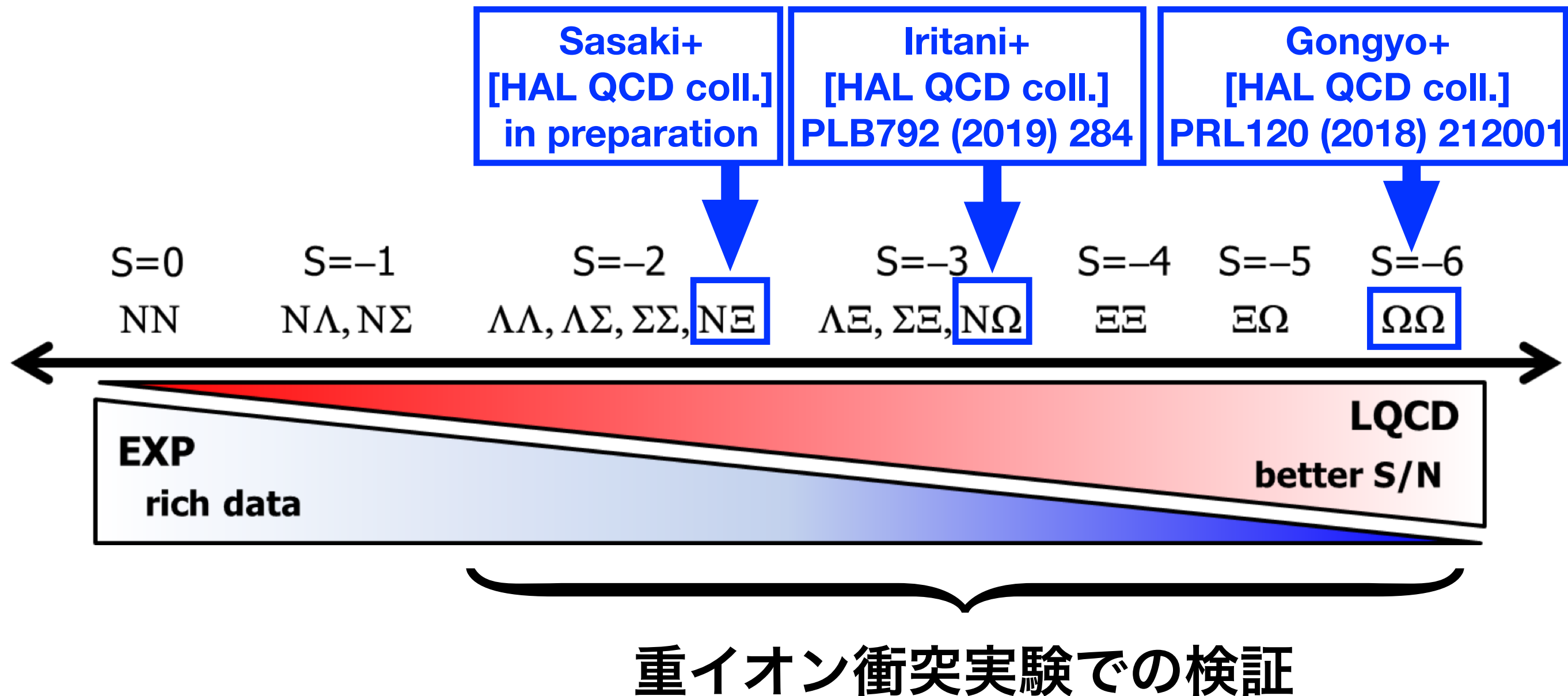


HALポテンシャルを用いた2体バリオン相関の解析 ならびに重イオン衝突実験データとの比較

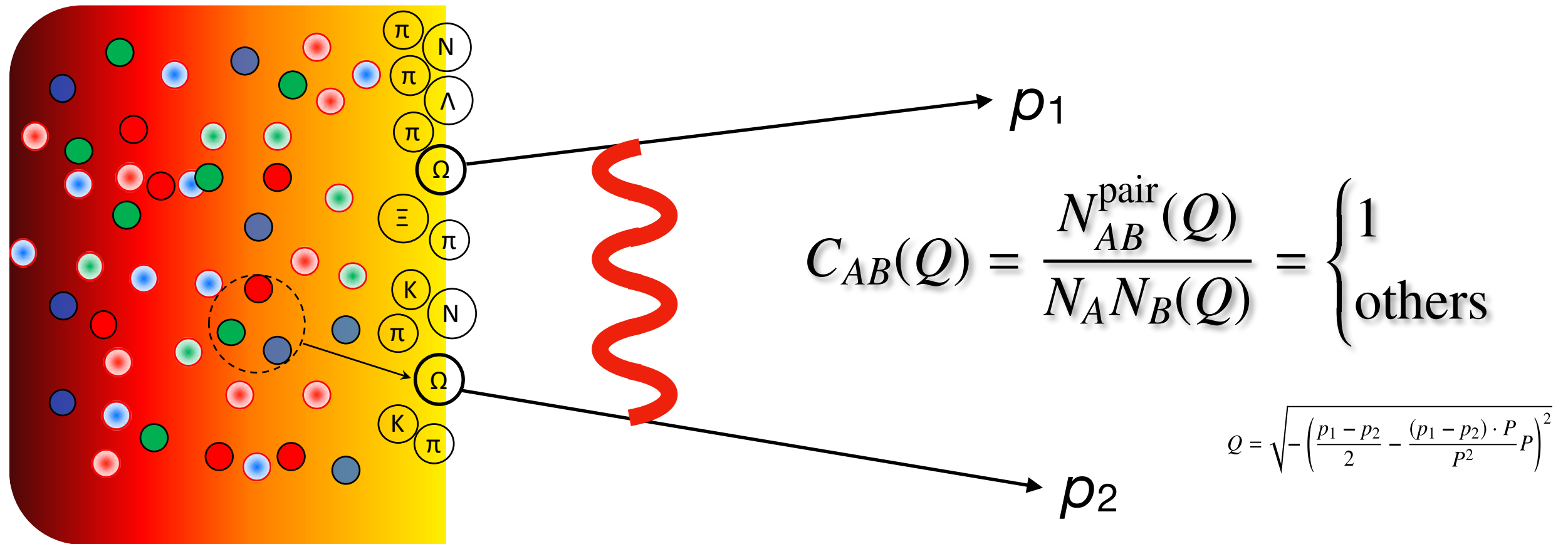
権業 慎也 (理研)

BB interaction near the physical point by HAL method

HAL QCD Coll. have studied from $S=0$ to $S=-6$.



重イオン衝突実験における2粒子相関測定



2バリオン相関 \Leftrightarrow 2バリオン相互作用

HALポテンシャル → BB相関関数

格子QCD

バリオン間相互作用

K. Morita+ , PRC94 (2016) 031901
K. Morita+ , NPA967 (2017) 856
K. Morita+ in preparation

“ $N\Omega$ correlation from HAL pot.”
“ $N\Xi$ correlation from HAL pot.”
“ $N\Omega$ & $\Omega\Omega$ correlations from HAL pot.”

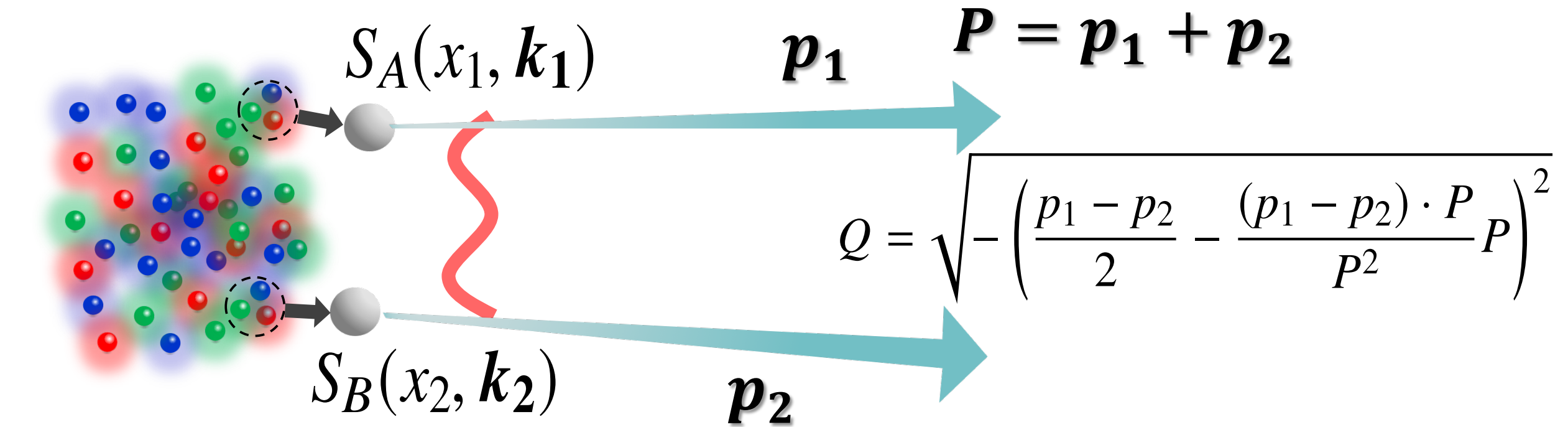
2バリオン相関関数

STAR Coll., Phys. Lett. B790 (2019) 490
ALICE Coll., arXiv:1905.07209
ALICE Coll., arXiv:1904.12198

“ $N\Omega$ correlation in Au+Au”
“ Λ correlation in p+p, p+Pb”
“ $N\Xi$ correlation in p+p, p+Pb”

LHC/RHICでの衝突実験データ

Two-Particle Momentum Correlation



Small Q

$$N^{\text{pair}}(Q) \simeq \int_{\Delta \mathbf{k}} \int_{x_1} \int_{x_2} S_A(x_1, \mathbf{k}_1) S_B(x_2, \mathbf{k}_2) |\psi_{AB}^{(-)}(\mathbf{r}^*, \mathbf{Q}^*)|^2$$

(# of pair) = integration of (emission probability x weight factor)

Random emission from the Source
 Constrained from γ , p_t spectrum etc

Scattering wave function
 FSI and (a)symmetrization (for identical pairs)

