A tribute in memory

of

Aliosha Kaidalov

(1940 - 2010)

Low x meeting & Santiago de Compostela

v. appropriate time to remember Aliosha Kaidalov

Aliosha has made a huge number of contributions

--- just a few highlights to hint at his long & outstanding career

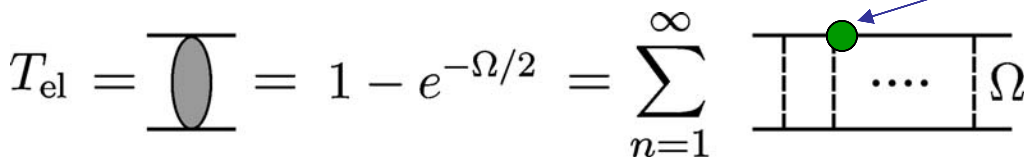
--- apologies for many omissions

Aliosha made many pioneering advances to the understanding of diffractive and low x processes in high-energy hadron interactions:

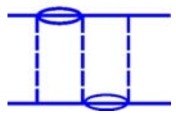
He was the first to evaluate the effects low mass (N*) diffraction (1971)

Nowadays 2-ch, p,N*

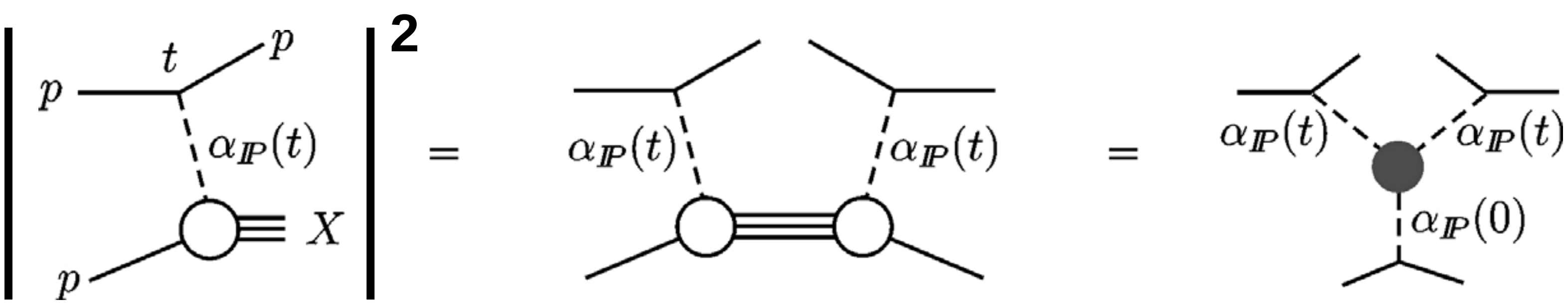
enhanced eikonal C=1.3



N*



Kaidalov+Khoze,Pirogov,Ter-Isaakyan/+Ter-Martirosyan performed the first triple-Regge data analyses (1973,74)



PHYSICS REPORTS (1979)

DIFFRACTIVE PRODUCTION MECHANISMS

A.B. Kaidalov

Contents:

0. Introduction 159
1. Theoretical description of diffractive processes from the s-channel point of view 160
   1.1. Impact parameter representation 160
   1.2. Geometrical models. Scattering on a black disk and a ring 162
   1.3. Bounds on amplitudes for inelastic diffractive processes from s-channel unitarity 164
   1.4. Quarks, gluons and diffractive scattering 168
2. t-channel models of diffraction. Regge approach 170
   2.1. Regge-pole model 170
   2.2. Drell–Hiida–Deck model 171
   2.3. Diffractive production of particles. Triple–Regge approach 174
   2.4. Production of several showers of particles. Multi-pomeron exchanges 179
   2.5. Regge cuts and eikonal models 185
   2.6. The problems of Reggeon theory at $s \to \infty$. Models with Froissart type asymptotic behaviour for amplitudes 194
3. Experimental information on the properties of diffraction 198
   3.1. Elastic scattering and σ^{tot} 198
   3.2. Exclusive diffractive processes 202
   3.3. Inclusive diffractive production of particles and the Pomeron–proton total cross sections 209
   3.4. Factorization and inclusive diffractive processes 215
   3.5. Energy dependence of the total inelastic diffractive cross section 216
   3.6. Properties of diffractively produced systems of particles 217
   3.7. Double Pomeron exchange 219
   3.8. Summary and conclusions 222

Acknowledgements 222

References 222

very comprehensive and still used to this day

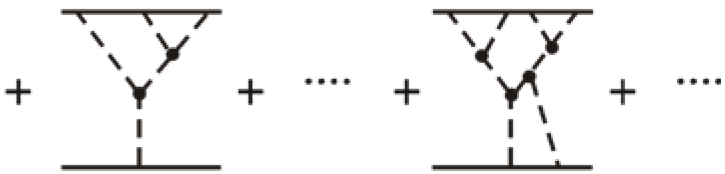
Pioneering model for soft high-energy hadron interactions

A.B. Kaidalov, K.A. Ter-Martirosyan, Yu. M. Shabelski;

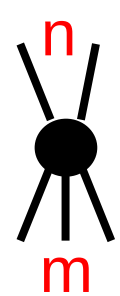
A.B. Kaidalov, L.A. Ponomarev, K.A. Ter-Martirosyan

Sov. J. Nucl. Phys. 43/44 (1986)

included multi-Pomeron diagrams in global description,
for first time, with vertices

