AD POLOSA

NEW AND OLD SPECTROSCOPY PROBLEMS: PRODUCTION OF X(3872) AT THE LHC

X(3872)

DISCOVERED BY BELLE IN 2003
CONFIRMED BY BaBar, DØ, CDF, CMS, LHCb & ATLAS!

 $pp \to X(3872)$ @CMS

PROMPT PRODUCTION

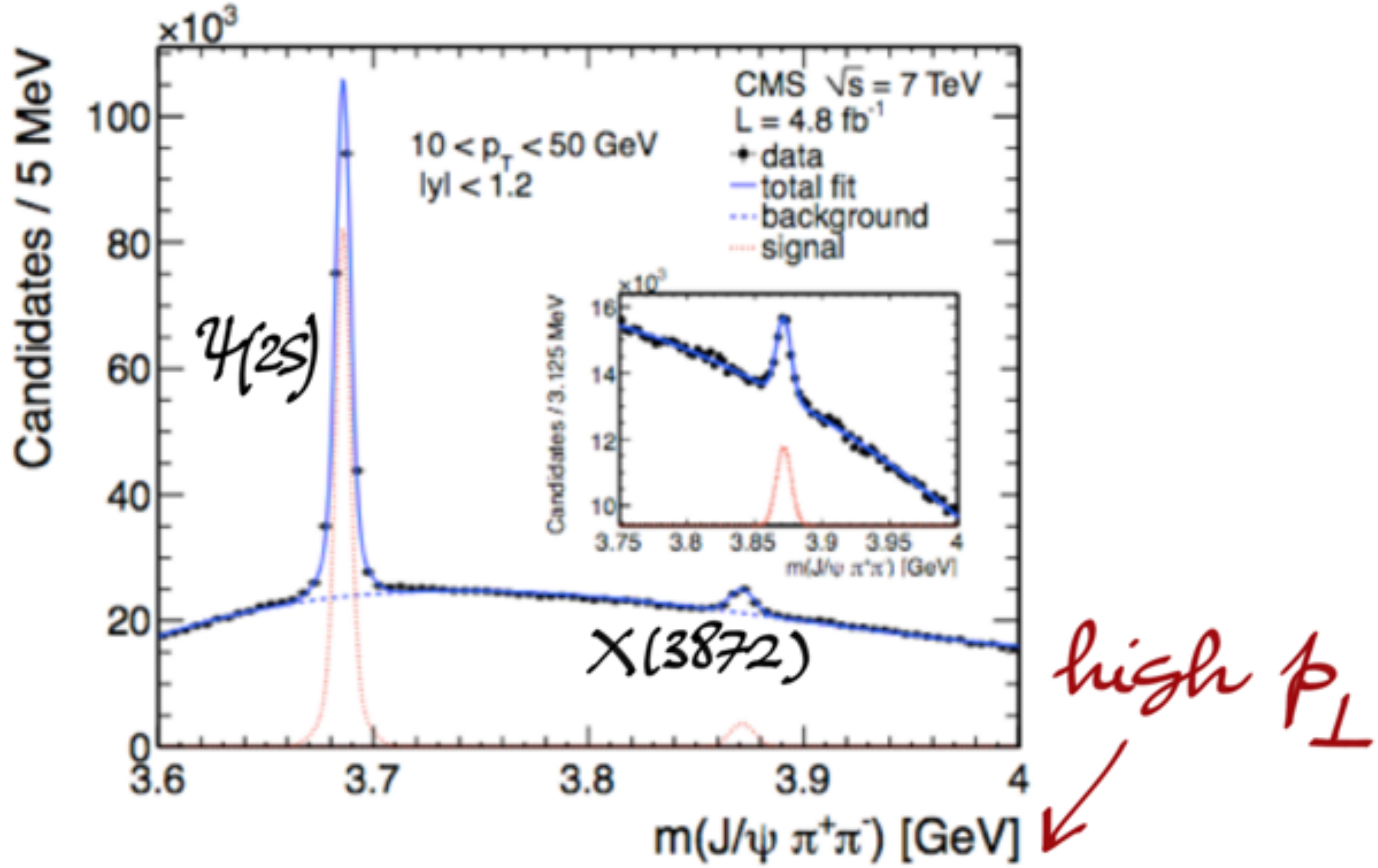
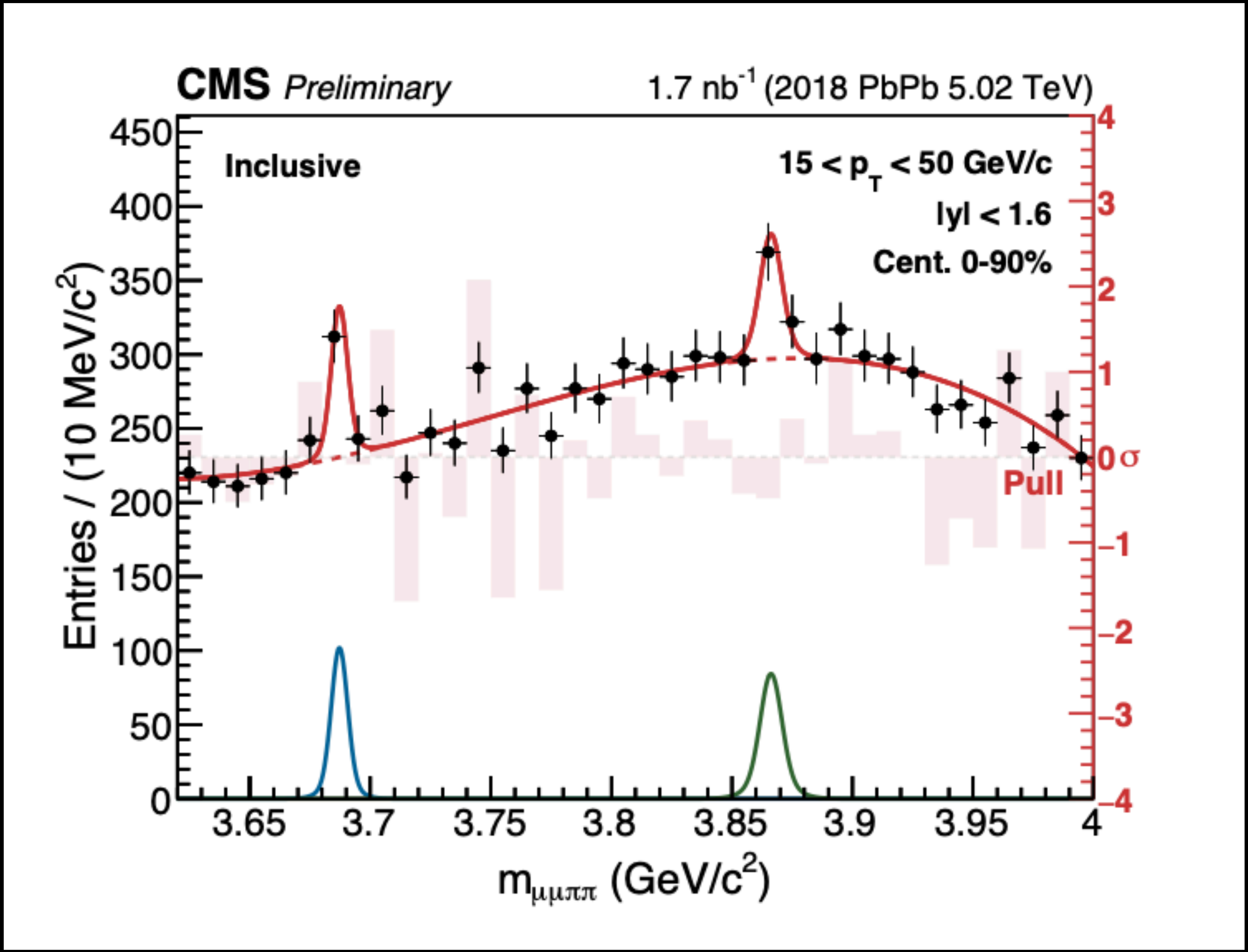


Figure 1: The $J/\psi\pi^+\pi^-$ invariant-mass spectrum for $10 < p_T < 50$ GeV and $|y| < 1.2$. The lines represent the signal-plus-background fits (solid), the background-only (dashed), and the signal-only (dotted) components. The inset shows an enlargement of the X(3872) mass region.

PRODUCTION IN PB-PB

CMS PAS HIN-19-005



LOW TRANSVERSE MOMENTUM RECOMBINATION/COALESCENCE

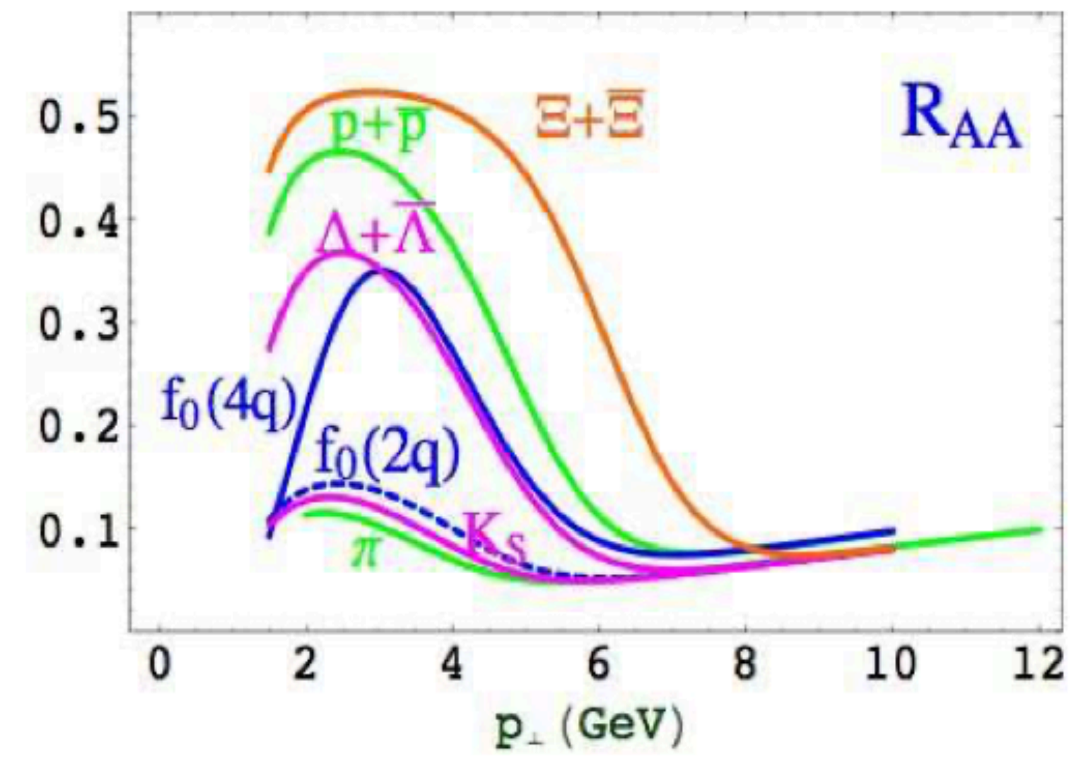


Figure 7: R_{AA} for LHC using the same notation as in Fig. 5.

$$R_{AA} = \frac{d^2 N_{\mathcal{N}+\mathcal{N}}(b=0)/dp_\perp^2}{N_{\text{coll}}(b=0)\, d^2 N_{p+p}(b=0)/dp_\perp^2}$$

