チャームバリオン励起状態とDN相互作用の応用

Tetsuo Hyodo[a],

Akinobu Doté[b], and Makoto Oka[a]

Tokyo Institute of Technology[a] KEK[b]

supported by Global Center of Excellence Program
"Nanoscience and Quantum Physics"

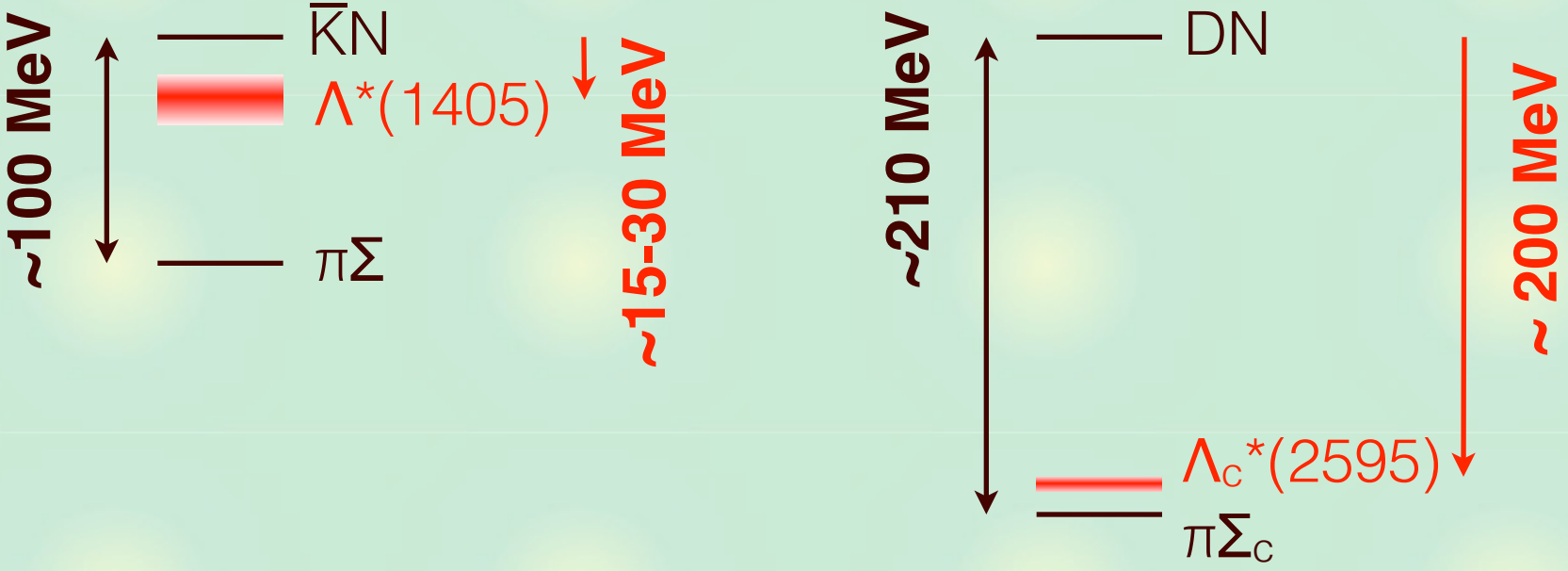
2013, Mar. 28th

Why DN and DNN?

