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Dislocation-mediated growth of bacterial cell walls

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Recent experiments have illuminated a remarkable growth mechanism of rod-shaped bacteria: proteins associated with cell wall extension move at constant velocity in circles oriented approximately along the cell circumference (Garner et al., Science (2011), Dominguez-Escobar et al. Science (2011), van Teeffelen et al. PNAS (2011). We view these as dislocations in the partially ordered peptidoglycan structure, activated by glycan strand extension machinery, and study theoretically the dynamics of these interacting defects on the surface of a cylinder. Generation and motion of these interacting defects lead to surprising effects arising from the cylindrical geometry, with important implications for growth. We also discuss how long range elastic interactions and turgor pressure affect the dynamics of the fraction of actively moving dislocations in the bacterial cell wall.

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