SFB 1078

Protonation Dynamics in Protein Function

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Colloquium

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The molecular pH-response mechanism of the plant light-stress sensor PsbS

Plants need to protect themselves from excess light, which causes photo-oxidative damage and lowers the efficiency of photosynthesis. Photosystem II subunit S (PsbS) is a pH sensor protein that plays a crucial role in plant photoprotection by detecting thylakoid lumen acidification in excess light conditions via two lumen-faced glutamates E71 and E176. However, how PsbS is activated under low-pH conditions is unknown. To reveal the molecular response of PsbS to low pH, we performed an NMR, FTIR and 2D-IR spectroscopic analysis of Physcomitrella patens PsbS and of the E176Q mutant in which an active glutamate has been replaced. The PsbS response mechanism at low pH involves the concerted action of repositioning of a short amphipathic helix containing E176 facing the lumen and folding of the luminal loop fragment adjacent to E71 to a 3-10 helix, providing clear evidence of a conformational pH switch. We propose that this concerted mechanism is a shared motif of proteins of the light-harvesting family that may control thylakoid inter-protein interactions driving photoregulatory responses.

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