$\bar{K}$ nuclei <-- Λ^*: a $\bar{K}N$ bound state in the $\pi\Sigma$ continuum

D nuclei? <-- Λ_c^*: a DN bound state in the $\pi\Sigma_c$ continuum

Comparison with $\bar{K}N$ system in I=0 channel

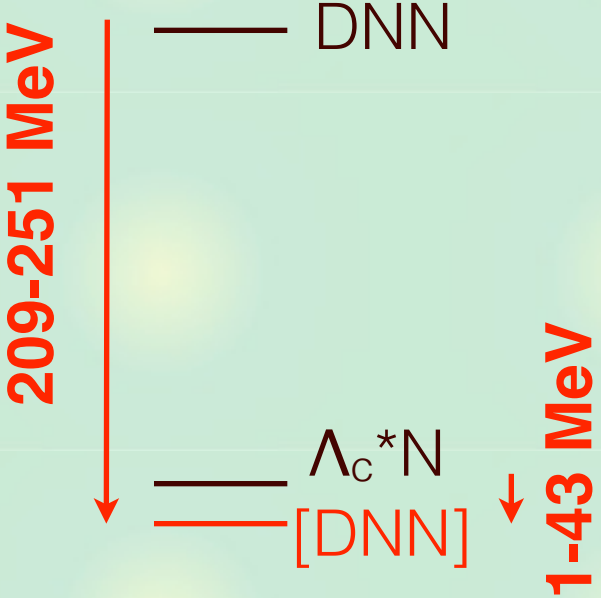


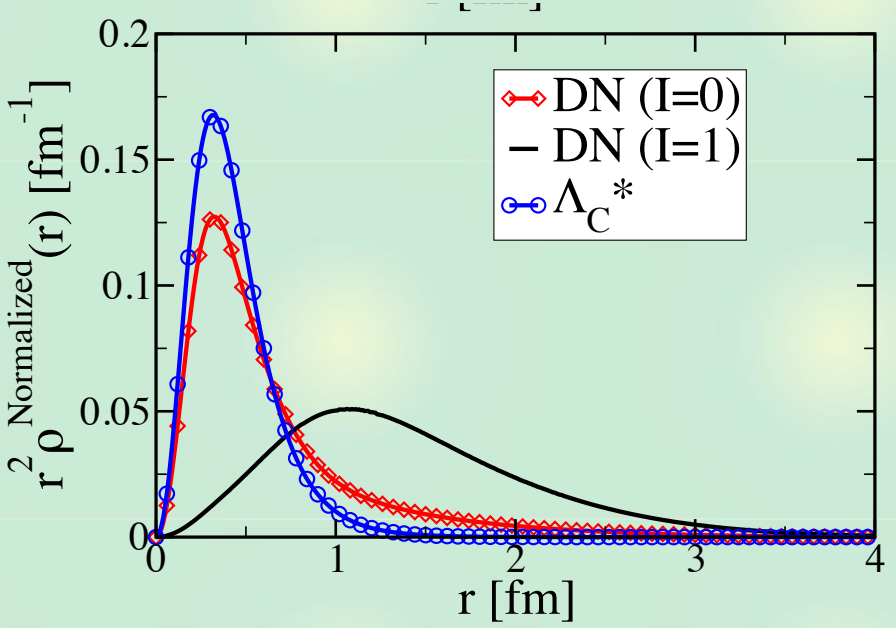
- narrow negative parity Λ_c^*, analogous to $\Lambda(1405)$?

Variational calculation: results

Results of the DNN system (I=1/2)

- **Bound state in J=0 channel. J=1 is unbound w.r.t. Λ_c*N.**
- **Mesonic decay width is small (~ 20-40 MeV).**
- DN (I=0) **correlation is similar to Λ_c* in vacuum.**





$$\rho_{DN}(r) = \langle \Psi | \sum_{i=1,2} \delta^3(|\boldsymbol{r}_D - \boldsymbol{r}_i| - r) | \Psi \rangle$$

M. Bayar, C.W. Xiao, T. Hyodo, A. Doté, M. Oka, E. Oset, Phys. Rev. C 86, 044004 (2012)

Extensions

- I=3/2 **sector of** DNN **state**
  - I=1 **component of the** DN **interaction**
  - **Information of** Σ_c^*
- **Bottom sector**
  - Λ_b^* **is recently observed by LHCb**
  - $\bar{B}$N **bound picture?**

DN isospin components in DNN

DNN **system with total isospin** I=1/2

- J=0, I_{NN}=1 **-->** DN(I=0):DN(I=1) **= 3:1** **c.f.** K^-pp
- J=1, I_{NN}=0 **-->** DN(I=0):DN(I=1) **= 1:3** **c.f.** K^-d

