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Accelerators and detectors

In the early days cosmic rays and astrophysical processes were the sources of high energy particle probes. However, much of the progress in the nuclear and particle physics has been due to particle beams produced from accelerators. Nucleus being a finite many-body system has closely spaced dense energy spectrum while in particle physics the masses of mesons, baryons and leptons are very widely distributed. A given nuclear level can be populated in many different channels, and it has many decay branching possible. This is not the case for hadrons and heavy leptons. Therefore the nuclear physics beam requirements are high phase space density, variable energy and as many as possible different types of beams. On the contrary, high energy particle physics beams are of few types, fixed energies and need not be of high phase space density. In the past decade, the two branches of accelerator community are closely working together on beam storage development. At the same time, the high energy physicists consider nucleus as a laboratory for nonperturbative study of quantum chromo-dynamics (QCD) and are interacting closely with nuclear physicists. The storage rings are designed for use of internal targets which reduces the background and makes efficient use of the beam. With these facilities exciting nuclear and atomic physics experiments involving low cross-sections will be planned in future.

The beam cooling is carried out using electron cooling, stochastic cooling and laser cooling techniques. The electrons moving with the ion beam velocity stop the beam in its rest frame (corresponding to large laboratory velocities) and the ions come in thermal equilibrium with the electrons. In the process, the ion beam of typical ion source temperature of several eV is cooled down to less than 0.1 eV in about 1 sec. In stochastic cooling a sensitive and fast detector detects the deviation of an ion trajectory from closed orbit and corrects it. Its cooling time is proportional to beam intensity. In laser cooling the photon absorption and its isotropic emission is used. The Doppler effect is used to achieve the longitudinal cooling. This rate of cooling is very fast.

The factors limiting the beam current and its brightness are discussed at length along with the related physics. The discussion of external versus internal targets, luminosity domains and cooling ring evaluation will be useful to experts. A summary of the available facilities can be found here.

The cost of linear colliders varies linearly while that of circular colliders quadratically with the beam energy. The emphasis currently is on designing, constructing and testing new devices and techniques for future colliders. The issues explored are very small emittance bunches, beams of extremely high power densities, multiple bunch beams, beam–beam interactions, positron target design, electron gun design, low emittance damping rings, wake field compensation, chromatic correction, halo collimation, reliability, instrumentation and controls. The discussion of beam transport, final focus, emittance centre and polarization is also given. The modern day accelerators are the connected set of accelerators with precision interphase. There are usually 100 beam parameters controlled by VAX using slow and fast feedback systems. Besides the role of colliders, the new sophisticated detectors played an equally important role in the fast developments in particle physics. The compensating calorimeters will become the standard for future experiments. Further developments towards integrated calorimetry, instruments that combine the functions of electromagnetic and hadronic shower measurements with electron and muon identification are taking place. The large versatile detectors ALEPH, DELPHI, L3 and OPAL provided the identification of electrons and muons, complete coverage and more precision in energy and angular momentum especially in the calorimetry. Their brief description can be found here.

The surface barrier Si detector telescopes for particle identification are not used in recent nuclear physics studies because of long flight paths of heavier particle resulting in small solid angles. Instead kinetic coincidence technique is used to detect both particles, with large area detectors along with ΔE–E techniques. It is limited to lighter systems. In all recent developments the particle identification by magnetic spectrograph or recoil mass separators, characteristic gamma rays of reaction products and chemical separation techniques followed by a measurement of characteristic gamma rays played an important role. The physics, working and limitations of these very powerful and elegant experimental techniques are summarized in this book.

