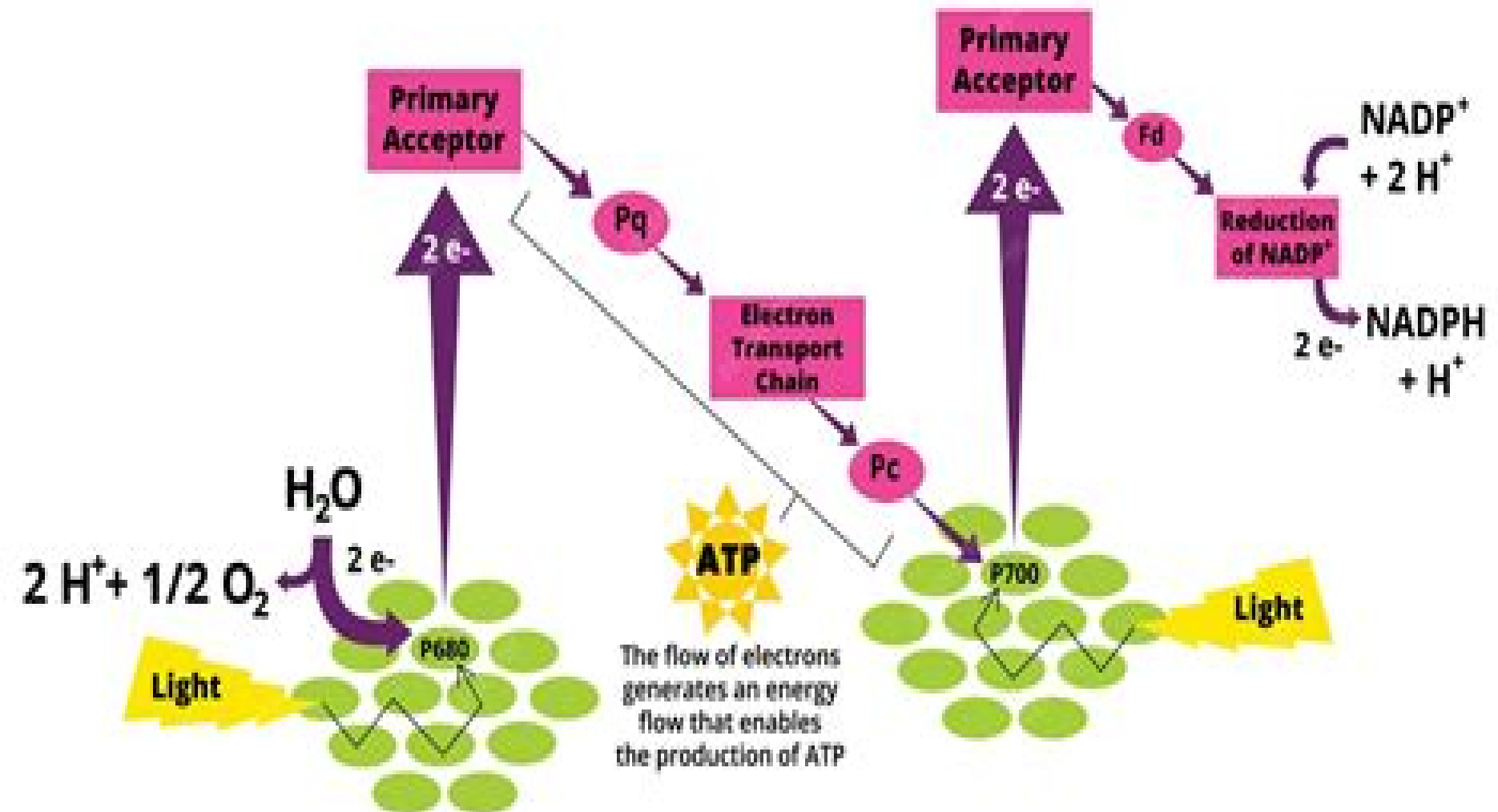


Photochemical Phase of Photosynthesis



Photosynthetic Excitons

**Roberta Croce, Rienk van
Grondelle, Herbert van Amerongen, Ivo
van Stokkum**



Photosynthetic Excitons:

Photosynthetic Excitons Herbert van Amerongen, Leonas Valkunas, Rienk van Grondelle, 2000 Excitons are considered as the basic concept used by describing the spectral properties of photosynthetic pigment protein complexes and excitation dynamics in photosynthetic light harvesting antenna and reaction centers Following the recently obtained structures of a variety of photosynthetic pigment protein complexes from plants and bacteria our interest in understanding the relation between structure function and spectroscopy has strongly increased These data demonstrate a short interpigment distance of the order of 1 nm or even smaller and a highly symmetric ring like arrangement of pigment molecules in peripheral light harvesting complexes of photosynthetic bacteria Books which were devoted to the exciton problem so far mainly considered the spectral properties of molecular crystals However the small size of these pigment aggregates in the pigment protein complexes as well as the role of the protein which is responsible for the structural arrangement of the complex clearly will have a dramatic influence on the pigment spectra and exciton dynamics All these aspects of the problem are considered in this book Exciton theory is mainly considered for small molecular aggregates dimers ring like structures etc Together with the theoretical description of the classical conceptual approach which mainly deals with polarization properties of the absorption and fluorescence spectra the nonlinear femtosecond spectroscopy which is widely used for investigations now is also discussed A large part of the book demonstrates the excitonic effects in a multitude of photosynthetic pigment protein complexes and how we can understand these properties on the basis of the exciton concept