L. Maiani, ADP, V. Riquer and C. Salgado, PL **B645** (2007) 041901

LOW TRANSVERSE MOMENTUM RECOMBINATION

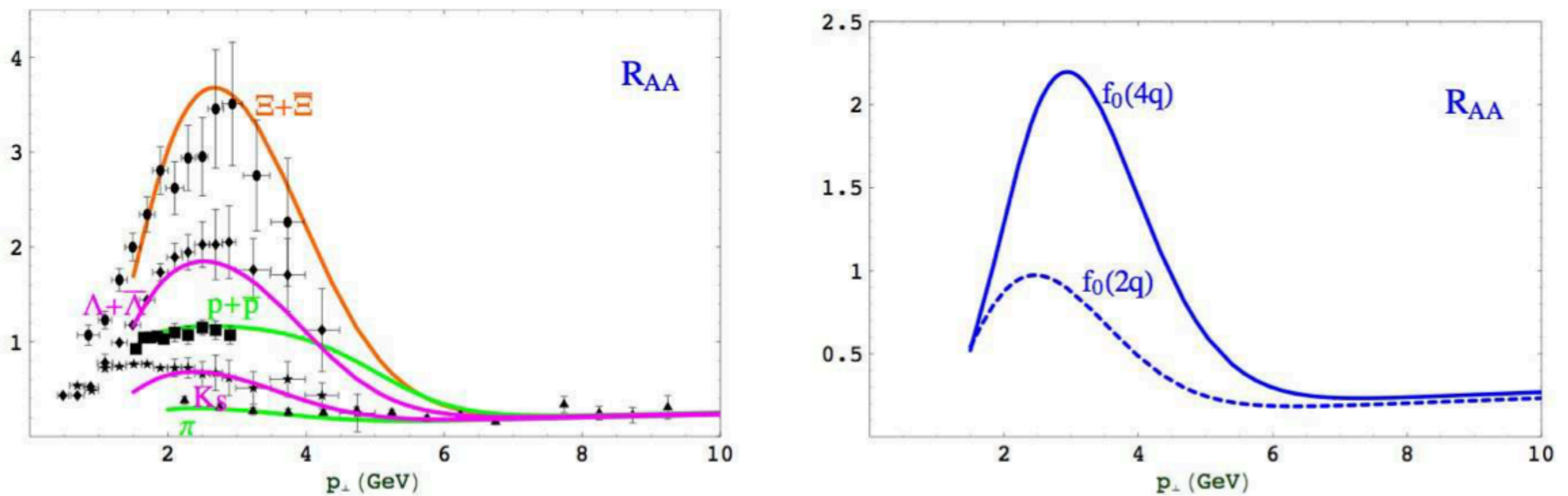


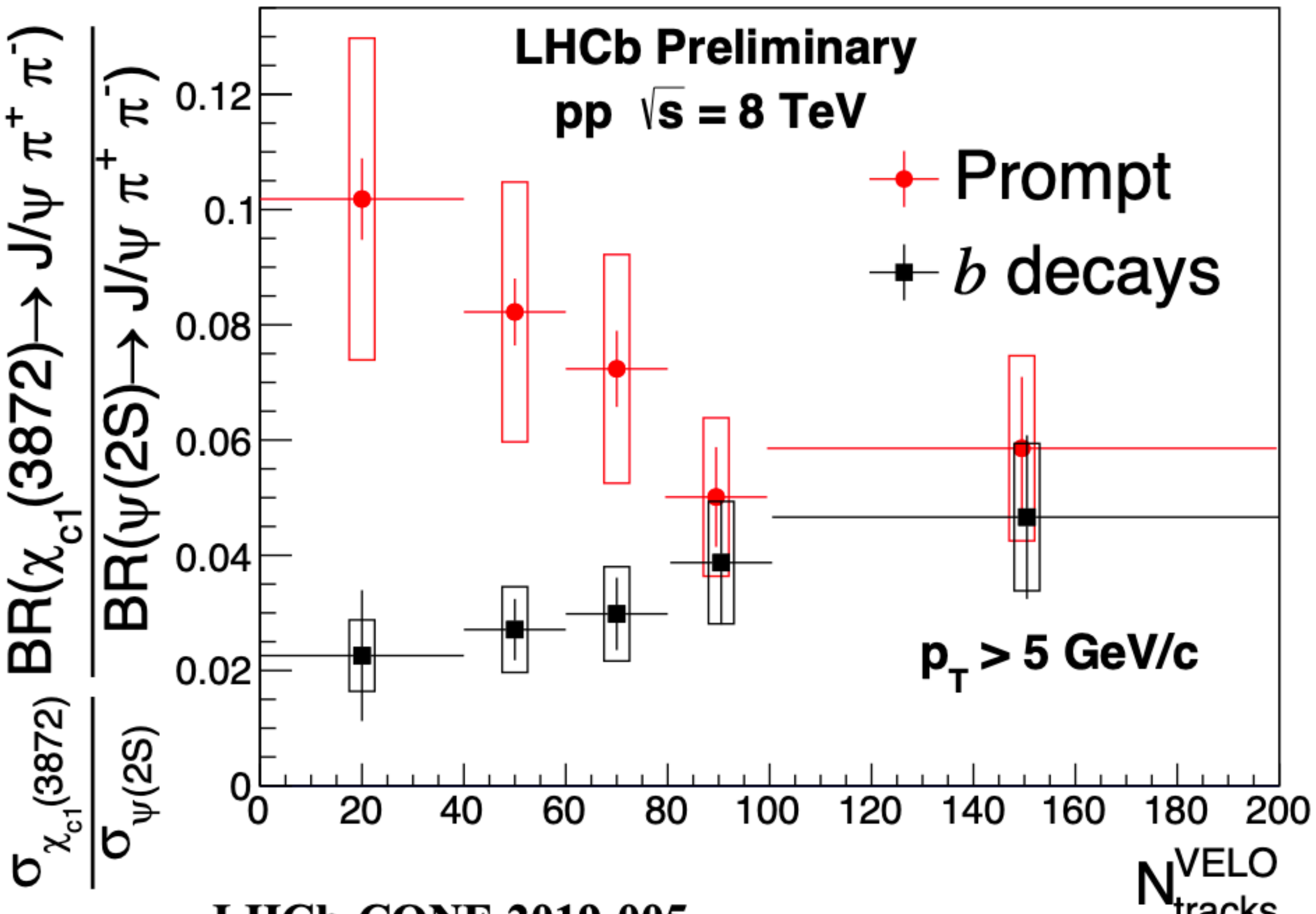
Figure 5: Starting from below: R_{AA}, Eq. (26), for π, K_S, $f_0(980)$ as a $s\bar{s}$ state, $p+\bar{p}$, $\Lambda+\bar{\Lambda}$, $f_0(980)$ as a 4-quark state and $\Xi^- + \bar{\Xi}^+$. Data from Ref. [38]. STAR Collab.

L. Maiani, ADP, V. Riquer and C. Salgado, PL **B645** (2007) 041901

ANOTHER STRANGE FACT ABOUT THE X

Ratio of cross sections

$$\frac{\sigma_{\chi_{c1}(3872)}}{\sigma_{\psi(2S)}} \times \frac{\mathcal{B}[\chi_{c1}(3872) \to J/\psi\pi^+\pi^-]}{\mathcal{B}[\psi(2S) \to J/\psi\pi^+\pi^-]} = \frac{N_{\chi_{c1}(3872)}\, f_{\text{prompt}}^{\chi_{c1}(3872)}}{N_{\psi(2S)}\, f_{\text{prompt}}^{\psi(2S)}} \times \frac{\varepsilon_{\psi(2S)}}{\varepsilon_{\chi_{c1}(3872)}}$$

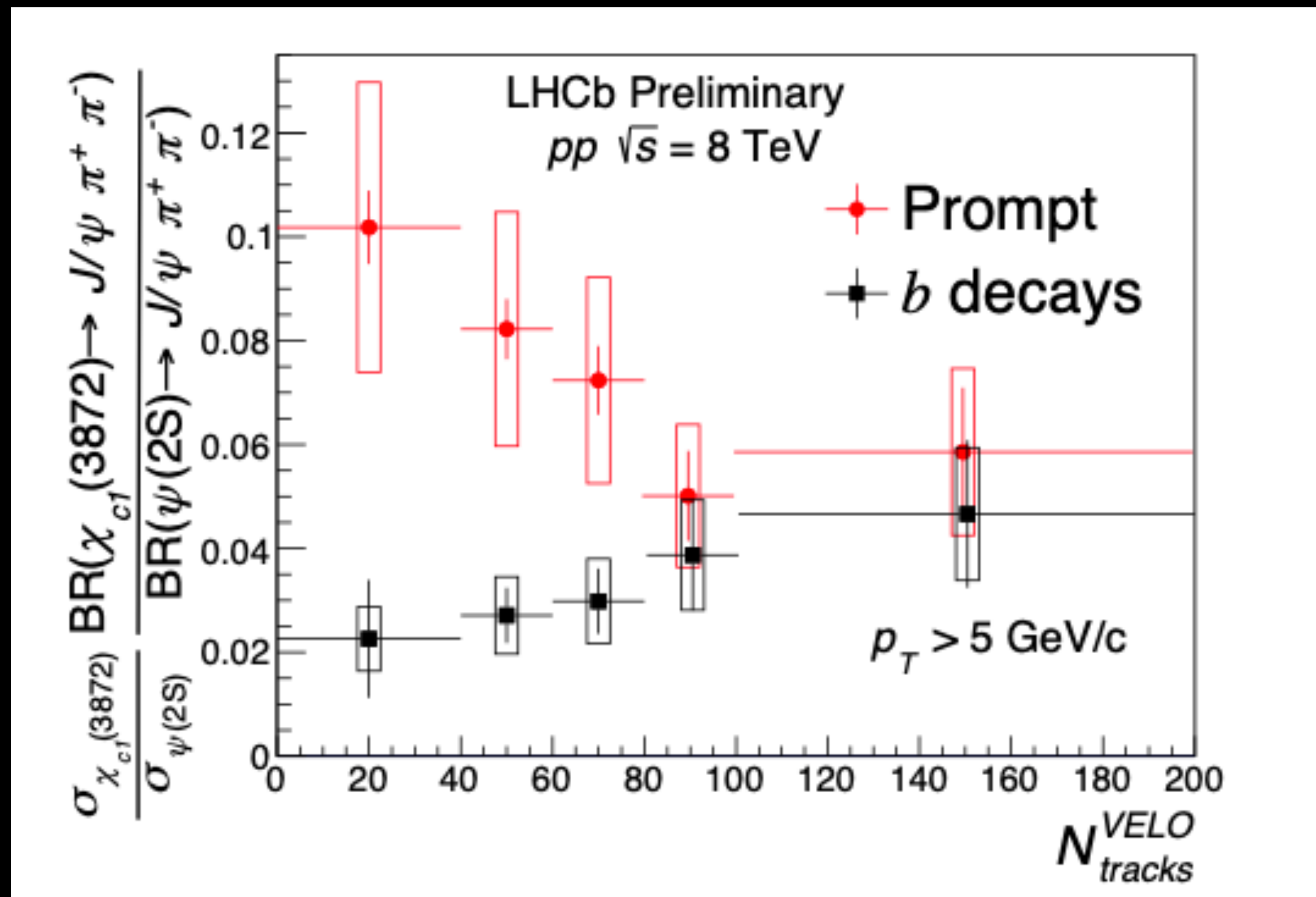


LHCb-CONF-2019-005

Prompt Component:
Increasing suppression of $X(3872)$ production relative to $\psi(2S)$ as event activity increases

***b*-decay component:**
No significant change in relative production, as expected for decays in vacuum. Ratio is set by ***b*** decay branching fractions.
Consistent with ATLAS measurement
R = 0.0395±0.0032±0.0008 (p_T>10GeV/c)
JHEP 2017:117 (2017)

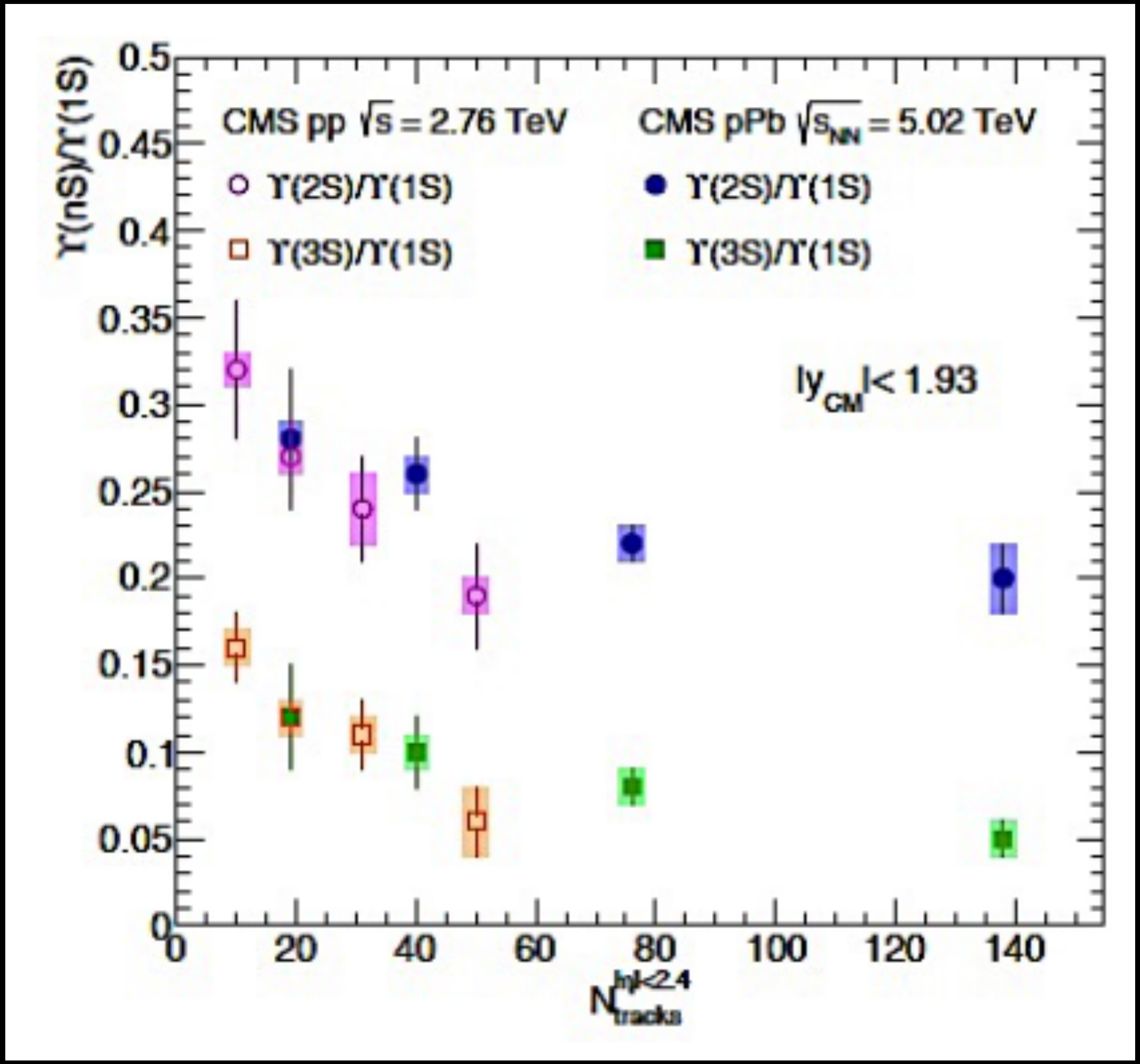
PRODUCTION AS A FUNCTION OF MULTIPLICITY (THE EXPERIMENTAL INTERPRETATION)



4. Summary and Outlook

We have found that the fraction of both $\psi(2S)$ and $\chi_{c1}(3872)$ which are produced promptly at the collision vertex decreases with increasing charged particle multiplicity in pp collisions at $\sqrt{s} = 8$ TeV. The ratio of the prompt cross sections $\sigma_{\chi_{c1}(3872)}/\sigma_{\psi(2S)}$ also decreases with multiplicity, while the ratio of cross sections from decays of B hadrons remains constant within uncertainties. This could indicate that promptly produced $\psi(2S)$ and $\chi_{c1}(3872)$ hadrons are being broken up via interactions with other particles produced in the event. These suppression more significantly affects the exotic $\chi_{c1}(3872)$ than the conventional $\psi(2S)$, which may indicate that the $\chi_{c1}(3872)$ has a smaller binding energy than the $\psi(2S)$. In this case, the $\chi_{c1}(3872)$ may be a very weakly bound state, such as a hadronic molecule.

