GR, Einstein did not seriously address this question. S. Chandrasekhar had also voiced the same opinion in a private conversation with the reviewer. It is remarkable that this volume too did not address this question.

On the strength of the powerful singularity theorems, it was generally believed including relativists that singularity is unavoidable in GR for physically reasonable behaviour of matter. This is wrong. In 1990, a young Spanish relativist, Jose Senovilla (*Phys. Rev. Lett.*, 1990, **64**, 2219) obtained a cosmological model without singularity and its matter content had perfectly accepted behaviour. This had shocked the entire scientific community including relativists. This was because no due heed was paid to one of the assumptions, which required the existence of a compact trapped surface. In a simple way, it means that it has been assumed *a priori* that the gravitational field would become strong enough to trap photons. Truly, it destroys generality of all the other assumptions which are almost self-evident and seriously hampers their applicability. Because how the field should behave should be left to the field equation, and postulating formation of trapped surface is no short of putting a singularity. It is however a different matter that the actual Universe might have been born in the Big-Bang singularity. It would have been appropriate to make this point in the essay on singularity. However, it would perhaps take some more time for historians of science to take its cognizance.

Today it is simple to understand the existence of zero rest mass particles which would not be at rest relative to any observer and hence must move with the same speed relative to all. The incorporation of this fact in mechanics leads to special relativity. Further making photons to interact with gravity would lead to the realization that gravity must curve space leading to GR. With this in view, it is always very fascinating to read the history of evolution of physical ideas, concepts and theories. The present volume precisely does this wonderfully.

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The 11 review articles appearing in this issue provide upgradation of the material available in some of the frontier areas of research in nuclear physics (3 reviews), particle physics (6 reviews), nuclear astrophysics (1 review) and application of accelerators in nuclear technology (1 review). This is the only review dealing with pure physics, limited to nuclear and particle physics. It is a mind-boggling proposition to review technical articles in the four fields mentioned above. Nevertheless, an overall perspective is provided here.

In the area of nuclear physics, all the three reviews deal with heavy ion reactions: on nuclear structure through the Coulomb excitation of low lying states, the excitation of the multiphonon giant resonances in nuclei both at intermediate energies and on measuring barriers to fusion from low energy fusion reactions.

T. Glasmacher reviews Coulomb excitation at intermediate energies. Coulomb excitation is a well-established technique for probing the nuclear structure. The extension of this technique to nuclei far from stability to obtain their structure is the main focus of this paper. It involves detection of inelastically scattered particles at very forward angles and measurement of gamma rays from the Coulomb excitation process in coincidence, employing a large array of detectors. The Coulomb excitation cross-section is related to the electromagnetic matrix elements. Some of the highlights are B(E1) value for the first excited state of ^{11}Be, the only neutron halo nucleus having a bound excited state and the observation of weakening of $N = 20$ magicity for ^{32}Mg and $N = 28$ magicity for ^{46}Ar and ^{44}S. On the theoretical front the relativistic mean field and Monte Carlo shell model theories successfully reproduce some of these features.

T. Aumann, P. F. Bortignon and H. Emling deal with multiphonon giant resonances in nuclei. Giant resonances (GR) are highly collective excitations of the nuclei occurring throughout the periodic table and are of different types. In recent years two-phonon giant resonances (TPGR) have been measured from heavy ion reactions at intermediate energies and pion-induced double charge exchange reactions. The properties of multiphonon states provide an answer to the fundamental question on the strength of the phonon–phonon interaction and the anharmonicity. The mean field description – the random phase approximation (RPA) – gives a good account of GRs in general. High energy heavy ions are suitable for excitation of multiplication GRs as the required cross-sections are large, and the non-resonant backgrounds are relatively less using these probes. It is observed that the E_x and the width of TPGR are, respectively, about 2 and 1.5 times that of the single GR. Much more work needs to be done both theoretically and experimentally.

