Yangnan Gu

Yangnan Gu is an Assistant Professor and newly established group leader in the Department of Plant & Microbial Biology at the University of California, Berkeley, USA. His lab studies the nuclear envelope and the roles of nuclear membrane proteins in plant immunity and stress responses. Yangnan was awarded the SEB's 2023 President's Medal for the Cell section.

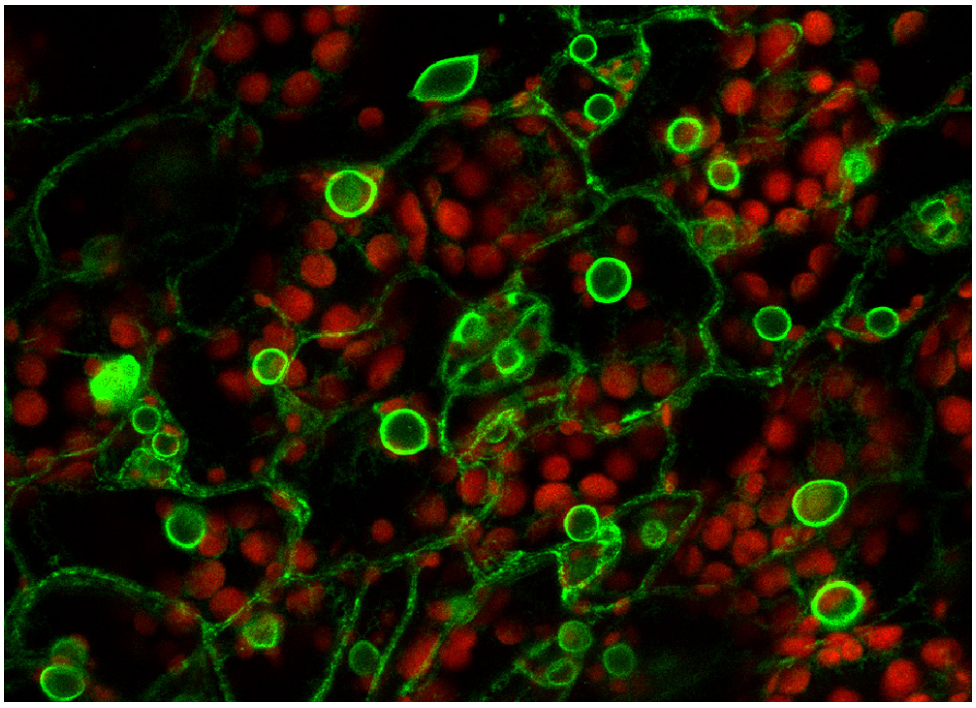
Tell us about your background.

I am an Assistant Professor at the Department of Plant & Microbial Biology at the University of California, Berkeley. I received my BS degree in Bioengineering from Xi'an JiaoTong University, China in 2007 and earned a PhD degree in Molecular, Cellular, and Developmental Biology as well as an MS degree in Applied Statistics from Indiana University Bloomington in 2013. I then undertook postdoctoral training at Duke University and Howard Hughes Medical Institute in 2013-2017 before landing an independent faculty position.

How did you first become interested in cell biology and nucelar membrane research?

I got interested in cell biology when I was studying the function of an *Arabidopsis* gene named KEEP ON GOING (KEG) during my second year of graduate school. I was surprised to find that the KEG-YFP protein localizes to numerous highly mobile punctate structures in the cytoplasm, which is inconsistent with KEG's hypothesized role in the nucleus. My subsequent efforts towards understanding the identity of these KEG-localized vesicles led me into the wonderful world of cell biology and made me fully appreciate the importance and complexity of membrane-bound organelles in plants and their differences to animal counterparts.

My interest in the nuclear membrane began during my postdoctoral research on an *Arabidopsis* autoimmune mutant with a mutation in a gene encoding an uncharacterized multiple transmembrane protein called CPR5. During my studies, I defined CPR5 as a novel plant-specific membrane component of the nuclear pore complex (NPC): a mega protein complex that penetrates the nuclear membrane and mediates nucleocytoplasmic transport of macromolecules. I demonstrated that CPR5 regulates immune activation through conformational reconfiguration of the NPC to change its permeability, a concept that has been supported by recent advances in both animals and yeasts. Since then, my research interests have expanded to include not only the NPC but also the nuclear envelope, which is one of the most important but least understood membrane compartments in plants.



Above: Staining of nuclei with GFP-tagged nuclear membrane protein WIP1 in the *cpr5* mutant background.

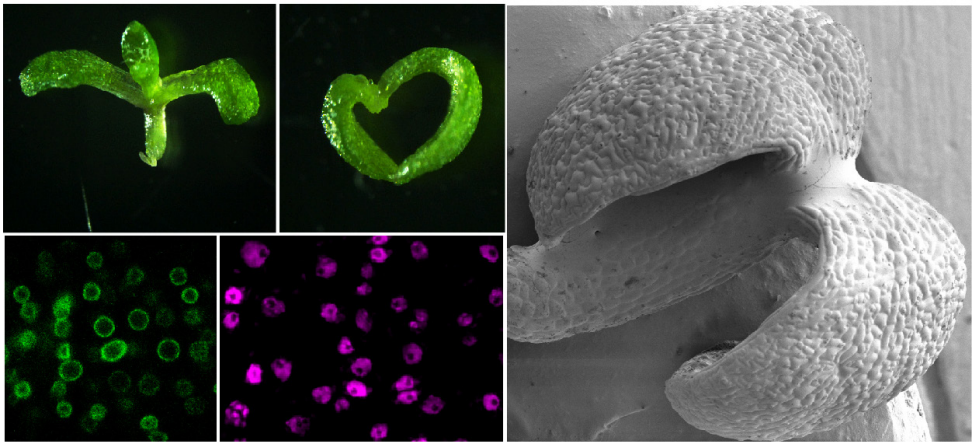
Below (second page): *Arabidopsis* plants that contain mutations in an inner nuclear membrane gene PNET2. Green fluorescence: nuclear membrane localization of PNET2 protein tagged with GFP; magenta fluorescence: DNA staining of nuclei in the *pnet2* mutant plants by DAPI; white plant: scanning electron micrograph of *pnet2* mutant plant.

