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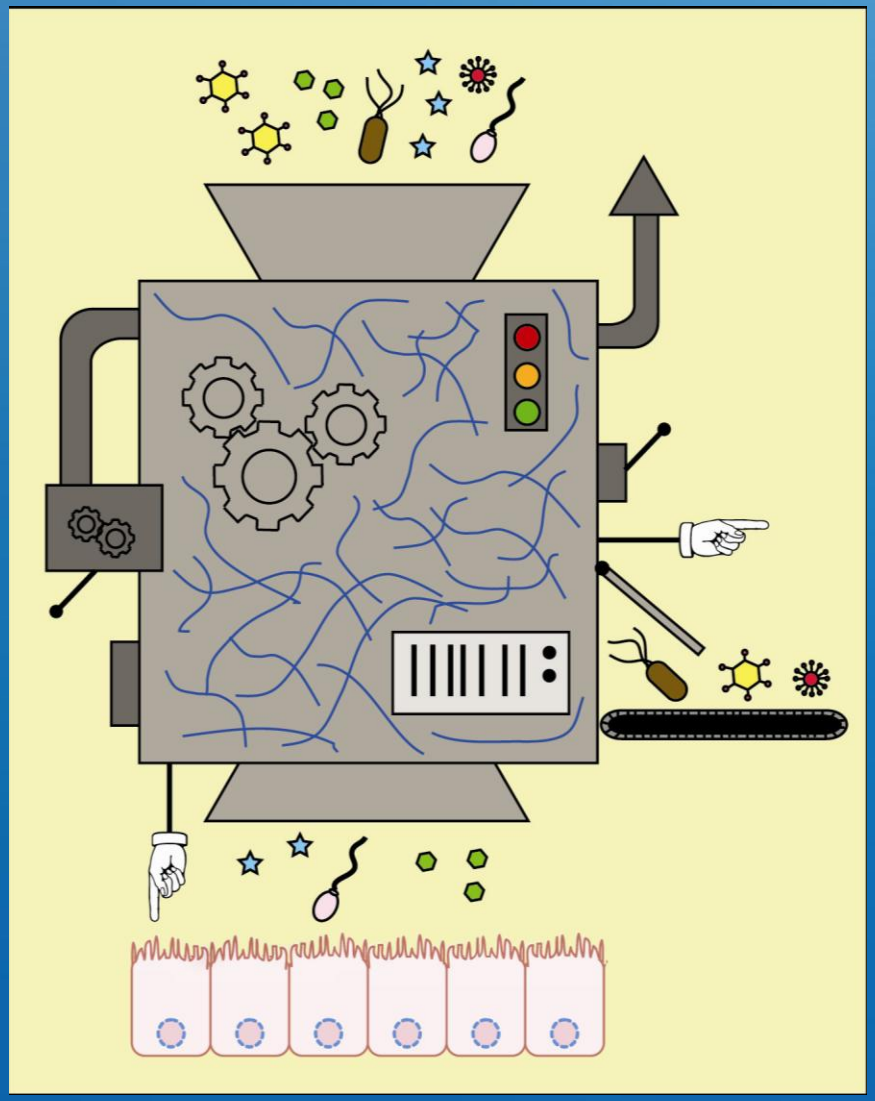
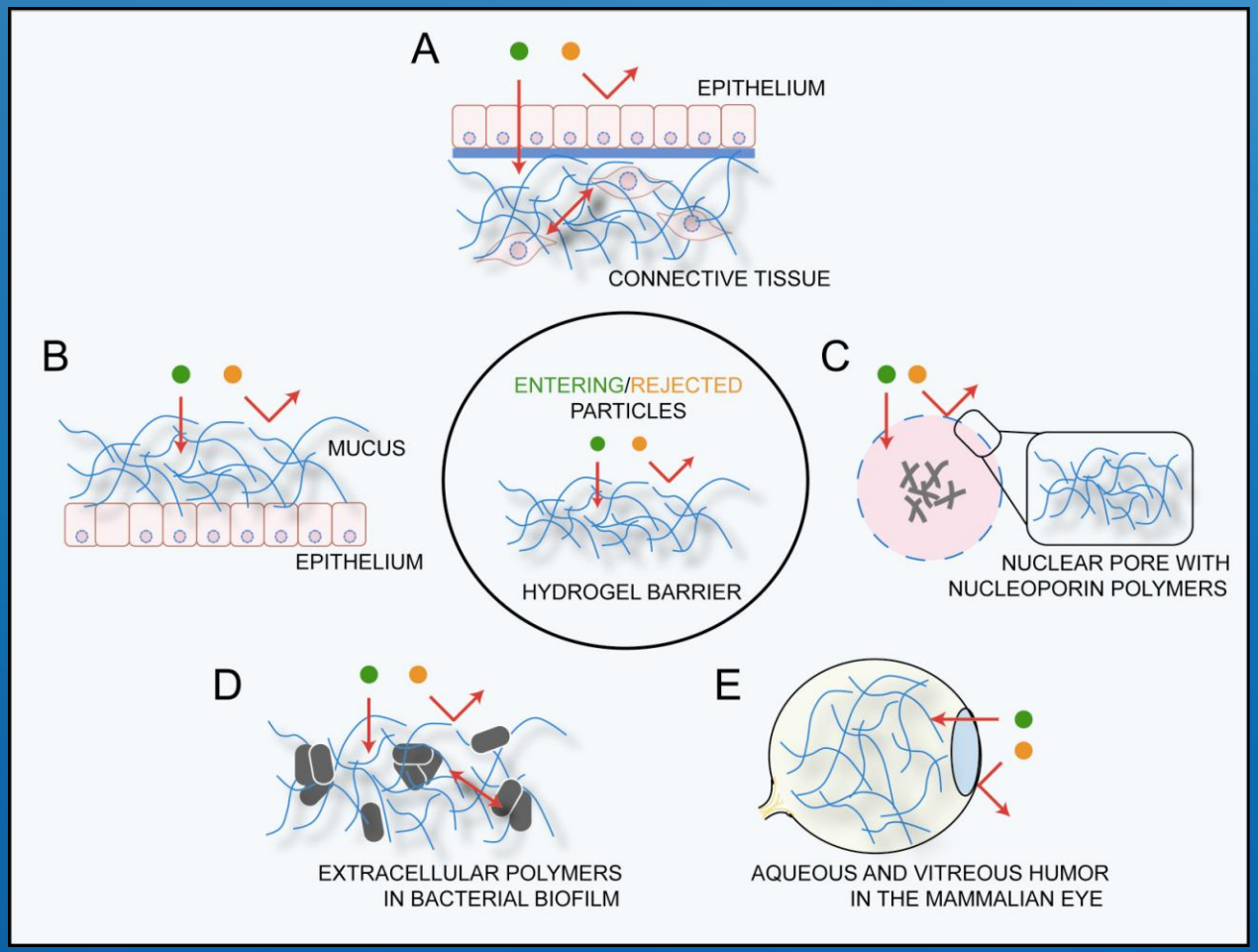
&
Katharina Ribbeck

Department of Biological Engineering



Selective filtering by (polyelectrolyte) biological hydrogels

Biological hydrogels control material exchange

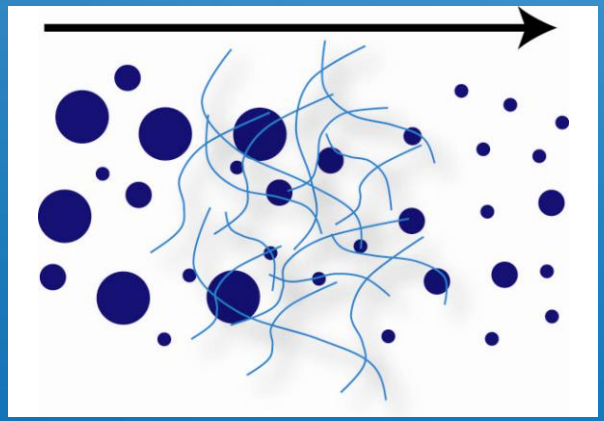


reviewed in: Lieleg and Ribbeck, *Trends in Cell Biology*, accepted

How to build an efficient polymer-based filter?

possible filtering mechanisms:

- size filter:
  particle/molecule size ⇔ mesh size

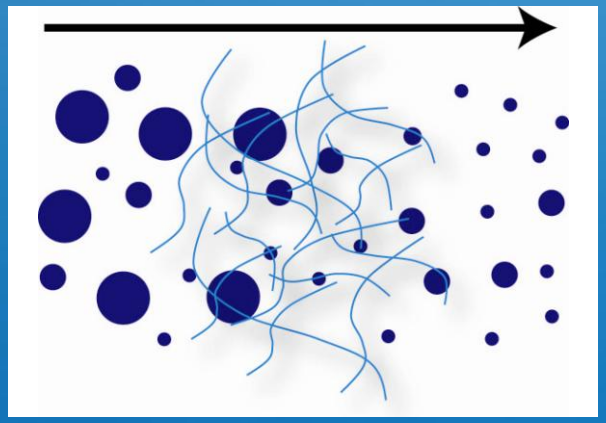


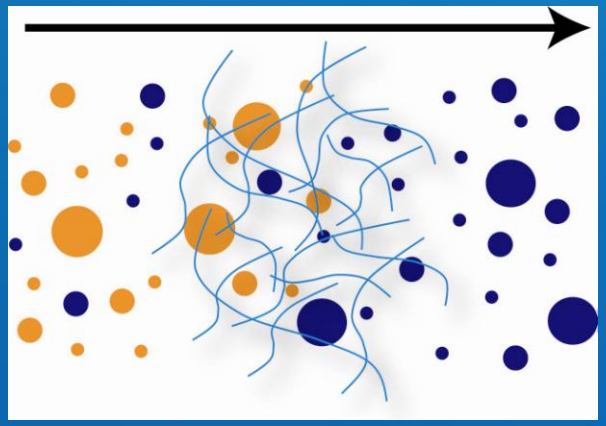
How to build an efficient polymer-based filter?

possible filtering mechanisms:

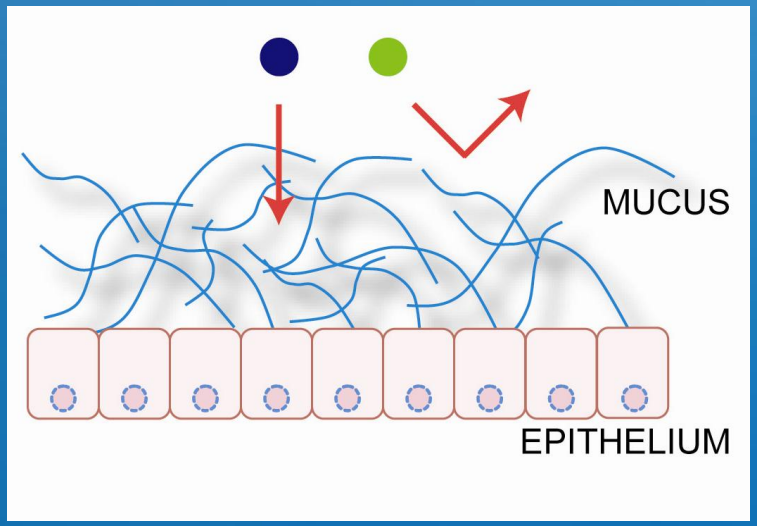
- size filter:
  particle/molecule size ⇔ mesh size

- interaction filter:
  particle/molecule surface properties
  ⇔ polymer properties





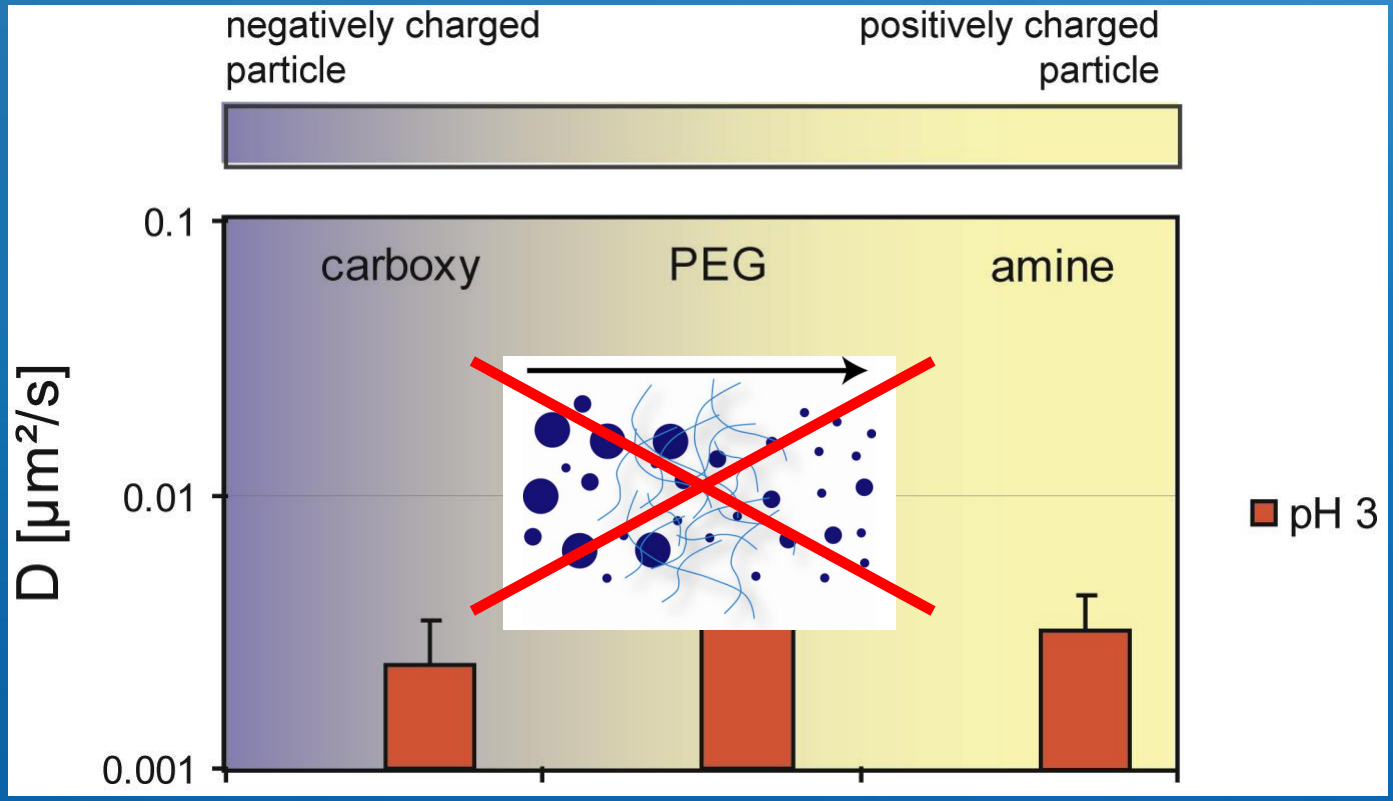
Mucus hydrogels



mucus is a major barrier for drug delivery agents AND pathogens

model system: reconstituted mucus from pig stomachs

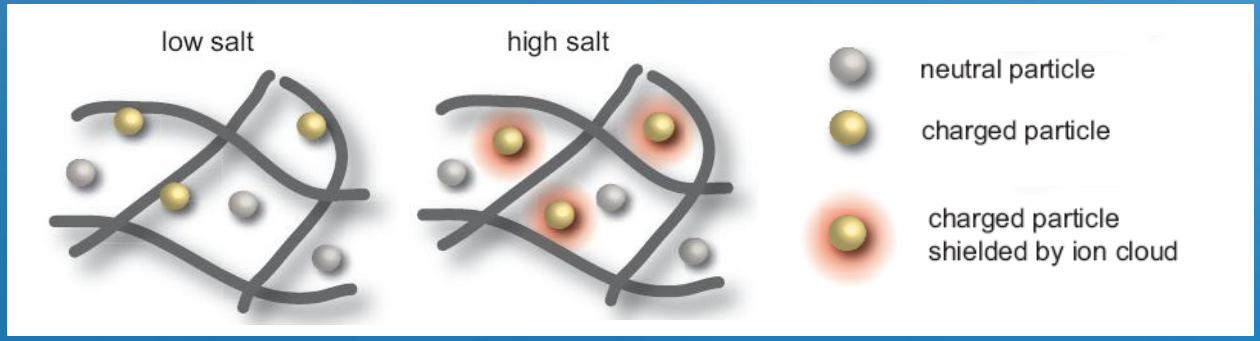
The diffusion behavior of microscopic particles in acidic mucin hydrogels depends on their surface charge