SIMILAR RATIOS FOR QUARKONIA



COMPACT TETRAQUARKS

- Four quarks cc*qq* in a **bag** should decay into **charmonium** + meson *or* 2 x **open-charm** mesons at ~ **same rate**.
- Compact tertraquarks should have **neutral** and **charged** states.
- **No isospin violations** are expected.
- There is no stringient reason for compact tetraquarks to be particularly close to **meson-meson thresholds**.

COMPACT TETRAQUARKS: THE X(3872)

- Four quarks cc*qq* in a bag should decay into charmonium + meson *or* 2 x open-charm mesons at ~same rate.

The branching ratio of X intro DD* is ~10 times that in ψρ

- Compact tertraquarks should have neutral and charged states.

The neutral X is observed but there is no trace (yet?) of charged X's

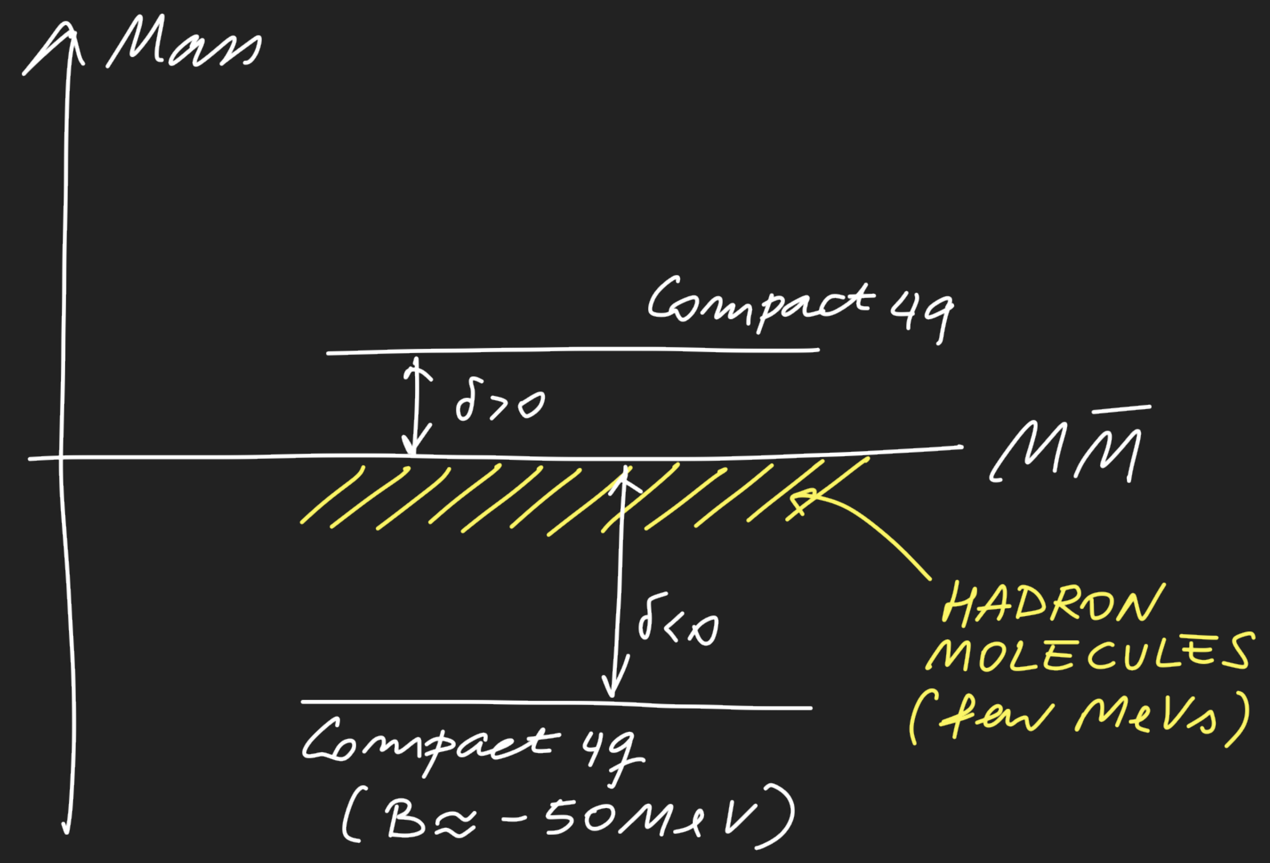
- No isospin violations are expected.

The X decays into ψρ and ψω with very similar rates

- There is no need for compact tetraquarks to be particularly close to meson-meson thresholds.

The X is an impressive example of \`fine tuning\` its mass being extremely close to DD*

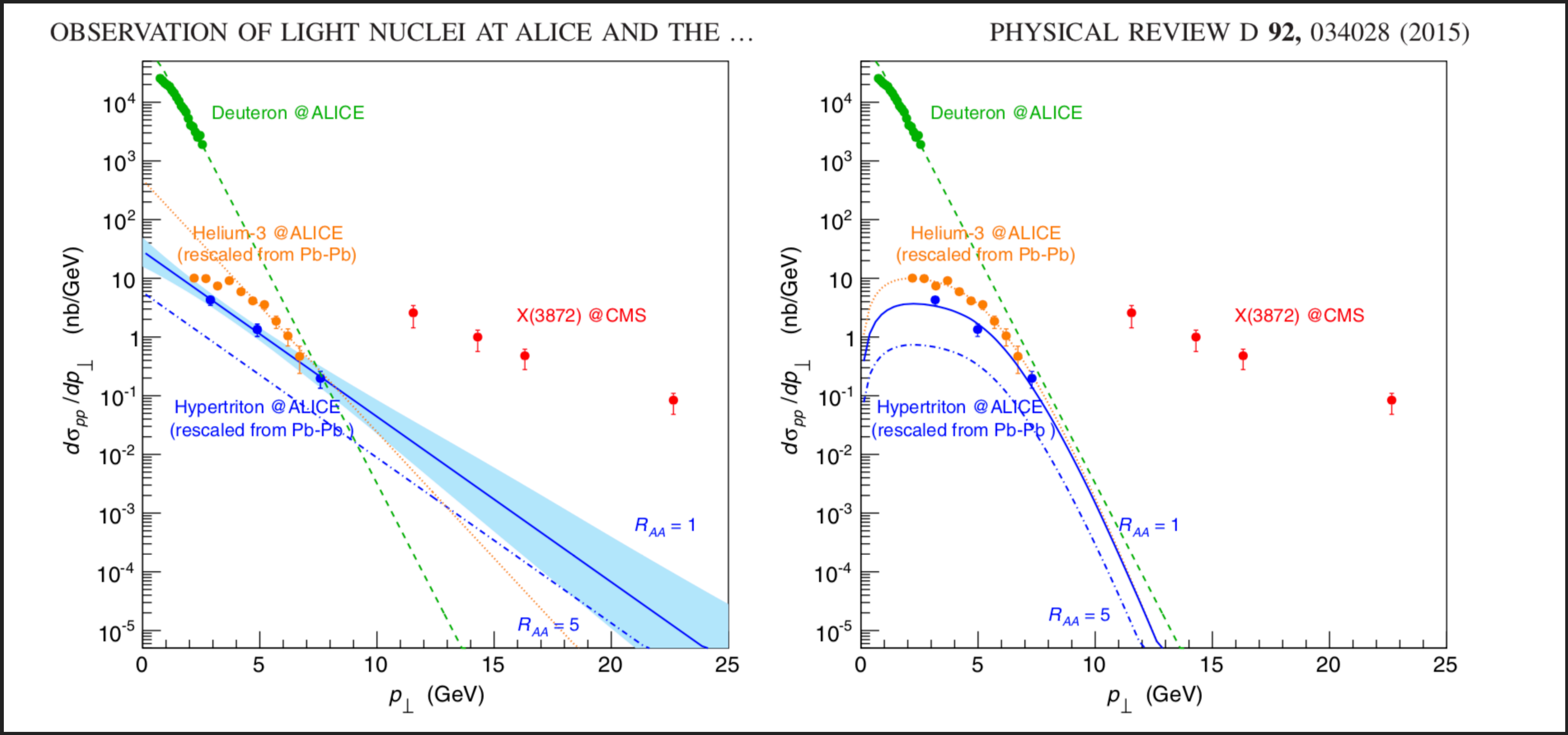
REASONS FOR COMPACT TETRAQUARKS



$X(3872)$	$Z_c^{0\pm}(3900)$	$Z_c^{0\pm}(4020)$	$Z_b^{0\pm}(10610)$	$Z_b^{0\pm}(10650)$
$D^0\bar{D}^{*0}$	$D^0\bar{D}^{*0\pm}$	$D^{*0}\bar{D}^{*0\pm}$	$B^0\bar{B}^{*0\pm}$	$B^{*0}\bar{B}^{*0\pm}$
$\delta \approx 0$	$+7.8$	$+6.7$ (MeV)	$+2.7$	$+1.8$

REASONS FOR COMPACT TETRAQUARKS

The X(3872) sort of anomalous charmonium with **1⁺⁺** quantum numbers **right at** *DD** threshold and rather close to $J/\psi+\rho$.



Esposito et al. PRD92 (2015) 034028

Bignamini, Grinstein, Piccinini, ADP, Sabelli, PRL103 (2009) 162001
Esposito, Grinstein, Maiani, Piccinini, Pilloni, ADP, Riquer, 1709.09631

A CC* COMPONENT?

$$|X\rangle = Z_1 |D^0\bar{D}^{*0}\rangle + Z_2 |\chi_{c1}(2P)\rangle + \dots$$

A predicted but not yet observed radial excitation

To explain the large prompt production Z_2 is needed as large as

$$|Z_2|^2 = 28 \div 44\ \%$$

As computed by Meng et al. PRD 97 (2017) 074014

The radius of the molecular component is

$$R \sim 1/\sqrt{2\mu |B|} \gtrsim 10 \text{ fm}$$

We might roughly expect that

$$\frac{|Z_2|^2}{|Z_1|^2} \lesssim \frac{V_{\chi_c} |\Psi_X(\bar{r})|^2}{V_{\text{mol}} |\Psi_X(\bar{R})|^2} \approx 100 \times \left(\frac{1}{10}\right)^3 \approx 0.1$$

A CC* COMPONENT?

Only two states mixed (for some reason…)

$$|X\rangle = \cos\varphi\,|D^0\bar{D}^{*0}\rangle + \sin\varphi\,|\chi_{c1}(2P)\rangle$$

$$\tan 2\varphi \sim 2\frac{\langle D\bar{D}^*|H_I|\chi\rangle}{M_{D\bar{D}^*} - M_\chi}$$

A 50-50 mixing is guaranteed if the mass of the molecule is equal to the mass of the charmonium state. At any rate

$$|\langle D\bar{D}^*|H_I|\chi\rangle|^2 \sim V_\chi |\Psi_{c\bar{c}\text{ in }DD^*}(0)|^2 \sim \left(\frac{1}{10}\right)^3$$

