



XV WORKSHOP ON HIGH ENERGY SPIN PHYSICS

DSPIN-13

Dubna, Russia **October 8 - 12, 2013**

Starts 1981

by L.I. Lapidus

Possibility to participate of physicists from the former USSR was important motivation. Distant trips are complicated by financial (earlier also by political and bureaucratic) reason.

125 participants

41 invited talks (40-30')

51 original talks (20')

4 posters



JINR 53, Russia 24 ,
USA 10 , Belarus 7,
Poland 6, Germany 4,
Czech Republic 3, Italy 3,
France 2 , Slovakia 2 ,
Iran 2, China 2,
Belgium , Bulgaria , India ,
Portugal, Sweden, Ukraine
and South Korea

**Program of DSPIN-13
(BLTP Conference Hall)**

| | 08.10 Tu | 09.10 We | 10.10 Th | 11.10 Fr | 12.10 Sa |
|--------------|-----------------|---------------|----------------|-------------------|----------------|
| Chair | Ledwicky | Tanida | Krisch | Kurak | Barish |
| 9.30 | Opening | Xu | Nurushev 30 | Tsytrnov | Fang |
| 9.50 | Krisch 40 | | Schoening 20 | Cherednikov | |
| 10.10 | | Barish | | Selvaev | Hockins 30 |
| 10.30 | Tanida 30 | | Nikolaev | Abdolkhafar | |
| 10.50 | | Kizenev | | Arbaciifer | Ladygin 30 |
| 11.10 | Rinkevicius 30 | | Shevchenko | Arbu2 | Strokovsky |
| 11.30 | Coffee break | Coffee break | Coffee break | Coffee break | Coffee break |
| 11.50 | Fang | Nowak | Soffer | Mikolaev | Sandacz |
| 12.10 | Bressan | Artur | Larin 30 | Pendricat 30 | Lizkov |
| 12.30 | Bradamante | Soffer | Zavada 30 | Punjabi 30 | Cocciariata |
| 12.50 | | | Peng | Ankin | Zakharov 30 |
| 13.10 | Nunes | Stroik-Kotiaz | | Christova | Sidorov 30 |
| 13.30 | Lunch | Lunch | Lunch | Lunch | Lunch |
| 13.50 | | | | | |
| 14.10 | Bressan | Bradamante | Savin | Stefanis | Fang |
| 14.30 | Ivanov | Danilov | Kovalenko | Khandamaj | Abramov |
| 14.50 | Sandacz | | | Solovtsova 30 | Filla |
| 15.10 | | Nowak W-D. | Kondratenko M. | | Gerasimov |
| 15.30 | Spaldier | | Kondratenko A. | Mikhailov 30 | Kuray |
| 15.50 | Coffee break | Coffee break | Coffee break | Coffee break | Soffer |
| 16.10 | | | | | |
| 16.30 | Pendricat | Terysev | Kovalenko | Efremov | SUMMARY |
| 16.50 | Golovkikov | | Filatov | Stefanis | Closing |
| 17.00 | | Daka 30 | Maschenkov | Grasslan 30 | Farewell party |
| 17.20 | du Fresno | Hehl | Guskov | | |
| 17.40 | Chen (by Skype) | | Akhuzjanov | Terysev 30 | |
| 18.00 | | Obukhov 30 | Shimanskiy | Pimkov | |
| 18.20 | Gorbunov | Sitenko 30 | Sharov | Shirkov | |
| 18.40 | Andreev | Buninski | | | |
| 19.00 | Welcome Party | | Concert | Conference dinner | Concert |

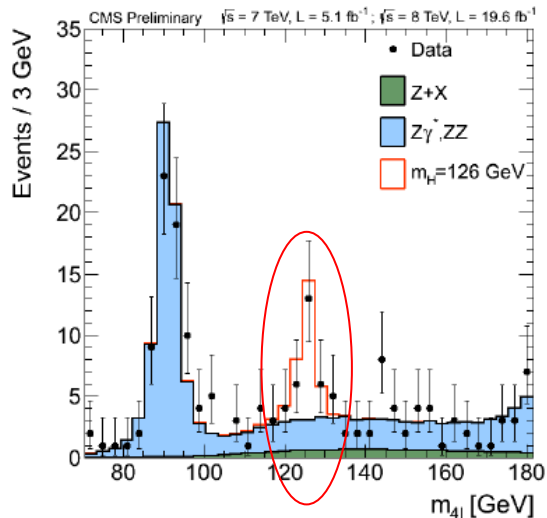
Parallel sessions (Blokhtintsev Auditorium)

| Poster Section | | 09.10 We | 10.10 Th | | 11.10 Fr |
|----------------|-------|-------------------|--------------|-------|-------------------|
| Chair | | Strokovsky | Artur | | Ladygin |
| Gorbunov | 16.40 | Miklukho 30 | Neznamov 30 | 9.30 | Jank |
| Gerasimov | 17.00 | Kurbin | | 9.50 | Narain |
| Bondarov | 17.20 | Novak | Nair 30 | 10.10 | Synda |
| Yashin | 17.40 | Filavin | Louboshitz | 10.30 | Alexsey |
| | 18.00 | Kochedin | Makhalan | 10.50 | Kurayev |
| | 18.20 | Makovsk | Shevichvili | 11.10 | Maksimovskov |
| | | | | | |
| | 19.00 | | Concert | | Conference dinner |

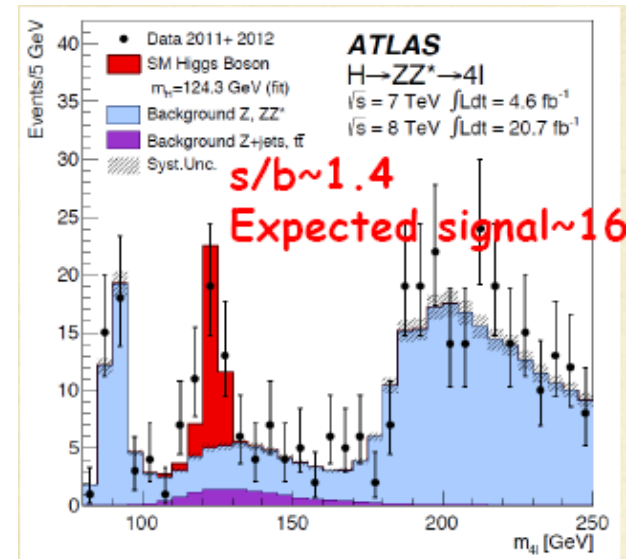
Few words of physics

Many experimental news!

Above all the discovery and quantum numbers of Higgs boson at LHC (A. Rinkevicius (USA) and Y. Fang (China))



