Necessity of protruding obstacles in our device to 'bump' large particles:

Our device does not have isolated "pillars" like a conventional DLD array, but does have obstacles which protrude into the central column, causing the streamlines to squeeze together. Thus, the center of a large particle will move from one streamline to another, and hence follow a different path after the protruding obstacle than a small particle. Our current work inherited this aspect from Liang's previous work on a "non-tunable" device[24].

Now, about the importance of protruding obstacles in our device in contrast to no obstacles:
Indeed, the "single-column DLD" device described in our tunable-device manuscript, the non-tunable single-column DLD[24] of Liang et al. (2020), and the Hydrodynamic Filtration[43] (HDF) device- all three devices rely on "large" particles not following the streamlines because they don't "fit" into a streamtube at its narrowest point and then "bump" (are displaced) into a different stream, which then follow to the final output.
We show here a **2-D** COMSOL simulation comparing our tunable single-column DLD device with the protruding obstacles (as in our experiments) and without the protruding obstacles, for a sample flowrate of 9 μL/min and crossflow of 1.5 μL/min. With the protrusion (obstacle) in the left figure, an 18-μm gap is required for a critical diameter of 7.2 μm, while the vertical channel width is 38 μm. Without the obstacle (similar to HDF) in the right figure, a vertical channel width of 17 μm (less than the half of 38 μm) is required to achieve the critical particle diameter of 8 μm (close to 7.2 μm). This implies that, for the similar critical sizes in a single-column device "with bumps" (our device) and "without bumps" (similar to HDF), the vertical channel width on an average would be larger in our structure with the obstacle (and less prone the clogging) than in device without protruding obstacles (which is similar to HDF).

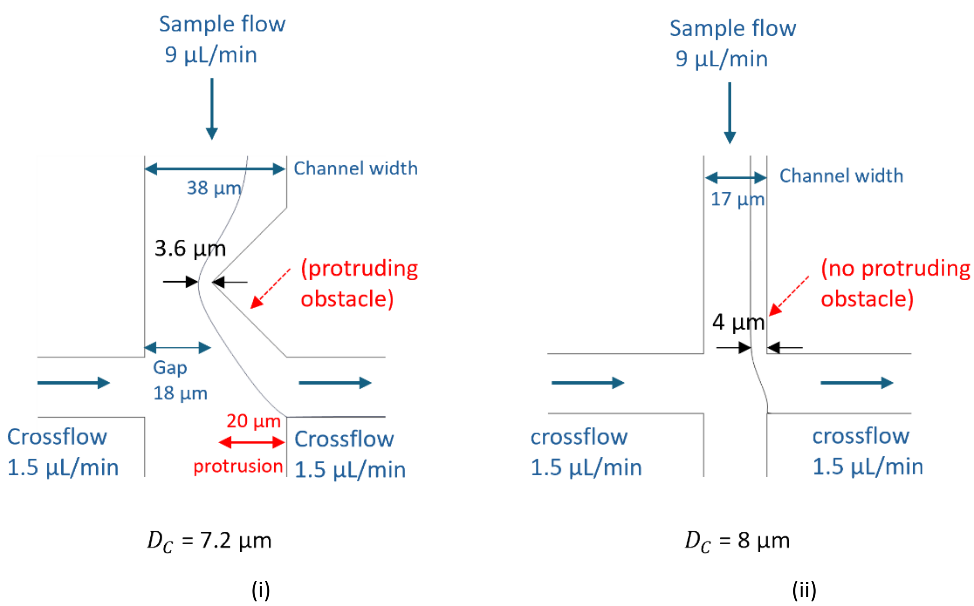

Figure: 2D COMSOL simulation comparing the role of the channel obstacle in a single-column device (i) with and (ii) without protruding obstacles designed to have the similar critical sizes of 7.2 μm (left figure) and 8 μm (right figure) at sample flowrate of 9 μL/min and crossflow of 1.5 μL/min. Note the device in (i) with a protuding obstacle has on average much wider (38 μm) vertical channel that on the right without the obstacle (17 μm), which makes it less prone to clogging.

References:

[24] Liang, W., Austin, R. H. & Sturm, J. C. Scaling of deterministic lateral displacement devices to a single column of bumping obstacles. *Lab. Chip* **20**, 3461–3467 (2020).
[43] Yamada, M. & Seki, M. Hydrodynamic filtration for on-chip particle concentration and classification utilizing microfluidics. *Lab. Chip* **5**, 1233–1239 (2005).