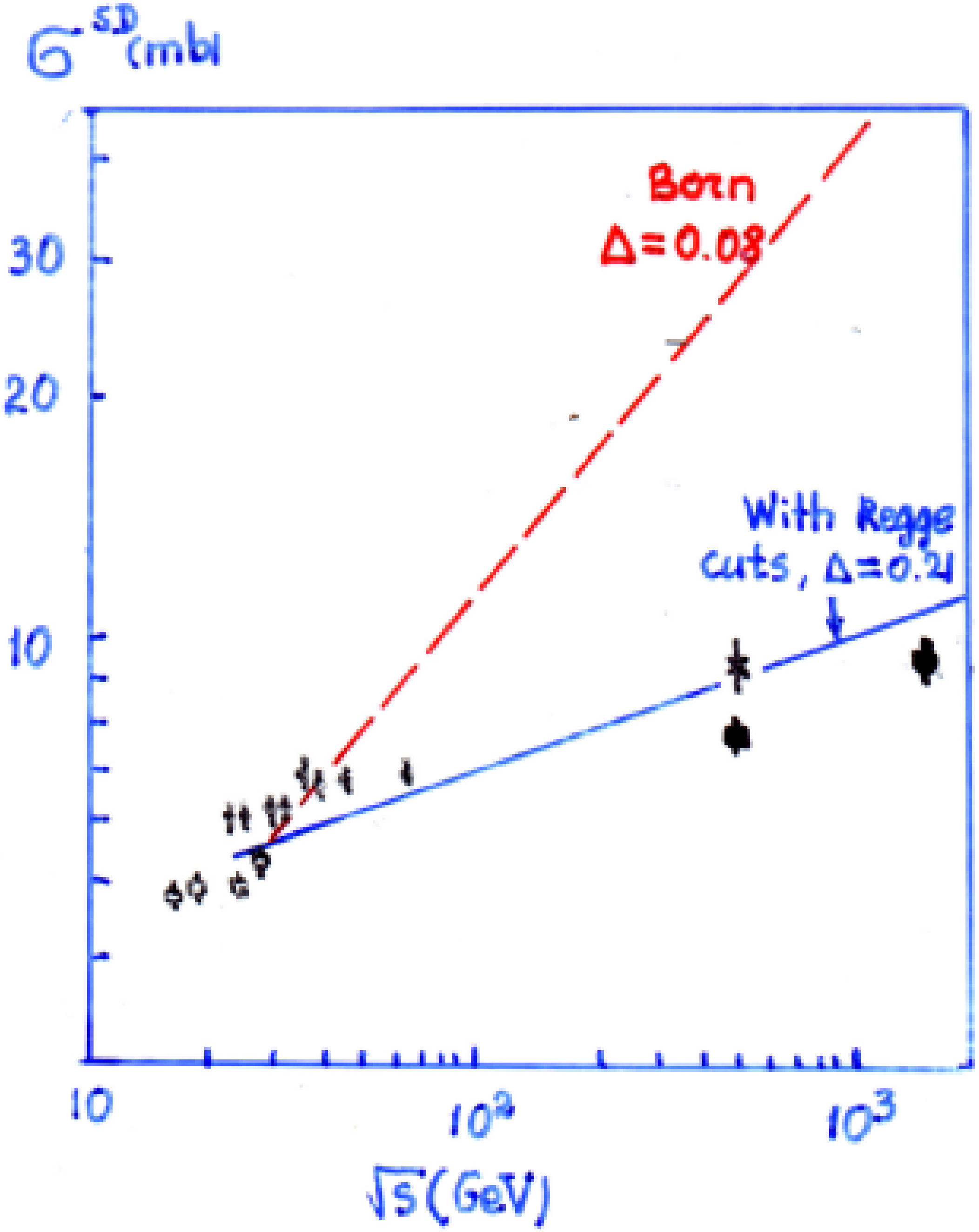


$$g(nP \rightarrow mP) = g_N \lambda^{n+m-2}$$



Basis of models, again still used to this day:
- Durham model (Khoze-Martin-Ryskin)
- Tel-Aviv model (Gotsman-Levin-Maor)
- Ostapchenko
- M. Poghosyan, A.B. Kaidalov

the effect of the unitarity corr^{ns} on SD due to multi-Pomeron diagrams



- ## Pomeron in QCD

It is usually assumed that the Pomeron in QCD is related to gluonic exchanges in the t-channel.
(exchange by 2 gluons leads to a singularity at $j=1$).

But what is an influence of confinement? Are there glueballs on the Pomeron trajectory?

Recently we have studied these problems with Yu. Simonov. (hep-ph/9911291, 9912434, Phys. Lett. 2000)

The spectrum of glueballs has been calculated using the nonperturb. method of Wilson loop path integrals.
The main assumption is:
area law for Wilson loops at large distances. $\langle W\rangle \sim \exp(-\sigma_{adj} S_{min})$

Kaidalov & Simonov

M (GeV)

J^{PC}	This work	Lattice data	
		C.M., M.P.	M. Teper
0^{++}	1.58	1.73 ± 0.13	1.74 ± 0.05
0^{++*}	2.71	2.67 ± 0.31	3.14 ± 0.10
2^{++}	2.59	2.40 ± 0.15	2.47 ± 0.08
2^{++*}	3.73	3.29 ± 0.16	3.21 ± 0.35
0^{-+}	2.56	2.59 ± 0.17	2.37 ± 0.27
0^{-+*}	3.77	3.64 ± 0.24	
2^{-+}	3.03	3.1 ± 0.18	3.37 ± 0.31

In the 1990's on….

Kaidalov and Orsay & Santiago de Compostela collaborations (Capella, Ferreiro, Merino,…..)

From 2001 on…..

Kaidalov and Durham (KMR) collaboration

More recently…. with the ALICE collab^{n} at LHC

Structure functions and low x physics

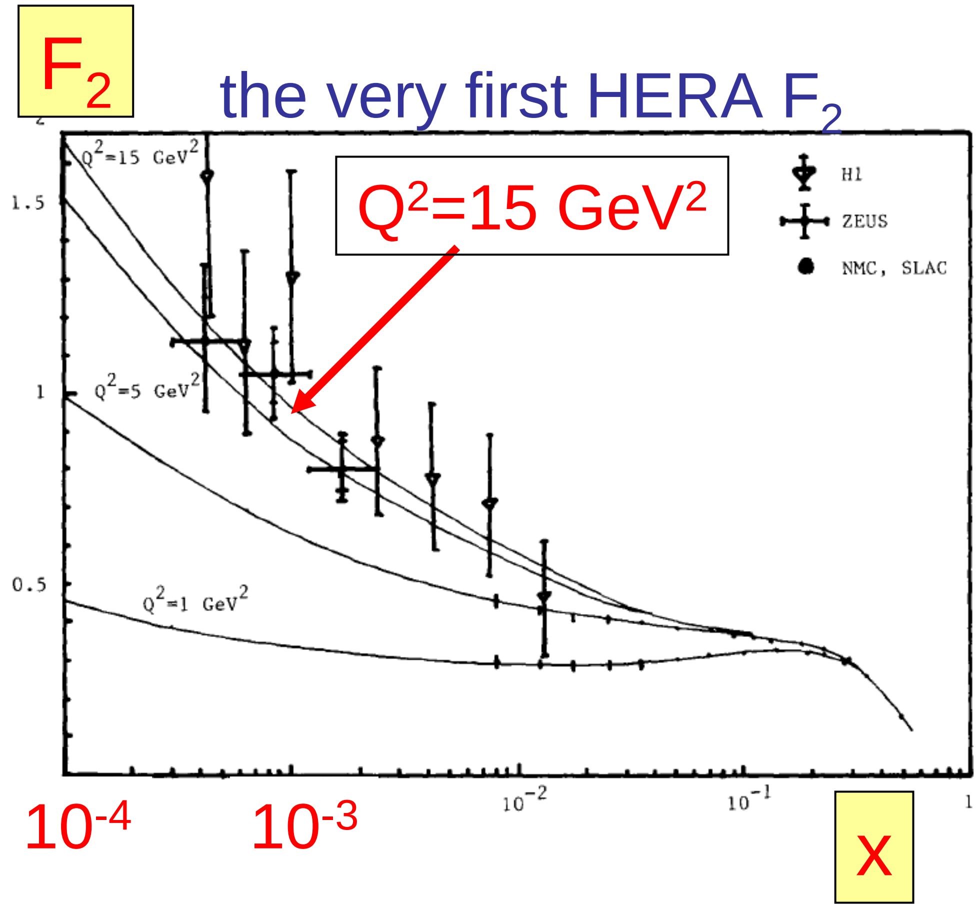
A. Capella, A. Kaidalov [1], C. Merino, J. Tran Thanh Van

