Diffractive dijet production: breakdown of factorization

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Birth of hard diffraction: QCD modelling of Pomeron Birth of hard diffraction: QCD modelling of Pomeron and the set \overline{a} total/inclusive cross-sections
- Sections-sections-sections-sections-sections-sections-sections-sections-sections-sections-sections-sections-

 $\frac{1}{\sqrt{1-\frac{1}{\sqrt{1+\frac{1$ \bigvee $(q + P)^2 \approx \bigvee$ \overline{y} s y \sim α $\overline{\Lambda}$ $2W_X = P_X$, $W_Y = Q$ T is the variable variable variable through Q^2 is the fixed epoch s ≡ (k + P)2 is the fixed epoch of P $\alpha=\frac{1}{\alpha-\rho}$, $x=\frac{1}{\alpha-\rho}$ by α is α is α $q \cdot (P - p_V)$ X and parameters Γ is the system of the system Γ and Γ and Γ and Γ and Γ is the system of $\mathbf{v}' + \mathbf{v}' = \sum \int_{\mathbf{v} \in \mathcal{V}} \int_{\mathbf{v} \in \mathcal{V}} \mathbf{v} \cdot \int_{\mathbf{v} \in \mathcal{V}} \mathbf{v}$ $f_{i\ell s}(x_{\alpha\ell}u_{\tau}^2)$ $\iota, j \quad J$ and ι is the system J \mathbf{r} at the proton vertex at the proton vertex and \mathbf{r} represents the proton of the pr $\int dx \quad \int \hat{x}(t) \quad \text{or} \quad \Omega \text{ is the } D(x) = 2 \quad \text{or} \quad \Omega$ $\int d\mu P \int d\mu P \, d\sigma \, (if \to \infty) \cos(j \, i \, (if \to \infty) \mu, \mu, \nu)$ Ω ω of ω \sim ω ω \sim ω invariant mass of the photon-proton system ρ is given by invariant mass of the photon-proton system ω θ + θ \mathbb{R} and py representing the system of the system of the system q $\begin{array}{cccc} P & \gamma & \gamma & \gamma & \gamma & \gamma \end{array}$ $q \cdot P$ T_{max} and T_{max} are the invariant masses of the system $\frac{1}{2}$ $f(X'+Y) = Y \cdot \text{Id}$ to $f_{\alpha/\alpha}(y) \cdot \text{Id}$ x_{α} $f_{\alpha/\alpha}(x_{\alpha}, u_{\alpha})$ beam momentum transferred to the system $\sum_{i=1}^n \int_{\mathcal{C}} \log \mathcal{P}(C_i \log \mathcal{P})$ i,j and v denoting the four-momenta of the i or photon and parton and parton (Figure 2a) entering the hard subprocess, the distribution of the distribution \mathcal{L} $\frac{1}{2}$ $\mathcal{S}\left(\left(\mathcal{I}_{F}^{\mathcal{P}}\left(\mathcal{Z}_{I\!\!P},\mu_{F}^{\mathcal{P}},x_{I\!