

# Mechanical softening of lipid membranes by the rotating motor protein F1F0 ATP synthase

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ATP synthase is a rotating membrane protein that synthesizes adenosine triphosphate (ATP), the chemical energy source of the cell. To unveil the mechanical impact of this molecular motor protein on the bending properties of its lipid environment, we have functionally reconstituted the ATP synthase in giant unilamellar vesicles and tracked the membrane fluctuations by means of flickering spectroscopy. We find that ATP synthase rotates at a frequency of about 20 Hz, promoting large out-of-equilibrium deformations at discrete hot-spots in lipid vesicles and thus inducing an overall membrane softening. Therefore, the rotation of ATP synthases promote mechanically adapted membranes with a high bending compliance and able to support high local curvatures. Our results evidence a mechanical functionality of the ATP synthase for biomembrane re-structuring and shaping.