Di-neutron correlations in ground and excited states

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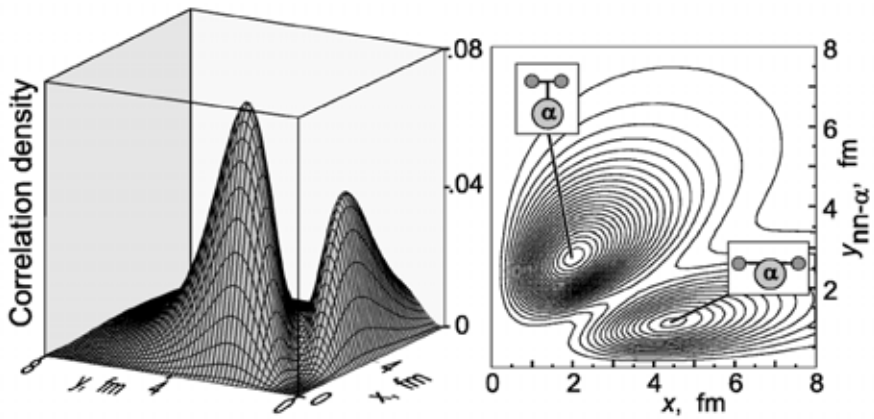
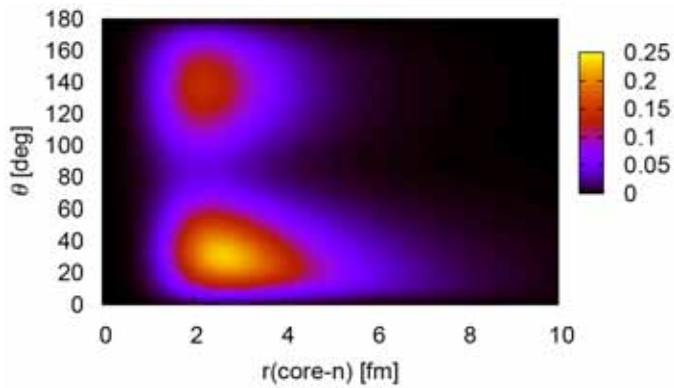
Di-neutron correlation in ^{6}He