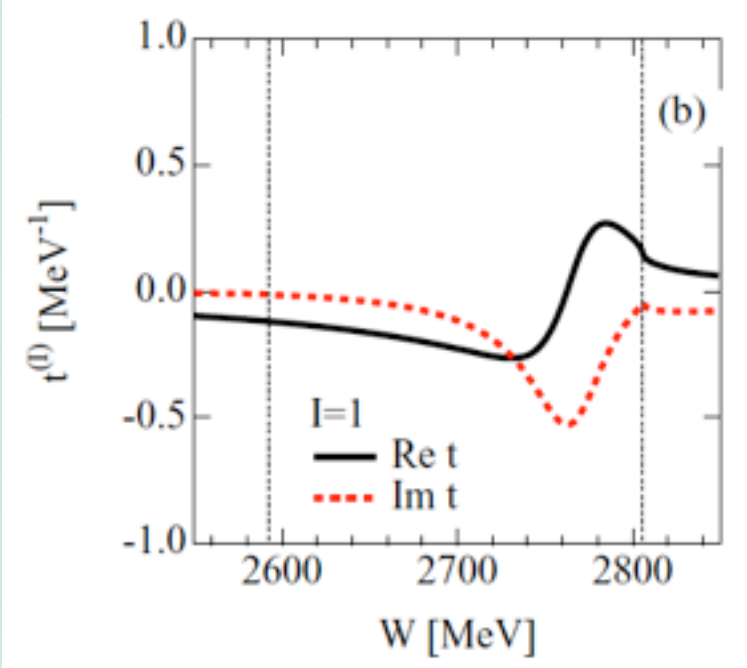
J=0 **is bound, because** Λ_c^* **is in** DN(I=0) **channel.**

DN(I=1) **is also attractive.**

Heavy mass of D

--> possible bound state (Σ_c^***?)**

with isospin symmetric cutoff.

