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This Week's Citation Classic

Kuti J & **Weisskopf V F.** Inelastic lepton-nucleon scattering and lepton pair production in the relativistic quark-parton model. *Phys. Rev. D* 4:3418-39, 1971.
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The subnuclear particles like protons and neutrons are composite systems. Their constituents, partons, are quarks and gluons as revealed by deep inelastic scattering of electrons and neutrinos from nuclear targets. This paper shows how to describe the proton and neutron in terms of quark and gluon partons in scattering experiments. [The ***SCI***® indicates that this paper has been cited over 300 times since 1971.]

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"The work reported, performed while I was a postdoctoral research fellow at the Massachusetts Institute of Technology, was undertaken to explain the challenging question: what is the nucleon made of?

"In 1969 Richard Feynman and James Bjorken suggested that in deep inelastic collisions of electrons on various nuclear targets at the Stanford Linear Accelerator Center (SLAC), in a joint experiment with MIT, the composite structure and the constituents of the nucleon were being deeply probed for the first time in the history of physics. The SLAC-MIT experiment carries the name of 'the new Rutherford experiment.'

"Bjorken identified the subconstituents of the nucleon as point-like quarks with fractional electric charge and with the same amount of intrinsic angular momentum as carried by the electron.

"I came to MIT in the fall of 1970 with great enthusiasm to work on the quark problem, since in the previous year a group of us in Budapest worked out a theoretical proposal to test the quark composition of the nucleon in a new polarized version of the SLAC-MIT experiment.

"Viki Weisskopf, who was chairman of the physics department at MIT in those years, just returned from Europe and gave a seminar about his recent ideas on quarks and partons. I asked a few questions and he suggested that we might work together. I was greatly honoured, since Viki is one of the most outstanding physicists of our times. His great personality made an impact on the rest of my life.

"After seven months of exciting collaboration we had a working model of the nucleon. In this model the nucleon was composed of three valence quarks, a cloud of an indefinite number of quark-antiquark pairs and gluons. The valence quarks carried the characteristic properties of the nucleon and the gluons were identified as the quanta of the force field between quarks.

"The scattering of electrons or neutrinos from the valence quarks was interpreted as the nondiffractive component of the differential cross section which was dependent on the nuclear composition of the target. Scattering from the quark-antiquark cloud was associated with diffractive scattering.

"There was only one constant adjustable in the model, the ratio of gluons to quark-antiquark pairs in the diffractive cloud surrounding the valence quarks. The model was used to calculate the deep-inelastic scattering of electrons by protons and neutrons and its dependence on the relative spin orientations, the inelastic scattering of neutrinos by nucleons, and the creation of massive muon pairs by proton-proton collisions. After adjusting the free parameter to the data of unpolarized electron-proton scattering, the theory predicted the other results.

"To me, the major importance of this paper lies in the fact that it was the first to show to theorists and experimentalists that a reasonably simple quark-parton model of the nucleon can explain a vast amount of observations, provide us with new testable predictions, and strengthen our belief in the quark and gluon constituents as new building blocks of nature below the known nuclear scale "