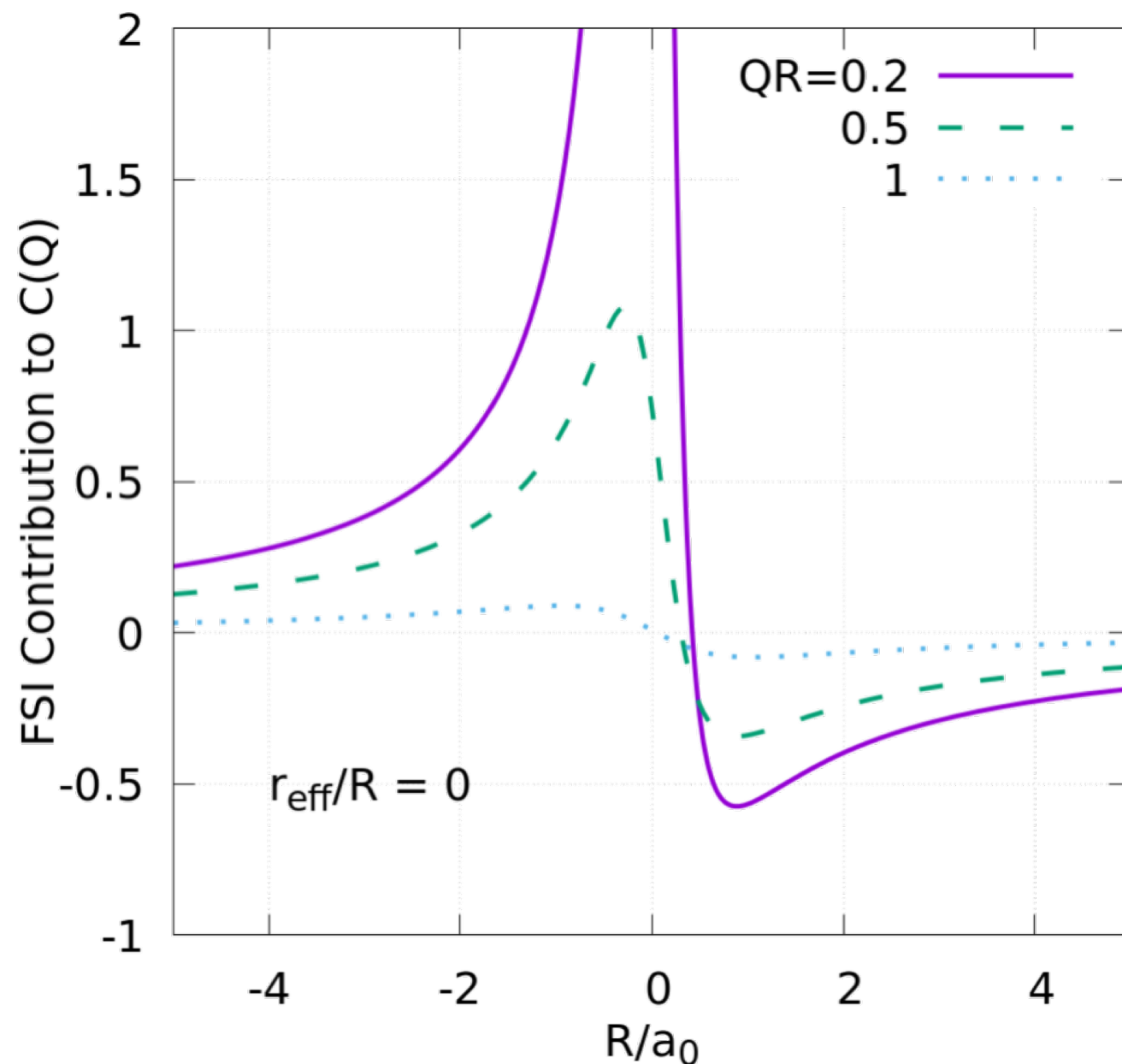
More rigorous formula found in Anchishkin, Heinz, Renk, PRC57 ('98)

Correlation from FSI

Static/Spherical Source

Lednicky+ '82

$$C_{AB}(Q) - 1 = \frac{4\pi}{(2\pi R^2)^3} \int dr r^2 S^{\text{rel}}(r) [|\chi_Q(r)|^2 - |j_0(Qr)|^2]$$



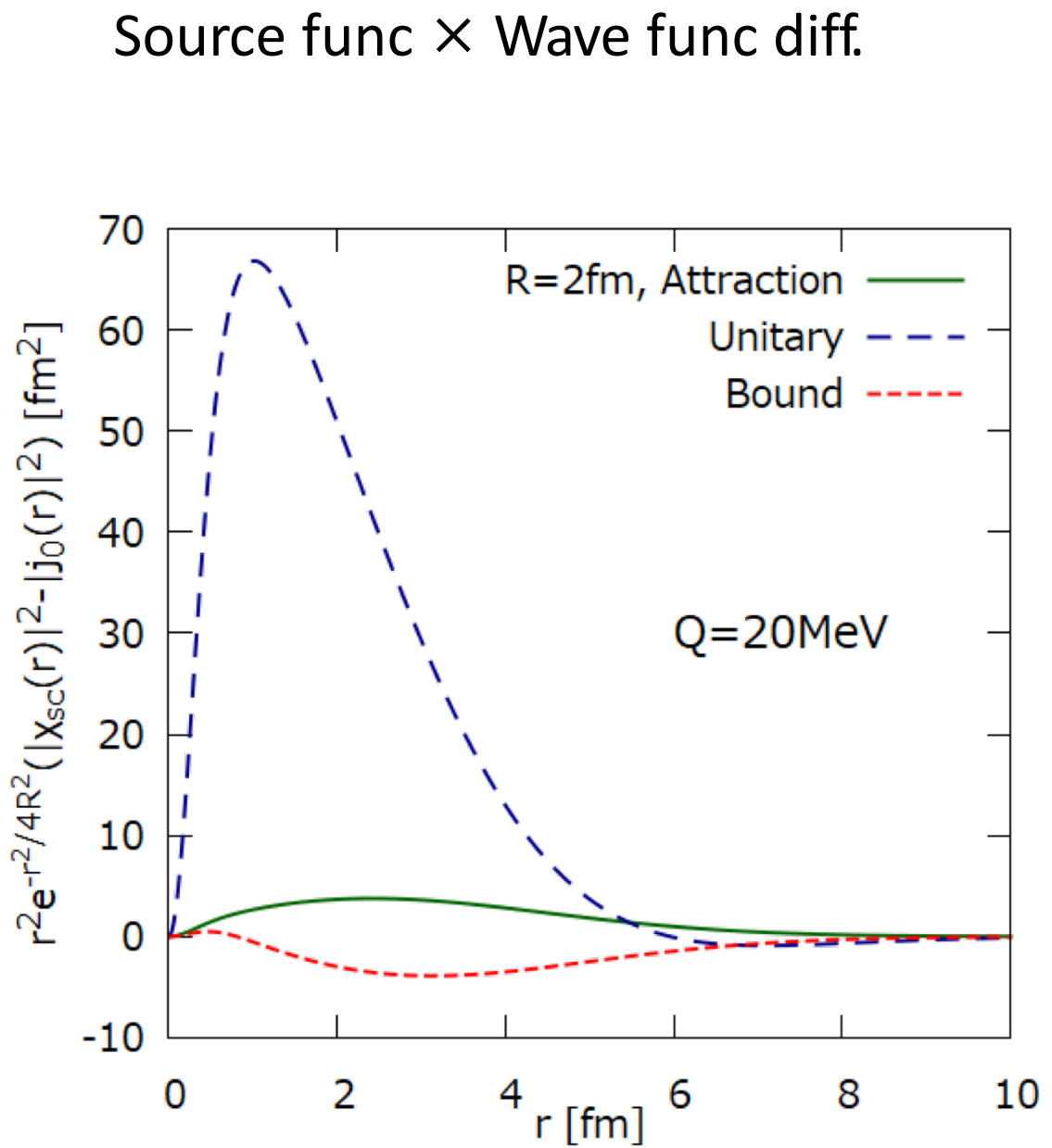
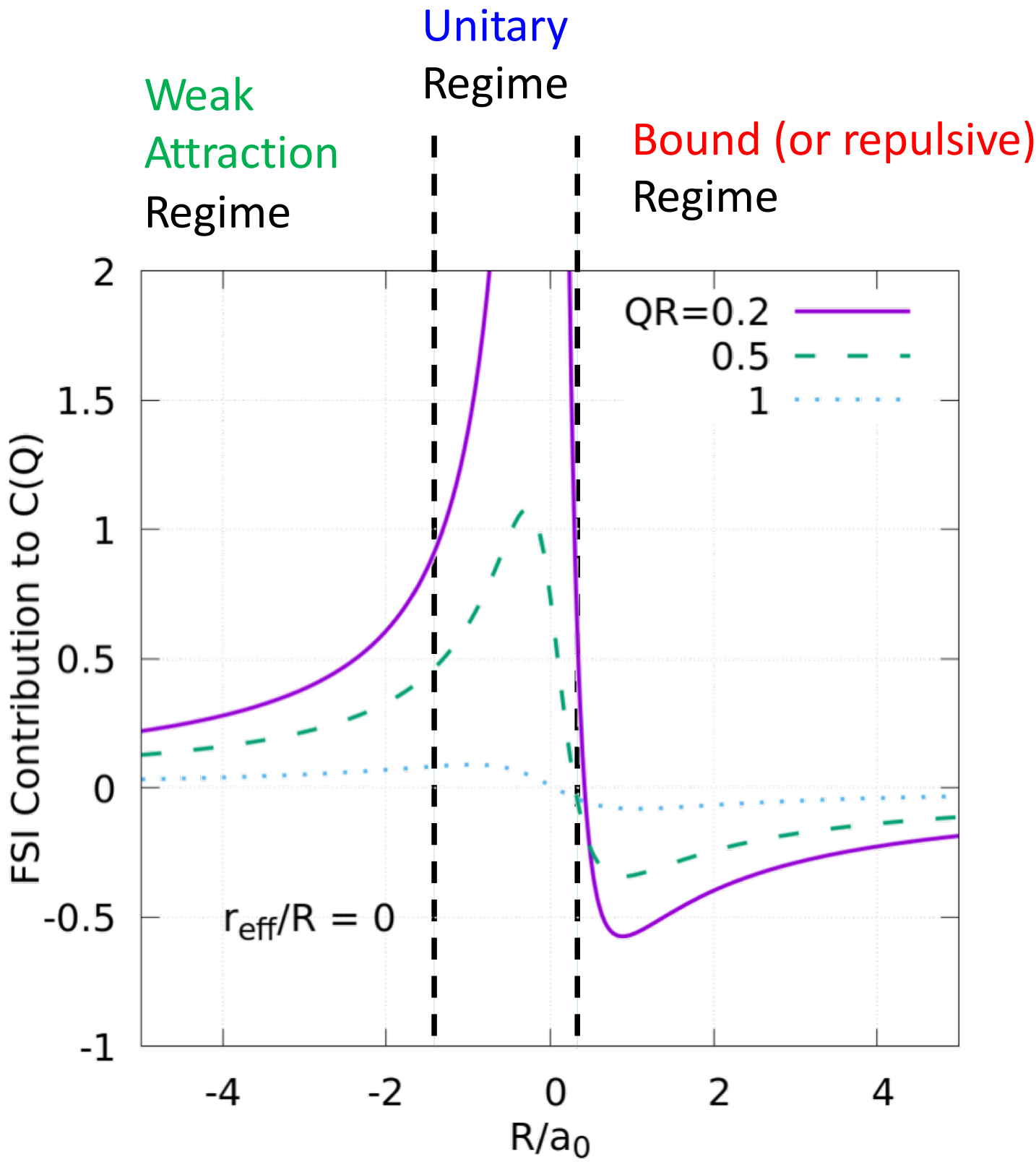
$$S^{\text{rel}}(r) = (\pi R^2)^{3/2} \exp\left(-\frac{r^2}{4R^2}\right)$$

Asymptotic S-wave scattering w.f.

