In the unactivated Limulus sperm, a 60 µm-long bundle of actin filaments crosslinked by scrin 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-scrin subunits deviate widely from a “standard” F-actin filament. This deviation appears to be related to the packing requirements of the scrin 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.


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