\!P},t\right) \right) \right)$ $\int \frac{d\omega}{r} \int \frac{d\omega}{r} \cos(\omega)$ and the difference of $\frac{d\omega}{r}$, $\frac{d\omega}{r}$, $\frac{d\omega}{r}$, $\frac{d\omega}{r}$ $Q^2 \equiv -q^2$, $y \equiv$ $q\cdot F$ $\frac{q}{k} \cdot P$, $x \equiv$ Q^2 $\frac{q}{2P \cdot q}$ $Q^2 \approx sxy$ $s \equiv (k)$ $\sum_{i=1}^{n}$ DIS kinematics $\Gamma \equiv -q^2$, $y \equiv \frac{q \cdot P}{1 \cdot R}$, $x \equiv \frac{Q^2}{3 R^2}$ $Q^2 \approx sxy$ $s \equiv (k + P)^2$ $c \cdot F$ satisfy such that invariant mass of the photon-proton system q is $(P - p_{n-1})$ $\frac{1}{i,j}$ and py representing the system of the systems $\frac{1}{i,j}$, we define the systems $\frac{1}{i,j}$ \mathbf{P} $Q^2 \equiv -q^2$, $y \equiv \frac{q \cdot P}{q \cdot q}$, $x \equiv \frac{Q^2}{q \cdot q}$ $Q^2 \approx sxy$ $s \equiv (k + P)^2$ $c \cdot P$ is $2P \cdot q$ invariant mass of the photon-proton system p $\left[\begin{array}{c}\n\mathrm{d}\sigma(e p \rightarrow e + z \,\mathrm{J} \mathrm{e}\mathrm{d} s + A + I\n\end{array}\right] = \sum_{i,j} \int \mathrm{d} g \, J\gamma/e(\mathcal{Y}) \int \mathrm{d} x \gamma \, Jj/\gamma(\mathcal{X}\gamma, \mu_F) \, \times \,$ $\times \int dt \int dx \mathbf{F} \int dz \mathbf{F} d\hat{\sigma}(ij \rightarrow 2 \text{ jets}(\mathbf{f}_i^D(z_{\mathbf{F}}, \mu_F^2, x_{\mathbf{F}}, t)).$ q · (P − p^Y) $\overline{}$ \mathcal{L} $\mathcal{$ **DIS kinematics** $Q^2 \equiv -q^2$, $y \equiv \frac{1}{k} p$, x $W = \sqrt{(q+P)^2} \approx \sqrt{y s - Q^2}$ $M_X^2 \equiv p_X^2$, $M_Y^2 \equiv p_Y^2$, $t \equiv (P - p_Y)^2$, $x_F \equiv$ θ representing the 4-momenta of the 4-momenta of the systems θ , we define <u>formula</u> 2 , xiP ≡ χ $\int dt \int dx_{\rm F} \int dz_{\rm F} d\hat{\sigma}(i i \rightarrow 2 \text{ jets}) f^D(z_{\rm F} \mu_{\rm F}^2 x_{\rm F} t)$ $\omega^2 \equiv -a^2$, $y \equiv \frac{q \cdot P}{r}$, $x \equiv \frac{Q^2}{r^2}$, $Q^2 \approx sxy$ $s \equiv (k+P)^2$ $q\cdot (P-p_Y)$ $\frac{P}{q \cdot P}$ $\int d\sigma (ep \rightarrow e + 2 \text{ jets} + X' + Y) = \sum \int dy f_{\gamma/e}(y) \int dx_{\gamma} f_{i/\gamma}(x_{\gamma}, \mu_F^2) \times$ four-momentum transferred at the proton vertex and $\overline{i,j}$ such the proton of th $\left(\begin{array}{c} \sim \int \alpha v \int \alpha w \mu \int \alpha z \mu \omega \left(v \right) \end{array} \right)$ factorisation $M^2 = n^2$ of $M^2 = n^2$ of $M^2 = n^2$ of $F = (D - n_{\rm F})^2$ or $r = \frac{q \cdot (P - p_{\rm F})^2}{r}$ \mathbf{v} by \mathbf{v} $d\sigma(ep \rightarrow e + 2 \text{ jets} + X' + Y) = \sum$ i,j " dy $f_{\gamma/e}(y)$ " $dx_{\gamma} f_{j/\gamma}(x_{\gamma}, \mu_F^2) \times$ × " $\mathrm{d}t$ $\int dx_{I\!\!P} \int dz_{I\!\!P} d\hat{\sigma}(ij \to 2 \text{ jets}) \left(f_i^D(z_{I\!\!P}, \mu_F^2, x_{I\!\!P}, t) \right)$