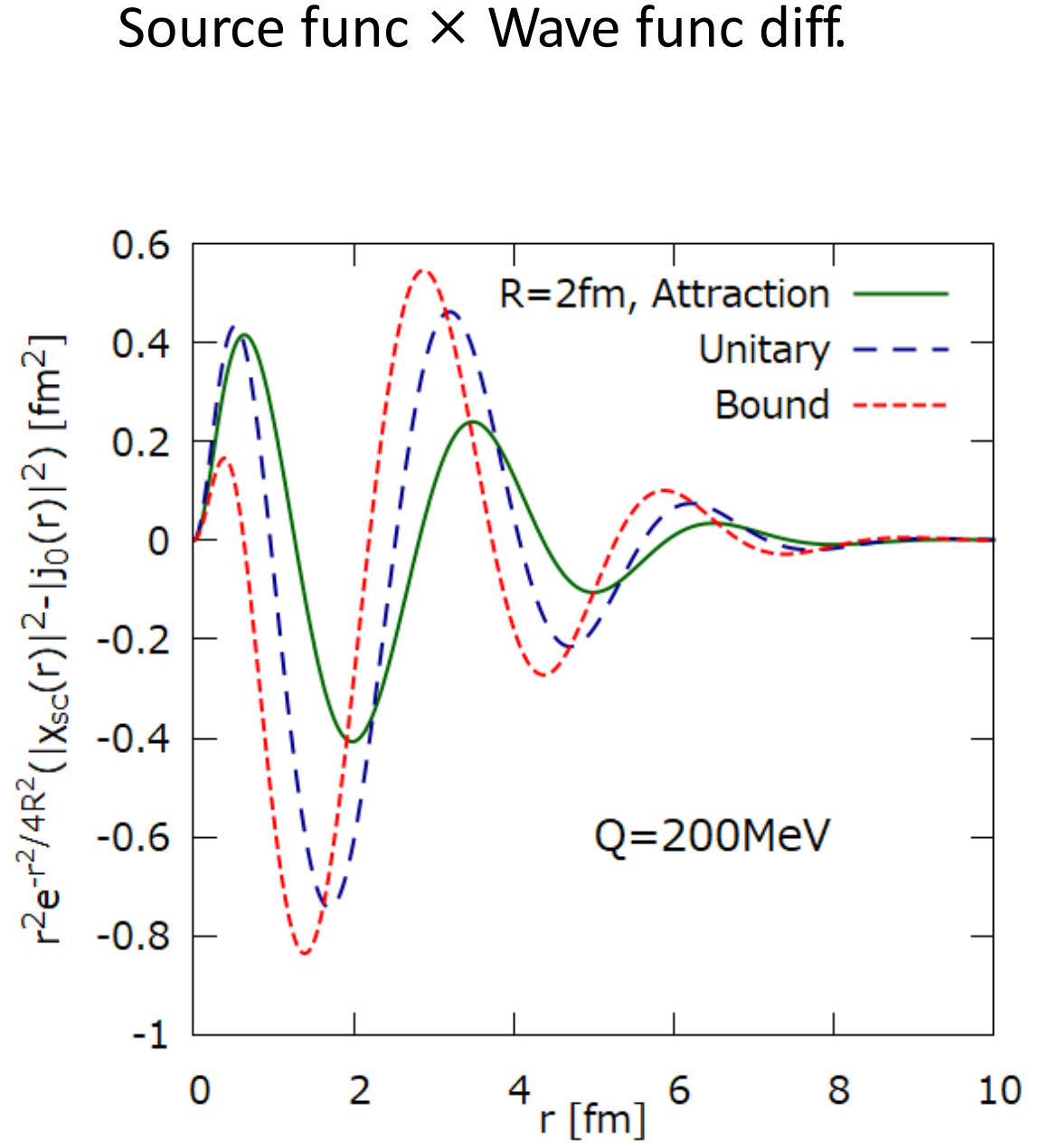
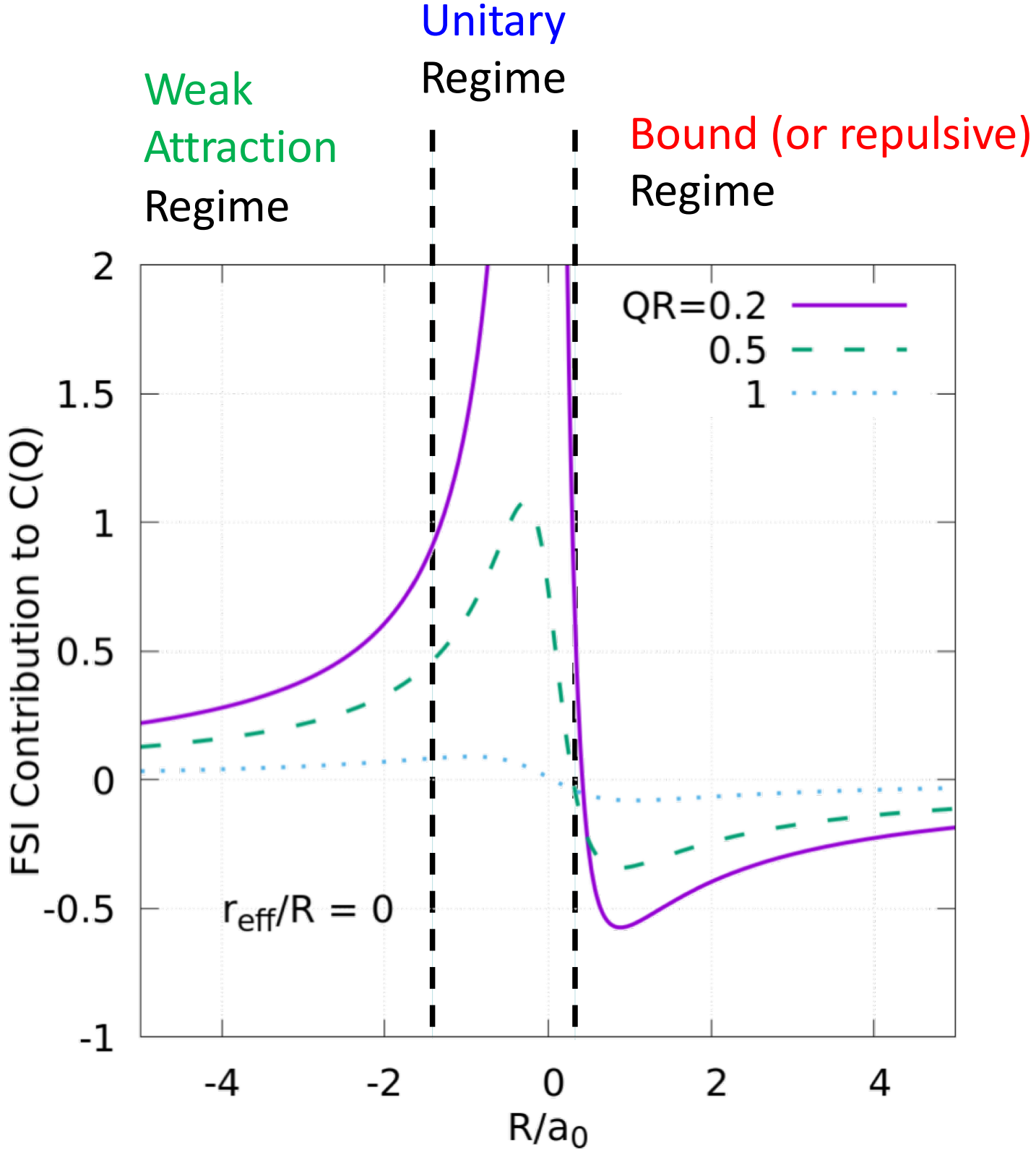
$$\chi_Q(r) = \frac{\sin(Qr + \delta)}{Qr}$$

