ESCRT-III helical polymers deform membranes into helical tubes

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ESCRT-III proteins assemble into membrane-remodeling polymers during many cellular processes, ranging from HIV budding to cytokinesis [1]. Despite their biological importance, the mechanism by which ESCRT-III polymers deform membranes is still unclear. In our recent experiments, we have looked at how ESCRT-III helical polymers deform spherical vesicles, in vitro. Surprisingly, we have observed that ESCRT-III helical polymers reshape vesicles into stable helical tubes [2]. A helical tube is an unusual shape for a membrane because of its high local curvature, which should make it energetically more expensive than, for example, a straight tube. Helical polymers could, in principle, generate straight tubes and wind around them. However, we can only observe helical tubes in the experiments, which raises the question of what makes them so energetically favorable. We have addressed this question combining theoretical models, based on the elasticity and mutual interactions of membranes and polymers, with cryoelectron tomography [2]. Our results suggest that the secret behind the stability of helical tubes is an anisotropy in the architecture of ESCRT-III polymers, which makes straight tubular configurations geometrically frustrated.

[1] L. Christ et al., Trends Biochem Sci. 42(1):42-56 (2017)
[2] J. Moser Von Filseck et al, bioRxiv 716308; doi: https://doi.org/10.1101/716308 (2019)