

Literaturverzeichnis

- Albert, D. A., Watts, A., Spooner, P. Groebner, G., Young, J., and Yeagle, P. L. (1997)
Biochim. et Biophys. Acta 1328: 75-82
A distance measurement between specific sites on the cytoplasmic surface of bovine rhodopsin in rod outer segment disk membranes
- Alcala, J. R., Gratton, E., and Prendergast, F. G. (1987) Biophys. J. 51: 597-604
Fluorescence lifetime distributions in proteins
- Alexiev, U., Marti, T., Heyn, M. P., Khorana, H. G., and Scherrer, P. (1994a) Biochem. 33: 13693-13699
Covalently bound pH-indicator dyes at selected extracellular or cytoplasmic sites in bacteriorhodopsin. 2. Rotational orientation of helices D and E and kinetic correlation between M formation and proton release in bacteriorhodopsin micelles
- Alexiev, U., Marti, T., Heyn, M. P., Khorana, H. G., and Scherrer, P. (1994b) Biochem. 33: 298-306
Surface charge of bacteriorhodopsin detected with covalently bound pH indicators at selected extracellular and cytoplasmic sites
- Alexiev, U., VWB-Verlag für Wissenschaft und Bildung (1995)
Protonenbewegung und Oberflächenpotentialänderungen während des Photozyklus der membranständigen Protonenpumpe Bacteriorhodopsin
- Altenbach, C., Yang, K., Farrens, D. L., Farahbakhsh, Z. T., Khorana, H. G., and Hubbell, W. L. (1996)
Biochem. 35: 12470- 12478
Structural features and light-dependent changes in the cytoplasmic interhelical E-F loop region of rhodopsin: A site-directed spin-labeling study
- Altenbach, C., Cai, K., Khorana, H. G., and Hubbell, W. L. (1999a) Biochem. 38: 7931-7937
Structural features and light-dependent changes in the sequence 306-322 extending from helix VII to the palmitoylation sites in rhodopsin: A site-directed spin-labeling study
- Altenbach, C., Klein-Seetharaman, J., Hwa, J., Khorana, H. G., and Hubbell, W. L. (1999b)
Biochem. 38: 7945-7949
Structural features and light-dependent changes in the sequence 59-75 connecting helices I and II in rhodopsin: A site-directed spin-labeling study

- Alfano, R. R., Yu, W., Govindjee, R., Becher, B., and Ebrey, T. G. (1976) *Biophys. J.* 16: 541-545
Picosecond kinetics of the fluorescence from the chromophore of the purple membrane protein of *halobacterium halobium*
- Amir, D., and Haas, E. (1987) *Biochem.* 26: 2126-2175
Estimation of intramolecular distance distribution in bovine pancreatic trypsin inhibitor by site-specific labeling and nonradiative excitation energy-transfer measurements
- Ando, T., and Asai, H. (1980a) *J. Biochem.* 88: 255-264
Charge effects on the dynamic quenching of fluorescence of 1,N⁶-ethenoadenosine oligophosphates by iodide, thallium (I) and acrylamide
- Ando, T., Fujisaki, H., and Asai, H. (1980b) *J. Biochem.* 88: 265-276
Electric potential at regions near the two specific thiols of heavy meromyosin determined by the fluorescence quenching technique
- Arnis, S. K., and Hofmann, K. P. (1993) *Proc. Natl. Acad. Sci. USA* 90: 7849-7853
Two different forms of metarhodopsin II: Schiff base deprotonation precedes proton uptake and signaling state
- Baldomero, O., Bates, P. A., Querol, E., Aviles, F. X., and Sternberg, M. J. E. (1997)
J. Mol. Biol. 266: 814-830
An automated classification of the structure of protein loops
- Baldwin, J. M. (1993) *EMBO J.* 12: 1693-1703
The probable arrangement of the helices in G protein-coupled receptors
- Baldwin, J. M., Schertler, F. G. X., and Unger, V. M. (1997) *J. Mol. Biol.* 272: 144-164
An alpha-carbon template for the transmembrane helices in the rhodopsin family of G protein-coupled receptors
- Balogh-Nair, V., Carriker, J. D., Honig, B., Kamat, M. G., Nakanishi, K., Sen, R., Sheves, M., and Tsujimoto, K. (1981) *Photochem. Photobiol.* 33: 483-488
The 'opsin shift' in bacteriorhodopsin: Studies with artificial bacteriorhodopsin
- Barkley, M. D., Kowalczyk, A.A., and Brand, L. (1981) *J. Chem. Phys.* 75: 3581-3593
Fluorescence decay studies of anisotropic rotations of small molecules

- Baumann, J., and Fayer, M. D. (1986) *J. Chem. Phys.* 85: 4087-4107
Excitation transfer in disordered two-dimensional and anisotropic three-dimensional systems:
Effects of spatial geometry on time-resolved observables
- Beechem, J. M., and Haas, E. (1989) *Biophys. J.* 55: 1225-1236
Simultaneous determination of intramolecular distance distributions and conformational dynamics
by global analysis of energy transfer measurements
- Belford, G., G., Belford, R., L., and Weber, G. (1972) *Proc. Natl. Acad. Sci. USA* 69: 1393-1399
Dynamics of fluorescence polarization in macromolecules
- Belrhali, H., Nollert, P., Royant, A., Menzel, C., Rosenbusch, J. P., Landau, E. M., and Pebay-Peyroula, E.
(1999) *Structure (London)* 7: 909-917
Protein, lipid and water organization in bacteriorhodopsin: A molecular view of the purple
membrane at 1.9 angstroms resolution
- Bialik, C. N., Wolf, B., Rachofsky, E. L., Ross, J. B. A., and Laws W. R. (1998) *Biophys. J.* 75: 2564-2575
Dynamics of biomolecules: assignment of local motions by fluorescence anisotropy decay
- Bigelow, J. D., and Inesi, G. (1991) *Biochem.* 30: 2113-2125
Frequency-domain fluorescence spectroscopy resolves the location of maleimide-directed
spectroscopic probes within the tertiary structure of the Ca-ATPase of *sarcoplasmic reticulum*
- Blackman, S. M., Piston, D. W., and Beth, A. H. (1998) *Biophys. J.* 75: 1117-1130
Oligomeric state of human erythrocyte band 3 measured by fluorescence resonance energy
homotransfer
- Bollinger, L. M., and Thomas, G. E. (1961) *Rev. Sci. Instrum.* 32: 1044-1050
Measurement of the time dependence of scintillation intensity by a delayed-coincidence method
- Borochoy-Neori, H., and Montal, M. (1983a) *Biochem.* 22: 197-205
Rhodopsin in reconstituted phospholipid vesicles. 1. Structural parameters and light-induced
conformational changes detected by resonance energy transfer and fluorescence quenching
- Borochoy-Neori, H., and Montal, M. (1983b) *Biochem.* 22: 206-213
Rhodopsin in reconstituted phospholipid vesicles. 2. Rhodopsin-rhodopsin interactions detected by
resonance energy transfer.