The Biophysics of Photosynthesis John Golbeck, Art van der Est, 2014-08-07 The volume is intended as an introduction to the physical principles governing the main processes that occur in photosynthesis with emphasis on the light reactions and electron transport chain A unique feature of the photosynthetic apparatus is the fact that the molecular structures are known in detail for essentially all of its major components The availability of this data has allowed their functions to be probed at a very fundamental level to discover the design principles that have guided evolution Other volumes on photosynthesis have tended to focus on single components or on a specific set of biophysical techniques and the authors goal is to provide new researchers with an introduction to the overall field of photosynthesis The book is divided into sections each dealing with one of the main physical processes in photosynthetic energy conversion Each section has several chapters each describing the role that a basic physical property such as charge or spin plays in governing the process being discussed The chapters proceed in an orderly fashion from a quantum mechanical description of early processes on an ultrafast timescale to a classical treatment of electron transfer and catalysis on a biochemical timescale culminating in evolutionary principles on a geological timescale

Molecular To Global Photosynthesis Mary D Archer, James Barber, 2004-05-10 Green plants and photosynthetic organisms are the Earth's natural photoconverters of solar energy In future biomass and bioenergy will become increasingly significant energy sources making a contribution both to carbon dioxide abatement and to the security diversity and

sustainability of global energy supplies In this book experts provide a series of authoritative chapters on the intricate mechanisms of photosynthesis and the potential for using and improving photosynthetic organisms plants and trees to sequester carbon dioxide and to provide fuel and useful chemicals for the benefit of man a *Diatom Photosynthesis* Johannes Wilhelm Goessling, João Serodio, Johann Lavaud, 2024-08-06 This comprehensive guide is designed for researchers professionals and students looking to deepen their knowledge of diatoms including detailed information on diatom photosynthesis regulation at the molecular scale as well as their significant ecological roles all aimed at promoting sustainable advancements and the safeguarding of aquatic ecosystems Diatoms exert an immense influence on the ecosystem of Earth due to their remarkable abundance and species diversity Thriving in diverse habitats spanning the oceans intertidal benthic zones saline and freshwater environments and even terrestrial niches like moist soil forests and caves they play an integral role Diatoms alone account for around 20% of the oxygen generated by photosynthesis comparable to the combined productivity of tropical rainforests worldwide while their primary production can reach 40 45% in marine ecosystems Nevertheless in contrast to the extensive research on macroscopic photosynthetic organisms investigations in this domain remain comparatively limited despite the role of diatoms in global biogeochemical processes This book presents an exhaustive review of the subject matter encompassing a wide spectrum of topics ranging from the intricate molecular mechanisms of diatom photosynthesis and light absorption to the dominant role of diatoms as primary producers within ecological frameworks Beyond this the book delves into the practical implications stemming from diatoms and their photosynthetic productivity A strong emphasis is placed on the importance of fundamental research in deepening our understanding of the natural world around us Diatoms Photosynthesis provides readers with a comprehensive guide to understanding the fundamentals of diatom photosynthesis and their ecological significance in aquatic ecosystems a guide to the potential of diatom derived products for sustainable technologies a roadmap from diatom photosynthesis to implications in applied sciences a bridge to span the gap between fundamental research on diatoms and their practical applications Audience This book caters to academic professionals students and researchers in the fields of marine biology ecology microbiology and biochemistry It offers insights and benefits into diatom photosynthesis diatom physiology biodiversity ecosystem health and sustainable technological advancements **Practical Applications of Chlorophyll Fluorescence in Plant Biology** Jennifer R. DeEll, Peter M. A. Toivonen, 2012-12-06 The technique of chlorophyll fluorescence has a relatively short history beginning with the observations by Kautsky Kautsky and Hirsch 1931 Since that time there have been several reviews devoted to the subject with most of them highly theoretical Bohlar Nordenkamp and Oquist 1993 Dau 1994 Schreiber et al 1994 There have also been many books devoted to generalized spectrophotometric and microscopic fluorescence techniques However to the best of our knowledge there has not been a book completely devoted to the practical applications and uses of chlorophyll fluorescence in plant biology As techniques mature applications multiply and so do their

potential advantages The chlorophyll fluorescence technique is maturing as can be seen in the increasing numbers of publications that are devoted to its use Therefore we considered that now was a good time to compile the existing knowledge for the applied use of this technique and provide a single volume to which a novice or experienced user could refer Highly trained experts in the field of photobiology have primarily used the chlorophyll fluorescence technique in the past In that work understanding the mechanisms and controls of the photosynthetic processes was the main focus of activity and discussion Much of the equipment used was highly specialized and expensive or in some cases one of a kind lab designed units However the development of several reliable commercially available chlorophyll fluorescence monitoring instruments has changed the potential user base for the technique

