

# Heavy quark symmetry for production and decay



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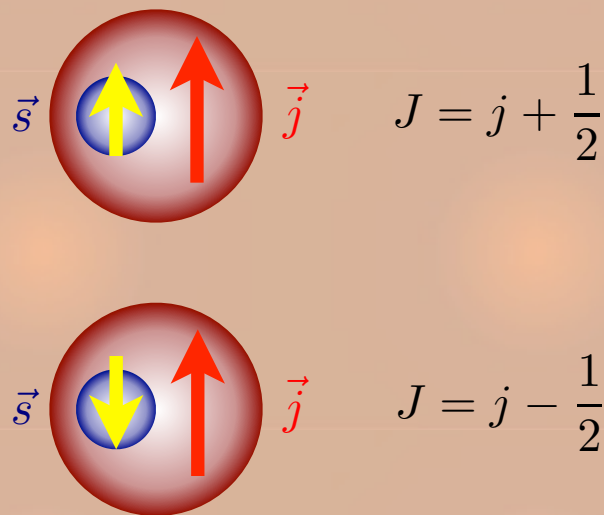
2014, Feb. 26th 1

## HQS multiplets

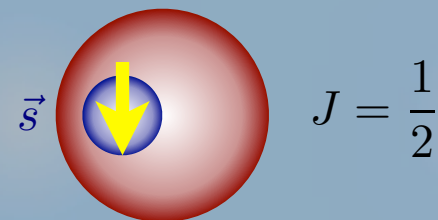
### Heavy quark symmetry (HQS)

N. Isgur, M.B. Wise, Phys. Lett. B 232, 113 (1989), ...

- spin of HQ is conserved in the heavy quark limit.
- singly-heavy hadrons form HQS multiplets.



**HQS doublet**



**HQS singlet**

Emergence of **spin-degeneracy** in the heavy quark limit

# Fractions in particle basis

## HQS for multi-hadrons: relation to particle basis

S. Yasui, K. Sudoh, Y. Yamaguchi, S. Ohkoda, A. Hosaka, T. Hyodo, Phys. Lett. B 727, 185-189 (2013);

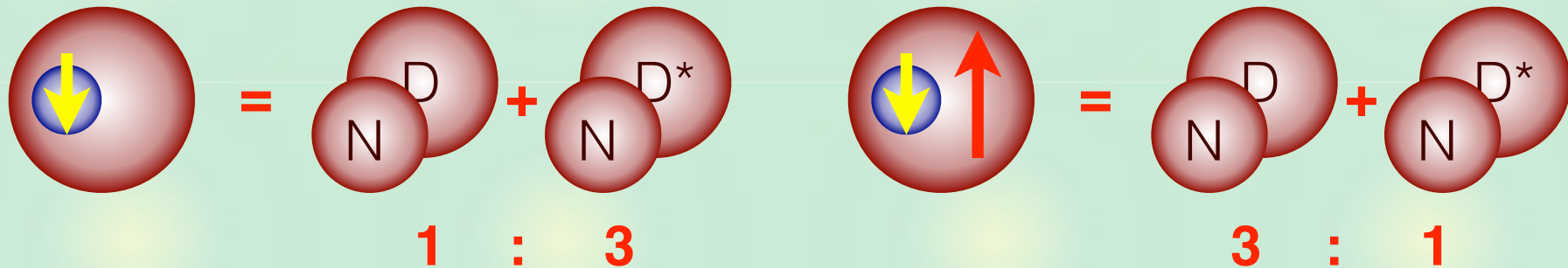
Y. Yamaguchi, S. Ohkoda, A. Hosaka, T. Hyodo, S. Yasui, arXiv:1402.5222 [hep-ph]

### - negative parity states with S-wave channels

$$|J = 1/2, j = 0\rangle = -\frac{1}{2}|DN\rangle + \frac{\sqrt{3}}{2}|D^*N\rangle$$

$$|J = 1/2, j = 1\rangle = \frac{\sqrt{3}}{2}|DN\rangle + \frac{1}{2}|D^*N\rangle$$