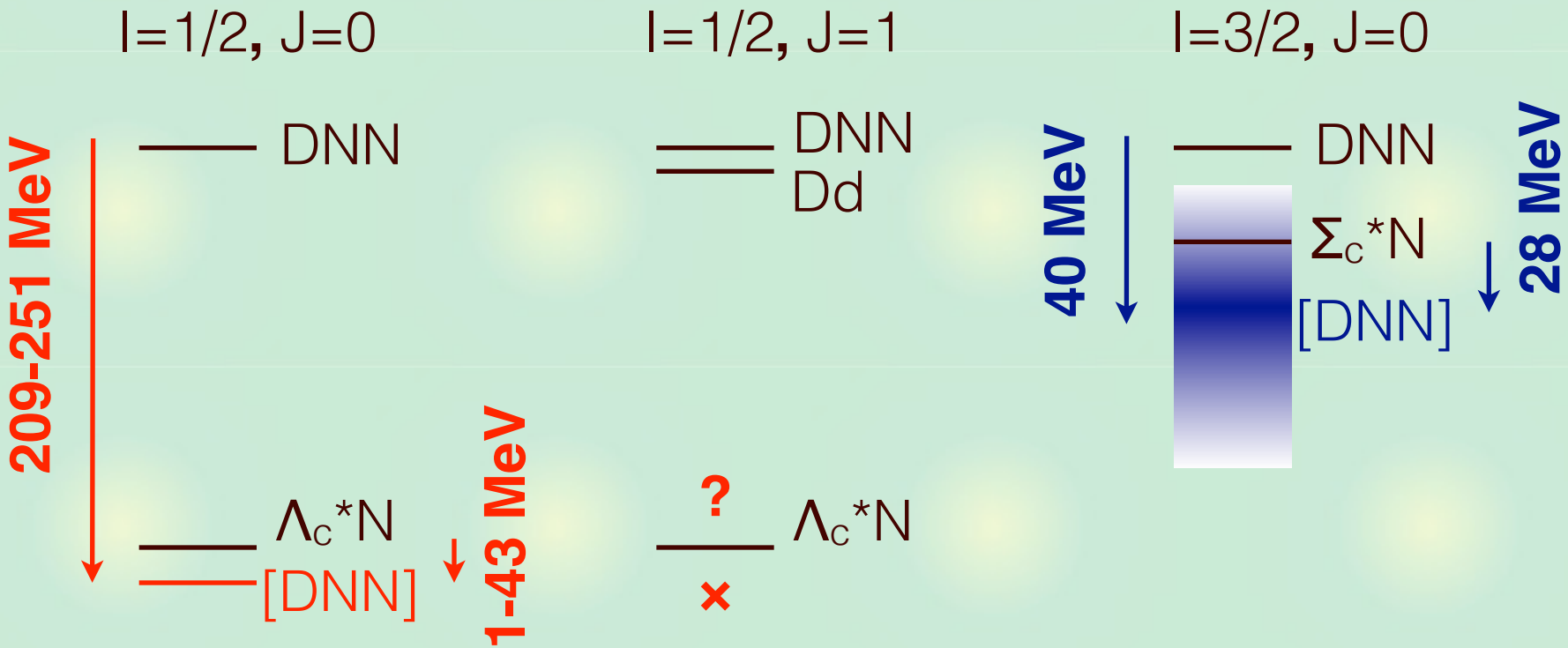


DNN **system with total isospin** I=3/2

- J=0, I_{NN}=1 **--> purely** DN(I=1)
- **Lowest threshold is** Σ_c^*N **(c.f. for** Λ_c^*N **in** I=1/2)

Result of DNN (I=3/2)

