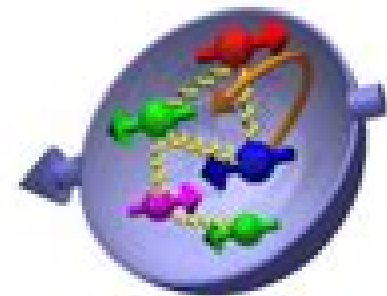
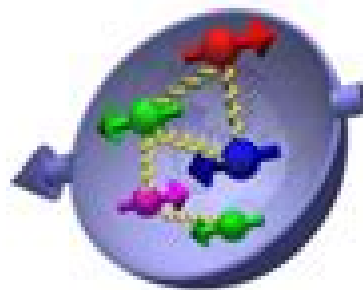
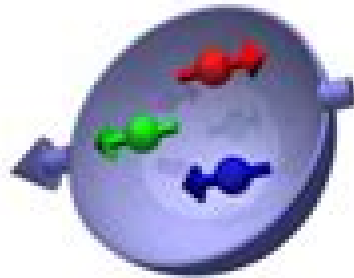


# the nucleon spin structure



QPM:

$$\frac{1}{2} = \frac{1}{2} \underbrace{(\Delta u_v + \Delta d_v)}_{\Delta \Sigma = 1}$$

$$\Delta \Sigma \approx 0.7$$

gluons are important !

→  $\Delta G$

→ sea quarks:  $\Delta q_s$

don't forget the orbital angular momentum!

EMC 1984

$\Delta \Sigma \approx 0.6 \pm \dots$

Spin Puzzle

$$\frac{1}{2} = \frac{1}{2} \underbrace{(\Delta u_v + \Delta d_v + \Delta q_s)}_{\Delta \Sigma} + L_q + \Delta G + L_G$$

→ SLAC, CERN, DESY:  $\Delta \Sigma \approx 0.2-0.4$

# Spin Structure Of The Nucleon

**Krzysztof Kurek**



## **Spin Structure Of The Nucleon:**

**Spin Structure of the Nucleon** Erhard Steffens, Revaz Shanidze, 2003-09-30 A comprehensive survey of the most recent results from the field of quark gluon structure of the nucleon in particular how the spin of the nucleon is shared by its constituents After very intriguing results from CERN and SLAC at the end of the 1980s the last decade has seen a set of second generation experiments at high energy accelerators that have yielded precise information on the solution of the Spin Crisis as well as opening up new questions The articles are written by experts from the leading collaboration and theory groups as well as providing an expert summary of the state of the art the book points the way to future research directions Its main focus is on semi inclusive and exclusive measurements of deep inelastic lepton scattering which enables for the first time the determination of the flavor separated quark spin distributions Future developments on generalized parton distributions and their interpretation as well as the transverse spin structure are also covered An indispensable volume for all working in hadronic physics

**The Spin Structure Of The Nucleon** Bernard Frois, Vernon W Hughes, N De Groot, 1998-02-24 From its early beginnings at SLAC in the 1970 s the study of nucleon spin structure using polarized lepton beams and polarized nucleon targets has become increasingly important in nuclear and particle physics with current experiments at several of the world s high energy and nuclear physics laboratories CERN DESY SLAC and Jefferson Lab and with enormous related theoretical studies The understanding of the fascinating but complicated problem of nucleon spin structure has progressed substantially but fundamental questions remain and it can be confidently predicted that future activity will be high The Erice Course on The Spin Structure of the Nucleon covered both the experimental and theoretical aspects of the subject and this volume includes the lectures given at the School In many cases the lecture material has been extended and updated by the authors In addition several recent publications on experimental work have been added in an appendix

