

In Memoriam  
Michael Pennington

1946 - 2018



Hadron 2015 - Newport News



† 23.5.2018

# Some key data

- 1968: Bachelor from Univ. of Edinburgh
- 1971: PhD Westfield College, Univ. of London (summa cum laude) supervised by E. Leader
- 1971-1973: postdoc Berkeley
- 1974-1975: postdoc Rutherford Appleton Laboratory
- 1976-1978: postdoctoral fellow CERN
- 1976-2010: Univ. of Durham
  - Full professor from 1999 on
  - Founder of Institute for Particle Physics Phenomenology (IPPP)
  - **Dean for Educational Outreach**
- 2010-2016: Associate director at JLAB for theoretical and computational physics
  - Founder of JPAC
- 2016-2018: Univ. of Glasgow

Numerous guest professorships (Adelaide, William&Mary, TU Munich....) and associateships with particle physics labs (e.g. BNL)

Publications (**> 200**) :

PDG yearly editions

Physics books - SuperB, DAPHNE, JLAB, PANDA, Physics@B-factories ....

Meson Dynamics Beyond the Quark Model: A Study of Final State Interactions

[K.L. Au](#) ([Durham U.](#)), [D. Morgan](#) ([Rutherford](#)), [M.R. Pennington](#) ([Durham U.](#)). Sep 16, 1986. 81 pp.

Published in Phys.Rev. D35 (1987) 1633 (**> 450 citations**)

## CONSTRAINTS IMPOSED ON $\pi\pi$ PARTIAL WAVES BY POSITIVITY

M. R. PENNINGTON

*Department of Physics, Westfield College, University of London*

*'Building Bridges'*



## PERTURBATIVE QCD FOR TIMELIKE PROCESSES: WHAT IS THE BEST EXPANSION PARAMETER?

M. R. PENNINGTON<sup>1</sup>

*Department of Physics, University of Durham, Durham, UK*

and

G. G. ROSS<sup>1</sup>

*Department of Theoretical Physics, University of Oxford, Oxford, UK*

BaBar-PUB-08/049  
SLAC-PUB-13323

Dalitz Plot Analysis of  $D_s^+ \rightarrow \pi^+ \pi^- \pi^+$





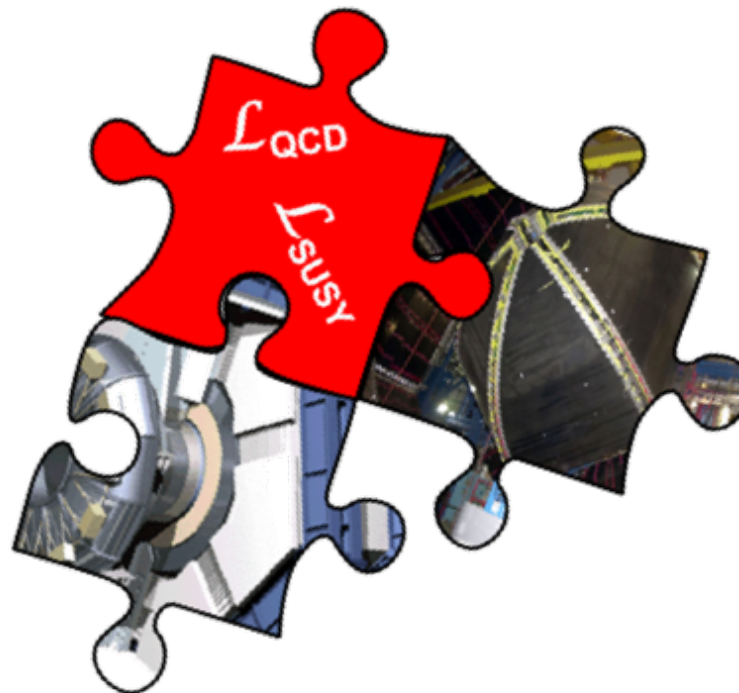
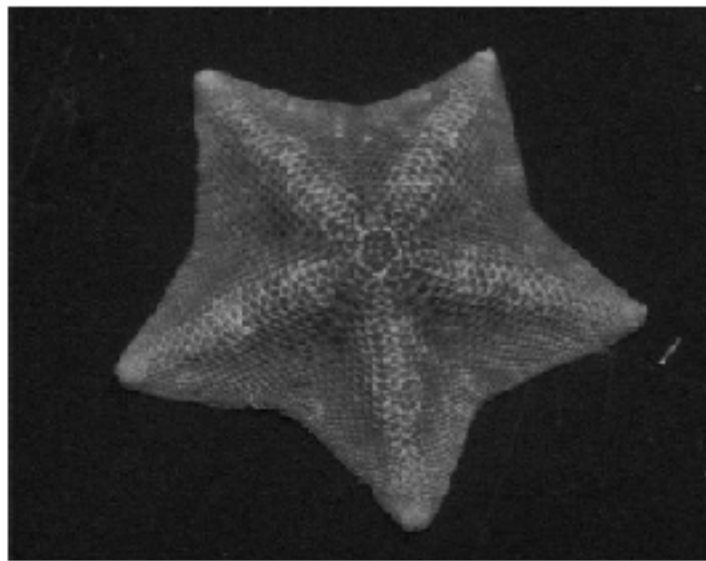
IN THE DEBRIS OF HADRON INTERACTIONS  
LIES THE BEAUTY OF QCD <sup>1</sup>

