



consistent with  
The final physi-  
cal stress  $\sigma_c$  for  
that this par-

# A competition between slicing and buckling underlies the erratic nature of paper cuts

Sif Fink Arnbjerg-Nielsen, Matthew D. Biviano, and Kaare H. Jensen  
Department of Physics, Technical University of Denmark

[khjensen@fysik.dtu.dk](mailto:khjensen@fysik.dtu.dk)  
[www.papermachete.org](http://www.papermachete.org)  
[www.jensen-research.com](http://www.jensen-research.com)



INDEPENDENT  
RESEARCH FUND  
DENMARK

# THE PAPER CUT PARADOX: Explaining why thin paper does not cut

Paper cuts are a common injury that can cause significant pain and discomfort [1]. Surprisingly, the physics underpinning a thin flexible sheet of paper slicing into soft tissues remains unresolved. (Other cases, such as chess-wire cutters, have been described; e.g., [2].) In particular, the unpredictable occurrence of paper cuts, often restricted to a limited thickness range, has not been explained.

Here, we visualized and quantified the motion, deformation, and stresses during paper cuts, uncovering a remarkably complex relationship between cutting, geometry, and material properties [3]. A model based on the hypothesis that competition between slicing and buckling controls the probability of initiating a paper cut was developed and successfully validated.

Our study reveals why paper with a specific thickness is most hazardous ( $\approx 65 \mu\text{m}$ , corresponding, e.g., to dot matrix paper or printed scientific journals). Based on our results, we developed the *Papermachete*, a cost-effective paper-based scalpel. It uses scrap paper blades and can easily cut vegetables and meat. To 3D print your own, use the files accessible [here](#).

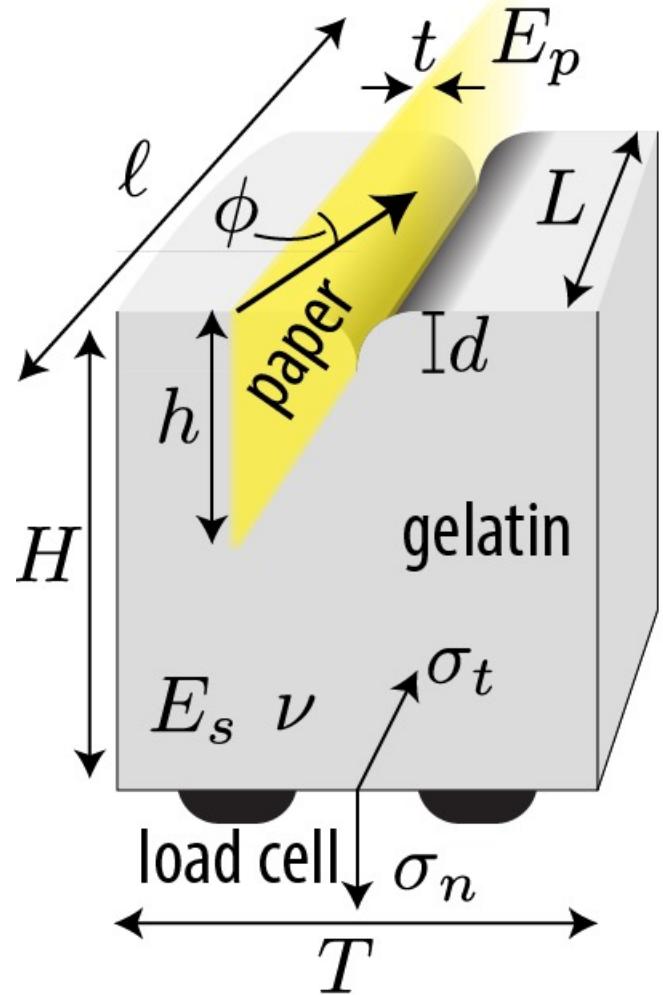
Website: [www.papermachete.org](http://www.papermachete.org)

Email for correspondence: [kjhjensen@fysik.dtu.dk](mailto:kjhjensen@fysik.dtu.dk)

