Chapter 1
Introduction to Holonomic–Compatible Models for Vision

1.1 STARTING REMARKS

The purpose of this book is to research possibilities for complementing neural models of early vision with the new preliminary quantum models of consciousness in order to construct a model of human image processing.

Contents. The contents of this book are the following. In the first chapter, a comprehensive introduction to the problem and the basic "tools" for tackling it will be presented and extended. These are the holonomic brain model and some computational models like the Independent Component Analysis (ICA) and quantum-implementable associative networks of coupled oscillators with phase-encoding. In the second chapter, the *Holonomic Brain Theory* of Karl Pribram, especially its part on vision, will be presented. In the third chapter, computational information-

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maximization models like the version of Independent Component Analysis (ICA) of Bell and Sejnowski and the sparseness-maximization net of Olshausen and Field will be presented and discussed in the context of Holonomic Brain Theory and related models. In the fourth chapter, the models of image processing are summarized and integrated into a complete, partially hypothetic, global picture. Some speculations about higher associative, attractor-based and quantum-rooted, visual processing, which gives results (images, episodes) that we are conscious of, are presented. For this purpose, models of dendritic image-processing in V1 and hypotheses on subcellular (e.g., microtubular) and quantum brain processing and binding are reviewed. Consciousness, in particular visual consciousness, and its neural correlates are discussed at the end.

The *second part* of the book provides additional or detailed information – auxiliary to the chapters of the first, main part. In the first auxiliary chapter, no. 6, information processing along visual pathways from retina to cortical areas will be presented as described by the modern main-stream experimental neuroscience (including neurophysiology, neuropsychology, cognitive neuroscience). The neuropsychology of image processing and related processes (like early vision, figure/ground segmentation, visual memory, object perception, visual attention and binding) will be presented. Recognition of edges and other features using contrast- and color-processing will be especially discussed. A comparison with the holonomic alternative will be made.

The majority of so-called auxiliary chapters mainly review neural-net-like quantum associative processing, starting from my list of neuro-quantum analogies which is then used for translation of a neural information-processing "algorithm" to quantum formalism. Some essential improvements where quantum associative processing transcends the neural-net basis are highlighted. These improvements are mainly based on holography-like phase-relationship processing.

Auxil. Chapter 6 can be skipped by neuroscience experts. The mathematical auxiliary chapters and appendices are complements to the main text and to the Auxil. Chapter 6 which, however, alone incorporate *all* the relevant neuropsychology. Mathematical Auxiliary Chapters provide theoretical and computational details mathematically and physically more rigorously, but are *not essential* for understanding of the main text (or of Auxil. Ch. 6).

Computer-implementable core. The central part of this work is to provide a global (rough) mathematically-supported, computer-implementable model, i.e. a "skeleton" of an information-processing "algorithm", for image processing giving a conscious result – a consciously perceived image. We will start with a "skeleton" based on neural-net models, enrich it with holography-like phase-dynamics, and embed it into quantum dynamics.