Physics Letters B 337 (1994) 358–366

CKMT

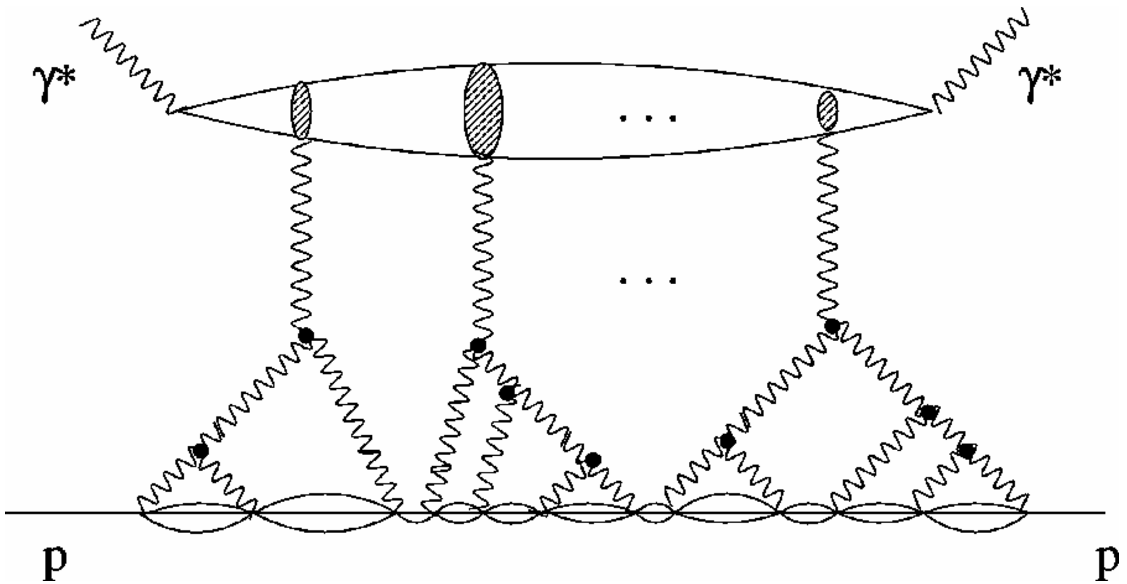
Using Regge theory for $\sigma_{tot}(\gamma p)$ and F_2 at low Q^2, $Q^2<5\ GeV^2$ they derived the input for DGLAP evolution to describe F_2 at any x, Q^2

the very first HERA F_2



DIS data and the problem of saturation in small-x physics
A.Capella, E. Ferreiro, A. Kaidalov, C. A: Salgado, PRD63 (2001) 054010

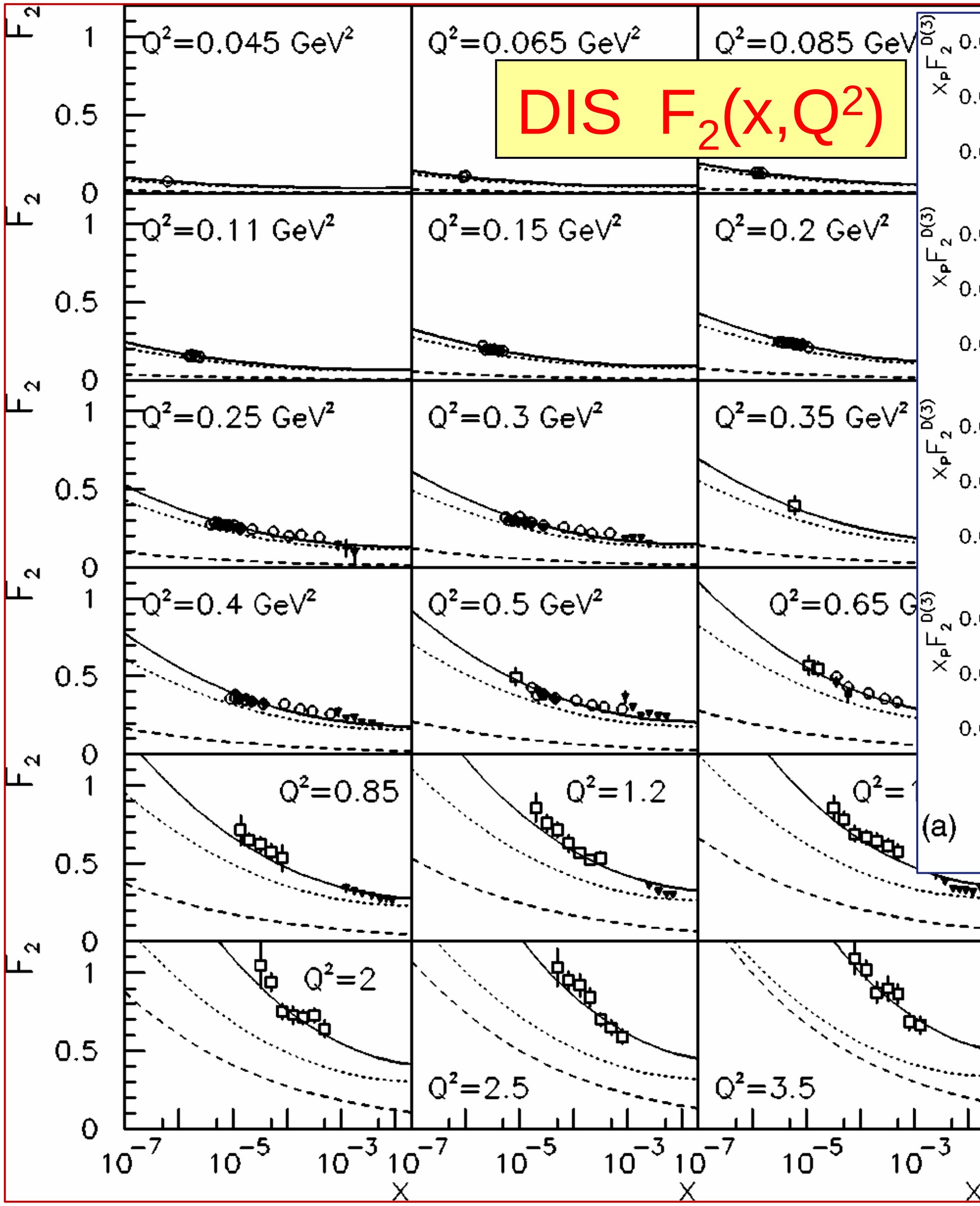
A unitary model for structure functions and diffractive prod^n at small x
A. Capella, E. Ferreiro, A. Kaidalov, C. A: Salgado, NPB593 (2001) 336

