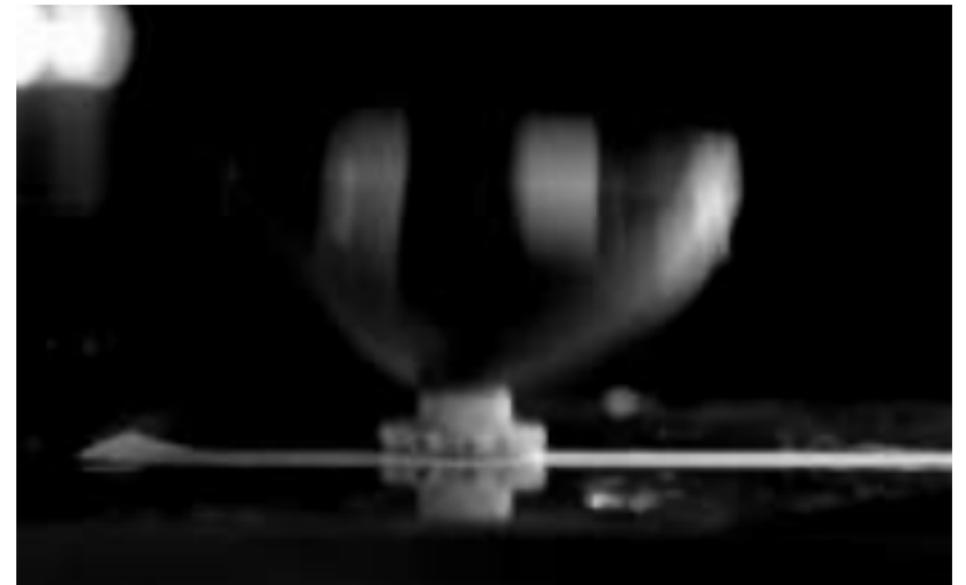
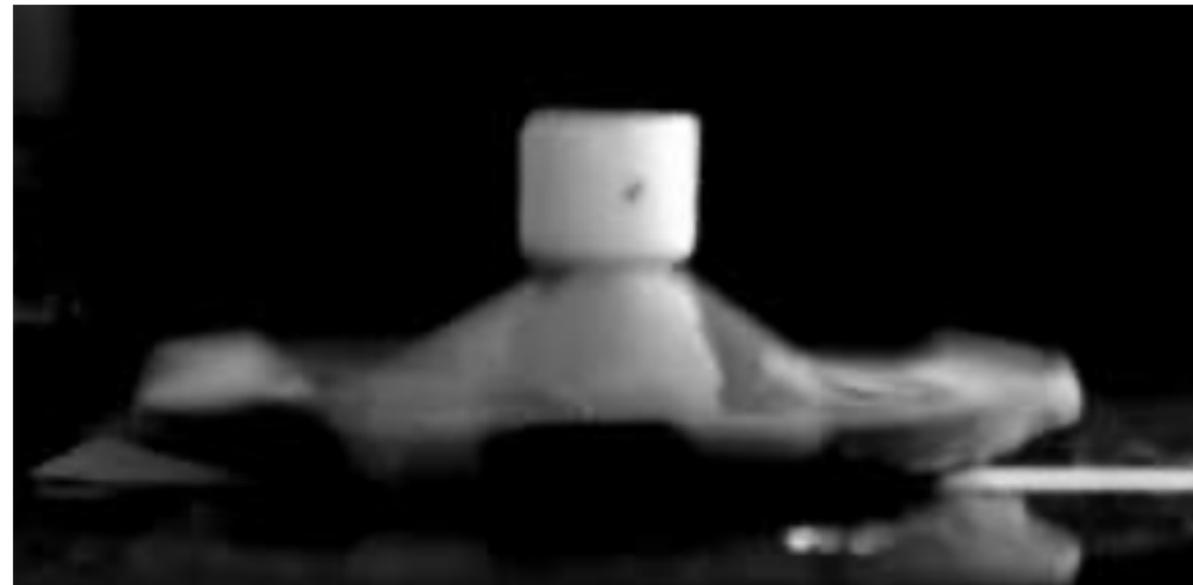
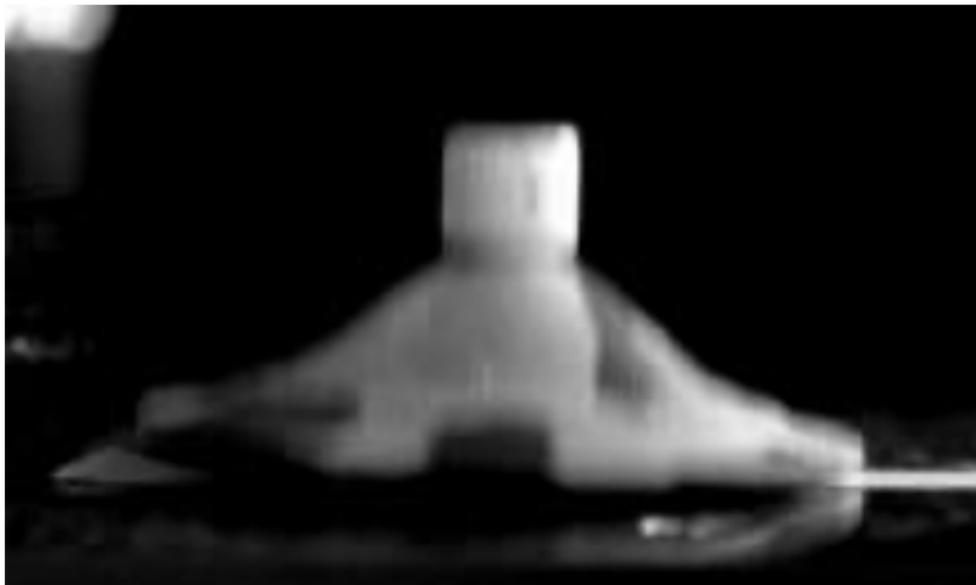


