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Practical Tractor Beams and Related Photokinetic Phenomena[1]

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Like any traveling wave, a beam of light exerts a force on an object that absorbs or scatters its momentum. Starting with Maxwell's pioneering formulation for plane waves, this force generally has been understood to be repulsive. We recently have demonstrated, however, that some specially structured beams of light have the remarkable ability to pull illuminated objects upstream along their entire length. In this respect, they are practical realizations of tractor beams, which previously had appeared only in science fiction stories. Explaining their operation with the theory of photokinetic effects leads to other surprises, including a mechanism by which light's spin angular momentum can exert forces on optically isotropic objects. Both the theoretical framework and experimental demonstrations will be presented.

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