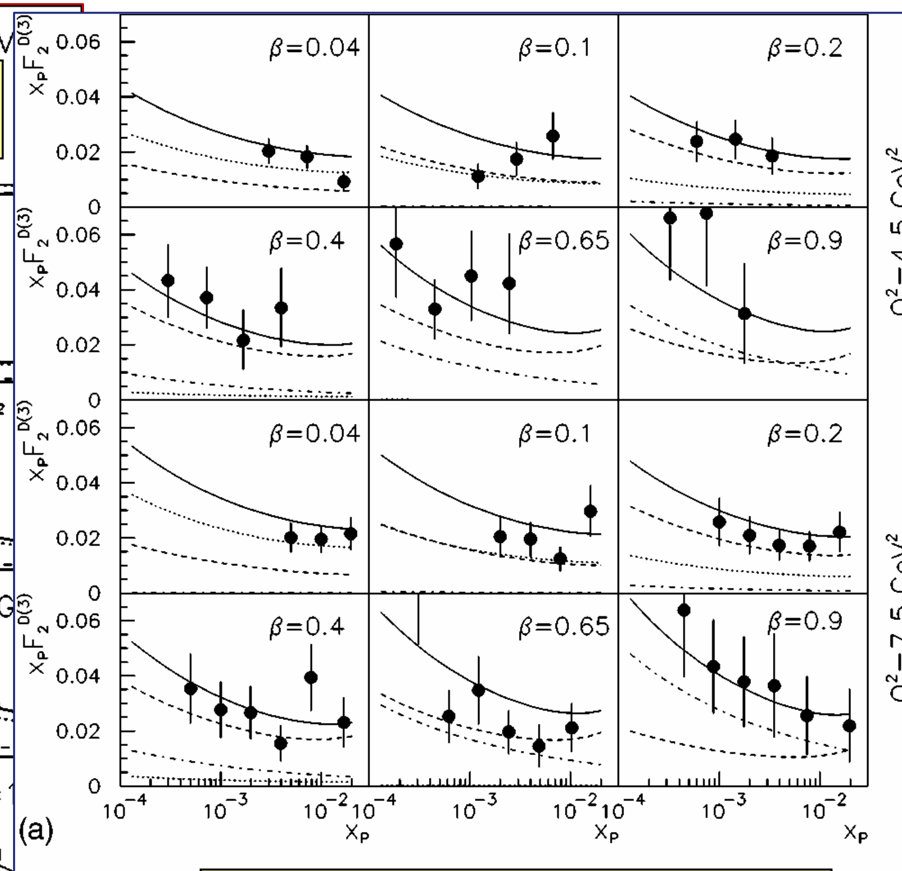


Role of unitarization effects in virtual photon-proton (γ *p) interactions at small x:

- The qqbar fluctuation of the initial photon: a small distance and a large dist. comp^t
- **Unitarization** of each component
- Born approximation for the small size component calculated using pQCD
- Reggeon diagram technique =>

oSelf-consistent scheme for both the total γ *p cross section and diffractive prod^n.
oDescrip^n of HERA data in the small-x region, with a single Pomeron of intercept 1.2.