- Borucki, B. (1998) Dissertation, Freie Universität Berlin
Die Orientierung des elektronischen Übergangsdipolmomentes in stationären und transienten Chromophorzuständen der lichtgetriebenen Protonenpumpe Bacteriorhodopsin
- Bownds, D., and Wald, G. (1965) *Nature* 205: 254-257
Reaction of the rhodopsin chromophor with sodium borhydride
- Brannon, J. H., and Magde, D. (1978) *J. Phys. Chem.* 82: 705-709
Absolute quantum yield determination by thermal blooming: Fluorescein
- Brink, D. M., and Satchler, G. R. (1961) *Angular momentum*, Oxford University, London, 2nd ed.
- Cai, K., Langen, R., Hubbell, W. L., and Khorana, H. G. (1997) *Proc. Natl. Acad. Sci. USA* 94: 14267-14272
Structure and function in rhodopsin: Topology of the C-terminal polypeptide chain in relation to the cytoplasmic loops
- Cai, K., Klein-Seetharaman, J., Farrens, D., Zhang, C., Altenbach, C., Hubbell, W. L., and Khorana, G. H. (1999) *Biochem.* 38: 7925-7930
Single-cysteine substitution mutants at amino acid positions 306-321 in rhodopsin, the sequence between the cytoplasmic end of helix VII and the palmitoylation sites: Sulfhydryl reactivity and transducin activation reveal a tertiary structure
- Cantor, C. R., and Pechukas, P. (1971) *Proc. Natl. Acad. Sci. USA* 68 : 2099-2101
Determination of distance distribution functions by singlet singlet energy transfer
- Carrero, J., and Voss, E. W. Jr. (1996) *J. Biol. Chem.* 271: 5332-5337
Temperature and pH dependence of fluorescein binding within the monoclonal antibody 9-40 active site as monitored by hydrostatic pressure
- Cevc, G., and Marsh, D. (1987) in *Cell Biology: A series of monographs*, Bittar E. E. ed., Vol. 5
Phospholipid bilayers: Physical principles and models
- Chandrasekhar, S. (1943) *Rev. Mod. Phys.* 15: 1-23
Stochastic problems in physics and astronomy
- Chen, R. F., and Scott, C. H. (1985) *Anal. Letts* 18: 393-421
Atlas of fluorescence spectra and lifetime of dyes attached to protein

- Chen, R. F., and Knutson, J. R. (1988) *Anal. Biochem.* 172: 61-77
Mechanism of fluorescence concentration quenching of carboxyfluorescein in liposomes:
Energy transfer to nonfluorescent dimers
- Chen, S. Y., and Cheng, K. H. (1996) *Biophys. J.* 71: 878-884
Detection of membrane packing defects by time-resolved fluorescence depolarization
- Cheung, H. C., Gonsolin, F., and Garland, F. (1985) *Biochim. et Biophys. Acta* 832: 52-62
An investigation of the SH₁-SH₂ and SH₁ - ATPase distances in myosin subfragment-1 by
resonance energy transfer using nanosecond fluorimetry
- Cheung, H. C. (1991) Resonance energy transfer, in *Topics in Fluorescence Spectroscopy, Principles,*
Volume 2: 127-176, J. R. Lakowicz (ed.) Plenum Press, New York
- Chuang, T. J., and Eisenthal, K. B. (1972) *J. Chem. Phys.* 57: 5094-5097
Theory of fluorescence depolarization by anisotropic rotational diffusion
- Clegg, R. M., Murchie, A. I. H., Zechel, A., Carlberg, C., Diekmann, S., and Lilley, D. M. J. (1992)
Biochem. 31: 4846-4856
Fluorescence resonance energy transfer analysis of the structure of the four-way DNA junction
- Craver, F. W., and Knox, R. S. (1971) *Mol. Phys.* 22: 385-402
Theory of polarization quenching by excitation transfer, II. Anisotropy and second-neighbour
considerations
- Cross, J. A., Waldeck, D. H., and Fleming G. R. (1983) *J. Chem. Phys.* 78: 6455-6467
Time resolved polarization spectroscopy: Level kinetics and rotational diffusion
- Cundall, R. B., and Dale, R. E. (1983) *Time-resolved fluorescence spectroscopy in biochemistry and biology,*
Plenum Press, New York
- Dale, R. E., and Eisinger, J. (1975) Polarized excitation energy transfer, in *Biochemical Fluorescence*
Concepts, Chen and Edelhoch, eds., New York
- Dale, R. E., and Eisinger, J. (1976) *Proc. Natl. Acad. Sci. USA* 73: 271-273
Intramolecular energy transfer and molecular conformation
- Dale, R. E., Eisinger, J., and Blumberg, W. E. (1979) *Biophys. J.* 26: 161-194
The orientational freedom of molecular probes: The orientation factor in intramolecular energy
transfer

- DeGrip, W. J. (1982a) *Meth. Enzym.* 81: 197-207
Purification of bovine rhodopsin over concanavalin A-sepharose
- DeGrip, W. J. (1982b) *Meth. Enzym.* 81: 223-236
Sulfhydryl chemistry of rhodopsin
- Delange, F., Merckx, M., Bovee-Geurts, P. H. , Pistorius, A. M., and Degrip, W. J. (1997)
Eur. J. Biochem. 243:174-180
Modulation of the metarhodopsin I/metarhodopsin II equilibrium of bovine rhodopsin by ionic strength: Evidence for a surface-charge effect
- Dewey, T. G., and Hammes G. G. (1980) *J. Biophys. Soc.* 32: 1023-1035
Calculation of fluorescence resonance energy transfer on surfaces
- Dickopf, S., Mielke, T., and Heyn, M. P. (1998) *Biochem.* 37: 16888-16897
Kinetics of the light-induced proton translocation associated with the pH-dependent formation of the metarhodopsin I/II equilibrium of bovine rhodopsin
- Dijkstra, D. S., Broos, J., Visser, A. J. W. G., van Hoek, A., and Robillard, G. T. (1997)
Biochem. 36: 4860-4866
Dynamic fluorescence spectroscopy on single tryptophan mutants of EII^{ml} in detergent micelles. Effects of substrate binding and phosphorylation on the fluorescence and anisotropy decay
- Dong, W.-J., Chandra, M., Xing, J., Solaro, R. J., and Cheung, H. C. (1997) *Biochem.* 36: 6745-6753
Conformation of the N-terminal segment of a monocysteine mutant of troponin I from cardiac muscle
- Döring, K., Beck, W., Konermann, L., and Jähnig, F. (1997) *Biophys. J.* 72: 326-334
The use of a long-lifetime component of tryptophan to detect slow orientational fluctuations of proteins
- Dunham, T. D., and Farrens, D. L. (1999) *J. Biol. Chem.* 274: 1683-1690
Conformational changes in rhodopsin: Movement of helix F detected by site-specific chemical labeling and fluorescence spectroscopy
- Eftink, M. R., and Ghiron, C., A. (1981) *Anal. Biochem.* 114: 199-227
Fluorescence quenching studies with proteins

- Eftink, M. R., Selva, T. J., and Wasylewski, Z. (1987) *Photochem. Photobiol.* 46: 23-30
Studies of the efficiency and mechanism of fluorescence quenching reactions using acrylamide and succinimide as quenchers
- Eftink, M. R. (1991) *Fluorescence quenching: Theory and applications*, in *Topics in Fluorescence Spectroscopy, Principles*, Volume 2: 53-126, J. R. Lakowicz (ed.) Plenum Press, New York
- Emeis, D., Kühn, H., Reichert, J., and Hofmann, K. P. (1982) *FEBS Letts.* 143: 29-34
Complex formation between metarhodopsin II and GTP-binding protein in bovine photoreceptor membranes leads to a shift of the photoproduct equilibrium
- Erijman, L., and Weber, G. (1991) *Biochem.* 30: 1595-1599
Oligomeric protein associations: Transition from stochastic to deterministic equilibrium
- Erijman, L., and Weber, G. (1993) *Photochem. Photobiol.* 57: 411-415
Use of sensitized fluorescence for the study of the exchange of subunits in protein aggregates
- Essen, L.-O., Siegert, R., Lehmann, W. D., and Oesterhelt, D. (1998)
Proc. Natl. Acad. Sci. USA 95: 11673-11678
Lipid patches in membrane protein oligomers: crystal structure of the bacteriorhodopsin-lipid complex
- Fa, M., Karolin, J., Aleshkov, S., Strandberg, L., Johansson, L. B.-A., and Ny, T. (1995)
Biochem. 34: 13833-13840
Time-resolved polarized fluorescence spectroscopy studies of plasminogen activator inhibitor type 1: Conformational changes of the reactive center upon interaction with target proteases, vitronectin and heparin
- Farahbakhsh, Z. T., Hideg, K., & Hubbell, W. L. (1993) *Science* 262: 1416-1419
Photoactivated conformational changes in rhodopsin: A time-resolved spin label study
- Farahbakhsh, Z. T., Ridge, K. D., Khorana, H. G., and Hubbell, W. L. (1995) *Biochem.* 34: 8812-8819
Mapping light-dependent structural changes in the cytoplasmic loop connecting helices C and D in rhodopsin: A site-directed spin labeling study
- Farrens, D. L., and Khorana, H. G. (1995) *J. Biol. Chem.* 270: 5073-5076
Structure and function in rhodopsin
- Farrens, D. L., Altenbach, C., Yang, K., Hubbell, W. L., and Khorana, H. G. (1996) *Science* 274: 768-770
Requirement of rigid-body motion of transmembrane helices for light activation of rhodopsin