$$Q \cot \delta = -\frac{1}{a_0} + \frac{1}{2} r_{\text{eff}} Q^2$$

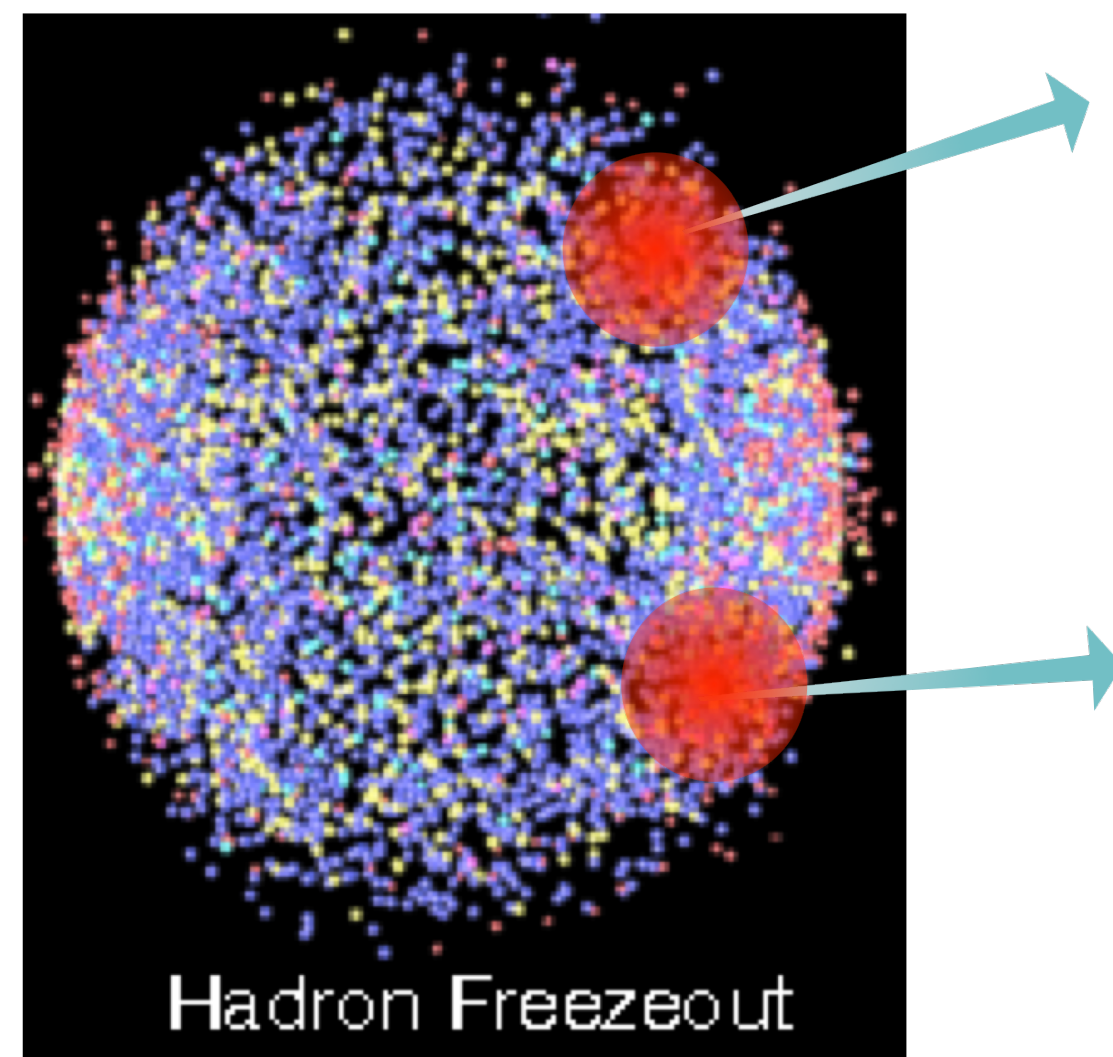
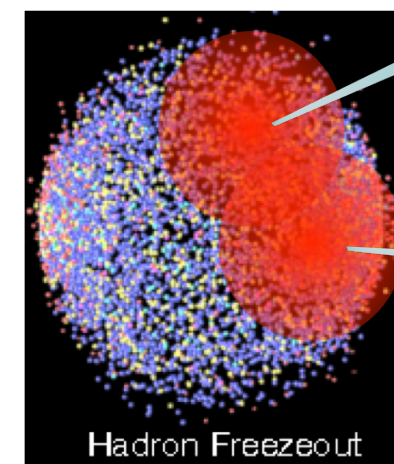
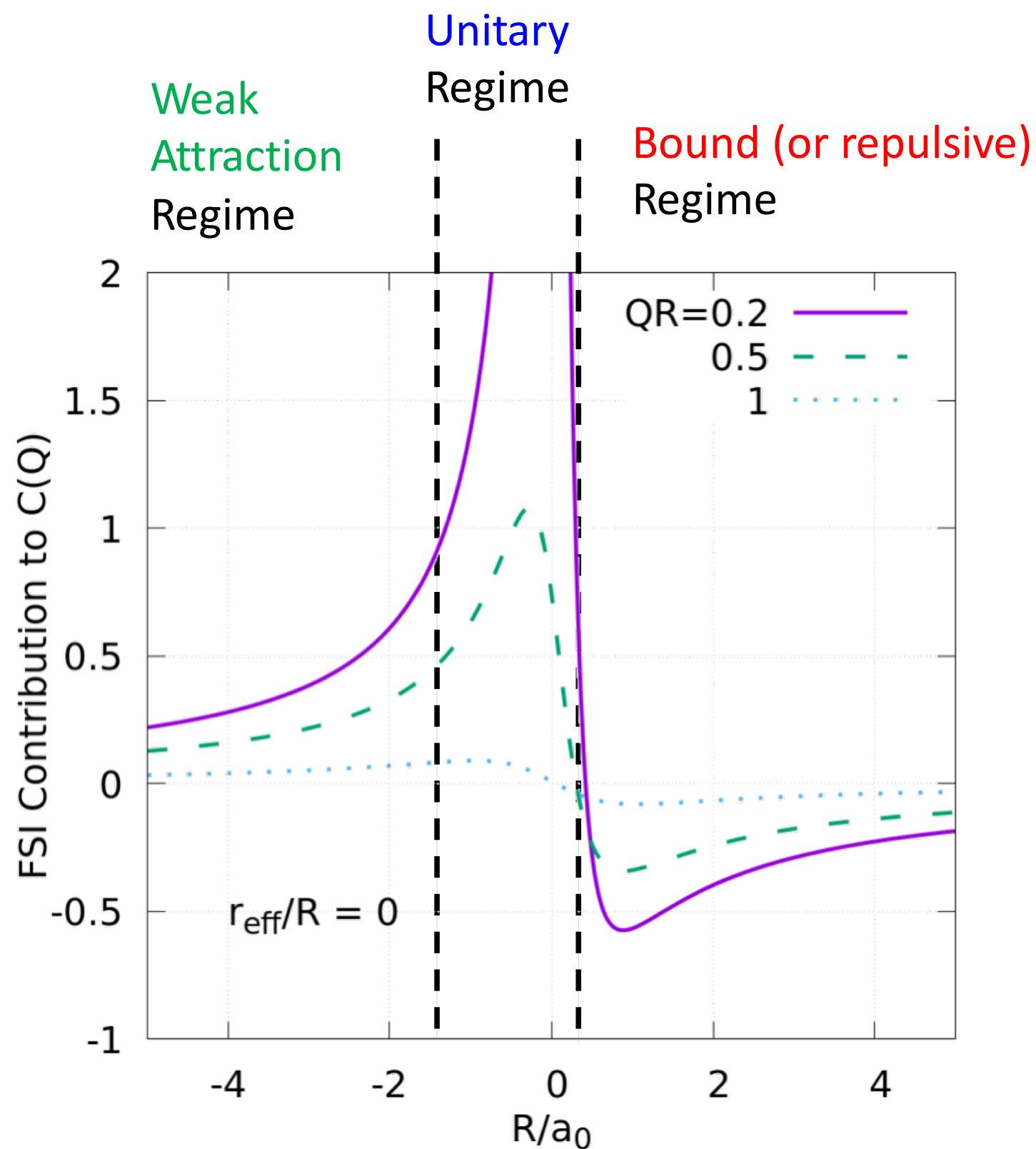
Correlation from FSI



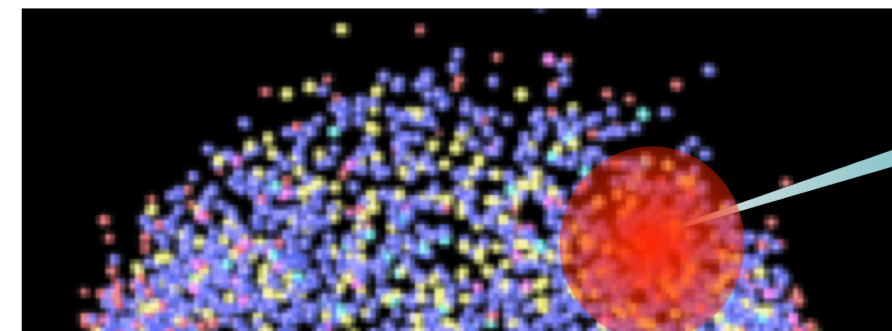
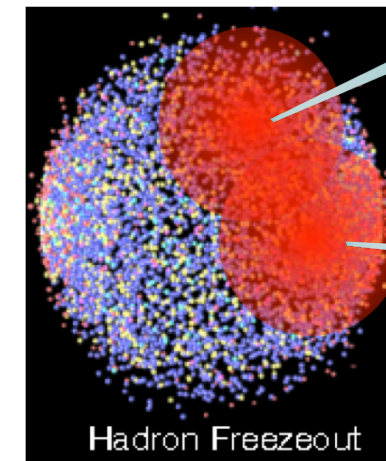
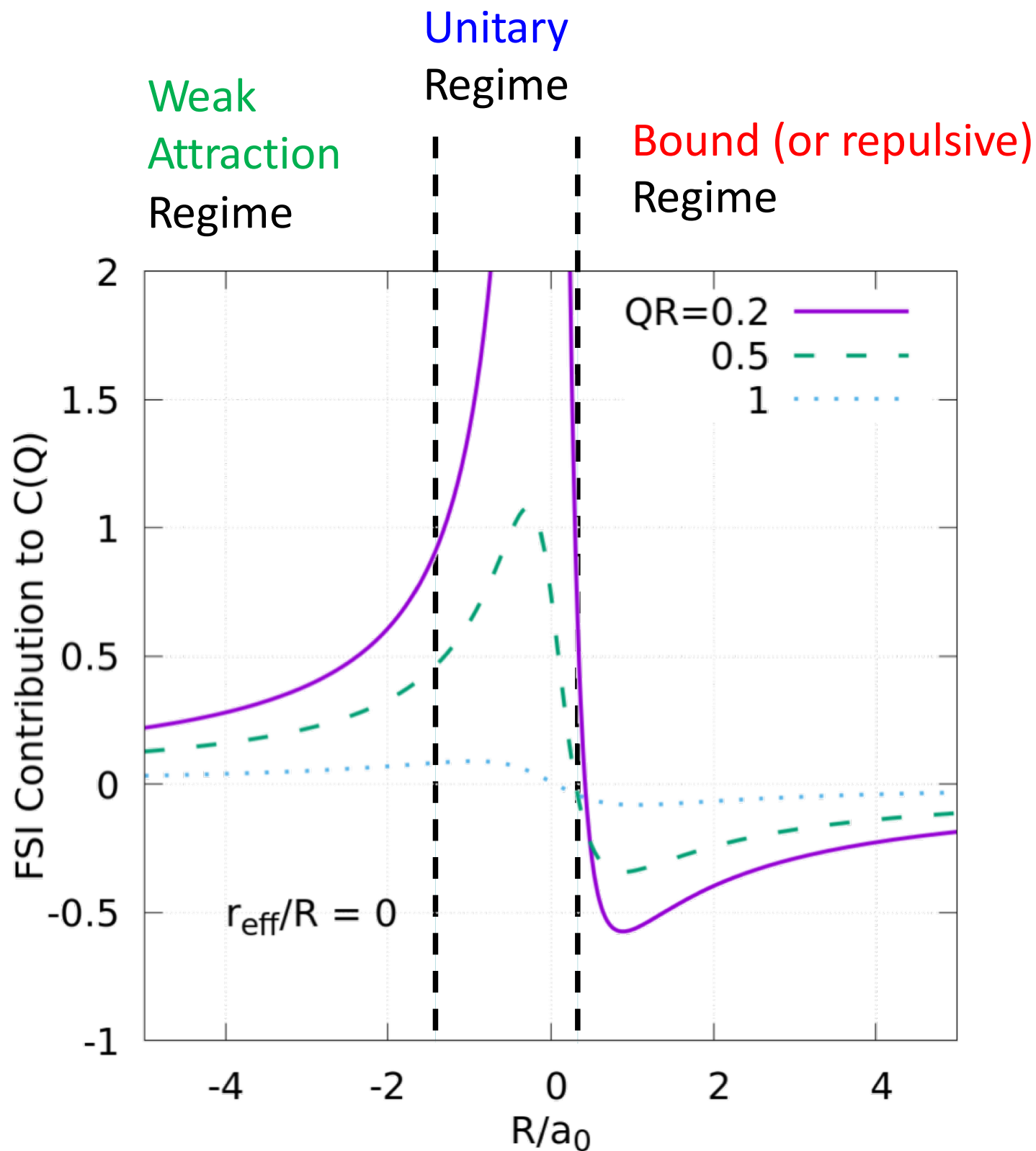
Correlation from FSI



Correlation from FSI



Correlation from FSI

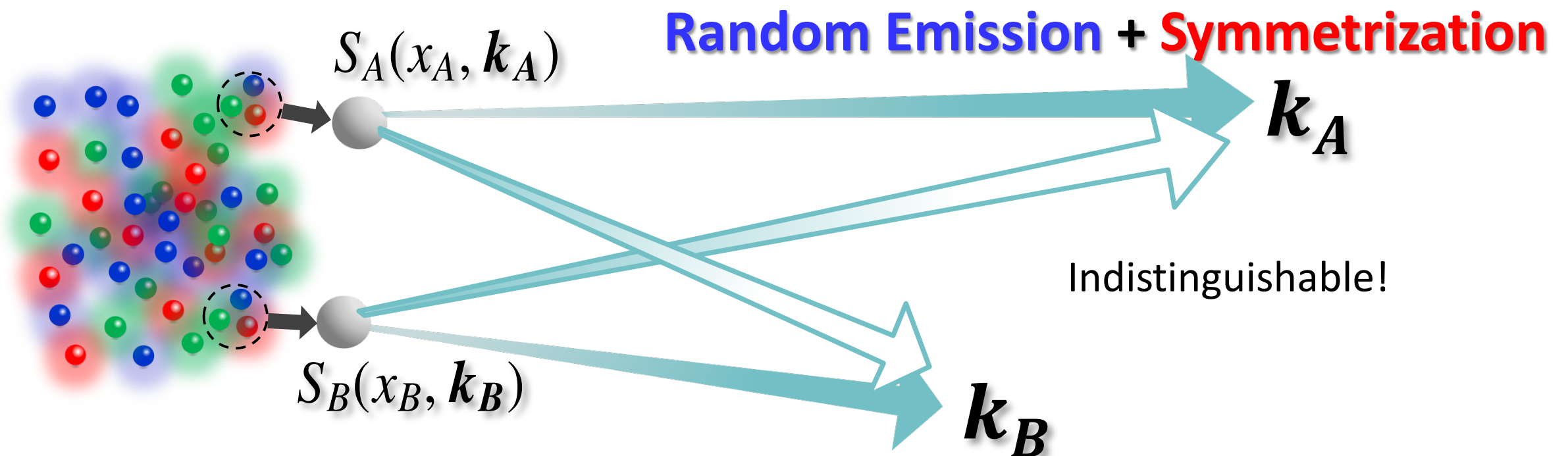


Strong signals for $R < 2a_0$

Measuring $C(Q)$ for different system size disentangles existence of B.S.