MODELLING THE DYNAMICS OF A JUMPING POPPER

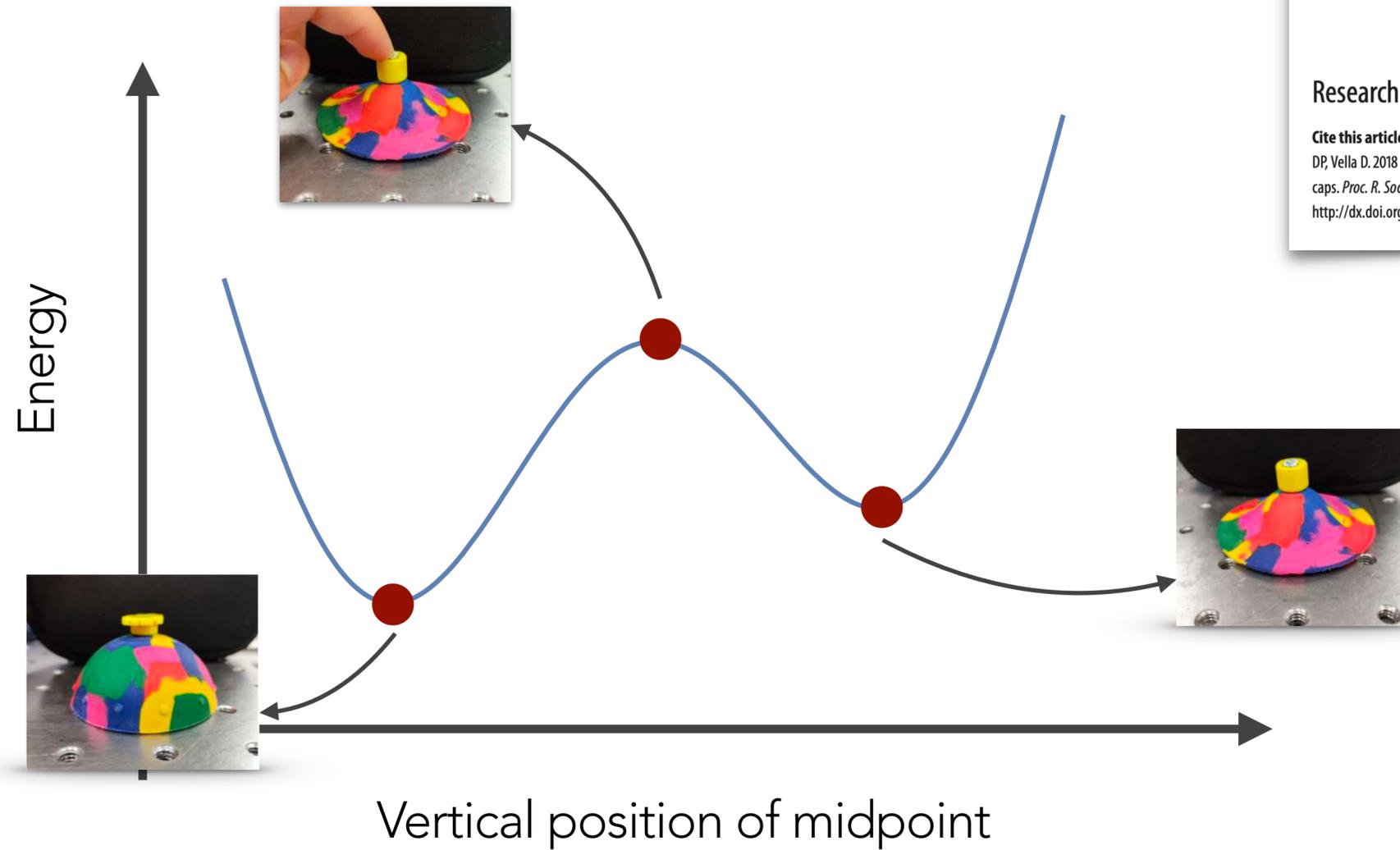
—MMSC CASE STUDY PROJECT—

Proposed by Marc Suñé

✉ msunesim@gmail.com



HEURISTICS—STATICS



PROCEEDINGS A

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Research