- Fedchenia, I. I., and Westlund, P.-O. (1994) *Phys. Rev. E.* 50: 555-565
Influence of molecular reorientation on electronic energy transfer between a pair of mobile chromophores: the stochastic Liouville equation combined with Brownian dynamic simulation techniques
- Fedchenia, I. I., and Westlund, P.-O. (1995) *Mol. Phys.* 84: 159-169
Energy transfer between two mobile chromophores in a zero energy transfer configuration. Cross-correlation effects in the fluorescence anisotropy $r(t)$
- Fernandez, M., and Fromherz, P. (1993) *J. Phys. Chem.* 31: 1755-1761
Lipoid pH indicators as probes of electrical potential and polarity in micelles
- Ferreira, S. T., Stella, L., and Gratton, E. (1994) *Biophys. J.* 66: 1185-1196
Conformational dynamics of bovine Cu, Zn superoxide dismutase revealed by time-resolved fluorescence spectroscopy of the single tyrosine residue
- Filizola, M., Carteni-Farina, M., and Perez, J. J. (1999) *J. Phys. Chem. B* 103: 2520-2527
Modeling the 3D structure of rhodopsin using a de novo approach to build G protein-coupled receptors
- Fimmel, S., Choli, T., Dencher, N. A., Büldt, G., and Wittman-Liebold, B. (1989) *Biochim. Biophys. Acta* 978: 231-240
Topography of surface exposed amino acid in the membrane protein bacteriorhodopsin determined by proteolysis and microsequencing
- Förster, T. (1948) *Ann. Phys. (Leipzig)* 2: 55-75
Intermolecular energy migration and fluorescence
- Förster, T. (1967) Mechanism of energy transfer, in *Comprehensive Biochemistry*, Florkin, M., and Statz, E. H., eds., Vol 22: 61-77, Elsevier, New York
- Franke, R. R., König, B., Sakmar, T. P., Khorana, H. G., and Hoffman, K. P. (1990) *Science* 250: 123-125
Rhodopsin mutants that bind but fail to activate transducin
- Franke, R. R., Sakmar, T. P., Graham, R. M., and Khorana, H. G. (1992) *J. Biol. Chem.* 267: 14767-14774
Structure and function in rhodopsin: Studies of the interaction between the rhodopsin cytoplasmic domain and transducin
- Fujiwara, T., and Nagayama, K. (1985) *J. Chem. Phys.* 83: 3110-3177
The wobbling-in-a-cone analysis of internal motion in macromolecules

- Gibson, S. K., Parkes, J. H., and Liebman, P. A. (1999) *Biochem.* 38: 11103-11114
Phosphorylation alters the pH-dependent active state equilibrium of rhodopsin by modulating the membrane surface potential
- Glaeser, R. M., Jubb, J. S., and Henderson, R. (1985) *Biophys. J.* 48: 775-780
Structural comparison of native and deoxycholate-treated purple membrane
- Govindjee, R., Becher, B., and Ebrey, T.G. (1978) *Biophys. J.* 22: 67-77
The fluorescence from the chromophore of the purple membrane protein
- Govindjee, R., Kinosita, K., Ikegami, A., and Ebrey, T.G. (1984) *Biophys. J.* 45: 214a
Conformational changes of bacteriorhodopsin as probed by a fluorescent dye
- Gratton, E., Jameson, D. M., Weber, G., and Alpert, B. (1984) *J. Biophys. Soc.* 45: 789-794
A model of dynamic quenching of fluorescence in globular proteins
- Grigorieff, N., Ceska, T. A., Downing, K. H., Baldwin, J. M., and Henderson, R. (1996)
J. Mol. Biol. 259: 393-421
Electron-crystallographic refinement of the structure of bacteriorhodopsin
- Grinvald, A., and Steinberg, I. Z. (1974) *Anal. Biochem.* 59: 583-593
On the analysis of fluorescence decay kinetics by the method of least-squares
- Grzesiek, S., and Dencher, N. A. (1986) *FEBS Letts.* 208: 337-342
Time-course and stoichiometry of light-induced proton release and uptake during the photocycle of bacteriorhodopsin
- Guan, J.-Q., and Tung, C.-H. (1998) *J. Coll. Inter. Sci.* 208: 90-95
Dynamics of fluorescence quenching of pyrene in novel micelles of the zwitterionic betaine surfactant N-(3-dodecyloxy-2-hydroxypropyl)-N,N-dimethylglycine
- Guest, C. R., Hochstrasser, R. A., Dupuy, C. G., Allen, D. J., Benkovic, S. J., and Millar, D. M. (1991)
Biochem. 30: 8759-8770
Interaction of DNA with the Klenow fragment of DNA polymerase I studied by time-resolved fluorescence spectroscopy
- Haas, E., Wilchek, M., Katchalski-Katzir, E., and Steinberg, I. Z. (1975)
Proc. Nat. Acad. Sci. USA 72: 1807-1811
Distribution of end-to-end distances of oligopeptides in solution as estimated by energy transfer

- Haas, E., and Steinberg, I. Z. (1984) *J. Biophys. Soc.* 46: 429-437
Intramolecular dynamics of chain molecules monitored by fluctuations in efficiency of excitation energy transfer
- Hamman, B. D., Oleinikov, A. V., Jokhadze, G. G., Traut, R. R., and Jameson, D. M. (1996a)
Biochem. 35: 16672-16679
Rotational and conformational dynamics of *Escherichia coli* ribosomal protein L7/L12
- Hamman, B. D., Oleinikov, A. V., Jokhadze, G. G., Traut, R. R., and Jameson, D. M. (1996b)
Biochem. 35: 16680-16686
Dimer/Monomer equilibrium and domain separations of *Escherichia coli* ribosomal protein L7/L12
- Handbook of Chemistry and Physics (1986), 67th edition, R. C. Weast ed., CRC Press Inc., Boca Raton, Florida
- Handel, T. M., Williams, S.A., Menyhard, D., and DeGrado, W. F. (1993) *J. Am. Chem. Soc.* 115: 4457-4460
Introduction of a Trp residue into α_4 as a probe of dynamics
- Hanson, D. C., Yguerabide, J., and Schumaker, V. N. (1981) *Biochem.* 20: 6842-6852
Segmental flexibility of immunoglobulin G antibody molecules in solution: A new interpretation
- Haran, G., Haas, E., Szpikowska, B. K., and Mas, M. T. (1992)
Proc. Natl. Acad. Sci. USA 89: 11764-11768
Domain motions in phosphoglycerate kinase: Determination of interdomain distance distribution by site-specific labeling and time-resolved fluorescence energy transfer
- Harms, G. S., Freund, W. L., and Johnson, C. K. (1998) *J. Phys. Chem. B* 102: 5004-5010
Time-resolved fluorescence study of conformational dynamics in opioid peptides
- Hargrave, P. A., McDowell, Curtis, J. H., Wang, D. R., Juszczak, E., Fong, S.-L., Mohanna-Rao, J. K., and Argos, P. (1983) *Biophys. Struc. Mech.* 9: 235-244
The structure of bovine rhodopsin
- Hargrave, P. A., and McDowell, J. H. (1992) *FASEB* 6: 2323-2331
Rhodopsin and phototransduction: a model system for G protein-linked receptors
- Haugland, R. P., (1996) *Handbook of fluorescent probes and research chemicals*, (K.D.Larrison, ed.), 6th Ed., Molecular Probes, Eugene, Oregon