*Internal Spin Structure Of The Nucleon - Proceedings Of The Symposium* Vernon W Hughes, Christian Cavata, 1995-07-14 The topic of the internal spin structure of the nucleon has become an unusually active subfield of particle and nuclear physics together with the relevant technologies This volume presents up to date coverage All the talks given at the symposium can be found in the volume In addition selected articles are reprinted including two early papers which record initial thinking about the topic all experimental papers giving data on nucleon spin structure functions determined from polarized lepton nucleon scattering and two valuable previously unpublished papers

The Spin Structure of the Nucleon Bernard Frois, Vernon W. Hughes, Nicolo De Groot, 1997 The Spin Structure of the Nucleon Bernard Frois, 1997 From its early beginnings at SLAC in the 1970 s the study of nucleon spin structure using polarized lepton beams and polarized nucleon targets has become increasingly important in nuclear and particle physics with current experiments at several of the world s high energy laboratories CERN DESY and SLAC and with enormous related theoretical studies The understanding of the fascinating but complicated problem of nucleon spin structure has progressed substantially but

fundamental questions remain and it can be confidently predicted that future activity will be high The Erice Course on The Spin Structure of the Nucleon covered both the experimental and theoretical aspects of the subject and this volume includes the lectures given at the School In many cases the lecture material has been extended and updated by the authors In addition several recent publications on experimental work have been added in an appendix **The Spin Structure of the Nucleon**

Michel C. Vetterli,1998 *Spin Structure Of The Nucleon - Proceedings Of The The Riken Symposium* Toshi-aki

Shibata,Shigemi Ohta,Naohito Saito,1996-08-30 After about three decades of experimental and theoretical efforts the structure of the nucleon proton and neutron is now fairly well understood based on quantum chromodynamics but only if averaged over its spin As the recent proton spin crisis revealed we do not understand much about the nucleon structure when its spin is polarized to a specific orientation We expect that our understanding on this challenging problem will soon be significantly improved by the RHIC Spin and other experiments in the near future as well as by the lattice and perturbative QCD theoretical calculations The purpose of this symposium was to summarize the current understanding and discuss the future perspective of this problem with experimental and theoretical physicists from both high energy and nuclear physics communities The symposium covered the overview of the structure studies updates on the experimental results from CERN SLAC DESY FNAL and KEK future experiments at RHIC and recent theoretical developments 18 presentations 113 participants **Spin Structure of the Nucleon and Polarization** ,1994 Spin Structure of the Nucleon - Status and Recent Results ,2009 After the initial discovery of the so called spin crisis in the parton model in the 1980s a large set of

polarization data in deep inelastic lepton nucleon scattering was collected at labs like SLAC DESY and CERN More recently new high precision data at large  $x$  and in the resonance region have come from experiments at Jefferson Lab These data in combination with the earlier ones allow us to study in detail the polarized parton densities the  $Q^2$  dependence of various moments of spin structure functions the duality between deep inelastic and resonance data and the nucleon structure in the valence quark region Together with complementary data from HERMES RHIC and COMPASS we can put new limits on the flavor decomposition and the gluon contribution to the nucleon spin In this report we provide an overview of our present knowledge of the nucleon spin structure and give an outlook on future experiments We focus in particular on the spin structure functions  $g_1$

The Nucleon Spin Structure Ulrich Stiegler,1996 The Internal Spin Structure of the Nucleon

Harald Fritzsche,Max-Planck-Institut für Physik und Astrophysik,1988 **QCD Spin Physics** ,2011 Nucleon Spin Structure Functions from HERMES: The First Year ,2001 HERMES und HERA RA und Measurement of  $g_1$  and  $S$  spin is a second generation experiment to study the spin structure of the nucleon by using polarized internal gas targets in the HERA 28 GeV electron storage ring Scattered positrons and coincident hadrons are detected in an open geometry spectrometer which includes particle identification Inclusive data with polarized  $^3\text{He}$  give the spin structure function  $g_1^p(x)$  and the Ellis Jaffe integral  $\int_0^1 g_1^p(x) dx$  for the neutron The semi inclusive spin

asymmetries are a unique and sensitive probe of the flavor dependence of quark helicity distributions and properties of the quark sea Data taken in 1995 with unpolarized hydrogen and deuterium targets provide measurements of the flavor distributions of sea and valence quarks In a preliminary analysis  $\Lambda$  sum rule is obtained at  $Q^2 = 3 \text{ GeV}^2$  for the Ellis Jaffe integral