M.R. Pennington

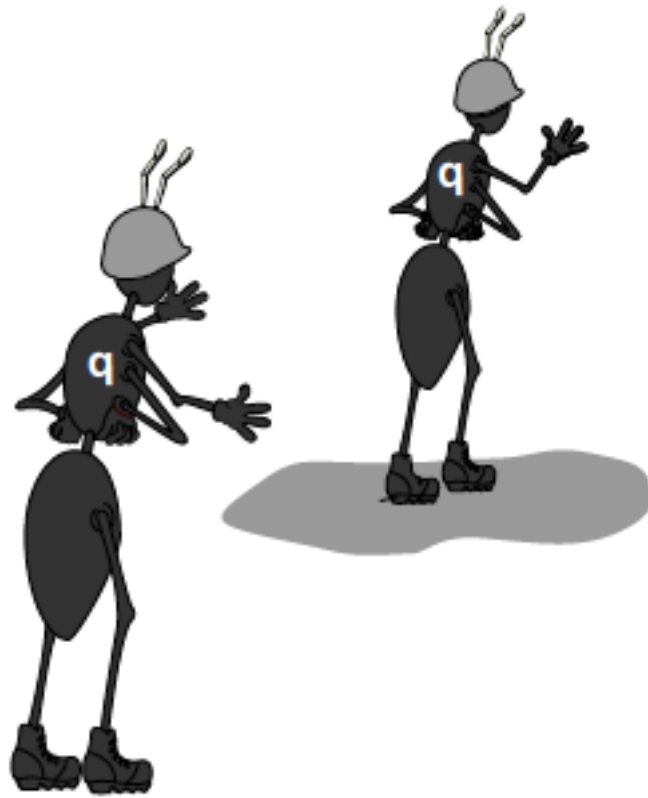
## SWIMMING WITH QUARKS

M. R. Pennington

### 2. Pentaquarks and tetraquarks



# Dyson Schwinger equations

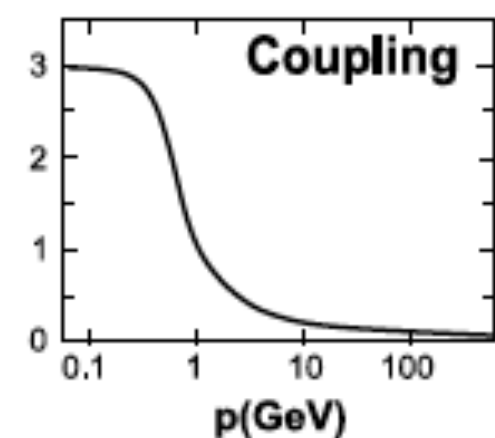
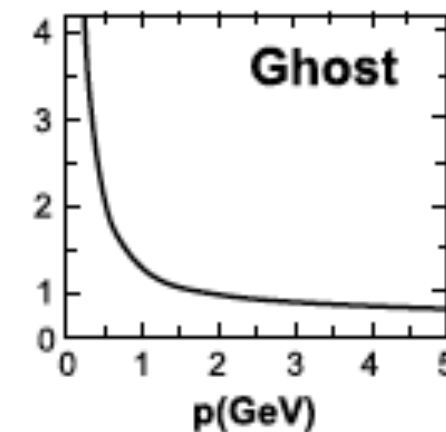
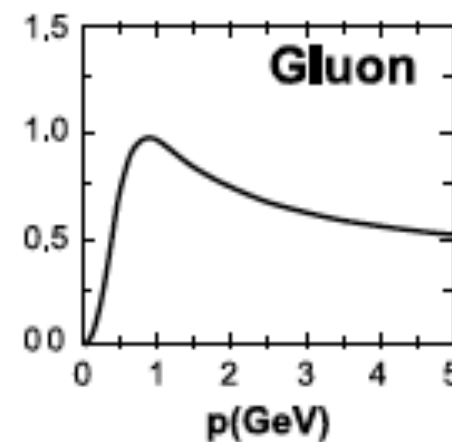