- N-N correlations in nuclei
  - Two-peaked structure in two-neutron halo

⇒ di-neutron vs. cigar-like



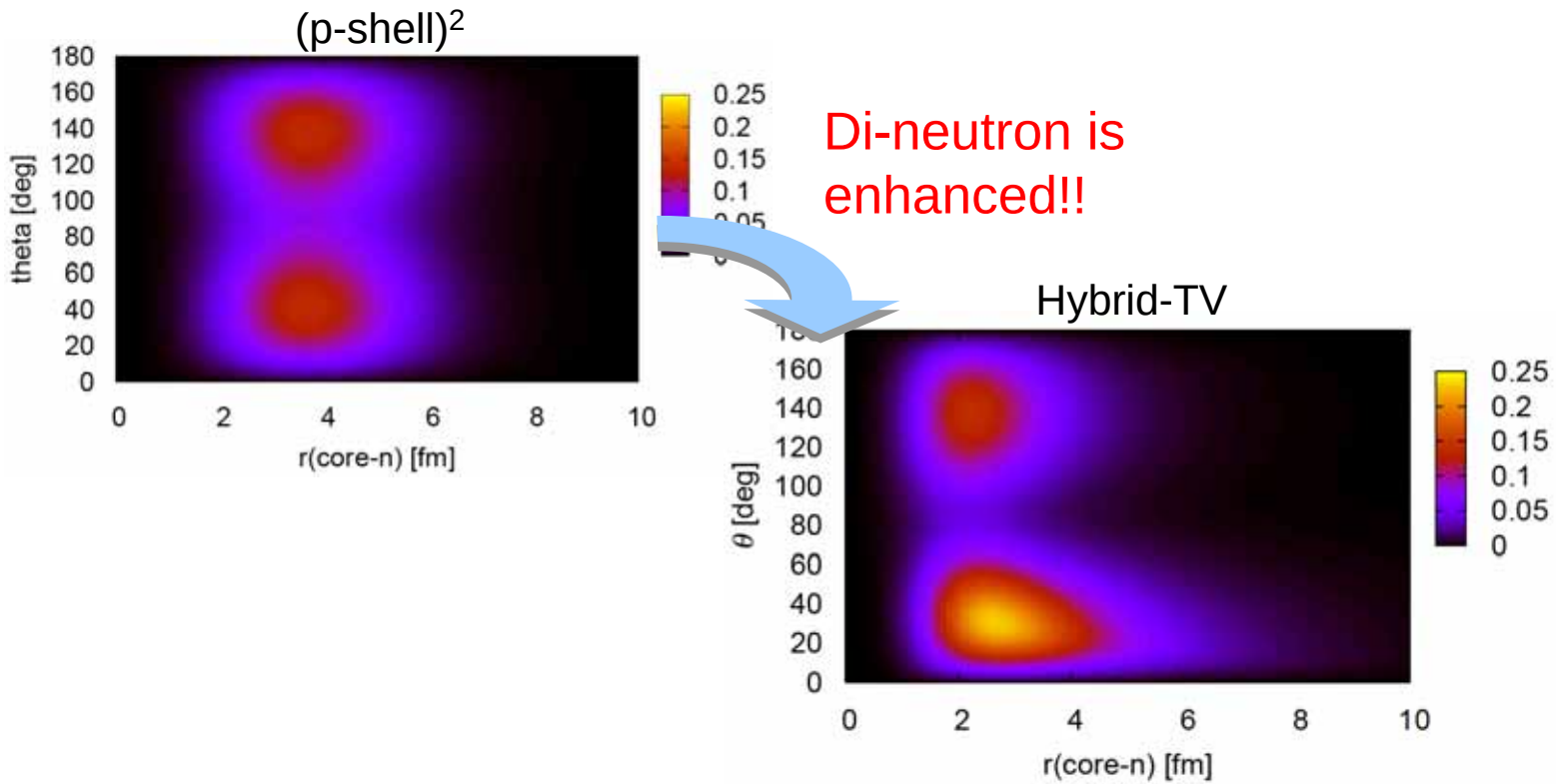


Yu.Ts. Oganessian, et al., Phys. Rev. Lett 82(1999), 4996

- Two types of configurations are suggested.
- What is important for such competitions in two-neutron halos?

Continuum coupling in halo

- Importance of the continuum coupling
  - The continuum coupling is important for the di-neutrons.

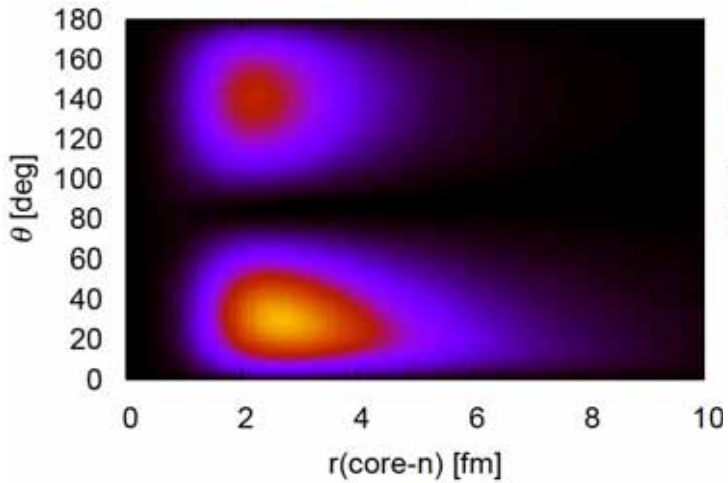


The continuum coupling enhances the di-neutron.

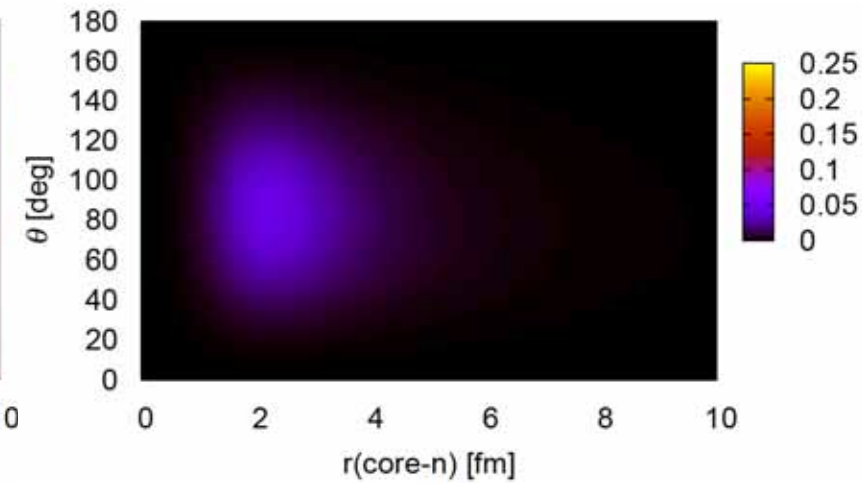
Di-neutron correlation in ground state

- The density distributions for valence neutrons
  - Density distributions for ^{6}He