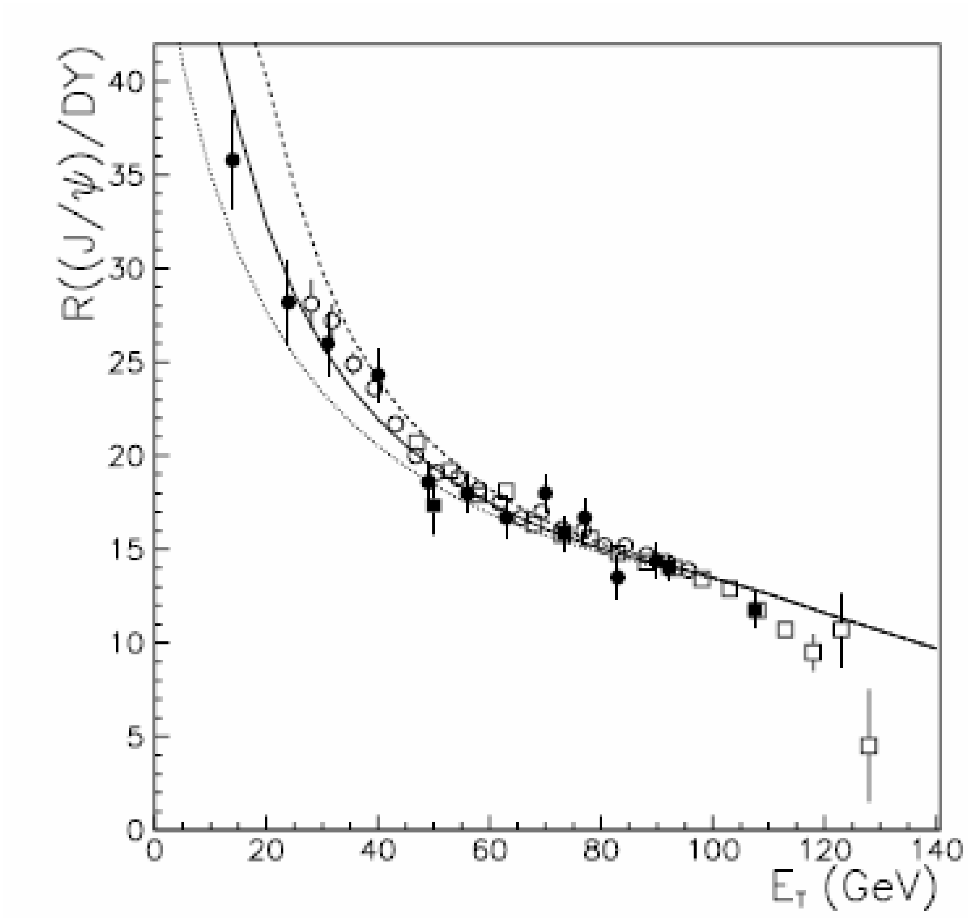
Diffractive DIS $F_{2D}^{(3)}$

$x_P F_{2D}^{(3)}$ as a function of x_P for $Q^2 = 4.5$ and 7.5 GeV^2

$F_2(x, Q^2)$ as a function of x for different values of Q^2

Nonsaturation of the J/ψ Suppression at Large Transverse Energy in the Comovers Approach

A. Capella, E. G. Ferreiro, A. B. Kaidalov, PRL85 (2000) 2080



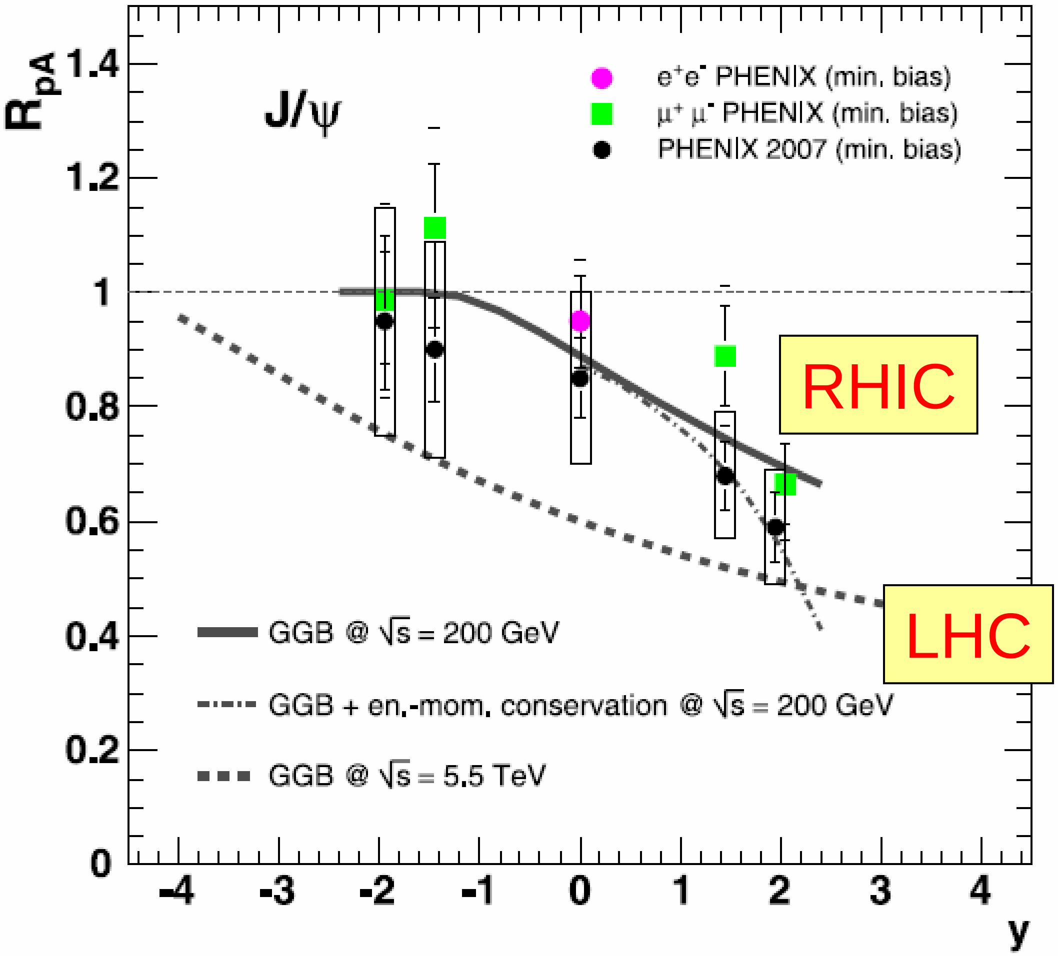
Explanation of SPS data on J/ψ suppression (via co-mover, final state inter^{ns} +energy correlations).

This refuted the claim that QGP had been discovered in the data

continued in ….. →

Charmonium dissociation and recombination at RHIC and LHC
A.Capella, L. Bravina, E.G. Ferreiro, A.B. Kaidalov, K. Tywoniuk, E. Zabrodin
EPJC58 (2008) 437

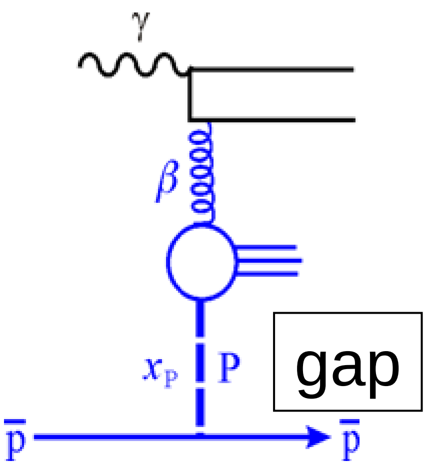
Can the RHIC J/psi puzzle(s) be settled at LHC?
A.Capella, L. Bravina, E.G. Ferreiro, A.B. Kaidalov, K. Tywoniuk, E. Zabrodin
EPJC61 (2009) 865

