EMMI RAPID REACTION TASK FORCE

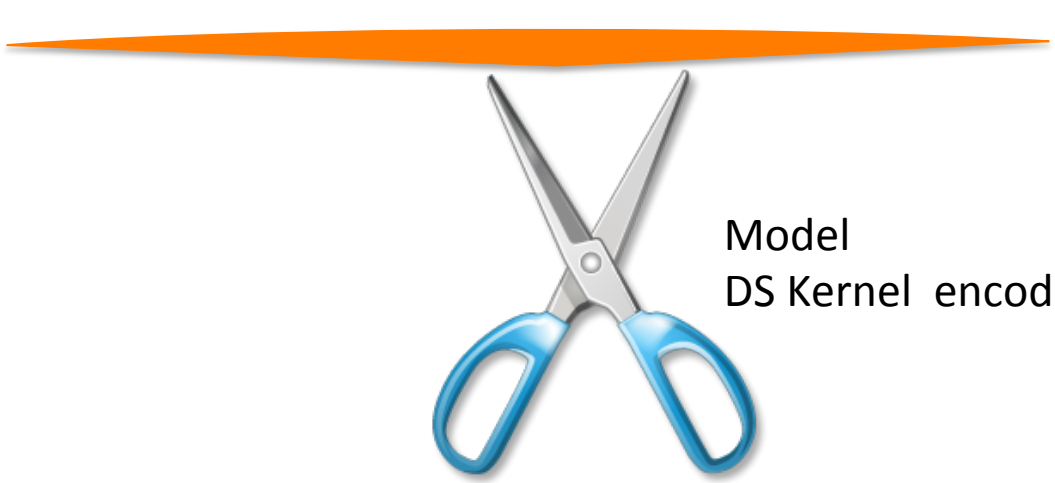
GSI, October 2013

Teresa Peña

TÉCNICO LISBOA


QCD
Experiment

QCD



Experiment

Model

DS Kernel encodes the quark-gluon level

QCD

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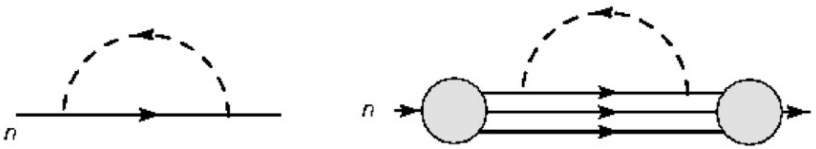
Multipion effects or valence quarks?”

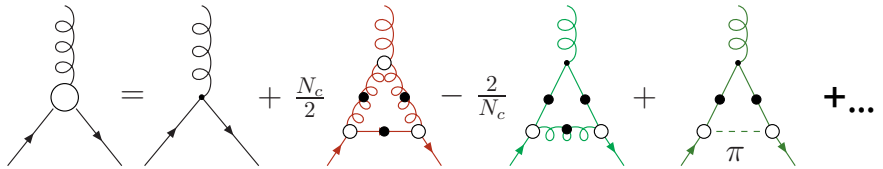
Joachim Stroth



First principles (quark-gluon level) can clarify?

Talk by C. Fischer

quark-gluon vertex:



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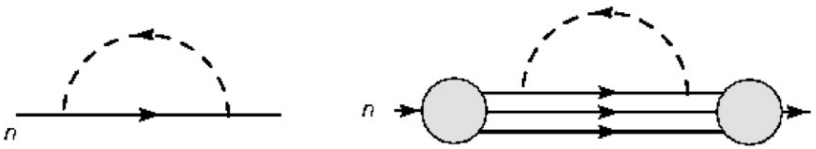

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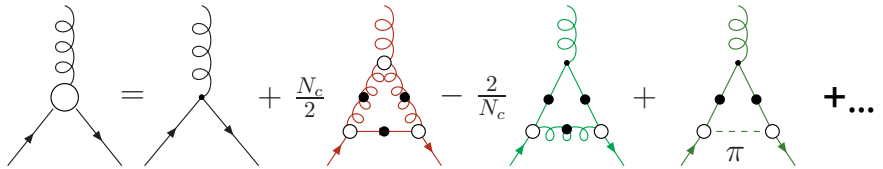