Hadron Freezeout

Quantum Statistics (HBT/GGLP)

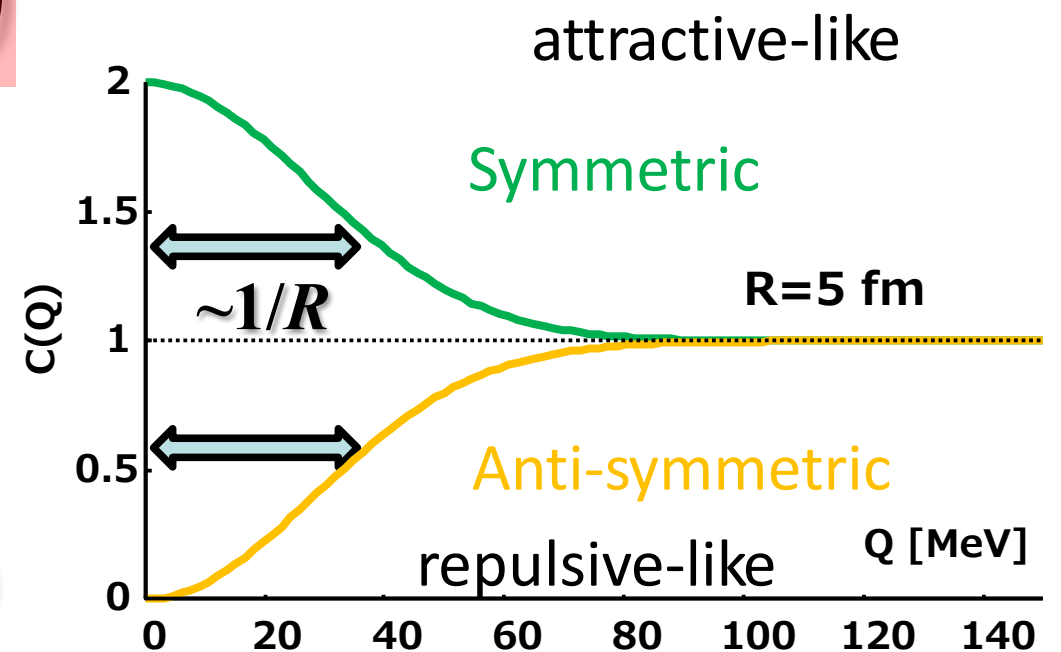


$$\psi_{AB} = \frac{1}{\sqrt{2}} \left(e^{ik_A \cdot x_A} e^{ik_B \cdot x_B} \pm e^{ik_A \cdot x_B} e^{ik_B \cdot x_A} \right)$$

$$= \begin{cases} e^{iK \cdot X} \sqrt{2} \cos(Q \cdot r) \\ e^{iK \cdot X} \sqrt{2} i \sin(Q \cdot r) \end{cases}$$

$$C_{id}(Q) = 1 \pm \frac{1}{N} \int d^3r \cos(2Q \cdot r) S_K^{rel}(r)$$

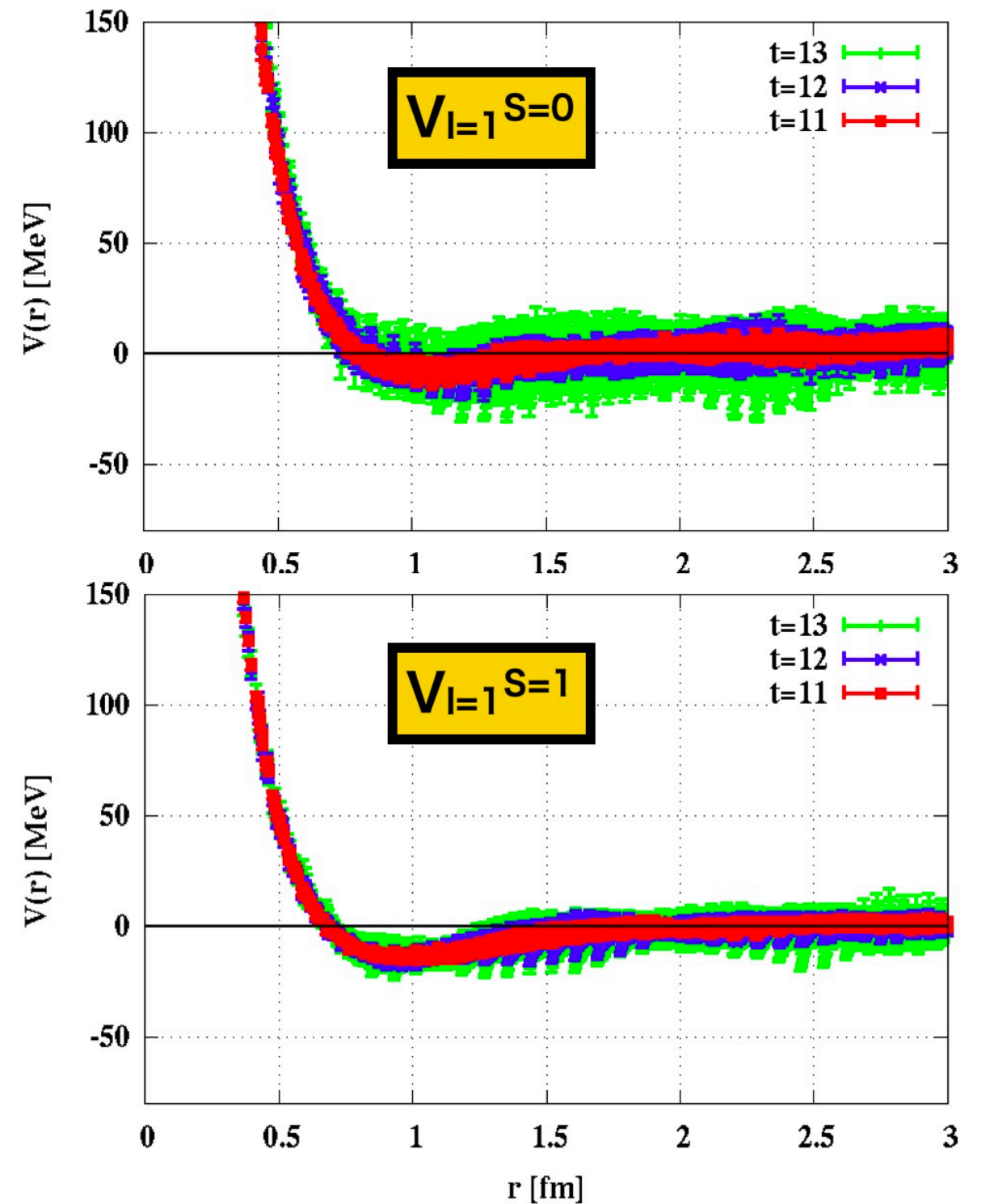
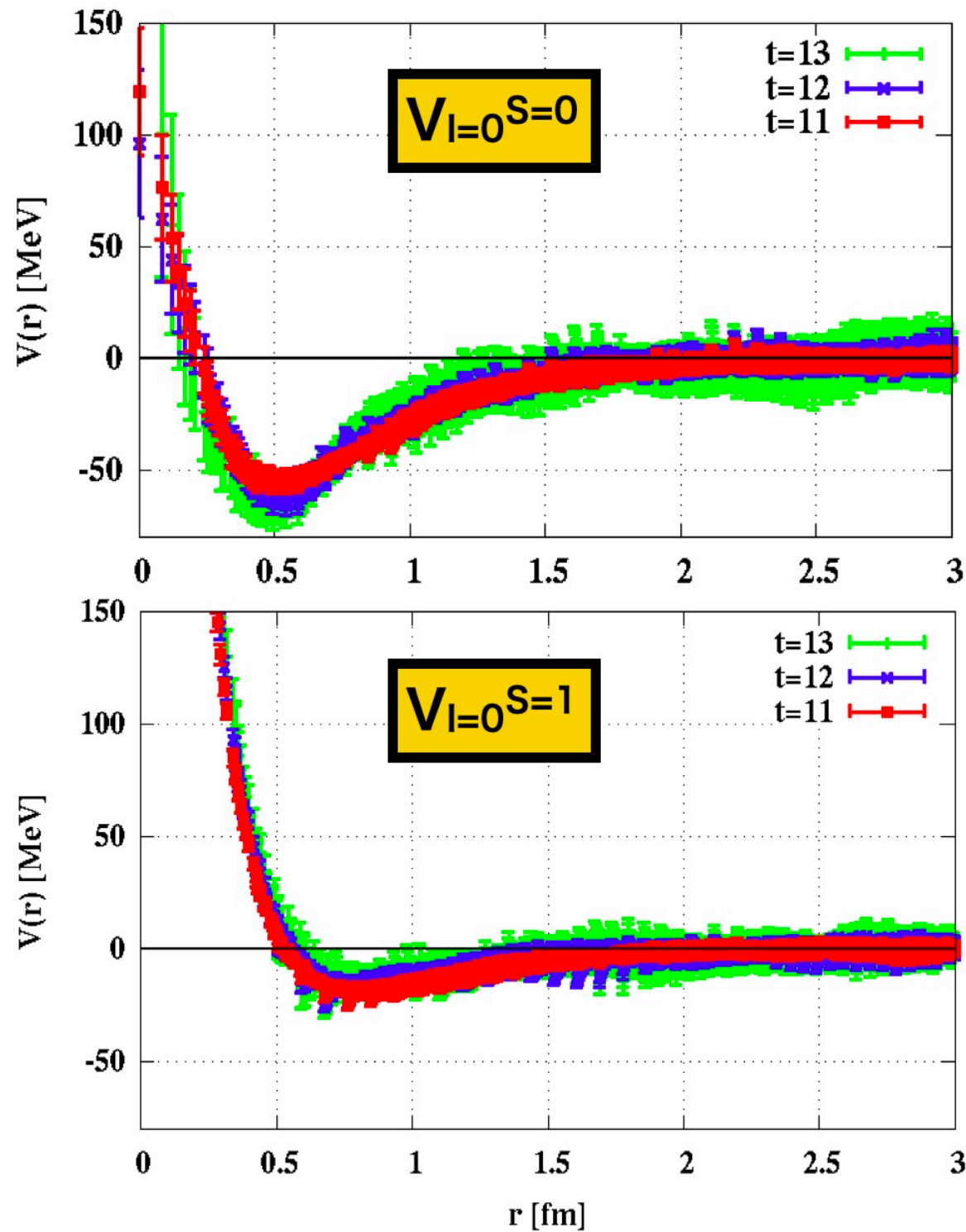
Fourier tr. of the emission func.