## Cornerstones of QCD

Rep. Prog. Phys., Vol. 46, pp 393–513, 1983. Printed in Great Britain

M R Pennington

Department of Physics, University of Durham, Durham DH1 3LE, UK



## Nonperturbative three-point vertex in massless quenched QED and perturbation theory constraints

A. Bashir

*Department of Physics, Quaid-i-Azam University, Islamabad, Pakistan*

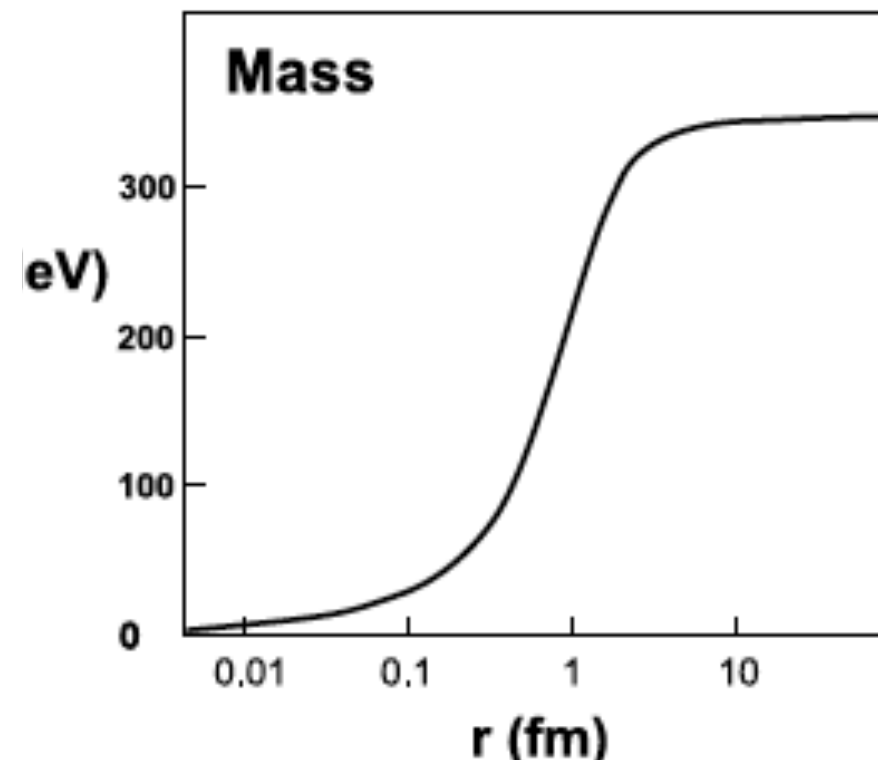
A. Kizilersü

*Department of Physics, University of Istanbul, Istanbul, Turkey*

M. R. Pennington

*Centre for Particle Theory, University of Durham, Durham DH1 3LE, United Kingdom*