MIXING FORMULA

$$M = \begin{pmatrix} \underbrace{\langle DD^* | H | DD^* \rangle}_{M_{DD^*}} & \langle DD^* | H | \chi \rangle \\ \langle \chi | H | DD^* \rangle & \underbrace{\langle \chi | H | \chi \rangle}_{M_\chi} \end{pmatrix} = R^T(\varphi) \cdot \begin{pmatrix} m_1 & 0 \\ 0 & m_2 \end{pmatrix} \cdot R(\varphi) = R^T \cdot M_0 \cdot R$$

$$R = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$$

$$M_{DD^*} = m_1 \cos^2\theta + m_2 \sin^2\theta \qquad M_\chi = m_1 \sin^2\theta + m_2 \cos^2\theta$$

$$\langle DD^* | H | \chi \rangle = (m_1 - m_2)\, \sin\theta \cos\theta$$

remove m_1, m_2

$$\tan 2\varphi = 2 \frac{\langle DD^* | H | \chi \rangle}{M_{DD^*} - M_\chi}$$

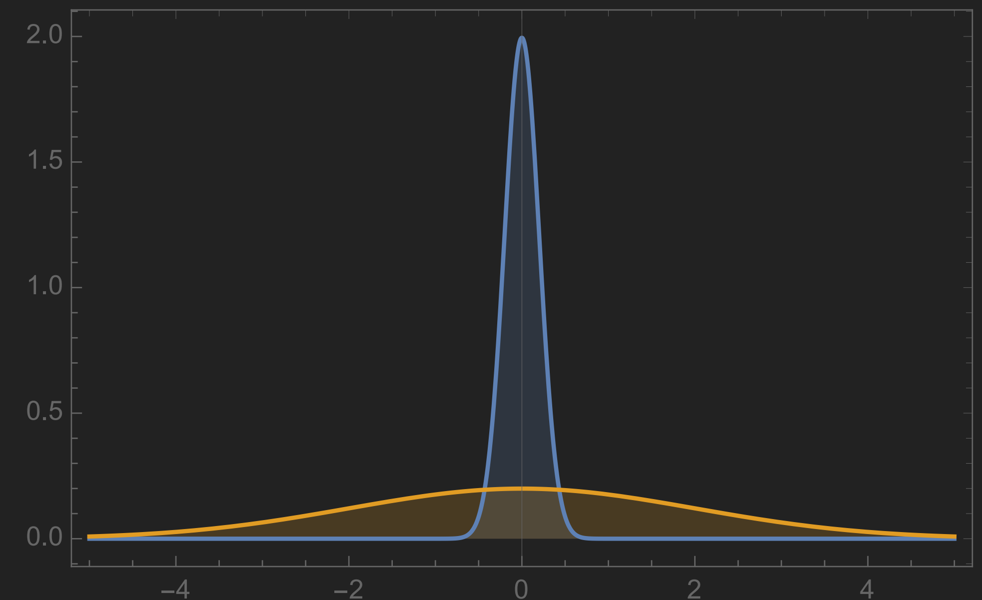
$$H = X^T M X = \begin{pmatrix} DD^* & \chi \end{pmatrix} \cdot M \cdot \begin{pmatrix} DD^* \\ \chi \end{pmatrix} = \begin{pmatrix} DD^* & \chi \end{pmatrix} \cdot (R^T M_0 R) \cdot \begin{pmatrix} DD^* \\ \chi \end{pmatrix}$$

A CC* COMPONENT?

$$|Z_2|^2 = |\langle \chi | X \rangle|^2 = \int_{V_\chi} |\langle \chi | \mathbf{x} \rangle \langle \mathbf{x} | X \rangle|^2 \, d^3x \leq \int_{V_\chi} |\langle \chi | \mathbf{x} \rangle|^2 \, d^3x \int_{V_\chi} |\langle \mathbf{x} | X \rangle|^2 \, d^3x$$

The volume over which $\psi_\chi(\mathbf{x})$ is appreciably different from zero

$$= \int_{V_\chi} |\langle \mathbf{x} | X \rangle|^2 \, d^3x \leq \underbrace{|\langle \bar{\mathbf{x}} | X \rangle|^2}_{|\psi_X(\bar{\mathbf{x}})|^2} \int_{V_\chi} d^3x$$



THE MIXED STATE

What about the temporal evolution of a state like (?)

$$\underbrace{|X\rangle}_{\Psi(t=0)} = Z_1 \underbrace{|D^0\bar{D}^{*0}\rangle}_{\Psi_1} + Z_2 \underbrace{|\chi_{c1}(2P)\rangle}_{\Psi_2} + \dots$$

The Hamiltonian responsible for the aggregation of DD^* is not the same as the one for the p-wave quarkonium. However we might roughly attempt

$$\Psi(x,t) = \sum Z_n \Psi_n e^{ip_X x} e^{-iE_n t} \quad \text{with} \quad E_n = \sqrt{M_n^2 + p_X^2}$$

Given that $p_X \geq (p_\perp)_X \gg M_n$ and taking $x \approx t$

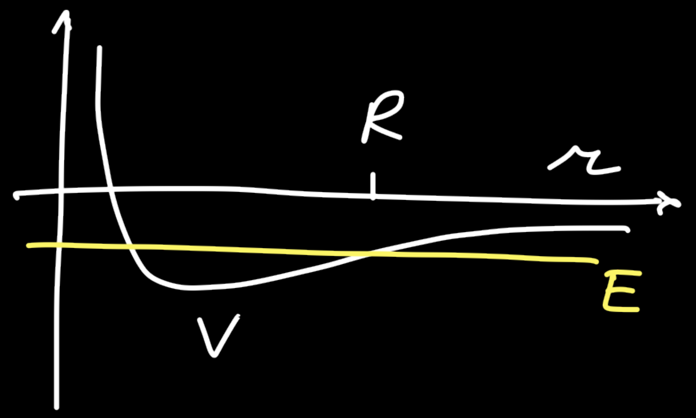
$$\Psi(t) \approx \Psi(0)$$

In the environment with several comovers, however the component Ψ_1 should get depleted along the way (before the X decays). Ψ_1 and Ψ_2 are not necessarily orthogonal - shouldn't be more appropriate a density matrix description?

$$\rho = \sum P_n [\Psi_n \Psi_n^\dagger]$$

In the quasi-classical approx. the w.f. in the classically allowed region, far from turning points is

$$\chi(r) = \frac{A}{\sqrt{p(r)}} \cos\left(\int_r^R p(r')\, dr' - \frac{\pi}{4} \right)$$



Require $\chi(0) = 0$ or

$$\int_0^R p(r)\, dr - \frac{\pi}{4} = \frac{\pi}{2} + n\pi$$

There follows

$$\frac{3}{4}\pi + n\pi = \int_0^R \sqrt{2m(E - V(r))} \simeq \int_0^R \sqrt{2m(-V(r))} > \int_0^R \sqrt{2m|E|} = R\sqrt{2m|E|}$$

SHALLOW RESIDUAL POTENTIAL

With uniform distribution between 0 and R we get

$$\langle r \rangle = \frac{1}{2} R \lesssim \frac{3\pi}{8\sqrt{2m|E|}}$$

This gives a max. for $\langle r \rangle$. Alternatively one can consider the region to the right of the (rightmost) turning point R where the wave function drops as

$$\chi(r) \simeq A \exp\left(-r\sqrt{2m|E|} \right) = A \exp\left(-\frac{r}{2\langle r \rangle} \right)$$

The binding energy $B = |E|$ of X interpreted as an hadronic molecule is $B \lesssim 3 \pm 190 \text{ KeV}$. If we assume $B \approx 100 \text{ KeV}$ we get the two compatible estimates

$$\langle r \rangle \lesssim 15 \text{ fm}$$

$$\langle r \rangle \approx 7 \text{ fm}$$

MOMENTUM DISTRIBUTION

Attractive Yukawa potential with $r_0 \sim 1/m_\pi = 1.4\ \mathrm{fm}$

$$V = -g\frac{e^{-r/r_0}}{r} \qquad g = \frac{f_{\pi N}^2}{4\pi} \qquad f_{\pi N} \approx 2.1 \text{ (deuteron)}$$

The (quantum) virial theorem gives

$$\langle 2T \rangle = \left(\Psi, \sum_{i=1}^{i=3} x_i \frac{\partial V(r)}{\partial x_i}\Psi\right) = \left(\Psi, r\frac{\partial V(r)}{\partial r}\Psi\right) = -\langle V \rangle + \frac{g}{r_0}\langle e^{-r/r_0}\rangle$$

and

$$\overline{E} = \langle T + V \rangle = -\frac{\langle p^2 \rangle}{2m} + \frac{g}{r_0}e^{-\langle r \rangle / r_0}$$

MOMENTUM DISTRIBUTION

$$\overline{E} = \langle T + V \rangle = -\frac{\langle p^2 \rangle}{2m} + \frac{g}{r_0} e^{-\langle r \rangle / r_0}$$

for the **deuteron**

$$B = |E| \simeq 2.2 \text{ MeV} \quad \langle \mathrm{r} \rangle = 2.1 \text{ fm}$$

thus

$$\sqrt{\langle p^2 \rangle} \simeq 105 \text{ MeV}$$

whereas for the X we define the **radius** of the ball $\mathscr{R}$ in momentum space to be

$$\Delta p \simeq 105 \text{ MeV}$$

The same calculation, using the known **values for the** X, gives

$$\Delta p \simeq 20 \text{ MeV}$$

PROMPT PRODUCTION

Consider the $\mathbf{p}$-dependent amplitude

$$C(\mathbf{p}) = \langle D^0 \bar{D}^{*0}(\mathbf{p}) \,|\, X \rangle$$

$$\sigma(p\bar{p} \to X + \mathrm{All}) \simeq \left| \int_{\mathscr{R}} \mathrm{C}^*(\mathbf{p}) \, \langle \mathrm{D}^0 \bar{\mathrm{D}}^{*0}(\mathbf{p}) \,|\, \mathrm{p}\bar{\mathrm{p}} \rangle \, \mathrm{d}^3\mathrm{p} \right|^2 \lesssim \int_{\mathscr{R}} |\, \mathrm{C}(\mathbf{p}) \,|^2 \, \mathrm{d}^3\mathrm{p} \int_{\mathscr{R}} |\, \langle \mathrm{D}^0 \bar{\mathrm{D}}^{*0}(\mathbf{p}) \,|\, \mathrm{p}\bar{\mathrm{p}} \rangle \,|^2 \, \mathrm{d}^3\mathrm{p}$$

$$\lesssim \int_{\mathscr{R}} |\, \langle D^0 \bar{D}^{*0}(\mathbf{p}) \; (+\mathrm{All}) \,|\, \mathrm{p}\bar{\mathrm{p}} \rangle \,|^2 \, \mathrm{d}^3\mathrm{p}$$

Where $\mathscr{R}$ is a ball of radius $\Delta p \approx 20 \ \mathrm{MeV}$ in momentum space

Bignamini, Grinstein, Piccinini, ADP, Sabelli, PRL103 (2009) 162001

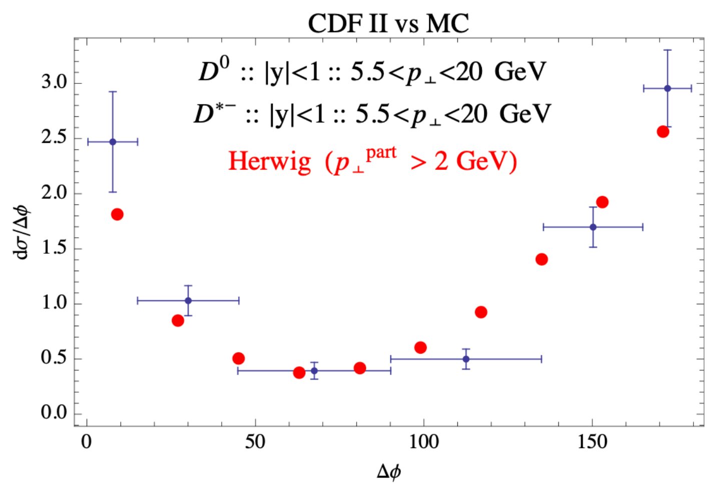


FIG. 1: The $D^0 D^{*-}$ pair cross section as function of $\Delta\phi$ at CDF Run II. The transverse momentum, $p_\perp$, and rapidity, y, ranges are indicated. Data points with error bars, are compared to the leading order event generator Herwig. The cuts on parton generation are $p_\perp^{\rm part} > 2$ GeV and $|y^{\rm part}| < 6$. We have checked that the dependency on these cuts is not significative. We find that we have to rescale the Herwig cross section values by a factor $K_{\rm Herwig} \simeq 1.8$ to best fit the data on open charm production.

