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# How flow of constricted particle suspension differs from hungry sheep herd?

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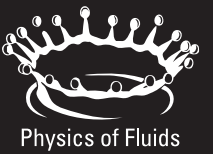
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# How flow of constricted particle suspension differs from hungry sheep herd?

Mathieu Souzy, Alvaro Marin

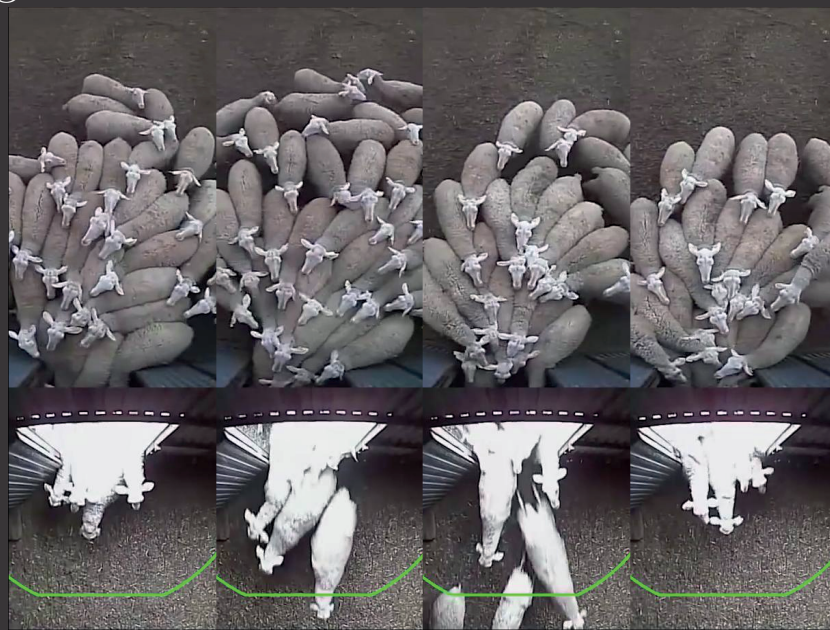
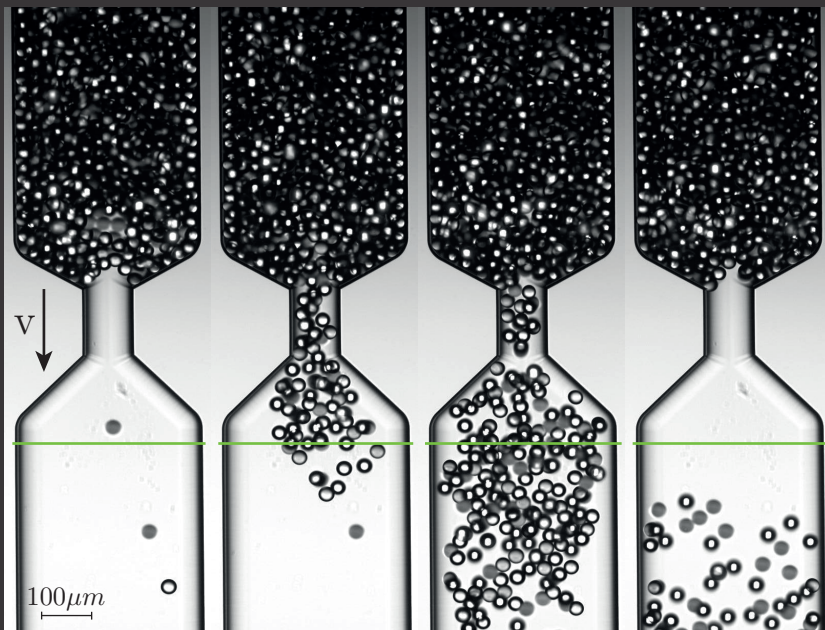
Physics of Fluids, University of Twente, The Netherlands



## Intermittent clogging

Successive images of a burst

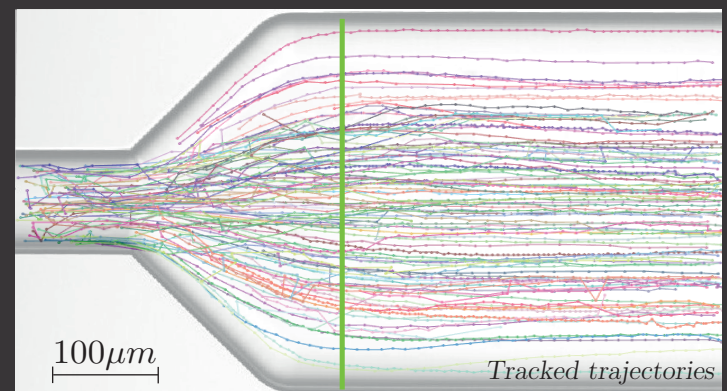
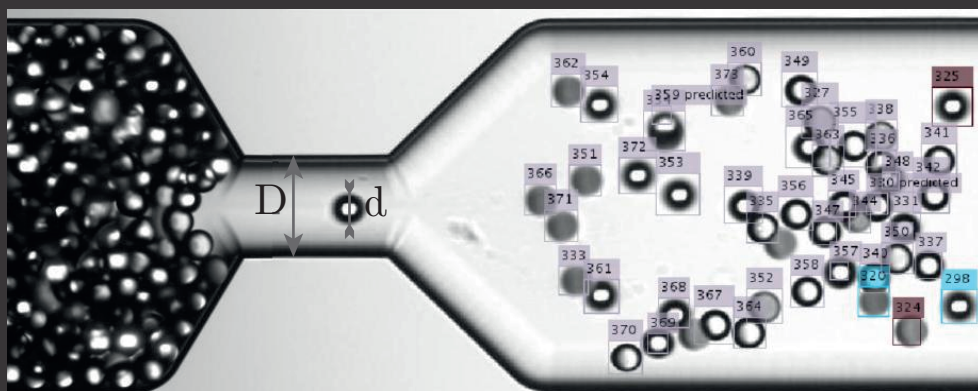
Spatio-temporal plot



