

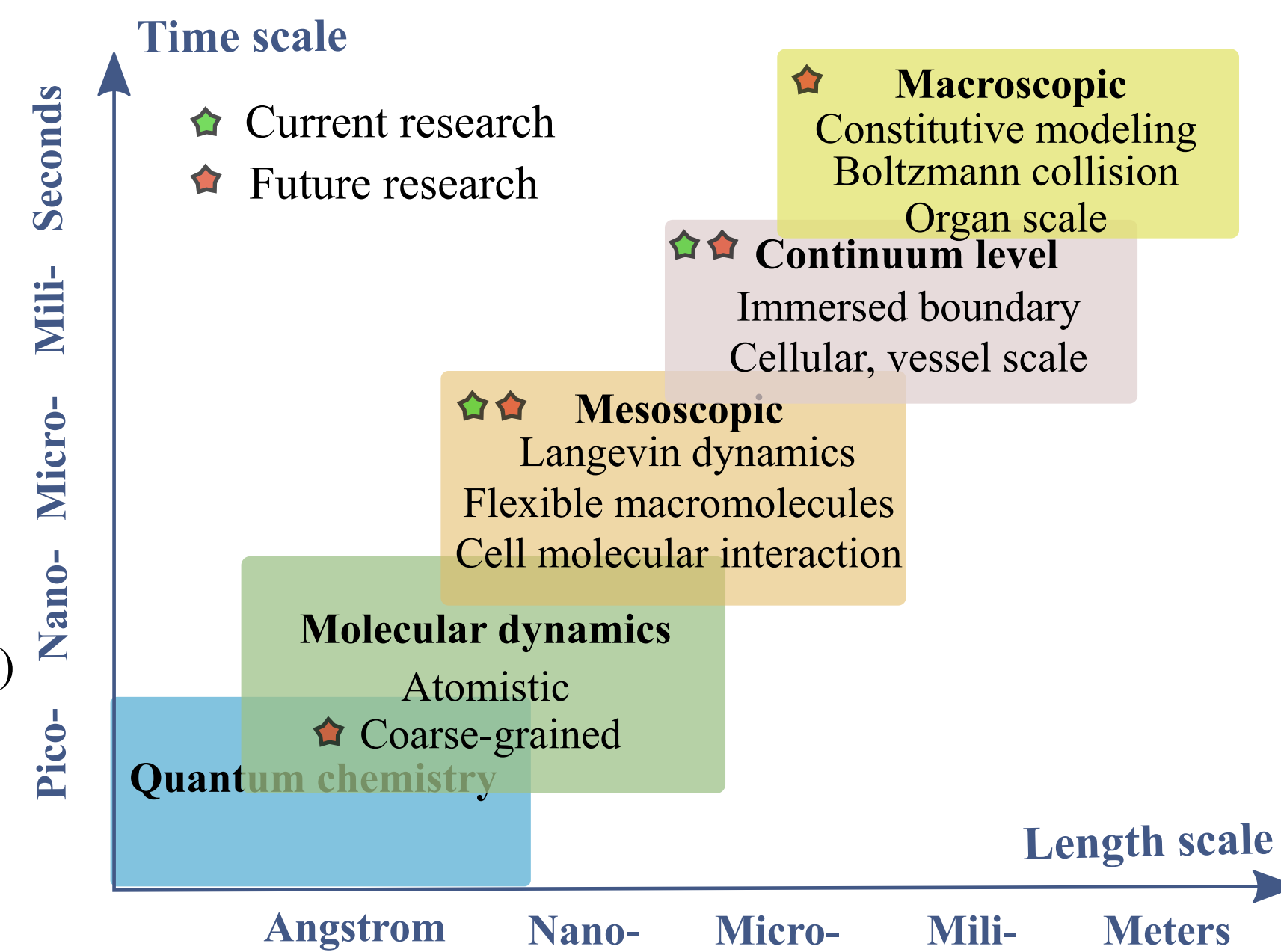
Multi-scale dynamics in biological soft matter and polymeric fluids



Amir Saadat (Postdoc advisor: Eric Shaqfeh, PhD advisor: Bamin Khomami)
Department of Chemical Engineering, Stanford University