or photon and parton (Figure 2a) entering the hard subprocess, the dijet system has squared

V Diffractive PDFs are non-universal

Some the same contract of the same of th or photon and photon and parton (Figure 2a) entering the hard subprocess, the distribution \mathcal{L} $\overline{\text{NE}}$ e are nen univereal

The quantities MX and MY are the invariant masses of the invariant masses of the systems X and Y , t is the sy
The system in the system i

- √ They can not be exported to describe other hard diffractive processes (e.g. in pp) $\boldsymbol{\mu}$ other hard difficient $\mathcal{P} = \{ \mathcal{P} \mid \mathcal{P} \in \mathcal{P} \mid \mathcal{P} \in \mathcal{P} \mid \mathcal{P} \in \mathcal{P} \mid \mathcal{P} \in \mathcal{P} \}$ rted to describe other hard diffractive processes (e.g. in pp) xported to describe other hard diffractive processes (e.g. in pp)
xip represents the proton of the proton √ They can not be exported to describe other hard diffractive processes (e.g. in pp)

∴ We recal to astarte the commission webshilter of the LPO's which is we see almonder to and fivir-diffyriade.
Hare the proton the describe other bard diffractive processes (e.g. in pp).
	- ✓ **We need to calculate the survival probability of the LRG's which is process-dependent** \cdots \cdots \cdots \cdots \cdots ate the survival probability of the LRG's which is process-dependent \checkmark We need to calculate the survival probability of the The fractional longitudinal momenta carried by the partonsfrom the photon (xγ) and the diffracι υσ σχρυτισα το ασscribe other hard unhactive processes (σ.g. in pp)
calculate the survival probability of the LRG's which is process-dependent parodidio the barrivar prowawinty of the ERO o minon to process aupondont

tive exchange (zIP) are given by

QCD factorisation in diffraction therefore used as the factorisation scale and as the renormalisation scale both indication scale both in Δ i are the diffractive participants of the diffractive participants for the x^P dependence of diffractive cross sections, with the exponent actually being a free is also covered by Tactorisation in diffraction which has two phenomenological power laws, is also concerned by the theorem proved in the theorem proved in the theorem proved in the this paper. However, is also concerned t power. Indeed, the QCD analysis by H1 [16], which has two phenomenological power laws, *(p Xp) ˆ f (x Q,z,t,) IP ^D ** ² ^σ ^γ [→] ⁼ ∑^σ [⊗]

 $\vert \cdot \frac{\vert \text{difference fact. n:}}{\vert \text{proven}}$ by Collins for a hard diffractive scattering (hep-ph/9709499) \vert

diffraction $\mathcal{O}(\mathcal{O})$ and $\mathcal{O}(\mathcal{O})$ by $\mathcal{O}(\mathcal{O})$

different in the parameter in the parameter in the set of \mathcal{X} in diffractive DIS to the power of S and in DIS and in DIS and as the factorisation scale both in DIS and in dences of the diffraction of the diffractions were factorized from the diffraction of the scale from t $\frac{1}{2}$ in hadron-hadron elastic scattering and can be broken • Regge fact.n: relates the power of $\mathcal{X}_{\mathbb{P}}$ in diffractive DIS to the power of S *IR IP i IP IP IP i i* \boldsymbol{S}

- $\sqrt{ }$ DPDFs are extracted from global NLO fits of inclusive diffraction data at HERA √ DPDFs are extracted from global NLO fits of inclusive diffraction data at HERA
√ Predictions based upon extracted DPDFs are fairly consistent with theoretical models √ DPDFs are extracted from global NLO fits of inclusive diffraction data at HERA exchange entering the hard scattering) s are extracted from global NLO fits of inclusive diffraction data at HFRA $\,$
- √ Predictions based upon extracted DPDFs are fairly consistent with theoretical models
∠ Importent tool for diffrective fectoriestion breaking etudies (conseielly in had had ooll) , v
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, v √ Predictions based upon extracted DPDFs are fairly consistent with theoretical models y consistent with theoretical models \blacksquare
- whipportant tool for unifactive factorisation breaking studies (especially in hau-hau con.) ✓ **Important tool for diffractive factorisation breaking studies (especially in had-had coll.)**