- Hauß, T., Grzesiek, S., Otto, H., Westerhausen, J., and Heyn, M. P. (1990) *Biochem* 29: 4904-4913
Transmembrane location of retinal in bacteriorhodopsin by neutron diffraction
- Henderson, R., Baldwin, J. M., Ceska, T. A., Zemlin, F., Beckmann, E., and Downing, K. H. (1990)
J. Mol. Biol. 213: 899-929
Model for the structure of bacteriorhodopsin based on high-resolution electron cryo-microscopy
- Heyn, M. P., Cherry, R. J., and Müller, U. (1977) *J. Mol. Biol.* 117: 607-620
Transient and linear dichroism studies on bacteriorhodopsin: determination of the orientation of the 568 nm all-trans retinal chromophore
- Heyn, M. P. (1979) *FEBS Letts.* 108: 359-364
Determination of lipid order parameters and rotational correlation times from fluorescence depolarization experiments
- Heyn, M. P., Cherry, R. J., and Dencher, N. A. (1981a) *Biochem.* 20: 840-849
Lipid-protein interactions in bacteriorhodopsin-dimyristoylphosphatidylcholine vesicles
- Heyn, M. P., Blume, A., Rehorek, M., and Dencher, N. A. (1981b) *Biochem.* 20: 7109-7115
Calorimetric and fluorescence depolarization studies on the lipid phase transition of bacteriorhodopsin-dimyristoylphosphatidylcholine vesicles
- Heyn, M. P., Westerhausen, J., Wallat, I., and Seiff, F. (1988) *Proc. Natl. Acad. Sci. USA* 85: 2146-2150
High sensitivity neutron diffraction of membranes: Location of the Schiff base end of the chromophore of bacteriorhodopsin
- Heyn, M. P. (1989) Order and viscosity of membranes: Analysis by time-resolved fluorescence depolarization, in *Methods in Enzymology*, Vol. 172: 462-471, *Membrane Analysis and Characterisation*, Academic Press, New York
- Hillel, Z., and Wu, C.-W. (1976) *Biochem.* 15: 2105-2113
Statistical interpretation of fluorescence energy transfer measurements in macromolecular systems
- Hiratsuka, T. (1997) *Biophys. J.* 72: 843-849
Monitoring the myosin ATPase reaction using an sensitive fluorescent probe: pyrene-labeled ATP
- Hofmann, K. P., Jäger, S., and Ernst, O. P. (1995) *Isr. J. Chem* 35: 339-355
Structure and function of activated rhodopsin

- Hudson, E. N., and Weber, G. (1973) *Biochem.* 12: 4154-4160
Synthesis and characterization of two fluorescent sulfhydryl reagents
- Hughson, F. M., Barrick, D., and Baldwin, R. L. (1991) *Biochem.* 30: 4113-4118
Probing the stability of a partly folded apomyoglobin intermediate by site-directed mutagenesis
- Hwa, J., Reeves, P. J., Klein-Seetharaman, J., Davidson, F., and Khorana, H. G. (1999)
Proc. Natl. Acad. Sci. USA 96: 1932-1935
Structure and function in rhodopsin: Further elucidation of the role of the intradiscal cysteines, Cys-110, -185, and -187 in rhodopsin folding and function
- Jablonski, A. (1935) *Z. Phys.* 94: 38-46
Über den Mechanismus der Photolumineszenz von Farbstoffen
- Jäger, F., Fahmy, K., Sakmar, T. P., and Siebert, F. (1994) *Biochem.* 33: 10878-10882
Identification of glutamic acid 113 as the Schiff base proton acceptor in the metarhodopsin II photointermediate of rhodopsin
- Jayaraman, S., Teitler, L., Skalski, B., and Verkman, A. S. (1999) *Am. J. Physiol.* 277: 1008-1018
Long-wavelength iodide-sensitive fluorescent indicators for measurement of functional CFTR expression in cells
- Johansson, L. B.-A., Edman, P., and Westlund (1996) *J.Chem.Phys.* 105: 10896-10904
Energy migration and rotational motion within bichromophoric molecules. II. A derivation of the fluorescence anisotropy
- Johnson, D. A., and Yguerabide, J. (1985) *Biophys. J.* 48: 949-955
Solute accessibility to N^ε-fluoresceinisothiocyanate-lysine-23 cobra α -toxin bound to the acetylcholine receptor
- Johnson, M. L. (1994) *Methods Enzymol.* 240: 1-22
Use of least-squares techniques in biochemistry
- Juszczak, L. J., Zhang, Z.-Y., Wu, L., Gottfried, D. S., and Eads, D. D. (1997) *Biochem.* 36: 2227-2236
Rapid loop dynamics of *yersinia* protein tyrosine phosphatases

- Kandori, H., Katsuta, Y., Ito, M., and Sasabe, H. (1995) *J. Am. Chem. Soc.* 117: 2669-2670
Femtosecond fluorescence study of the rhodopsin chromophore in solution
- Karnik, S. S., Sakmar, T. P., Chen, H.-B., and Khorana, H. G. (1988)
Proc. Natl. Acad. Sci. USA 85: 8459-8463
Cysteine residues 110 and 187 are essential for the formation of correct structure in bovine rhodopsin
- Karolin, J., Fa, M., Wilczynska, M., Ny, T., and Johansson, L. B.-A. (1998) *Biophys. J.* 74: 11-21
Donor-Donor energy migration for determining intramolecular distances in proteins:
I. Application of a model to the latent plasminogen activator inhibitor-1 (PAI-1)
- Kawato, S., Kinoshita, K., and Ikegami, A. (1977) *Biochem.* 16: 2319-2324
Dynamic structure of lipid bilayers studied by nanosecond fluorescence techniques
- Kelly, L. A., Trunk, J. G., and Sutherland, J. C. (1997) *Rev. Sci. Instrum.* 68: 2279-2286
Time-resolved fluorescence polarization measurements for entire emission spectra with a resistive-anode, single-photon-counting detector: The Fluorescence Omnilyzer
- Kemple, M. D., Yuan, P., Nollet, K. E., Fuchs, J. A., Silvia, N., and Prendergast, F. G. (1993)
Biophys. J. 66: 2111-2126
¹³C NMR and fluorescence analysis of tryptophan dynamics in wild-type and two single-Trp variants of *Escherichia coli* thioredoxin
- Khorana, H. G., Gerber, G. E., Herlihy, W. C., Gray, C. P., Anderegg, R. J., Nihei, K., and Biemann, K. (1979) *Proc. Natl. Acad. Sci. USA* 76: 5046-5050
Amino acid sequence of bacteriorhodopsin
- Khorana, H. G. (1988) *J. Biol. Chem.* 263: 7439-7442
Bacteriorhodopsin, a membrane protein that uses light to translocate protons
- Khorana, H. G. (1992) *J. Biol. Chem.* 267: 1-4
Rhodopsin, photoreceptor of the rod cell
- Kibelbek, J., Mitchell, D. C., Beach, J. M., and Litman, B. J. (1991) *Biochem.* 30: 6761-6768
Functional equivalence of metarhodopsin II and the Gt-activating form of photolyzed bovine rhodopsin
- Kinoshita, K., Kawato, S., and Ikegami, A. (1977) *Biophys. J.* 20: 289-305
A theory of fluorescence polarization decay in membranes