Quantum Effects In Biology Sisir Roy, 2025-08-13 This book intends to give a systematic exposition of the validity of quantum principles in biological systems There are two types of applications of quantum theory in physical systems the trivial applications and non trivial applications Since every object in this universe consists of atoms and molecules they should be described by the laws of quantum theory which we call trivial applications On the other hand there exist some systems where the observational results cannot be explained by the laws of classical physics and this requires a change of paradigm these are known as non trivial applications Many authors pointed out such non trivial applications of quantum theory to explain how some biological systems function In this book we review such kinds of results in a systematic manner which clearly indicates the need to change the paradigm to understand these biological systems better

Chlorophyll a Fluorescence G.C. Papageorgiou, Govindjee, 2007-11-12 Chlorophyll a Fluorescence A Signature of Photosynthesis highlights chlorophyll Chl a fluorescence as a convenient non invasive highly sensitive rapid and quantitative probe of oxygenic photosynthesis Thirty one chapters authored by 58 international experts provide a solid foundation of the basic theory as well as of the application of the rich information contained in the Chl a fluorescence signal as it relates to photosynthesis and plant productivity Although the primary photochemical reactions of photosynthesis are highly efficient a small fraction of absorbed photons escapes as Chl fluorescence and this fraction varies with metabolic state providing a basis for monitoring quantitatively various processes of photosynthesis The book explains the mechanisms with which plants defend themselves against environmental stresses excessive light extreme temperatures drought hyper osmolarity heavy metals and UV It also includes discussion on fluorescence imaging of leaves and cells and the remote sensing of Chl fluorescence from terrestrial airborne and satellite bases The book is intended for use by graduate students beginning researchers and advanced undergraduates in the areas of integrative plant biology cellular and molecular biology plant biology biochemistry biophysics plant physiology global ecology and agriculture

Biophysical Techniques in Photosynthesis Thijs Aartsma, Jörg Matysik, 2008-02-01 Since the first volume on Biophysical Techniques in Photosynthesis Research published in 1996 new experimental techniques and methods have been devised at a rapid pace The present book is a sequel which complements the first volume by providing a comprehensive overview of the most important new

techniques developed over the past ten years especially those that are relevant for research on the mechanism and fundamental aspects of photosynthesis The contributions are written by leading scientists in their field The book is divided into 5 sections on Imaging Structure Optical and laser spectroscopy Magnetic resonance and on Theory respectively Each chapter describes the basic concepts of the technique practical applications and some of the scientific results Possibilities and limitations from a technical as well as a scientific point of view are addressed allowing the reader not only to recognize the potential of a particular method for his her own quest but to assess the resources that are required for implementation

Light Harvesting in Photosynthesis Roberta Croce, Rienk van Grondelle, Herbert van Amerongen, Ivo van Stokkum, 2018-01-12 This landmark collective work introduces the physical chemical and biological principles underlying photosynthesis light absorption excitation energy transfer and charge separation It begins with an introduction to properties of various pigments and the pigment proteins in plant algae and bacterial systems It addresses the underlying physics of light harvesting and key spectroscopic methods including data analysis It discusses assembly of the natural system its energy transfer properties and regulatory mechanisms It also addresses light harvesting in artificial systems and the impact of photosynthesis on our environment The chapter authors are amongst the field's world recognized experts Chapters are divided into five main parts the first focused on pigments their properties and biosynthesis and the second section looking at photosynthetic proteins including light harvesting in higher plants algae cyanobacteria and green bacteria The third part turns to energy transfer and electron transport discussing modeling approaches quantum aspects photoinduced electron transfer and redox potential modulation followed by a section on experimental spectroscopy in light harvesting research The concluding final section includes chapters on artificial photosynthesis with topics such as use of cyanobacteria and algae for sustainable energy production

Photosynthesis in silico Agu Laisk, Ladislav Nedbal, Govindjee, 2009-06-19 Photosynthesis in silico Understanding Complexity from Molecules to Ecosystems is a unique book that aims to show an integrated approach to the understanding of photosynthesis processes In this volume using mathematical modeling processes are described from the biophysics of the interaction of light with pigment systems to the mutual interaction of individual plants and other organisms in canopies and large ecosystems up to the global ecosystem issues Chapters are written by 44 international authorities from 15 countries Mathematics is a powerful tool for quantitative analysis Properly programmed contemporary computers are able to mimic complicated processes in living cells leaves canopies and ecosystems These simulations mathematical models help us predict the photosynthetic responses of modeled systems under various combinations of environmental conditions potentially occurring in nature e g the responses of plant canopies to globally increasing temperature and atmospheric CO₂ concentration Tremendous analytical power is needed to understand nature's infinite complexity at every level

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