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Static bistability of spherical caps

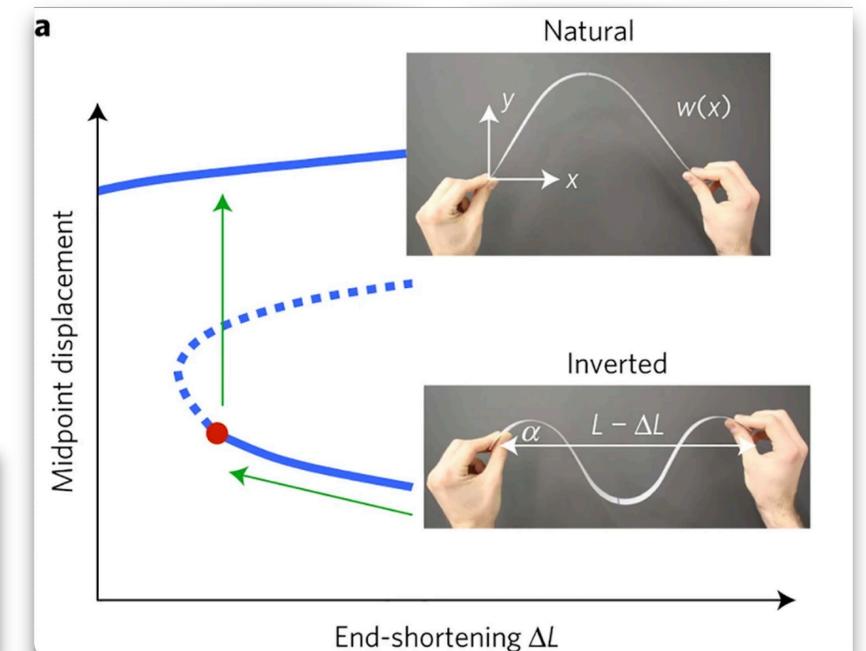
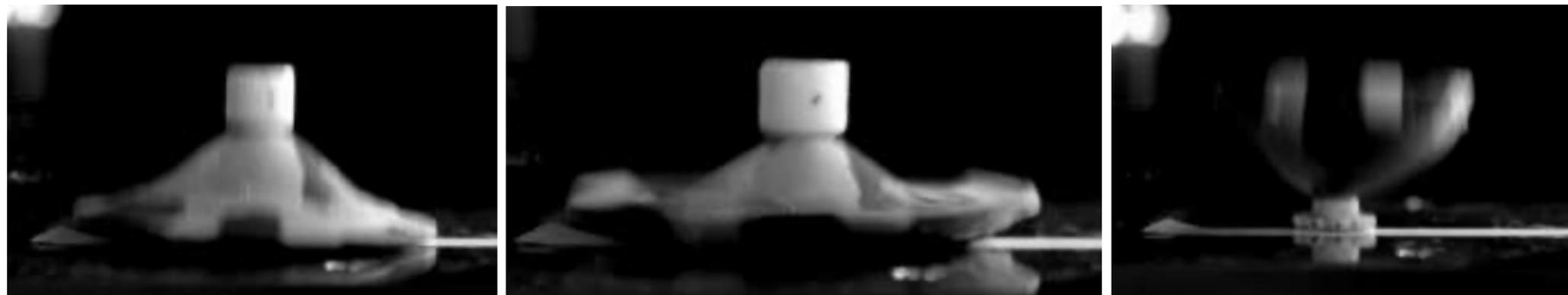
Matteo Taffetani¹, Xin Jiang², Douglas P. Holmes² and Dominic Vella¹