- Kinosita, Jr., K., Ikegami, A., and Kawato, S. (1982) *Biophys. J.* 37: 461-464
On the wobbling-in-cone analysis of fluorescence anisotropy decay
- Klein-Seetharaman, J., Hwa, J., Cai, K., Altenbach, C., Hubbell, W. L., and Khorana, H. G. (1999a)
Biochem. 38: 7938-7944
Single-cysteine substitution mutants at amino acid position 55-75, the sequence connecting the cytoplasmic ends of helices I and II in rhodopsin: Reactivity of the sulphhydryl groups and their derivatives identifies a tertiary structure that changes upon light-activation
- Klein-Seetharaman, J., Getmanova, E. V., Loewen, M. C., Reeves, P. J., and Khorana, H. G. (1999b)
J. Am. Chem. Soc. 96: 13744-13749
NMR spectroscopy in studies of light-induced structural changes in mammalian rhodopsin: Applicability of solution ^{19}F NMR
- Kliger, D. S. and Lewis, J. W. (1995) *Isr. J. Chem* 35: 289- 307
Spectral and kinetic characterisation of visual pigment photointermediates
- König, B., Arendt, A., McDowell, J. H., Kahlert, M., Hargrave, P. A., and Hoffman, K. P. (1989)
Proc. Natl. Acad. Sci. USA 86: 6878-6882
Three cytoplasmic loops of rhodopsin interact with transducin
- Kometani, T., Kinosita, K., Furuno, T., Kouyama, T., and Ikegami, A. (1987) *Biophys. J.* 52: 509-517
Transmembrane location of retinal in purple membrane
- Kooyman, R., P., H., Levine, Y. K., and van der Meer, W. (1981) *Chem. Phys.* 60: 317-326
Measurement of second and fourth rank order parameters by fluorescence polarization experiments in a lipid membrane system
- Kouyama, T., Kimura, Y., Kinosita jr, K., and Ikegami, A. (1981) *FEBS Letts.* 124: 100-103
Immobility of the chromophore in bacteriorhodopsin
- Kraayenhof, R., Sterk, G.J., and Sang, H.W.W.F. (1993) *Biochem.* 32: 100057-10066
Probing biomembrane interfacial potential and pH profiles with a new type of float-like fluorophores positioned at varying distance from the membrane surface

- Krebs, M. P., Mollaaghababa, R., and Khorana, H. G. (1993) Proc. Natl. Acad. Sci. USA 90: 1987-1991
Gene replacement in *halobacterium halobium* and expression of bacteriorhodopsin mutants
- Krebs, A., Villa, C., Edwards, P. C., and Schertler, G. F. X. (1998) J. Mol. Biol. 282: 991-1003
Characterisation of an improved two-dimensional p22₁2₁ crystal from bovine rhodopsin
- Kumke, M. U., Li, G., and McGown, B. (1995) Anal. Chem. 67: 3945-3951
Hybridization of fluorescein-labeled DNA oligomers detected by fluorescence anisotropy with protein binding enhancement
- Lamba, O. P., Borchman, D., and O'Brien, P. J. (1994) Biochem. 33: 1704-1712
Fourier transform infrared study of the rod outer segment disk and plasma membranes of vertebrate retina
- Lakowicz, J. R., (1983) Principles of Fluorescence Spectroscopy, Plenum Press, New York
- Lakowicz, J. R., (1999) Principles of Fluorescence Spectroscopy, Second Edition, Plenum Press, New York
- Lakowicz, J. R., (1991) Topics in Fluorescence Spectroscopy (Vol.1 - 3), Plenum Press, New York
- Landau, E. M., and Rosenbusch, J. P. (1996) Proc. Natl. Acad. Sci. USA 93: 14532-14535
Lipidic cubic phases: A novel concept for the crystallization of membrane proteins
- Langen, R., Cai, K., Altenbach, C., Khorana, G. H., and Hubbell, W. L. (1999) 38: 7918-7924
Structural features of the C-terminal domain of bovine rhodopsin: A site-directed spin-labeling study
- Lanyi, J. K. (1993) Biochim. Biophys. Acta 1183: 241-261
Proton translocation mechanism and energetics in the light-driven pump bacteriorhodopsin
- Lanyi, J. K., and Váró, G. (1995) Isr. J. Chem. 35: 365-385
The photocycles of bacteriorhodopsin
- Lee, S. P., Porter, D., Ghirikjian, J. G., Knutson, J. R., and Han, M. K. (1994)
Anal. Biochem. 220: 377-383
A fluorometric assay for DNA cleavage reactions characterized with *bam*HI restriction endonuclease

- Lehrer, S. S. (1971) *Biochem.* 10: 3254-3263
Solute perturbation of protein fluorescence: The quenching of the tryptophyl fluorescence of model compounds and of lysozyme by iodide ion
- Lehrer, S. S., and Leavis, P. C. (1978) *Methods Enzymol.* 49: 222-236
Solute quenching of protein fluorescence
- Leszczynski, J. F., and Rose, G. D. (1986) *Science* 234: 849-855
Loops in globular proteins: a novel category of secondary structure
- Liao, M.-J., London, E., and Khorana, H. G. (1983) *J. Biol. Chem.* 258: 9949-9955
Regeneration of the native bacteriorhodopsin structure from two chymotryptic fragments
- Lim, K., Jameson, D. M., Gentry, C. A., and Herron, J. N. (1995) *Biochem.* 34: 6975-6984
Molecular dynamics of the anti-fluorescein 4-4-20 antigen-binding fragment. 2. Time-resolved fluorescence spectroscopy
- Lin, S., and Mathies, R. A. (1989) *Biophys. J.* 56: 653-660
Orientation of the protonated retinal Schiff base in bacteriorhodopsin from absorption linear dichroism
- Lipari, G., and Szabo, A. (1980) *Biophys. J.* 30: 489-506
Effect of vibrational motion on fluorescence depolarization and nuclear magnetic resonance relaxation in macromolecules and membranes
- Lipari, G., and Szabo, A. (1981) *J. Chem. Phys.* 75: 2971-2976
Padé approximants to correlation functions for restricted rotational diffusion
- Lipari, G., and Szabo, A. (1982a) *J. Am. Chem. Soc.* 104: 4546-4559
Model-free approach to the interpretation of nuclear magnetic-resonance relaxation in macromolecules: 1. Theory and range of validity
- Lipari, G., and Szabo, A. (1982b) *J. Am. Chem. Soc.* 104: 4559-4570
Model-free approach to the interpretation of nuclear magnetic-resonance relaxation in macromolecules: 2. Analysis of the experimental results
- Lopez Martinez, M. C., and De la Torre, J. G. (1987) *Biophys. J.* 52: 303-310
Brownian dynamics simulation of restricted rotational diffusion