Current topics in nuclear physics

The recent experimental studies have revealed that rotating nuclei can adopt a rich variety of shapes. These shape changes are understood from the models based on the interplay of macroscopic degrees of freedom and the microscopic few particle dynamics. Rotation changes the nucleonic occupation of specific shape driving orbitals and modifies the moment of inertia. Phenomena observed in fast-rotating nuclei are: particle spins alignment along the rotation axis (back bending), the transition from prolate to oblate aligned particle structures (band termination), triaxial shapes and octopole instabilities. The spectacular experimental result is the observation of superdeformation in fast rotating lighter nuclei arising from the trapping of a nucleus in a metastable potential minimum associated with elongated shapes with axis ratios 2:1:1. The striking properties of such a nucleus is the strong population of superdeformed bands at high spins and the apparent lack of link between them and the yrst levels. They are seen near $A = 150$ and $A = 190$ mass region. The superdeformed bands occur with identical transition energies in nuclei differing by one and two mass units. The mechanism of feeding these states and their decays is yet to be well understood. As in the case of single particle shell model, large gaps also occur in the spectrum of axially symmetric oscillator when the lengths of the principal axis are in the ratio 2:1:1 corresponding to 0.65 beta derformation parameter value. The shell corrections calculated from this spectrum are responsible in generating a local minimum in the nuclear potential energy surface. The rotational energy balances out the surface energy at large deformation and makes superdeformation possible through shell correction energy contribution. In such nuclei signature partner pair of bands are seen at high spins. The gamma ray energies in one of the bands lie midway between those of the others within 1 keV over the entire frequency range and both bands are of similar intensity. The transition energies of superdeformed band in neighbouring nuclei are surprisingly close to each other. The pairing and high spin intruder states play an important role in understanding some of these features qualitatively from the strong coupling model and pseudospin formalism.

The light ion collision with a nucleus of incident energy just above Coulomb barrier produces direct reactions and compound nucleus formation. On the other hand heavy ion collision above the barrier produces diverse spectrum of reaction modes, such as deep ineleastic scattering, incomplete fusion and quasi-fission. The reaction evolves from deep ineleastic processes to quasi-elastic reactions as the impact parameter increases from its low value to grazing value, while the central collision gives rise to fusion and fission-like reactions. The recent studies on quasi-elastic reactions induced by heavy ($A>20$) projectile up to uranium reveal the occurrence of simple one-step transition to complicated multi-step reactions. The long range Coulomb force steeply increases the total inelastic yields with projectile mass. When the bombarding energy is 20% above the barrier the large yields for peripheral transfer reactions strongly influence fusion reactions. However, the fusion becomes less important for heavier systems. The analysis showed that strong inelastic channels influence elastic as well as transfer reactions. The two-step processes substantially contribute to two particle transfer reactions and they are the important doorway states to fusion reactions for collisions below the barrier. Next to inelastic scattering, one and two nucleon transfer reactions have the largest cross section among quasi-elastic processes and therefore also influence elastic and fusion reactions. Heavy ion-induced transfer reactions to individual states are sparse. At sub-barrier energies, neutron transfer occurs via a tunnelling process that exponentially increases the cross-section as a function of incident energy. At energies above the barrier the overlap of two nuclei is large enhancing thereby the neutron transfer cross-sections. The particle level density and the width of the θ-window then controls its energy dependence. A large overlap is required for proton transfer because of its higher binding energy and associated steeper fall-off of the wave function. Mostly negative θ-values favour proton stripping. Proton pickup yields are smaller for neutron rich targets. The angular distributions for multiparticle transfer reactions exhibit a change from the bell-shaped structure associated with quasi-elastic scattering to a forward picking characteristic of deep inelastic scattering. At energies close to Coulomb barrier, neutron transfer is the dominant reaction process contributing 60% of the total reaction cross-section, quasi-elastic cross-section 5% and fusion and deep inelastic process make up the rest of the total cross-section at the lowest energy. The hindrance in the fusion process caused by dissipation in the system before the occurrence of fusion is observed. At energies below the barrier deep inelastic contribution is small. Therefore, the increase in quasi-elastic reaction strength is seen for heavy systems $Zz>1600$ at such energies.