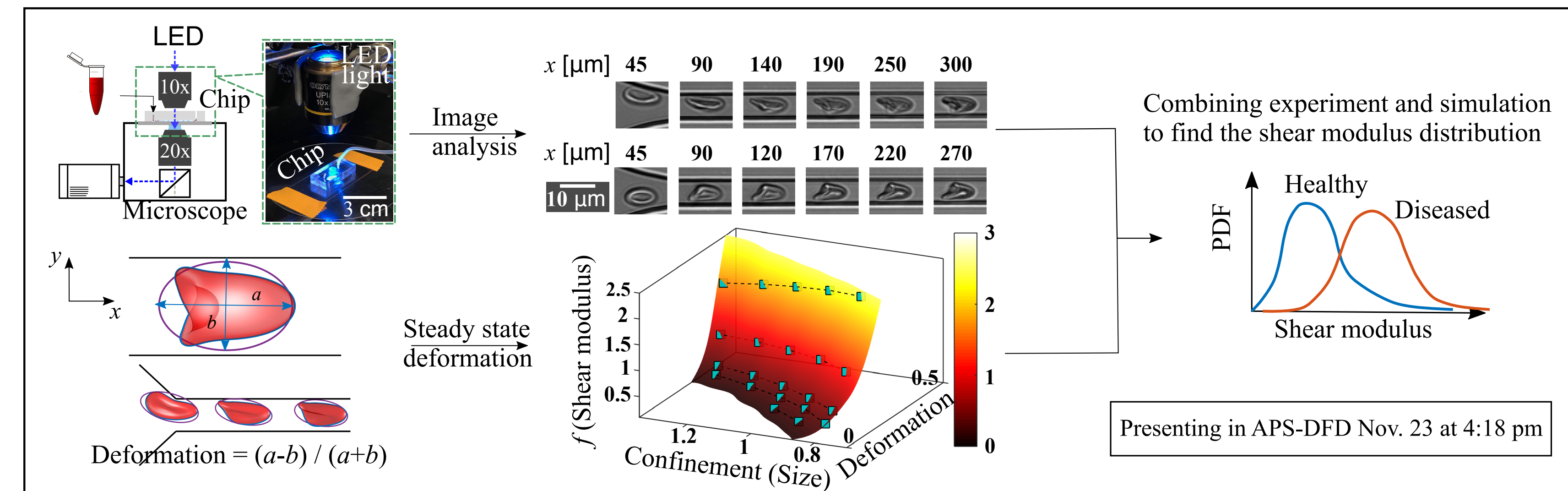
Research experience and vision

- Grant writing experience
 - Open Medicine Foundation (OMF), 1 year, \$100K
 - NSF's XSEDE computational allocation, 1 year, \$40K
 - NVIDIA-Stanford for leveraging GPU computing, \$50K
 - NIH R01 (under review, co-authored)
- Research experience and skills
 - Designing microfluidic platforms for medical diagnosis
 - Blood suspension biology (microcirculation modeling)
 - Image analysis and microfluidic experiments of blood cells
 - Parallel computing CPU and GPU (Fortran, C/C++, CUDA)
 - Continuum level techniques (finite element, finite volume)
 - Dynamics of flexible and semiflexible macromolecules
 - Molecular simulations (semidilute polymeric solutions)
 - Rheology and processing of polymer nanocomposites



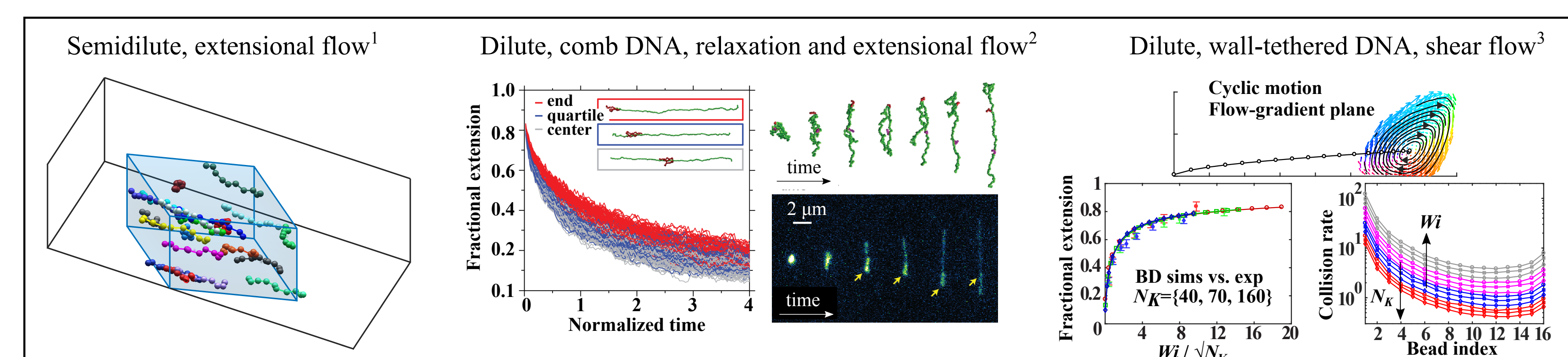
High-throughput measurement of red blood cell (RBC) biomechanics