Dasgupta *et al.* deal with fusion barriers. Reactions of interacting nuclei at near Coulomb barrier energies are strongly influenced by the coupling between their nuclear structure and relative motion. Coupling of entrance channel to other channels leads to multiple fusion barriers, with some of them lying below and others above the original uncoupled barrier. The fusion cross-sections represented in the form of a barrier distribution enhance the sensitivity of the data to structure aspects of the fusing nuclei. The role of target deformation (quadrupole and hexadecapole) has been brought out from fusion studies involving ^{16}O + ^{154}Sm and ^{186}W systems; the coupling to target phonon states or projectile excitations have come out, respectively, from ^{16}O + ^{144}Sm and ^{40}Ca + ^{194}Pt studies; the importance of multiphonon excitations has resulted from data for Ni isotopes. The fusion barrier distribution shows increased sensitivity to the break up the channel in the case of weakly bound projectiles.

Particle physics has developed in the last four decades as the one involved in the description of the four fundamental processes, specifically dealing with the unification of the fundamental interactions – the gravitational, the electromagnetic, the weak and the strong interactions. The latter three are described by the quantum guage field theories with running coupling constants which describe interaction among fermions by the mediation of guage vector bosons. The strong interaction is well-described by the quantum chromodynamics (QCD). QCD is treated perturbatively in a weak coupling domain. The strong coupling QCD is non-perturbative and is difficult to deal with. Four articles are devoted to the standard model of the unified electro-weak interaction including the perturbative QCD while there is one each dealing with the nonperturbative QCD and the supersymmetry which play a vital role in the string theory – a promising approach for unifying all the four interactions.

J. Ellison and J. Wudka have studied the trilinear guage-boson couplings at the Tevatron Collider. The nonabelian guage theories manifest interaction between the guage bosons unlike the abelian QED. Thus the standard model also has the trilinear couplings $WW\gamma$, $ZZ\gamma$, $Z\gamma\gamma$, and ZZZ which have been probed in D0 and CDF experiments at $E_{c.m} = 1800$ GeV using the pp^- Tevatron collider at Fermilab. Various events dealing with trilinear couplings are analysed. D0 has also measured events with the missing total energy in the Z decay, thereby detecting the $\nu\nu^-$. The analysis performed with Tevatron will be repeated with improved precision in experiments at LEP II and the large hadron collider LHC at CERN. The present data test the fundamental prediction of the standard model on the trilinear guage-boson couplings and do not necessitate new physics beyond.

The article by L. K. Gibbons deals with the measurement of the CKM matrix element $|V_{ub}|$ and exclusive $B \rightarrow \pi l \nu$ and $B \rightarrow \rho l \nu$ decays. The trinity of d, s and b quarks having electric charge – 1/3 are not simultaneously the eigenstates of the strong and the electro-weak interactions. The Cabbibo–Kobayashi–Maskawa (CKM) matrix is a unitary matrix with four parameters which connects the two sets of eigenstates and allows the decay of these quarks in the flavour direction. The CKM matrix also describes the CP violation and its elements which are crucial for the standard model. The inclusive measurement of the decay $b \rightarrow \pi l \nu$ from Y(4S) state yields the value of $|V_{ub}/V_{cb}|$. The exclusive measurements carried out with the CLEO detector at the Cornell Electron Storage Ring (CESR) through the production of $Y(4S)$ resonance have also been discussed. The decay form factor calculations affecting the determination of $|V_{ub}|$ are dealt with in quark models as well as the ones obtained through dispersion relations from the chiral perturbation theory of heavy hadrons and through the lattice QCD. The value of $|V_{ub}|$ from exclusive decays agrees with the one derived from the inclusive measurements of the B decay.

The article by K. Lingel, T. Skwarnicki and J. G. Smith on Penguin decays of B mesons, also deals with B decay from the three colliders – the CESR at Cornell, the LEP at CERN and the Tevatron at Fermilab and has a lot of overlap in theme with the previous article. Penguin diagram is a loop in the $b \rightarrow s$ decay in which W^- and t quark occur. The emitted radiation of W^- or t gives rise to a variety of penguins such as the electromagnetic, the electroweak and the gluonic ones dealt with an effective Hamiltonian. Penguin decays are promising to look for new physics beyond the standard model. The measurements provide values of some of the CKM matrix elements. The measured $b \rightarrow s\gamma$ transition is consistent and constrains the new physics models.