*(Received 24 July 1997; published 22 December 1997)*



INDIANA UNIVERSITY



PHYSICAL REVIEW D

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1 MARCH 1987

## Meson dynamics beyond the quark model: Study of final-state interactions

K. L. Au

*Department of Physics, University of Durham, Durham, United Kingdom*

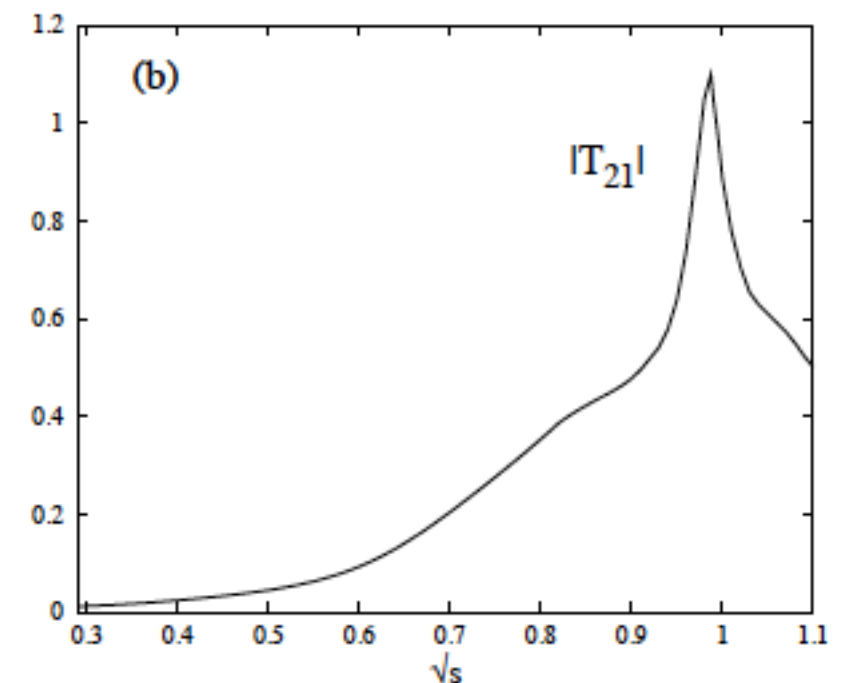
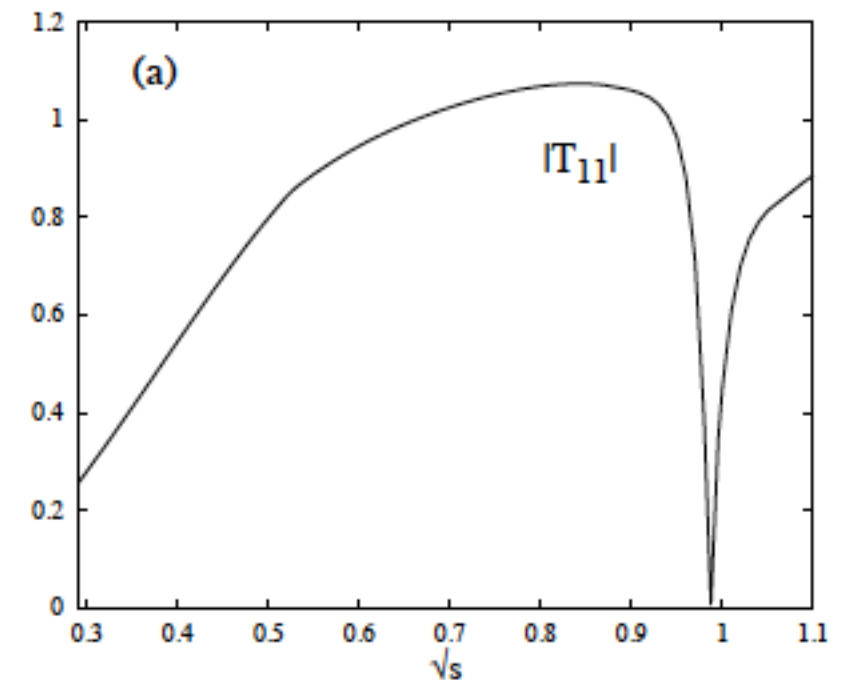
D. Morgan

*Rutherford Appleton Laboratory, Chilton, Didcot, Oxon, United Kingdom*

M. R. Pennington

*Departments of Mathematical Sciences and Physics, University of Durham, Durham, United Kingdom*

(Received 4 September 1986)