Standard model physics

In the standard model the carriers of the interactions are photon, gluons, and $W^{\pm}$ and Z guage bosons. While its fermi particles are three generations of leptons and quarks spanning the enormous mass range from left handed zero mass neutrino to very massive quarks and leptons. The Higgs doublet breaks the $SU_c(3)\times SU_L(2)\times U_y(1)$ down to electromagnetic U(1), making W and Z bosons massive. The fermion masses are free parameters determined from experiments and are related to their couplings to Higgs doublet, while the guage boson masses are related to guage couplings. The model correctly predicted the existence and properties of W, Z and gluons which described strong interaction symmetries. It incorporated the successes of quark model, quantum electrodynamics and the weak *V–A* theory. Only the top quark remains undiscovered of predicted mass 130 ± 40 GeV, and the Higgs scalar of mass lying between 48 GeV and 1 TeV. The recent weak interaction experiments have reached a per cent or better mark in testing this theory. Now experiments probe it hoping to find deviations which will lead to the ultimate theory of every thing. The precise muon life-time measurement gave the accurate value of the fermi constant, while the measured charged current transition rates determined the precise quark mixing matrix. The comparison of $\nu\bar{\nu}$ and e^+e^-, Z boson widths are found to be consistent with three light neutrinos. Pseudoscalar decay constants are precisely obtained. The phenomenology of weak neutral currents agrees well with ν scattering data. The atomic parity violation and the forward backward asymmetry of polarized electron scattering data and the precisely measured masses and widths of *W* and *Z* decay rates are well within the theoretical predictions.

The standard linear collider (SLC) and electron-positron project (LEP) were built to observe directly the *Z* boson and to study its leptonic and hadronic decays in details. SLC produced refinements in *Z* mass (91.14 ± 0.12) GeV and width ($2.42+0.45$; -0.35) GeV and determined the number of neutrino families, three, while LEP provided improved statistical errors on these data and continues producing *Z* decays checking the foundations of the standard model. The electron–positron collider clean data at 105 GeV at *Z* resonance were very crucial in testing standard model. Because at *Z* mass energies the nonresonance cross-section is small, the model independent analysis of *Z* line shape can be carried out. The three parameters of the theory are fixed from electromagnetic fine structure constant, the fermi constant and mixing angle θ_W which is obtained from charged to neutral current cross-sections in ν scattering. The lepton and *b* quark forward backward asymmetry and polarization asymmetry have tested electroweak theory. In short, collider data at *Z* resonance provided values of the parameters of the theory to a high accuracy.

The observations of weak decays of *B* mesons provide complementary knowledge of mixing matrix elements although not so accurately. In the e^+e^- annihilation of $B\bar{B}$ channel, there is a $r(4S)$ resonance which decays to $B\bar{B}$. Therefore, the Bs are produced in the $J^P=1^-$ accurately determined two-body state of $B\bar{B}$. Because of this advantage most of the knowledge of *b* quarks has come from experiments at $r(4S)$. Its decay branching ratio to non-B$\bar{B}$ is found to be less than 14%. While its decay branching to B$^+$B$^-$ and B^{0}B^0 is not known but expected to be equal. From the inclusive B meson data which is obtained by summing D$^+$, D^0, Ds, Ac and c$\bar{c}$ bound state, it is clear that *b* quark decays mainly to *c* quark $b \to cW^-$. The *B* meson decay branching into baryon-antibaryon pairs is obtained to be about 7% which is deduced from Λ yield coming mainly from *B* decays to Ac. The hadronic decays allow accurate measurements of B$^\pm$ and B^0 masses and tests models of hadronic *B* decays. In such semi-leptonic decays, the decay amplitude is factorized into the product of hadronic and leptonic current matrix elements (short range perturbative and long range binding separation). The spectator model predicts semileptonic branching ratio to be 14% as against its measured value (10.3±0.4%). The vector to pseudovector decay ratio is obtained from exclusive semileptonic decay measurements. The *B* menson measured average lifetime is (1.18±0.11) ps. The details of the separate lifetimes of B$^\pm$ and B^0, B$\bar{B}$ oscillations, the mixing matrix elements, and the top quark mass range analysis can be found in this chapter.

