organization. Based on our structural and biophysical results, we are able to manipulate LLPS in vitro and to use this knowledge to reprogram plant temperature response in the model plant *Arabidopsis thaliana*.