Title: Electrostatics

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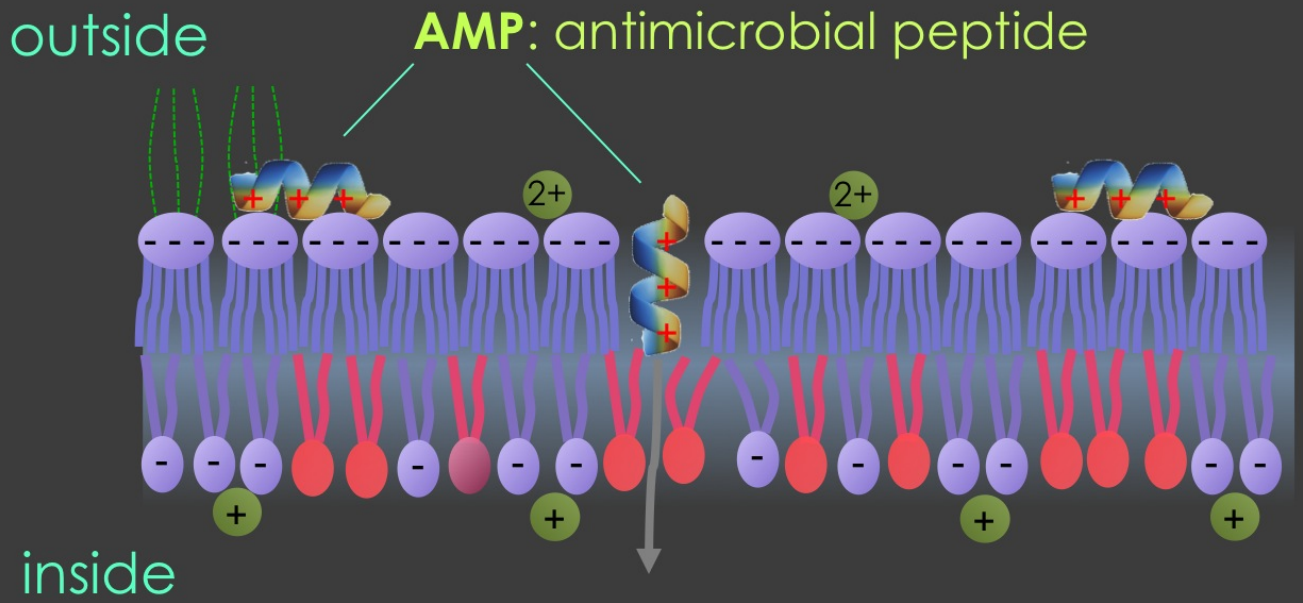
Abstract: Electrostatic phenomena in soft matter systems are often intriguing or even counterintuitive. DNA condensation by polyvalent counterions is now a classic example by which highly-negatively charged DNA strands attract each other in the presence of poly-cations. Also Mg2+ can stabilize inverted hexagonal phases of lipid aggregates that would otherwise form lamellar phases. Here we discuss another intriguing electrostatic phenomenon: electrostatic modification of lipid membranes by poly-cations. In particular we examine how the poly-anionic nature of LPS (lipopolysaccharide) molecules is implicated in the permeability properties of LPS membranes.