The hadronic proton–antiproton colliders at Berkeley and Texas also are aimed at studying fundamental fields of standard model and are looking for deviations from the predictions of this theory. The study of electroweak physics from hadronic decays of *W* and *Z* is masked with QCD background. Therefore hadronic colliders are limited to leptonic decays. Because of their highest available energy, they probe the shortest length scales. The measured charged particle pseudorapidity distribution is nearly constant over the centre of mass energy (ε) range 546 to 1800 GeV. The single particle transverse momentum P_t spectrum falls rapidly, however at higher values of ε, the high P_t tail becomes apparent in the data. This non-exponential tail at highest transverse ε_t is the point of onset of hard scattering. Above such P_t the strong interaction constant α_s becomes small and scattering is described by pertubative QCD. Because of larger colour factor and dominance of gluon structure function $f(x,\mu)$ at low *x*, gluon–gluon scattering dominates over that of quarks in the range of *x*, where the cross-section is largest. The parton elastic scattering is dominated by *t*-channel gluon exchange, hence similar to that of Rutherford scattering. The production of high P_t leptons is reduced relative to elastic parton scattering by several orders of magnitude because they are produced by weak decay of heavy quarks and electroweak bosons. Since in the analysis α_s and $f_g(x,\mu)$ are fixed at the hard momentum scale, the inclusive jet and boson cross-sections at high values of *x* and μ are calculated to next to leading order. The properties of jets, electroweak bosons γ, *W*, and *Z* and of neutrinos υ_l are measured in hard scattering processes. The total inelastic cross-section is large relative to hard scattering rate in which jet rate dominates. The agreement between the observed and calculated jet cross-sections and their angular distributions tested the QCD model of strong interactions. Hadronization is a soft process taking place with limited P_t with respect to initial parton direction following collimated jet of particles. The leptons produced from heavy quarks, *W* and *Z* bosons have much lower P_t than that of jets. The jet production is large background to these low P_t leptons. According to the standard model, the isolated leptons are produced in Drell–Yan and weak Drell–Yan processes and heavy quark decay of massive top quark. While the decays of *b* and *c* quarks produce nonisolated leptons. The massive *b* quark decays produce leptons with higher P_t than do *c* quarks. Heavier t quarks produce even more isolated leptons. The measurements of *W* and *Z* masses, widths and decay distributions provided tests of perturbative QCD and information on electroweak structure of nature. Latest data so far show no evidence of SUSY particle production. The future investigations would be on new particle searches and detailed measurements of particles and processes predicted by standard model in order to go beyond it.

The measurements and theoretical calculations of charm meson states and their decays have enhanced our understanding of standard model parameters, Higgs boson couplings and *b* and *c* decay physics. It is hoped that the study of charm baryon spectroscopy may further help in understanding these properties better. The bottom baryon has not yet been seen. The heavy hadrons composed of *c* and *b* quarks are quite distinct in their properties from light flavoured hadrons composed of *u*, *d* and *s* quarks. The mass scales of heavy quarks exceeds the confinement scale of 300 MeV that governs the physics of light hadrons. The heavy–light quark interaction becomes spin independent at equal velocity, and generates additional spin-flavour symmetry in current induced transitions not manifest in the original QCD lagrangian. The spin–spin interaction reproduces the $1/2^+$ and $3/2^+$ charmed baryon masses in a variety of models with differing degrees of sophistication. The observed Λ_c and Ξ_c states are weakly decaying having 2×10^{-13} s and 2.6×10^{-13} s lifetimes respectively as against theoretically predicted value of 2.46×10^{-13} s. The experimental $\Gamma(\Lambda_c \to e^+ + x)$ is $(22.5 \pm 8.7) \times 10^{10}\,s^{-1}$. The free quark decay rate calculated from this using the parton model gives a value $17.4 \times 10^{10}\,s^{-1}$. The recent advances in understanding of current induced transitions among heavy–heavy and heavy-light hadrons are pointed out. It may be possible to analyse in future the angular distributions in nonleptonic and semileptonic decays with increased statistics, and perform photo production experiments of charm baryons.

