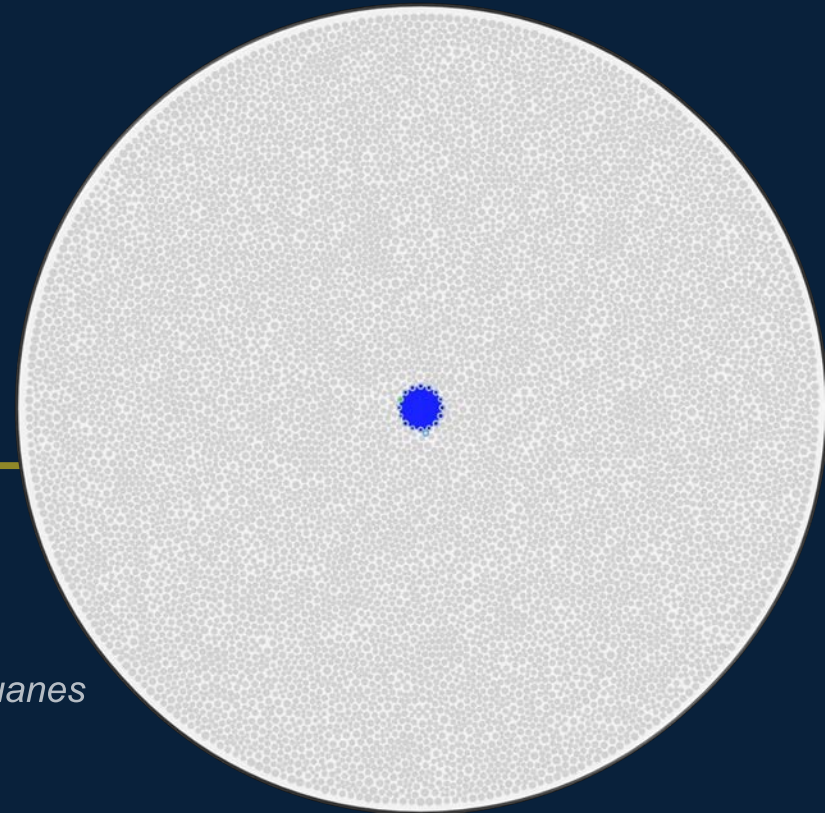


Wettability and Quasi-Static Fluid-Fluid Displacement in Micromodels

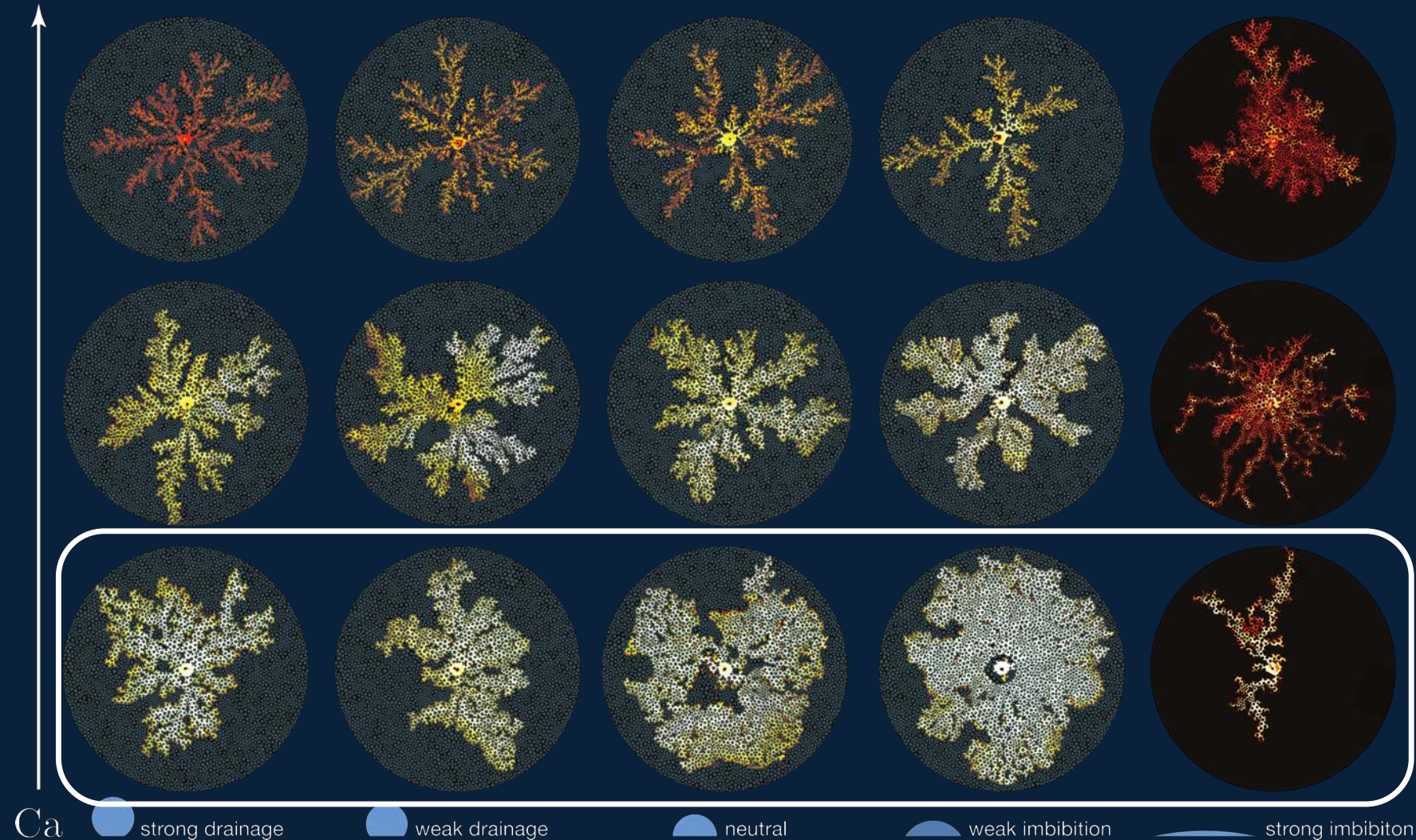
B. Primkulov

GRADUATE STUDENT [CIVIL AND ENVIRONMENTAL ENGINEERING]

In collaboration with S. Talman, R. Chalaturnyk, K. Khaleghi, A. Shokri, B. Zhao, C. MacMinn, R. Juanes

