

The wrinkling of old nuclei

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Just as paper crumples when crushed by a fist, some cell nuclei wrinkle inside the crowded and fluctuating environment within cells.

Inside fruit flies' ovaries are egg chambers, which are home to giant cells known as nurse cells. As nurse cells grow and mature, the envelopes of their nuclei grow bigger and softer and become wrinkled, with sharp anisotropic creases and folds reminiscent of crumpled paper. These wrinkles are generated by a combination of thermal and active fluctuations, whose effects can be analyzed through three-dimensional imaging and reconstructions of the nuclear envelopes.

Analysis of the spatial fluctuation power spectrum reveals that the physics of these membranes is dominated by the geometric non-linearities governing thin shell elasticity, which can easily bend but resist stretching. Within a strongly fluctuating environment, the resulting resistance of the shell to Gaussian curvature change leads to localized creases, giving them a characteristic crumpled paper-like appearance.