Intermediate nuclear physics

Recently there has been interest in studying the low energy (less than 2 GeV) antiproton physics. The nucleon–antinucleon (N$\bar{N}$) potential V(N$\bar{N}$) has opposite sign relative to V(NN) arising from the exchange of odd G-parity mesons, while that arising from the exchange of even G-parity mesons is the same. The complex short range potential is added to simulate the effect of annihilation channels in V(N$\bar{N}$). The NN scattering for p (lab) greater than 1.5 GeV is mainly diffractive while that of N$\bar{N}$ becomes diffractive at somewhat lower energy. At low momenta P$\bar{P}$ scattering requires more partial waves than its PP counterparts. Because of strong absorption in P$\bar{P}$ s-wave, the dominant partial waves are *p* and some *D* even at 300 MeV/c, while PP scattering is dominated by *s*-wave. The N$\bar{N}$ spin averaged *P* wave is repulsive and turns attractive below 300 MeV/c while *s*-wave remains repulsive. The ratio of real to imaginary parts of the scattering length $\rho = -1.08 \pm 0.09$ which rises towards positive values at higher momenta. The polarization data are very sensitive to short range parametrization of $V(N\bar{N})$. The charged exchange cross-section is forward-peaked between 180 and 300 GeV/c. In the annihilation of $P\bar{P}$ to $\Lambda\bar{\Lambda}$ close to the threshold s-wave scattering, the amplitude is purely imaginary and close to the unitarity limit due to strongly absorbing initial and final channels. The understanding of the total cross-section near threshold requires the inclusion of P wave because of its attractive nature.

The study is initiated with expectation that the annihilation process might give new insight into the physics of hadronization. At high energy hadronization dominates. The particle production is qualitatively understood from the dynamics of stretching colour flux tube which hadronizes into jets as in the Lund model while the low energy $N\bar{N}$ annihilation is thought of generating a hot and dense $q\bar{q}$ gas that evaporates into an average of 5 pions. Thus they are the small versions of quark gluon plasma. No model satisfactorily explains the branching ratio of $P\bar{P}$ annihilation to different pion channels. The search for exotic mesons q^2q^{-2}, $q\bar{q}g$, glue balls and other multiquark/hybrid gluon mesons was the other attraction to pursue this study.

The angular distribution of exclusive $\pi^+\pi^-$ shows a peak for $|\cos\theta| = 1$ into the $P\bar{P}$ annihilation in flight while that of K^+K^- is flat. The observed behaviour of the analysing power of π^- or K^- has not yet been understood. The two meson doorway state model so far is the most successful of all in explaining the pions and kaons productions. In the recent studies it is found that $\eta(1440)$ is made up of three states $f_1(1443)$, $\eta(1416)$ and $\eta(1490)$; the $E(1420)$ 0^{-+} decays to $K^\pm K^0 \pi^\pm$ with the $a_0(980)\pi$ its dominant decay mode (a_0 decays to $K\bar{K}$); $f_2(1565)$ decays to $\pi^+\pi^-$. The decay modes of 0^{++} and 2^{++} mesons and their detailed properties are investigated. The enhancement of strangeness production in $\bar{P}$–nucleus interaction is seen. It is planned to study the charmonium states, charm supernuclei and colour transparency of nuclei.

In the studies of particle production in the hadron bombardment of target nuclei, it is found that the particle yield is made up of an incoherent superposition of yields from individual hadron nucleon collision in the high energy part of the spectrum. While in the low energy part of the spectrum it is expected to be sensitive to the coherent particle production. In the subthreshold domain it therefore depends on the phase space distribution of nucleons in the nucleus. The dynamical phase-space distribution of nucleons in the collision process is obtained by solving the Lioville equation. Since at high energies emission of pions is a major source of cooling for nucleus–nucleus system the pions, deltas and other baryon resonances have to be coupled to the phase-space evolution equation. The production of pions, kaons, etas, nucleon resonances, photons and dimuon pairs is qualitatively explained by this approach.