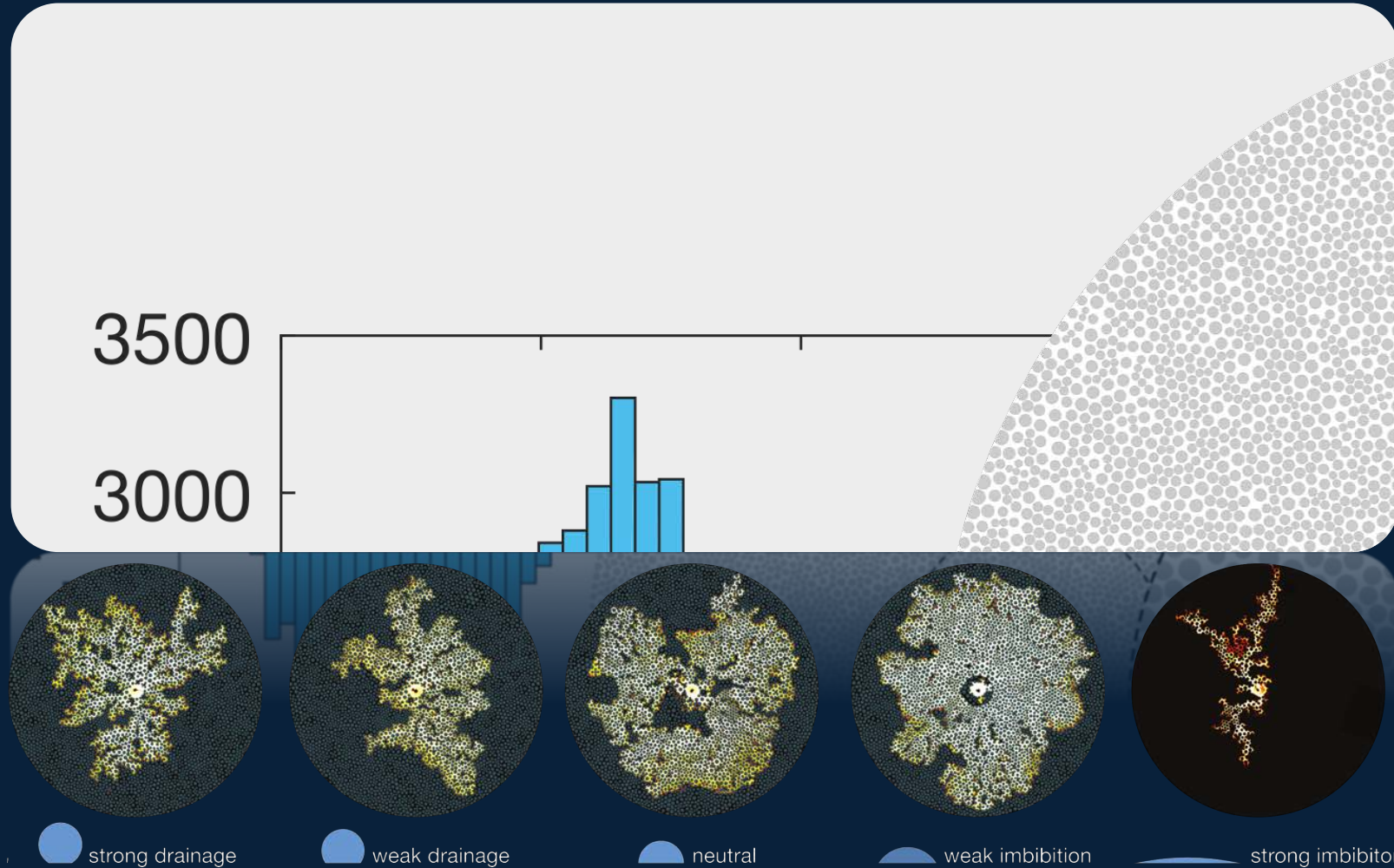


Experimental Phase Diagram

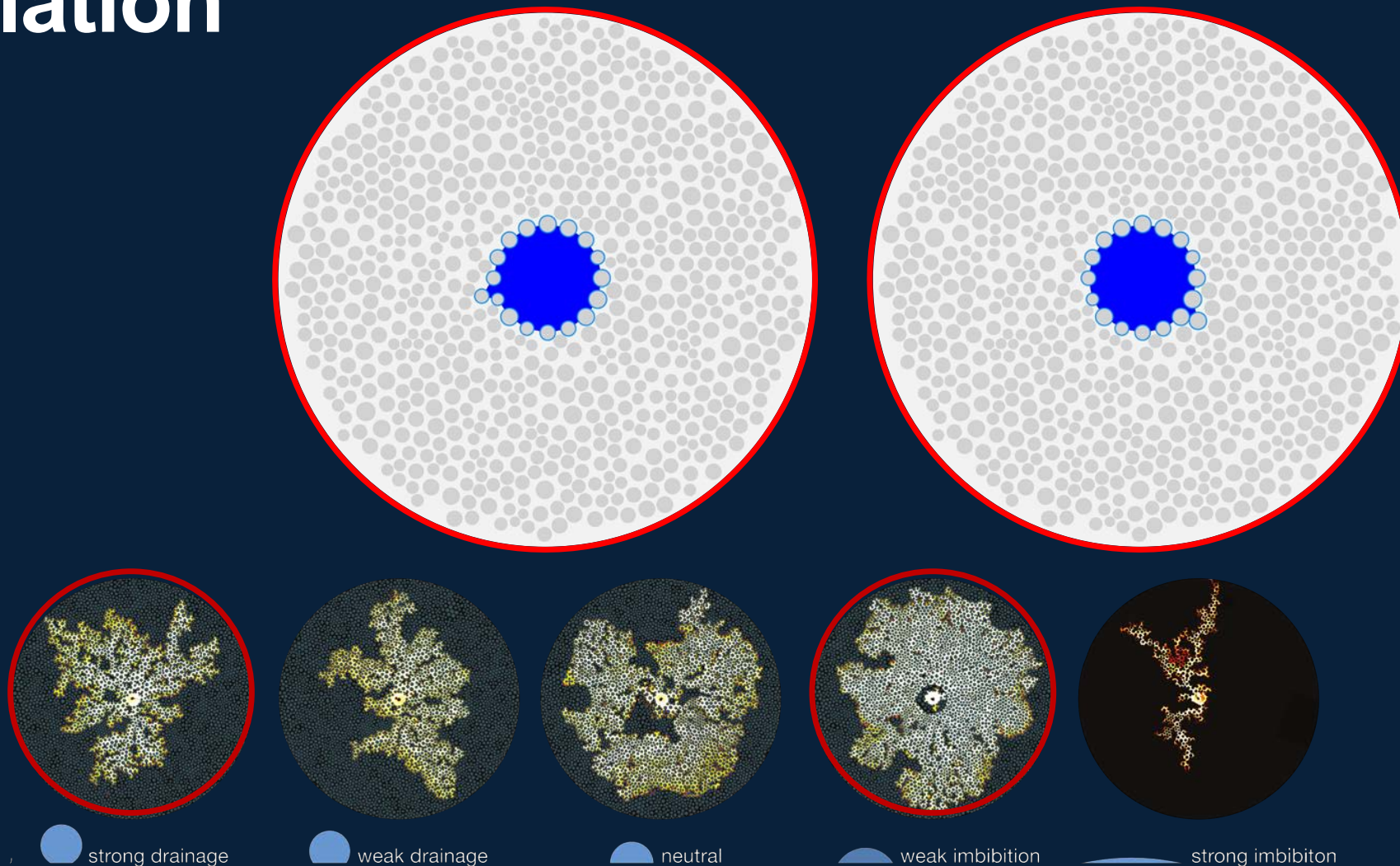


Zhao et al., PNAS 2016

Modeling through Invasion-Percolation