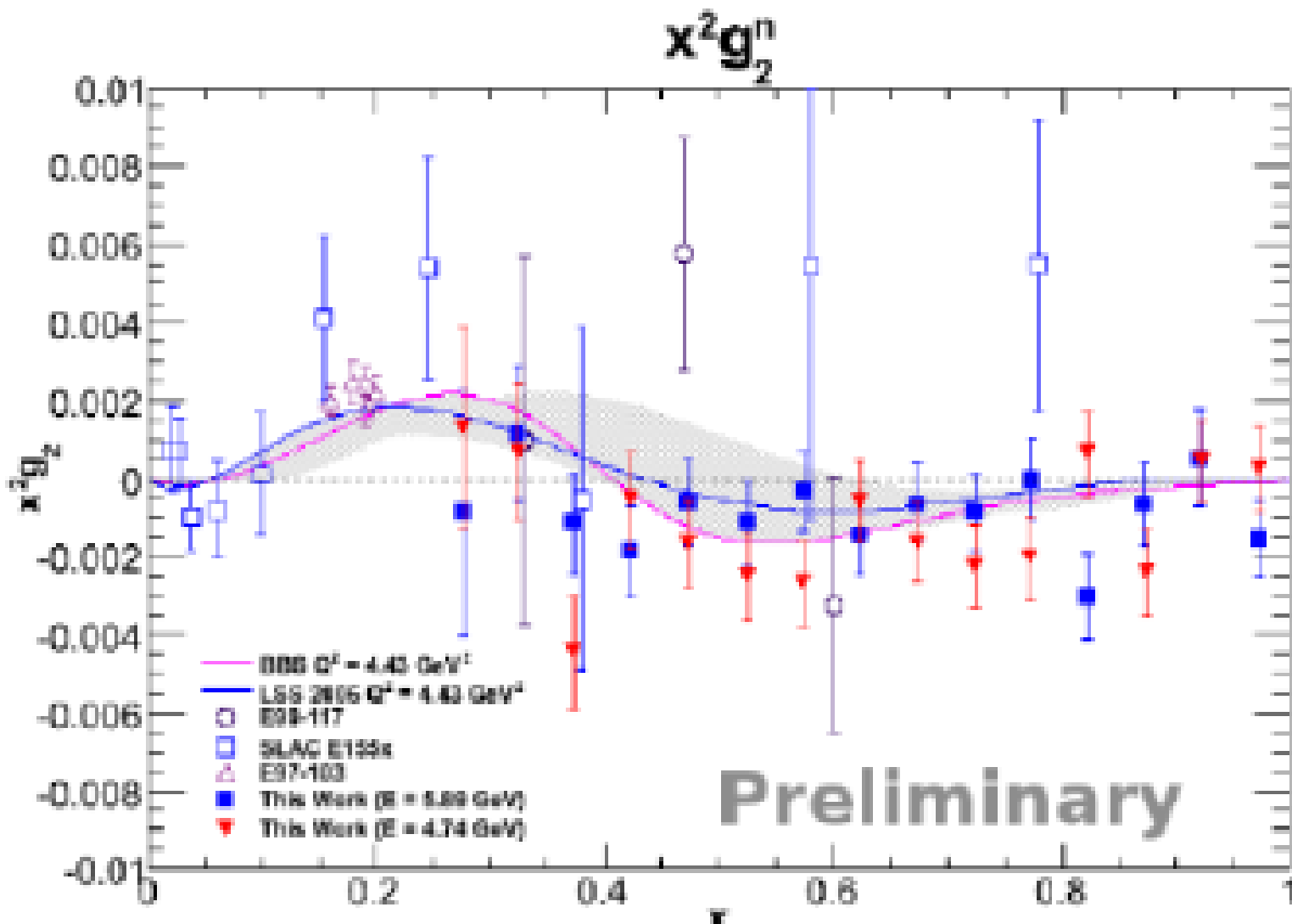
$$m_H = 125.8 \pm 0.5(\text{stat.}) \pm 0.2(\text{syst.}) \text{ GeV}$$



| Model | CL _S |
|--|-----------------|
| ZZ | |
| 0 ⁻ | 0.16% |
| 0 _h ⁺ | 8.1% |
| 1 ⁻ | < 0.1% |
| 1 ⁺ | < 0.1% |
| 2 _m ⁺ (gg) | 1.5% |
| 2 _m ⁺ (q \bar{q}) | < 0.1% |

Spin-0 nature of the Higgs boson, with positive parity is strongly preferred.

New measurements of g_2 of the proton and neutron (^3He) (Jian-ping Chen, JLab)





1 - COMPASS Festival

- Present and Future of the COMPASS experiment ([A. Bressan](#))
- Transverse spin and t. momentum structure of the nucleon ([F. Bradamante](#))
- A_1^P and g_1^P at low values of x and Q^2 ([A. Nunes](#))
- g_1^P with 200 GeV beam ([A. Ivanov](#))
- The GPD program at COMPASS ([A. Sandacz](#))
- Exclusive meson production ([P. Sznajdar](#))
- Hadron multiplicities and quark fragmentation functions ([N. du Fresne](#))
- Drell-Yan: Short and long-term programs ([O. Denisov](#))

- Recent results from HERMES ([W.-D. Nowak](#))

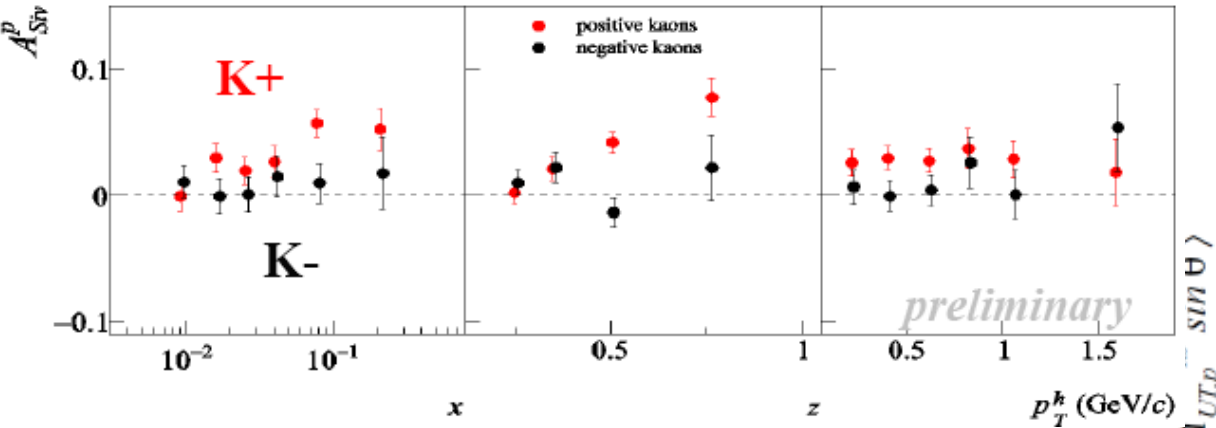
differences between K^+ and π^+ amplitudes

- ➡ role of sea quarks in conjunction with possibly large FF
- ➡ various contributions from decay of semiinclusively produced vector-mesons
- ➡ the k_T dependences of the fragmentation functions

Sivers function

COMPASS results on proton target

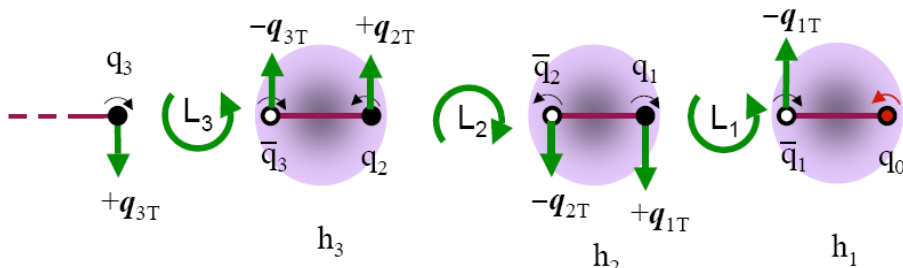
combined 2007 – 2010 results



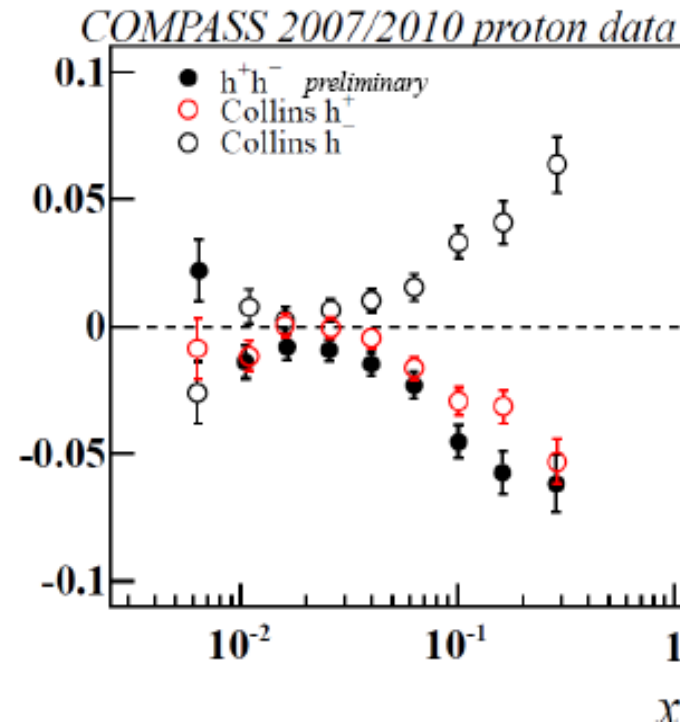
in the overlap x range, agreement with HERMES, but clear indication that the strength decreases