What is your lab working on currently?

My lab currently focuses on the discovery of novel nuclear membrane proteins and investigating their functional significance in different aspects of plant physiology and cell biology. This involves a combined molecular, cellular, genetic, and multi-omic approach. My group is also interested in exploring the role of nuclear transport receptors (karyopherins) in mediating nuclear shuttling of signaling cargos across the nuclear envelope and the significance of this in determining plant immune responses.

What does a typical day look like for you? What do you most enjoy about your work?

I love my research topic, and I typically spend a significant proportion of my day analyzing data and discussing experimental designs and interpretation of results with my postdocs and students. I am most excited when an important or intriguing hypothesis is generated out of such a discussion, and that alone is sufficient to imbue my day with a sense of fulfillment. I have a passion for writing, particularly research papers as these allow me to effectively convey our exciting stories and compelling ideas. I allocate a significant proportion of my time to teaching, dedicating several hours each day to preparation and instruction (expect during the summer). I teach the graduate Cell Biology class and the undergraduate Plant Physiology and Biochemistry class. I love to share my knowledge and experience with my students, and also the challenge of engaging and inspiring young minds. Lastly, I find great delight in the precious moments I am able to spend with my beloved 7-year-old.



> "I love to share my knowledge and experience with my students, and the challenge of engaging and inspiring young minds"

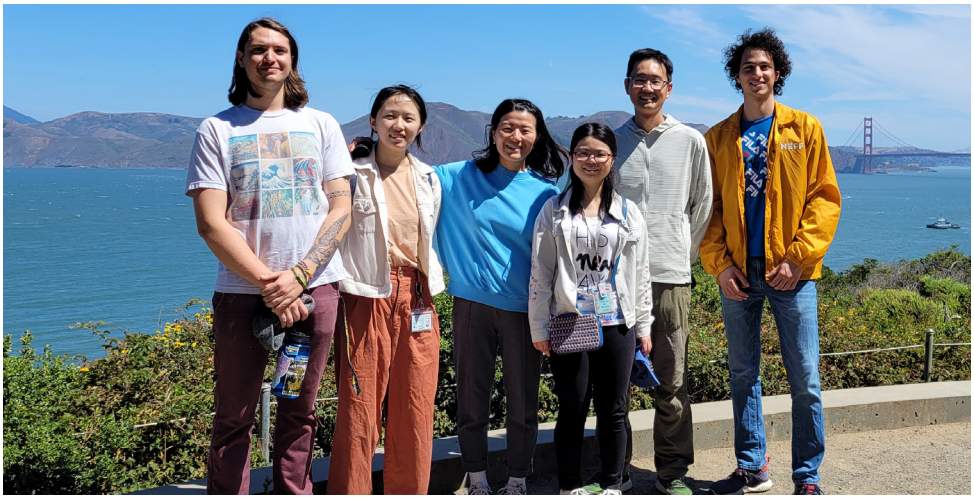
What do you find most challenging?

As a junior faculty member, the biggest challenges I face include time management and securing funding, especially funding for the kind of basic cell biology research that we are pursuing. Also, as a new PI and nascent member of a research area, obtaining recognition from the field can be another long and demanding journey. However, I do consider myself fortunate to have the camaraderie and support of my esteemed colleagues, who consistently exhibit amiability and kindness towards me.

What is your lab hoping to work on in the future?

In the future, we hope to establish a precise and comprehensive view of the protein landscape and protein functions at and around the nuclear envelope. We plan to fulfill this goal first in the model organism *Arabidopsis* and later in other plant species. We believe that this project has far-reaching implications in understanding the fundamental biological principles underlying nuclear membrane biology. Emerging evidence indicates that the nuclear envelope is a critical platform for regulating abiotic and biotic stress responses in plants. Therefore, we also expect this work to identify a number of genes involved in plant stress regulation that will be of potential significance for improving crop resistance against increasingly severe environmental stresses caused by global climate change.

Meanwhile, we are also establishing a previously uncharacterized chaperoning activity of the karyopherin family proteins, which are known for their classical function in mediating the nuclear transport of macromolecules. We are currently deciphering this transport-independent function of karyopherin proteins in regulating immune-related biomolecular condensation in plants.



Above: The Gu lab at the Golden Gate Bridge, California, 2022. Left to right: Ryan Kenelley- graduate student, Yiling Fang- graduate student, Min Jia- postdoc, Yu Tang- postdoc, Yangnan Gu- PI, Enrico Calvanese- graduate student.

Selected Publications from SEB Journals

Calvanese E, Gu Y. 2022. Towards understanding inner nuclear membrane protein degradation in plants. Journal of Experimental Botany 73, 2266–2274.