The in-medium behaviour of pion which carries strong interaction is greatly governed by an isobar excitation in a nucleus. The pion and delta propagation in nuclear medium depends on the nucelon–delta interaction which is attractive at finite momentum. The medium effects on this interaction are expected to be larger than in NN scattering due to this attraction and different Pauli blocking effects. This effect shifts the delta resonance by 30 MeV and broadens further to $\Gamma = 240$ MeV due to medium effects. The emphasis here is on the analysis of inclusive charge exchange reactions separated into spin longitudinal and spin transverse response. In proton–neutron charge exchange experiments no enhancement in spin longitudinal channel is observed at momentum transfer near 1.75 f. It is well known that spin transverse response is probed by the electromagnetic interaction of photons and electrons. In nuclear medium the cross section per nucleon is close to its average value for proton and neutron. Electron scattering in delta region is dominated by transverse response. At low energies it shows similar behaviour to that of photon absorption. With increase in four momentum transfer delta peak becomes less pronounced in the spectrum. The pion absorption cross-section is very large and forward angle scattering is strongly modified by medium effects. The spin longitudinal nature of pion–nucleon–delta vertex results in coherent pion scattering in forward direction. However, the NN to $N\Delta$ reaction cross-section is very small, particularly the $\Delta S = 0$ contribution. The composite spin longitudinal form factors are extracted using spin transverse form factors from electron scattering data, particularly at large momentum transfers. The heavy ion induced inclusive isobar excitations are extreme surface reactions. The factorization approximation qualitatively explains the observed data. The exclusive cross-section of proton induced pion production on nuclear targets indicates quasi-free delta formation.

Search for fifth force

It is well known that scalar and vector boson mediated forces are attractive and repulsive respectively. While the forces generated by pseudoscalar and pseudovector particle exchange are necessarily spin-dependent. However, the net spin-dependent force between unpolarized composite bodies vanishes. In the past, new force was discovered when the contribution of all the other known forces to the observation was vanishingly small. The theoretical speculations of intermediate long-range forces have provided rationale to search for new macroscopic forces. Many experiments are performed to test the limits of the existing known forces with the hope to find a clue to this unknown macroscopic force. The experimental hints of apparent violations of both inverse square law and universality of free fall were presented as evidence for the existence of a fifth force. If all extraneous forces are rendered negligible and gravitational field is uniform, any difference in the acceleration of two dissimilar bodies would constitute evidence for new physics. Experiments of this type designed to test inverse square law have yielded little information. Any spin-dependent force will have no gravitational background, however, macroscopic polarized bodies are difficult to obtain. There is no evidence for the fifth force of range $10 < \lambda < 100$ m which is deduced from the observed correlation between the differential acceleration of test bodies and their difference between baryon number to mass number ratio. Many different Cavendish balance experiments aimed at accurately measuring the gravitational constant G and testing the validity of inverse square law over wide range of distances are summarized in this chapter. At shorter length scales less than 1 m the casimir effect arising from surface charges cannot be entangled from gravitational force. On the large astronomical and laboratory scale the departure from the inverse law has not yet been claimed. Geophysical tests show no evidence of a new force of range $10<\Lambda<1000$ m within uncertainties of the Earth's gravity field at the experimental site, arising from unknown surface structure. The borehole measurements designed to test gravitational law within a range of $\Lambda<1000$ m are not consistent with each other. The tower measurements and moving source experiments are consistent with the value of laboratory G to within 0.4%. Free fall experiments with elementary particles give the neutron acceleration $(1.00011\pm 0.00017)g$ while the measured antiproton acceleration agrees to within 0.01 g accuracy. The solar, terrestrial source and floating ball experiments are performed and improved spaceborne experiments are being planned. In the absence of any outstanding and clean unexplained experimental result the search for new force will continue setting better limits on the validity of existing known forces.