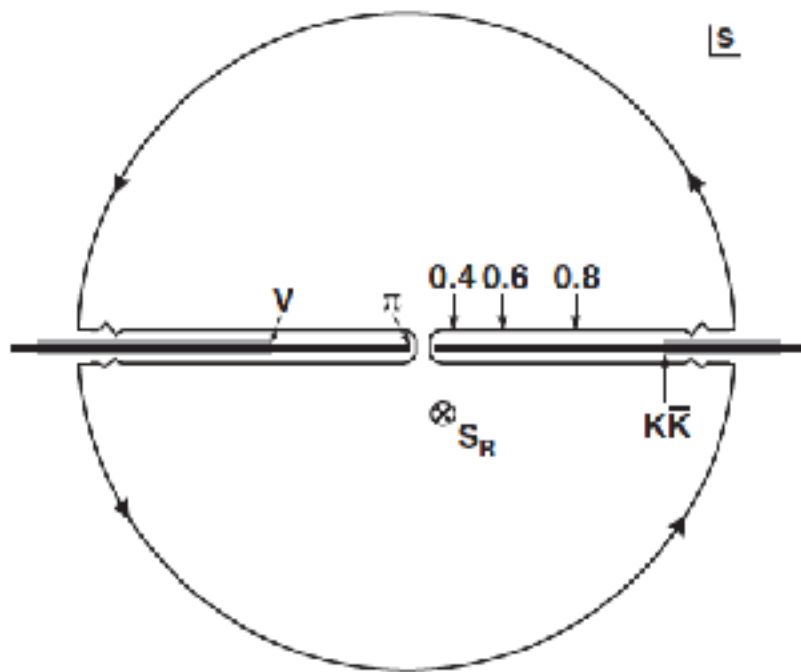
**Figure 9.** Plots (a) and (b) show the  $I = J = 0$  ReVAMP hadron amplitudes [34]  $|T(\pi\pi \rightarrow \pi\pi)|$  (labelled  $T_{11}$ ) and  $|T(\bar{K}K \rightarrow \pi\pi)|$  (labelled  $T_{21}$ ) from which  $F(s)$  is constructed, according Eq. (1), where  $\sqrt{s} = M(\pi\pi)$ , the c.m. energy.

Used in all major partial wave analyses

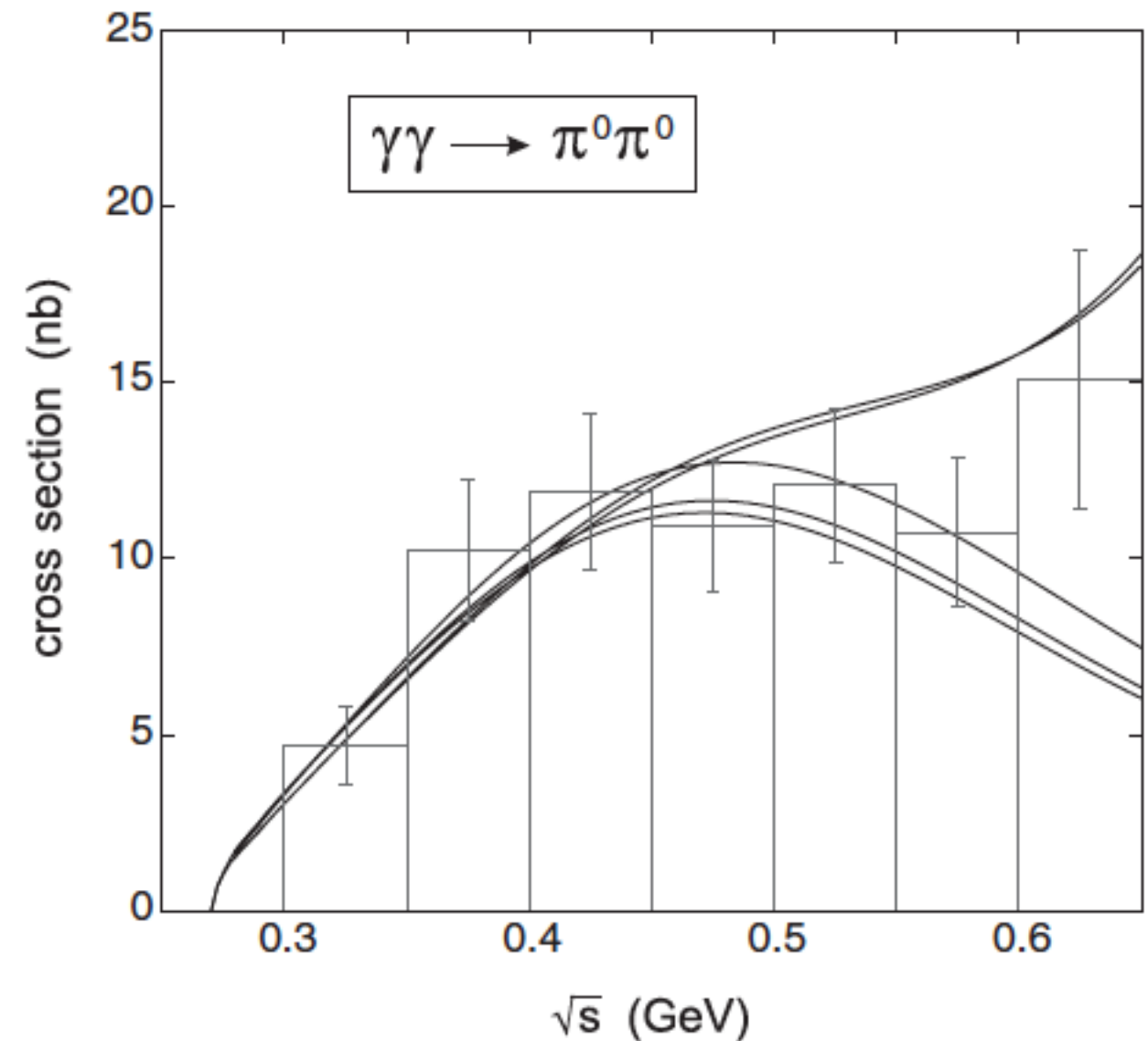
# Sigma Coupling to Photons: Hidden Scalar in $\gamma\gamma \rightarrow \pi^0\pi^0$

