



Autonomous Motility of Active Filaments due to Spontaneous Flow-Symmetry Breaking

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(Submitted on 6 Apr 2012 (v1), last revised 10 Oct 2012 (this version, v4))

We simulate the nonlocal Stokesian hydrodynamics of an elastic filament which is active due a permanent distribution of stresslets along its contour. A bending instability of an initially straight filament spontaneously breaks flow symmetry and leads to autonomous filament motion which, depending on conformational symmetry, can be translational or rotational. At high ratios of activity to elasticity, the linear instability develops into nonlinear fluctuating states with large amplitude deformations. The dynamics of these states can be qualitatively understood as a superposition of translational and rotational motion associated with filament conformational modes of opposite symmetry. Our results can be tested in molecular-motor filament mixtures, synthetic chains of autocatalytic particles, or other linearly connected systems where chemical energy is converted to mechanical energy in a fluid environment.

Comments: 7 pages, 3 figures; contains supplemental text; movies at [this http URL](#); published in Physical Review Letters

Subjects: **Soft Condensed Matter (cond-mat.soft)**; Biomolecules (q-bio.BM)

Journal reference: Phys. Rev. Lett. 109, 158302 (2012)

DOI: [10.1103/PhysRevLett.109.158302](https://doi.org/10.1103/PhysRevLett.109.158302)

Cite as: [arXiv:1204.1416](#) [cond-mat.soft]

(or [arXiv:1204.1416v4](#) [cond-mat.soft] for this version)

Submission history

From: Somdeb Ghose [[view email](#)]

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[v2] Mon, 9 Apr 2012 09:20:17 GMT (15124kb,A)

[v3] Mon, 13 Aug 2012 05:57:17 GMT (5072kb)

[v4] Wed, 10 Oct 2012 16:37:22 GMT (5072kb)

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