## References

- [1] Mirsky, S., The unkindest cut, *Scientific American* 306, 80, 2012
- [2] Reyssat, E., Tallinen, T., Le Merrer, M., & Mahadevan, L. Slicing softly with shear. *Physical review letters*, 109(24), 244301, 2012
- [3] Arnbjerg-Nielsen S. F., Biviano M. D., & Jensen, K. H., Competition between slicing and buckling underlies the erratic nature of paper cuts, *Physical Review E* (2024) [www](#)

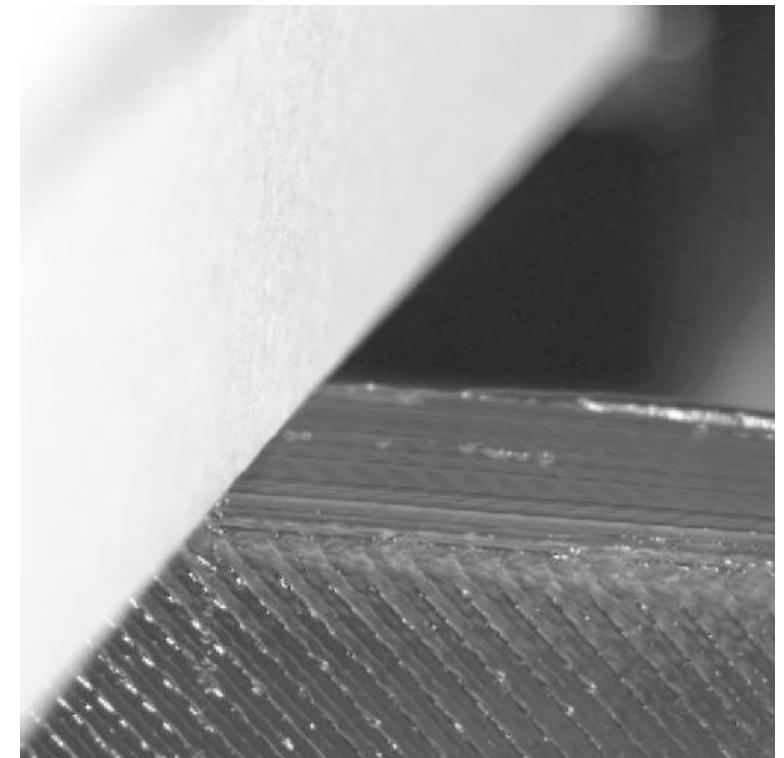
# We built a paper cutting machine



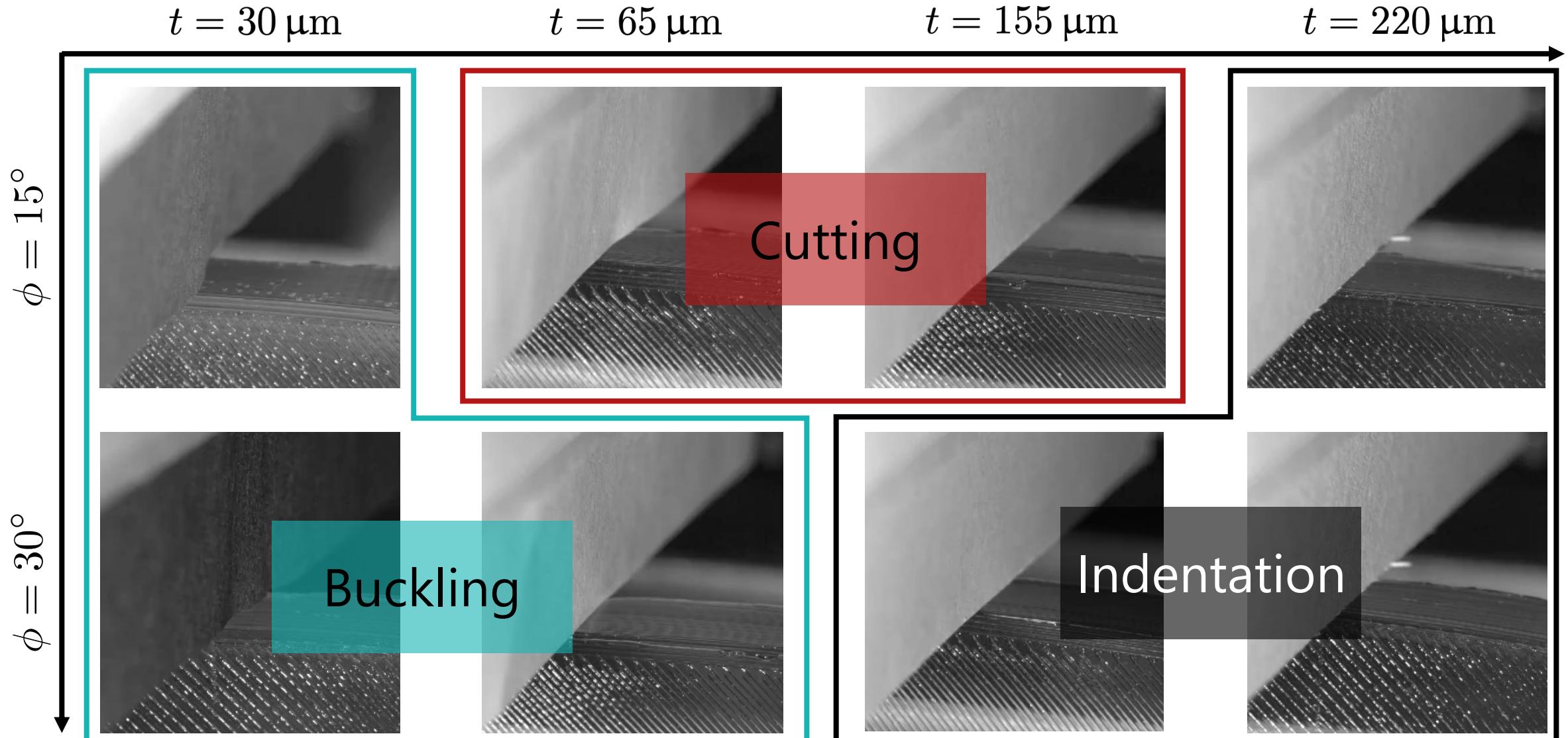
$$\phi = 5^\circ$$

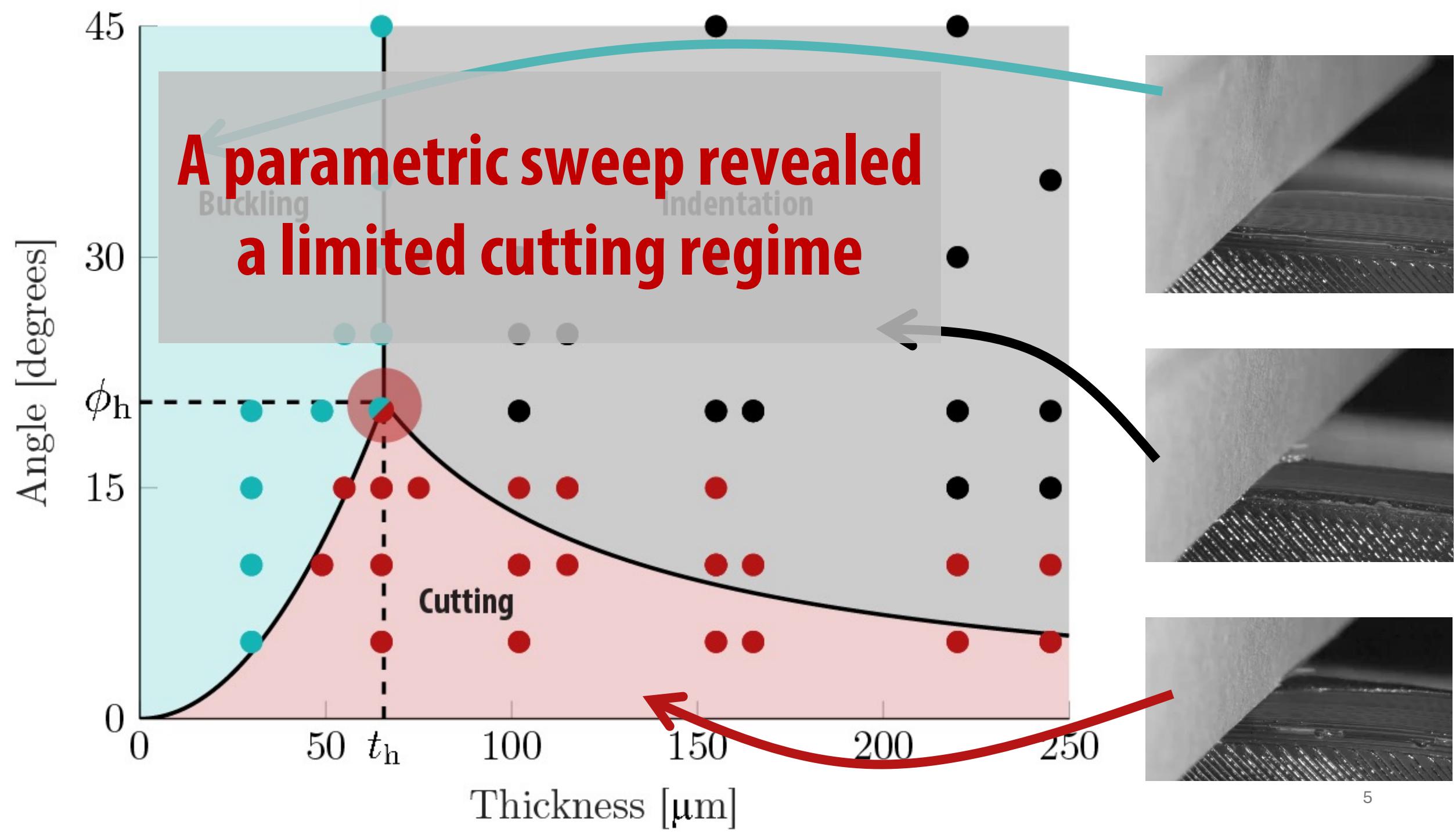


$$\phi = 90^\circ$$



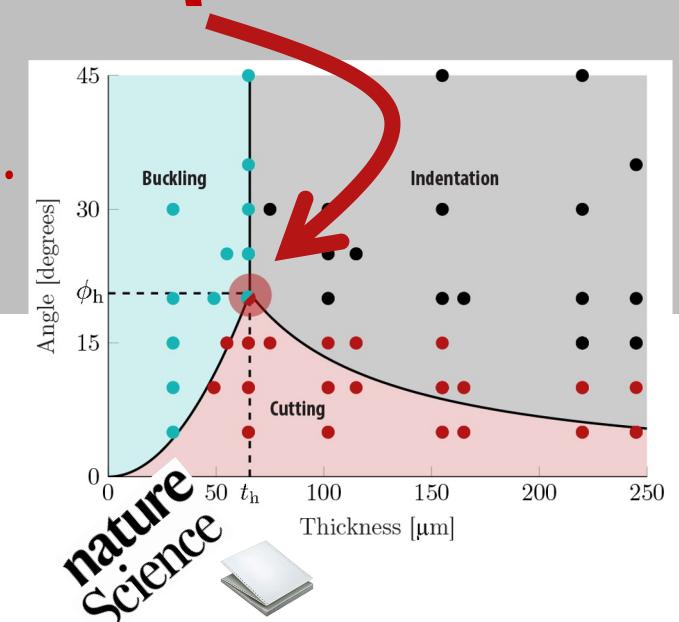
... revealing when buckling, indentation and cutting occurs





# And the most hazardous thickness: 65 $\mu\text{m}$

This is close to dot-matrix printer paper,  
but the journals *Nature* and *Science* are also dangerous...



# THE PAPERMACHETE

Based on our results, we developed the *Papermachete*, a cost-effective paper-based scalpel. It uses scrap paper blades and can easily cut vegetables and meat.

To 3D-print your own, use the files accessible at [www.papermachete.org](http://www.papermachete.org)