K. Hagiwara's article deals with electro-weak studies at Z factories. The large electron–positron collider LEP I at CERN and the linear collider at SLAC have produced the Z boson in abundance. These Z factory experiments have tested the standard electro-weak with remarkable precision. The Z mass has been determined to an accuracy of 2 parts in a million with a very precise measurement of total and partial widths. The masses of the W boson, the top quark and lower limit of the Higgs scalar boson have also been deduced. The precision measurements at the Z boson energy establishes the standard model and the models beyond this have also been constrained.

E. Jenkin's article is about large-N_c baryons. The hadrons are made of quarks of three colours occurring in nature as colour singlet. The internal colour symmetry is described by SU(3) group giving rise to gluons of eight colours. The composite hadrons, i.e. baryons and mesons are described by QCD which is the theory of quarks and gluons. The QCD description of hadrons falls in its nonperturbative domain. One of the methods then is to describe the hadrons by SU(N) group of N colours. In such a case the physical quantities such as masses appear as series in $1/N$ expansion. The limit $N = 3$ can then describe the hadrons. The article is specifically devoted to baryons through $1/N$ expansion. It deals with relationship for the baryonic masses composed of light quarks. The axial vector couplings, magnetic moments, heavy quark baryons and the excited state baryons are also described. The applications to nuclear potential and chiral perturbation theory are also pointed out.

E. Poppitz and S. P. Trivedi mention about Dynamical supersymmetry breaking in their article. The supersymmetry (SS) is a powerful idea in the field theory of particles as it deals with bosons and fermions in pairs and SS theories can answer several issues raised by the standard model such as the orders of magnitude difference between the Planck scale and the electro-weak scale. The Higgs particle gets contribution to its mass from bosons as well as from fermions canceling each other, thereby making the theory convergent. The extra particles appearing as the supersymmetric partners are to be made very heavy so as to describe the experiments. Hence a symmetry breaking mechanism like the dynamical one is the theme of this article. Models of calculable SS breaking such as the instanton-driven and the gaugino condensation are discussed. Two phenomenological applications are supergravity having the gravity as the messenger interaction and the gauge-mediated interaction, both breaking the SS. This article is an indicator of the direction in which grand unification may finally take place.

F. Kappeler, F. K. Thielemann and M. Wiescher deal with current quests in nuclear astrophysics and experimental approaches. One of the fascinating and perhaps the most interesting aspects of study of nuclear and sub-nuclear physics is the connection between the lessons learned in the laboratory and the behaviour of the universe at large. Essential to the understanding of stellar evolution and nucleosynthesis, are the reaction cross-sections that can be measured in our laboratories. There are several reactions taking place during the p–p, CNO, C and O burning stages and explosive nucleosynthesis for which data are either available with poor accuracy or not measured at all. Some of the reactions of interest involving light nuclei are: $^{7}Be(p, \gamma)$, $^{12}C(\alpha, \gamma)$, $^{12}C + {}^{12}C$ fusion, $^{18}O(p, \gamma)$, $^{17}F(p, \gamma)$, $^{27}Si(p, \gamma)$, $^{18}F(p, \gamma)$, $^{25}Al(p, \gamma)$. Some of these can now be studied with the radioactive ion beams available in several accelerator facilities.

C. D. Bowman discusses accelerator-driven systems for nuclear waste transmutation. Even though nuclear reactors are immensely beneficial to society at large for the amount of nuclear power they produce, there is an associated concern of safe disposal or storage of long-lived nuclear wastes consisting of plutonium, minor actinides, some of the long-lived fission fragments and their radioactive daughter products. In recent years there has been considerable interest in developing techniques for transmutation of the above-mentioned nuclear wastes. A promising route is the accelerator-driven subcritical system which consists of intense neutrons produced from a spallation reaction induced by high energy protons, followed by slowing down of these neutrons to initiate secondary fission and capture reactions to carry out the task of waste transmutation. It appears that the liquid fueled thermal neutron spectrum offers major advantages over the solid fueled fast spectrum system in accomplishing this task. As a bonus, electrical power can also be made available from the accelerator-driven subcritical assemblies.

