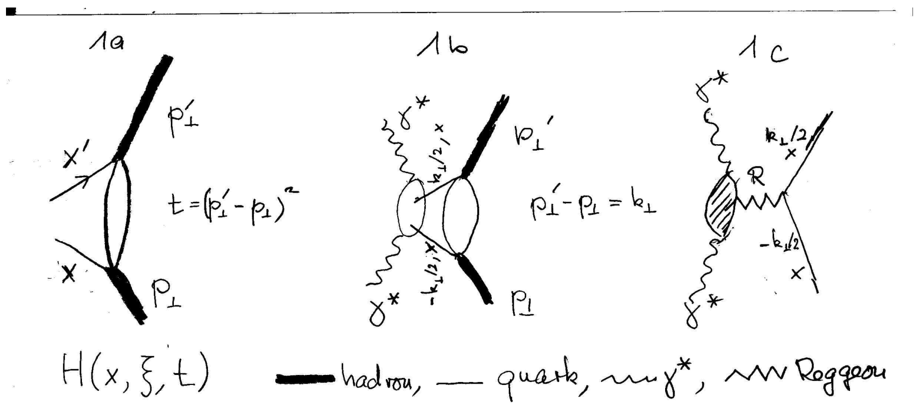

Figure 1: Motivation of the Regge-ansatz, see text

Motivation of the Regge ansatz .

The motivation for the application of Regge theory to GPD in Goeke et al (2001) around eq. 134,135 is rather thin. They are perfectly aware of that and formulate very cautiously:

"It is interesting to note that the features of the t-dependence of GPDs shown on Fig. 6 ⟨motivaed by some soliton model, HGD⟩ can be qualitatively reproduced by the following ansatz " and it follows the Regge ansatz in their eq. (134)

$$H^q(x, \xi = 0, t) = \frac{1}{x^{\alpha' t}}\, q(x). \tag{1}$$

In our approach Regge theory gives a veey important constraint. Though it is some time that I was working in it, I shall try to motivate the use of Regge theory, especially in view of our model. Please scrutinize it. After your comments we could send it to more up-to-date Regge experts, like Markus, for criticism.

The GPD, Fig. 1a), can be related e.g. to the hadronic Compton effect, Fig. 1b). In it the quark-γ^* elastic scattering is a subprocess. This elastic quark-γ^* scattering (Fig. 2a) is dominated by the energy $\sim 1/x$. For high energies corresponding to small x it is governed by Regge (R) exchange, see Fig. 1c. Tis is leading to the t dependence $\frac{1}{x^{\alpha' t}}\beta(t)$ (This is more general then the ansatz of Goeke et al given in (1)). The Regge residue $\beta(t)$ is in our model related to the slope of the general function $w(x)$. I shall come to that later. This connection with Regge theory has two interesting features:

1) In order for the *rho* to couple to the Reggeon, the hadronization of the virtual photon γ^* is essential, that is exactly as in our model, where only the dressed current leads to the Beta-function FF

2) Whereas the elastic scattering for high energies (small x), Fig 1c), is supposed to be determined by Pomeron exchange with a residue near $\alpha_P(0) \approx 1$ and a slope $\alpha'_P \approx \frac{1}{4}\mathrm{GeV}^{-2}$, it is related in our model to rho exchange with $\alpha_\rho(0) = \frac{1}{2}$ and a slope $\alpha'_\rho \approx 1\mathrm{GeV}^{-2}$. This is in accordance with the assumption that the pomeron does not couple to quarks, but only to the gluon content in the hadron, see Donnachie et al (2002), Ch. 6.7 and 8.5. This is also well compatible with the gluon dominance in the PDFs at small x, see PDG, 2016, Fig. 19.5.

The value $\alpha'_P \approx 1\mathrm{GeV}^{-2}$ is well compatible with the data. In our model we could change the

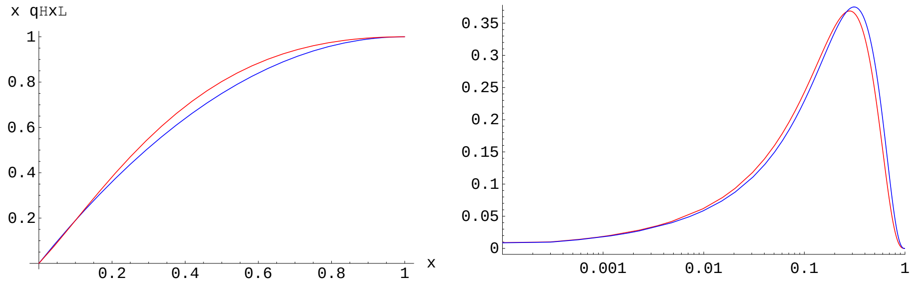

Figure 2: The functions $w(x)$ and $x\,q(x)$ for different parametrizations. Red: Parametrization of preprint (2); Blue: polynomial parametrization (3)

intercept and slope by assuming $w(x) \sim x^\beta$. This changes slope and intercept by a factor β. In order to obtain the intercept 1 we had to choose $\beta = \frac{4}{3}$, which would change the slope to $\alpha' = \frac{4}{3}\mathrm{GeV}^{-2}$, very far away from the pomeron slope $\frac{1}{4}\mathrm{GeV}^{-2}$.

Ambiguities of reparametrization .

Since the function $w(x)$ is only fixed by some conditions at $x = 0$ and $x = 1$ there is a continuum of possible choices. Besides the one of the preprint ,

$$w(x) = x^{1-x}\, e^{-a(1-x)^2} \tag{2}$$

another very rational 1-parameter choice, which fulfills all the conditions, is the polynomial:

$$w(x) = A\,x + (3 - 2A)\,x + (A - 2)\,x^2 \tag{3}$$

Choosing $A = 0.566$ one obtains a very similar $w(x)$ and correpondingly also a vvery similar $xq(x)$. The parameter $A = e^{-0.507}$ was chosen to give the same the same Regge residue $\beta(t)$ as for the preprint parametrization. The functions $w(x)$ and $x\,q(x)$ are shown in Fig. 2, red preprint, blue polynomial (3). It is very conforting that the Regge residue and the conditions at $x = 0$ and $x = 1$ determine largely the GPD.

Literature .

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S. Donnachie, H.G. Dosch, P. Landshoff, O. Nachtmann, Pomeron Physics and QCD , Cambridge University Press, 2002.

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