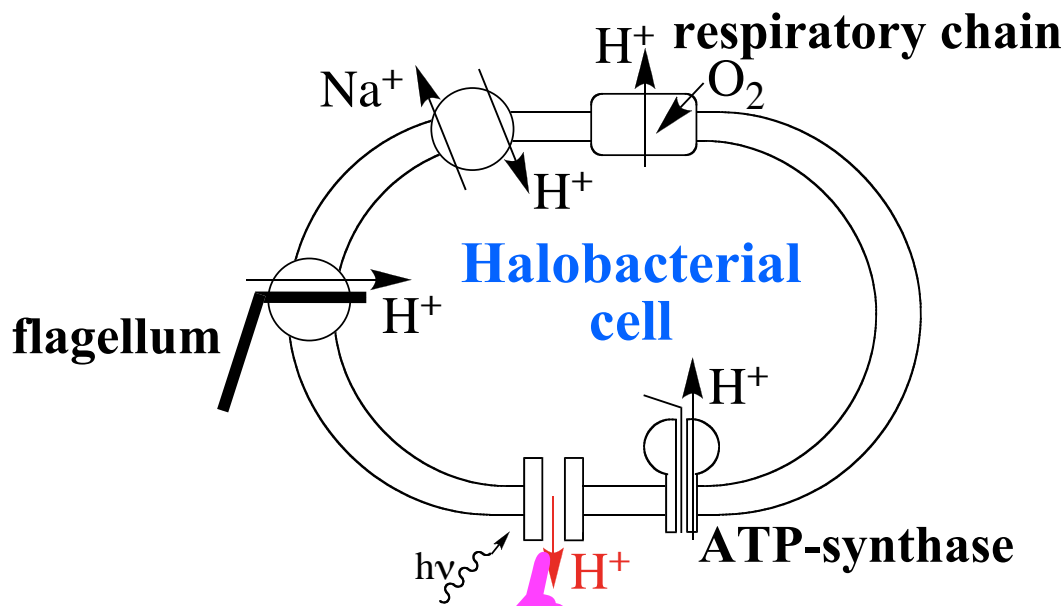


**Physics of  
Solar Energy Conversion  
in Halobacteria by  
Photoinduced Proton Pumping**

**Christoph Kuhn and Hans Kuhn  
Tschingel, Switzerland**



**Light-driven proton pumping from inside to outside of cell**

**Photoinduced translocation of  $H^+$  from cytoplasmatic channel with  $pH > 10$  to extracellular channel with  $pH < 3.5$**

Traditional model: *How can this happen?*

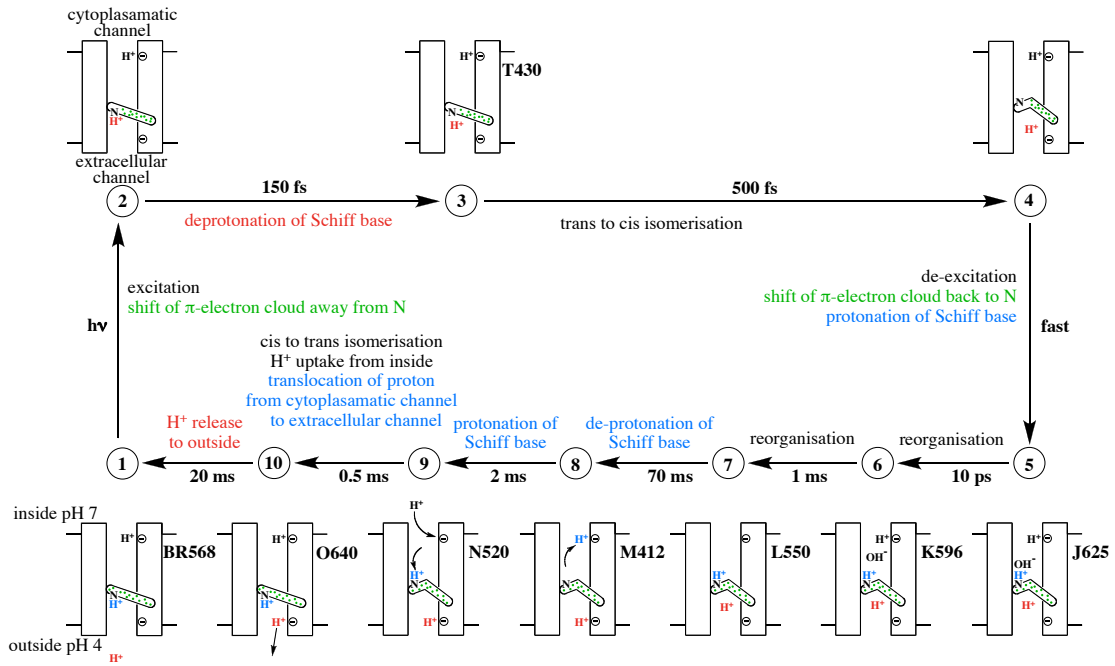
- translocation of  $H^+$  from cytoplasmatic channel to extracellular channel by conformational change of protein corresponding to step from 7 (stage L550) to 8 (stage M412)

