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THE CREATION OF THE LIGHT ELEMENTS—COSMIC RAYS AND COSMOLOGY

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1. INTRODUCTION

Since the pioneering and persuasive work of Burbidg
(1957) it has been clear that most of the elements are created by nuclear reactions in the centers of stars. Some of these elements, including those most abundant, are produced during the long quiescent periods of hydrogen and helium burning which occupy most of a star's life. Others are produced much more quickly, on time scales of seconds or fractions

NN EXPERIMENTS AND THE *NN* INTERACTION

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1. INTRODUCTION

After more than 40 years of effort, we at last begin to have a detailed quantitative understanding of the nucleon–nucleon interaction. It is a tangled web of exchanges of π, σ, ρ, ω and other mesons, with and without excitation of intermediate baryon resonances (Fig. 1). The ingredients going into these diagrams now tie together consistently not only *NN* elastic data, but πN phase shifts up to 2 GeV/c, $\pi\pi$ phase shifts up to 1 GeV/c, the electromagnetic structure of the nucleon, and the limited amount we know about *NN*

PION PRODUCTION IN NUCLEI: THINGS KNOWN AND UNKNOWN

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Abstract—The experimental and theoretical status of reactions of th
the final nucleus is left in a definite state, is reviewed. Particular emphas
the various theoretical approaches which have been used, on the relat
and on the remaining difficulties and unknowns particulai

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1. INTRODUCTION

In recent years a great deal of excitement has been generated by exclusive (p, π) reactions, i.e., the reaction $p+A \rightarrow \pi+(A+1)$ in which the incoming nucleon is captured by the nucleus A leaving the resulting nucleus $A+1$ in a definite final state. In this review we survey the progress which has been made in understanding these very interesting reactions and discuss the many outstanding problems which have so far prevented full understanding of the process.

CURRENT STATUS OF QUARK SEARCH EXPERIMENTS

L. LYONS

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Abstract—The quark model is successful in the fields of hadronic spectroscopy and high energy scattering processes, but the question of whether free quarks exist remains of fundamental importance. The experimental situation was reviewed in 1977 by Jones[1] who concluded that there was little evidence for free quarks. Developments since then are pres
whether experiments claiming positive results are compatible wi
suggestions for the future are mad(

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1. INTRODUCTION

The success of the quark model in the fields of hadronic spectroscopy[41] and various aspects of scattering phenomenology[42] has provided the impetus for the search for free quarks in a wide range of experimental situations. The diversity of methods used and potential sources investigated are summarised in Fig. 1. The lack of success of the majority of these experiments has given rise to the concept of confinement—that the interaction between quarks is strong and/or so long ranged such that they cannot be separated from each other.

If this is correct and confinement is absolute, then of course quarks will never appear except inside hadrons, and hence the search for free quarks would be doomed to failure. Since, however, no-one has yet even demonstrated that, for example, confinement is a necessary consequence of quantum chromodynamics (QCD), the search for fractional charge or other quark signatures continues.

The situation concerning searches for quarks at accelerators, in cosmic rays, in various

MASSIVE LEPTON PAIR PRODUCTION IN HADRONIC INTERACTIONS AND THE QUARK MODEL

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Abstract—The experimental data on the production of $\mu^+\mu^-$ and e^+e^- pairs in hadronic interactions are reviewed. The region above ~ 3 GeV in lepton pair mass is considered, with continuum and resonance contributions being dealt with separately.

The continuum is compared critically with the predictions of the naive Drell–Yan model of $q\bar{q}$ annihilation, and its limitations are discussed. To the extent that the simple model is applicable, quark distributions in hadrons can be extracted; these supplement information from other sources. Embellishments to the simplest Drell–Yan picture, and their degree of success in explaining the data, are considered. Higher order QCD processes may be the dominant mechanism, especially at large transverse momentum.

Resonance production (of the ψ and Υ families) differs from the continuum. Various mechanisms, differing at the level of which partons contribute, have been proposed. None of these on its own seems adequate, but a picture of what sort of mixture is required is emerging.

The aim for the future is to check in more detail the higher order corrections to the Drell–Yan process for the continuum, and to test more stringently wheth
processes whose relative magnitudes are derived theoretically reall
resonance production. This may then enable us to use lepton pa
the parton structure of hadrons, and to understand better the
phenomena to hard scattering processes.

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THE CURRENT STATUS OF CHARM

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1. INTRODUCTION

In the current view of particle physics the fundamental [illegible] quarks[1] and leptons. The leptons (e, μ, τ) can be observed l [illegible] remain confined within the hadrons. The evidence for the existence of these spin $\frac{1}{2}$ particles, derived from