¹Mathematical Institute, University of Oxford, Woodstock Road, Oxford OX2 6GG, UK

²Department of Mechanical Engineering, Boston University, Boston, MA 02215, USA

 MT, 0000-0001-9587-156X; DV, 0000-0003-1341-8863

HEURISTICS—DYNAMICS



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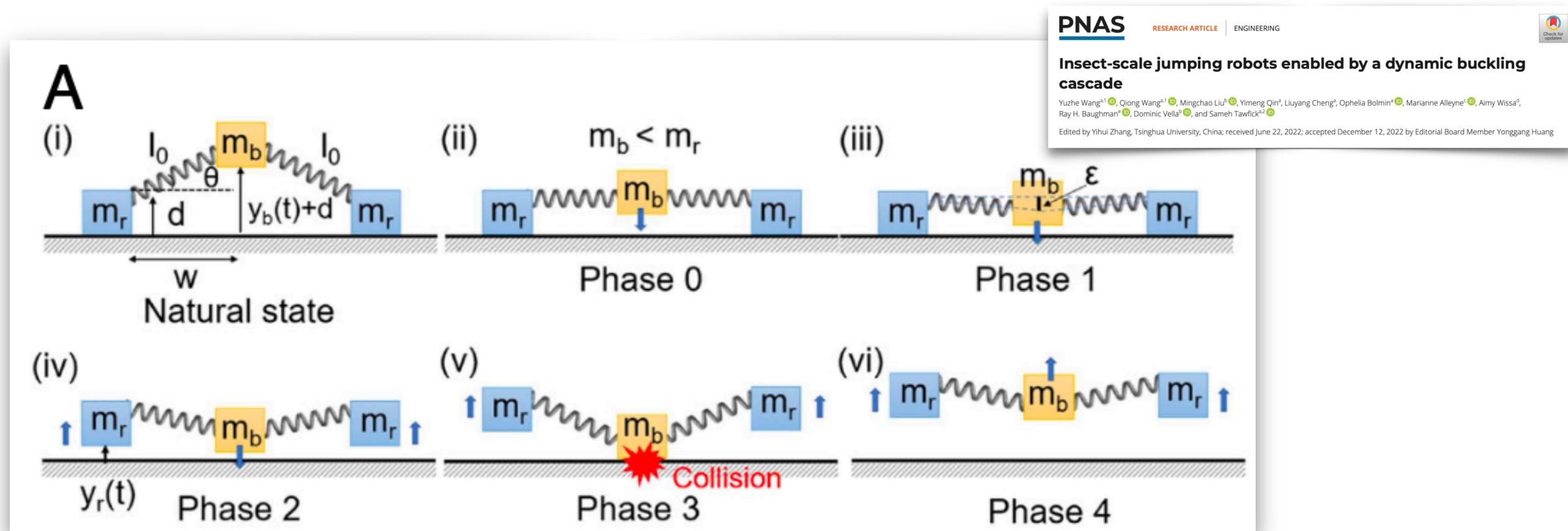
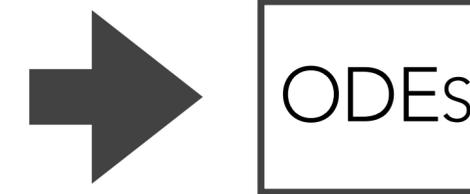
**Critical slowing down in purely elastic
'snap-through' instabilities**