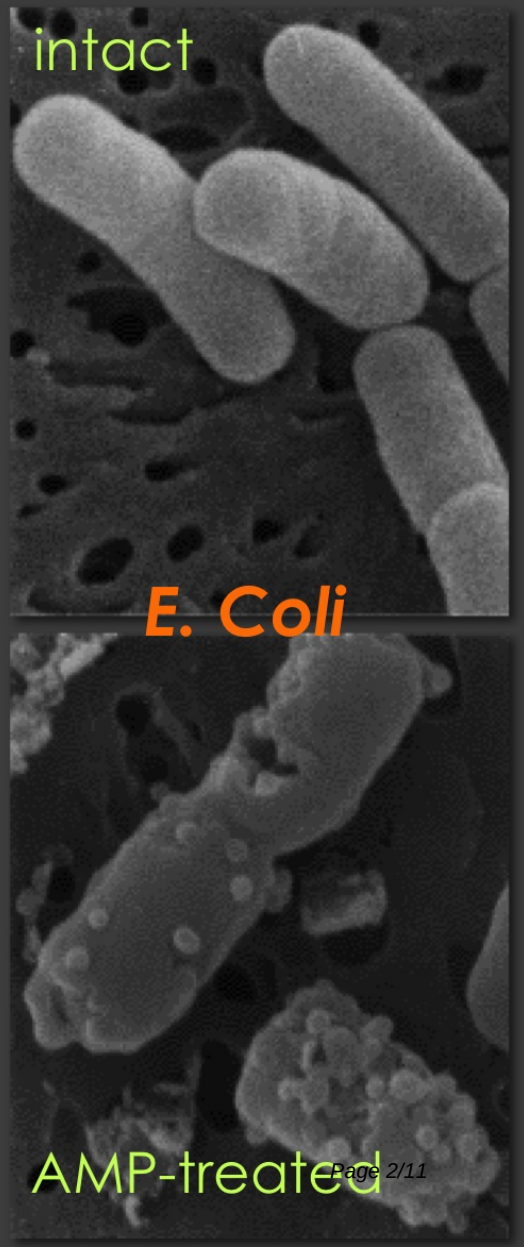
Electrostatics for soft interfaces

: poly-cations and outer membrane permeability

Norman Lam, Zheng Ma, & Bae-Yeun Ha



Outer-membrane perturbation by AMPs

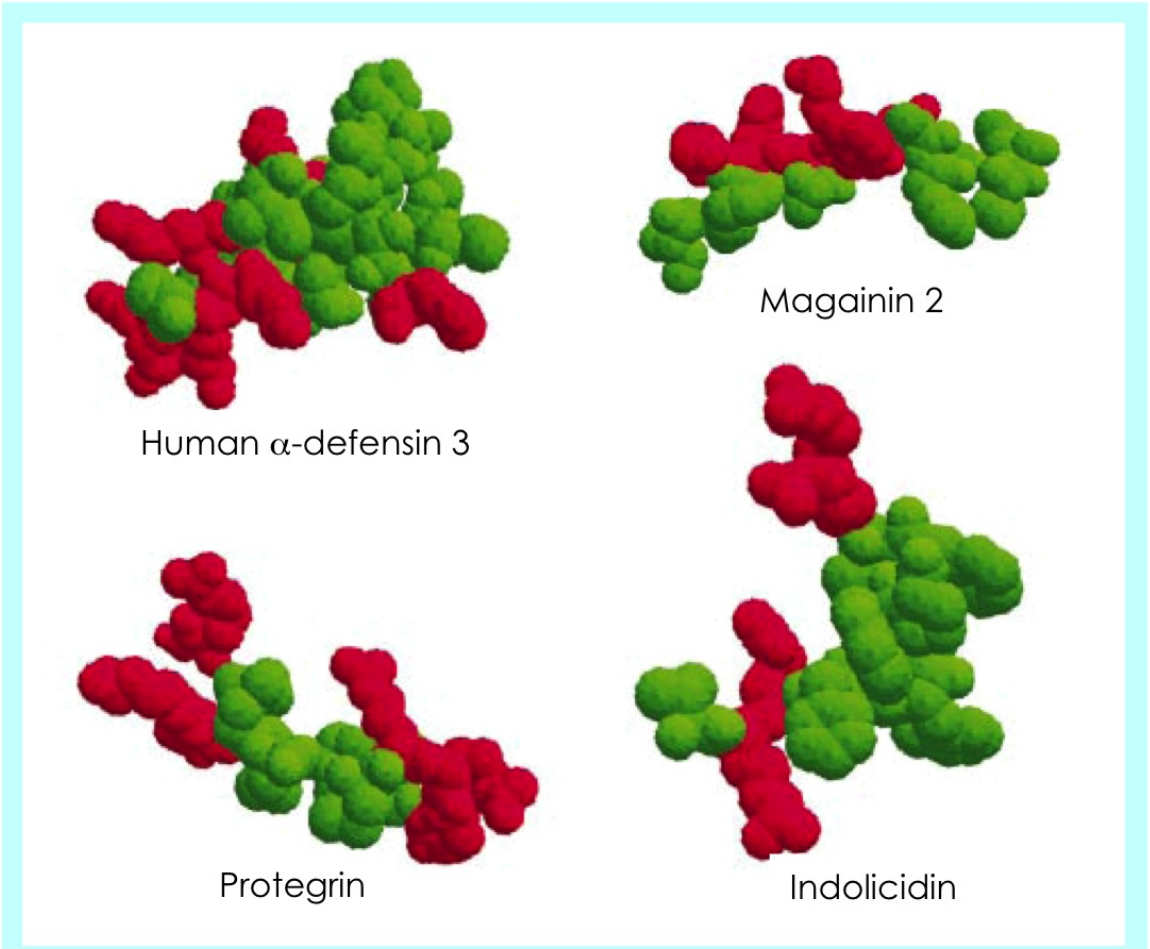


Skerlavaj et al, *FEBS Lett* (1999)

Antimicrobial peptides (AMPs)

Both animals and plants possess potent, broad-spectrum antimicrobial peptides, which they use to fend off a wide range of microbes, including bacteria, fungi, viruses and protozoa.