Present model:

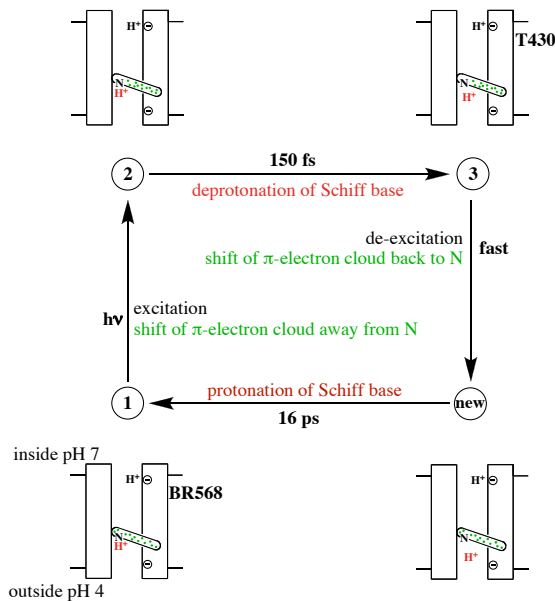
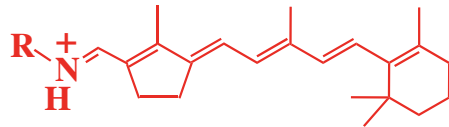
- initial steps from 1 to 3: **photoinduced  $\pi$ -electron shift away from N and thus deprotonation of Schiff base** leaving  $H^+$  in extracellular channel
- **translocation of  $H^+$  from cytoplasmatic channel to extracellular channel** by thermal cis-trans isomerisation (step from 9 to 10)



# Presented model: Synopsis



Present model supported  
by mutant  
in which trans-form of chromophore is blocked:



- photoinduced release of H<sup>+</sup> into extracellular channel as in wild-type
- recombination slow (16ps)

### Traditional model:

- U. Haupts, J. Tittor, D. Oesterhelt  
Biochemistry 36, 2 (1997)

### Present model:

- H. Kuhn, C. Kuhn  
Chem. Phys. Lett. 253, 61 (1996)
- H.Kuhn, H.-D. Försterling, D.  
Waldeck Principles of Physical Chemistry  
2nd Ed., Wiley 2008

### Femto-second spectroscopy:

- J. Dober, W. Zinth, W. Kaiser, D. Oesterhelt  
Chem. Phys. Lett. 144, 215 (1988)
- J. Herbst, K. Heyne, R. Diller  
Science 217, 822 (2002)

### Mutant with chromophore blocked in trans-form:

- A. Aharoni, I. Weiner, M. Ottolenghi, M. Sheves  
J. Biol. Chem. 275, 21010 (2000)