QCD factorisation in diffraction

- **√ Triple-Regge graphs for diffractive DIS offer a way**
 b probe the structure function of the Pomeron **to probe the structure function of the Pomeron**
- ✓ **Provided that the parton densities in the Pomeron EXECUTE THE TRIPLE-REGISTER CONSTRUCT AND LOSTED OF APPROX the cross section of any hard diffractive process**
- **√** Diffractive di-jets production in hadron-hadron **collisions is an important probe of QCD factorisation in hadronic diffraction, historically has been for the faction is at the cross in the cross in the cross of the cross is used to test QCD factorisation at Tevatron** මු
- ✓ **Attempts to use the diffractive PDFs of However, the attempts to use this diffractive PDFs the Pomeron for diffractive jets production have failed: Tevatron data contradict the predictions by an order of magnitude badly: data from the Tevatron contradict the Four Auturity of use the unit active I Drs of**
the Demore for diffree tive iets preduction here
- **∕** The reason: QCD factorisation is broken for hard
produce diffusation! **hadronic diffraction!**

QCD factorisation breaking in had-had collisions

Incoming hadrons are not elementary — experience soft interactions dissolving them leaving much fewer rapidity gap events than in ep scattering

Sources of QCD factorisation breaking, usually discussed:

- ✓ soft survival (=absorptive) effects (Khoze-Martin-Ryskin and Gotsman-Levin-Maor)
- ✓ interplay of hard and soft fluctuations in incoming hadron wave function
- ✓ saturated shape of the universal dipole cross section for large dipole sizes

Two distinct approaches treating the above effects:

- ✓ **Regge-corrected (KMR) approach** the first source of Regge factorisation breaking is accounted at the cross section level by "dressing" QCD factorisation formula by soft Pomeron exchanges
- ✓ **Color dipole approach** the universal way of inclusive/diffractive scattering treatment, accounts for all the sources of Regge factorisation breaking at the amplitude level (Kopeliovich, RP et al)