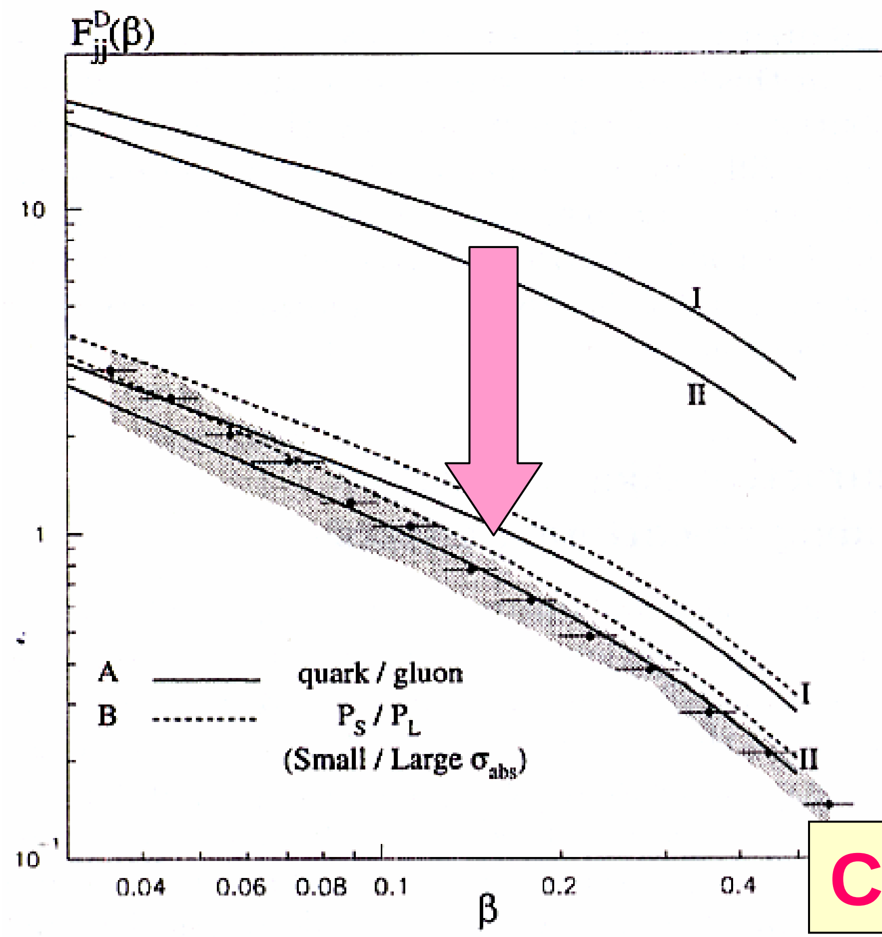


J/Ψ suppression is expected from **shadowing** corrections calculated in the Glauber-Gribov framework

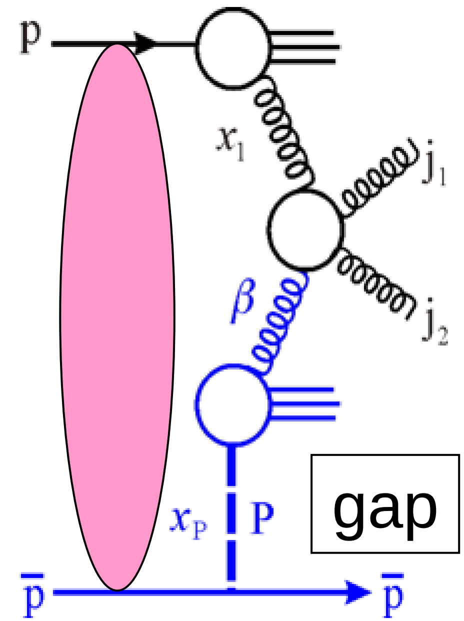
To be taken into account as a baseline for a right interpretation of the J/Ψ as a QGP signal

Kaidalov + KMR Durham (2001)





soft rescatt.



CDF diff^{ve} dijets

HERA→diff^{ve} PDFs

CDF data

$E_T^{Jet1,2} > 7$ GeV

$0.035 < \xi < 0.095$

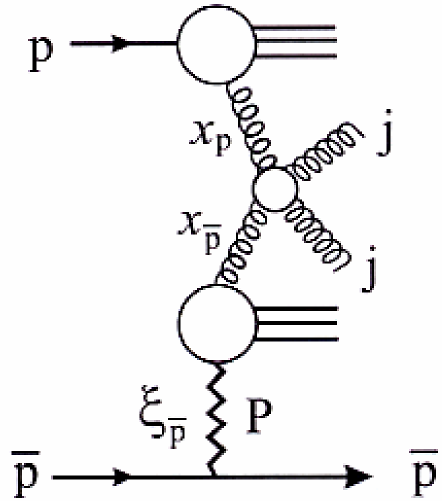
$|t| < 1.0$ GeV^2

Paper also discussed possible β dependence, and emphasized enhanced rescatt. effects

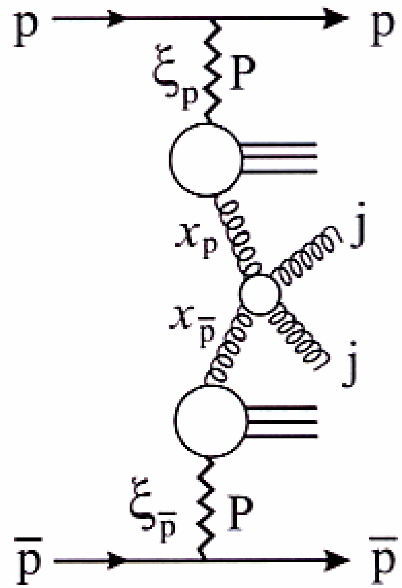
KKMR

A.B. Kaidalov et al. / Physics Letters B 559 (2003)