Spectrum of the DNN system

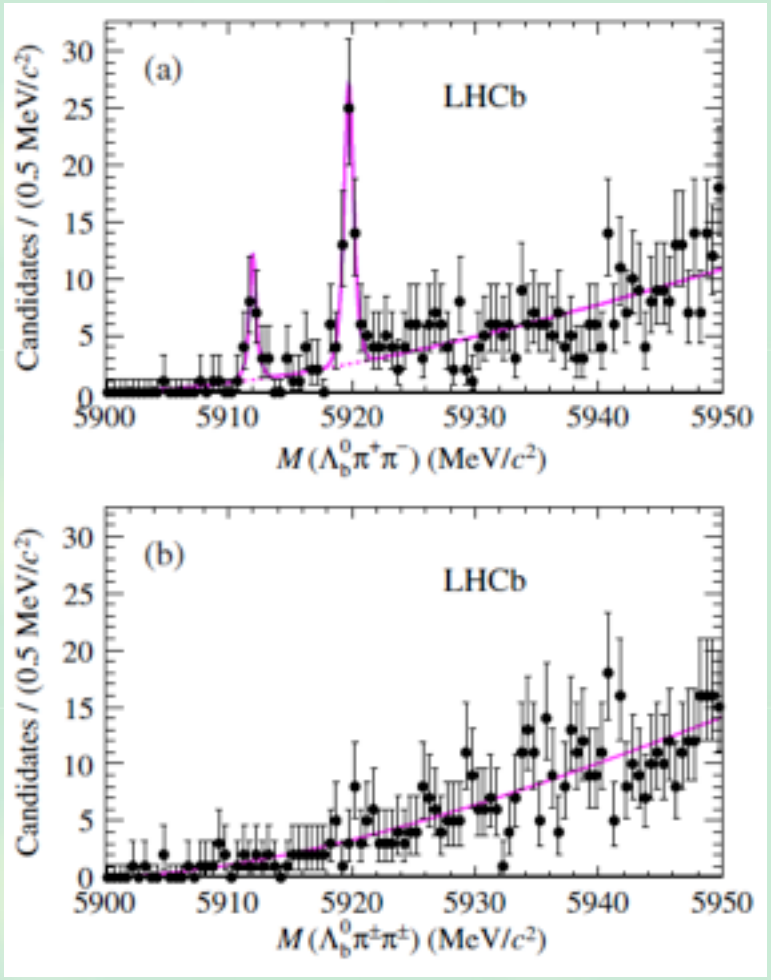


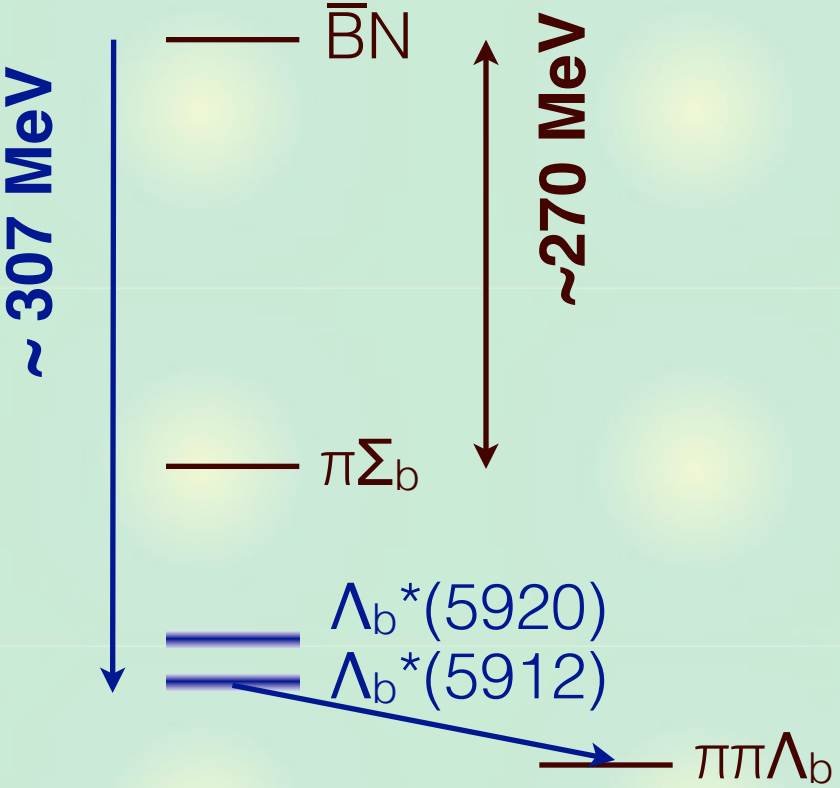
- **Bound state in** I=3/2
- **Mesonic decay width to** $\pi\Lambda_c N$, $\pi\Sigma_c N$ **is large (~ 100 MeV).**
- **Maximal charge:** D^+pp, D^0nn **--> advantageous in detection**
- **Closely related to the position of** Σ_c^*.