- Lozier, R. H., Bogomolni, A., and Stoeckenius, W. (1975) *Biophys. J.* 15: 955- 962
Bacteriorhodopsin: A light-driven proton pump in *halobacterium halobium*
- Luecke, H., Richter, H. T., and Lanyi, J. K. (1998) *Science* 280: 1934-1937
Proton Transfer Pathways in Bacteriorhodopsin at 2.3 Angstrom Resolution
- Luecke, H., Schobert, B., Richter, H.-T., Cartailler, J.-P., and Lanyi, J. K. (1999) *J. Mol. Biol.* 291: 899-911
Structure of bacteriorhodopsin at 1.55 angstrom resolution
- Luecke, H., Schobert, B., Richter, H.-T., Cartailler, J.-P., and Lanyi, J. K. (1999) *Science* 286: 255-259
Structural changes in bacteriorhodopsin during ion transport at 2 angstrom resolution
- Lugtenburg, J., Muradin-Szweykowska, M., Heermans, C., and Pardoën, J. A. (1986)
J. Am. Chem. Soc. 108: 3104-3105
Mechanism for the opsin-shift of retinal's absorption in bacteriorhodopsin
- Marque, J., Kinosita, K., Govindjee, R., Ikegami, A., Ebrey, T.G., and Otomo, J. (1986)
Biochem. 25: 5555-5559
Environmental modulation of C-terminus dynamic structure in bacteriorhodopsin
- Marr, K., and Peters, K. S. (1991) *Biochem.* 30: 1254-1258
Photoacoustic calorimetric study of the conversion of rhodopsin and isorhodopsin to lumirhodopsin
- Mathies, R. A., Lin, S. W., Ames, J. B., and Pollard, W. T. (1991)
Annu. Rev. Biophys. Biophys. Chem. : 491-517
From femtoseconds to biology: mechanism of bacteriorhodopsin' s light-driven proton pump
- Matthews, R. G., Hubbard, R., Brown, P. K., and Wald, G. (1963) *J. Gen. Phys.* 47: 215-240
Tautomeric forms of metarhodopsin
- McDowell, J. H., and Kühn, H. (1977) *Biochem.* 16: 4054-4060
Light-induced phosphorylation of rhodopsin in cattle photoreceptor membranes: substrate activation and inactivation
- Michl, J., and Thulstrup, E. W. (1995) *Spectroscopy with Polarized Light*, VCH Publishers, Inc.
- Mielke, T. (2000) Dissertation (in Bearbeitung), Freie Universität Berlin
Untersuchung zur Struktur und Dynamik der zytoplasmatischen Loopbereiche von Rhodopsin

- Miyata, H., and Asai, H. (1981) *J. Biochem.* 90: 133-139
Amphoteric charge distribution at the enzymatic site of 1,N⁶-ethenoadenosine triphosphate-binding heavy meromyosin determined by dynamic fluorescence quenching
- Möller, C., Allen, M., Elings, V., Engel, A., and Müller, D. (1999) *Biophys. J.* 77: 1150-1158
Tapping-mode atomic force microscopy produces faithful high-resolution images of protein surfaces
- Molecular Probes, (1996) *Handbook of Fluorescent Probes and Research Chemicals*, sixth edition
by R. P. Haugland
- Mollaaghababa, R., Steinhoff, H.-J., Hubbell, W. L., and Khorana, H. G. (2000) *Biochem.* 39: 1120-1127
Time-resolved site-directed spin-labeling studies of bacteriorhodopsin: loop-specific conformational changes in M
- Moncrieffe, M. C., Juranic, N., Kemple, M. D., Potter, J. D., Macura, S., and Prendergast, F. G. (2000)
J. Mol. Biol. 297: 147-163
Structure-fluorescence correlations in a single tryptophan mutant of carp parvalbumin:
Solution structure, backbone and side-chain dynamics
- Müller, D. J., Schabert, F. A., Büldt, G., and Engel, A. (1995) *Biophys. J.* 68: 1681-1686
Imaging purple membranes in aqueous solutions at subnanometer resolution by atomic force microscopy
- Müller, D. J., Sass, H.-J., Müller, S., Büldt, G., and Engel, A. (1999) *J. Mol. Biol.* 285: 1903-1909
Surface structures of native bacteriorhodopsin depend on the molecular packing arrangement in the membrane
- Munro, I. H., and Schwentner, N. (1983) *Nuclear Instruments and Methods* 208: 819-834
Time resolved spectroscopy using synchrotron radiation
- Nakanishi, K., Balogh-Nair, V., Arnaboldi, M., Tsujimoto, K., and Honig, B. (1980)
J. Am. Chem. Soc. 102: 7945-7947
An external point-charge model for bacteriorhodopsin to account for its purple colour
- Nathans, J. (1992) *Biochem.* 31: 4923-4931
Perspectives in biochemistry; rhodopsin: structure, function, and genetics
- Nishimoto, E., Yamashita, S., Szabo, A. G. and Imoto, T. (1998) *Biochem.* 37: 5599-5607
Internal motion of lysozyme studied by time-resolved fluorescence depolarisation of tryptophan residues

- O' Connor, D. V., and Phillips, D. (1984) Time-correlated single photon counting. Academic Press, New York
- Oesterhelt, D., and Stoeckenius, W. (1973) Proc. Natl. Acad. Sci. USA 70: 2853-2857
Functions of a new photoreceptor membrane
- Oesterhelt, D., and Stoeckenius, W. (1974) Methods Enzymol. 31: 667-678
Isolation of the cell membrane of *halobacterium halobium* and its fractionation into red and purple membrane
- Oseroff, A. R., and Callender, R. H. (1974) Biochem. 13: 4243-4248
Resonance Raman spectroscopy of rhodopsin in retinal disk membranes
- Ottolenghi, M. (1980) The photochemistry of rhodopsins, in Advances in Photochemistry Vol. 12, Ed. Pitts, J. N., and Hammond, G. S., John Wiley & Sons, Inc. New York
- Ovchinnikov, Y. A., Abdulaev, N. G., Feigina, M. Y., Kiselev, A. V., and Lobanov, N. A. (1979) FEBS Letts. 100: 219-224
The structural basis of the functioning of bacteriorhodopsin: An overview
- Ovchinnikov, Y. A. (1982) FEBS Lett. 148: 179-191
Rhodopsin and bacteriorhodopsin: Structure-function relationships
- Palmer, A. G., Hochstrasser, R. A., Millar, D. P., Rance, M., and Wright, P. E. (1993) J. Am. Chem. Soc. 115: 6333-6345
Characterization of amino acid side chain dynamics in a zinc-finger peptide using ^{13}C NMR spectroscopy and time-resolved fluorescence spectroscopy
- Parkes, J. H., and Liebman, P. A. (1984) Biochem. 23: 5054-5061
Temperature and pH dependence of the metarhodopsin I-metarhodopsin II kinetics and equilibria in bovine rod disk membrane suspensions
- Parkes, J. H., Gibson, S. K., and Liebman, P. A. (1999) Biochem. 38: 6862-6878
Temperature and pH dependence of the metarhodopsin I-metarhodopsin II equilibrium and the binding of metarhodopsin II to G protein in rod disk membranes
- Peng, K., Visser, A. J. W. G., van Hoek, A., Wolfs, C. J. A. M., Sanders, J. C., and Hemminga, M. A. (1990a) Eur. Biophys. J. 18: 277-283
Analysis of time-resolved fluorescence anisotropy in lipid-protein systems, I: Application to the

lipid probe octadecyl rhodamine B in interaction with bacteriophage M13 coat protein incorporated in phospholipid bilayers

Peng, K., Visser, A. J. W. G., van Hoek, A., Wolfs, C. J. A. M., Sanders, J. C., and Hemminga, M. A. (1990b)

Eur. Biophys. J. 18: 285-293

Analysis of time-resolved fluorescence anisotropy in lipid-protein systems, II: Application to tryptophan fluorescence of bacteriophage M13 coat protein incorporated in phospholipid bilayers

Peters, J., Peters, R., and Stoeckenius, W. (1976) FEBS Letts. 61: 128-134

A photosensitive product of sodium borohydride reduction of bacteriorhodopsin

Pogozheva, I. D., Lomize, A. L., and Mosberg, H. I. (1997) Biophys.J. 72: 1963-1985