Dijet production at the Tevatron



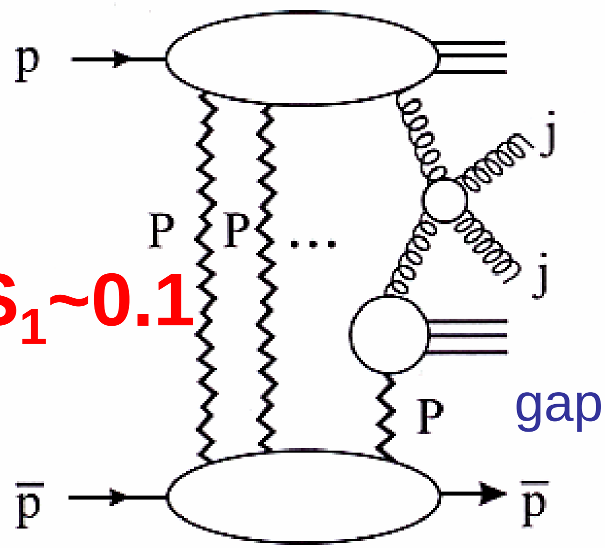
SD



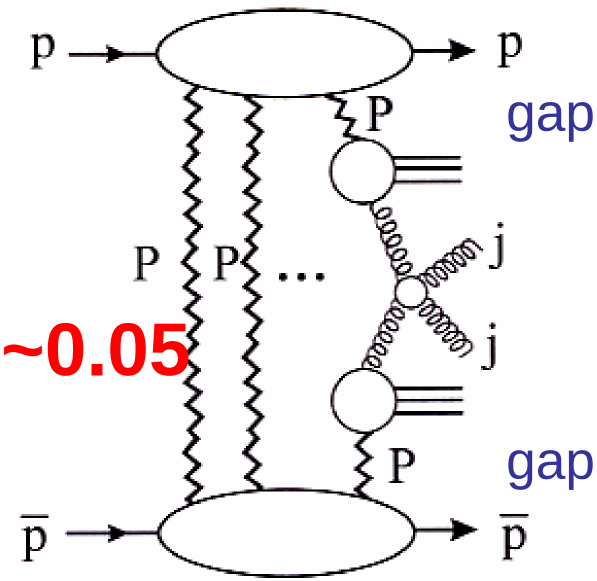
DPE

Survival prob. of gaps:

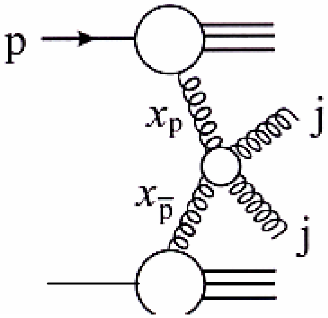
$S_1 \sim 0.1$



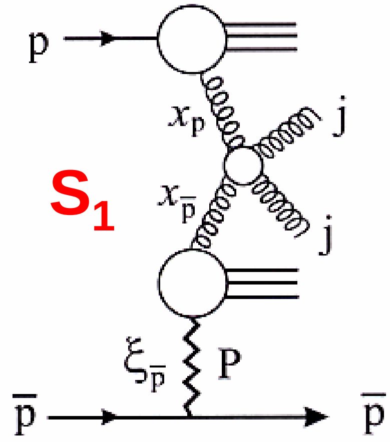
$S_2 \sim 0.05$



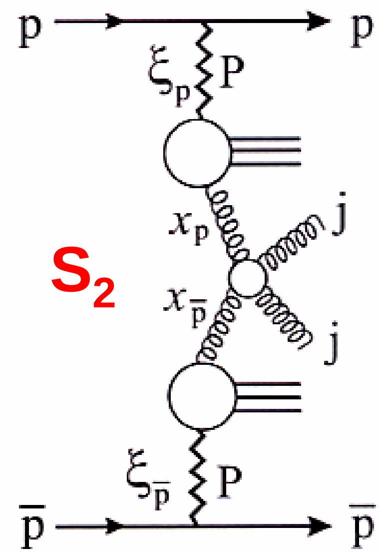
F_P is Pomeron "flux factor"
ξ is fraction of incoming mom. carried by Pom.
$x = \beta\xi$
f are the effective PDFs



ND



SD



DP

$$R_{\mathrm{ND}}^{\mathrm{SD}} \equiv \frac{\sigma_{jj}^{\mathrm{SD}}}{\sigma_{jj}^{\mathrm{ND}}} = \frac{F_P(\xi_{\bar{p}}) f_P(\beta)\beta}{f_{\bar{p}}(x_{\bar{p}})x_{\bar{p}}} S_1$$

$$R_{\mathrm{SD}}^{\mathrm{DP}} \equiv \frac{\sigma_{jj}^{\mathrm{DP}}}{\sigma_{jj}^{\mathrm{SD}}} = \frac{F_P(\xi_p) f_P(\beta_1)\beta_1}{f_p(x_p)x_p} \frac{S_2}{S_1}$$

Need same kinematics.
Uncertainities cancel.
Could study $S(\beta)$

$$D = \frac{R_{\mathrm{ND}}^{\mathrm{SD}}}{R_{\mathrm{SD}}^{\mathrm{DP}}} = \frac{F_P(\xi_{\bar{p}}) f_P(\beta)\beta}{F_P(\xi_p) f_P(\beta_1)\beta_1} \frac{f_p(x_p)x_p}{f_{\bar{p}}(x_{\bar{p}})x_{\bar{p}}} \frac{S_1^2}{S_2}$$

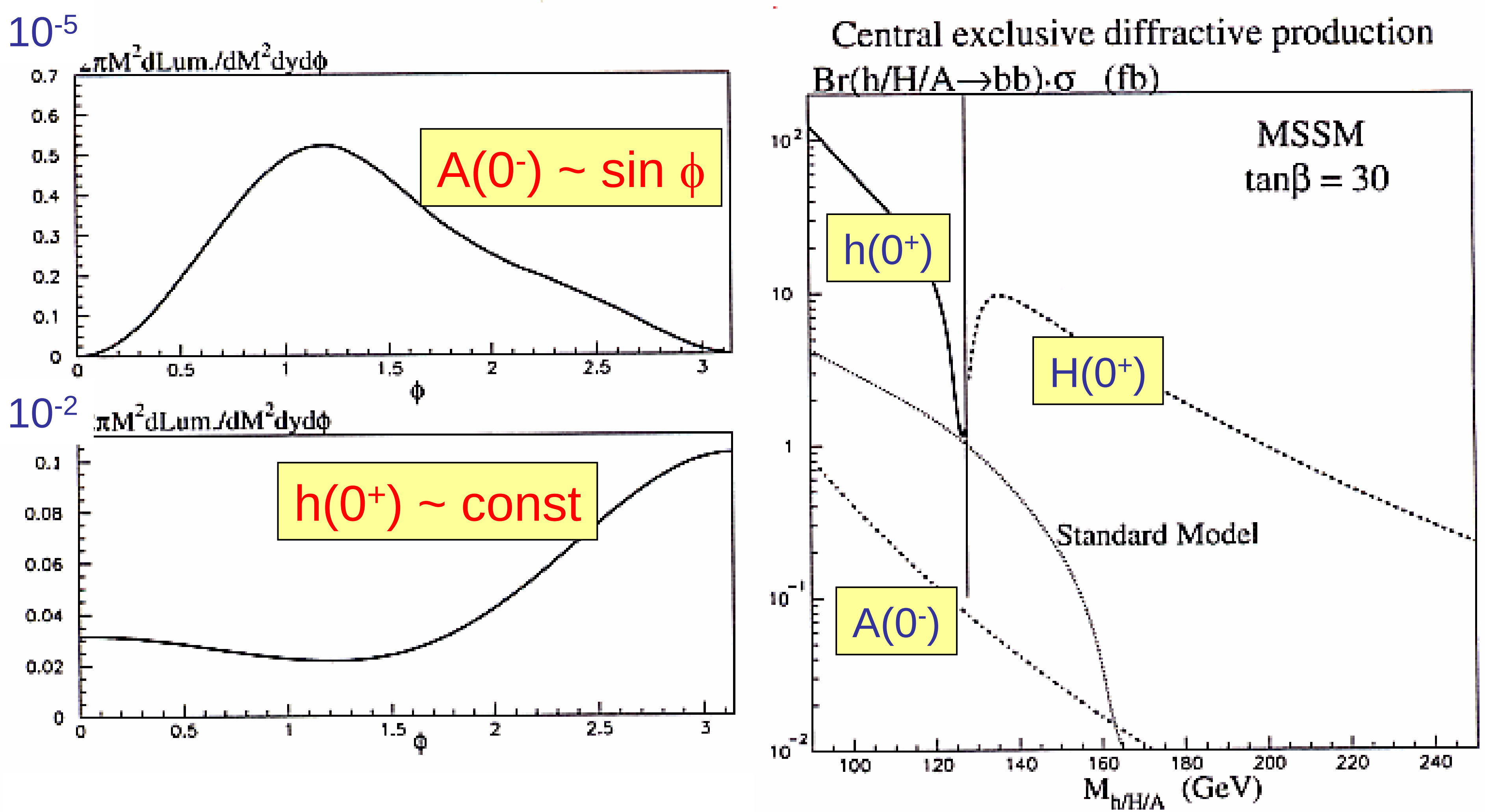
$= S_1^2/S_2$ (if $\beta=\beta_1$, same ξ)