Michael Gomez, Derek E. Moulton and Dominic Vella*

MODEL

MASS-SPRING MODEL (2D&3D):

- MASSES
- SPRINGS
- TORSION SPRINGS (TO BREAK UP-DOWN SYMMETRY)



PROPOSAL

STATICS:

- WRITE DOWN THE CONTINUUM MECHANICS MODELS FOR THE MECHANICAL EQUILIBRIUM OF SHALLOW SHELLS AND ELASTIC BEAMS.
- IDENTIFY THE RELEVANT DIMENSIONLESS PARAMETERS AND THE CORRESPONDING BIFURCATION BEHAVIOUR.
- TUNE THE MASS-SPRING MODEL SO THAT IT HAS THE SAME BIFURCATION BEHAVIOUR AS THESE.

DYNAMICS:

- WRITE DOWN THE ODES OF THE MASS-SPRING MODEL.
- IDENTIFY THE DIFFERENT PHASES OF THE MOTION.
- INTEGRATE THE MASS-SPRING MODEL
 - ANALYTICALLY—WITH APPROXIMATIONS
 - NUMERICALLY—MATLAB

SCIENTIFIC QUESTIONS

- IS THERE A SCALING LAW FOR THE MINIMUM HEIGHT REQUIRED FOR JUMPING?
- HOW CAN THE GEOMETRIC PARAMETERS BE TUNED TO OPTIMISE THE JUMPING PERFORMANCE?
- ... EXPERIMENTS? WHY NOT?!

REFERENCES

PNAS RESEARCH ARTICLE | ENGINEERING 

Insect-scale jumping robots enabled by a dynamic buckling cascade

Yuzhe Wang^{a,1} , Qiong Wang^{a,1} , Mingchao Liu^b , Yimeng Qin^a, Liuyang Cheng^a, Ophelia Bolmin^a , Marianne Alleyne^c , Aimy Wissa^d, Ray H. Baughman^e , Dominic Vella^b , and Sameh Tawfik^{a,2} 

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Critical slowing down in purely elastic 'snap-through' instabilities

Michael Gomez, Derek E. Moulton and Dominic Vella*

PHYSICAL REVIEW LETTERS **132**, 267201 (2024)

Transient Amplification of Broken Symmetry in Elastic Snap-Through

Qiong Wang^{1,*} , Andrea Giudici^{2,*} , Weicheng Huang,³ Yuzhe Wang⁴ ,
Mingchao Liu^{2,5,6} , Sameh Tawfik¹ , and Dominic Vella^{2,7} 

¹Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA
²Mathematical Institute, University of Oxford, Woodstock Rd, Oxford OX2 6GG, United Kingdom
³School of Engineering, Newcastle University, Newcastle upon Tyne NE1 7RU, United Kingdom
⁴Singapore Institute of Manufacturing Technology, Agency for Science, Technology and Research, Singapore, 138634, Singapore
⁵School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore 639798, Singapore
⁶Department of Mechanical Engineering, University of Birmingham, Birmingham B15 2TT, United Kingdom

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Static bistability of spherical caps

Matteo Taffetani¹, Xin Jiang², Douglas P. Holmes² and Dominic Vella¹

Research

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¹Mathematical Institute, University of Oxford, Woodstock Road, Oxford OX2 6GG, UK
²Department of Mechanical Engineering, Boston University, Boston, MA 02215, USA

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Dynamics of snapping beams and jumping poppers

A. PANDEY¹, D. E. MOULTON², D. VELLA² and D. P. HOLMES^{1(a)}

¹ Department of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University Blacksburg, VA, 24061, USA
² Mathematical Institute, University of Oxford - Woodstock Rd, Oxford, OX2 6GG, UK

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MODELLING THE DYNAMICS OF A JUMPING POPPER

—MMSC CASE STUDY PROJECT—

Wednesdays 9-10 am room C2 [Week 5: Tuesday 10-11 am]

✉ msunesim@gmail.com