Zasloff, Nature 2002



The double membrane of *E. coli*

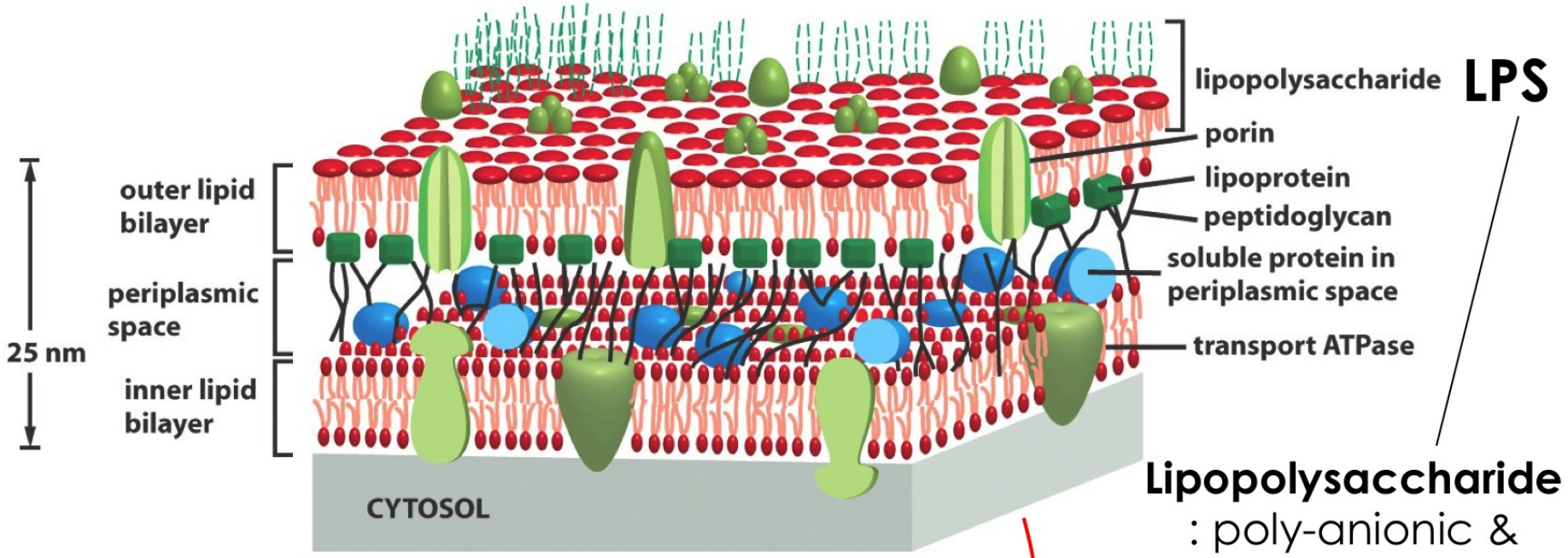


Figure 11-18 *Molecular Biology of the Cell* (© Garland Science 2008)

