2018 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

Low-Cost, High-Throughput Cyber Physical DNA Synthesis

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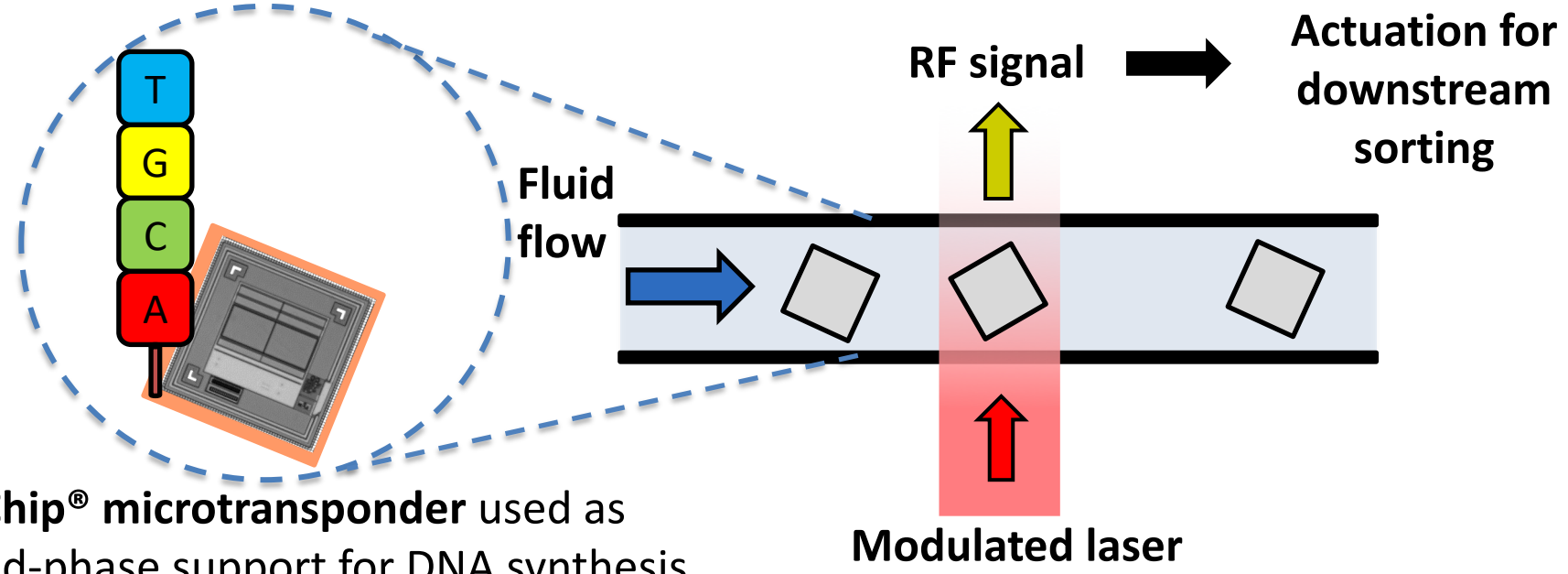
Rapid p-Chip® sorting for DNA synthesis

The project investigates a new process for **manufacturing large-scale libraries of synthetic DNA oligonucleotides**