Good-Walker formulation Elastic amplitude: ⟨Ψ0|*T*|Ψ0⟩ = !|*cn*0| ²*Tn* = ⟨*T*⟩

Kopeliovich & Povh, Z.Phys. A354 (1997) R. J. Glauber, Phys. Rev. 100, 242 (1955). *E*. Feinberg and I. Ya. Pomerano Projectile has a substructure! *m*_{*k*} *h*_{*k*} *dood and w*, *D*, *wan*cr, *f hys. hev. 120* (1500) 100 $|h\rangle = \sum_{\alpha} C^h_{\alpha} |\alpha\rangle \qquad \hat{f}_{el} |\alpha\rangle = f_{\alpha} |\alpha\rangle$ Diffractive excitation determined by the fluctuations: *d* = *d drop* eqn be excited: 1 Hadron can be excited: **Mean dipole Mean dipole** $\langle r^2 \rangle = \frac{1}{Q^2 z(1-z) + m_z^2}$ **separation:** $Q^2z(1-z) + m_q^2$ not an eigenstate of interaction! The second separation: ations in a highly virtual photon and the cross section of \mathcal{A} **semi-hard/** Completeness and orthogonality **semi-soft soft** $\langle h'|h\rangle = \sum_{\alpha=1}^{\infty} (C_{\alpha}^{h'})^* C_{\alpha}^h = \delta_{hh'}$ *hard hard* $|C_\alpha|^2$ $\begin{array}{c|c} 2 & \sigma_{\alpha} & \sigma_{tot} = \Sigma \end{array}$ $|C_{\alpha}|^2 \sigma_{\alpha} \sigma_{sd} = \sum_{\alpha}$ $|C_{\alpha}|^2 \sigma_{\alpha}^2$ α=*so ft* α=*so ft* $\langle \beta | \alpha \rangle = \sum_{\mu} (C_{\beta}^{h'})^* C_{\alpha}^{h'} = \delta_{\alpha \beta}$ $\langle r^2 \rangle \sim 1/Q^2$ |Hard ~ 1 | $\sim \frac{1}{Q^2}$ | $\sim \frac{1}{Q^2}$ | $\sim \sim$ Hard $\vert \sim 1 \, \vert \sim \frac{1}{Q'}$ 1 1 $\frac{1}{Q^2}$ ∼ Q^4 Elastic and single diffractive **Aligned jets!**amplitudes $\left. \frac{m_q^2}{Q^2} \right| \sim$ $\langle r^2 \rangle \sim 1/m_q^2 \left[Soft \left[\sim \frac{m_q^2}{Q^2} \right] \sim \frac{1}{m_q^2} \right]$ 1 1 1 Soft $\big|\sim$ \sim *Q*² ∼ m_a^2 *qQ*² $f_{el}^{h\rightarrow h} = \sum_{\alpha=1}^{\infty} |C_{\alpha}^{h}|^2 f_{\alpha}$ **Dispersion of the eigenvalues** independent. One can test this picture studying the *Q*² depen**distribution** $\frac{d}{d\pi} \left[\sum_{s} |f_{sd}^{un}|^2 - |f_{el}^{un}|^2 \right]$ Single diffractive cross section $\begin{array}{ccc} \text{S} & \cdots & \text{S} \end{array}$ is a source of nuclear shadowing $\begin{array}{ccc} \text{S} & \text{S} & \text{S} \end{array}$ $1\left[\sum_{\alpha} |a_{\alpha}|^2 \left(\sum_{\alpha} |a_{\alpha}|^2 \right)^2 \right] \left[\left\langle f_{\alpha}^2 \right\rangle - \left\langle f_{\alpha} \right\rangle^2 \right]$ $f_{\alpha} = \frac{1}{4\pi} \left[\sum_{\alpha} |C''_{\alpha}|^2 |f_{\alpha}|^2 - \left(\sum_{\alpha} |C''_{\alpha}| f_{\alpha} \right)^2 \right] = \left[\frac{\sqrt{2\alpha} \sqrt{2\pi}}{4\pi} \right]$ Important basis for the dipole picture! Γ_{α} and Γ_{α} weak scaling to Γ_{α}

Phenomenological dipole approach

see e.g. B. Kopeliovich et al, since 1981

Eigenvalue of the total cross section is
 Eigenstates of interaction in QCD:

Color dipoles the universal dipole cross section into a particular form of Compton scattering building blocks in the graphs form. The different building compton scattering for \mathbb{R}^n

Eigenstates of interaction in QCD: **color dipoles**

$$
\sum_{h'} \frac{d\sigma_{sd}^{h\to h'}}{dt} \bigg|_{t=0} = \sum_{\alpha=1} |C_{\alpha}^{h}|^2 \frac{\sigma_{\alpha}^2}{16\pi} =
$$

SD cross section

$$
\int d^2 r_T \Big(\Psi_h(r_T)\Big) \frac{\sigma^2(r_T)}{16\pi} = \frac{\langle \sigma^2(r_T) \rangle}{16\pi}
$$

wave function of a given Fock state is the picture wave already we have already we have already we have already we have already sect. 1.2.1.2.1.2.
The picture we have already section of the picture we have a strong section of the section of the section of t

total DIS cross section

total DIS cross section
$$
\sigma_{tot}^{\gamma^* p} (Q^2, x_{Bj}) = \int d^2 r_T \int_0^1 dx \, |\Psi_{\gamma^*}(r_T, Q^2)|^2 \sigma_{qq} (r_T, x_{Bj})
$$

Theoretical calculation of the dipole CS is a challenge

<u>Theoretical calculation of</u>
the dipole CS is a challenge **EVALUAN BUT!** Can be extracted from data and used in ANY process!