**Understanding the Nucleon's Spin Structure**  
 Krzysztof Kurek, 2013 A modern understanding of the nucleon's spin structure is presented Polarisation dependent deep inelastic experiments have shown that the helicity contribution of quarks to the nucleon spin is much smaller than expected from the simple quark model This observation and the role of the triangle anomaly lead to the conclusion that gluons if strongly polarised might solve the spin problem of the nucleon Therefore a direct gluon polarisation measurement is the one of main goals of the COMPASS experiment spin physics programme New results for the gluon polarisation are obtained The results strongly support the hypothesis that the gluons inside the nucleon are weakly or not polarised Therefore the possible importance of quark and gluon angular momenta are discussed A short review of the nucleon's spin structure results obtained in a Lattice Quantum Chromodynamics approach is presented The concept that the presence of the angular momentum of quarks inside nucleon is related to the spatial deformation of the quark densities in the transverse plane is also reviewed

*Transverse Spin Structure of the Nucleon from Lattice QCD Simulations*, 2006 Physics Objectives for Future Studies of the Spin Structure of the Nucleon Wolf-Dieter Nowak, 2002

**Symposium on the Internal Spin Structure of the Nucleon** Vernon W. Hughes, Christian Cavata, 1995

**New Results on Nucleon Spin Structure**, 2005

Recent precision spin structure data from Jefferson Lab have significantly advanced our knowledge of nucleon structure in the valence quark high  $x$  region and improved our understanding of higher twist effects spin sum rules and quark hadron duality First results of a precision measurement of the neutron spin asymmetry  $A_1^n$  in the high  $x$  region are discussed The new data shows clearly for the first time that  $A_1^n$  becomes positive at high  $x$  They provide crucial input for the global fits to world data to extract polarized parton distribution functions Preliminary results on  $A_1^p$  and  $A_1^d$  in the high  $x$  region have also become available The up and down quark spin distributions in the nucleon were extracted The results for  $\Delta d$  disagree with the leading order pQCD prediction assuming hadron helicity conservation Then results of a precision measurement of the  $g_2^n$  structure function to study higher twist effects are presented The data show a clear deviation from the lead twist contribution indicating a significant higher twist twist 3 or higher effect The second moment of the spin structure functions and the twist 3 matrix element  $d_2^n$  results were extracted at a high  $Q^2$  of  $5 \text{ GeV}^2$  from the measured  $A_2^n$  in the high  $x$  region in combination with existing world data and compared with a Lattice QCD calculation Results for  $d_2^n$  at low to intermediate  $Q^2$  from  $0.1$  to  $0.9 \text{ GeV}^2$  were also extracted from the JLab data In the same  $Q^2$  range the  $Q^2$  dependence of the moments of the nucleon spin structure functions was measured providing a unique bridge linking the quark gluon picture of the nucleon

and the coherent hadronic picture Sum rules and generalized forward spin polarizabilities were extracted and compared with Chiral Perturbation Theory calculations and phenomenological models Finally preliminary results on the resonance spin structure functions in the  $Q^2$  range from 1 to 4  $\text{GeV}^2$  were presented which in combination with DIS data will enable a detailed study of the quark hadron duality in spin structure functions

**Investigation of the Spin Structure of the Nucleon at the COMPASS Experiment** Malte Christian Wilfert, 2017

**Spin Structure of Nucleon in the Asymptotic Limit** Jian Tang, 1996

## Unveiling the Power of Verbal Artistry: An Psychological Sojourn through **Spin Structure Of The Nucleon**

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