- **Synthetic biology research**
- **Long-term data storage**

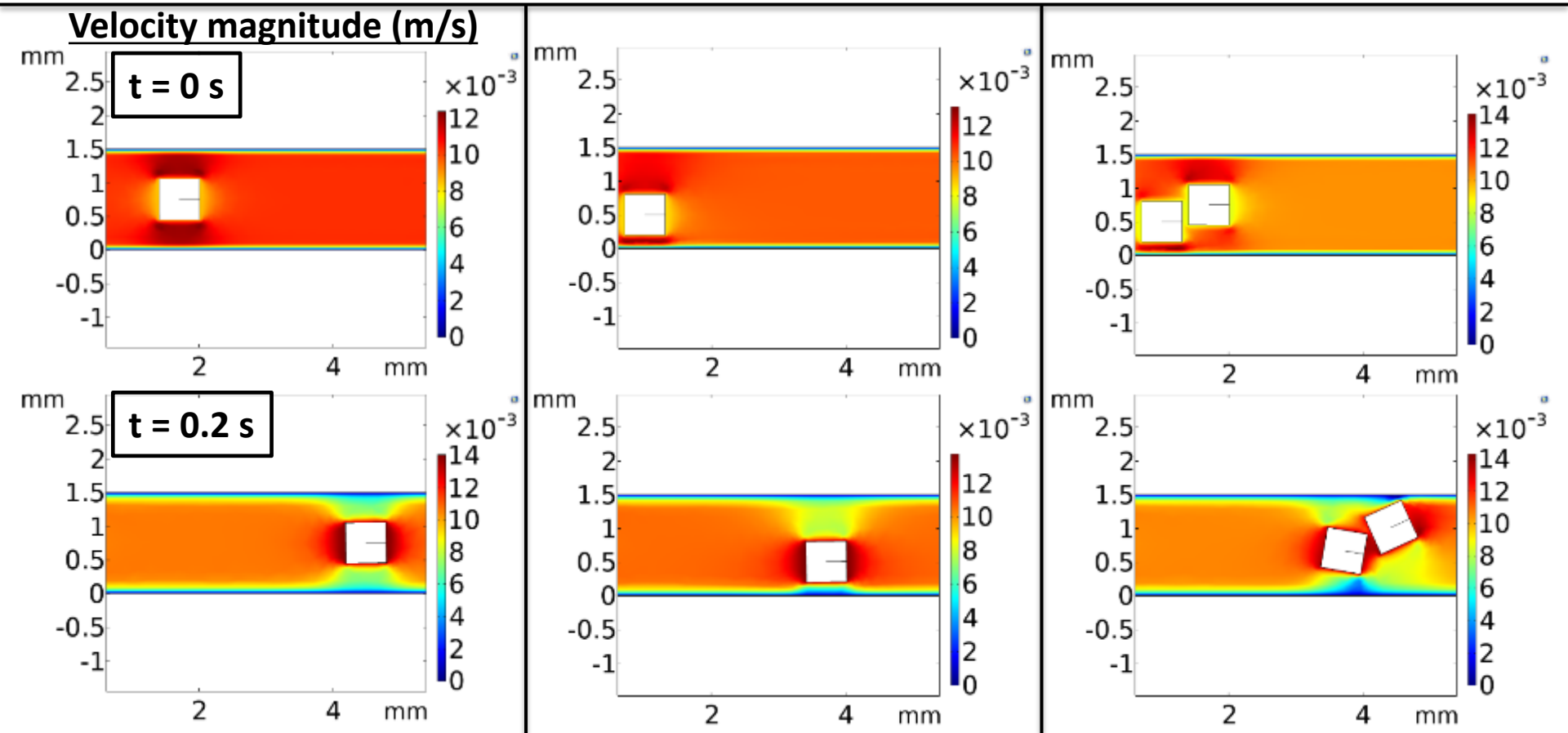


p-Chip® microtransponder used as solid-phase support for DNA synthesis

- Evaluate p-Chip motion in fluid flow using finite element (FE) models
- Design an integrated microfluidic manifold for real-time p-Chip sorting and encrypted DNA synthesis
- Implement protection against side-channel attacks

Finite element simulations of p-Chip translation and rotation in fluid flow

- Performed FE simulations of non-spherical p-Chips flowing through microchannels in water using COMSOL® FE software
- Arbitrary Lagrangian-Eulerian framework of the simulations captures two-way coupled fluid-structure interaction



Axially-ordered trains of p-Chips in fluid flow

- Particle wake-length (specified as a function of diagonal particle length, D) increases with increasing particle Reynolds number, Re_p
- Optimized axial interparticle spacing with minimal fluid-particle interaction are determined for aligning p-Chips in stable trains

Initial axial particle spacing (mm)	Inlet flow velocity (m/s)	Re_p	Wake length (D)
2.0	0.01	4.8	1.8D
	0.05	24.1	2.0D
	0.10	48.2	2.5D