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Neural Networks and Analog Computation. H. T. Siegelmann. Birkhäuser Verlag AG, P.O. Box 133, CH-4010 Basel, Switzerland. 1998. 200 pp. Price: SFr 88/DM 98.

Numerous physical processes in nature are hard to simulate on a digital computer. This led to a paradigm shift in the field of computation, revising the Turing model of computation to encompass physical processes. For example, Feynman suggested using quantum mechanical systems to simulate quantum mechanics. Models of neurons also turned out to be powerful computing systems. Can these physical process models (quantum computers, neural networks, DNA computation) be viewed as general-purpose computers? How do these models fare with respect to the conventional digital computer and the Turing model? *Neural Networks and Analog Computation* by Hava T. Siegelman addresses this question.

One obvious difference is the continuous phase space of physical processes. The computational advantages of neural networks and quantum computers over classical computing are in part due to the fact that these systems can be in a state of superposition of different states. Unfortunately Siegelman overlooks this important issue. These physical computers are reaction–diffusion systems, for example, DNA computer can be viewed as a reaction–diffusion system where patterns formed are given computational interpretation. A diffusion process by virtue of its ability to fill the entire volume enumerates all possibilities. A reaction mechanism selects and amplifies those that satisfy a certain criterion (solution). In this book we have the interesting result that recurrent neural networks with real weights and sigmoid activation are more powerful than quantum and DNA computers. It would be interesting to see where reaction–diffusion, which is giving all the patterns we see in nature, fits in the computational hierarchy.

The thesis of the author is – no possible abstract analog device can have more computational capabilities than first-order recurrent network. In chapter 2, the author first identifies weights and activation functions as the two key determinants of its computational power and shows that neural networks with integer weights and threshold function can simulate finite automata. In chapter 3, we find that Turing machines can be simulated with neural networks having rational weights. In this book we find a detailed study of the activation function with respect to the Turing model. In chapter 7, the author shows the universality of sigmoidal networks; and gives the lower bound on the computational power of sigmoidal networks. Chapter 10 gives the upper bound. Chapter 8 proves that any function for which the left and right limits exist and are different gives networks that are at least as powerful as finite automaton.

Chaotic motion (Henon map) cannot be mimicked by the Turing machine, but can be simulated with recurrent neural networks with real weights and sigmoid activation function, which leads to the super-Turing model. We also find that randomness does not increase the computational power in the case of integer and real weights, but stochastic rational weight neural networks are more powerful than deterministic (rational) neural networks (chapter 9). In chapter 10, the author shows that higher-order neurons are not computationally superior to first-order neurons.

In summary, this book is a comprehensive study showing the universality of recurrent neural networks and measures the changes brought about by changing weights (integer, rational, real) and activation functions (threshold, sigmoid) against the benchmark of the Turing model.

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In Vivo Models of Inflammation. D. W. Morgan and L. A. Marshall (eds). Birkhäuser Verlag AG. P.O. Box 133, Basel, Switzerland. 1999. 360 pp. Price: Sfr 198/DM238 (Hardbound).

Inflammation is a response of the living tissue to injury. Injury could be physical, chemical, biological or immunological. 'Inflammation in itself is not to be considered as a disease, but as a salutary operation consequent either to some violence or some disease' wrote John Hunter three decades ago. It was in the 18th century that the precise well-timed process of inflammation was described step by step. Observations of Conheim in the frog mesentery, and Metchnikoff in the starfish, of the sequence of events and the cells taking part in this dynamic process were only the beginning of a number of explosive discoveries. Thenceforth, detailed microscopic descriptions of inflammation in various tissues, function of the different types of cells, the interplay of numerous cytokines these cells release and biochemical changes taking place have found place in all standard text books.