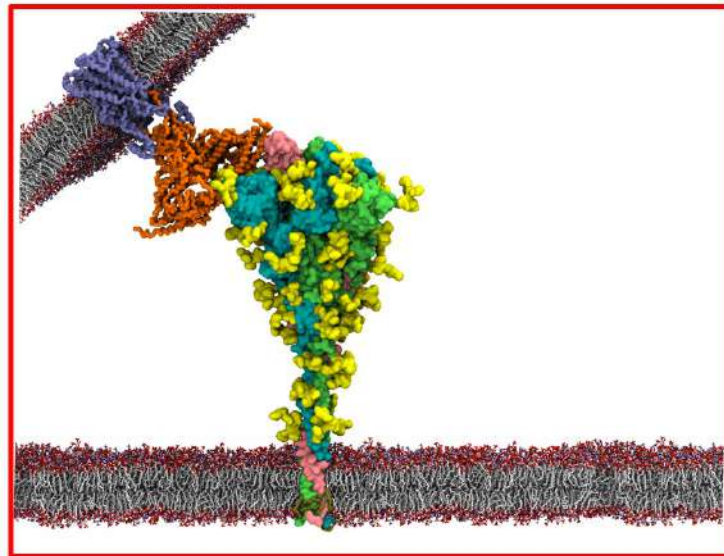
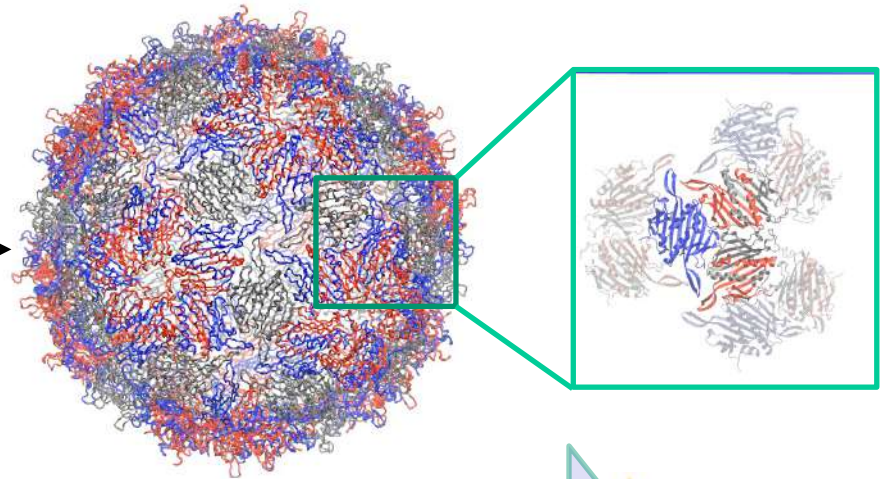
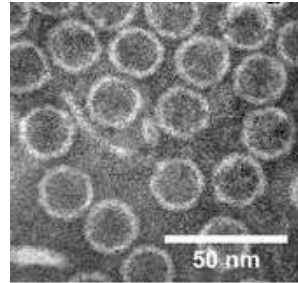
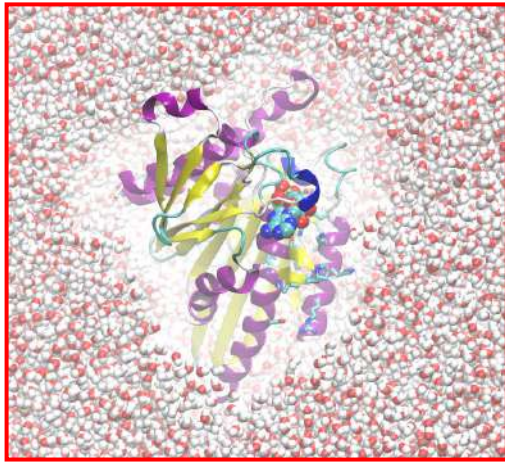


# Multiscale Simulation, Modelling & Design – Progress Report 2023

Peter J. Bond

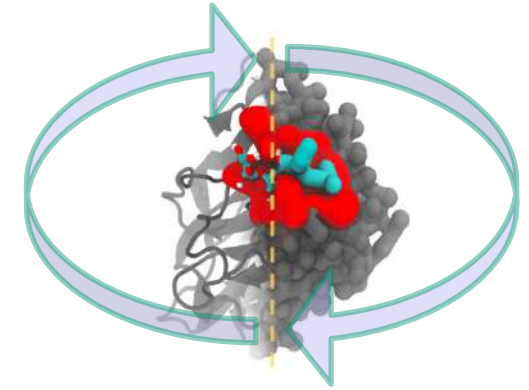


# Multiscale Simulations & Research Focus



$$E_{\text{total}} = \underbrace{\sum_{\text{bonds}} K_r (r - r_{\text{eq}})^2 + \sum_{\text{angles}} K_\theta (\theta - \theta_{\text{eq}})^2 + \sum_{\text{dihedrals}} \frac{V_\phi}{2} [1 + \cos(n\phi - \gamma)]}_{\text{Bonded}} + \underbrace{\sum_{i < j} \left[ \frac{A_{ij}}{R_{ij}^{12}} - \frac{B_{ij}}{R_{ij}^6} + \frac{q_i q_j}{\epsilon R_{ij}} \right]}_{\text{Non-bonded}}$$