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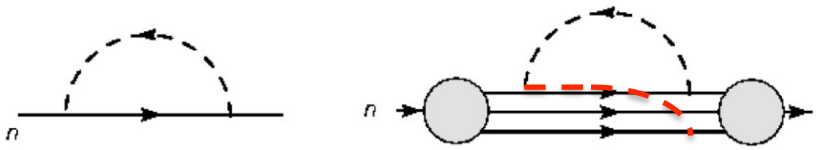

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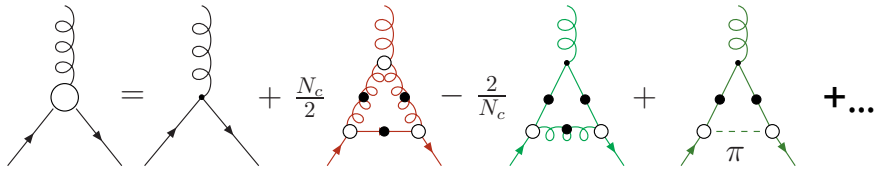

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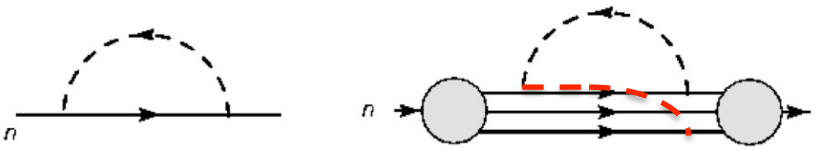

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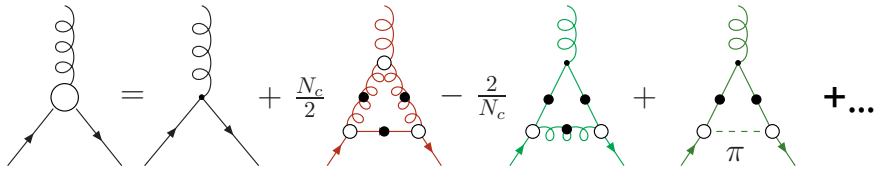

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Roper N*(1440)

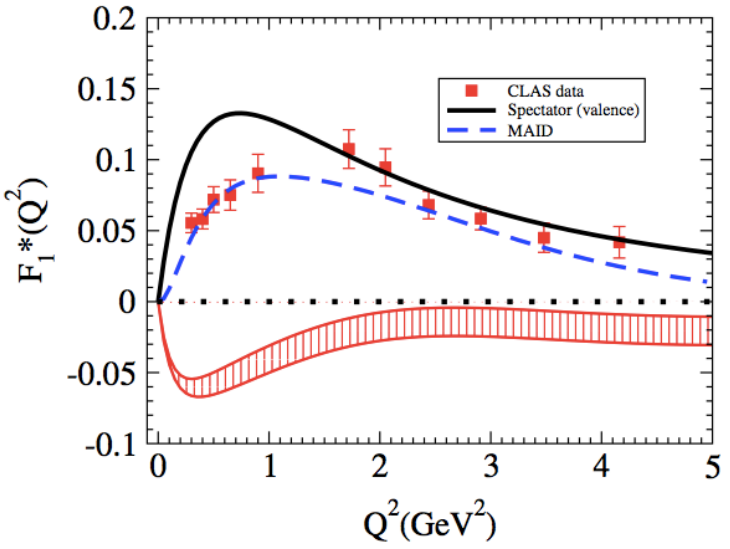
$N \rightarrow N^*(1440)$

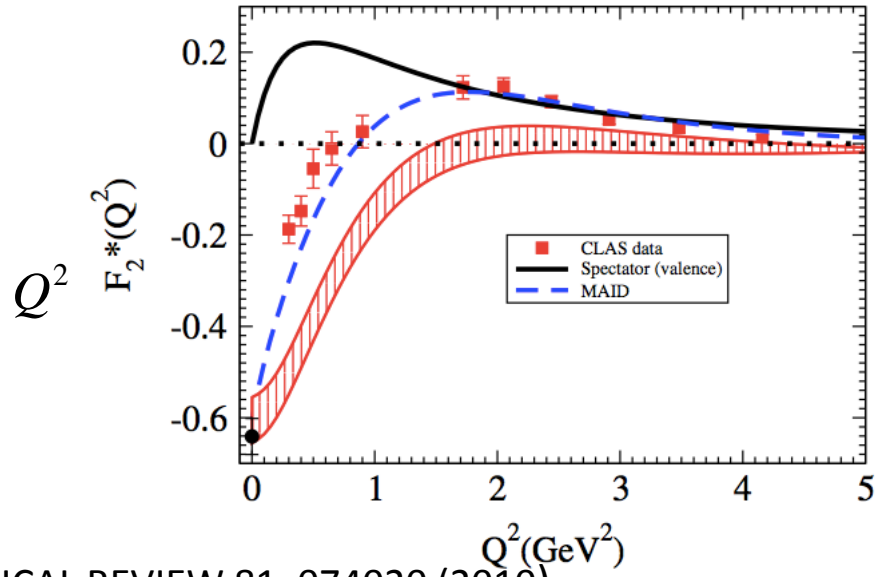
- The orthogonality condition fixes term of the radial excitation.