Collins and two-hadron asymmetries

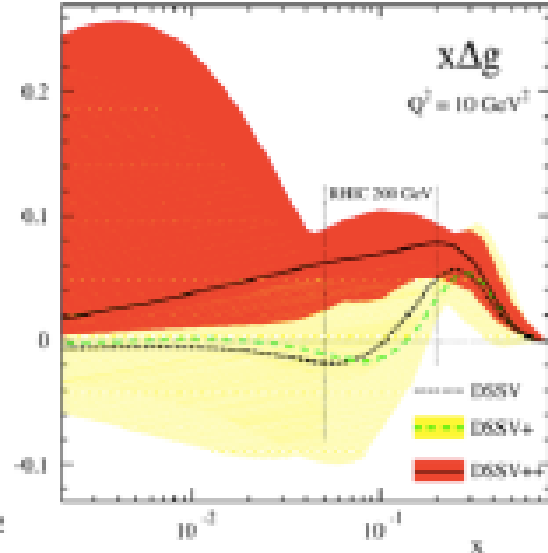
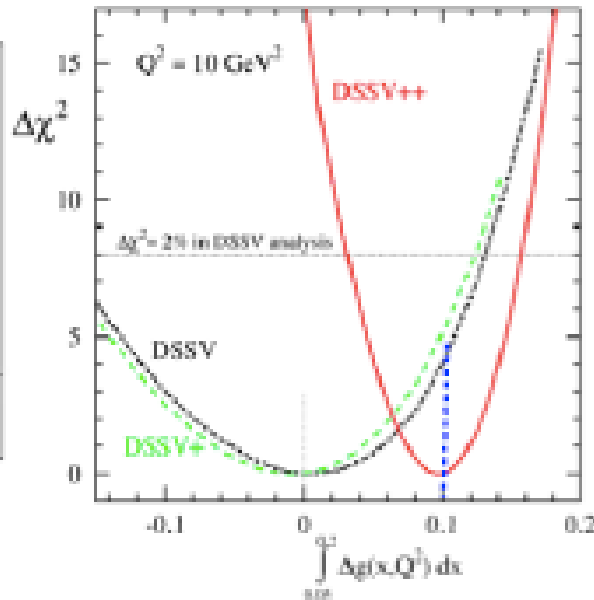
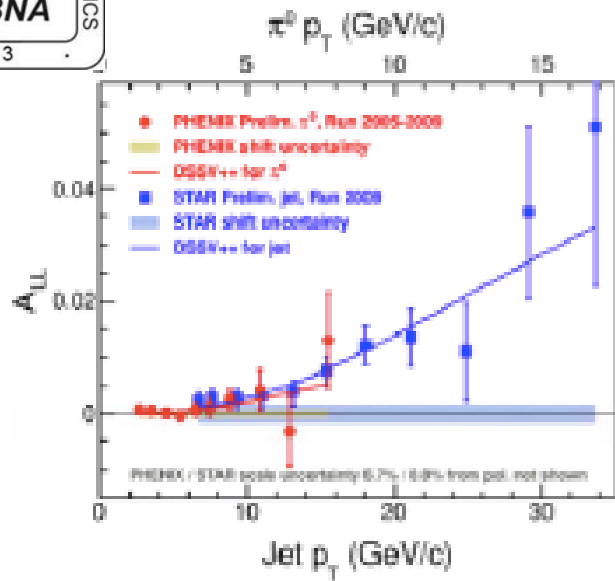
Remarkable similarity among Collins asymmetry for h^+ , Collins asymmetry for h^- and hadron pair asymmetry



F. Bradamante (Trieste)



Sequential fragmentation model. The program is realized in the Monte Carlo method (Artru).



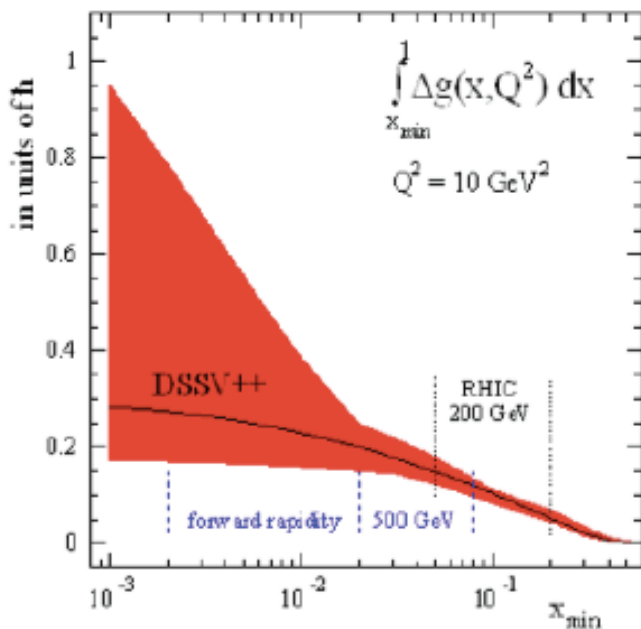
- DSSV++ is new global analysis from the DSSV group that include the preliminary 2009 A_{LL} results from STAR and PHENIX:

$$\int_{0.05}^{0.2} \Delta g(x, Q^2 = 10 \text{ GeV}^2) dx = 0.10 \pm_{0.07}^{0.06}$$

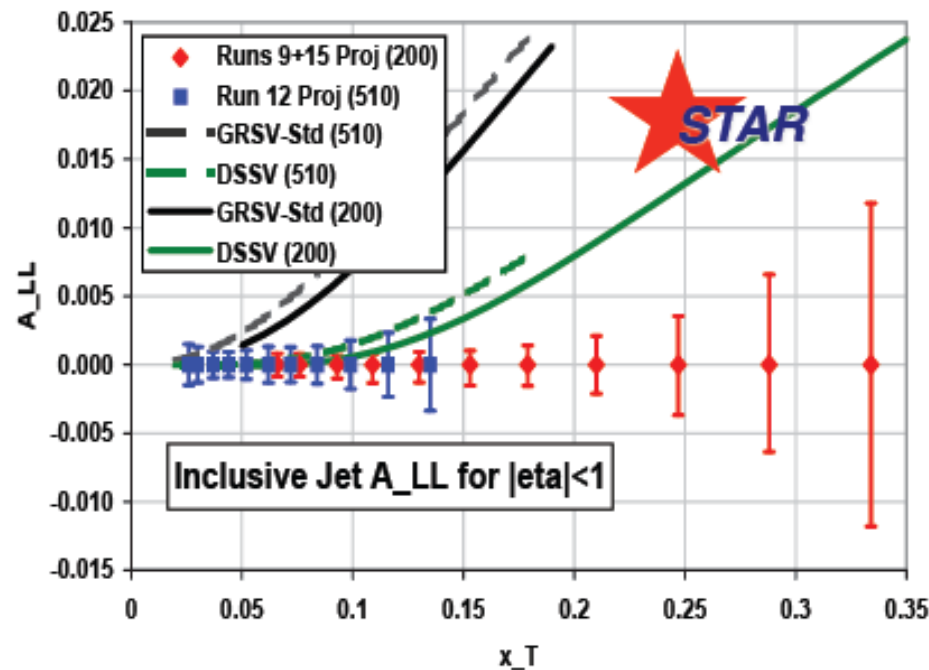
- First experimental evident of non-zero gluon polarization in the RHIC x range ($0.05 < x < 0.2$)