$\sim 0.1^2/0.05 = 0.2$

CDF data $\quad D = 0.19 \pm 0.07$

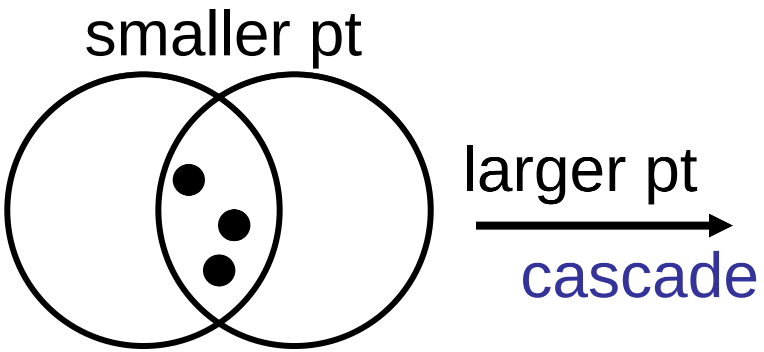
Exclusive SUSY Higgs: pp → p + (h, H, A) + p

KKMR
Durham,2003



Elliptical Flows in Reggeon Theory

Boreskov, Kaidalov, Kancheli (2008)



showed that Reggeon theory can generate the azimuthal anisotrophy observed in heavy-ion collisions (without resorting to the standard thermodynamic mechanism of collective motion of a hadron medium).

Factorisation breaking in diffractive dijet photoproduction at HERA

A.B. Kaidalov[1], **V.A. Khoze**[2,3,a], **A.D. Martin**[2], **M.G. Ryskin**[2,3]

[1] Institute of Theoretical and Experimental Physics, Moscow 117259, Russia
[2] Institute for Particle Physics Phenomenology, University of Durham, Durham DH1 3LE, UK
[3] Petersburg Nuclear Physics Institute, Gatchina, St. Petersburg 188300, Russia

Received: 15 December 2009 / Published online: 19 February 2010

Abstract We discuss the factorisation breaking observed in diffractive dijet photoproduction by the H1 and ZEUS collaborations at HERA. By considering the effects of rapidity gap survival, hadronisation, migration and NLO contributions, we find that the observed data are compatible with theoretical expectations.

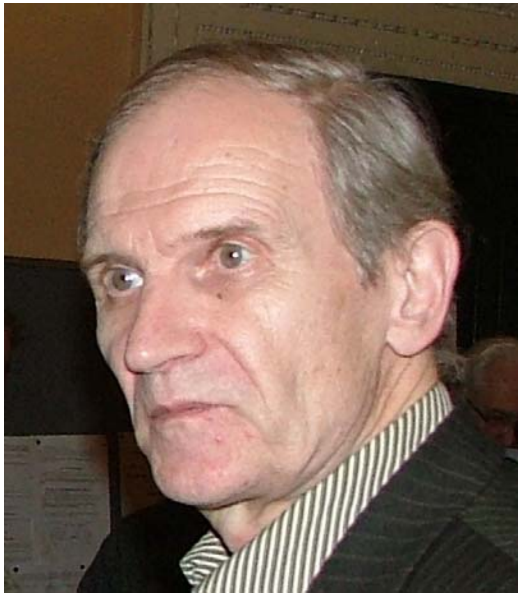
stimulated by discussions between Alice Valkarova and Aliosha et al. at the "low x" meeting in Ischia, Italy, 2009

Kaidalov et al. (2003)

Kaidalov et al. (2010):

In summary, the hadron-like component of the resolved photon, which is suppressed by a factor $\boxed{S^2 \simeq 0.34}$ [14], only starts to be important for small x_γ. Indeed, to feel the hadron-like component one needs to observe dijets far in rapidity from the photon, corresponding to $x_\gamma < 0.1$. This region was difficult to access at HERA.[10] The point-like component of the resolved photon, which is calculable perturbatively, is the dominant one for $x_\gamma > 0.1$, and has a small suppression. For this component, the spectator partons have third jet. Finally, after including the direct component and taking into account the effects of hadronisation and migration, we find that our expectations are consistent with the observed data for diffractively photo-produced dijets.

We miss **Aliosha Kaidalov**



for his wide and deep knowledge

for his modesty, and his patience and care
of others less brilliant than himself

for his quiet humour and distinctive chuckle

for his singing, that has enriched many a conference dinner

for his calm and stoical approach to his illnesses

but above all for his humanity, for his friendship to those who
were fortunate enough to meet him. A life so well-lived

A wonderful person. He is greatly missed