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Physics of Bacteria During Osmotic Shock JORDAN PRICE, WILLIAM KLUG, Department of Mechanical and Aerospace Engineering, UCLA — Bacteria combat hypoosmotic shocks by opening mechanosensitive ion channels located within the inner membrane. These channels are believed to act as "emergency release valves, reducing transient pressure during the shock by regulating solute and water flux. Recent experiments have shown that cell survivability depends strongly on channel populations and the rate of osmotic shock. However, the understanding of the physical mechanisms behind osmotic protection remains unclear. We investigate how channel deletions, variations in shock rate, and cell envelope mechanics affect survivability by constructing theoretical elasticity and transport models. We find that reducing the number of channels and applying faster shocks significantly increases the time-dependent stress of the cell membrane and wall. This result provides insight into physical mechanisms that govern cell failure, including membrane rupture and wall fracture.

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