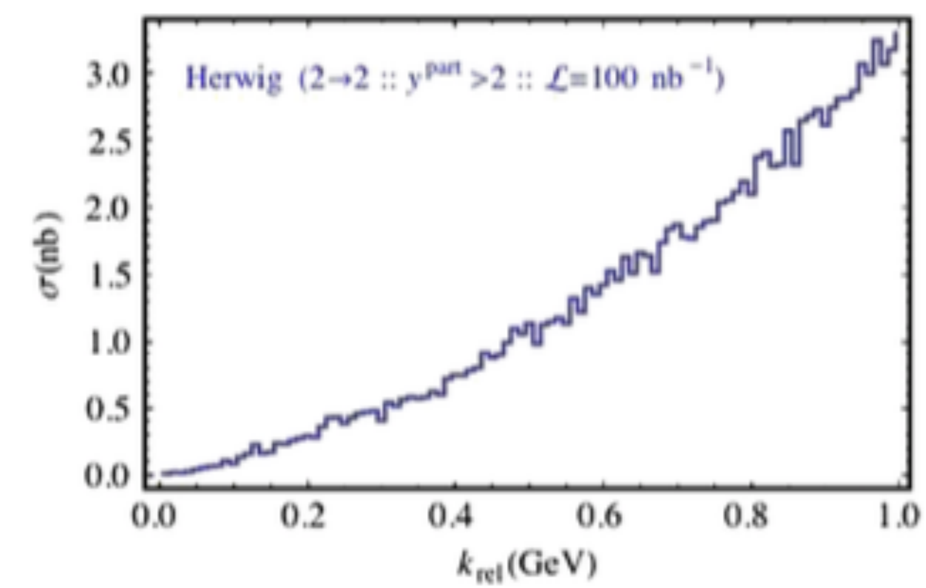
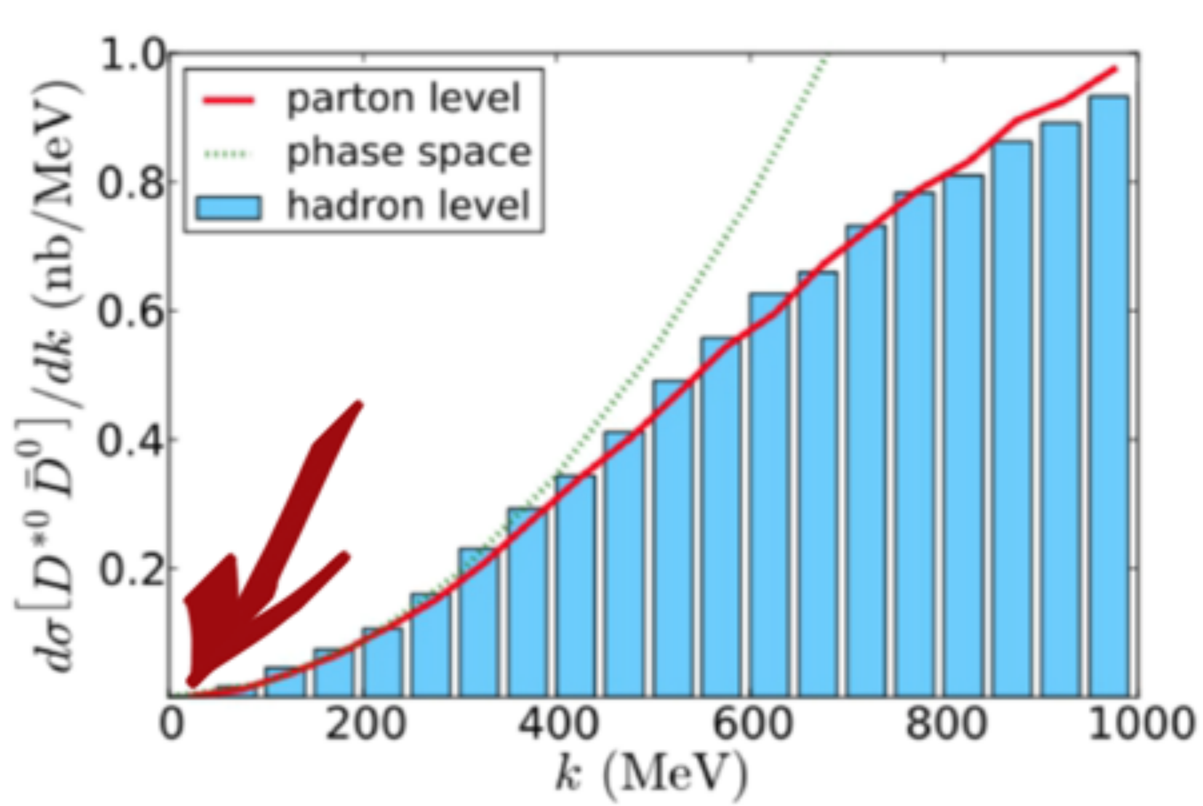


FIG. 3 (color online). The integrated cross section obtained with HERWIG as a function of the center of mass relative momentum of the mesons in the $D^0\bar{D}^{*0}$ molecule. This plot is obtained after the generation of 55×10^9 events with parton cuts $p_\perp^{\rm part} > 2$ GeV and $|y^{\rm part}| < 6$. The cuts on the final D mesons are such that the molecule produced has a $p_\perp > 5$ GeV and $|y| < 0.6$.

Bignamini, Grinstein, Piccinini, ADP, Sabelli, PRL103 (2009) 162001



Braaten and Artoisenet, PRD81103 (2010) 114018

Esposito, Piccinini, Pilloni, ADP
J. Mod. Phys. 4 (2013) 1569
Guerrieri, Piccinini, Pilloni, ADP
Phys. Rev. D90 (2014) 034003

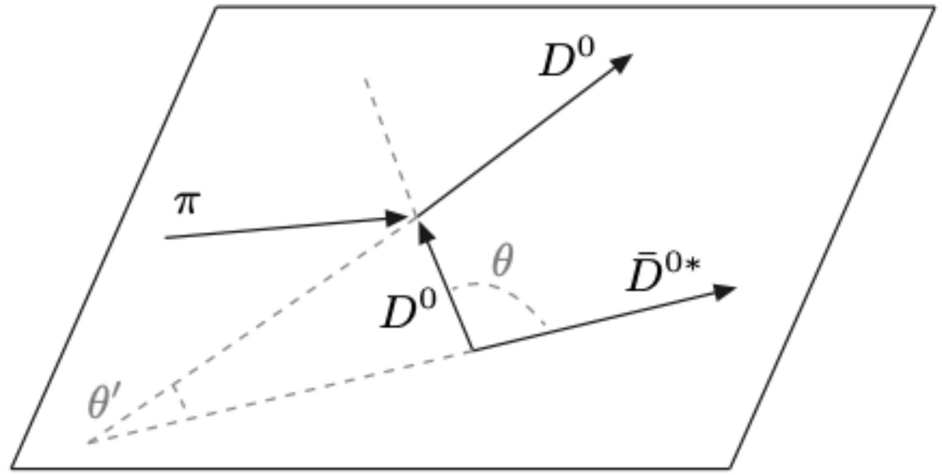


FIG. 1: The elastic scattering of a D^0 (or D^{*0}) with a pion among those produced in hadronization could reduce the relative momentum $\boldsymbol{k}_0$ in the centre of mass of the $D^0\bar{D}^{0*}$ pair.

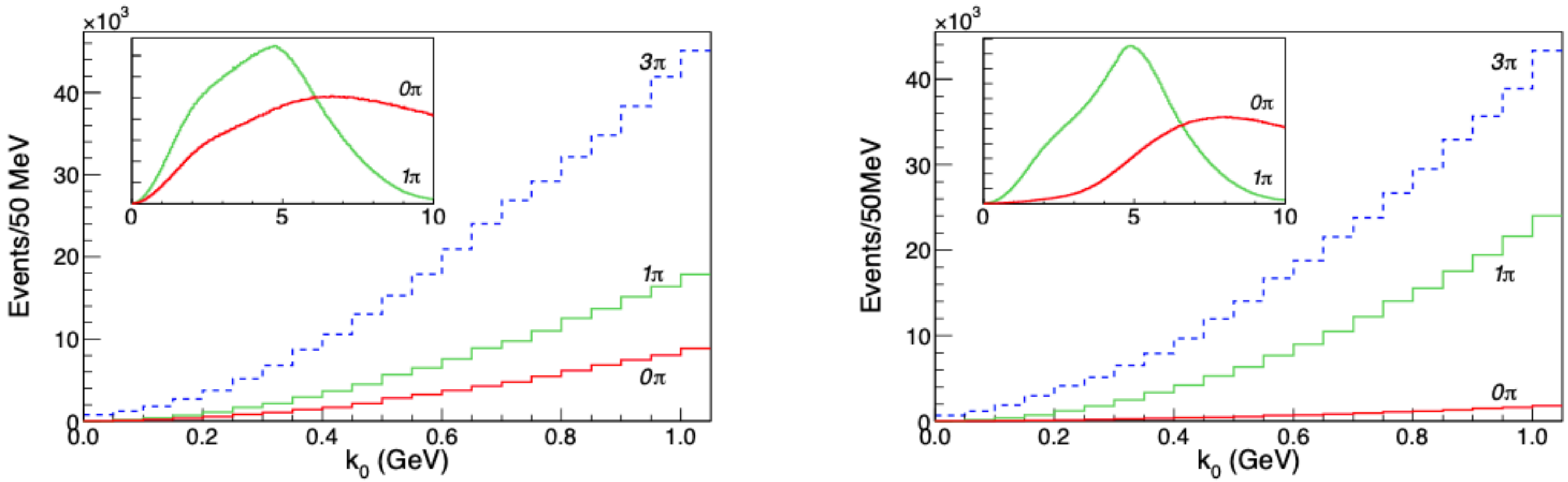


FIG. 3: Number of $D^0\bar{D}^{*0}$ pairs (events) counted with Herwig (left panel) and Pythia (right panel) when generating 10^{10} $p\bar{p} \to c\bar{c}$ events at $\sqrt{s} = 1.96$ TeV with the cuts on partons and hadrons described in the text. The 0π histogram reproduces the shape found in [2]. The histograms named 1π and 3π are related to the elastic scattering of open charm mesons with one or three pions selected as described above. In the insects we report a broader k_0 range.

DEUTERON AND MULTIPLICITY

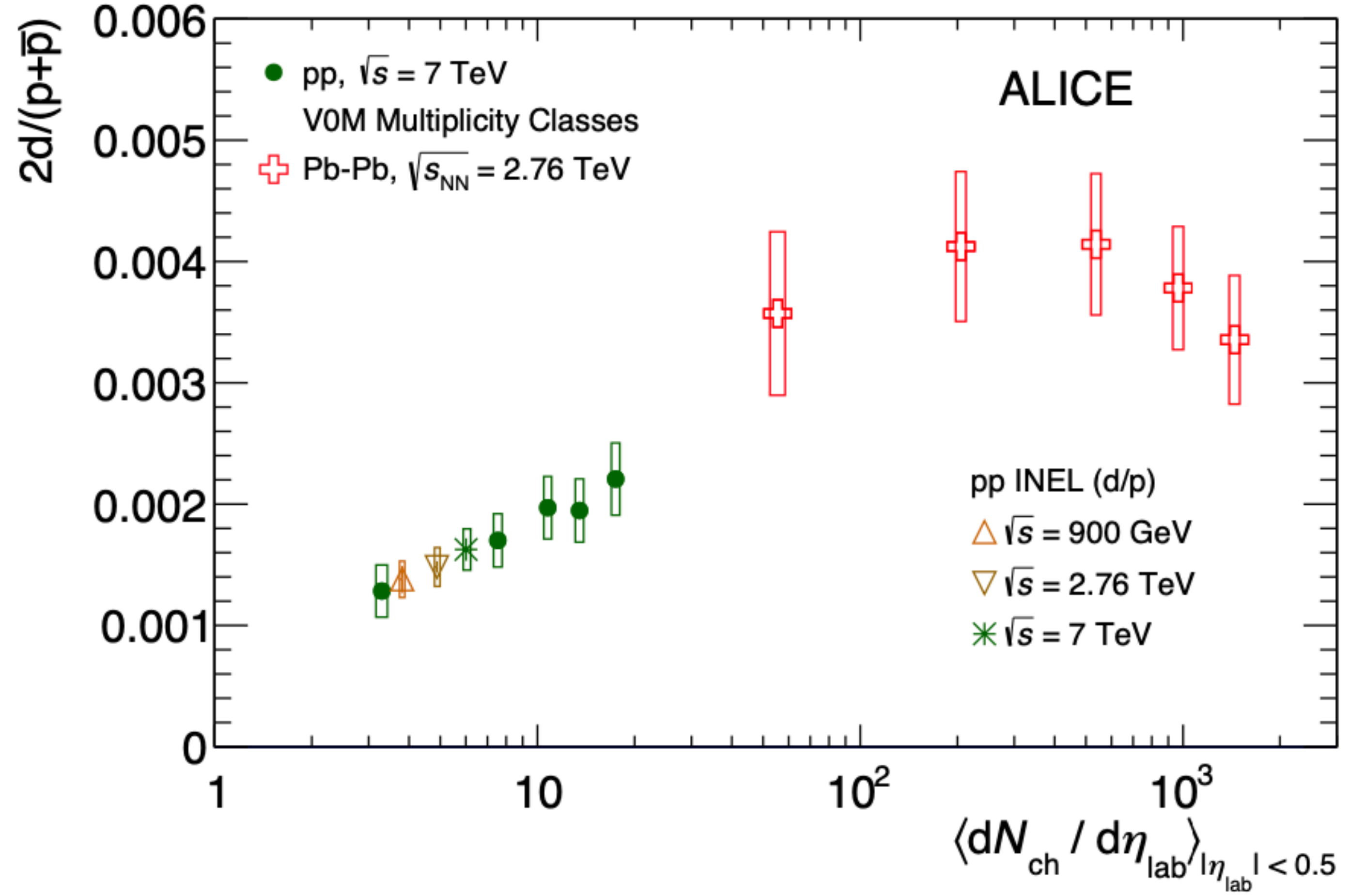


Fig. 8: Ratio between the p_T-integrated yield of deuterons and protons as a function of charged-particle multiplicity at mid-rapidity in pp (this work) and Pb–Pb collisions [12] at the LHC. The deuteron-to-proton ratio measured in inelastic pp collisions at $\sqrt{s} = 0.9, 2.76$ and 7 TeV [13] has also been reported.

COMPACT TETRAQUARKS: THE X(3872)

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The branching ratio of X intro DD* is ~10 times that in ψρ

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The neutral X is observed but there is no trace (yet?) of charged X's

- No isospin violations are expected.