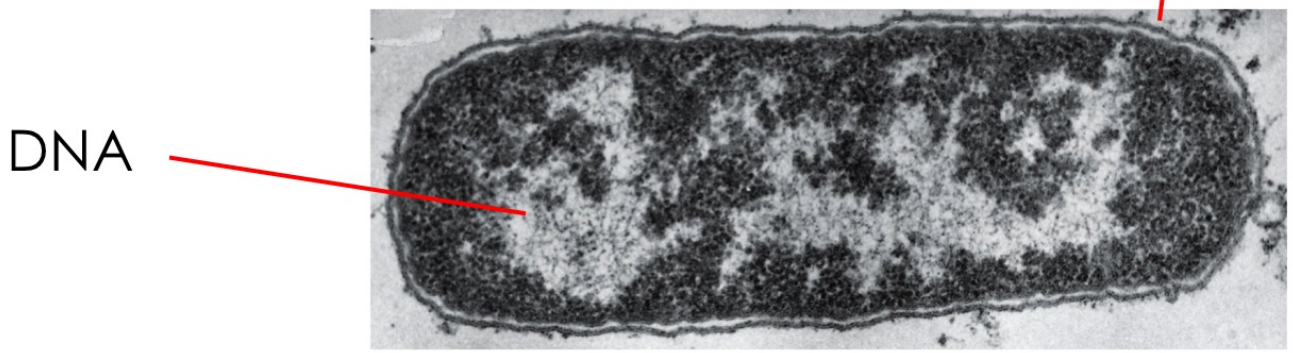


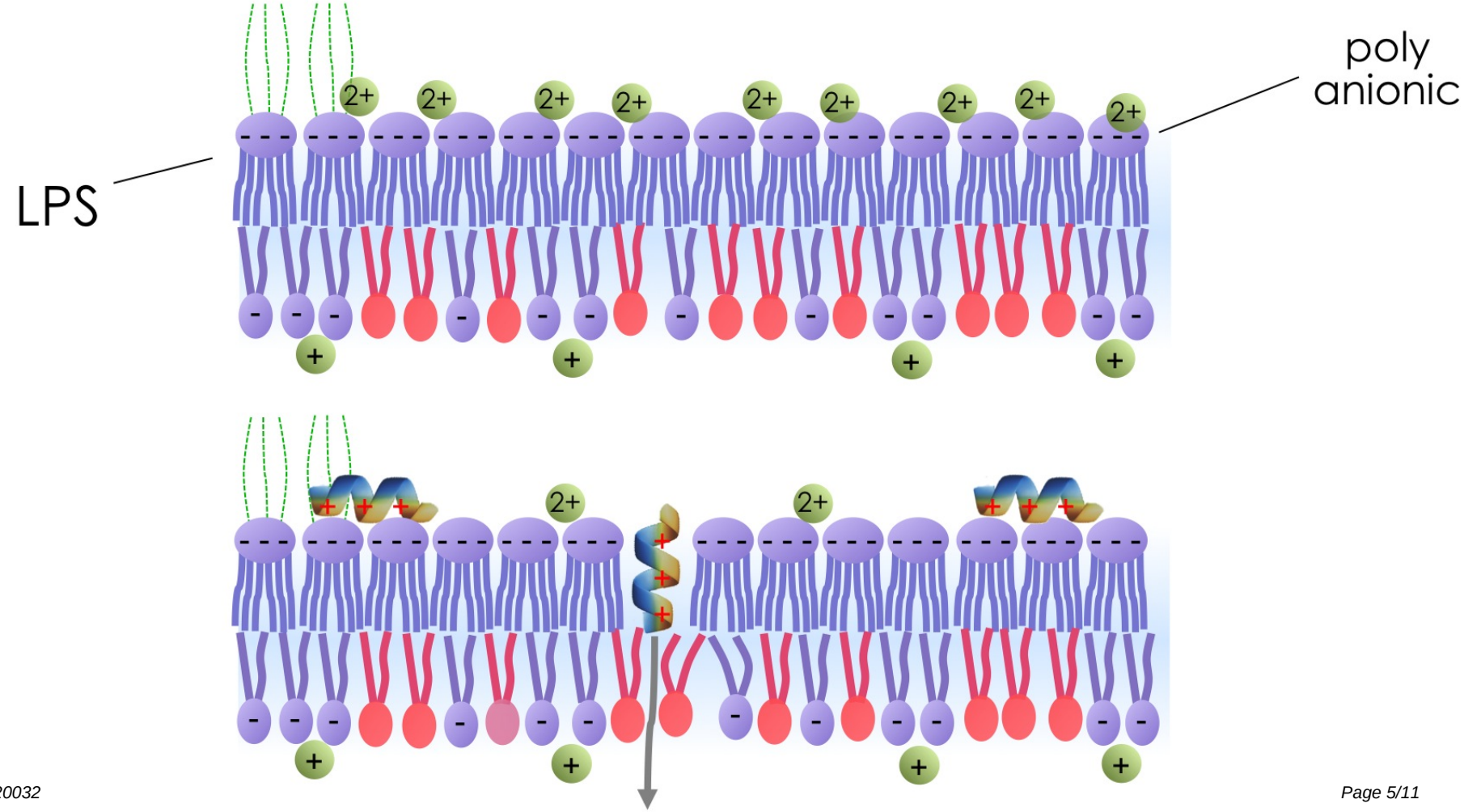
Figure 1-11 *Essential Cell Biology* (© Garland Science 2010)

What controls membrane permeability?

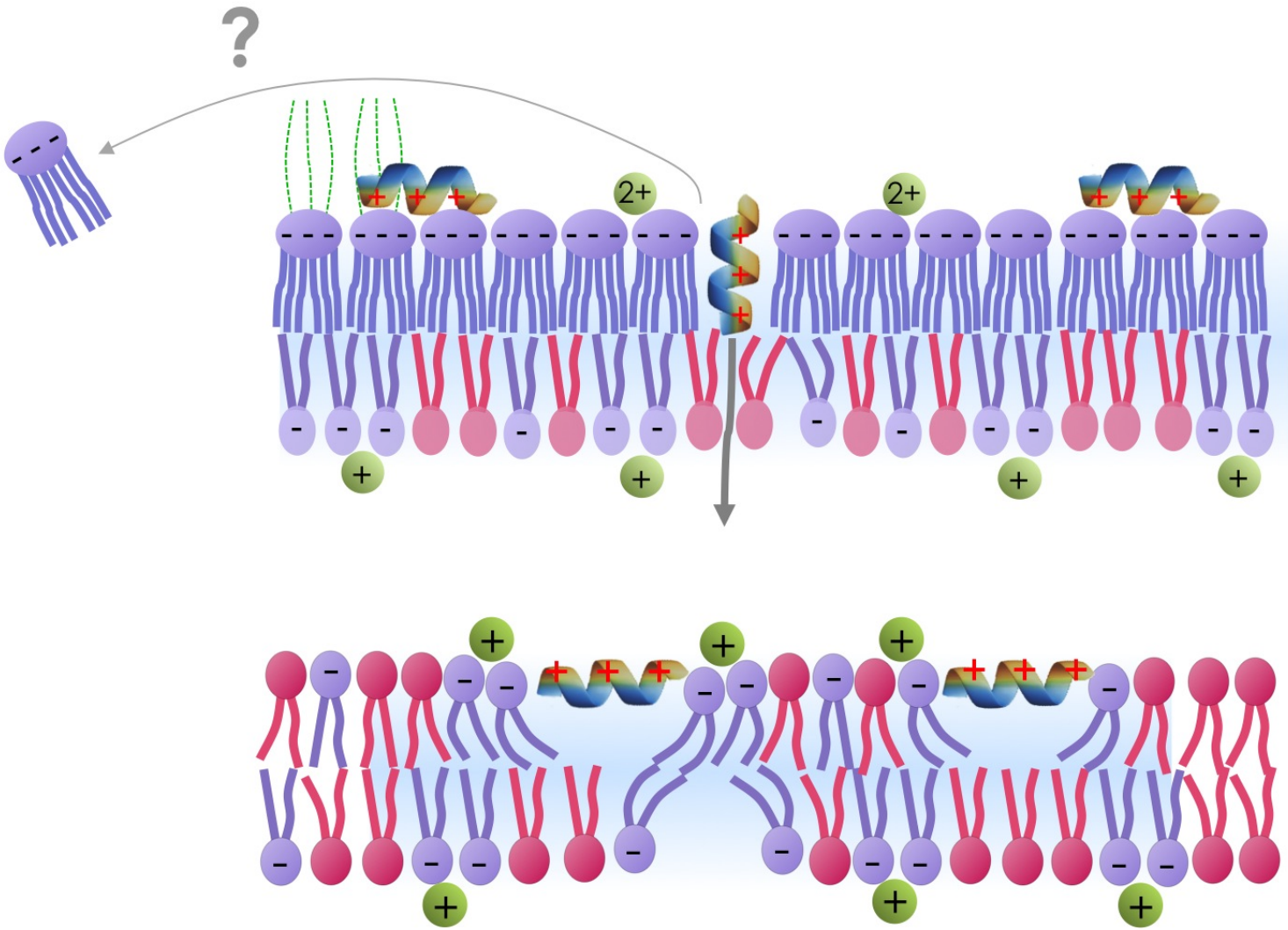
How can AMPS cross the outer membrane?

