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### **Statistical Physics Approaches to Microbial Ecology<sup>1</sup>**

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The unprecedented ability to quantitatively measure and probe complex microbial communities has renewed interest in identifying the fundamental ecological principles governing community ecology in microbial ecosystems. Here, we present work from our group and others showing how ideas from statistical physics can help us uncover these ecological principles. Two major lessons emerge from this work. First, large, ecosystems with many species often display new, emergent ecological behaviors that are absent in small ecosystems with just a few species. To paraphrase Nobel laureate Phil Anderson, "More is Different", especially in community ecology. Second, the lack of trophic layer separation in microbial ecology fundamentally distinguishes microbial ecology from classical paradigms of community ecology and leads to qualitative different rules for community assembly in microbes. I illustrate these ideas using both theoretical modeling and novel new experiments on large microbial ecosystems performed by our collaborators (Joshua Goldford and Alvaro Sanchez).

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