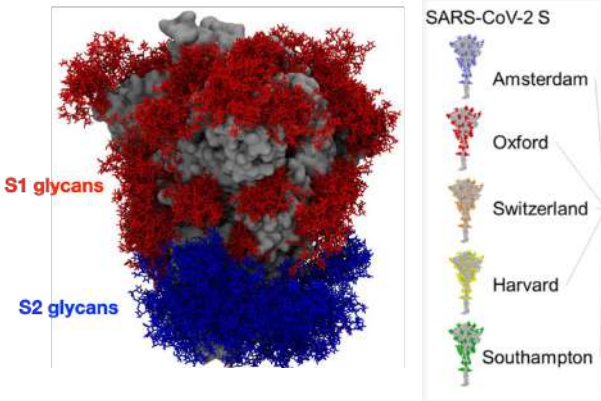
Schematic diagrams illustrating the components of the energy function. The 'Bonded' section shows bond stretching (two red spheres connected by a double-headed arrow), angle bending (three red spheres forming an angle with a double-headed arrow), and dihedral rotation (four red spheres forming a chain with a double-headed arrow around a bond). The 'Non-bonded' section shows van der Waals interactions (two spheres, one red and one green, with a double-headed arrow) and electrostatic interactions (a red sphere and a white sphere with a double-headed arrow).



- Viral life cycles, vaccines / therapeutics (coronaviruses, dengue) & disinfectants .
- Membrane (protein) dynamics in the context of:
  - (i) bacterial envelopes & antimicrobials;
  - (ii) host-pathogen interactions, innate immunity (TLRs);
  - (iii) mammalian protein drug targets.

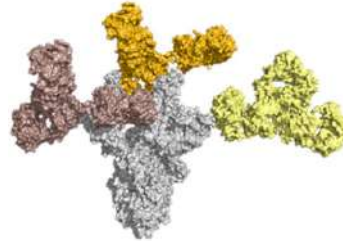
# Structure-Function Studies of SARS-CoV-2 Spike

## Epitope Glycosylation



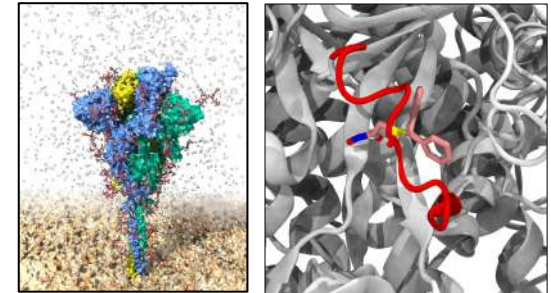
*J Mol Biol* (2022) 434:167332

## Novel Antibodies



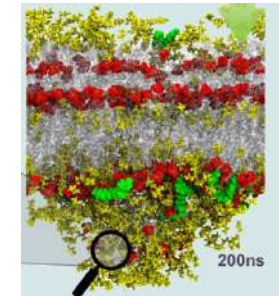
under revision (2023)

## Druggable Pockets



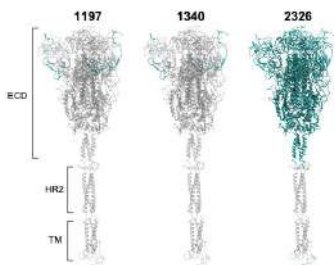
*Structure* (2022) 30:1062  
*Structure* (2022) 30:590