Competing effects of AMP & Mg^{2+} on LPS

LPS layer is stabilized by Mg^{2+}.
AMPs can displace Mg^{2+} from the LPS layer.
[Zasloff, Hancock, …]

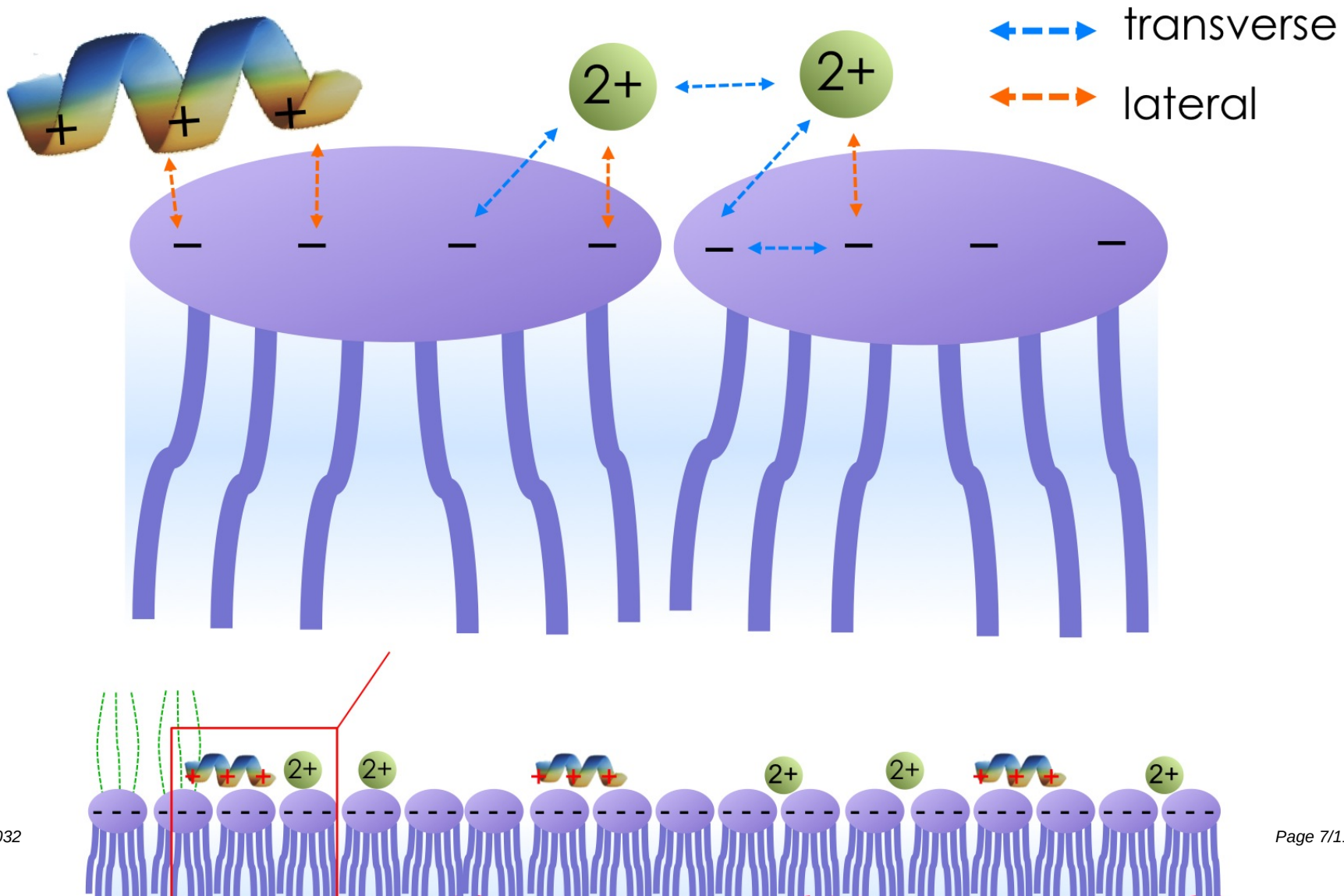


AMP's entry into the inner membrane

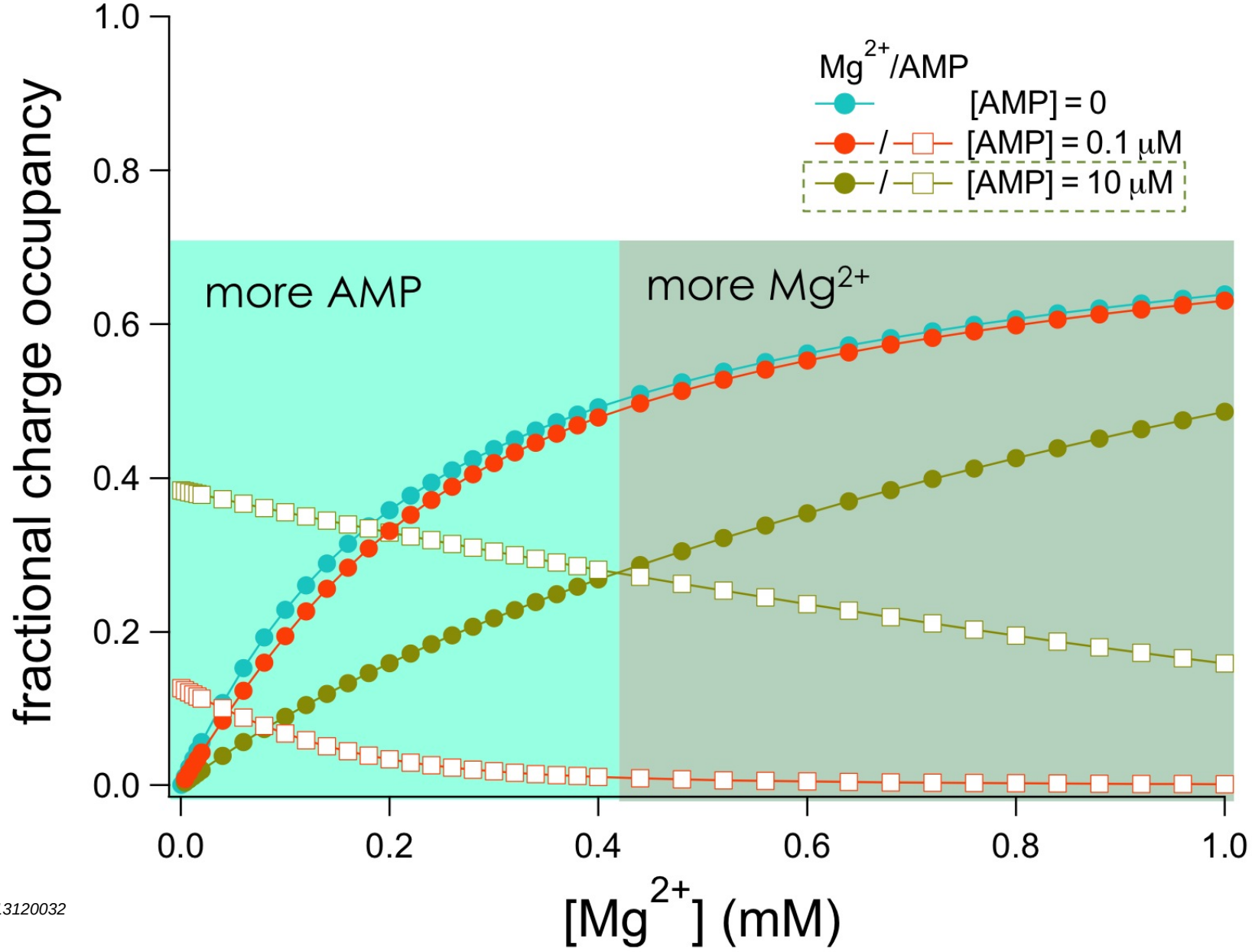


Theoretical modeling

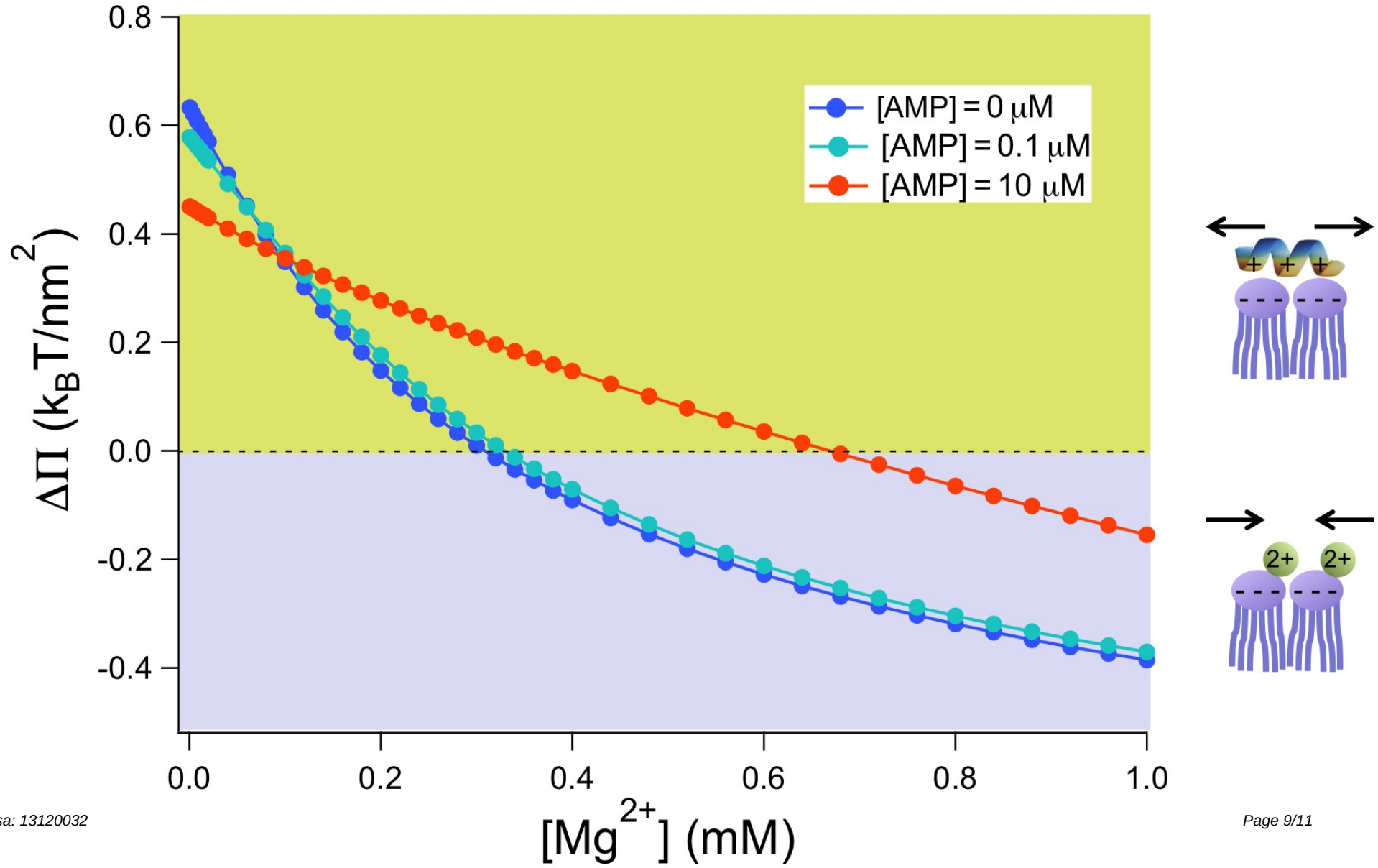