Projections with future jet measurements

- *Can we further improve our knowledge on $\Delta g(x)$? Yes!*



arXiv:1304.0079

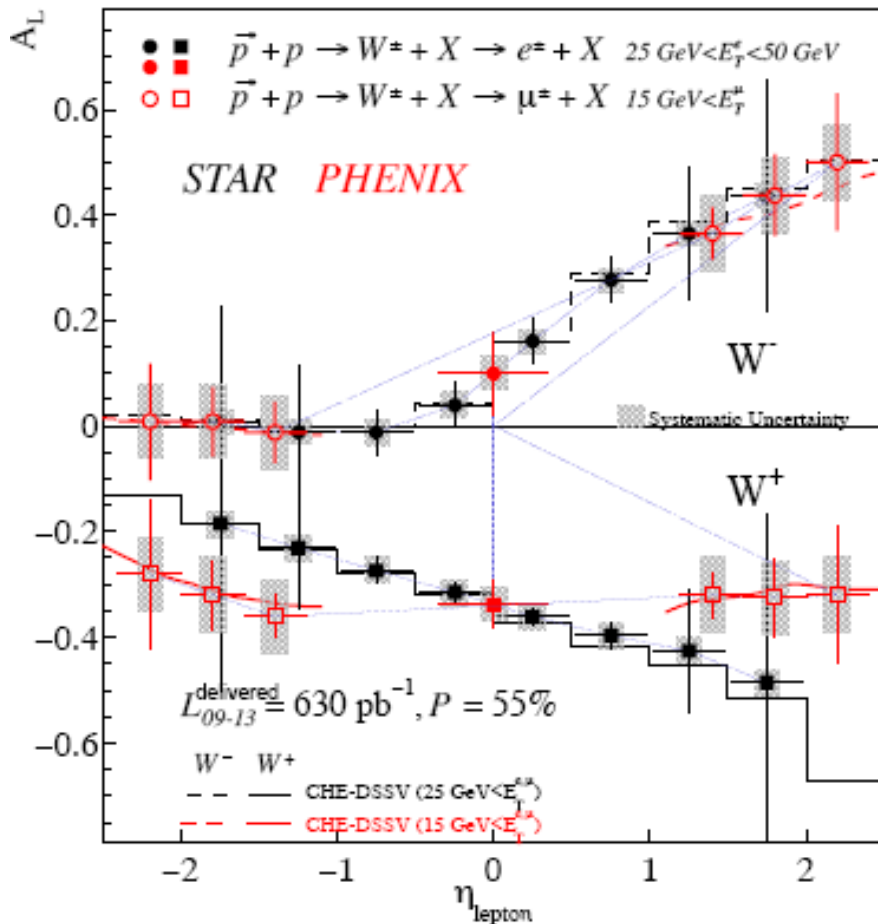


- Measure inclusive jet A_{LL} with STAR 2012(+2013) of 510 GeV collision.
- STAR expects to double the existing 200 GeV data sample during the 2015 RHIC run.

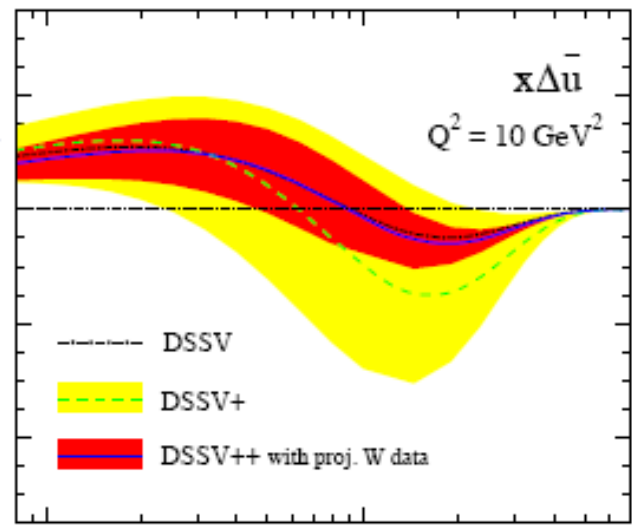
STAR Run 9-13 Projections at 500 GeV

arXiv:1304.0079

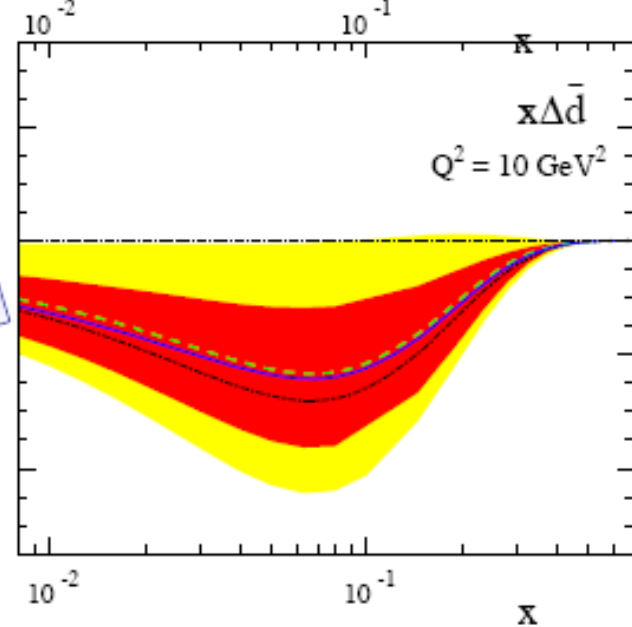
(pseudo-data randomized around DSSV)



$\Delta \bar{u}$

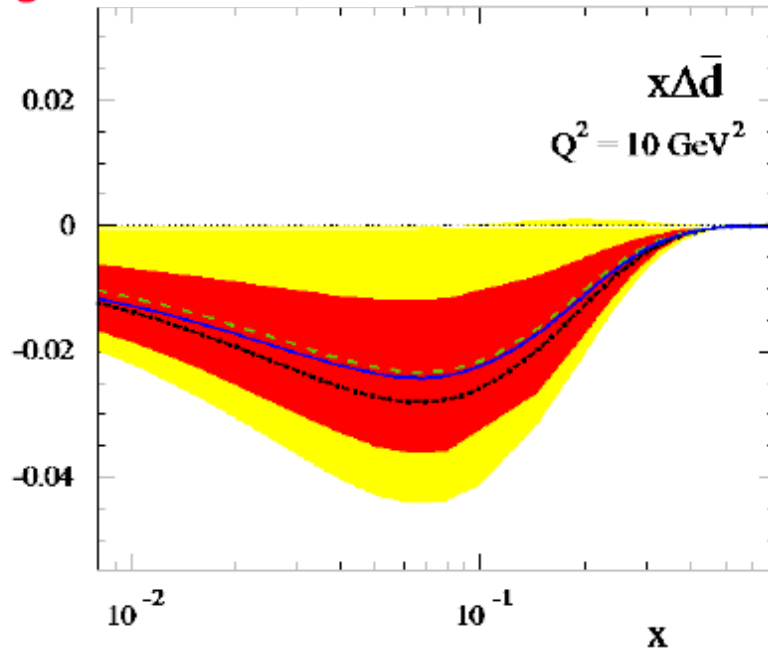
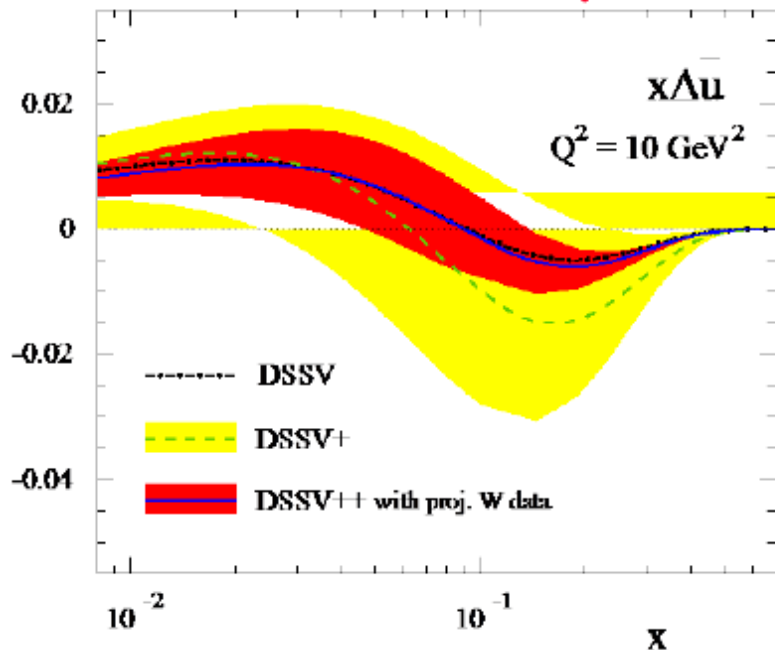


