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Interactions Between Single Actin and Vimentin Filaments

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The cytoskeleton plays a crucial role in maintaining cellular structure, mechanics, and function. Recent advances suggest that the diverse tasks of the eukaryotic cytoskeleton depend on the interactions between its filamentous components - microtubules, actin filaments, and intermediate filaments. Despite a growing number of studies aimed at better understanding these interactions, it remains unclear whether actin and intermediate filaments interact directly in the absence of an auxiliary protein. Previous in vitro studies on reconstituted mixed filament networks have reported contradictory results. To clearly resolve this contradiction, it is essential to further simplify the system down to the single filament level. Here, we present a study on the direct interactions between actin filaments and vimentin intermediate filaments at the single filament level. Using quadruple optical tweezers combined with confocal microscopy and microfluidics, we precisely control interaction conditions, visualize interactions in real time, and measure forces involved. Our research provides direct evidence of actin-vimentin interplay at the network level.