Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Physics of the gut: How polymers dynamically structure the gut environment ASHER PRESKA STEINBERG, SUJIT DATTA, SAID BOGATYREV, RUSTEM ISMAGILOV, California Institute of Technology — While the gut microbiome and biological regulation of the gut environment is being exhaustively studied by the microbiology community, little is known about the rich physics that governs the macro- and microstructure of the gut environment. The mammalian gut abounds in soft materials; ranging from soluble polymers (e.g. dietary fibers, therapeutic polymers and mucins) to colloidal matter (e.g. bacteria, viruses and nanoparticles carrying drugs). We have found experimentally that soluble polymers can dynamically re-structure the colonic mucus hydrogel by modulating its degree of swelling. We implemented a mean-field Flory-Huggins model to reveal that these polymer-mucus interactions can be captured using a simple, first principles thermodynamics model. In this model, the amount of deswelling increases with polymer concentration and size. We then used these physical principles to make predictions about how different polymer solutions affect the structure of mucus. Lastly, we explore applying this framework and similar physical principles to a variety of biological problems in the gut.

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Date submitted: 10 Nov 2016 Electronic form version 1.4