$\Delta \bar{d}$

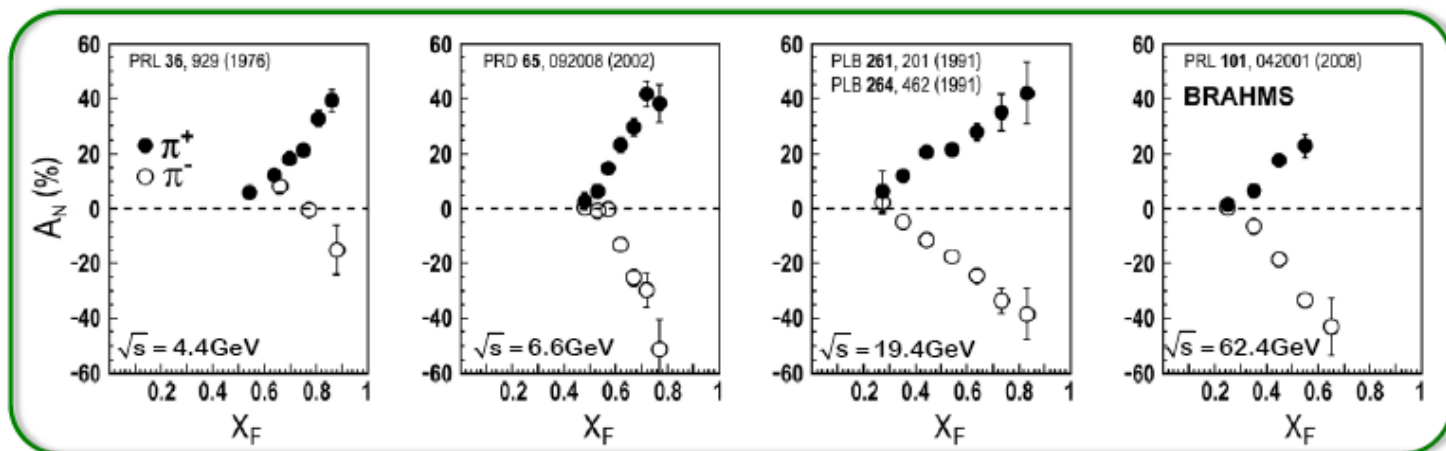


RHIC: $\int L_{09-13} = (50 + 100 + 120 + 475) = 745 \text{ pb}^{-1}$
DSSV+: DSSV+COMPASS
DSSV++: DSSV+ & STAR-W 2012
DSSV++: DSSV+ & RHIC-W proj.

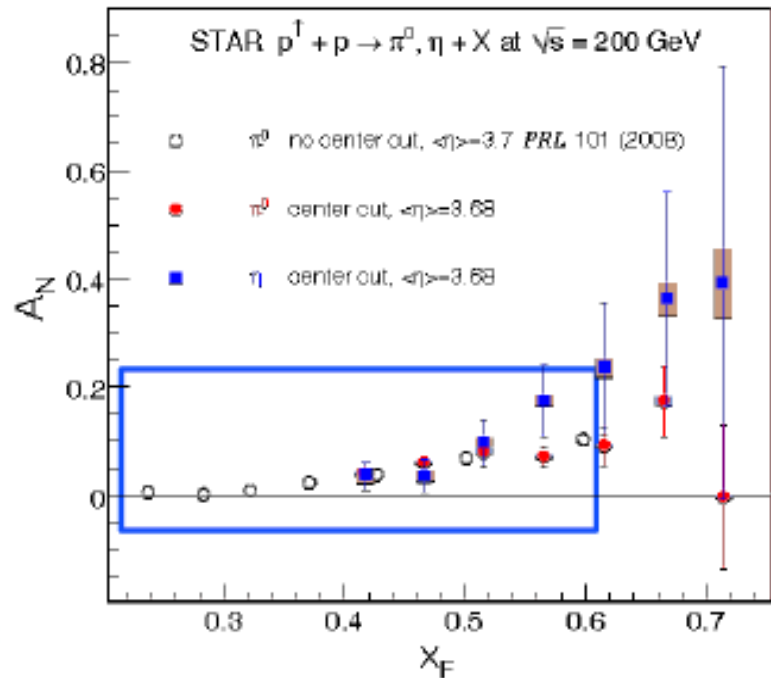
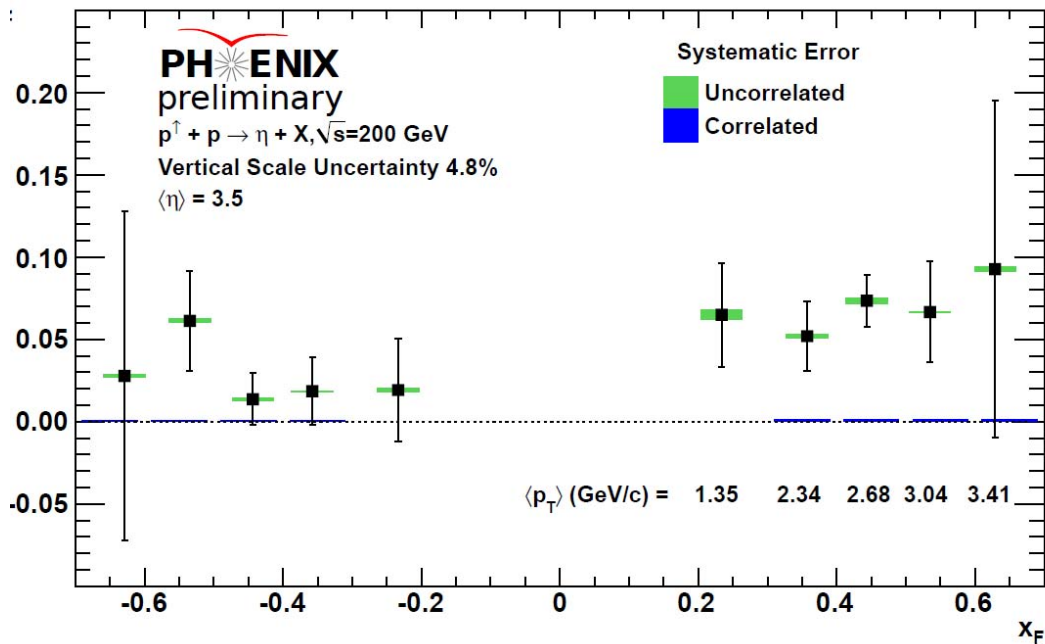
W → μ Analysis Status



Forward $A_N(\eta)$



PHENIX does not see a large difference in the asymmetries of η - and π^0 -mesons obtained earlier by STAR.



PRD86 (2012) 051101

- Future prospects:** High luminosity and polarization
- » 2013 500 GeV Longitudinal Run Analysis—Complete W measurements
 - Access ΔG to lower x
 - » 200 GeV Transverse Running (2015) – Interference fragmentation functions
 - Back to back jets (Collins)

Other new results

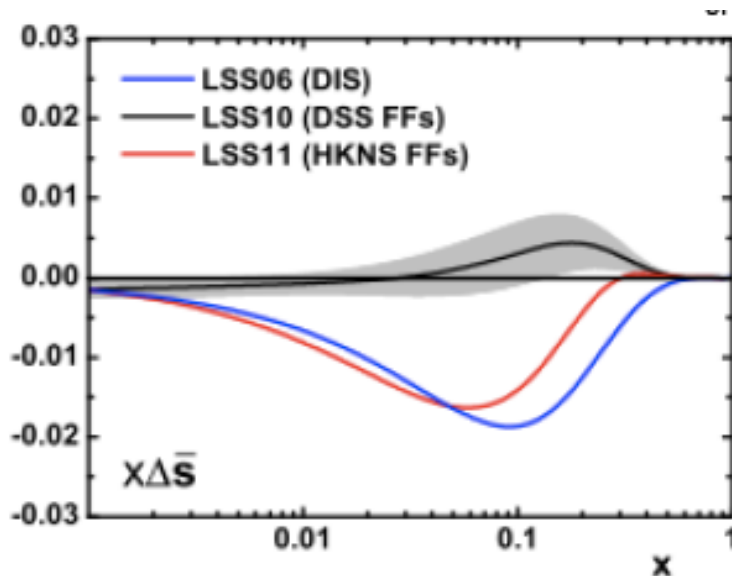
Antiquark helicity distributions

- It was found (Sidorov) that kaon DSS FFs are source of the conflict between negative $\Delta s(x)$ DIS and sign-changing $\Delta s(x)$ DIS+SIDIS. If Hirai et al. FFs are used, $\Delta s(x)$ DIS+SIDIS is negative and consistent with $\Delta s(x)$ DIS

- Quark helicity distributions more accurate measurements by COMPASS and CLAS and its fits where also presented (Soffer, Strozik-Kotlorz, Abdolghafari, Arbabifar).
- New modified methods of selecting PGF to measure $\Delta G(x)$ was used @COMPASS (Bressan).