spin singlet



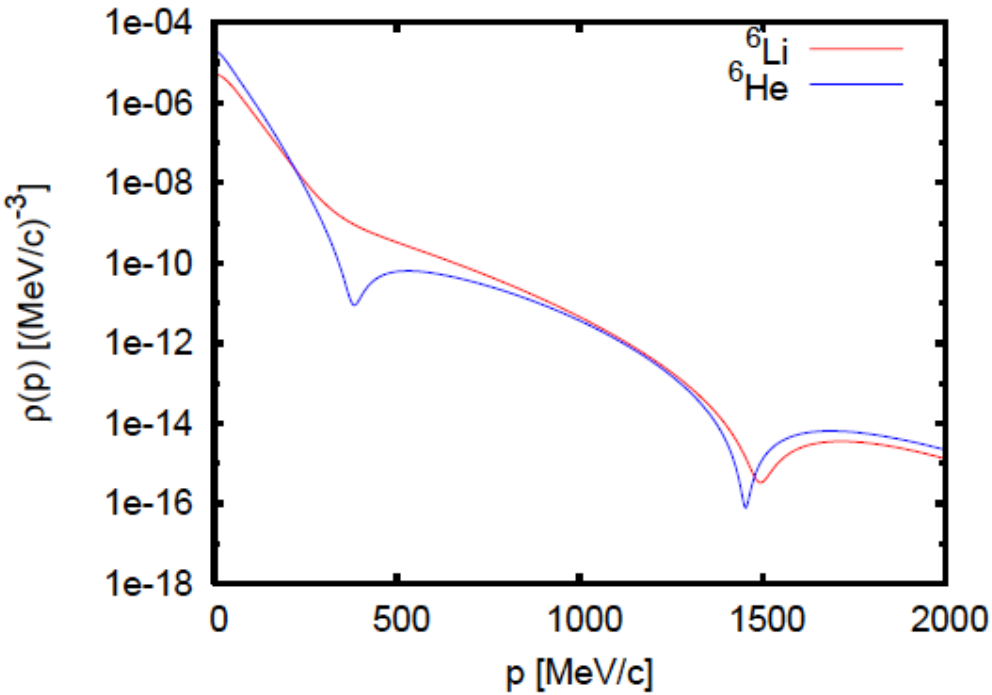
spin triplet



Spin singlet state is dominant for di-neutron correlation.

Di-neutron correlation in ground state

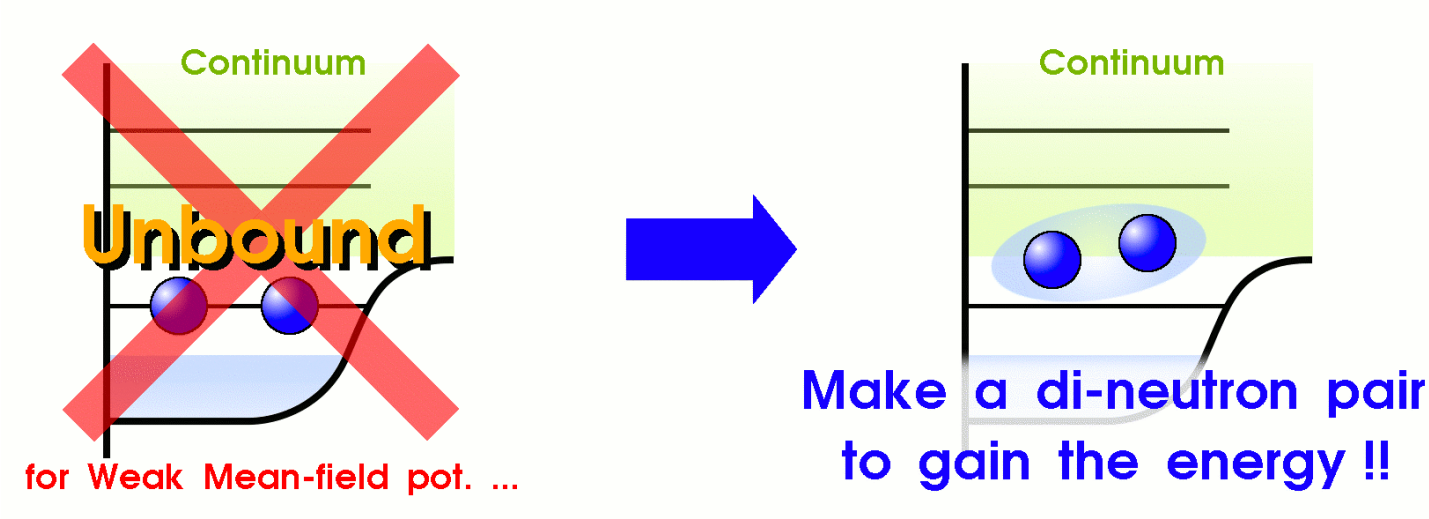
- Momentum distributions for valence neutrons