M. R. Pennington

PRL 97, 011601 (2006)



$$\Gamma(\sigma \rightarrow \gamma\gamma) = \frac{\alpha^2 |\rho(s_R) g_\gamma^2|}{4M_\sigma} = (4.09 \pm 0.29) \text{ keV}.$$



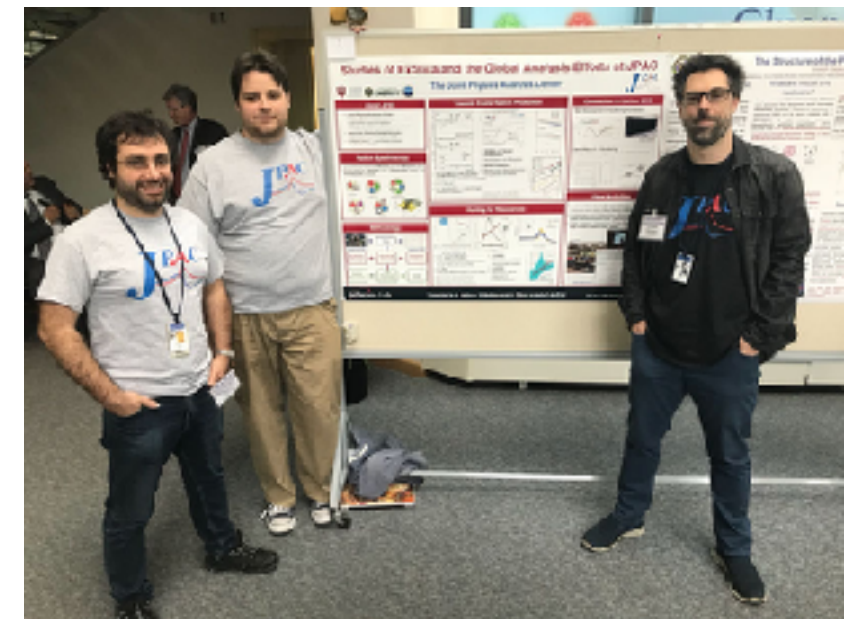
Consistent with a qq hypothesis



# Joint Physics Analysis Center

“We would joke that he was creating a Jefferson Lab hegemony by stealth. Within the Jefferson Lab theory community, he was adept at exploiting flexibility; retirements led to bridge appointments or joint appointments to expand the effective size of the Jefferson Lab theory group quite substantially. An excellent example is how Mike facilitated the establishment of the Joint Physics Analysis Center (JPAC) to enhance the collaborative efforts of the JLab Theory Center in the realm of hadronic spectroscopy”

## Hugh Montgomery, former Jefferson Lab Director





$$A(s, t) = \frac{\Gamma(-J(s))\Gamma(-J(t))}{\Gamma(-J(s) - J(t))}$$

$$\mathcal{A}_n(s, t; N) = \frac{2n - \alpha_s - \alpha_t}{(n - \alpha_s)(n - \alpha_t)} \sum_{i=1}^n a_{n,i} (-\alpha_s - \alpha_t)^{i-1} \\ \times \frac{\Gamma(N+1 - \alpha_s)\Gamma(N+1 - \alpha_t)}{\Gamma(N+1 - n)\Gamma(N+n+1 - \alpha_s - \alpha_t)}$$