- Primary deformability issues (hereditary, mutation)
 - Sickle cell disease, thalassemia, malaria infection
- Secondary deformability issues (hydration, oxidative stress)
 - Sepsis, diabetes, metabolic syndrome, etc.
- Now investigating **chronic fatigue syndrome**, no definitive cure, affects millions of individuals and 2 out of 100 children



1 - A. Saadat*, D. Huyke*, D. Oyarzun*, P. Escobar, I. Oevreeide, E. Shaqfeh, J. Santiago, (Submitted to PNAS)
2 - A. Saadat*, C. Guido*, G. Iaccarino, E. Shaqfeh, *Phys. Rev. E* 98, 063316 (2018)

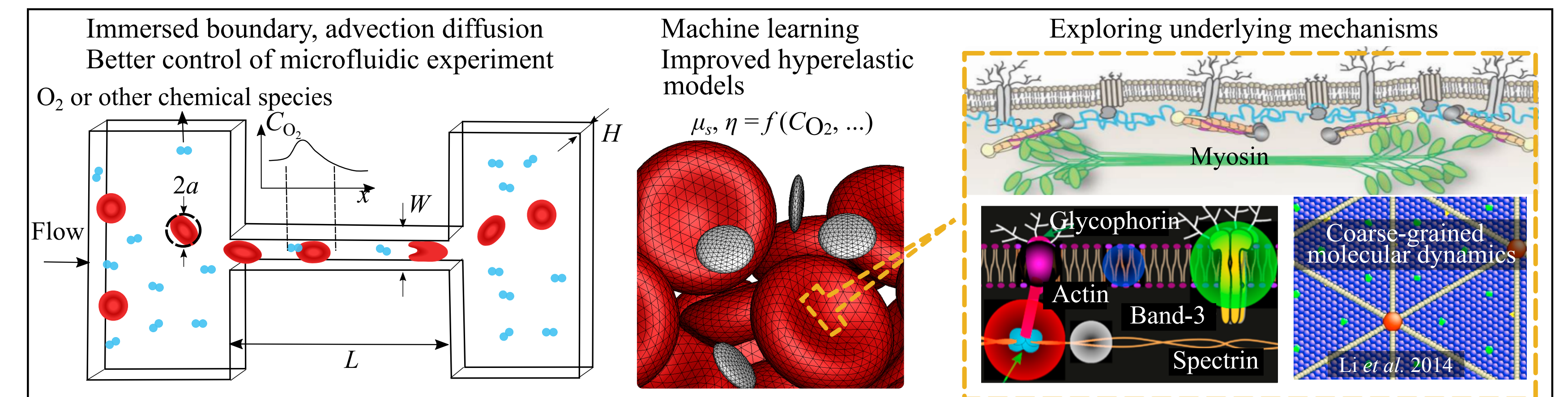
Structure and dynamics of polymer solutions via molecular modeling