## Sanitizer MOA

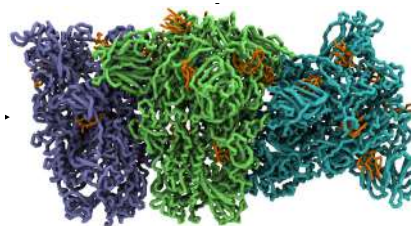


*J Mol Biol* (2023) in press

## Other Functional Spike Studies...



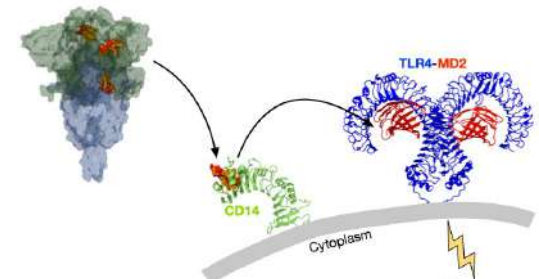
*Microbiol Spectr* (2023) in press



*FEBS Lett* (2022) 596:2566

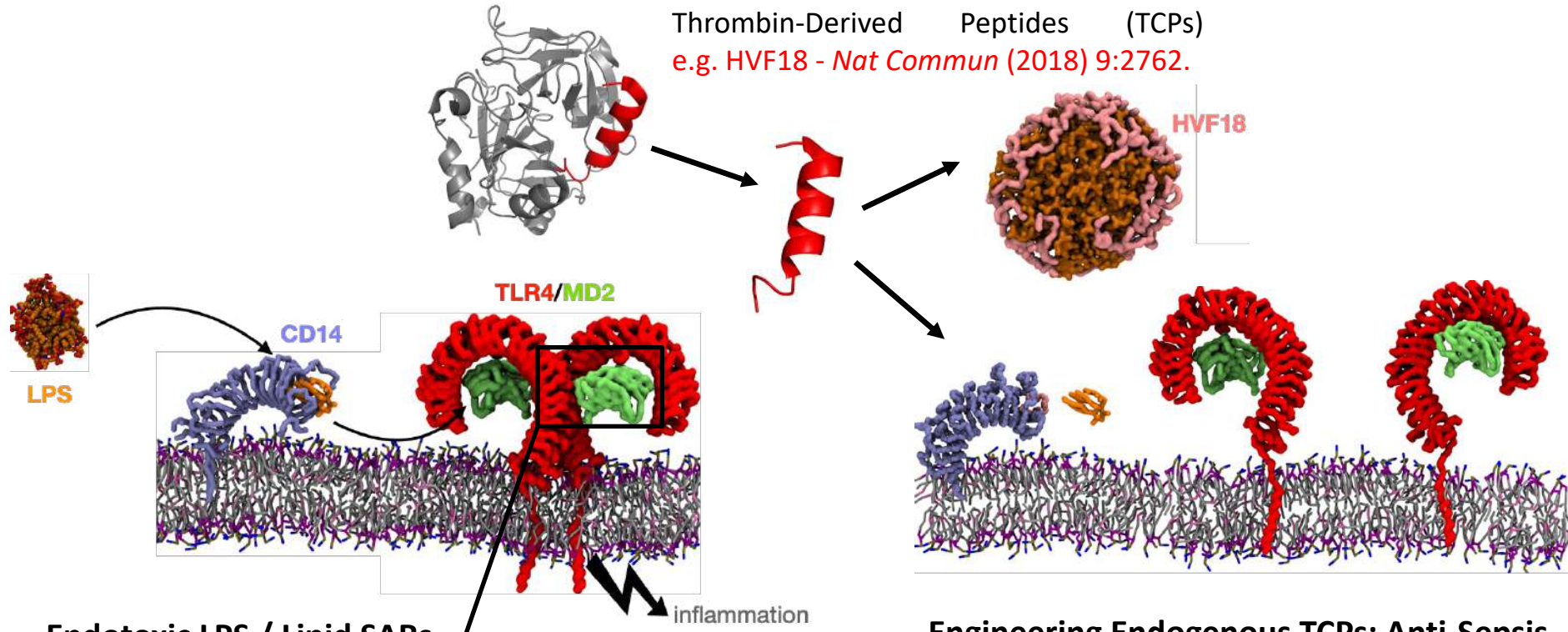
Funding:  
ID HCO SF

## Inflammatory "Boosting"



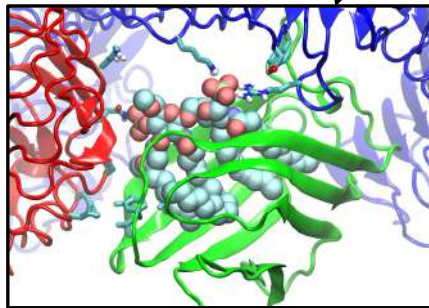
*J Mol Cell Biol* (2023) 14:mjac058

# Inflammatory Pathways: TLR4 Function & Inhibition

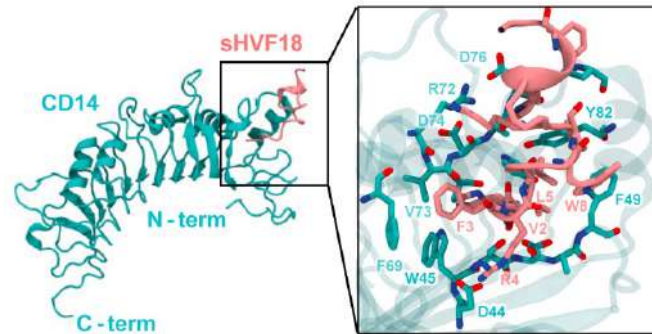


Endotoxic LPS / Lipid SARs

Engineering Endogenous TCPs: Anti-Sepsis



- ▶ Guan Xue Li (LKC-Med) – ESKAPE bacteria
  - ▶ Jose Bengoechea (Queen's) – *Y. pestis*
  - ▶ Eicke Latz (Bonn) – mammalian fats
- under review, 2023



Artur Schmidtchen (Lund University)  
- under review (2023)