Its low value insufficient for resolving the spin crisis. Hope for AOM and GPDs.

- Plans for check of change sign of Sivers and B-M TMD in DY in COMPASS (O.Denisov), RHIC (), PANDA-PAX () and NICA.



LSS: ArXiv:1103.5979

$\Delta g/g$

- $\Delta g/g (x \sim 0.13) = -0.06 \pm 0.21 \pm 0.08$ LO Open Charm
- $\Delta g/g (x \sim 0.09) = +0.12 \pm 0.06 \pm 0.06$ LO High- p_T $Q^2 > 1$ (GeV/c)²
- $\Delta g/g (x \sim 0.09) = +0.01 \pm 0.06 \pm 0.06$ LO High- p_T $Q^2 < 1$ (GeV/c)²
- $\Delta g/g (x \sim 0.2) = -0.13 \pm 0.15 \pm 0.15$ NLO Open Charm

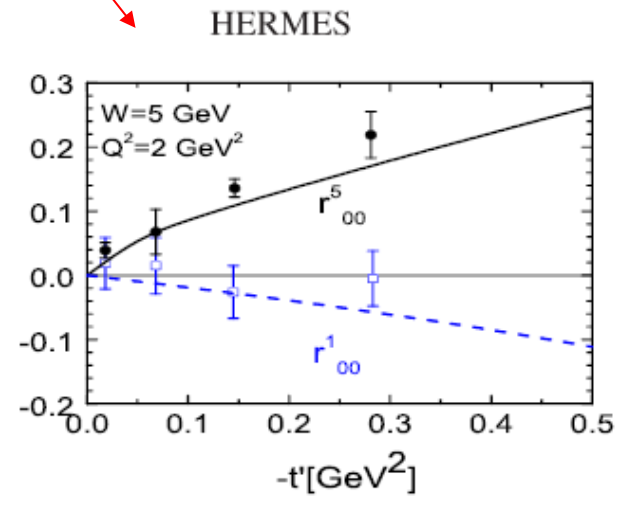
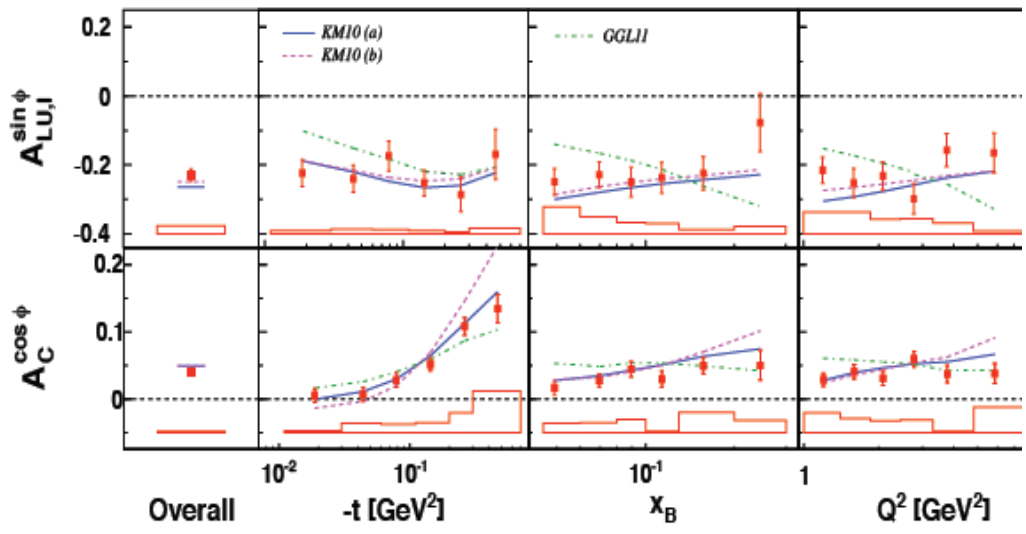
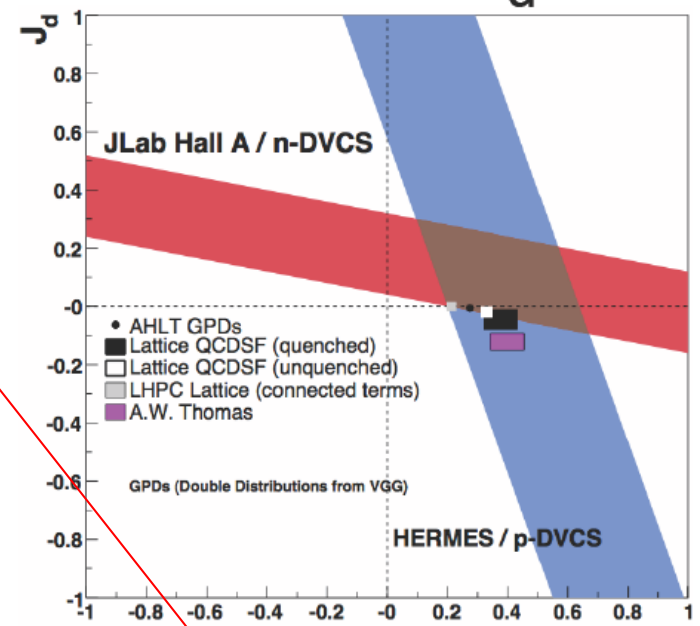
GPDs

- Different theoretical and experimental aspects were considered in the talks by **S.Goloskokov**, **S.Nair**, **M.Deka** and by **W.-D. Nowak (HERMES)**
- Preparation for new measurements were presented by **A.Sandacz**, **A. Bressan (COMPASS)**.