BB correlation from HAL pot

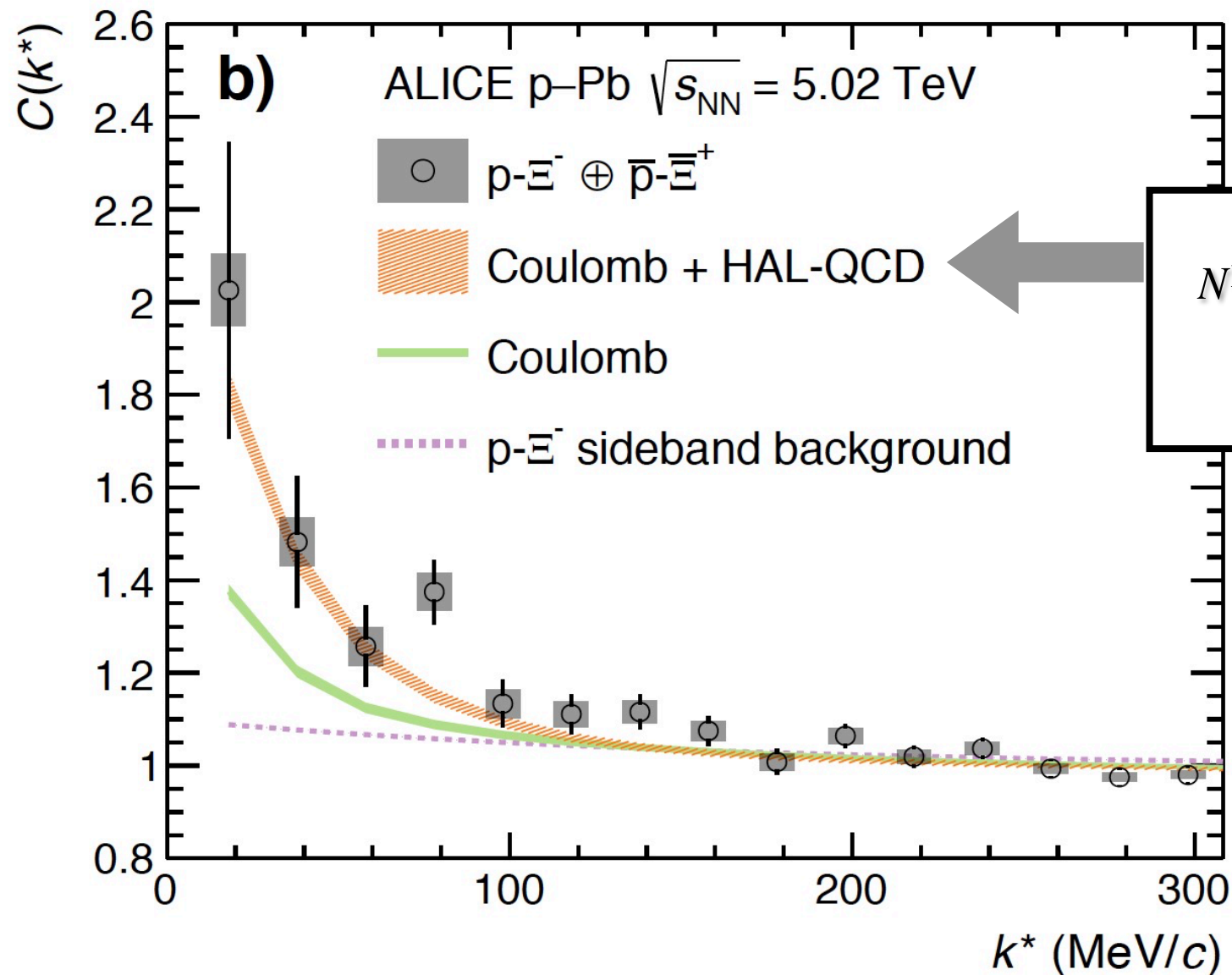
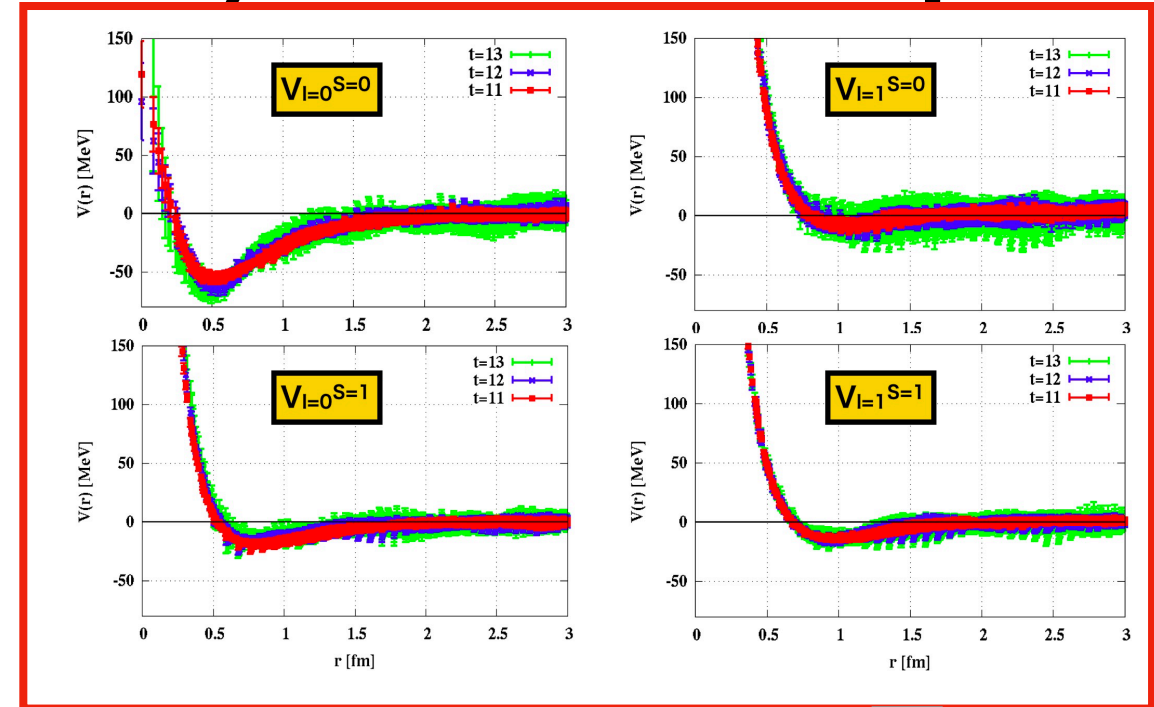
$N\bar{E}$ interaction by HAL method

Sasaki+ [HAL QCD coll.] in preparation



$N\bar{E}$ correlation at LHC(p-Pb) from HAL pot

ALICE Coll., arXiv:1904.12198



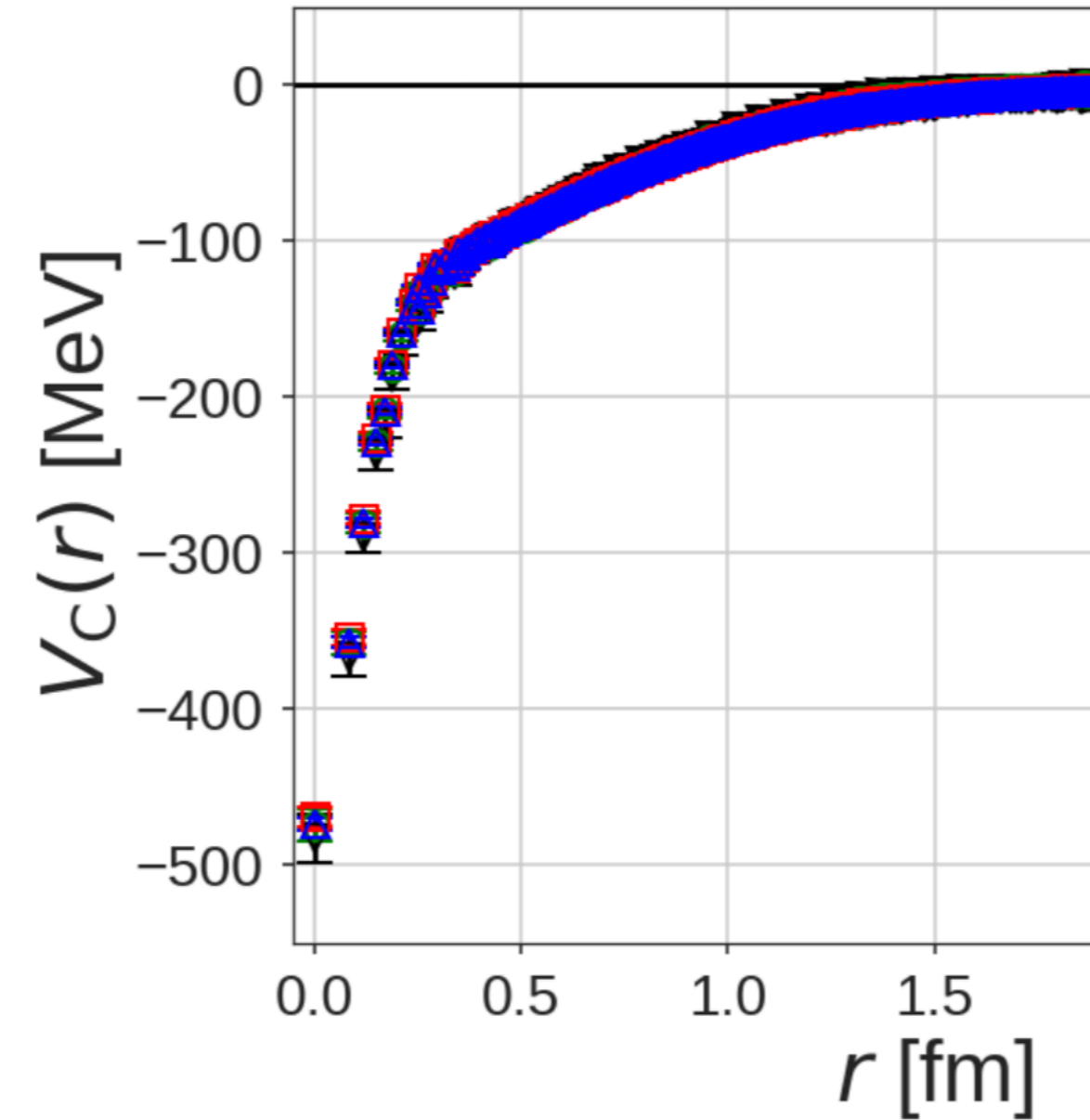
$$N^{\text{pair}}(Q) \simeq \int_{\Delta k} \int_{x_1} \int_{x_2} S_A(x_1, k_1) S_B(x_2, k_2) |\psi_{AB}^{(-)}(r^*, Q^*)|^2$$