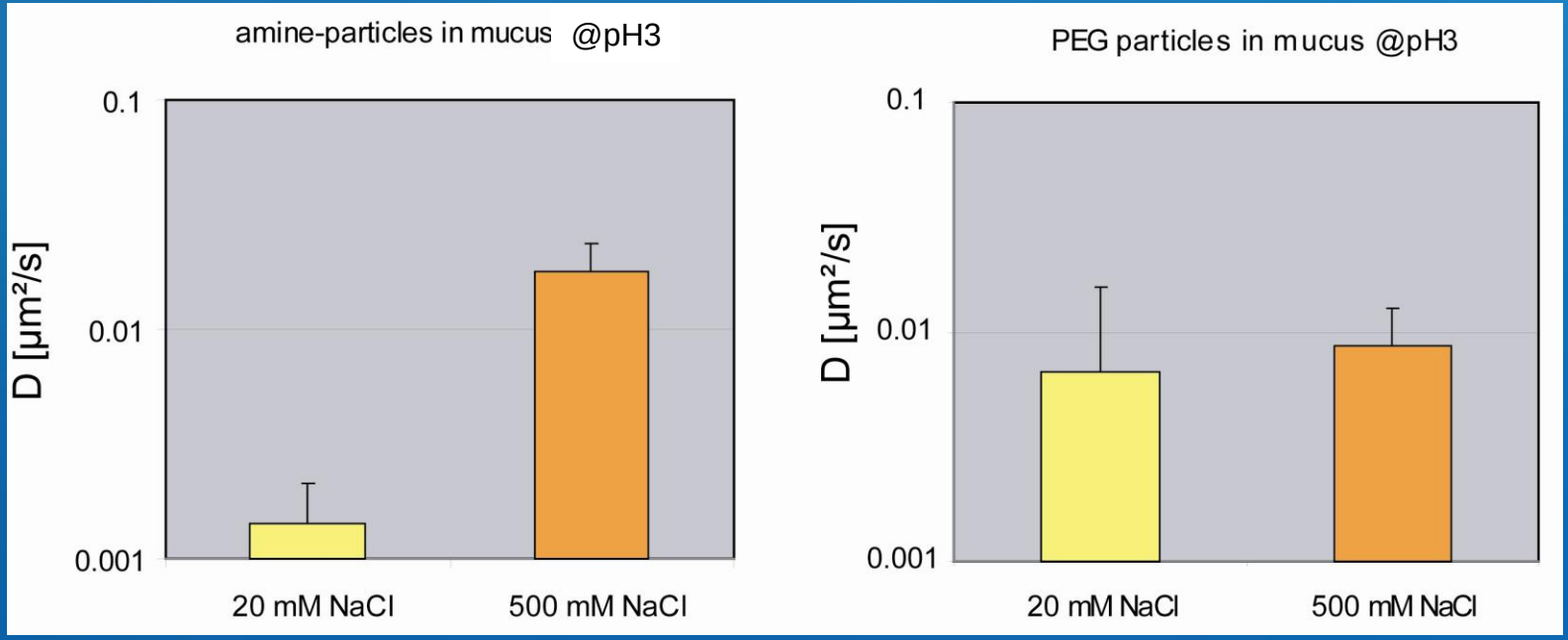


particle size: 1 μm

OL, Vladescu and Ribbeck, BJ 2010

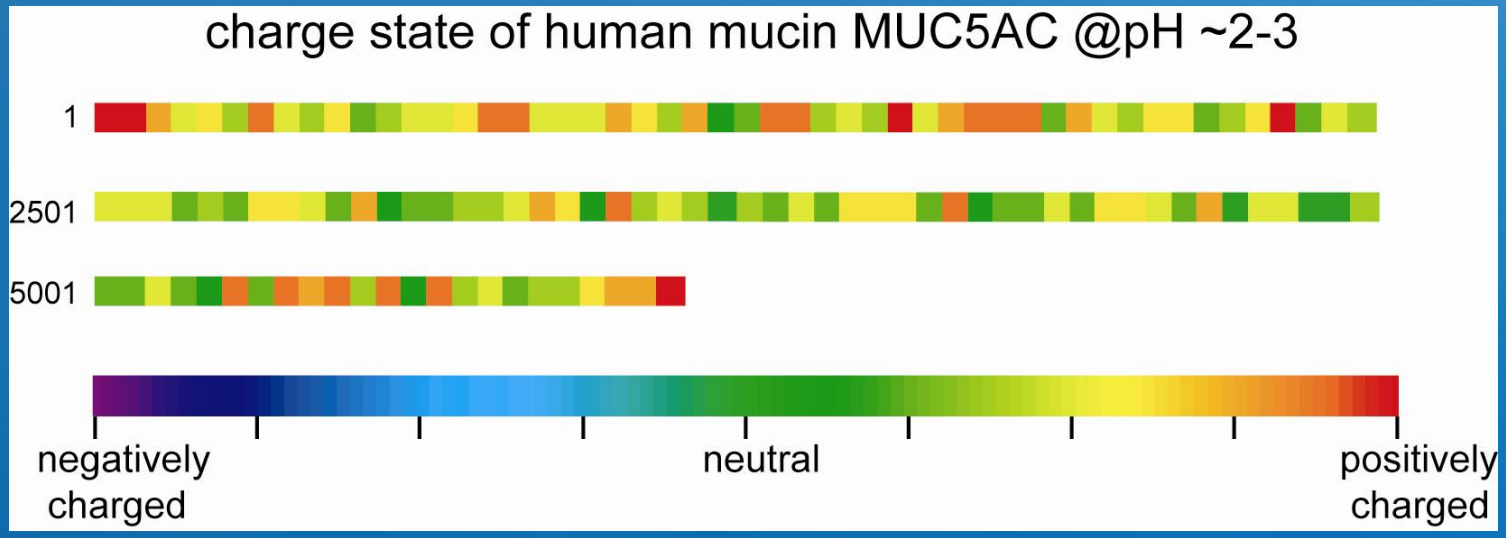
Mobility rescue by Debye screening





OL, Vladescu and Ribbeck, BJ 2010

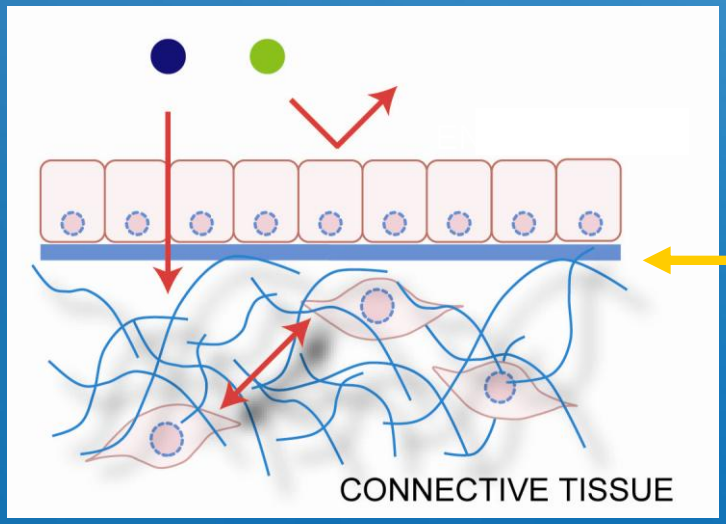
Mucins are polyelectrolytes



1 “blob“ = total charge of 50 subsequent 50 AS

glycosylation (here neglected) adds negative charge patches

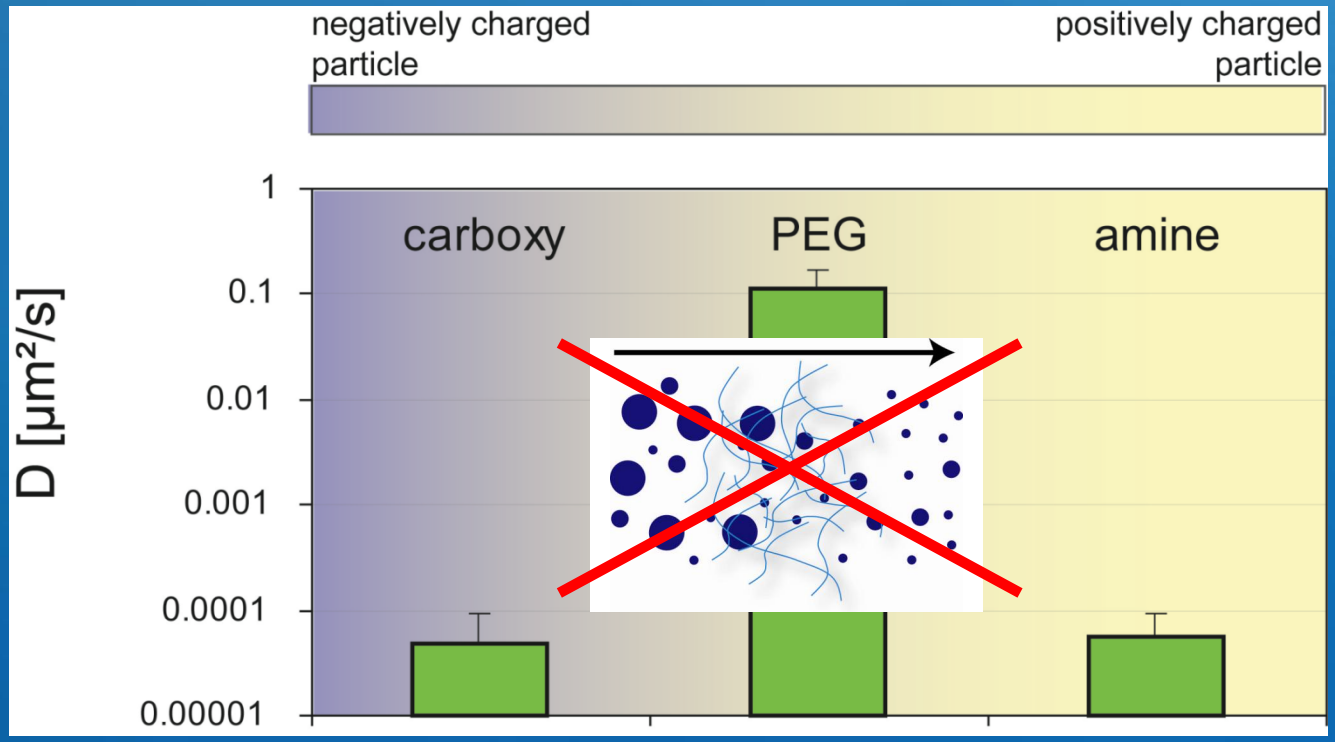
The basal lamina - an extracellular matrix (ECM)



regulation of cell communication, growth factor storage, barrier function, homeostasis

model system: matrigel = basal lamina from Engelbreth Holm Swarm sarcoma of mice

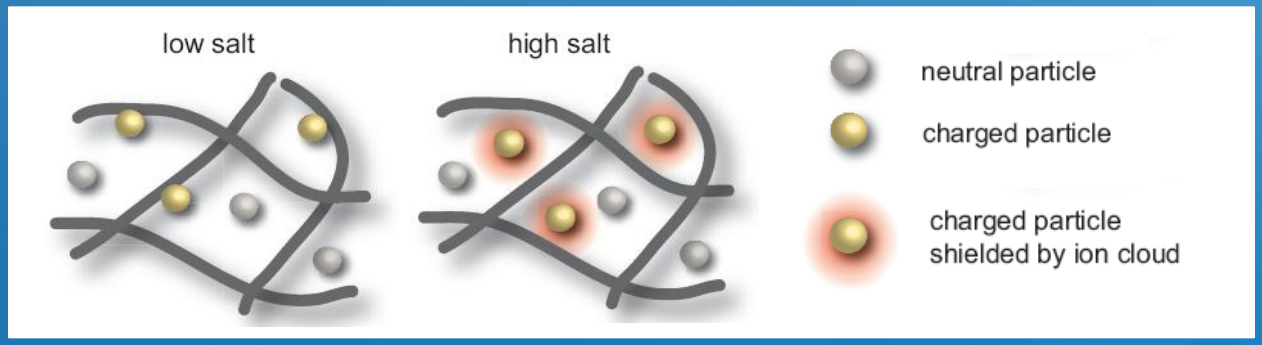
The diffusion behavior of microscopic particles in ECM depends on their surface charge