Constraint on J_d and J_u

$$A_C^{\cos \phi} \propto \text{Re}[F_1 \mathcal{H}]$$

$$A_{LU,I}^{\sin \phi} \propto \text{Im}[F_1 \mathcal{H}]$$

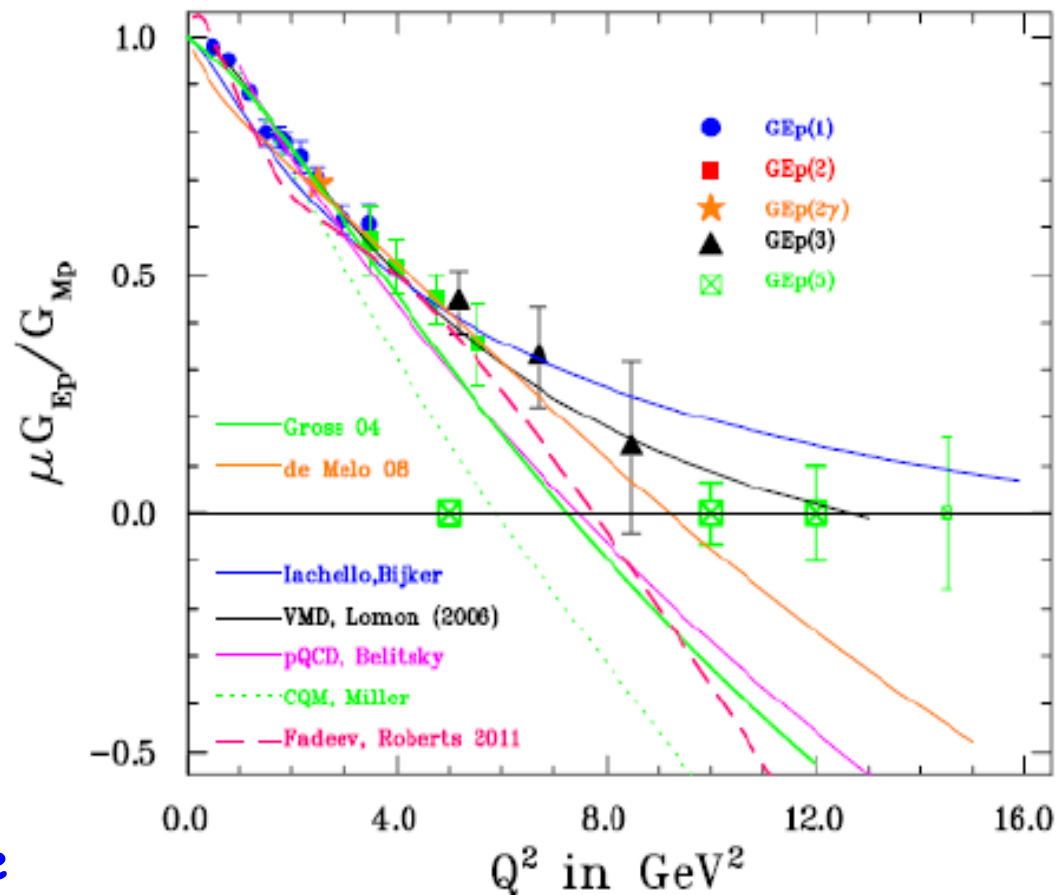


Survey of Nucleon Electromagnetic Form Factors

Charles Perdrisat, Vina Punjabi

Expected error bars for $G_{Ep}(5)$

- Two more experiments bringing the maximum Q^2 to 8.5 GeV^2 (GEp(3)).
- Theorists have suggested that two photon exchange might explain the behavior.
- The neutron is slowly revealing its electric structure. Does G_{En} cross zero near 10 GeV^2 ? Does G_{En} reach similar values as G_{Ep} below 10 GeV^2 .
- On theoretical front, all older models were revised, and new ones developed in the last 10 years.

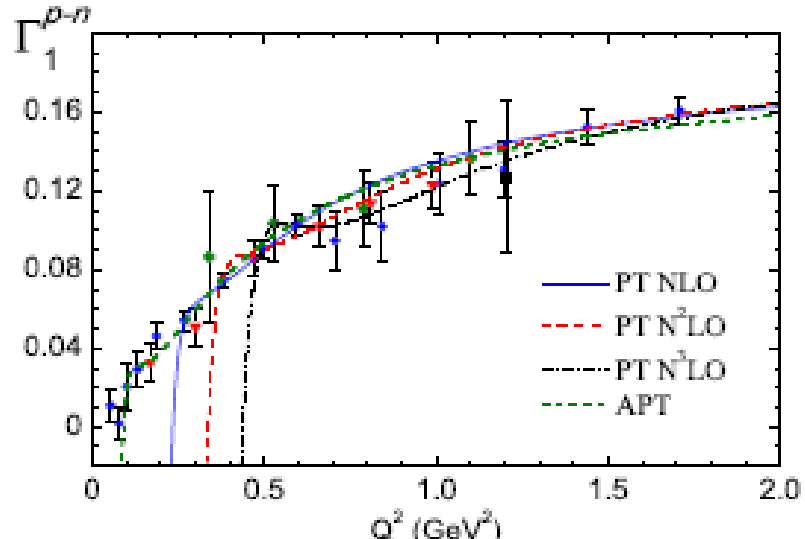


- Separate section was devoted to a problem of localization of energy momentum and spin in the classical field theory (F. Hehl, Muenich) .

It was shown that particles with spin were the only tester for so-called "torsion" of space-time (Yu. Obukhov, A. Silenko).

- Special session on development of so-called analytic perturbation theory (APT) by Solovtsov-Shirkov was devoted to the blessed memory of Alexander P. Bakulev.

Imposition of an additional condition of the analyticity of divergent series defining $\alpha_s(Q^2)$ eliminates the pole and makes the value of $\alpha_s(Q^2)$ finite up to $Q^2 = 0$. Various aspects of application of this theory as well as a difficult situation in QCD description of transition form factor $F_{\gamma\gamma^*\pi}$ were subject of talks by V. Khandramai, O. Solovtsova, A. Oganesian, N. Stefanis, S. Mikhailov , O. Teryaev , A. Pimikov and D. Shirkov



A possible way to measure the deuteron EDM at COSY

Electric dipole moment (EDM)

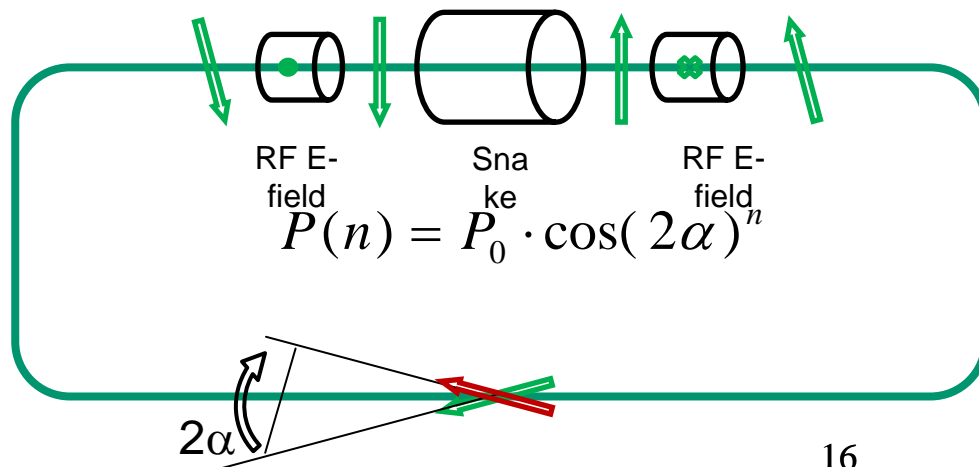
A permanent EDM of a fundamental particle violates both parity (P) and time reversal symmetry (T).

Assuming CPT to hold, the combined symmetry CP is violated as well.

P fell in 1956, CP in 1964

• **The deuteron EDM $< 1 E-27 e cm$ is within the reach of COSY supplemented by RFE-flipper running at approx. 5 % of the ring frequency.**

• **Similar upper bound is feasible for the proton (N.Nikolaev)**



Further development of polarization studies.

LHEP accelerating complex of JINR development.

Some of the new proposals for research on basis of upgraded Nuclotron-M were also presented (V. Ladygin, R. Kurilkin, S. Piyadin, E. Stokovsky, Dubna). In particular, the proposal for a new experiment **BM@N** whose main purpose is to study the properties of dense nuclear matter especially with strange quark participation.

- Program of polarized proton beam formation from decay of Λ -particles at the IHEP U-70 for spin studies at SPASCHARM (S.Nurushev). He stressed the importance of a comparative study of spin effects induced by particles and antiparticles.

Special session NICA-SPD preliminary program (Kovalenko, M&A. Kondratenko, Filatov, Guskov, Shimansky, Sharov, et al.)

