# Advanced Topics in Analysis and the Calculus of Variations
# (V5B5) The analysis of thin elastic objects

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**Content** Thin elastic objects show a strikingly different behaviour than bulk elastic materials. The can easily undergo large deformations, form a fascinating variety of complex patterns and often provide optimal structures. For this reason they play a fundamental role in engineering as well as in biology. From a mathematical point of view thin elastic structure are also very interesting in view of their universal behaviour which is dictated by geometry rather than the specific properties of a concrete material.

Over the centuries and beginning with the work of Euler many mathematical theories to describe thin elastic objects have been developed. Only in the last ten to twenty years a rigorous mathematical approach how to related these theories to the well accepted theory for three-dimensional nonlinear elasticity has emerged.

In this course I will discuss both the derivation of mathematical theories for thin elastic objects and some interesting patterns arising in thin elastic objects.

The course will be mostly based on the lecture notes [1] which will be available to course participants through sciebo. A short overview of some fascinating phenomena can be found here. A much more detailed account of the physics literature is given in [2]

**Prerequisites** Sobolev spaces, basic in the calculus of variations.

## References

[1] S. Müller, Mathematical problems in thin elastic sheets:scaling limits, packing, crumpling and singularities, in: Vector-valued partial differ-

ential equations and applications, pp. 125–193, Lecture Notes in Math. **2179**, Springer, Cham, 2017.

[2] B. Audoly and Y. Pomeau, Elasticity and geometry - from hair curls to the non-linear response of shells, Oxford Univ. Press, 2010.