Does orientation of bacteria change the light attenuation?

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In a previous note, we use a simple calculation to show that in the weak-attenuation limit, the orientation of an object does not affect the light attenuation. In this note, we want to verify this hypothesis in experiment.

We take a video of a randomly reorienting bacterium in water. If our hypothesis is valid, the light intensity, measured by the average pixel value, is a constant. Due to the fact that the light source cannot be perfect and always has a fluctuation, our image cannot have a strictly constant light intensity. We are not looking to obtain a constant light intensity in our experiment. Instead, we estimate the fluctuation of the light source, and compare it with the fluctuation of the single bacterium image.

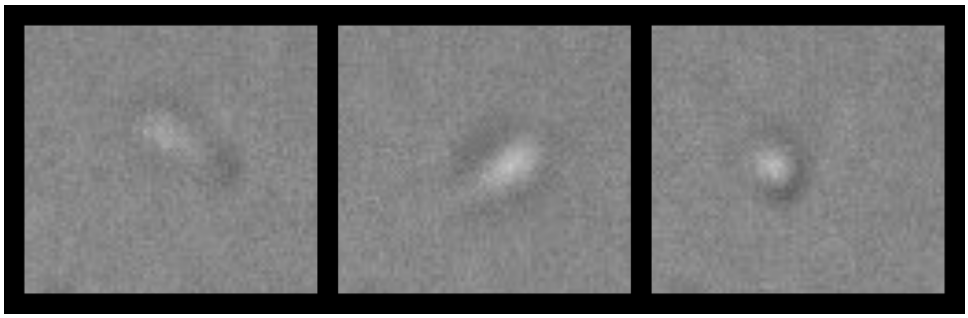

FIG. 1. Three snapshots from a video of a single reorienting bacterium

Figure 1 shows 3 snapshots of a single reorienting bacterium. The total length of the video is 250 frames, shot at 30 frames per second. This single bacterium video is cropped from a larger field of video, which contains several tens of bacteria. Let's assume that the fluctuation of the larger field of view video is a good estimate of the fluctuation of the light source. We will extract the intensity fluctuations of both the small video and the large video, and then compare them. Figure 2 shows the mean intensities of the one-bacterium video and the large field of view video over time. Both intensities fluctuate, and the fluctuation of the one-bacterium video is much stronger.

This result suggests that the orientation of bacteria may affect the local light attenuation.

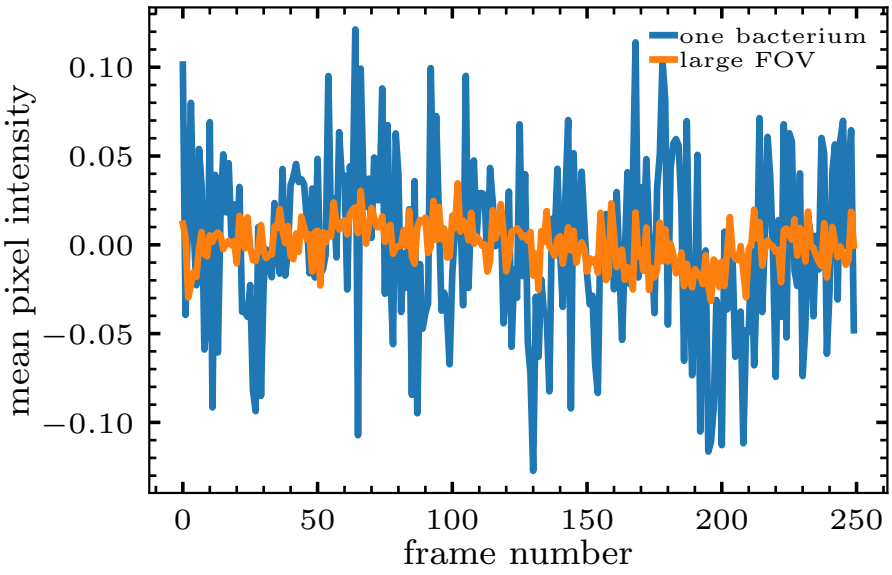

FIG. 2. Mean intensities of the one-bacterium video and the large field of view video over time.