Example: **Naive GBW parameterization of HERA data**

color transparency high-energy factorization is the relation

QCD factorisation

 ${\sf c}$ aturatos at ${\sf c}$ Example: Naive GBW parameterization $\sigma_{aa}(r_{T} , x) = \sigma_0 \left[1 - e^{-\frac{1}{4}r_T^2Q_s^2(x)}\right]$ large separations determined by the inverse of HERA data momentum scale, i.e. $\frac{1}{2}$

saturates at large separations

$$
r_T^2 \gg 1/Q_s^2
$$

 $\sigma_{qq}(r_T) \propto r_T^2 \quad r_T \to 0$ $\sigma_{q\bar{q}}(r, x) \propto r^2 x g(x)$

A point-like colorless object does not interact with external color field!

at any diffractive scattering is due to a destructive interference of dipole scatterings! leading log x approximation. A more precise version of the relation (7) involves the kt dependent gluon gluon
Involves the kt dependent gluon (7) involves the kt dependent gluon gluon gluon gluon gluon gluon gluon gluon

Hadronic diffraction via dipoles: diffractive Drell-Yan

since a diffractive cross section, which is proportional to the dipole cross section squared,

Diffractive vs inclusive di-jets $T = 1$ and $T = 0$ on $\sigma = 0$ on $S = 0$. So are given, in particular, in particular, in particular, i.e., $\sigma = 0$ **,** <u>**,** *∧B* 1 *06* **+ 1 ***x* + 2 *x* + 2 *x* + 2 *x*</u> $\sum_{i=1}^{n} \int_{0}^{1} f(x) \, dx$ properly accounted for in the dipole transmission in the dipole transmission radiation. The dipole transmissio $\sum_{i=1}^n \sum_{i=1}^n \frac{1}{n}$ $\mathbf{e}^{\mathbf{e}}$ Γ ^{transplace that a point-like color distribution distribution} P IIII active v_i

RP, B. Kopeliovich, I. Potashnikova, arXiv:1897.05548 *^X*, containing the digeter, *RP, B. Kopeliovich, I. Potashnikova, arXi* $\mathbf{p}_{\mathbf{p}}$ mechanism (quark excitation) as well as $\mathbf{p}_{\mathbf{p}}$ well as $\mathbf{p}_{\mathbf{p}}$ $\mathbf{r}, \mathbf{p}, \mathbf{n}$ *R*² ⁰(*x*) , В. Кореиоу \mathbf{r} *R*² *, r*² ⌧ *^R*² ⁰(*x*)*,* (3.4)

$$
\mathcal{R}_{\text{SD}/\text{incl}} = \frac{\Delta \sigma_{\text{SD}}/\Delta \xi}{\Delta \sigma_{\text{incl}}}, \qquad \Delta \xi = 0.06, \qquad \xi \equiv 1 - \frac{\pi}{s} = \frac{M_{X}^{2}}{s}
$$
\nfractional longitudinal momentum
\nof the recoil p
\nScale
\nScale
\n $Q^{2} = \frac{(E_{T}^{1} + E_{T}^{2})^{2}}{4}, \qquad \frac{\pi}{E_{B}} = \frac{1}{\xi} \sum_{i=1}^{3} E_{T}^{i} e^{-\eta_{i}} \frac{M_{X}^{2}}{2E_{F}} \qquad \frac{\text{fractional LC momentum of the target parton}}{\text{of the target parton}} \qquad \frac{\pi}{E_{B}} = \frac{1}{\xi} \sum_{i=1}^{3} E_{T}^{i} e^{-\eta_{i}} \frac{M_{X}^{2}}{2E_{F}} \qquad \frac{\pi}{E_{B}} \qquad \frac{\pi}{E$

Diffractive di-jets: qN vs NN collisions A. Di↵ractive excitation of a projectile quark \overline{D} *f*ractive di-jets: qN *ffractive di-iets: qN vs NN collisions* $\boldsymbol{\dot{\mathbf{u}}}$ *f* di-iets: aN vs NN ⌧*l d*2 *reⁱ*~~*^r ^q*!*qG*(~*r,* ↵)*qq*¯(~*r*)*.* (4.6) **piiiractive di-jets: qn vs nn coilisions** f^* such that f^* such that f^* such that f^* THE PARTIES OF THE PARTIES

