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Stacking of Red Blood Cells due to Depletion Effects

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The aggregation of red blood cells into coin-like stacks called rouleaux is associated with a number of underlying causes including infections and diseases such as cancer.

Rouleaux formation occurs when the protein concentration in blood plasma is high. Hence, one possible cause for rouleaux formation is red blood cells clumping together due to depletion forces. In the case of several large objects suspended in a bath of small objects (the depletants), it is globally entropically favourable at high depletant concentration for the large objects to remain in contact since this gives more free space to the smaller objects.

The depth of the resulting depletant potential is directly related to the density of the depletants.
In this presentation I will present results from coarse-grained simulations investigating depletant induced rouleaux formation. Simulations are performed for different depletant and red blood cell densities.
Rouleaux formation is observed to happen relatively suddenly at a critical depletant density.
The rouleaux stacks are characterized in terms of the cluster size and the number of aligned red blood cells with the stack.

Results indicate that the stacks form with a central, orderly aligned stack that has a maximum size after which additional red blood cells adhere to the sides of the stack yielding a more disordered morphology.
The dependency of these results on the red blood density is also explored.
Large scale systems that yield multiple rouleaux formation are investigated within the context of network formation via nucleation processes.

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