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**Time-Resolved Synchrotron X-Ray Footprinting of the  $\text{Ca}^{2+}$  Activated Structure of the Human Plasma Gelsolin Protein as a Function of  $\text{Ca}^{2+}$  Concentration**

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Gelsolin is a six-subunit (S1-S6) actin binding protein that is activated by  $\text{Ca}^{+2}$  and functions to remodel the actin cytoskeleton during development and in cell motility through its ability to cap and sever filaments. Using synchrotron protein footprinting and mass spectrometry, we have determined the specific locations of structural changes that occur as a function of  $\text{Ca}^{+2}$  binding. Upon activation, actin binding surfaces are revealed that are accompanied by changes in accessible surface areas for side chain residues that are probed in the footprinting experiments. Using time-resolved protein footprinting, where calcium is mixed with gelsolin on millisecond timescales to a final calcium concentration of 5 mM, we have observed the activation of peptides 431-454 and 722-745 to be half-completed within 80 milliseconds. Further experiments will identify the calcium dependence of the rates of activation and search for kinetic intermediates in the process.