Bottom sector

LHCb recently found two excited Λ_b^* in $\Lambda_b\pi\pi$ spectrum

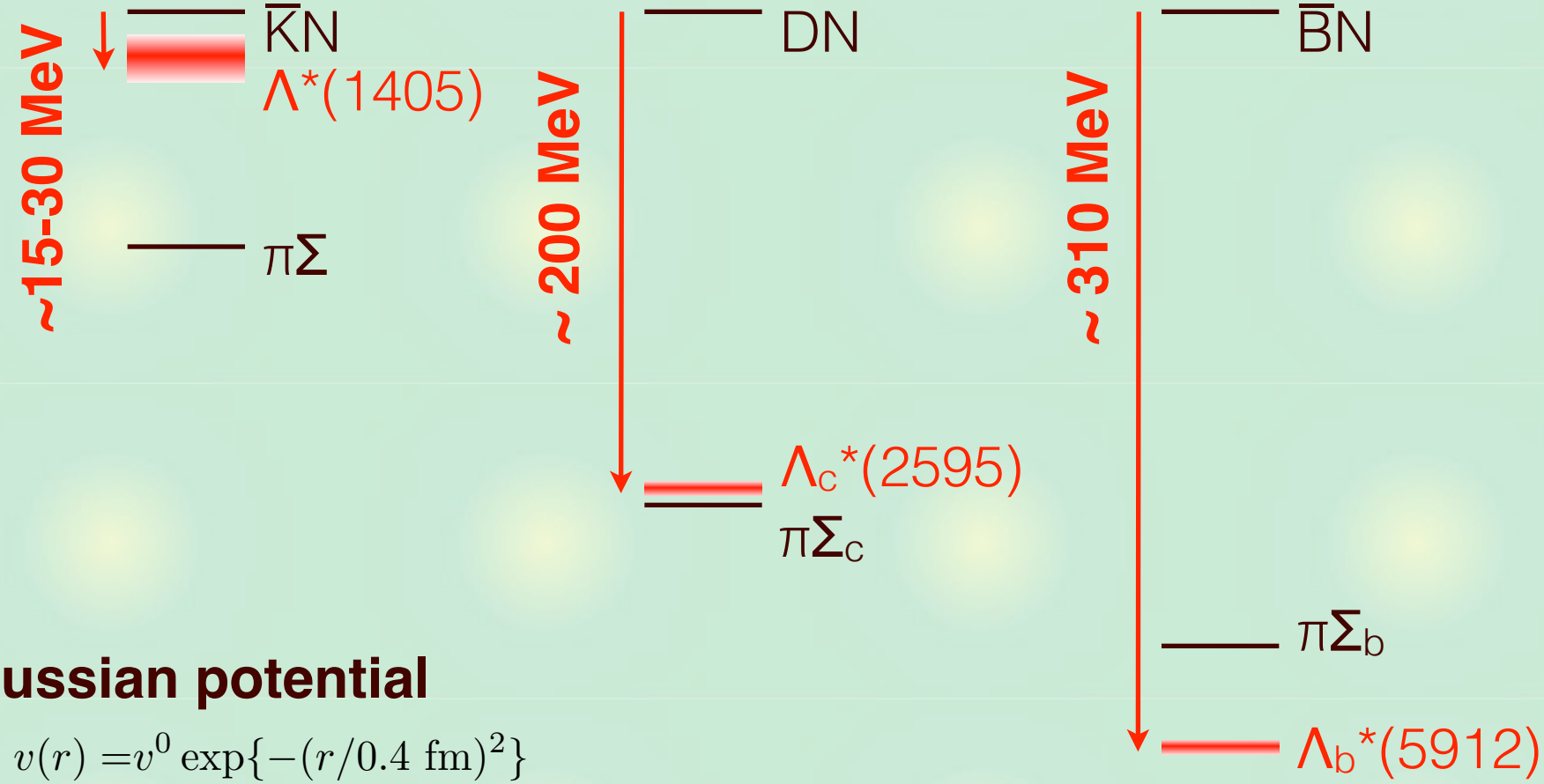
R. Aaij *et al.*, Phys. Rev. Lett. 109, 172003 (2012)





Simple potentials for $\bar{K}N$, $D N$, $\bar{B}N$

Can we regard Λ_b^* as a $\bar{B}N$ bound state?



Gaussian potential

$$v(r) = v^0 \exp\{-(r/0.4\ \mathrm{fm})^2\}$$

$\bar{K}N$	DN	$\bar{B}N$
$v^0_{\bar{K}N} = -1227 - 201i$ MeV	$v^0_{DN} = -1335 - 31i$ MeV	$v^0_{\bar{B}N} = -1363$ MeV
$\mu = 325$ MeV	$\mu = 625$ MeV	$\mu = 797$ MeV

Almost same potential strengths?

Summary

We study DN interaction and DNN system

- **Regarding $\Lambda_c^*(2595)$ as "DN quasi-bound state", bound state of DNN is found.**

  M. Bayar *et al.*, Phys. Rev. C 86, 044004 (2012)

- **DNN (I=3/2) may also be bound. It is related to the Σ_c^* resonance.**

- **Newly found $\Lambda_b^*(5912)$ can be regarded as a $\bar{B}N$ bound state with almost same potential strength with $\bar{K}N$ and DN.**