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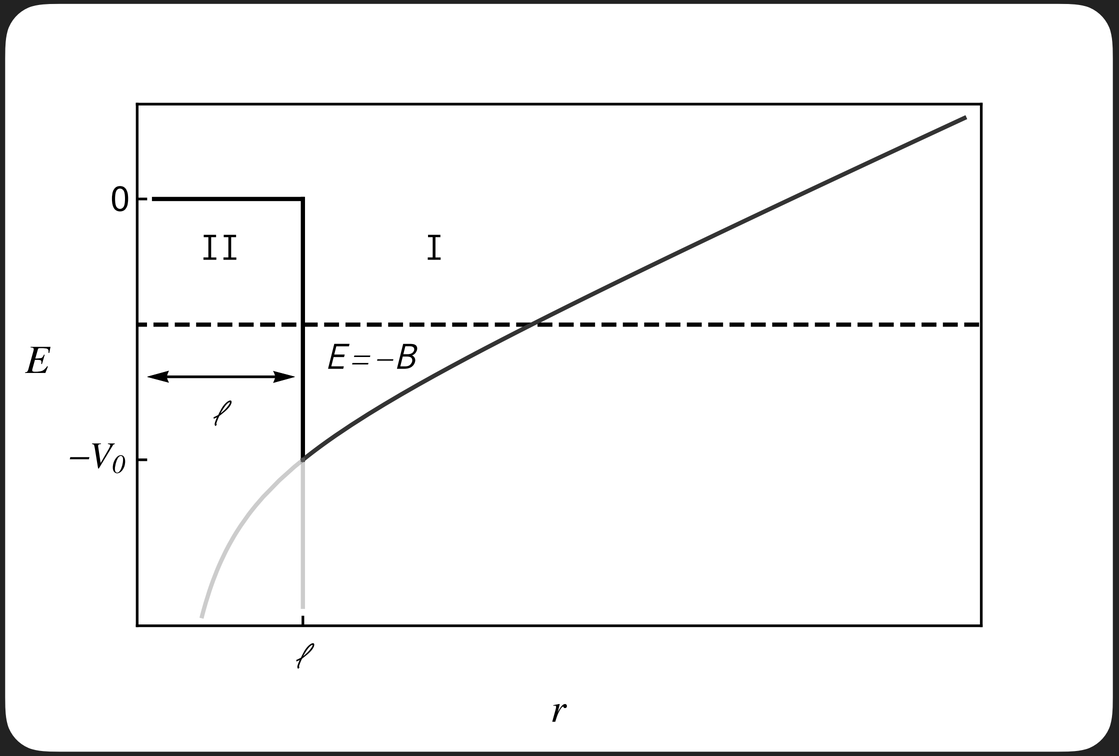
The X is an impressive example of \`fine tuning\` its mass being extremely close to DD*

METASTABILITY OF THE DIQUARK-ANTIDIQUARK STATE

A potential barrier may segregate away in space diquarks from antidiquarks.



Selem and Wilczek, hep-ph/0602128

Maiani, ADP, Riquer, PLB778 (2018) 247

Esposito, ADP, EPJ C78 (2018) 782

This would explain why ***i)*** *X(1++)* has a quasi-degenerate partner *Z(1+-)*

ii) *X* decays into $J/\psi+\rho$ with a much smaller rate than into *DD**

iii) On the basis of the barrier model we find a 'universal' width formula for *X* and *Z* states

TETRAQUARKS AS TWO LENGTH SCALE SYSTEMS

- Size of the diquark-antidiquark bound state = *R*
- Size of the diquark = *r*

There are two possible descriptions of the *X(3872)* meson

$$X = X_u = [cu][\bar{c}\bar{u}] \qquad X = X_d = [cd][\bar{c}\bar{d}]$$

Introduce the ratio

$$\lambda = R/r \geq 1$$

For appropriate values of λ, these two states can be quasi-degenerate in mass!

$$M(X_u) - M(X_d) = f(\lambda)$$

perfect degeneracy occurs for

$$\lambda \approx 3$$

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CHARGED X

The X^+ (degenerate with X_u and X_d) should decay (through barrier) into D^+D^{*0} which however is approx 5 MeV heavier than its mass value.

$$X^+ \to D^+ \bar{D}^{*0}$$

It has to be searched (like X_d) in the suppressed charmonium+meson mode.

To which extent $J/\psi + \rho^{\pm}$ final states have been experimentally investigated?

The BES charged Z_c's, being slightly heavier, are seen in meson-meson channels.

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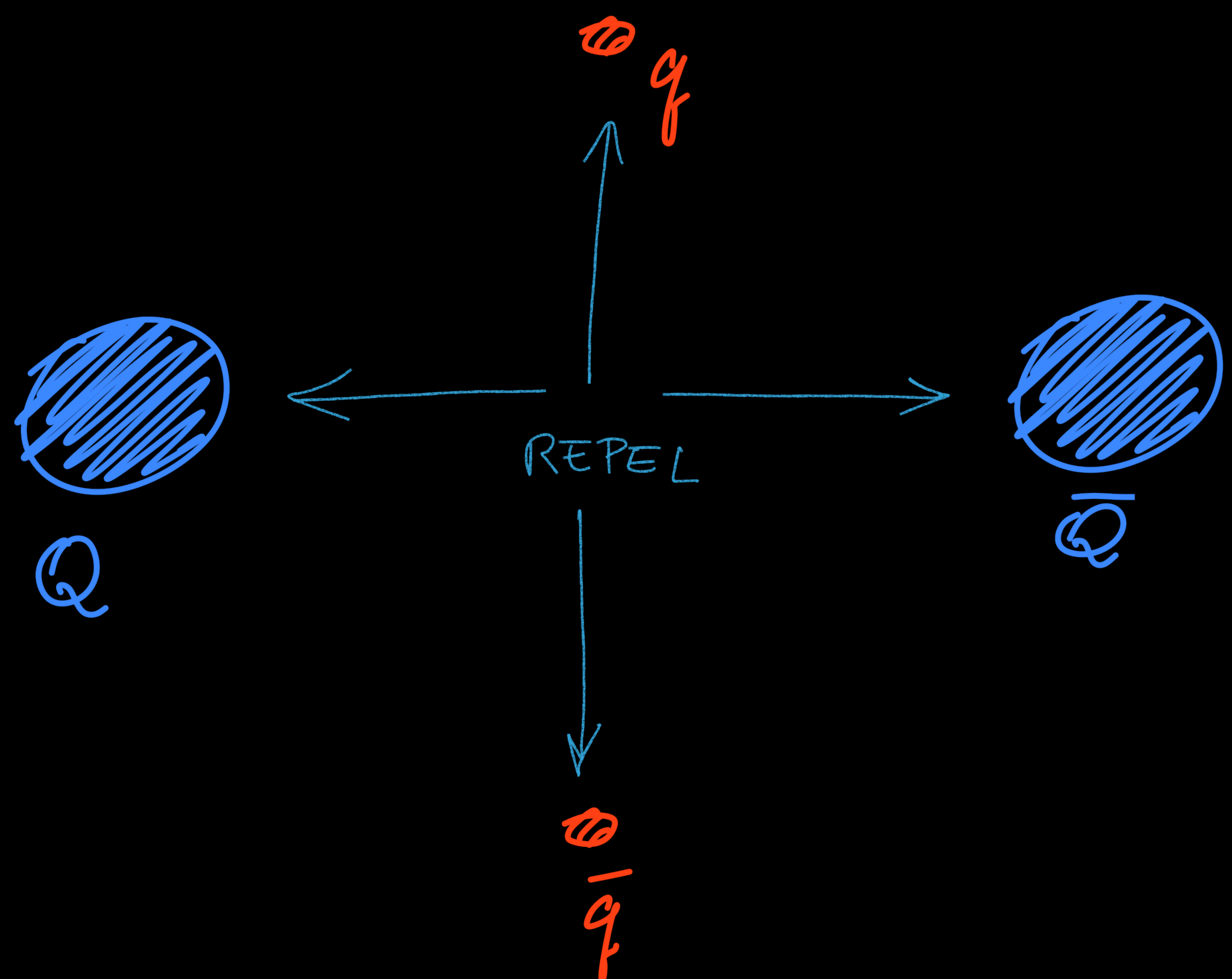
THE HYDROGEN BOND OF QCD

The analog of the H_2 molecule



Maiani, ADP, Riquer, PR **D100** 2019, 014002; PR **D100** 2019, 074002

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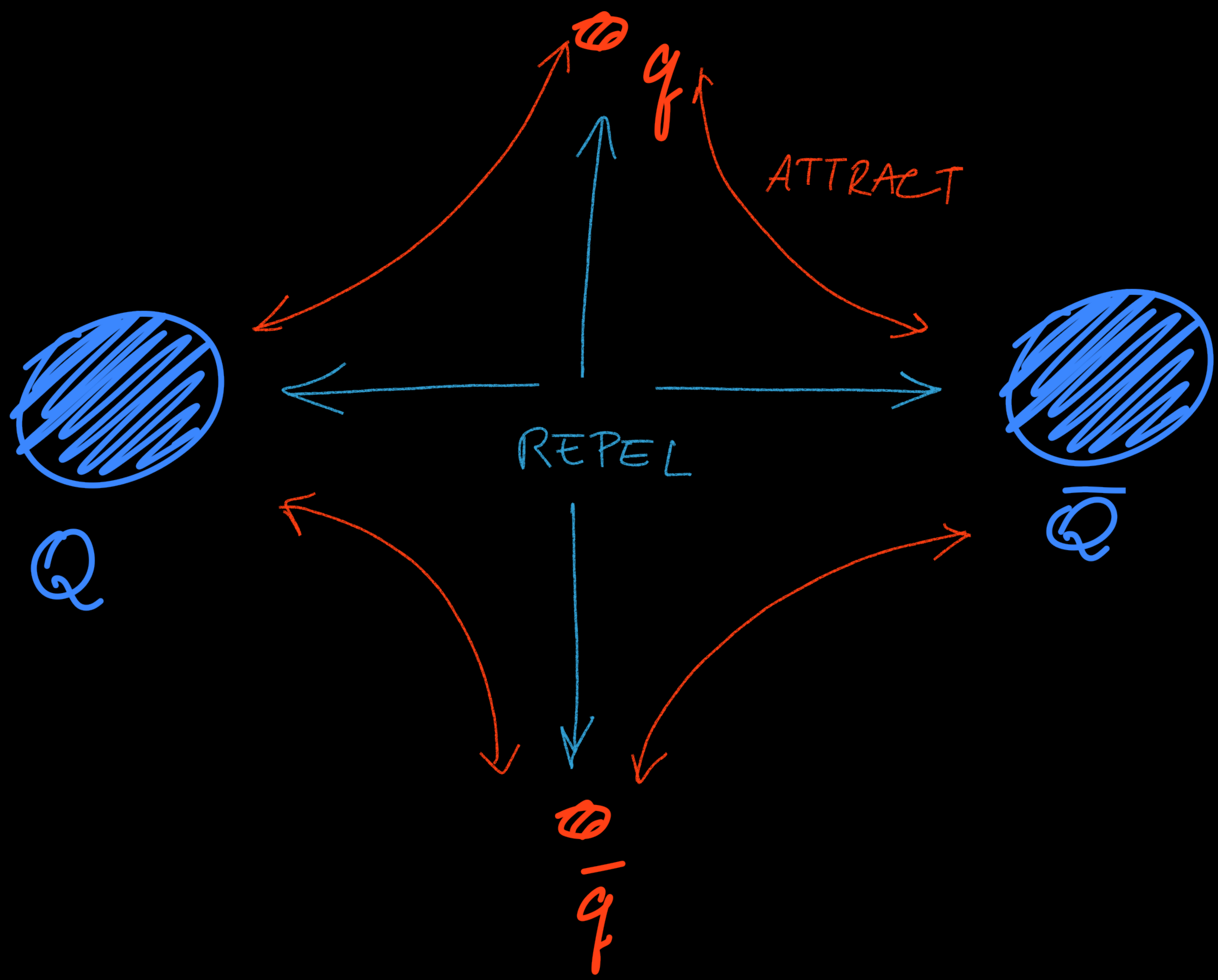

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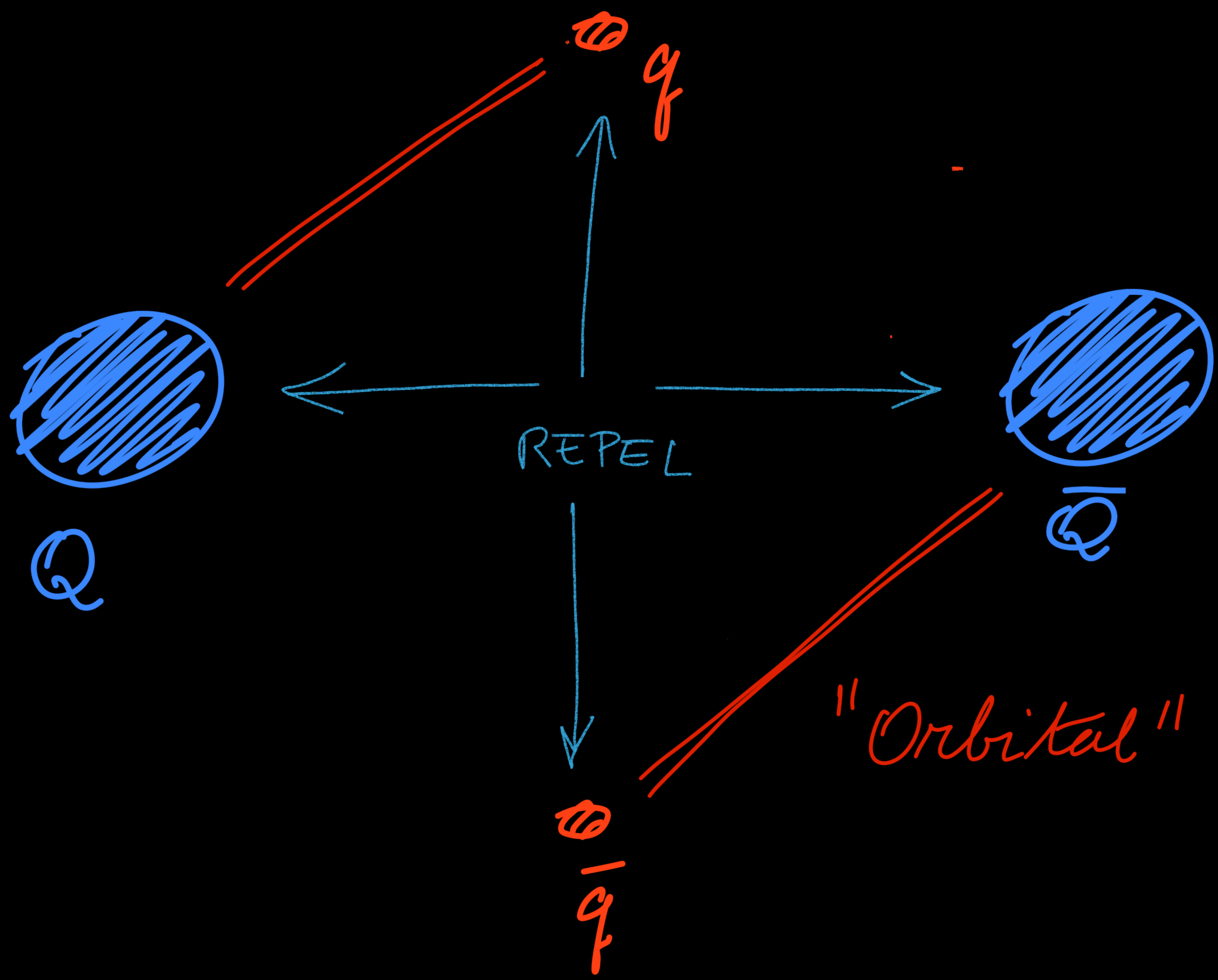