- Quark core amplitude describes high data.

- Pion cloud estimated as difference between MAID fit and the quark core.

- Error bands from error bars in the data





G. Ramalho, K. Tsushima, PHYSICAL REVIEW 81, 074020 (2010)

Position of zero $\mu G_E/G_M$
Can it be understood from quark-gluon level principles ?

Revealing dressed-quarks via the proton's charge distribution

Ian C. Cloët,[1,2] Craig D. Roberts,[2,3] and Anthony W. Thomas[1]

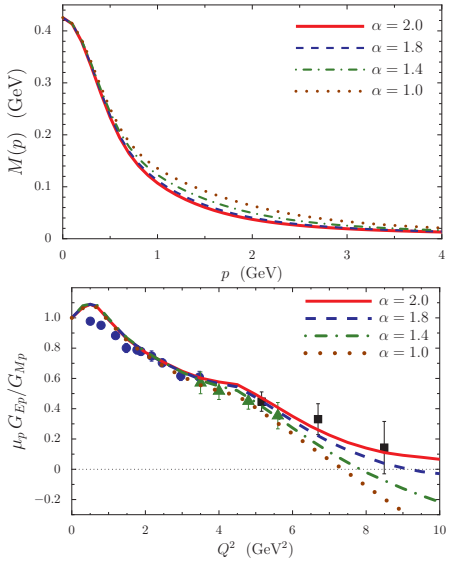


FIG. 2. *Upper panel.* Dressed-quark mass function. $\alpha = 1$ specifies the reference form and increasing α diminishes the domain upon which DCSB is active. *Lower panel.* Response of $\mu_p G_E/G_M$ to increasing α; i.e., to an increasingly rapid transition between constituent- and parton-like behaviour of the dressed-quarks. Data are from Refs. [6, 9–12].

Dramatic effect of small changes in the fall-off rate of the quark masses to their ultra-violet limit

Momentum-independent quark masses:

Zero of $\mu G_E/G_M$ at $Q^2 \approx 4$ GeV ^{2}

Rapid fall-off of momentum-dependent quark mass functions:

No zero of $\mu G_E/G_M$

$$G_E(Q^2) = F_1(Q^2) - \tau F_2(Q^2)\,,$$
$$G_M(Q^2) = F_1(Q^2) + F_2(Q^2)\,,$$

$$\tau = \frac{Q^2}{2M}$$

G_E is more sensitive than G_M

Rapid fall-off of momentum-dependent quark mass
-> faster diminishing of magnetic moment
-> F_2 falls faster than F_1 due to diminishing of quark anomalous magnetic -> no zero!

Or…higher partial waves?

Can first principles (at quark-gluon level) clarify

-Baryon transition form factors behavior at both high and low Q^2?

-Medium effects (multipion states)?

-Position of zeros of nucleon form factors?

-Role of diquarks?

QCD = LQCD

1) Status and future improvements
-Spectroscopy
-Form Factors for Stable particles
-Transition Form Factors

2) Prospects for
-Decays???
-Medium effects??? $\pi\pi$, multipion channels
-Spectral functions???

3) Where may it be enlightening to couple models to LQCD?

PHYSICAL REVIEW C **85**, 025205 (2012)

Nucleon and Roper electromagnetic elastic and transition form factors

D. J. Wilson,[1] I. C. Cloët,[2] L. Chang,[1] and C. D. Roberts[1,3,4]

Elastic scattering and resonance electroproduction experiments probe the evolution of the strong interaction's running masses and coupling to infrared momenta.

For example, the existence, and location if so, of a zero in the ratio of nucleon Sachs form factors are strongly influenced by the running of the dressed-quark mass.