The transmembrane 7-alpha-bundle of rhodopsin: Distance geometry calculations with hydrogen bonding constraints

Radding, C. R., and Wald, G. (1956) J. Gen. Phys. 39: 909-923

Acid-base properties of rhodopsin and opsin

Raymond, F. C., and Knutson, J. R. (1988) Anal. Biochem. 172: 61-77

Mechanism of fluorescence concentration quenching of carboxyfluorescein in liposomes: Energy transfer to non fluorescent dimers

Rehorek, M., Dencher, N., and Heyn, M. P. (1983) Biophys. J. 43: 39-45

Fluorescence energy transfer from diphenylhexatriene to bacteriorhodopsin in lipid vesicles

Rehorek, M., Dencher, N., and Heyn, M. P. (1985) Biochem. 24: 5980-5988

Long-range lipid-protein interactions. Evidence from time-resolved fluorescence depolarization and energy-transfer experiments with bacteriorhodopsin-dimyristoylphosphatidylcholine vesicles

Resek, J. F., Farahbakhsh, Z. T., Hubbell, W. L., and Khorana, H. G. (1993) Biochem. 32: 12025-12023

Formation of the meta II photointermediate is accompanied by conformational changes in the cytoplasmic surface of rhodopsin

Ridge, K. D., Zhang, C., and Khorana, H. G. (1995) Biochem. 34: 8804-8811

Mapping of the amino acids in the cytoplasmic loop connecting helices C and D in rhodopsin. Chemical reactivity in the dark state following single cysteine replacements

- Rink, T., Pfeiffer, M., Oesterhelt, D., Gerwert, K., and Steinhoff, H.-J. (2000) *Biophys. J.* 78: 1519-1530
Unraveling photoexcited conformational changes of bacteriorhodopsin by time resolved electron paramagnetic resonance spectroscopy
- Rose, G. D., Gierasch, L. M., and Smith, J. A. (1985) *Adv. Protein Chem.* 37: 1-109
Turns in polypeptides and proteins
- Rosenhagen, H. (1994) Diplomarbeit, TU-Berlin
Untersuchung von ausgesuchten Oberflächenaminoaciden von Bakteriorhodopsin mittels zeitaufgelöster Fluoreszenzdepolarisation
- Runnels, L. W., and Scarlata S. F. (1995) *Biophys. J.* 69: 1569-1583
Theory and application of fluorescence homotransfer to melittin oligomerization
- Sakmar, T. P., Franke, R. R., and Khorana, H. G. (1989) *Proc. Natl. Acad. Sci. USA* 86: 8309-8313
Glutamic-acid 113 serves as the retinilydine Schiff base counterion in bovine rhodopsin
- Sakmar, T. P. (1998) in *Progress in Nucleic Acid Research and Molecular Biology* Vol. 59
Rhodopsin: A prototypical G protein-coupled receptor
- Sato, H., Takeda, K., Tani, K., Hino, T., Okada, T., Nakasako, M., Kamiya, N., and Kouyama, T. (1999) *Acta Crystallogr. Sect. D* 55: 1251-1256
Specific lipid-protein interactions in a novel honeycomb lattice structure of bacteriorhodopsin
- Scherrer, P., Mathew, M. K., Sperling, W., and Stoeckenius, W. (1989) *Biochem.* 28: 829-834
Retinal isomer ratio in dark-adapted purple membrane and bacteriorhodopsin monomers
- Scherrer, P., Alexiev, U., Marti, T., Khorana, H. G., and Heyn, M. P. (1994) *Biochem.* 33: 13684-13692
Covalently bound pH-indicator dyes at selected extracellular or cytoplasmic sites in bacteriorhodopsin. 1. Light-induced proton release kinetics and proton migration along the surface of bacteriorhodopsin micelles
- Schertler, G. F. X., Villa., C., and Henderson, R. (1993) *Nature* 362: 770-772
Projection structure of bovine rhodopsin
- Schmitz, K. S., and Schnur, J. M. (1972) *J. Phys. Chem.* 76: 534-545
The role of orientation constraints and rotational diffusion in bimolecular solution kinetics

- Schneider, W. P., Wensel, T. G., Stryer, L., and Oi, V. T. (1988) *Proc. Natl. Acad. Sci. USA* 85: 2509-2513
Genetically engineered immunoglobulins reveal structural features controlling segmental flexibility
- Schwehm, J. M., and Stites, W. E. (1998) *Methods in Enzymology* 295: 150-169
Application of automated methods for determination of protein conformational stability
- She, M., Dong, W.-J., Umeda, P. K., and Cheung, H. C. (1997) *Biophys. J.* 73: 1042-1055
Time-Resolved Fluorescence Study of the Single Tryptophans of Engineered Skeletal Muscle Troponin C
- Shi, W., Osawa, S., Dickerson, C. D., and Weiss, E. R. (1995) *J. Biol. Chem.* 270: 2112-2119
Rhodopsin mutants discriminate sites important for the activation of rhodopsin kinase and Gt
- Shoup, D., Lipari, G., and Szabo, A. (1981) *Biophys. J.* 36: 697-714
Diffusion-controlled bimolecular reaction rates: The effect of rotational diffusion and orientation constraints
- Steinberg, I. Z. (1971) *Ann. Rev. Biochem.* 47: 819-846
Long-range nonradiative transfer of electronic excitation energy in proteins and polypeptides
- Steinhoff, H.-J., Mollaaghababa, R., Altenbach, C., Hideg, K., Krebs, M. P., Khorana, H. G., and Hubbell, W. L. (1994) *Science* 266: 105-107
Time-resolved detection of structural changes during the photocycle of spin-labeled bacteriorhodopsin
- Stivers, J. T., Abeygunawardana, C., and Mildvan, A. S. (1996) *Biochem.* 35: 16036-16047
¹⁵N NMR relaxation studies of free and inhibitor-bound 4-oxalocrotonate tautomerase: Backbone dynamics and entropy changes of an enzyme upon inhibitor binding
- Stoeckenius, W., and Bogomolni, R. A. (1982) *Annu. Rev. Biochem.* 51: 587-616
Bacteriorhodopsin and related pigments of halobacteria
- Straßburger, J. M., Gärtner, W., and Braslavsky, S. E. (1997) *Biophys. J.* 72: 2294-2303
Volume and enthalpy changes after photoexcitation of bovine rhodopsin: laser-induced optoacoustic studies

- Straume, M., Frasier-Cadoret, S. G., and Johnson, M. L. (1991) Least-squares analysis of fluorescence data, in *Topics in Fluorescence Spectroscopy, Principles, Volume 2: 177-239*, J. R. Lakowicz (ed.) Plenum Press, New York
- Stryer, L. (1978) *Ann. Rev. Biochem.* 47: 819-846
Fluorescence energy transfer as a spectroscopic ruler
- Stryer, L. (1988) *Cold Spring Harb. Symp. Quant. Biol.* 53: 283-294
Molecular basis of visual excitation
- Stryer, L. (1990) *Biochemie*, Spektrum der Wissenschaft Verlagsgesellschaft mbH, Heidelberg
- Subramaniam, S., Faruqi, A. R., Oesterhelt, D., and Henderson, R. (1997)
Proc. Natl. Acad. Sci. USA 94: 1767-1772
Electron diffraction studies of light-induced conformational changes in the Leu-93 - Ala bacteriorhodopsin mutant
- Subramaniam, S., Gerstein, M., Oesterhelt, D., and Henderson, R. (1993) *EMBO J.* 12: 1-8
Electron diffraction analysis of structural changes in the photocycle of bacteriorhodopsin
- Szabo, A. (1984) *J. Chem. Phys.* 81:150-167
Theory of fluorescence depolarization in macromolecules and membranes
- Tanaka, F., and Mataga, N. (1979) *Photochem. Photobiol.* 29: 1091-1097
Theory of time-dependent photoselection in interacting fixed media
- Tanaka, F., and Mataga, N. (1982) *Biophys. J.* 39: 129-140
Dynamic depolarization of interacting fluorophores, effect of internal rotation and energy transfer
- Tanaka, F., Tamai, N., Mataga, N., Tonomura, B., and Hiromi, K. (1994) *Biophys. J.* 67: 874-880
Analysis of internal motion of single tryptophan in streptomyces subtilisin inhibitor from its picosecond time-resolved fluorescence
- Tanaka, F. (1998) *J. Chem. Phys.* 109: 1084-1092
Theory of time-resolved fluorescence under the interaction of energy transfer in a bichromophoric system: Effect of internal rotations of energy donor and acceptor
- Tuzi, S., Naito, A., and Saito, H. (1994) *Biochem.* 33: 15046-15052
¹³C NMR Study on conformation and dynamics of the transmembrane α -helices, loops, and C-terminus of [3-¹³C] Ala-labeled bacteriorhodopsin