Diffractive di-jets in NN collisions *N* **rac** $\mathbf{D}^{\prime}\mathcal{L}\mathcal{L}_{\text{max}}$ of \mathbf{J}^{\prime} is the integral $\mathbf{M}\mathbf{N}$ of \mathbf{M}^{\prime} ⁰ (*R*~*ⁱ · ^R*~*^j*)*, i, j* = 1*,* ²*,* ³ *,* Z iffractive di-jets in NN collisions

Integrating out all soft-scale phenomena over the incoming projectile wave function:

grating out	\n $\frac{d\sigma_{\text{SD}}^{q\rightarrow qG}}{d\Omega} \simeq \frac{\mathcal{K}_{\text{SD}}^{q\rightarrow qG}(s, \hat{s}, \alpha)}{(2\pi)^2} q(x_q, \mu^2) \int d^2 \rho d^2 \rho' e^{i\vec{\kappa}(\vec{\rho}-\vec{\rho}')} (\vec{\rho} \cdot \vec{\rho}')$ \n
the incoming	\n $\times \sum \hat{\Psi}_{q\rightarrow qG} (\vec{\rho}, \alpha) \hat{\Psi}_{q\rightarrow qG}^{\dagger} (\vec{\rho}', \alpha),$ \n

$$
\mathcal{K}_{\text{SD}}^{q \to qG} = \frac{1}{B_{\text{SD}}} \frac{9 a \overline{\sigma}_0(\hat{s})^2}{256 \pi} \Big\{ \mathcal{W}_1(\hat{s}) \left[1 - \frac{2\alpha}{3} + \frac{7\alpha^2}{27} \right] + \mathcal{W}_2(\hat{s}) \left[1 + \frac{2\alpha}{3} - \frac{13\alpha^2}{27} \right] \Big\},\,
$$

$$
\mathcal{W}_{1}(\hat{s}) = \frac{8}{(4 + a\overline{R}_{0}^{2})^{2}} + \frac{12}{(12 + a\overline{R}_{0}^{2})^{2}}, \qquad \hat{s} = x_{q} s, \qquad \overline{R}_{0} = \overline{R}_{0}(\hat{s}),
$$

$$
\mathcal{W}_{2}(\hat{s}) = \frac{6a^{2}\overline{R}_{0}^{4}}{(3 + 8a\overline{R}_{0}^{2} + a^{2}\overline{R}_{0}^{4})^{2}} - \frac{a^{2}\overline{R}_{0}^{4}}{(3 + 4a\overline{R}_{0}^{2} + a^{2}\overline{R}_{0}^{4})^{2}}.
$$
...and analogically
for qolar & GG
dijets!

complete analogy to the above expressions, except that the (anti)quark densities are replaced **Diffractive di-jets in NN collisions: results**

$$
\mathcal{R}_{\text{SD/incl}} = \frac{1}{\Delta \xi} \frac{d\sigma_{\text{SD}}^{q \to qG} / dx_G + d\sigma_{\text{SD}}^{G \to q\bar{q}} / dx_G + d\sigma_{\text{SD}}^{G \to G_1 G_2} / dx_G}{d\sigma_{\text{incl}}^{q \to qG} / dx_G + d\sigma_{\text{incl}}^{G \to q\bar{q}} / dx_G + d\sigma_{\text{incl}}^{G \to G_1 G_2} / dx_G}
$$

Scale and energy dependence driven by linear (in r) dependence of the diffractive amplitude is similar to that of Drell-Yan!

Conclusions

✓ **The dipole picture enables to visualise the dominant configurations in diffractive reactions such as diffractive DIS in ep collisions, as well as diffractive Drell-Yan and di-jets production**

✓ **In DDIS, the dominant fluctuations are soft, arising from the aligned-jets configurations, yielding the same scale dependence as for the inclusive DIS.**

✓ **In diffractive NN collisions, the hadron-induced diffraction is driven by a different mechanism: such processes receive mixed (semi-hard/semi-soft) dominant contributions due to an interplay of hard and soft fluctuations from the hadron-scale destructively interfering projectile dipoles in the incoming hadron.**