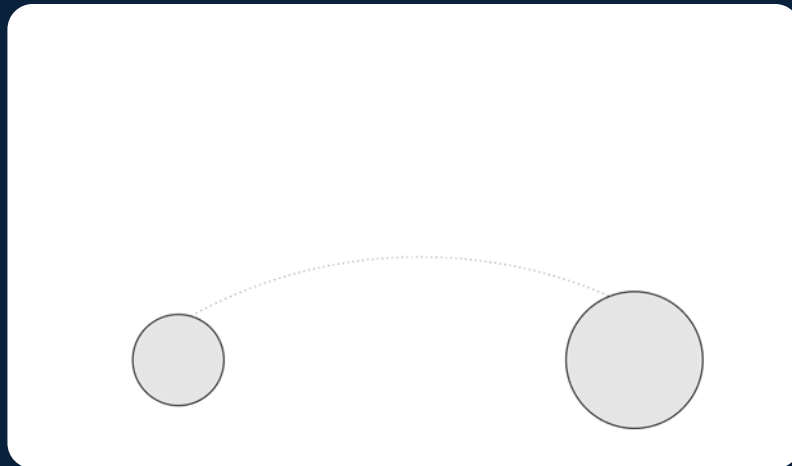


Modeling through Invasion-Percolation



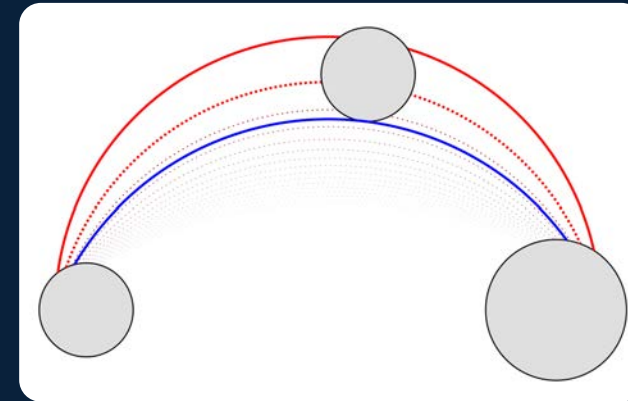
Pore-level Instability Events

“Burst”