- Unger, V. M., Hargrave, P. A., Baldwin, J. M., and Schertler, G. F. X. (1997) *Nature* 389: 203-206
Arrangement of rhodopsin transmembrane α -helices
- Van der Meer, B. W., Pottel, H., Herreman, W., Ameloot, M., Hendrickx, H., and Schröder, H. (1984)
Biophys. J. 46: 515-523
Effect of orientational order on the decay of the fluorescence anisotropy in membrane suspensions
- Van der Meer, B. W., Raymer, M. A., Wagoner, S. L., Hackney, R. L., Beechem, J. M., and Gratton, E.
(1993) *Biophys. J.* 64: 1243-1263,
Designing matrix models for fluorescence energy transfer between moving donors and acceptors
- Van der Meer, B. W., Coker G. III, and Chen, S.-Y. (1994) *Resonance energy transfer: Theory and data*,
VCH Publishers Inc.
- Van Paridon, P. A., Shute, J. K., Wirtz, K. W. A., and Visser, A. J. W. G. (1988) *Eur. Biophys. J.* 16: 53-63
A fluorescence decay study of parinaroyl-phosphatidylinositol incorporated into artificial and
natural membranes
- Visser, A. J. W. G., Ykema, T., van Hoek, A., O'Kane, D. J., and Lee, J. (1985) *Biochem.* 24, 1489-1496
Determination of rotational correlation times from deconvoluted fluorescence anisotropy decay
curves. Demonstration with 6,7-dimethyl-8-ribityllumazine and lumazine protein from
photobacterium leiognathi as fluorescent indicators
- Voet, D., and Voet, J. (1995) *Biochemistry*, John Wiley & Sons, Inc. New York
- Wahl, P. (1975a) *Chem. Phys.* 7: 210-219
Fluorescence anisotropy of chromophores rotating between two reflecting barriers
- Wahl, P. (1975b) *Chem. Phys.* 7: 220-228
Theoretical determination of decay, quantum yield and anisotropy of chromophores attached to
macromolecules and performing a local brownian motion
- Wald, G. (1968) *Nature* 219: 800-807
The molecular basis of visual excitation
- Wallach, D. (1967) *J. Chem. Phys.* 47: 5228-5268
Effect of internal rotation on angular correlation functions
- Weber, G., and Teale, F. W. J. (1956) *Trans Faraday Soc.* 54: 646-655
Determination of the absolute quantum yield of fluorescent solutions

- Weber, G., and Shinitzky, M. (1970) *Proc. Natl. Acad. Sci. USA* 65: 823-830
Failure of energy transfer between identical aromatic molecules on excitation at the long wave edge of the absorption spectrum
- Weber, G. (1971) *J. Chem. Phys.* 55: 2399-3887
Theory of fluorescence depolarization by anisotropic Brownian rotations. Discontinuous distribution approach
- Wolber, P. K., and Hudson, B. S. (1979) *Biophys. J.* 28: 197-210
An analytic solution to the Förster energy transfer problem in two dimensions
- Wu, C.-W., and Stryer, L. (1972) *Proc. Nat. Acad. Sci. USA* 69: 1104-1108
Proximity relationships in rhodopsin
- Wu, P., and Brand, L. (1994) *Anal. Biochem.* 218: 1-13
Resonance energy transfer: Methods and applications
- Yang, C., and Söll, D. (1974) *Biochem.* 13: 3615- 3621
Covalent attachment of fluorescent groups to transfer ribonucleic acid:
Reactions with 4-Bromomethyl-7-methoxy-2-oxo-2H-benzopyran
- Yang, C., and Söll, D. (1974) *Proc. Nat. Acad. Sci. USA* 71: 2838-2842
Studies of transfer RNA tertiary structure by singlet-singlet energy transfer
- Yang, K., Farrens, D. L., Hubbell, W. L., and Khorana, H. G. (1996a) *Biochem.* 35: 12464-12469
Structure and function in rhodopsin: Single cysteine substitution mutants in the cytoplasmic interhelical E-F loop region show position-specific effects in transducin activation
- Yang, K., Farrens, D. L., Altenbach, C., Farahbakhsh, Z. T., Hubbell, W. L., and Khorana, H. G. (1996b) *Biochem.* 35: 14040-14046
Structure and function in rhodopsin: Cysteines 65 and 316 are in proximity in a rhodopsin mutant as indicated by disulfide formation and interactions between attached spin labels
- Yeagle, P. L., Alderfer, J. L., and Albert, A. D. (1995a) *Nat. Struct. Biol.* 2: 832-834
Structure of the carboxyl-terminal domain of bovine rhodopsin
- Yeagle, P. L., Alderfer, J. L., and Albert, A. D. (1995b) *Biochem.* 34: 14621-14625
Structure of the third cytoplasmic loop of bovine rhodopsin

- Yeagle, P. L., Alderfer, J. L., and Albert, A. D. (1996) *Mol. Vis.* 2: 12-18
Structure determination of the fourth cytoplasmic loop and carboxyl terminal domain of bovine rhodopsin
- Yeagle, P. L., Alderfer, J. L., Salloum, A. C., Ali, L., and Albert, A. D. (1997a) *Biochem.* 36: 3864-3869
The first and second cytoplasmic loops of the G protein receptor, rhodopsin, independently form α -turns
- Yeagle, P. L., Alderfer, J. L., and Albert, A. D. (1997b) *Biochem.* 36: 9649-9654
Three-dimensional structure of the cytoplasmic face of the G protein receptor rhodopsin
- Yguerabide, J. (1972) *Meth. Enzymol.* 26: 498-578
Nanosecond fluorescence spectroscopy of macromolecules
- Yguerabide, J. (1994) *Biophys. J.* 66: 683-693
Theory for establishing proximity relations in biological membranes by excitation energy transfer measurements
- Young, R. M., Arnette, J. K., Roess, D. A., and Barisas, B. G. (1994) *Biophys. J.* 67: 881-888
Quantitation of fluorescence energy transfer between cell surface proteins via fluorescence donor photobleaching kinetics
- Yu, H., and Oprian, D. D. (1999) *Biochem.* 38: 12033-12040
Tertiary interactions between transmembrane segments 3 and 5 near the cytoplasmic side of rhodopsin
- Zannoni, C. (1981) *Mol. Phys.* 42: 1303-1320
A theory of fluorescence depolarization in membranes
- Zannoni, C., Arcioni, A., and Cavatorta, P. (1983) *Chem. Phys. Lipids.* 32: 179-250
Fluorescence depolarization in liquid crystals and membrane bilayers