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FRET 65: A Celebration of Förster

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FRET is a physical process where energy is transferred from an excited donor fluorophore to adjacent chromophores via nonradiative dipole interactions. While resonance energy transfer was first observed in fluorescence polarization studies in the 1920s, interest in FRET was limited to understanding the concentration dependence of fluorescence depolarization. Now, after decades as a chemical curiosity, the number of citations using FRET has increased almost 300 fold over the past 20 years. This rapid growth in FRET publications results primarily from the application of FRET spectroscopy and microscopy as a tool to study biological processes such as protein interactions, conformational changes, the assembly and stoichiometry of biological complexes. It is also the basis for the development of new biosensors. Importantly, recent applications of FRET imaging have opened the door to applying the classical quantitative biochemical approach that has been so successful over the past 50 years for *in vitro* studies, to now explore biological reactions inside living cells.

While FRET was originally coined as an acronym for fluorescence resonance energy transfer, more recently this four-letter acronym has been redefined as Förster resonance energy transfer to honor Theodor Förster who developed the theory that quantitatively explained this energy-transfer phenomenon, and who made the connection that energy transfer was fundamental to photosynthesis, the basis of life itself. Förster was a German physical chemist, born on May 15, 1910, who died on May 20, 1974. He earned his PhD from the University of Frankfurt and Main, and was a professor at the State University of Poznan. He wrote the first publication on FRET, "Energy migration and fluorescence," in 1946.¹

It is the purpose of this special section to honor Förster's achievements 65 years after his first publication on resonance energy transfer, to highlight the evolution of FRET microscopy through the presentation of state-of-the-art FRET studies, and to celebrate related imaging technologies and reagents, such as new fluorescent proteins, single-molecule fluorescence, and fluorescence correlation spectroscopy, that along with FRET microscopy continue to push the envelope of our biophysical curiosity.

Several very interesting manuscripts appear in this special section of JBO. Förster's first paper on FRET has been translated from German into English by Dr. Klaus Suhling. Access to this landmark paper 65 years after its original publication in German is now available to the English-speaking FRET community. R. Knox, who knew and worked with Förster, has written a historical perspective about FRET. S. Ernst et al. describe the use of a three-color FRET approach to investigate the rotary mechanism of the FOF1-ATP syntheses at the single-molecule level. E. Deplazes et al. describe how to estimate the relative contributions in inter- and intramolecular FRET, as well as how to model FRET with various ratios of donors and acceptors. B. Maliwal et al. describe the theory and implementation of a method to measure the distance between donor and acceptor molecules separated by distances greater than the established 10-nm maximum for FRET. L. Kraft et al. use both FRET and FRAP to demonstrate that Atg4bc74A and LC3 exist within the same multiprotein complex in both the cytoplasm and nucleoplasm of living cells.

Finally, we would like to acknowledge all of the authors who contributed to this special section on FRET at 65: A Celebration of Förster, as well as the reviewers whose hard work was instrumental to the timely publication of this special issue.

Reference

1. T. Förster, "Energiewanderung und fluoreszenz," *Naturwissenschaften* **33**(6), 166–175 (1946).

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Special Section Guest Editors