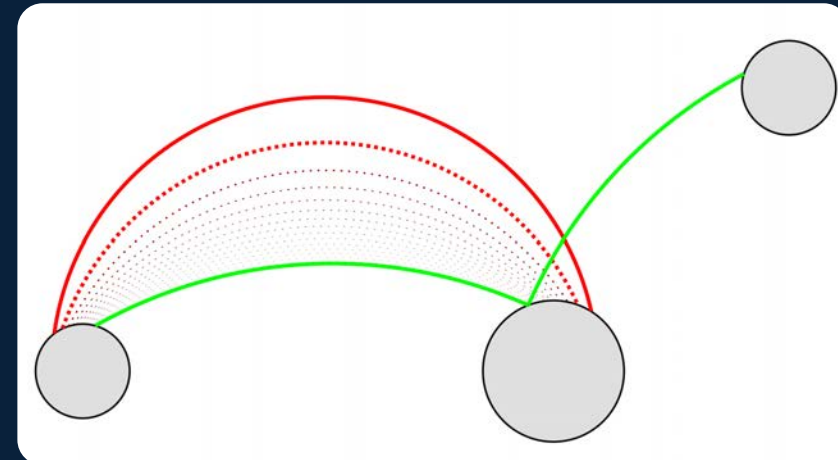


Cieplak and Robbins, PRL 1988, PRB 1990

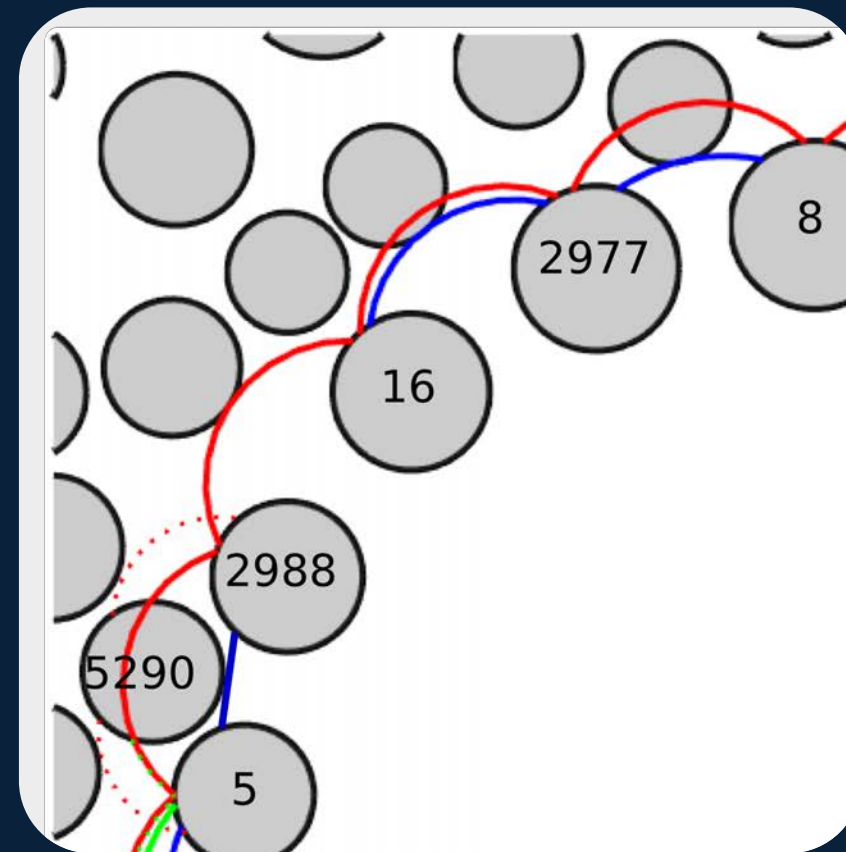
