Project 3.3 Ultra-high-throughput single-microbe profiling to study microbiome

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Background:

Microbes inhabit almost every part of the human body, living for example in gut, on the eye and skin in the total number of dozens of trillions of cells. Estimates suggest there are more than ten thousand bacterial species living in the human body, forming a complex community called the microbiome. This number is constantly being refined as researchers discover new species. On the other site, the total number of bacterial species living on Earth is estimated to be over 1 trillion. However, only about 660,000 species have their genome determined i.e. 99.99993% bacterial species remain undiscovered.

Aim:

We plan to develop a powerful new tool that can examine each individual bacterium in a community, like the gut microbiome. This tool would look at both the bacteria's DNA (its blueprint) and its active genes (like the instructions being used). We're developing this tool by combining cutting-edge techniques in chemistry, physics, and genetics. Here's how it works: We can analyze hundreds of thousands of bacteria at once, like taking a giant fingerprint of their DNA and genes. We use special labels to track each bacterium and sequence its entire genetic code, along with which genes are turned on. This allows us to see not only what kind of bacteria are present (species level) but also what each individual bacterium is doing (cell state level). This technology will be a game changer for understanding the microbiome. It's like creating detailed maps of healthy and diseased microbiomes, revealing not only the composition of the microbiome but also which biological or to be more specific metabolic pathways are affected in disease conditions. This knowledge could lead to new treatments.

Requirements:

- M.Sc. degree in Biotechnology, Biology, Genomics, Medicine, or related quantitative Discipline;
- solid knowledge and familiarity with techniques in Molecular and Cell Biology;
- familiarity with Next Generation Sequencing.