波動関数

$N\Omega$ interaction by HAL method

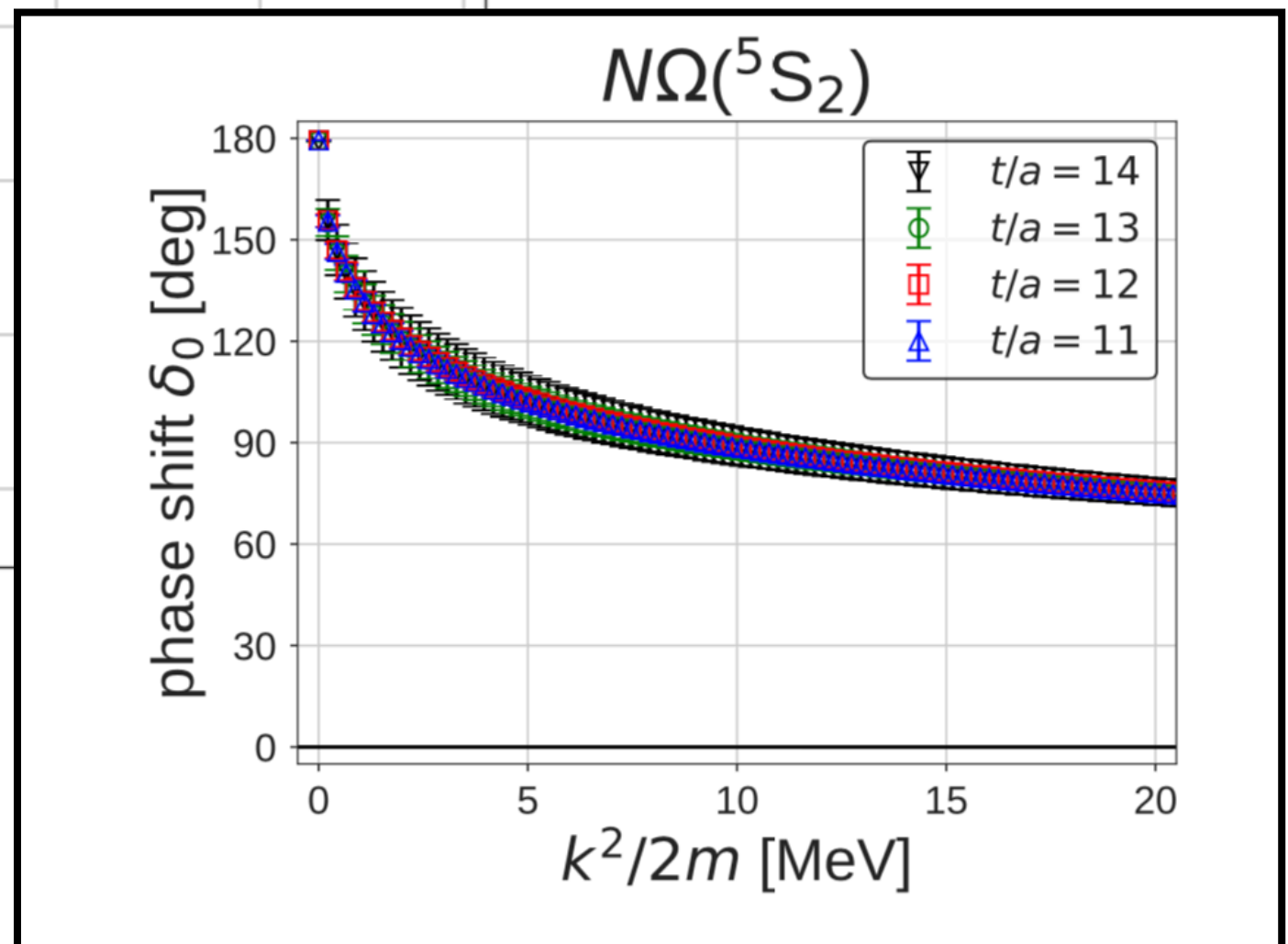
Iritani+ [HAL QCD coll.] PLB792 (2019) 284

(a) $N\Omega(^5S_2)$



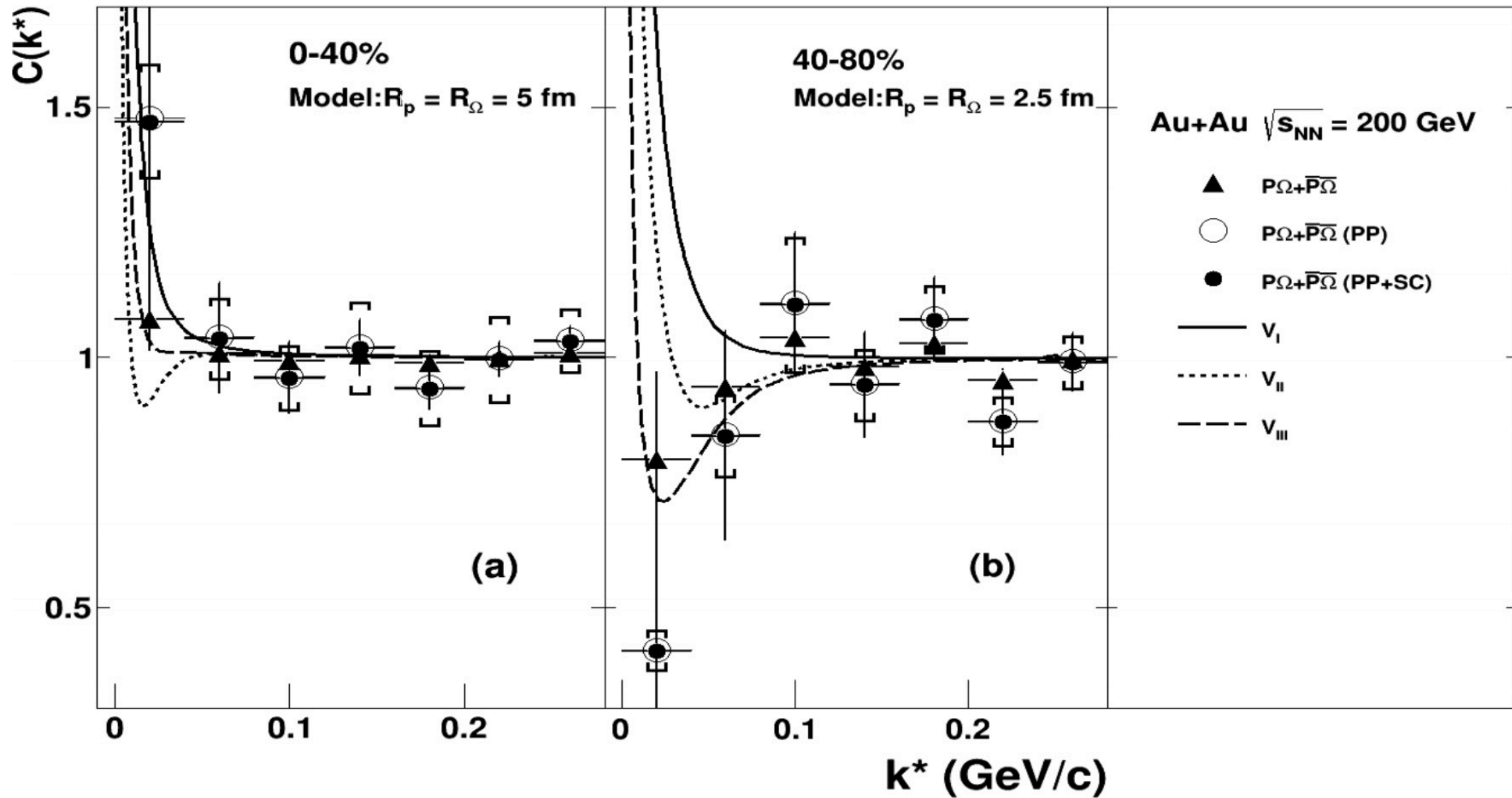
$$a_0 = 5.30(0.44)^{(+0.16)}_{(-0.01)} \text{ fm},$$

$$r_{\text{eff}} = 1.26(0.01)^{(+0.02)}_{(-0.01)} \text{ fm}$$



$p\Omega$ correlation at RHIC (Au-Au)