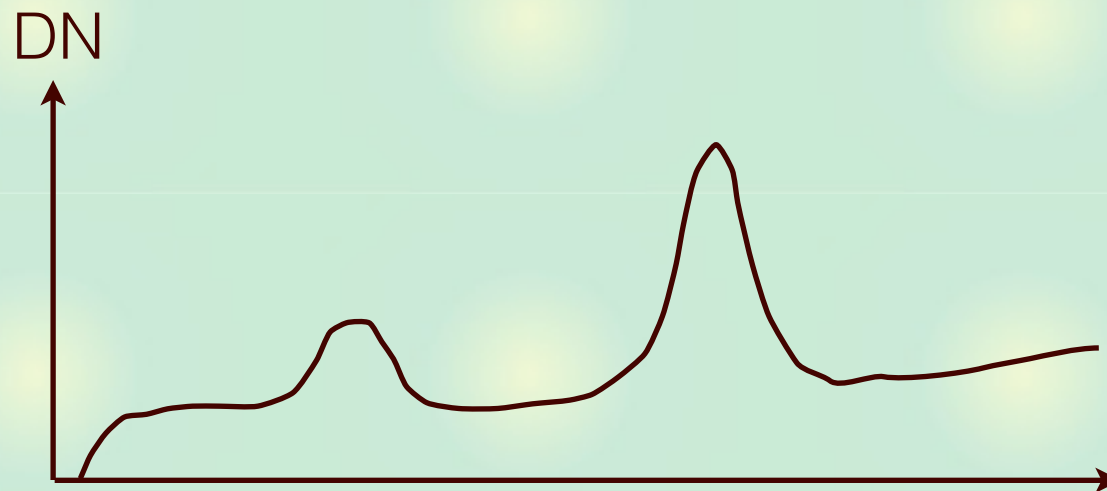
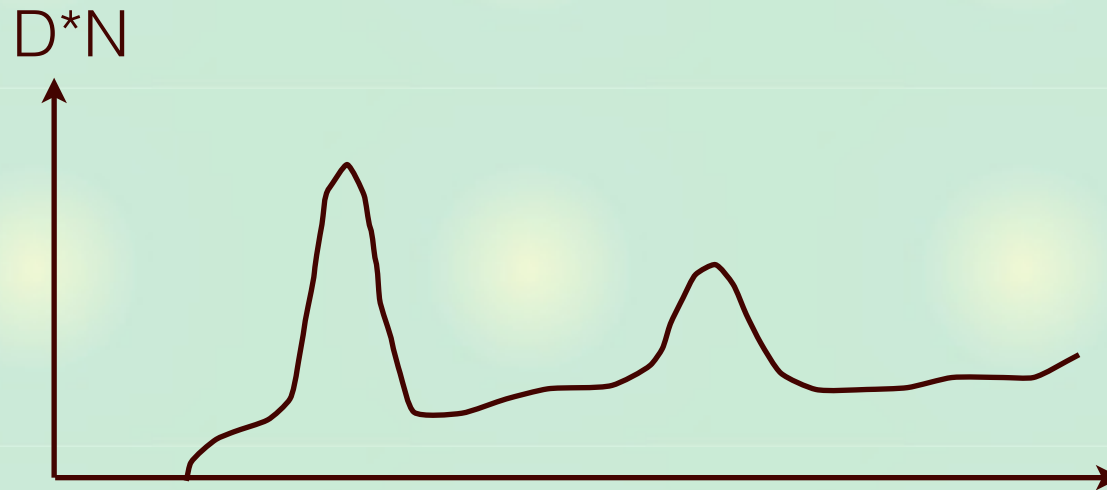
$$|J = 3/2, j = 1\rangle = -|D^*N\rangle$$