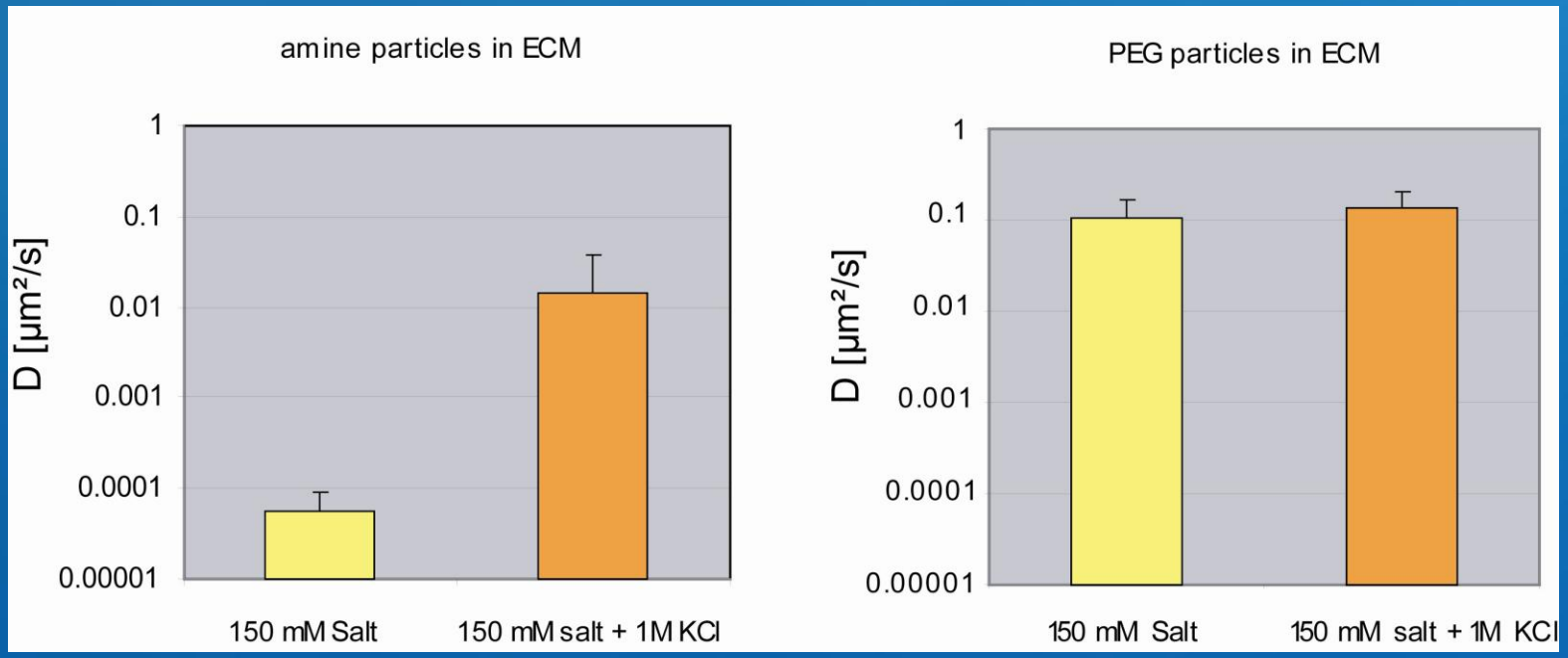


particle size: 1 μm

OL, Baumgärtel and Bausch, BJ 2009

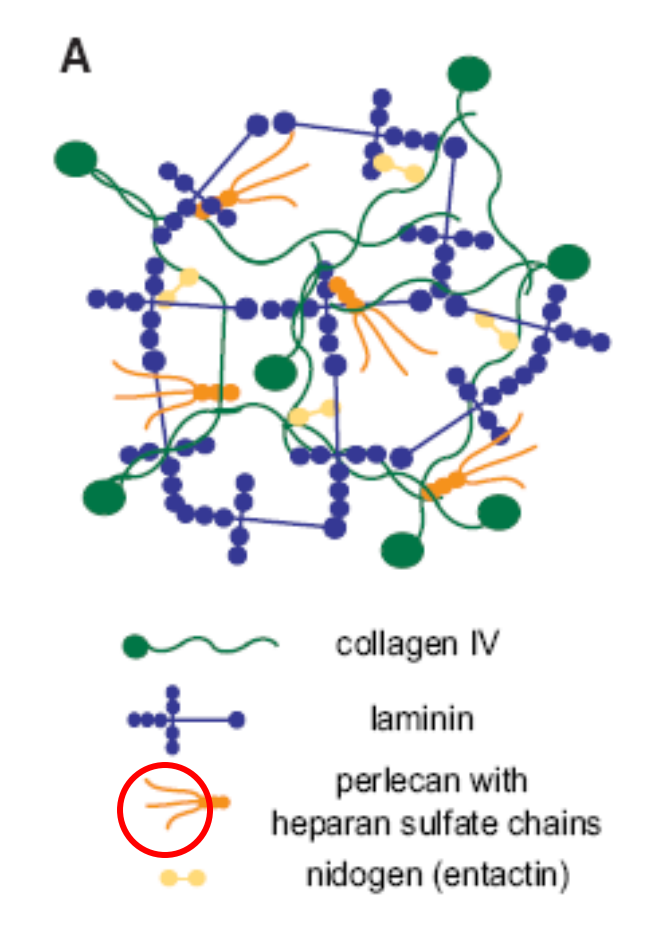
Mobility rescue by Debye screening

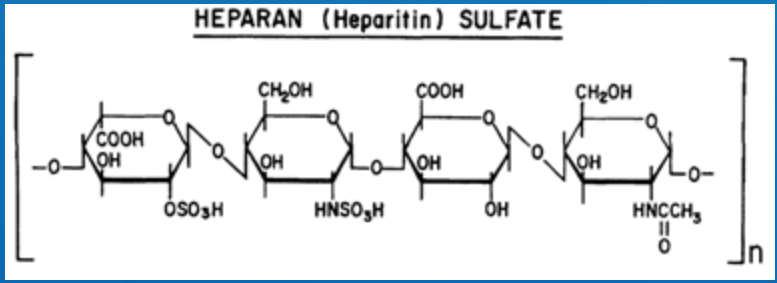