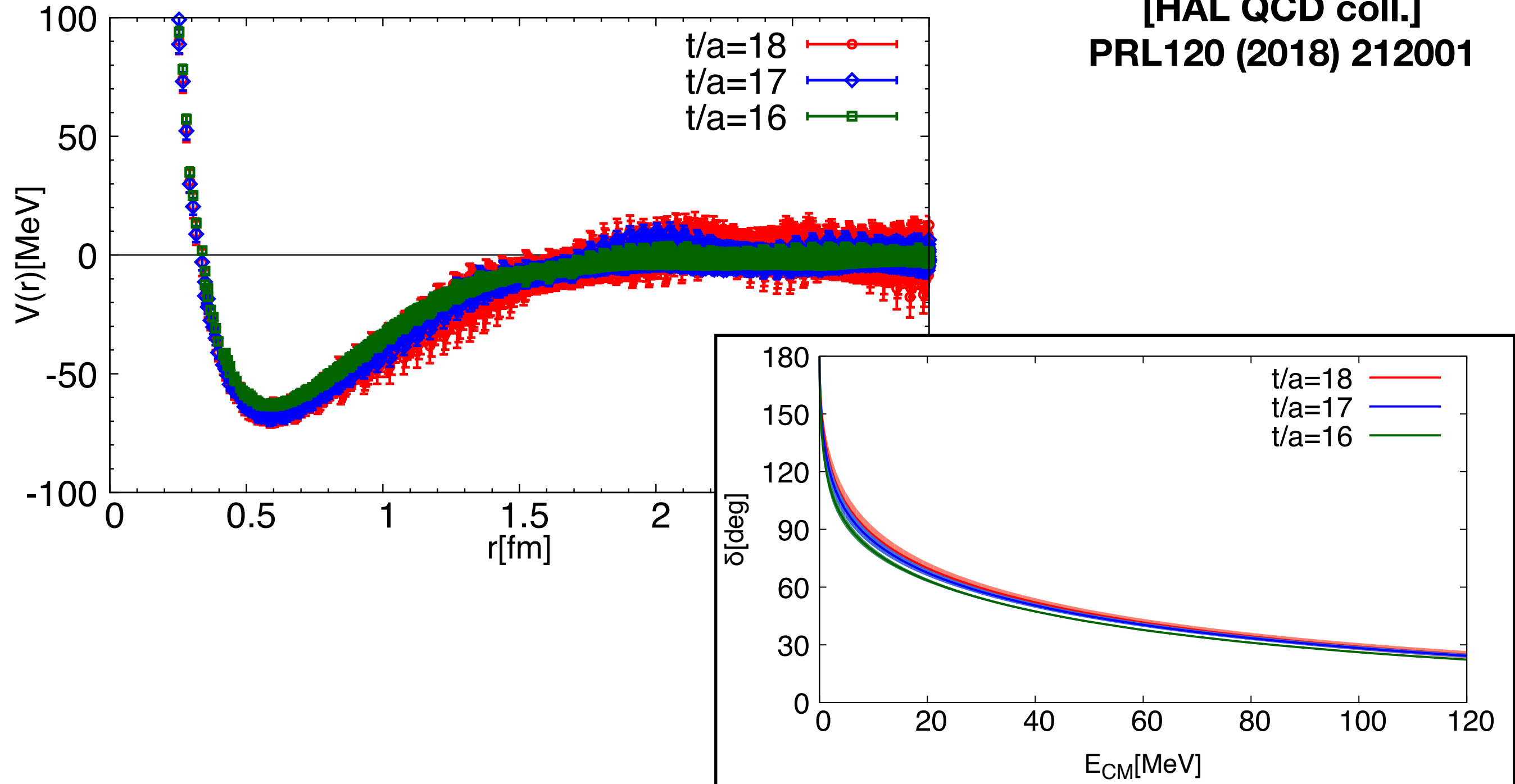
STAR Coll., Phys. Lett. B790 (2019) 490



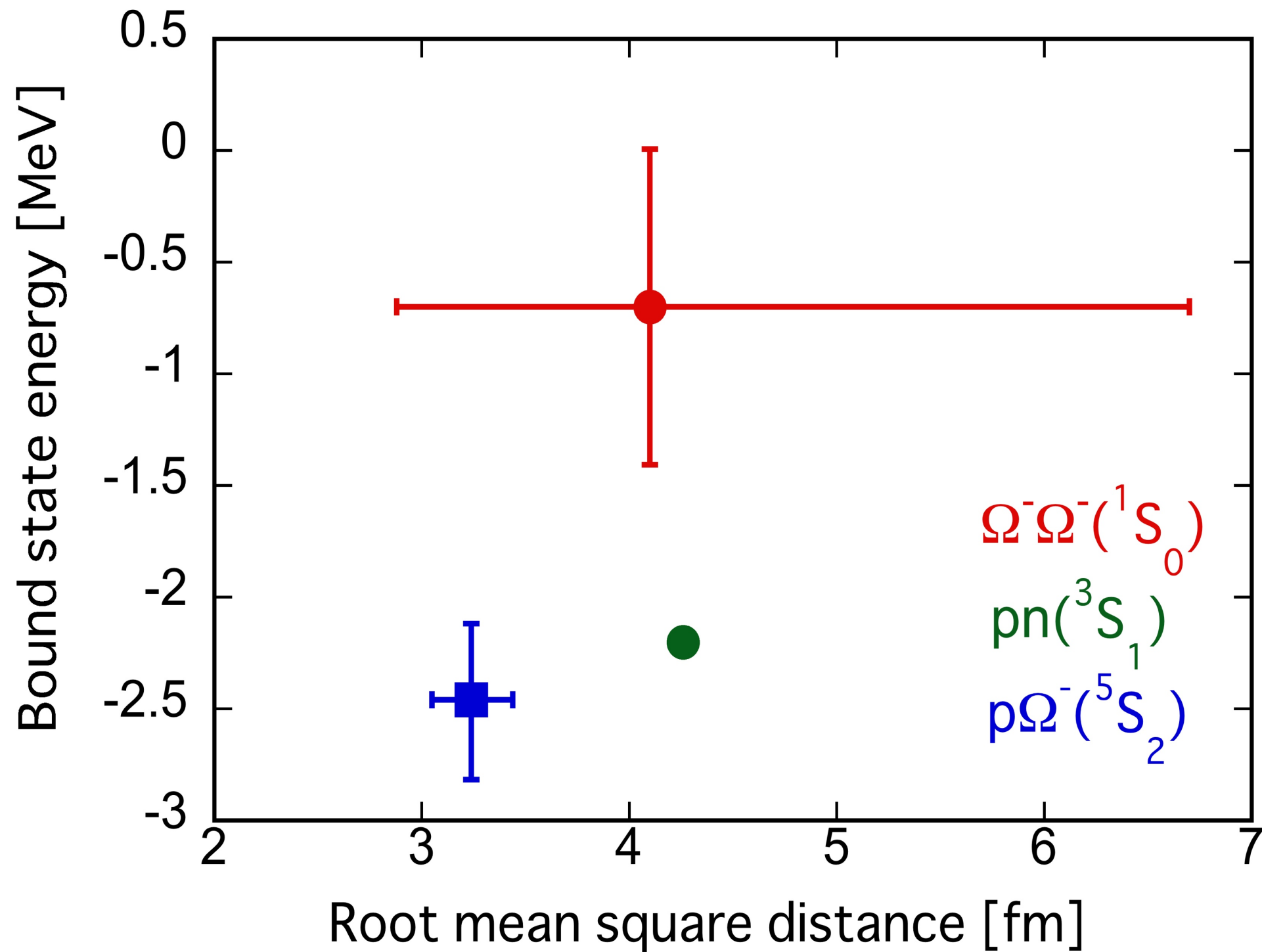
ALICE data has just appeared.

$\Omega\Omega$ interaction by HAL method

Gongyo+
[HAL QCD coll.]
PRL120 (2018) 212001

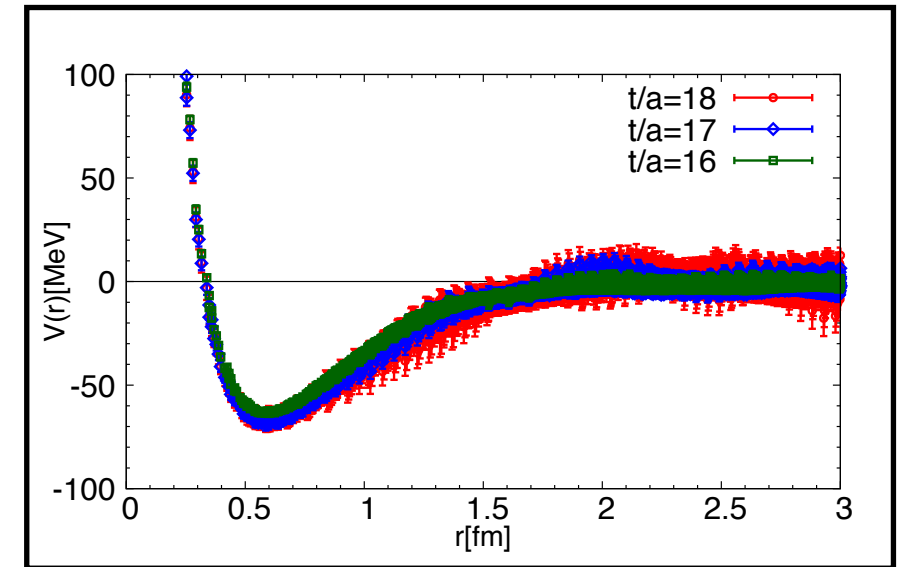
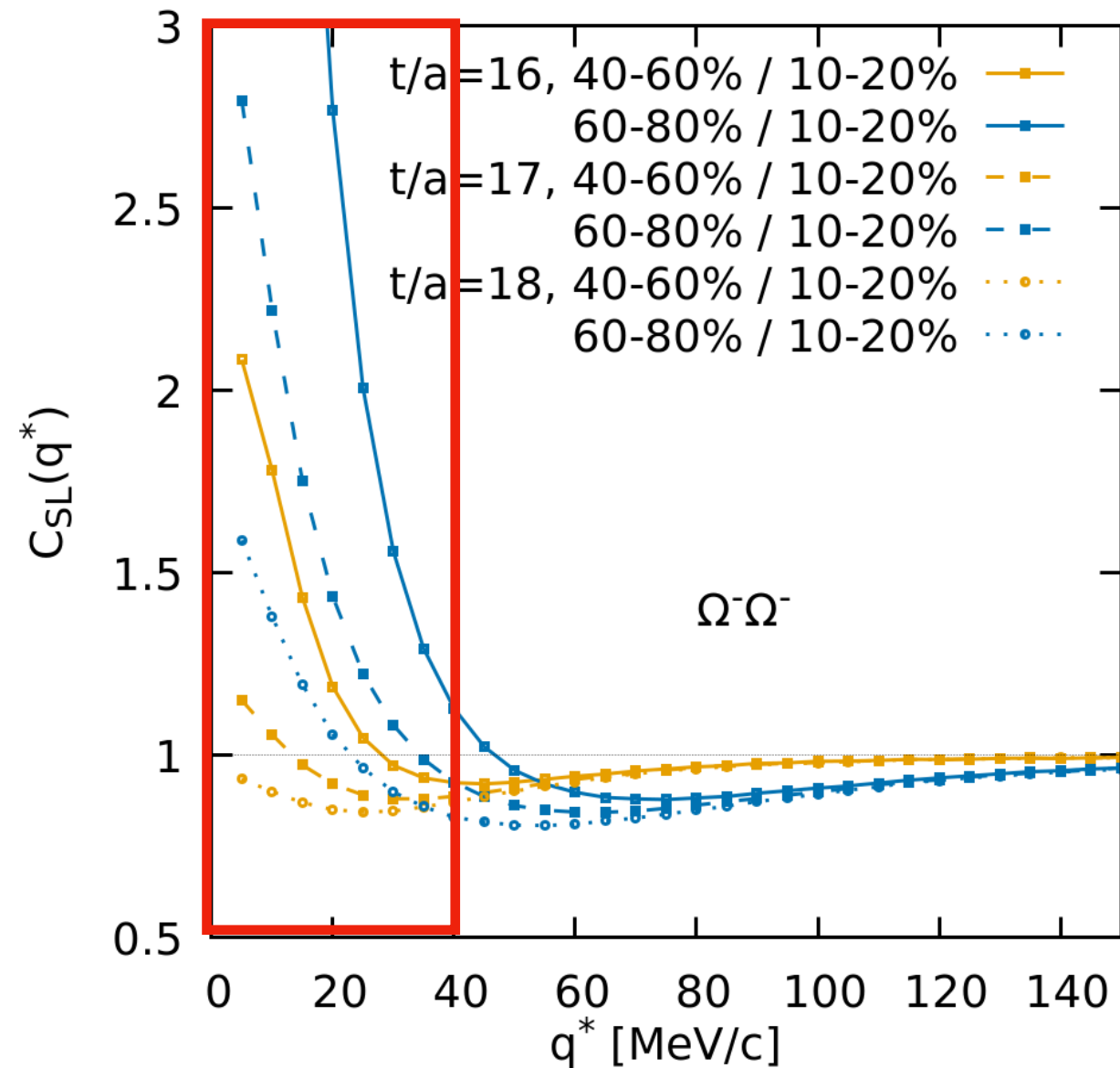


New dibaryons near unitary



Prediction of $\Omega\Omega$ correlation

K. Morita+ in preparation



$$N^{\text{pair}}(Q) \simeq \int_{\Delta k} \int_{x_1} \int_{x_2} S_A(x_1, k_1) S_B(x_2, k_2) |\psi_{AB}^{(-)}(r^*, Q^*)|^2$$

波動関数

次世代重イオン衝突実験 (LHC RUN3/FAIR/J-PARC)での
 ダイオメガの検出可能性

LHC RUN3でのダイバリオン検出可能性

2021-2023で過去9年の**100**倍のデータを収集

収量からの推定

From Hamagaki's Slide

Total number of strangeness	Combination	Current status	LHC RUN3
1	$N+\Lambda$ ($N+\Sigma$)	Δ <u>Au+Au 200GeV (STAR)</u> <u>p+Nb 3.2GeV (HADES)</u> <u>p+p 7TeV, 13TeV (ALICE)</u>	○
2	$\Lambda+\Lambda$ ($\Lambda+\Sigma, \Sigma+\Sigma$)	Δ <u>Au+Au 200GeV (STAR)</u> <u>p+p 7TeV, 13TeV (ALICE)</u>	○
2	$N+\Xi$	Δ <u>p+p 13TeV (ALICE)</u> Δ <u>p+Pb 5.02TeV (ALICE)</u>	○
3	$N+\Omega$	Δ <u>Au+Au 200GeV (STAR)</u>	○
3	$\Lambda+\Xi$ ($\Sigma+\Xi$)	×	○
4	$\Xi+\Xi$	×	○
5	$\Xi+\Omega$	×	○
6	$\Omega+\Omega$	×	○

2021年 『富嶽』 とLHC RUN3 稼働

格子QCDと重イオン衝突実験

の協働が盛んに