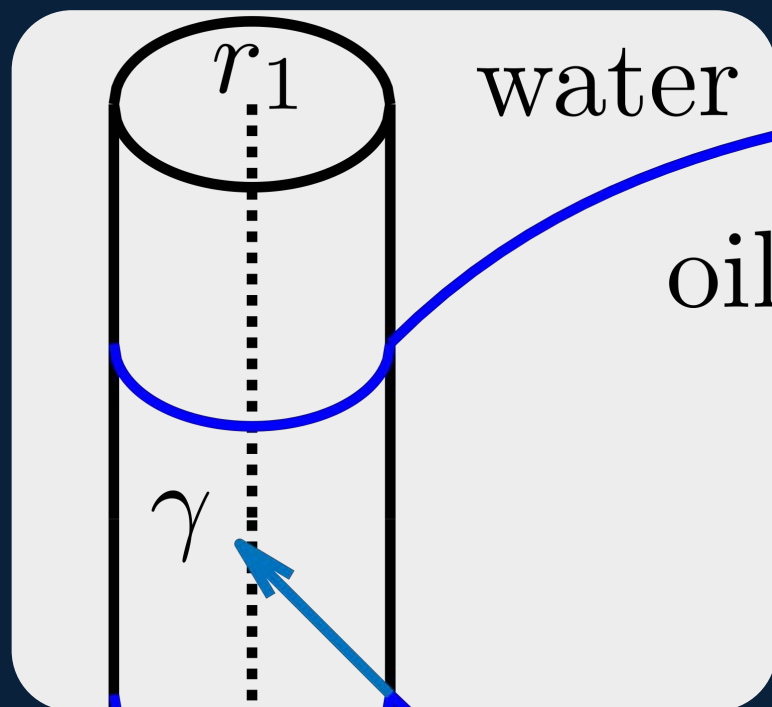
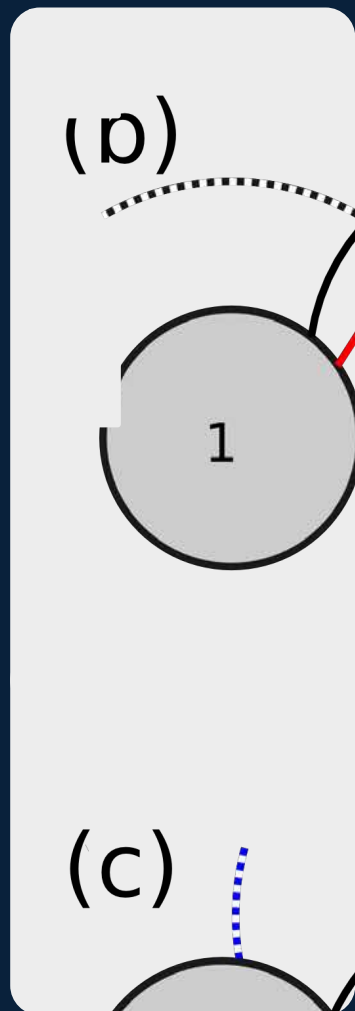
“Touch”



