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Biological Large Scale Integration

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The integrated circuit revolution changed our lives by automating computational tasks on a grand scale. My group has been asking whether a similar revolution could be enabled by automating biological tasks. To that end, we have developed a method of fabricating very small plumbing devices chips with small channels and valves that manipulate fluids containing biological molecules and cells, instead of the more familiar chips with wires and transistors that manipulate electrons. Using this technology, we have fabricated chips that have thousands of valves in an area of one square inch. We are using these chips in applications ranging from screening to structural genomics to ultrasensitive genetic analysis. However, there is also a substantial amount of basic physics to explore with these systems the properties of fluids change dramatically as the working volume is scaled from milliliters to nanoliters!