OL, Baumgärtel and Bausch, BJ 2009

Polyelectrolytes in the basal lamina: Heparan sulfate

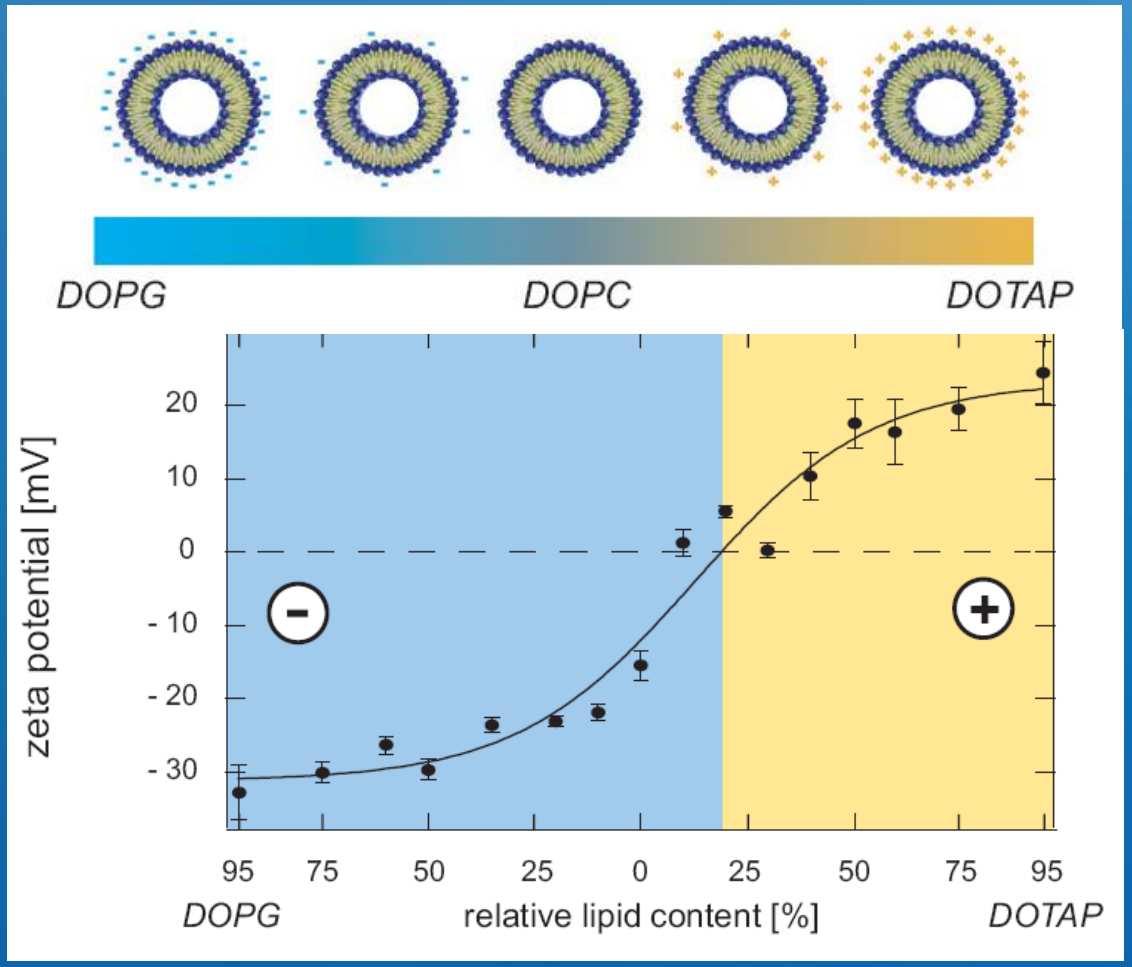




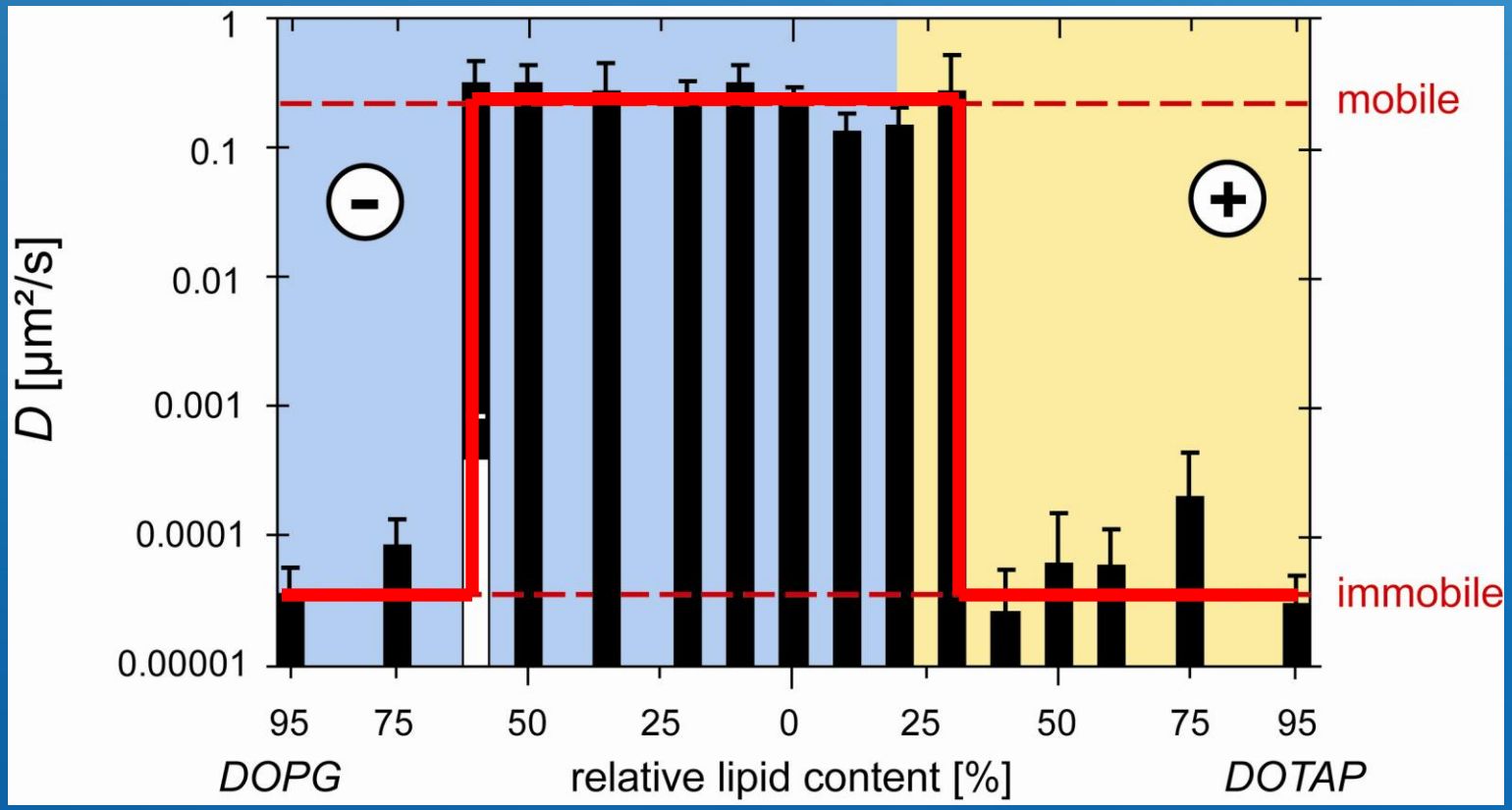
Problem 1:

all-or-nothing vs gradual mobility increase

Liposome particles with tunable surface properties

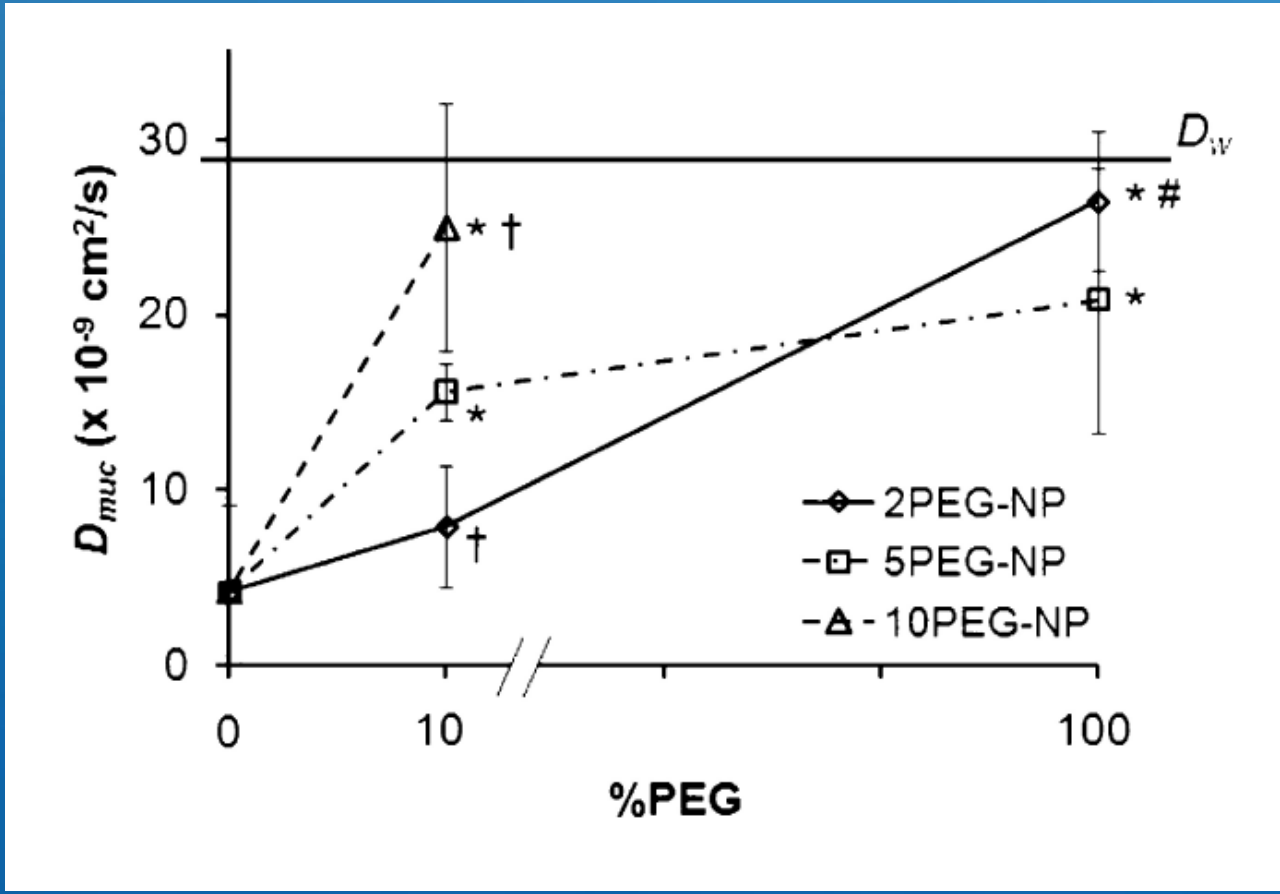


The basal lamina acts as an electrostatic bandpass



OL, Baumgärtel and Bausch, BJ 2009

PEGylation (surface neutralization) gradually enhances particle diffusion in native cervical mucus



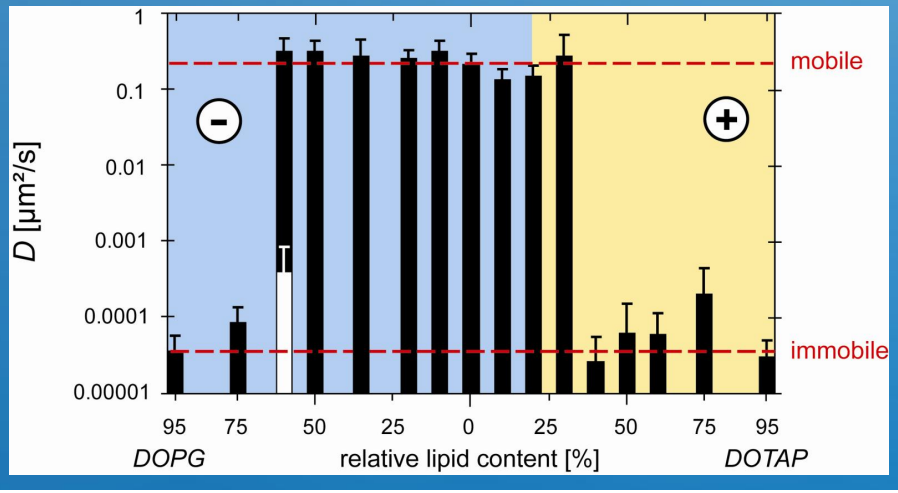
Cu and Saltzmann, MolPharm2008

Problem 2:

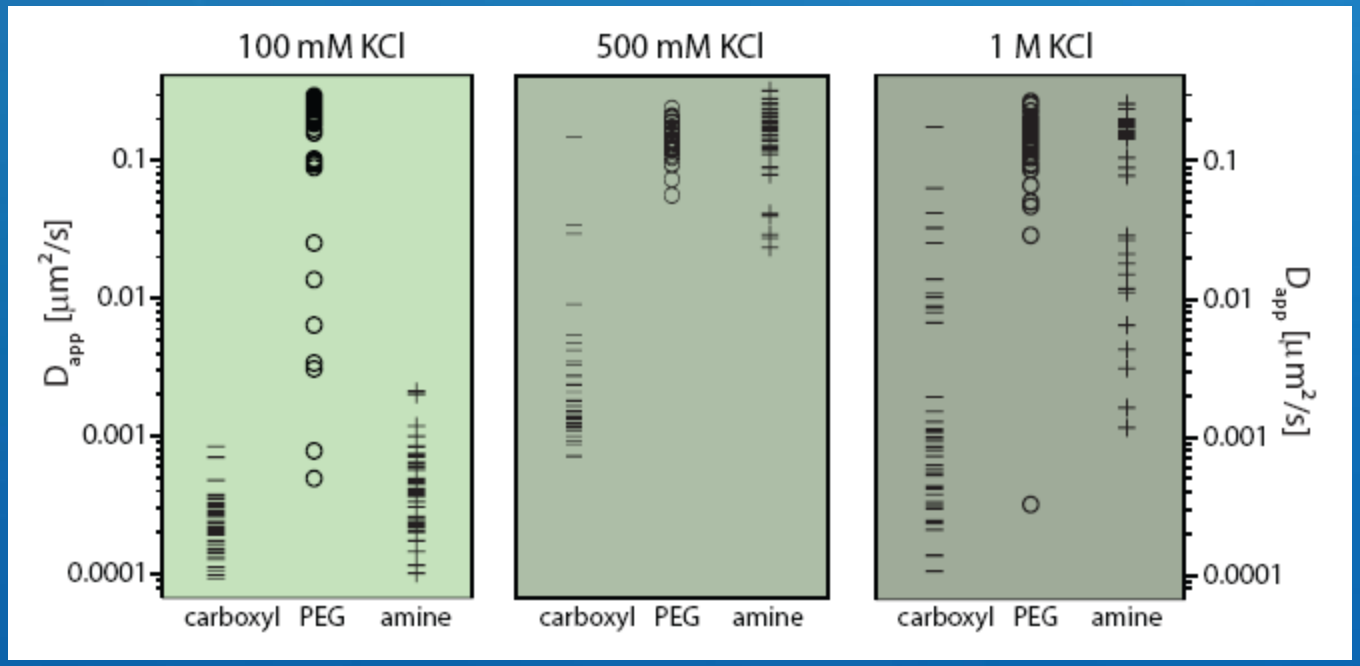
varying particle charge: all-or-nothing

Debye screening: broad distribution of D values

Varying particle surface charges:



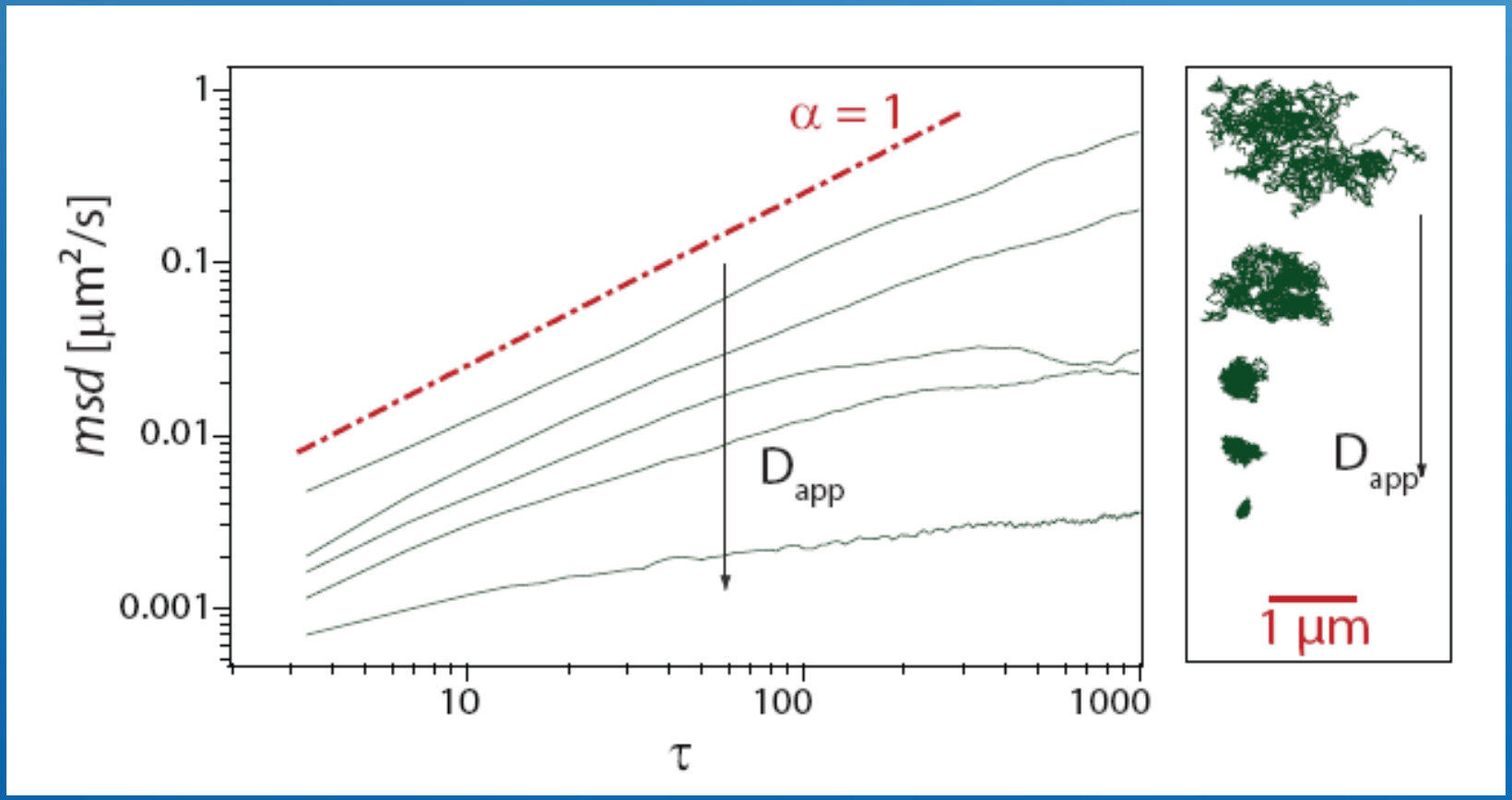
Debye screening:



Data obtained in basal lamina hydrogels

Problem 3:

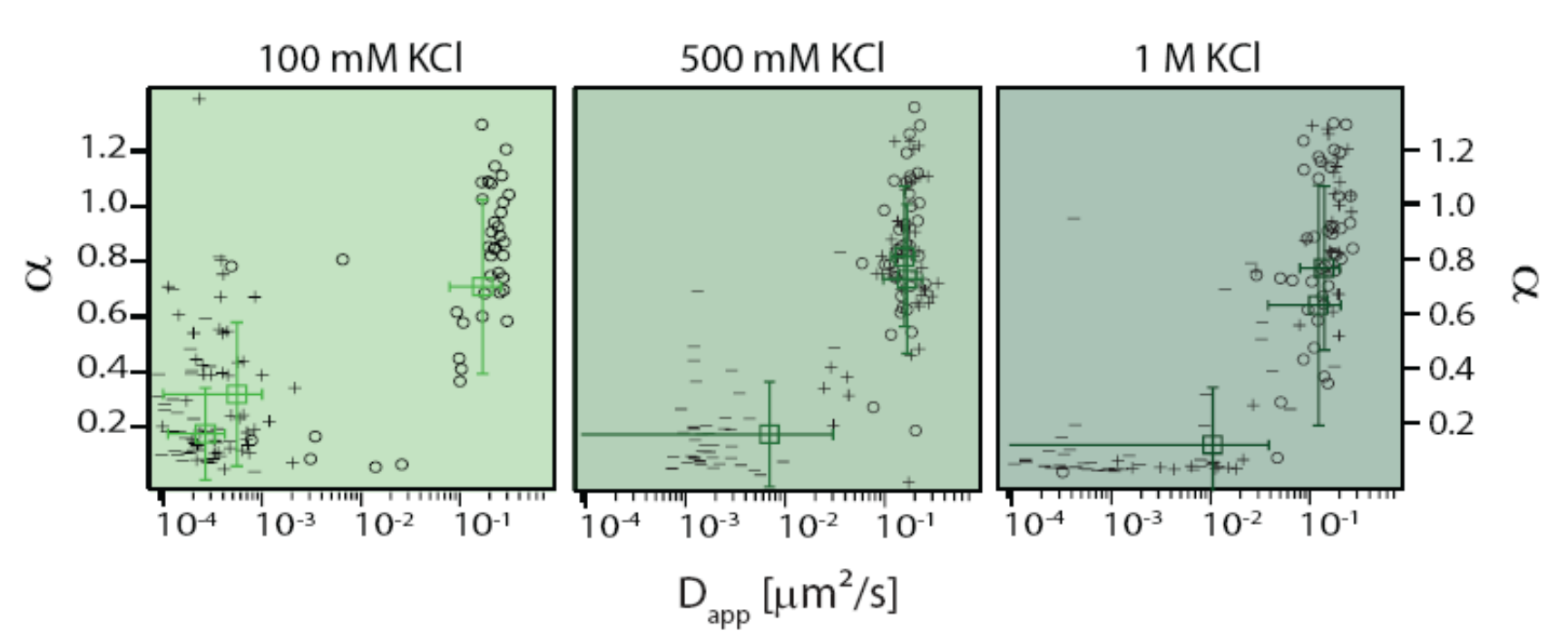
How to describe the subdiffusive process theoretically?



