Structure of the Acrosomal Bundle, a Biological Machine, at 9.5 Å Resolution

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In the unactivated Limulus sperm, a 60 µm-long bundle of actin filaments crosslinked by scruin is bent and twisted into a coil around the base of the nucleus. At fertilization the bundle uncoils and fully extends in five seconds to support a finger of membrane, the acrosomal process. This biological spring is powered by stored elastic energy and does not require the action of motor proteins or actin polymerization. Our 9.5 Å electron cryomicroscopic structure of the extended bundle [1] shows that twist, tilt, and rotation of actin-scruin subunits deviate widely from a "standard" F-actin filament. This deviation appears to be related to the packing requirements of the scruin cross-linkers. The structural organization allows filaments to pack into a highly ordered and rigid bundle in the extended state, but also suggests a mechanism for storing and releasing energy between the coiled and extended states.

[1] Schmid M.F., Sherman M.B., Matsudaira P., Chiu W., *Nature*, 2004, **431**, 104.

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