20 YEARS OF ZAKOPANE:

1991-2010

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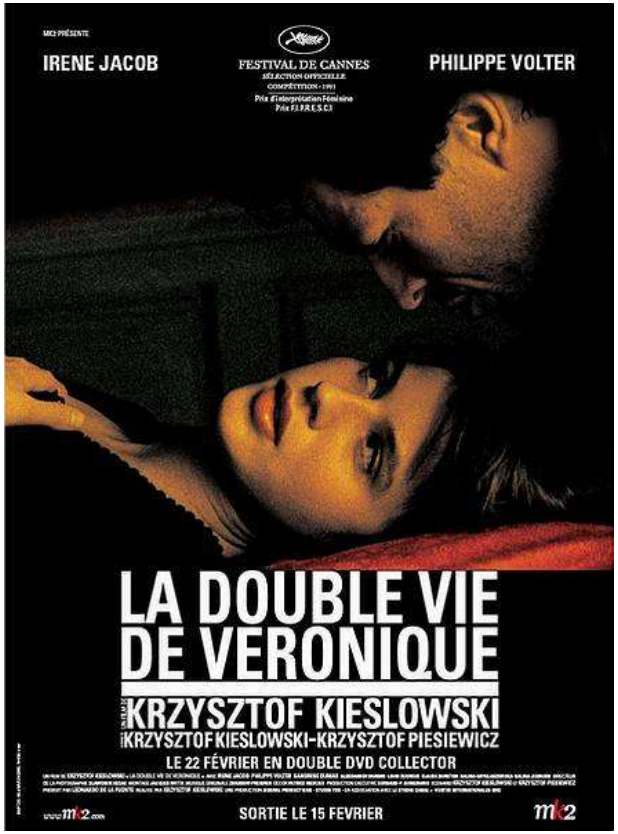
ZAKOPANE, JUNE 10, 2010

1991



INSTANTONS
AND THE PROTON'S AXIAL CHARGE*

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(Received September 24, 1991)

We show that non-perturbative contributions to the nucleon matrix elements of quark and gluon operators may explain the surprising experimental results of the EMC collaboration on the nucleon's axial charge. We discuss the phenomenological consequences of this way of understanding the data, and we argue that recent experimental results on the Gottfried sum rule may be understood in the same way.

THEN

- 1989-90: EXPERIMENTAL DISCOVERY THAT QUARKS IN A POLARIZED PROTON ARE ALMOST UNPOLARIZED
- FIRST EXPLANATIONS: PERHAPS Δg LARGE? IF SO, LARGE SCHEME DEPENDENCE (ANOMALY). PERHAPS Δs LARGE? (SKYRMIONS)
- IDEA: NONPERTURBATIVE CONTRIBUTIONS (INSTANTONS) CANCEL QUARK DUE TO ANOMALY: Δq AND Δg BOTH SMALL?

NOW

- SECOND GENERATION OF EXPERIMENTS: SMC/SLAC/HERMES 1990-2000 RESULT CONFIRMED, BUT Δg, Δs STILL UNKNOWN
- LOTS OF THEORETICAL ACTIVITY (HIGHEST CITED EXPT PAPER UP TO 2000)
- THIRD GENERATION OF EXPTS, COMPASS/RHIC: Δg PROBABLY SMALL...

1993

THE LIGHT–FLAVOR STRUCTURE
OF THE NUCLEON*

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(Received October 19, 1993)

Recent data on the Gottfried sum and less recent ones on the pion-nucleon sigma term seem to disagree with naive parton-based expectations on the light (*i.e.*, up, down and strange) quark content of the nucleon. We show that these discrepancies are resolved if nonperturbative contributions are included in the analysis of the data. These appear both in the computation of matrix elements of operators, and in their QCD scale dependence, and depend strongly on the quantum numbers of the given state.

THEN

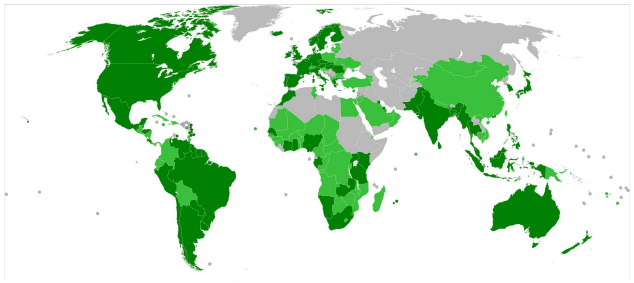
- EXPT DISCOVERY (NMC) THAT LIGHT QUARK SEA IS FLAVOUR-ASYMMETRIC
- IS IT TRUE? WHY? EFFECTIVE MODELS, PAULI BLOCKING. . .
- IDEA: NONPERTURBATIVE (HIGHER TWIST) CONTRIBUTIONS DRIVEN BY ANOMALY LEAD TO ASYMMETRIC EVOLUTION OF SYMMETRIC B.C.

NOW

- DRELL-YAN & ν DIS EXPERIMENTS $\Rightarrow$ COMPLEX SEA STRUCTURE $\Rightarrow$ NUTEV ANOMALY
- ELECTROMAGNETIC CONTRIBUTIONS TO EVOLUTION

1995

WORLD TRADE ORGANIZATION



UNIVERSALITY AND SCALING
IN PERTURBATIVE QCD AT SMALL x *

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(Received December 1, 1995)

THEN

- EXPT. DISCOVERY AT HERA THAT F_2 RISES AT SMALL x
- EVIDENCE FOR THE "HARD" BFKL POMERON?
- IDEA: CHCEK SCALING PROPERTIES OF RESULT: AGREE WITH NLO PERTURBATIVE QCD! (DOUBLE ASYMPTOTIC SCALING)

NOW

- HERA DATA 1995-2005$\Rightarrow$ PRECISION NLO QCD
- BFKL AT NLO (1998): HUGE CORRECTION
- STABLE SMALL x RESUMMATION: 2000-2010