Abstract for the general public

The natural world is full of striking examples of geometric form, from the spiral of the nautilus shell to the pattern at the center of a sunflower. On the nanoscale, these examples of interesting geometric forms are just as numerous, often bringing intricate functionality to the material. A spectacular example of this is in the prolamellar body, which is a cellular structure in the early stages of plant development. Here, the cell membrane forms a well known classical surface from differential geometry, called the diamond minimal surface. How does such a spectacular surface form in a biological system? That is the question that this project will consider.

The main aim of this project is to decipher the structural pathways of the prolamellar body formation by employing an interdisciplinary approach combining nanomorphological and biochemical studies with geometric and topological modeling. Until now, the limits of nanoscale biological imaging have made it difficult to decipher this formation pathway, but new advances in these techniques make a new investigation possible. A key result of the project will be a dynamic structural model of the prolamellar body formation that could suggest ways that other similar cubic membranes form in cells across the kingdoms of life.

This project will be undertaken as a collaboration between plant biologists in Warsaw and mathematicians in Potsdam, in order to utilize cutting edge techniques from both disciplines to understand this important biological structure. The combination of expertise in the two project partners will capitalize on this spectacular combination of geometry and biological form, leading to insight into this important biological question.