lateral vs transverse interactions



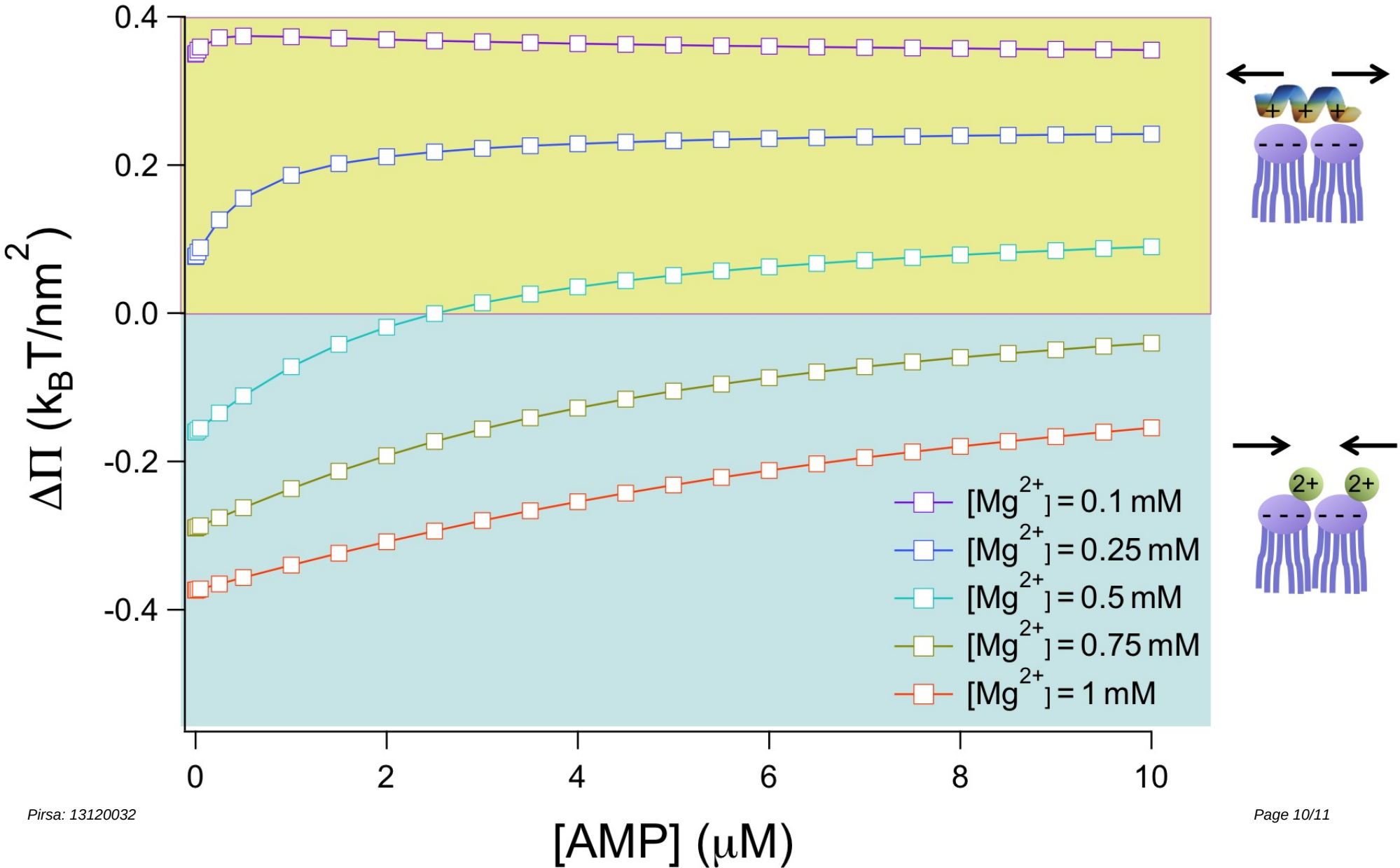
Competitive binding of AMP & Mg^{2+}



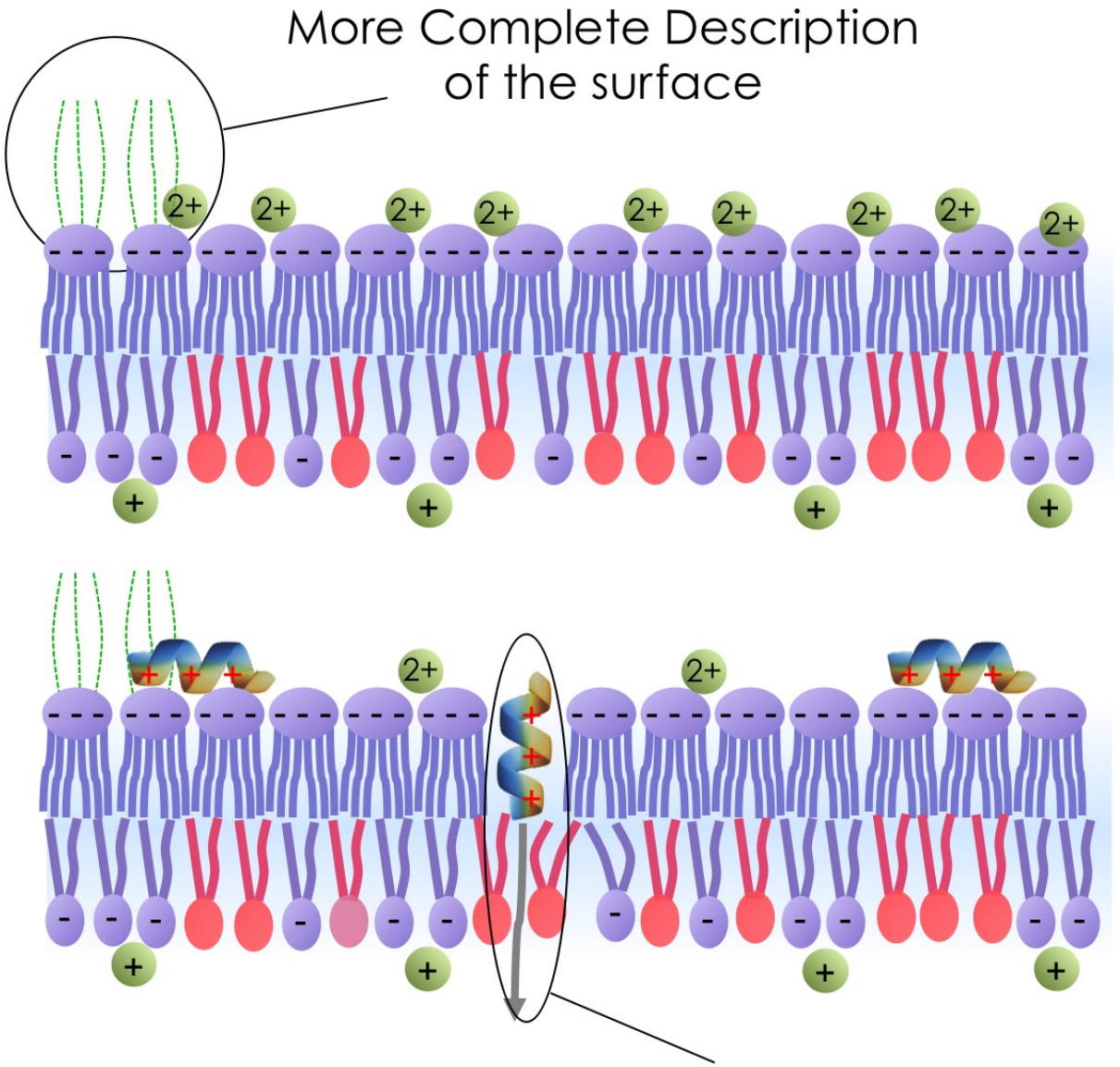
Competing effects of AMP & Mg^{2+} on LPS



Competing effects of AMP & Mg^{2+} on LPS



Future Work


More Complete Description
of the surface
2+
AMP's entry into the inner membrane