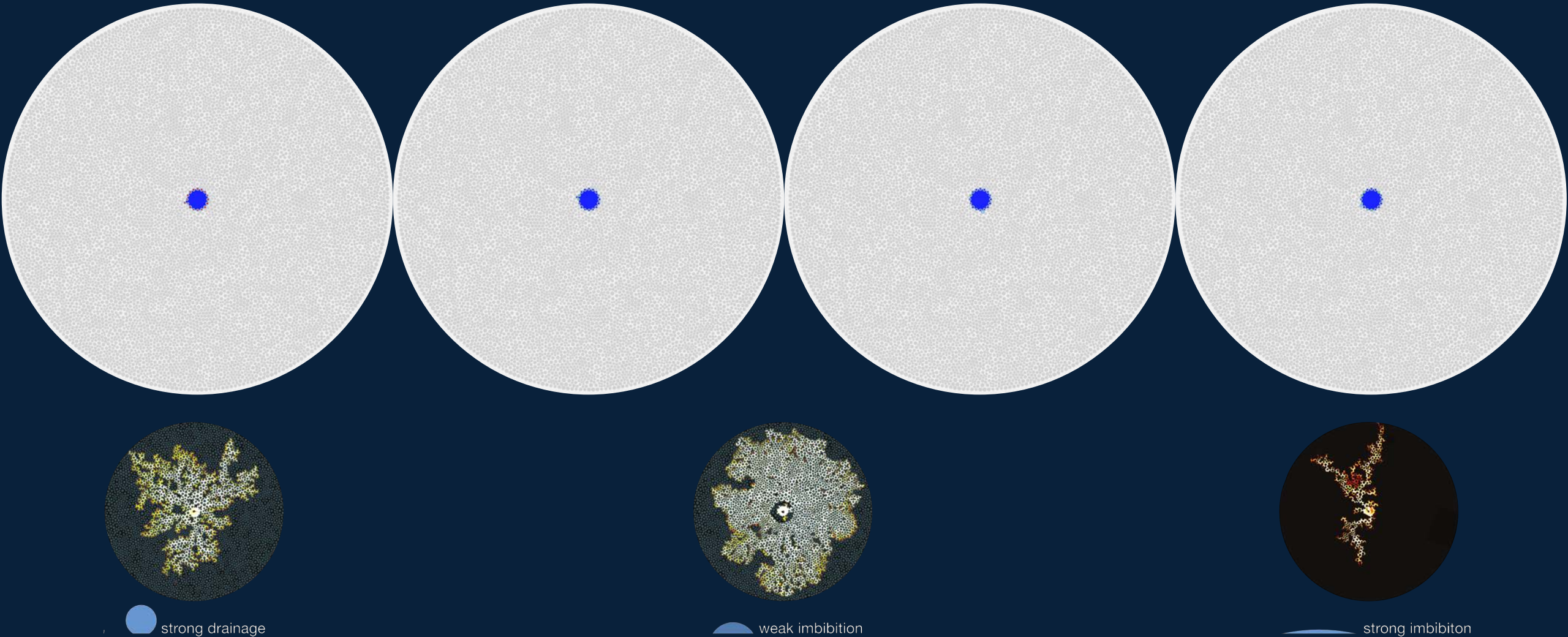
“Overlap”