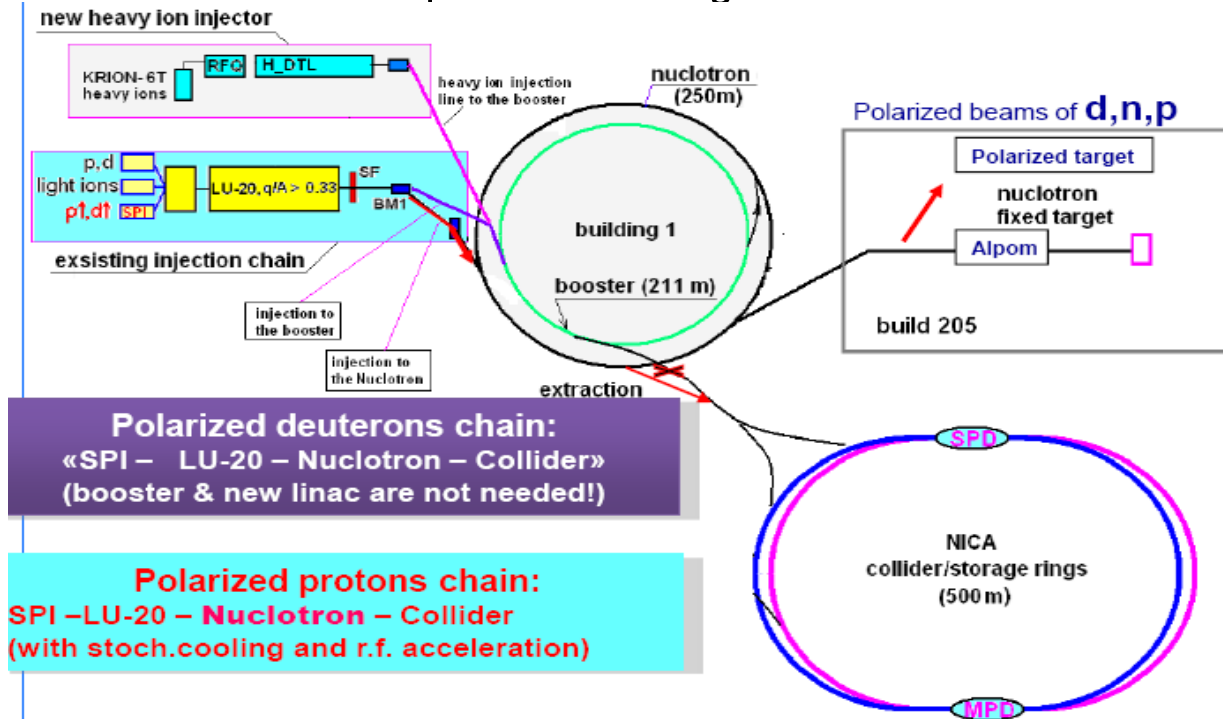
- Drell-Yan processes,
- J/Ψ production processes,
- Spin effects in $pp, pd, dd, pp\uparrow, p\uparrow p\uparrow$, and $d\uparrow d\uparrow$ interactions,
- Polarization effects in heavy ions collisions

(Kovalenko, M&A. Kondratenko, Filatov, Guskov, Shimansky, Sharov, et al.)



Polarized beams of protons and deuterons requirements:

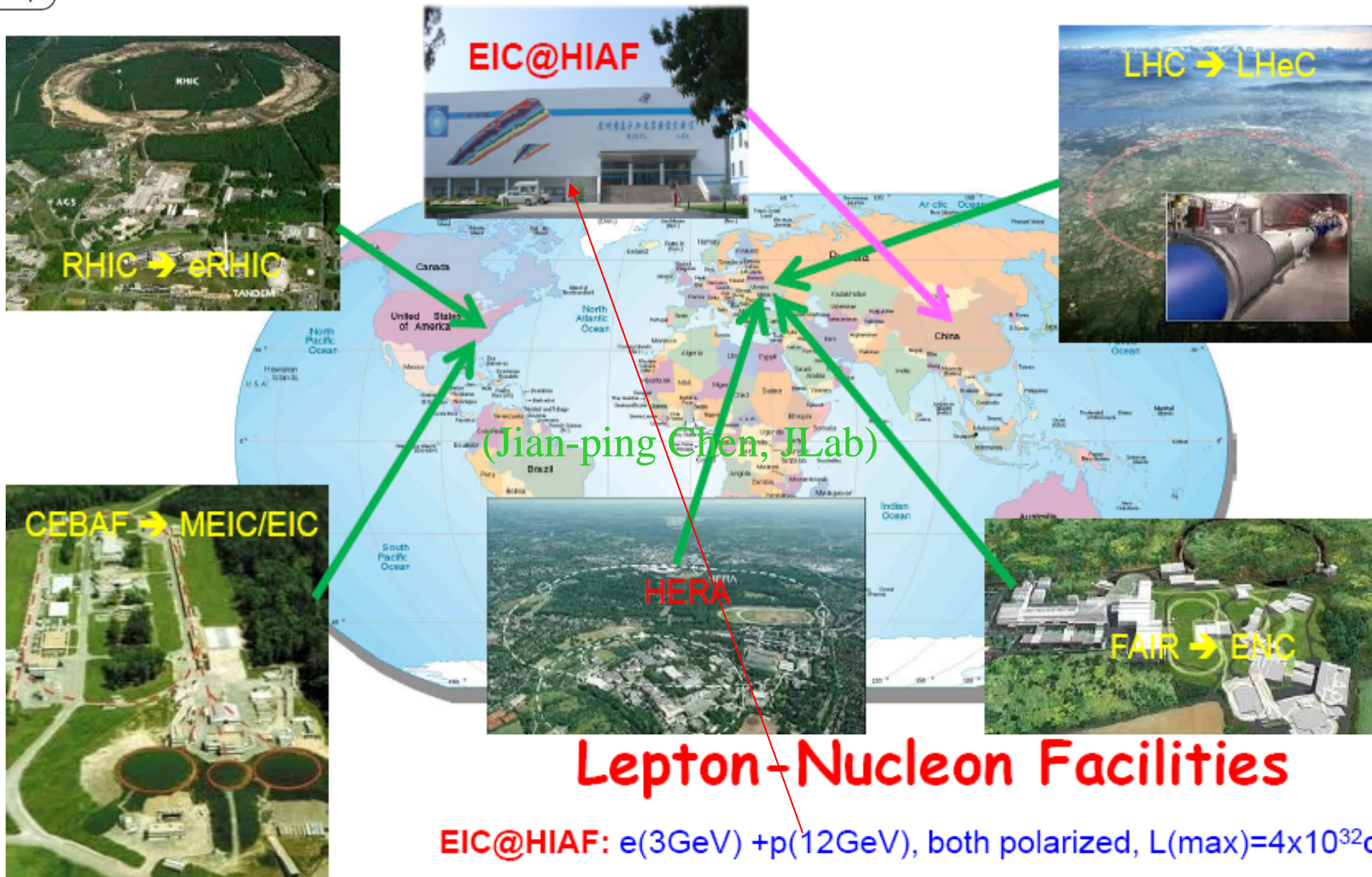
- **longitudinal and transverse** polarizations in MPD and SPD detectors
- $p\uparrow p\uparrow \sqrt{s_{pp}} = 12 \div 27$ GeV (5 \div 12.6 GeV kinetic energy)
- $d\uparrow d\uparrow \sqrt{s_{NN}} = 4 \div 13.8$ GeV (2 \div 5.9 GeV/u ion kinetic energy)
- **Leverage $\approx 1 \cdot 10^{32}$ cm⁻²s⁻¹ (at $\sqrt{s_{pp}} \geq 27$ GeV)**
- Sufficient lifetime of polarization degree



Lol is accepted by PAC

Invitation to NICA-SPD Collaboration!

Electron Ion Colliders on the World Map



(Jian-ping Chen, JLab)

Sponsored by:

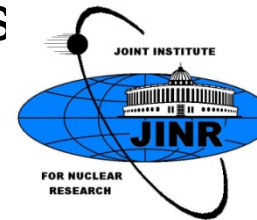
Russian Foundation for Basic Research,
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Physics-Online.ru
International Committee of Spin Physics,
European Physical Society,
JINR programs on international cooperations
Heisenberg-Landau, Bogolyubov-Infeld and
Blokhintsev-Votruba.



Dynasty



European Physical Society
more than ideas



Bundesministerium
für Bildung
und Forschung

The Proceedings of DSPIN-13 are published and sent to all participants
Available at <http://theor.jinr.ru/~spin/2013/proceedings13.pdf>

Wellcome at
DSPIN-15!!!