Data obtained in basal lamina hydrogels at 1 M NaCl

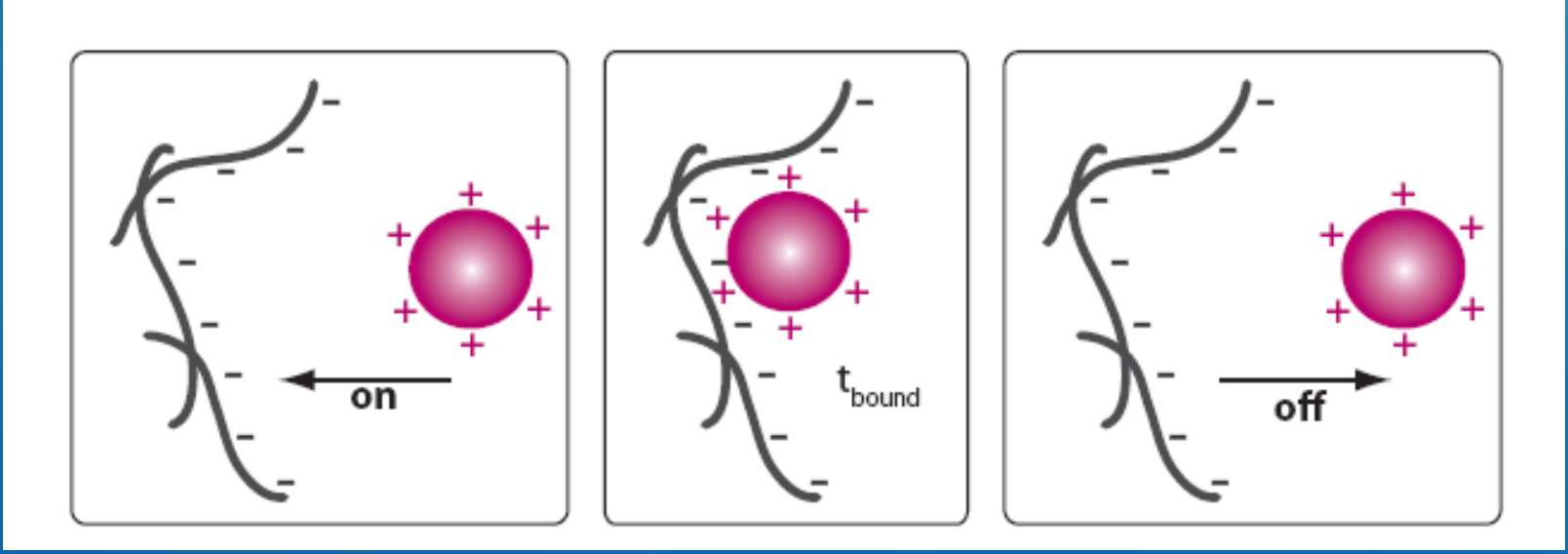
Data acquisition at 300 fps

Power law exponents of the particle MSD curves

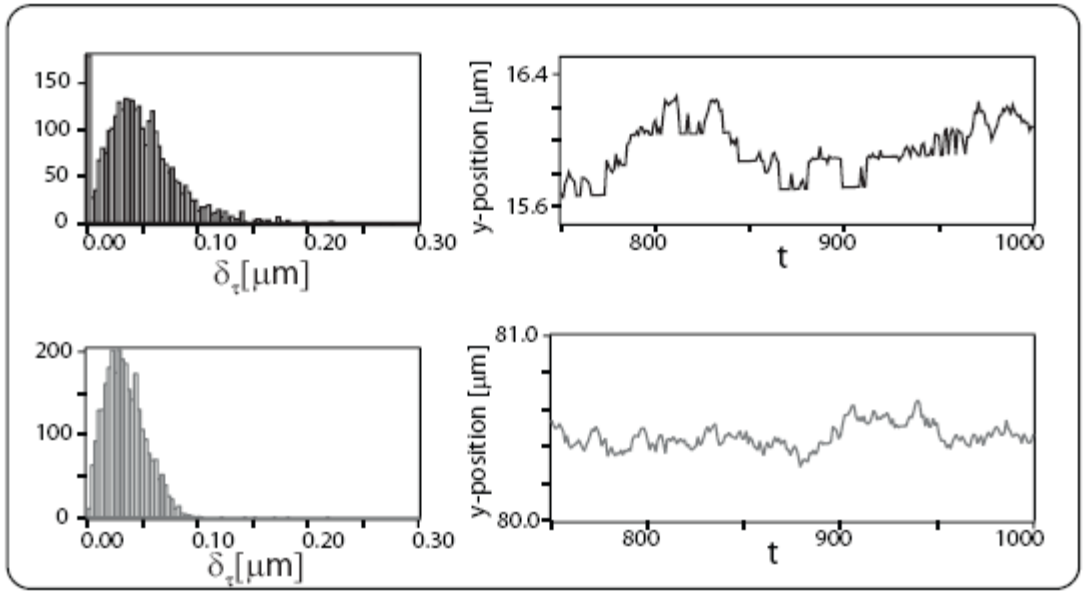


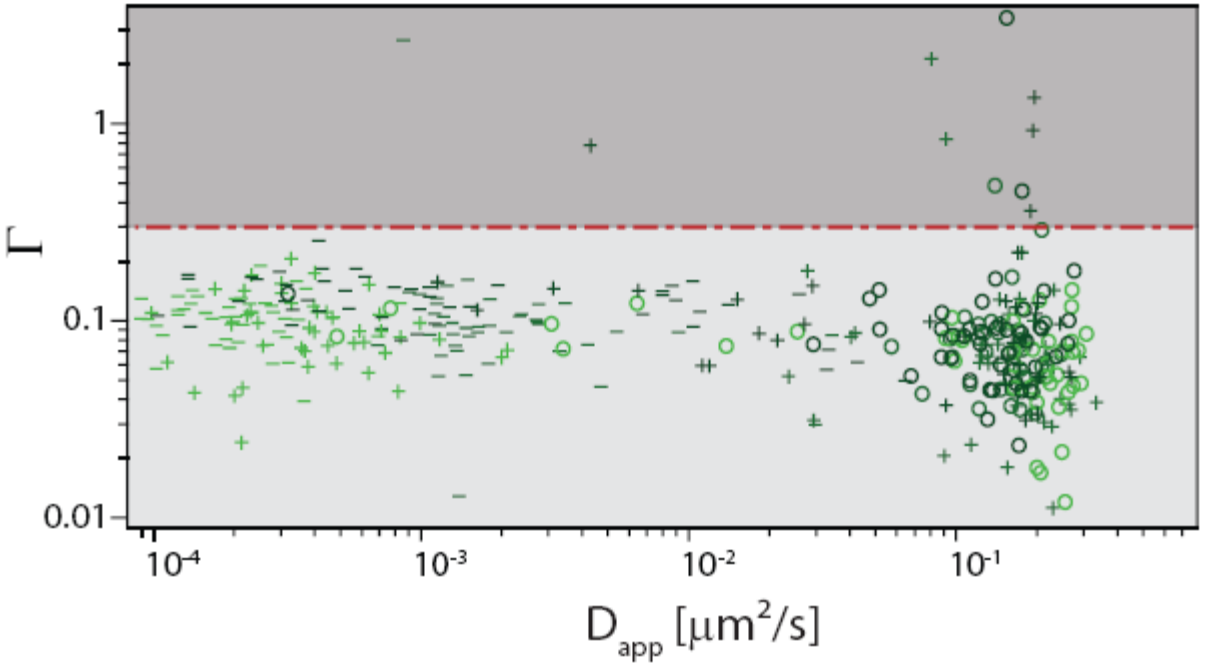
Data obtained in basal lamina hydrogels

Is there a temporary particle arrest due to binding to the hydrogel polymers?



Massachusetts Institute of Tech





Data obtained in basal lamina hydrogels at 1 M NaCl

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