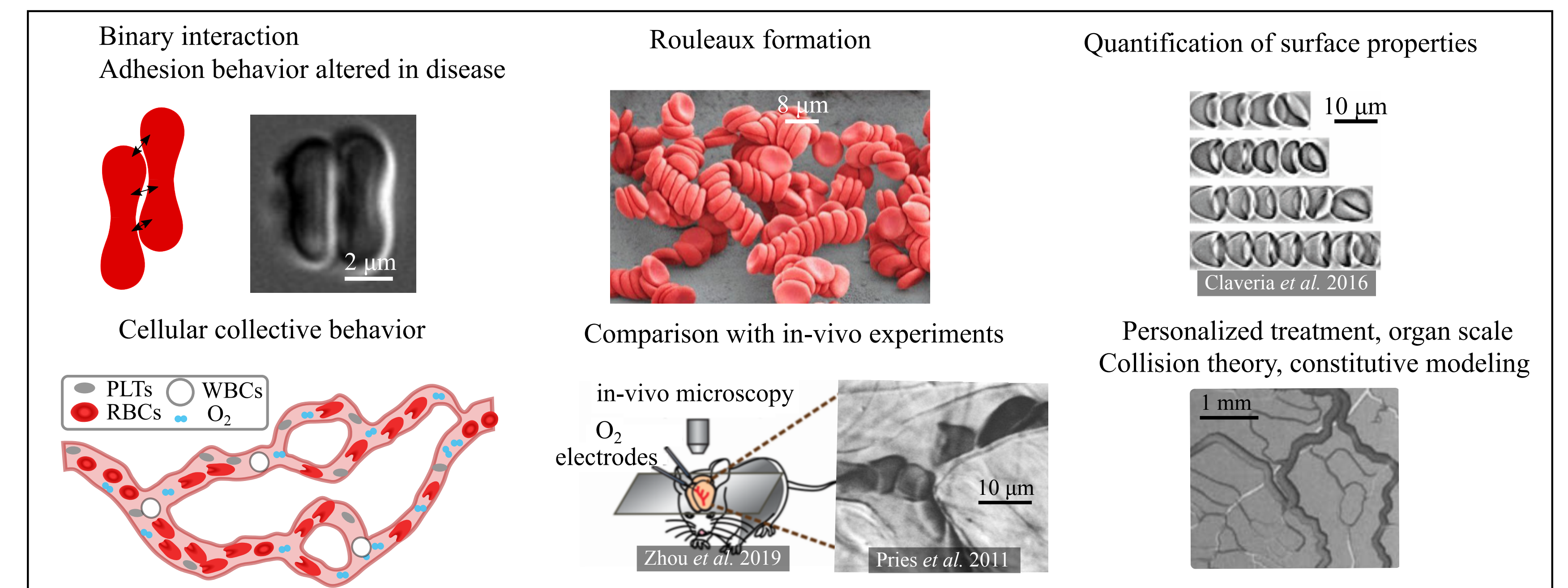
1 - A. Saadat, B. Khomami, BDpack, an open source parallel Brownian dynamics simulation package, *J. Rheol.* 61, 147 (2017)
2 - D. Mai*, A. Saadat*, B. Khomami, C. Schroeder, *Macromolecules* 51, 1507 (2018)
3 - T. Lin*, A. Saadat*, A. Kushwaha, E. Shaqfeh, *Macromolecules* 51, 254 (2018)

Engineering medical diagnosis and treatment: molecular to organ scale

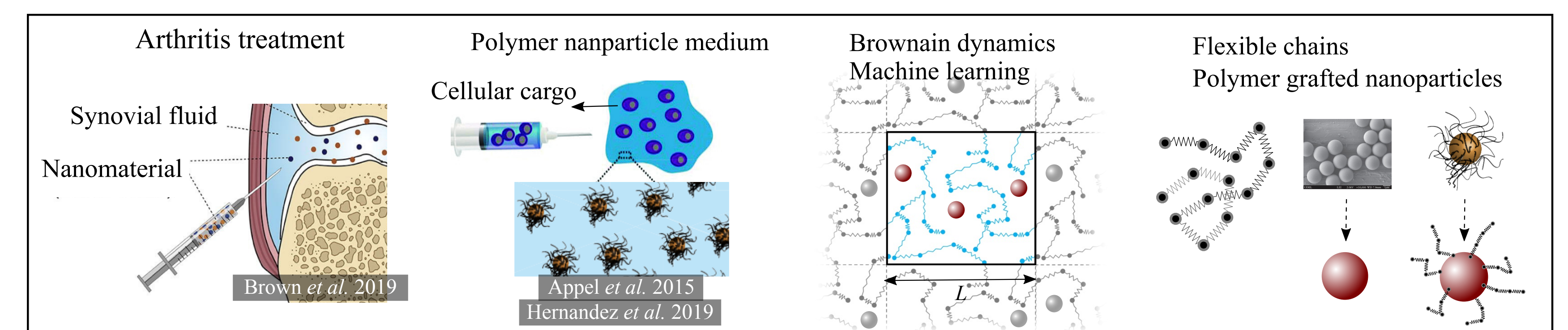
- Defects in the brain blood circulation is believed to contribute to **synaptic loss** and **cognitive decline**, e.g., Alzheimer's
- It is assumed that oxygen pressure and species concentration affect cytoskeleton activation state and RBC deformability



- Blood viscosity**, and **RBC adhesion** to each other and to the endothelium is altered in many blood associated diseases
- Surface properties influence RBC self-organization and interactions in the vascular network



- Arthritis** of the knee affects **46 million (22%) of adults** in the US
- Synovial fluid is in semidilute concentration regime. Treatment methods include injection of polymers and nanomaterials



Funding opportunities

- Open Medicine Foundation (OMF) for chronic fatigue syndrome investigation
- NSF Mathematical and Physical Sciences (MPS), Mathematical Biology and CDS&E suitable for all three projects
- NSF's XSEDE (4 times every year) and INCITE (due June each year) for computational resources allocation
- National Institute of Health (NIH) R01 and R21 for all three projects, National Institute on Aging (NIA) for the first project
- American Heart Association (AHA) and American Society of Hematology (ASH) for blood projects