Maiani, ADP, Riquer, PR **D100** 2019, 014002; PR **D100** 2019, 074002

THE HYDROGEN BOND OF QCD

$$T = (\bar{c}\lambda^A c)(\bar{q}\lambda^A q) = (\bar{c}c)_{\mathbf{8}}(\bar{q}q)_{\mathbf{8}}$$

$$T = \sqrt{\frac{2}{3}}\,\underbrace{(cq)_{\bar{\mathbf{3}}}(\bar{c}\bar{q})_{\mathbf{3}}}_{\text{diquarks}} - \sqrt{\frac{1}{3}}\,(cq)_{\mathbf{6}}(\bar{c}\bar{q})_{\bar{\mathbf{6}}}$$

"Orbitals" cq and $\bar{c}\bar{q}$: Coulomb + Confinement ($\lambda = -1/3\,\alpha$)

"Pertubations" δH: $c\bar{q}(\bar{c}q), q\bar{q}$ ($\lambda = -7/6\,\alpha, \lambda = +1/6\,\alpha$)

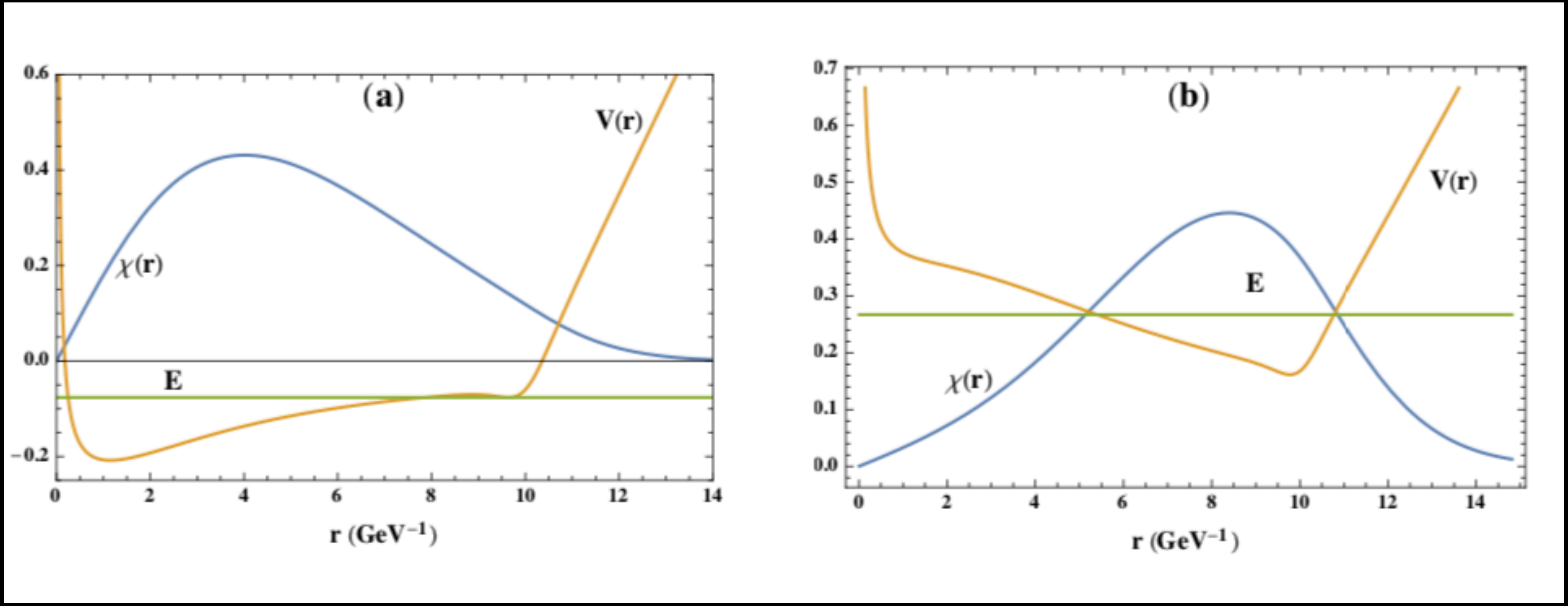
Define a *Born-Oppenheimer potential*:

Coulomb between heavy quarks + $\delta E(r_{c\bar{c}})$ + Confinement($r_{c\bar{c}}$)

Maiani, ADP, Riquer, PR **D100** 2019, 014002; PR **D100** 2019, 074002

THE ORIGIN OF THE BARRIER

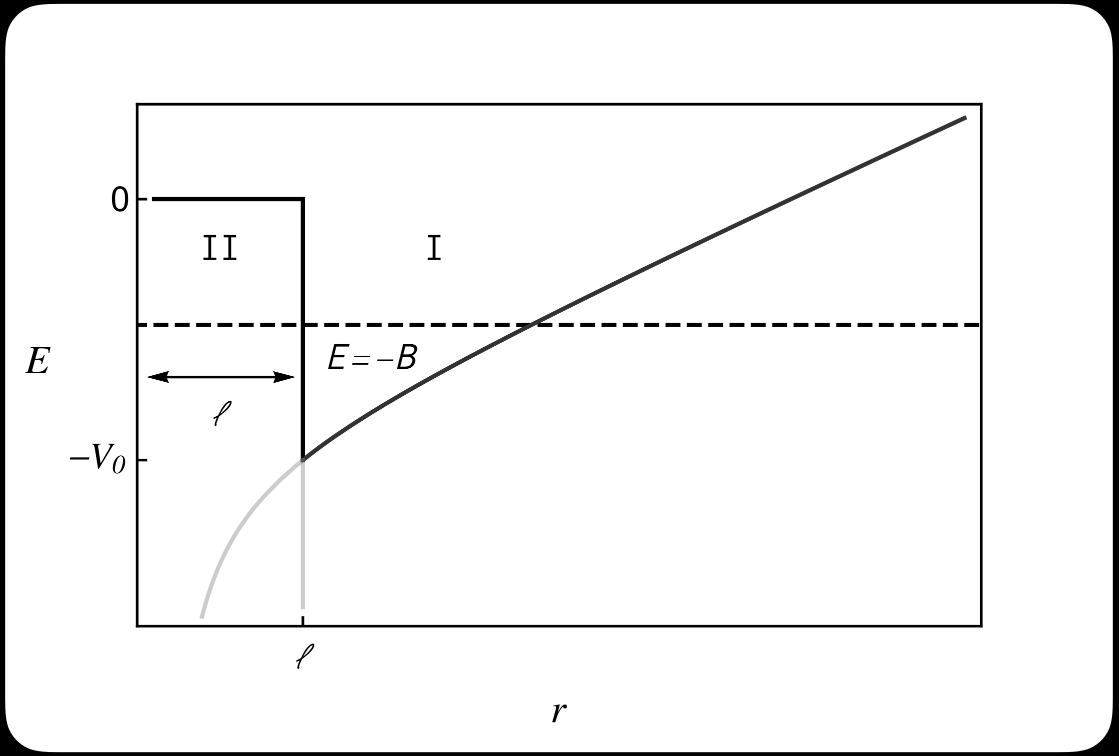
Tune all knobs — couplings computed with perturbative one-gluon exchange methods — until it is found that an increase of the repulsion in the $q\bar{q}$ channel raises a barrier between "orbitals"



A mild barrier between diquarks.

Maiani, ADP, Riquer, PR **D100** 2019, 014002; PR **D100** 2019, 074002

TUNNELING



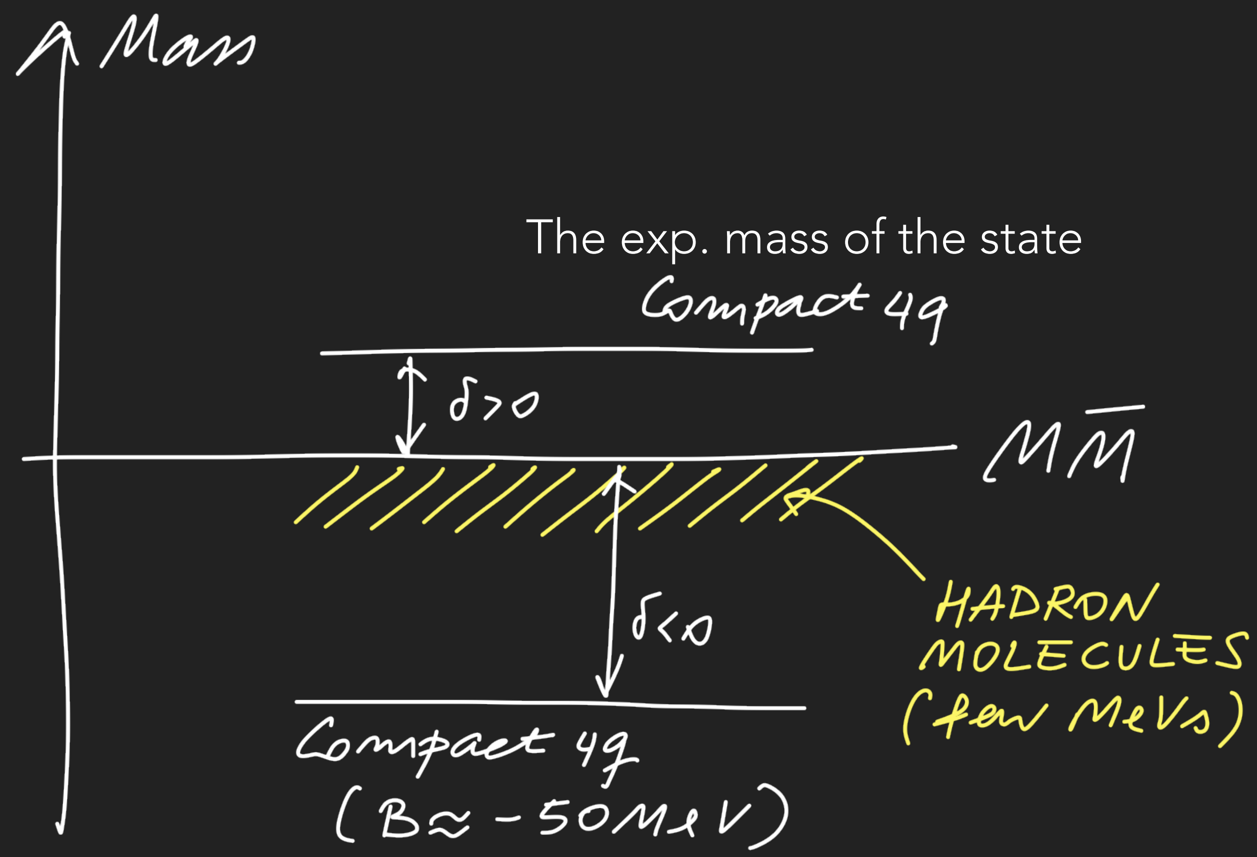
Esposito, Pilloni, ADP, PLB758 (2016) 292

Esposito, ADP, EPJ C78 (2018) 782

$$\Gamma = A\left(\frac{\sqrt{m}}{m_{dq}}, B, \ell\right)\sqrt{\delta}$$

In passing from charm to beauty states the (constituent) masses change strongly. However we would expect $B_b \simeq B_c$ and $\ell_b \lesssim \ell_c$. Thus we would guess $A_b \neq A_c$

REASONS FOR COMPACT TETRAQUARKS



$X(3872)$	$Z_c^{0\pm}(3900)$	$Z_c^{0\pm}(4020)$	$Z_b^{0\pm}(10610)$	$Z_b^{0\pm}(10650)$
$D^0\bar{D}^{*0}$	$D^0\bar{D}^{*0\pm}$	$D^{*0}\bar{D}^{*0\pm}$	$B^0\bar{B}^{*0\pm}$	$B^{*0}\bar{B}^{*0\pm}$
$\delta \approx 0$	$+7.8$	$+6.7$	$+2.7$	$+1.8$

(MeV)