Result should hold for **any** structure of heavy hadrons

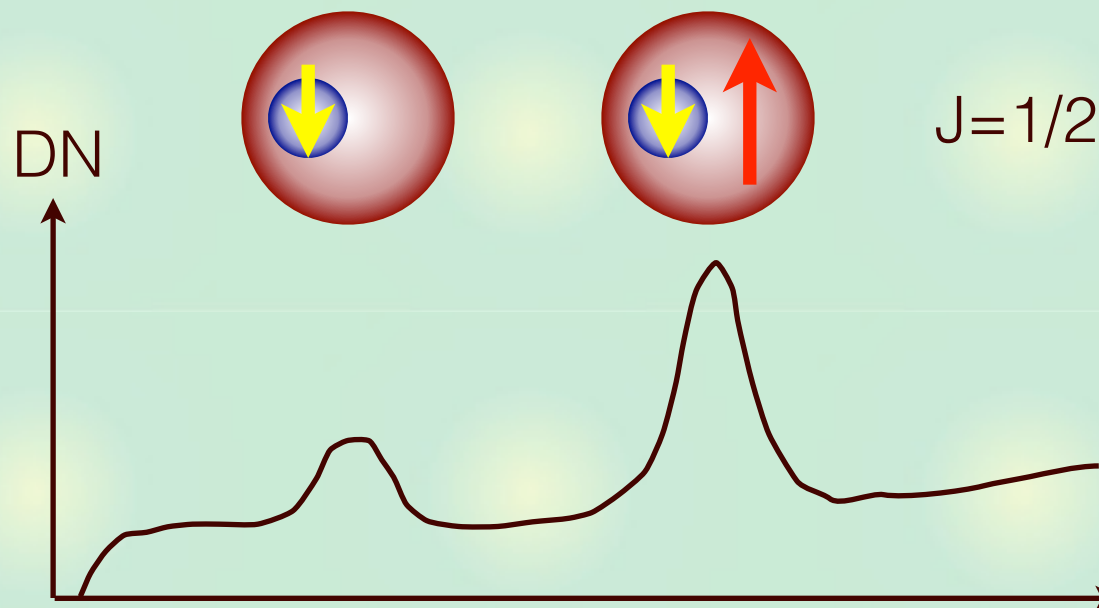
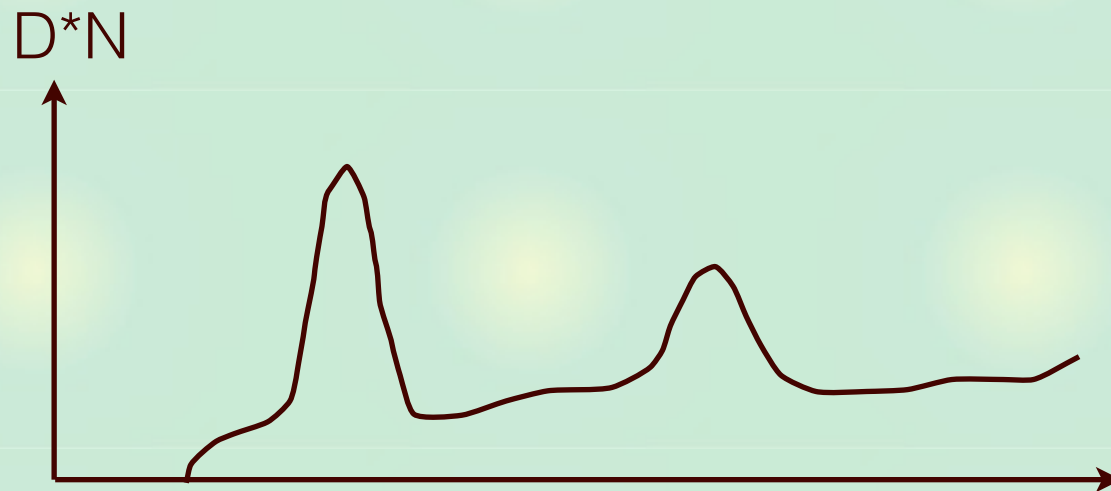
## Implication to spectrum

