Distribution of active twister ribozymes throughout the tree of life discerned by high-throughput screening and machine learning

Prof. Philip Bevilacqua

Distinguished Professor

Chemistry and of Biochemistry & Molecular Biology

Pennsylvania State University

Abstract

Small nucleolytic ribozymes have been studied for decades and have well characterized structures and mechanisms. However, much less is known about their tolerance of imperfections and their distribution throughout the tree of life. I will describe high-throughput methods that our lab has developed to test thousands of ribozymes for function that reveal an amazing tolerance for imperfections. I will also present machine learning approaches that suggest that twisters are present in some branches of life but devoid in others. These findings suggest that twister ribozymes may have important roles in gene regulation and biological function that are not well understood.

Biography

Phil's obtained his Ph.D. with Professor Douglas Turner at the University of Rochester in 1993. His postdoctoral studies were with Professor Thomas Cech at the University of Colorado. In 1997 he joined the faculty of the Department of Chemistry at Penn State University as an Assistant Professor of Chemistry. In 2003 he was promoted with tenure to Associate Professor of Chemistry and in 2007 he was promoted to Full Professor of Chemistry. In 2015 he obtained a second appointment as Professor of Biochemistry & Molecular Biology. He is a co-founder of the Center for RNA Molecular Biology at Penn State and is active in several interdepartmental graduate programs at Penn State including Plant Biology, Molecular Cellular and Integrative Biosciences (MCIBS), and Bioinformatics and Genomics. His research has been recognized by a National Science Foundation (NSF) CAREER Award, Alfred P. Sloan Foundation Fellow, Camille Dreyfus Teacher-Scholar, Elected Fellow of the American Association for the Advancement of Science (AAAS), the Penn State Faculty Scholar Medal, the ACS Morley Medal, and is a Distinguished Professor. In addition, his teaching has been recognized through the NSF CAREER Award, Camille Dreyfus Teacher Scholar, and Penn State Faculty Scholar Medal, as well as being designated a Distinguished Honors Faculty Fellow, a CESE Tombros Education Fellow, and awarded the C. I. Noll Award for Excellence in Teaching and the Priestley Teaching

Prize. Phil's served as Department Head from 2018 through 2024 and will be on the Board of Directors of the RNA Society from 2026-2027.

Phil has focused on obtaining molecular insights into the myriad roles of RNA in biology through mechanistic approaches. His lab has introduced new approaches to study RNA, and demonstrated active roles for nucleobases in RNA catalysis, identification of functions for *in vivo* RNA structure in RNA processing events, and elucidation of RNA determinants for innate immune responses (PAMPs) at the primary, secondary, and tertiary RNA structural levels, which provided a key publication in the 2023 Nobel Prize in Physiology or Medicine.