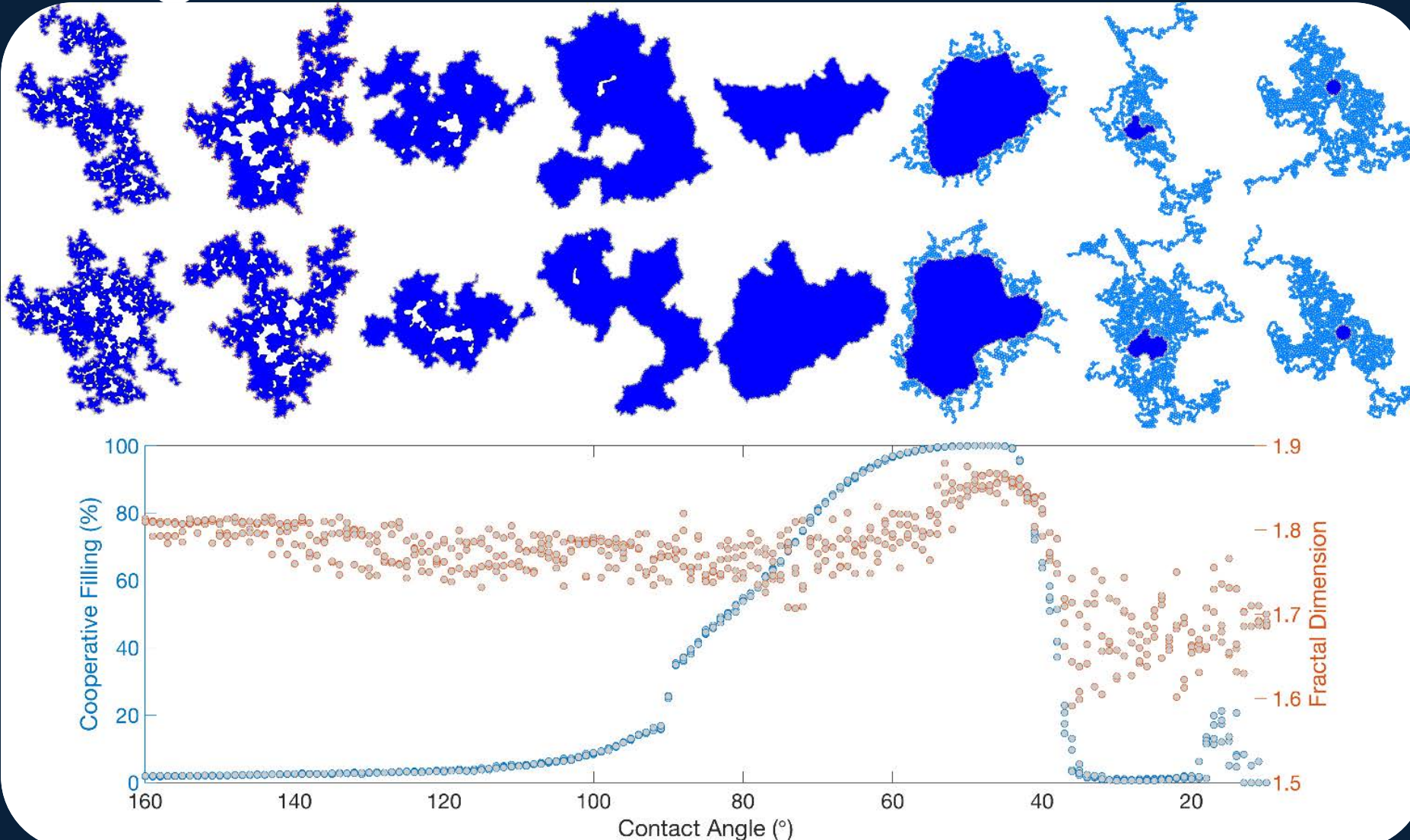
Pore-level Instability Events



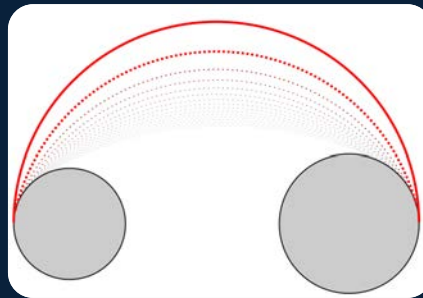
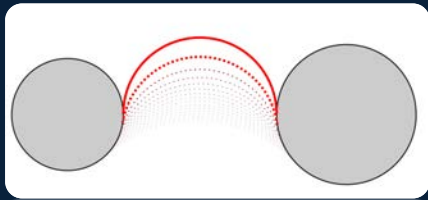
Macroscopic Invasion Patterns