### Possible $DN/D^*N$ spectra



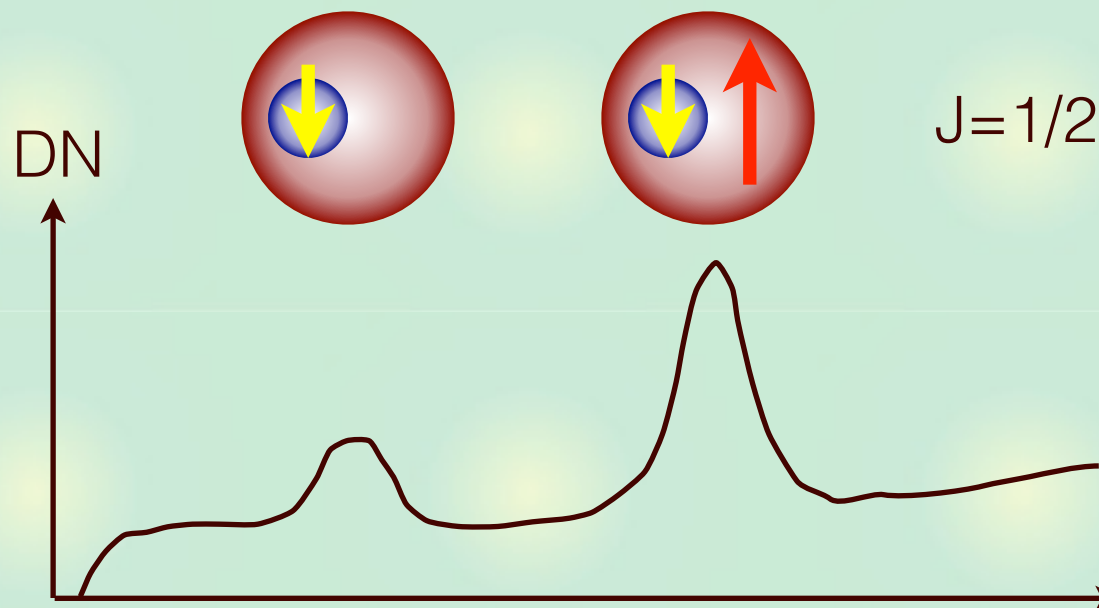
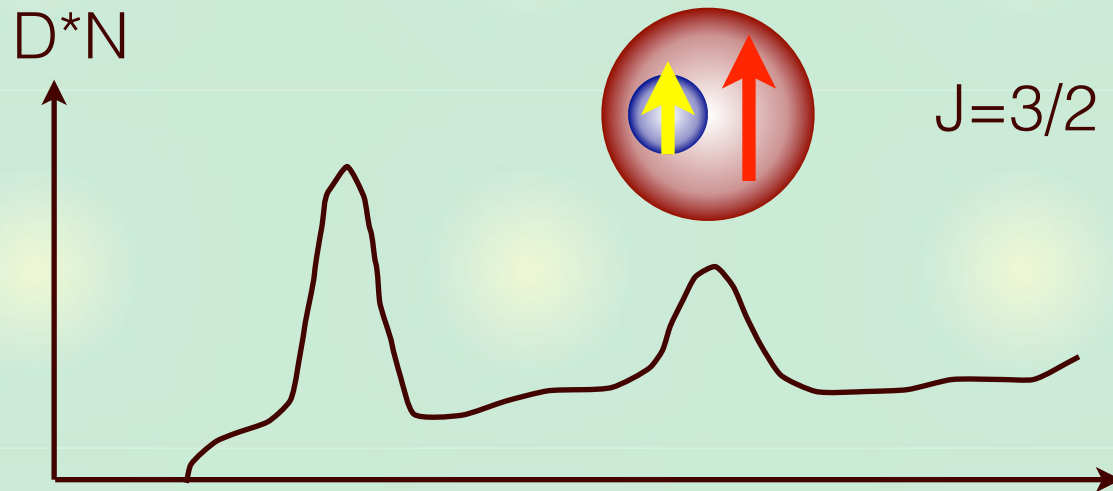
# Implication to spectrum

## Possible $DN/D^*N$ spectra






# Implication to spectrum

## Possible $DN/D^*N$ spectra



## Summary

# HQS for the production/decay of HQ hadrons

-  **HQS** provides model-independent constraints (LO in  $1/m_Q$  expansion) for hadron structure.
-  If one observe a heavy hadron with spin  $J$ , there must be a **partner** with  $J+1$  or  $J-1$  with a similar mass (exception:  $J=1/2$ ).
-  **Fractions** of components will be reflected in the production/decay.