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An Introduction to Peptide Chemistry. P. D. Bailey. John Wiley & Sons, Singapore. 1992. 232 pp. Price: $39.95.

When proteins have been talked about since decades, why have the peptides gained importance? This short and crisp textbook of *peptide chemistry* reveals the answer. 'The peptides are an amazing class of compounds'—an excellent punchline made at the start of this book. Although every peptide contains amino acids as their backbone, each of them exhibits a remarkable range of biological properties. The importance of research in this field has emerged from the medicinal properties they possess and the flexibility with which they can be synthesized, sequenced and analysed.

As peptides assume an increasingly important role in biological phenomena, methods for their purification and characterization, design and development of antagonists, determination of the biologically relevant conformation and conversion to peptidomimetic therapeutic agents become increasingly more important. Peptide chemistry (and, of course, peptide biology), a rapidly advancing field has weaved the path for the production of peptide hormones (human calcitonin and fast-acting insulin), neuropeptides (neuropeptide Y, cholecystokinin analogs and casomorphins), peptide vaccines (HIV and influenza), peptide inhibitors (for angiotensin-converting enzyme and enkephalin-aminopeptidase) and so on.

Intended mainly for undergraduates and post-graduates in chemistry, biochemistry and molecular biology, this book will certainly find a prominent place in biotechnology on the whole.

It contains just the right amount of information for beginners and displays the author's skill in condensing elaborate material into precise, crisp and apprehendable chapters. With an introductory chapter on peptides (what are they?, how should they be studied?, their biological properties, etc.) and another on amino acids (especially DNA encoded amino acids, unusual amino acids, their chemical reactions and physical properties) the author continues with chapters which outline various general steps of isolation and purification, viz. dialysis, gel filtration, ion-exchange chromatography, HPLC, GC and electrophoresis. Three more chapters related to amino acid analysis, sequencing and synthesis are well endowed with mainly theoretical aspects.

Peptide chemistry application has been well projected by an entire chapter on LH-RH (luteinising hormone–releasing hormone), given as an example for young and aspiring peptide chemists. LH–RH is a hormone known to have control on the growth and development of ovaries and testes as well as release of other hormones such as oestrogen and testosterone. This unique chapter explains structure determination, end group analysis, fragmentation of LH–RH, sequencing, synthesis and medicinal properties. This chapter is unique because it revolves round the story of Andrew Sally—recipient of the Nobel prize for Medicine in 1977 and is not merely a textbook version of a sample peptide.

At the end of the book the author has very thoughtfully incorporated three sections of appendix; one devoted to general methods of amino acid synthesis, another to the structure of peptides and a third section to the use of DNA/RNA technology (or genetic engineering) for sequencing and synthesis of peptides. At the end of every chapter, a few puzzling questions are sure to benefit the student community.

Many interesting peptides have been discovered so far and many more are still in the 'pot'. There may be an array of synthetic peptides by the turn of the century but the study of peptides comes handy for the discovery of naturally occurring ones. One such remarkable peptide is galanin. Discovered only ten years ago, galanin has now been termed by experts as a 'multi-functional peptide in the neuro-endocrine system'. Isolated in 1983 by Tatemoto, Mutt and colleagues, galanin has been shown to have remarkable effects on presynaptic inhibition of acetylcholine release, glucose-stimulated release of insulin and growth hormone release regulation.

Although unnecessary information has not been mentioned, and most of the methods covered, a few more interesting examples on custom made peptides would have thrown more light on the subject. Nevertheless, this book is certainly 'short, crisp and simple'.

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The Essentials of Viruses, Vectors and Plant Diseases. A. N. Basu, B. K. Giri. Wiley Eastern Limited, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002, 1993. pp. 242. Price: Rs 400.

This book on plant virology by Basu and Giri is, as the authors point out, a venture to offer a balanced coverage of the multidisciplinary subject with special emphasis on the needs of undergraduate students studying in Indian universities.

The authors have succeeded in selecting topics that are most important for the virologists working in Indian uni-