VMD validation in vector meson production (C. Roberts)

ector Meson Elastic
lectric Form Factor

In three panels at right, plot G_E^V as functions of $x = Q^2/m_V^2$

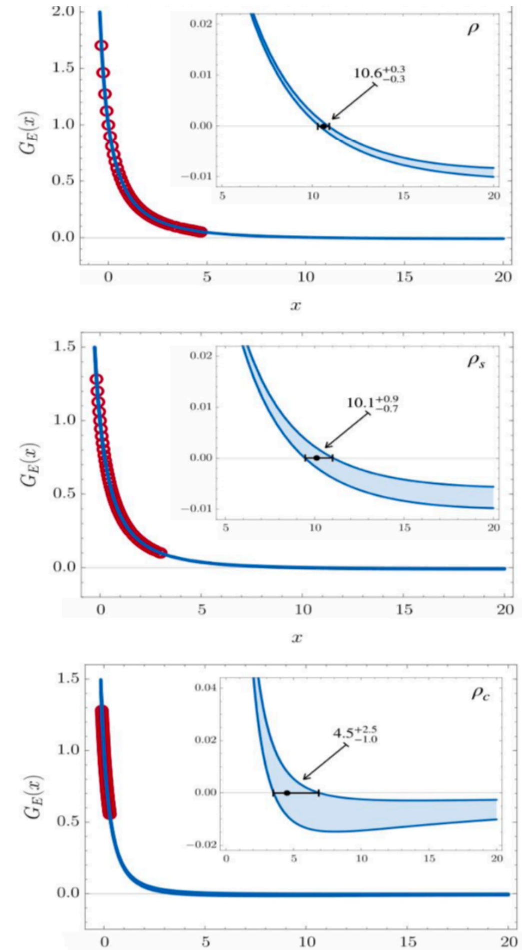
for V = $u\bar{d}$, $u_s\bar{d}_s$, $u_c\bar{d}_c$

Analysis predicts a zero in each case

Importantly, as the current-mass of the system's valence-quarks is increased, the x-location of the zero, x_z, moves toward $x = 0$

$\mathcal{V}$	ρ	ρ_s	ρ_c
x_z	$10.6(3)$	$10.1^{(9)}_{(7)}$	$4.5^{(2.5)}_{(1.0)}$

Shift is initially slow; but the pace increases as one leaves the domain upon which emergent mass is dominant and enters into that for which explicit (Higgs-connected) mass generation overwhelms effects deriving from strong-QCD dynamics.



$$x = Q^2/M_V$$

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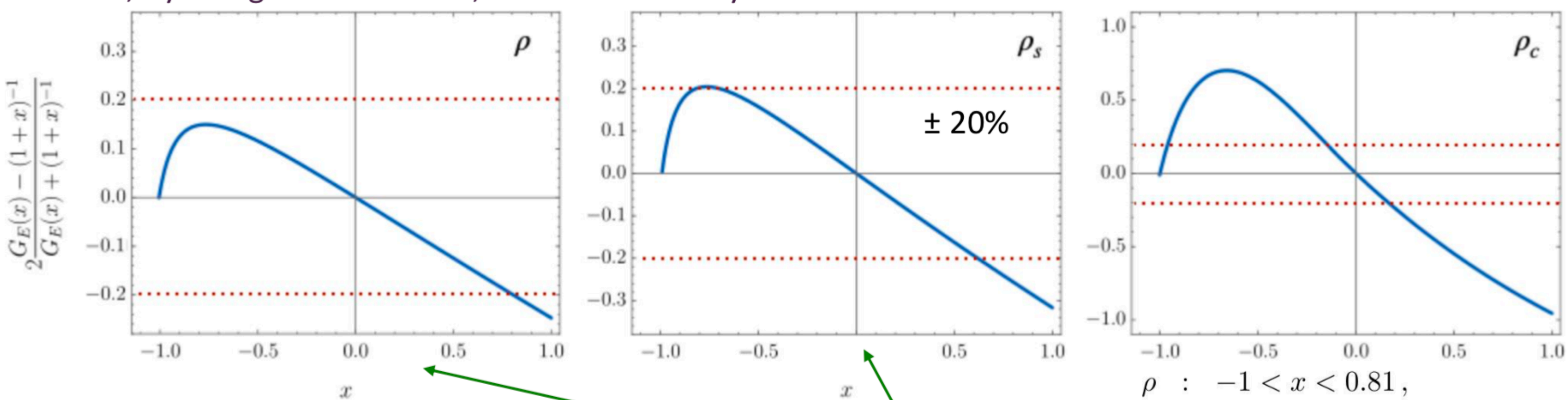
Vector Meson Dominance

- Existence of a zero in $G_E^V(x) \Rightarrow$ validity domain for single-pole VMD model is circumscribed.
- Notwithstanding this, $G_E^V(x)$ is the best case for VMD:
  - must agree with the computed result in some neighbourhood of x = −1
  - and, by charge conservation, also in the vicinity of x = 0.

J/Ψ: VMD fails beyond 4% virtuality

VMD discrepancy ratio



$\rho\ :\ -1 < x < 0.81\,,$

$\rho_s\ :\ -1 < x < 0.60\,,$

$\rho_c\ :\ -1 < x < -0.96\ \ \&\ \ -0.15 < x < 0.24\,.$

- Findings …
  - VMD approximation is fair on a reasonable domain for light-quark systems
  - However, VMD is poor for states in which the Higgs-mechanism of mass generation is dominant; hence, likely yields erroneous estimates for off-shell properties of $\bar{c}c$ states & more massive

$$2\frac{G_E(x)-(1+x)^{-1}}{G_E(x)+(1+x)^{-1}} \qquad\qquad x = Q^2/M_V$$