When people, animals<sup>1</sup>, or particles are forced through a constriction, they either flow continuously, intermittently, or even not at all when a clogging arch is formed. Herein we focus on non-adhesive colloidal particles in suspension flowing through a constriction. We find that the neck-to-particles size ratio  $D/d$  determines the flow regime and is analogous to the sheep-to-door size ratio for a hungry herd. This raises the following questions:

- Do these two systems behave quantitatively similarly ?
- For which neck-to-particles size ratio  $D/d$  is the flow intermittent?

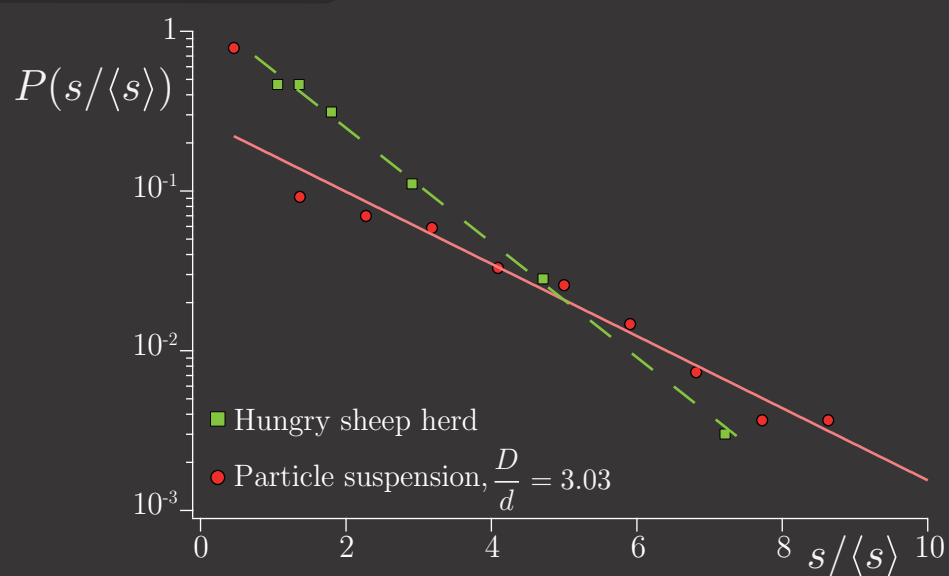
## Track 'em, tag 'em



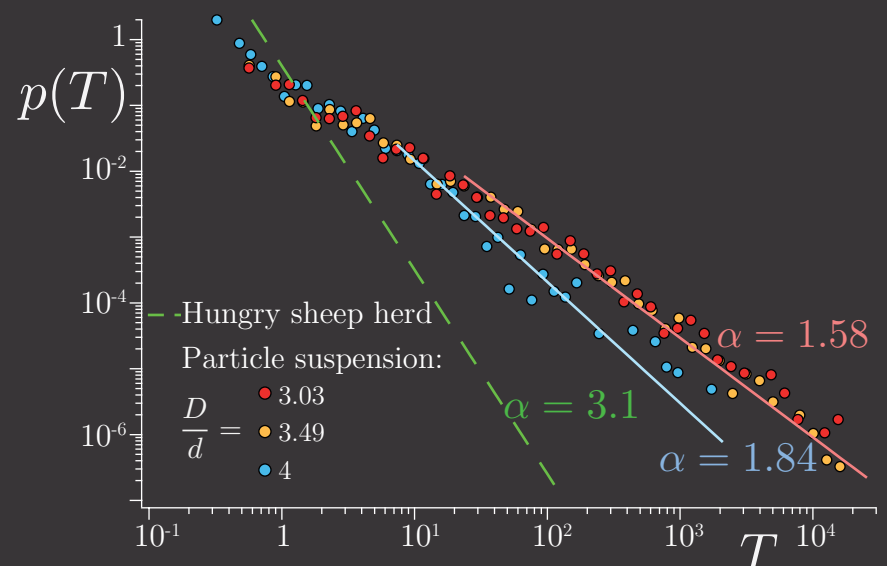
Using a Kalman predictor tracking method, we get: i) the number of escapees per burst  $s$

ii) the time lapse  $T$  between the passage of successive particles

## Conclusions



i)  $P(s/\langle s \rangle) \propto e^{-s/\langle s \rangle}$



ii)  $p(T) \propto T^{-\alpha}$

For  $\alpha \leq 2 \rightarrow$  permanent clogged state, some clogs remain indefinitely

- Both systems exhibit the same statistics
- Hunger is more efficient than lubrication to decrease long clogging events
- High sensitivity of  $\alpha$  for  $3.5 \leq \frac{D}{d} \leq 4$  for particulate suspensions