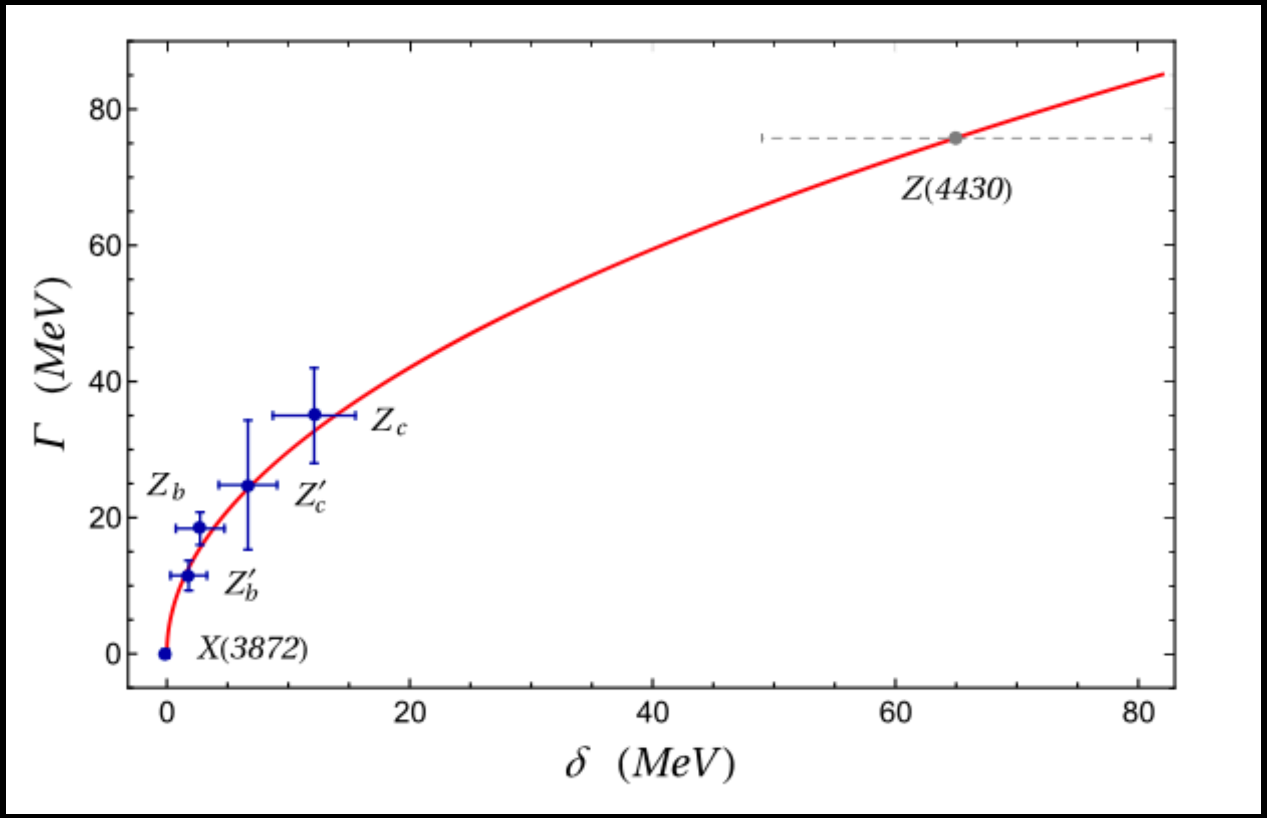
TUNNELING

$$\Gamma = A\left(\frac{\sqrt{m}}{m_{dq}}, B, \ell\right)\sqrt{\delta}$$

Esposito, Pilloni, ADP, PLB758 (2016) 292

Esposito, ADP, EPJ C78 (2018) 782

In passing from charm to beauty states the diquark masses change.
However we would expect $B_b \simeq B_c$, $\ell_b \lesssim \ell_c$. Thus we would guess $A_b \neq A_c$
But this is not what happens. The fit of beauty and charm states works very well with one A only



Esposito, Pilloni, ADP, PLB758 (2016) 292

Esposito, ADP, EPJ C78 (2018) 782

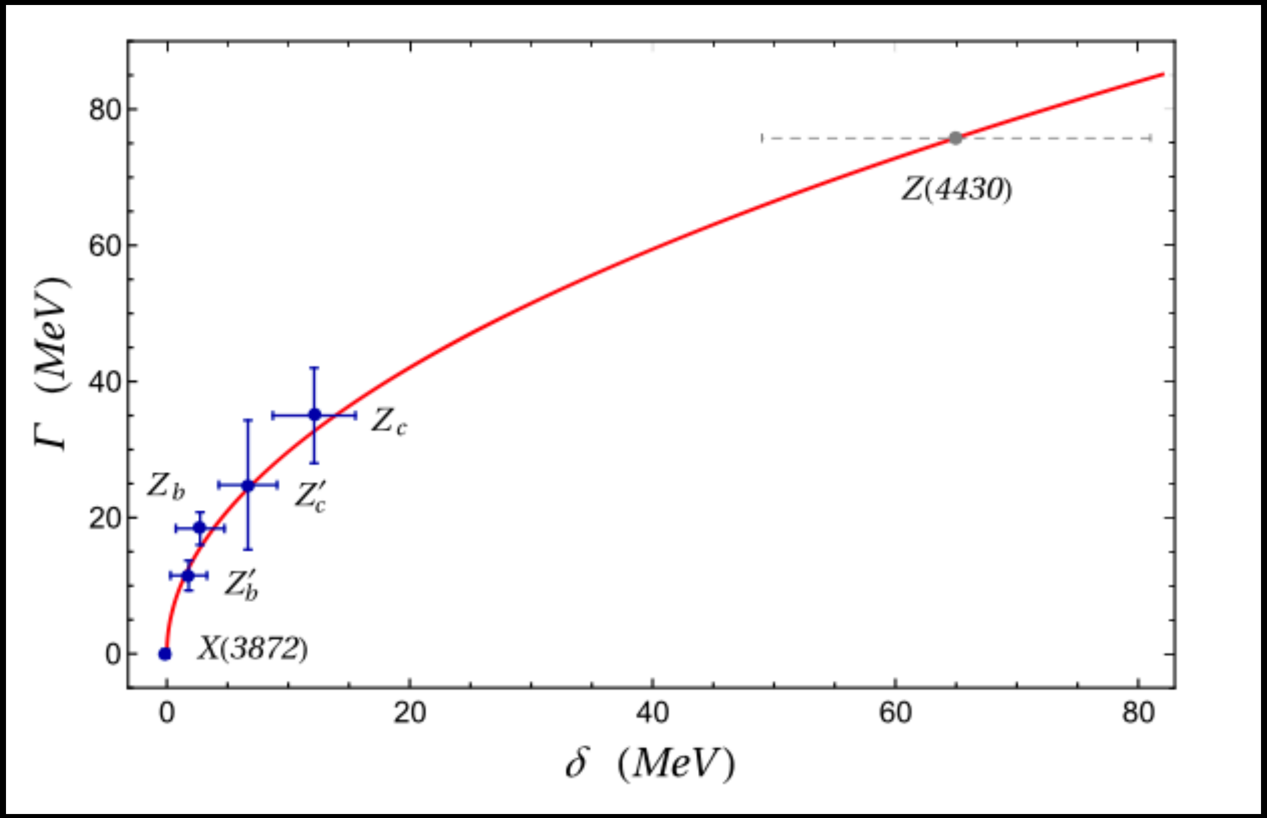
TUNNELING

$$\Gamma_{oc} = A\left(\frac{\sqrt{m}}{m_{dq}}, B, \ell\right)\sqrt{\delta}$$

Esposito, ADP, EPJ C78 (2018) 782

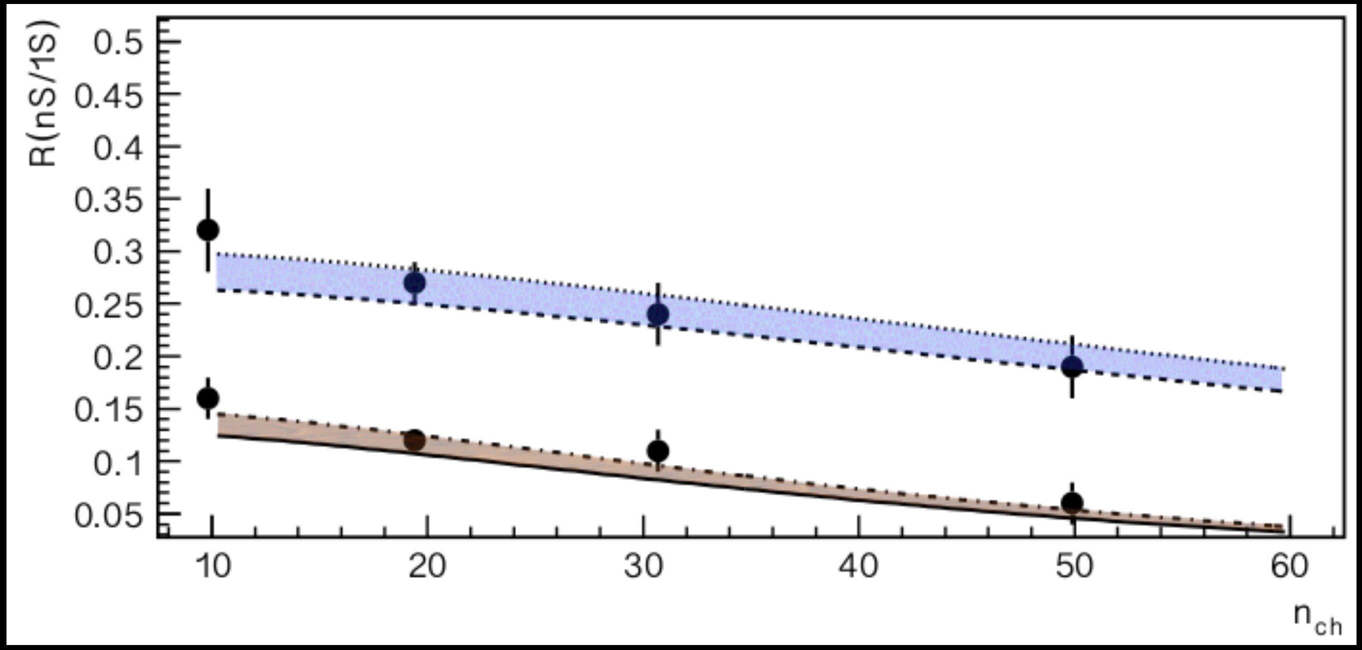
A contains $\mathcal{T} = \exp\left(-2\ell\sqrt{2mB}\right)$

A slight variation of ℓ in the direction $\ell_b \lesssim \ell_c$ allows to compensate the variation in m_{dq}

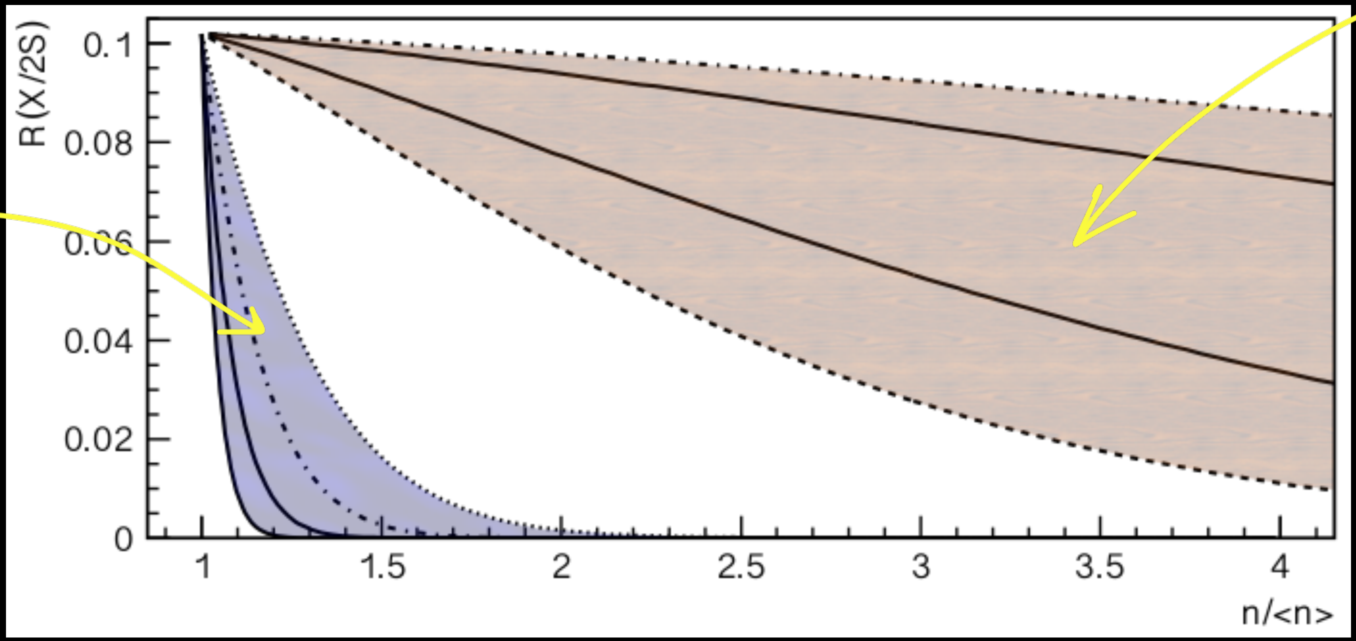


WORK-IN PROGRESS

E. Gonzales-Ferreiro & C. Salgado



LHCb drop



How a mol. X should drop

CONCLUSIONS

- Recent data on X production in heavy ion collisions (CMS) are not understood
- It would be of great use to have a pT distribution of latter data (for the moment a single bin is available 10 < pT < 50 GeV)
- Recent data on X production in pp by LHCb do not contain an obvious intepretation, as claimed by the collaboration
- Could CMS/LHCb say the final word on $J/\psi + \rho^{\pm}$ around 38## MeVs?