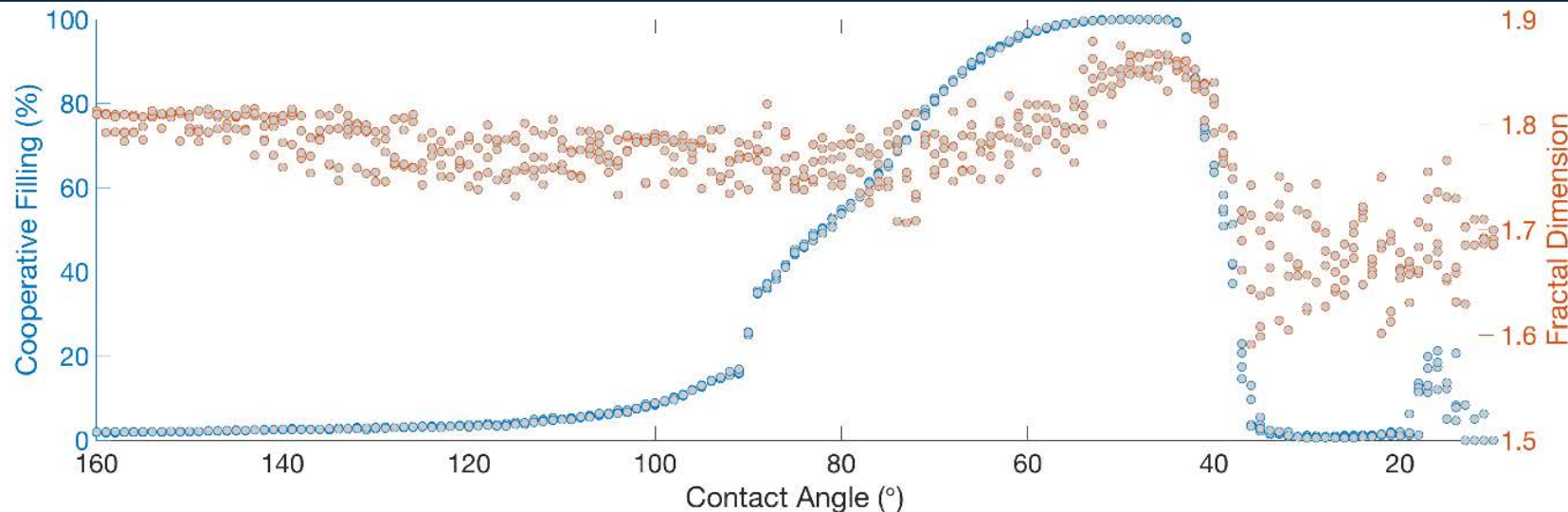
Statistics with Randomized Contact Angles



Statistics with Randomized Contact Angles

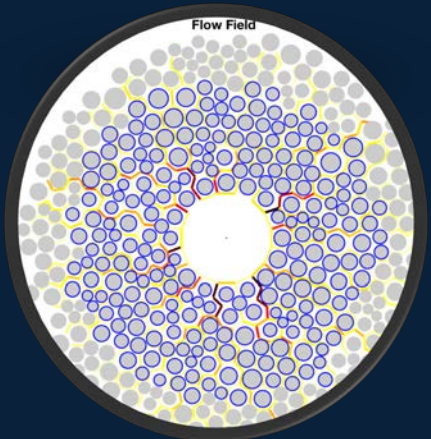
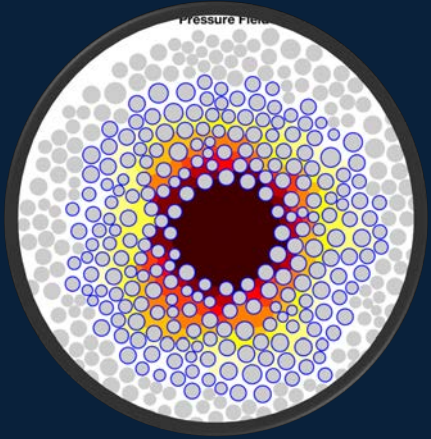


- Wettability dictates predominant events
- Relative frequency determines the pattern
 - Invasion-Percolation
 - Cooperative Filling
 - Corner Flow

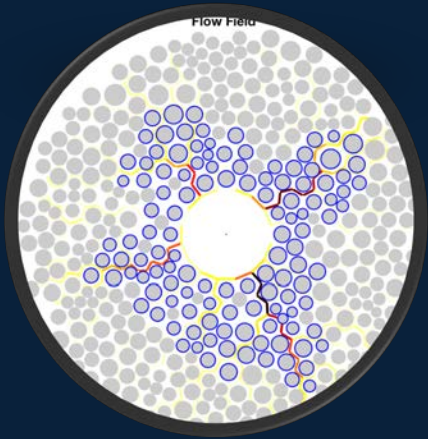
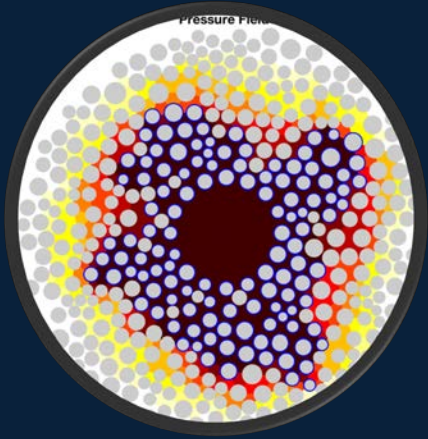


Final Remarks

$$\frac{\mu_w}{\mu_o} \gg 1$$



$$\frac{\mu_w}{\mu_o} \ll 1$$



- Invasion-Percolation Model with Wetting Transition
 - [strong drainage – strong imbibition]
- Reproduced the “corner flow” transition observed by Zhao et al., 2016
- Model can be utilized to study effects of gravity, hysteresis, and disorder and extended to include viscous effects

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