  - S-wave component is dominant for neutron pair in ^{6}He.
  - On the other hand, the s- and d-wave mixing occurs in ^{6}Li for strong tensor correlations.

Enhance mechanism of di-neutron

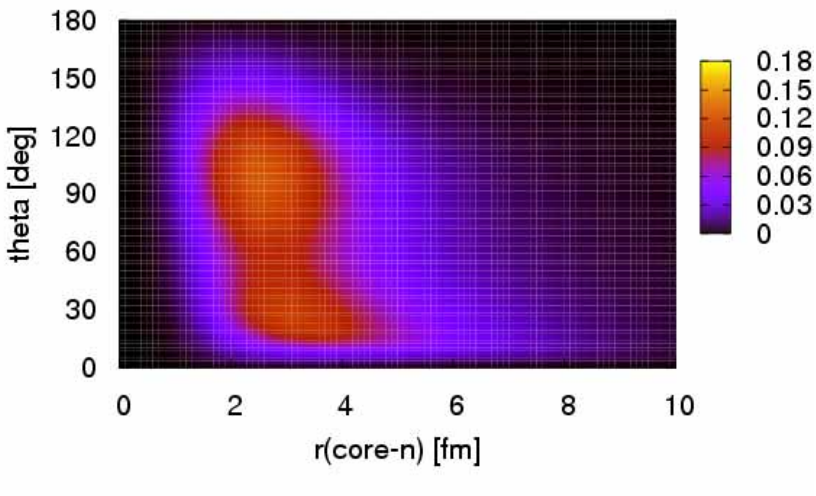
- Di-neutron correlations as $^1S_0$ clustering
  - The di-neutron is one of the results from a weak but attractive interaction between neutrons.



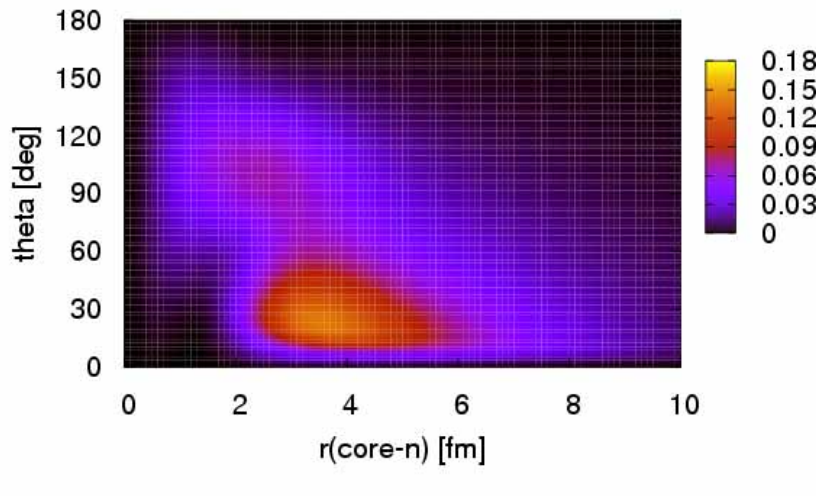
  - This mechanism also occurs in ^{6}Li to form the deuteron cluster.
  - The di-neutron is one of the precursor of clustering.

Di-neutron correlation in ^{11}Li

- Large s-wave mixing in ^{11}Li
  - $^1S_0$ clustering may be enhanced.



$(s_{1/2})^2$=6.3%



$(s_{1/2})^2$=46.9%

Large $^1S_0$ state enhances di-neutron correlation.

To analyze di-neutron correlation

- What is the di-neutron correlation?
  - The di-neutron correlation have been discussed as the exotic spatial correlations in theoretically.

  However…
  - How can we decompose the wave function into di-neutron and cigar-like experimentally?
  - Can we treat the di-neutron correlation as the ordinary cluster correlation?

  Ordinary cluster correlation

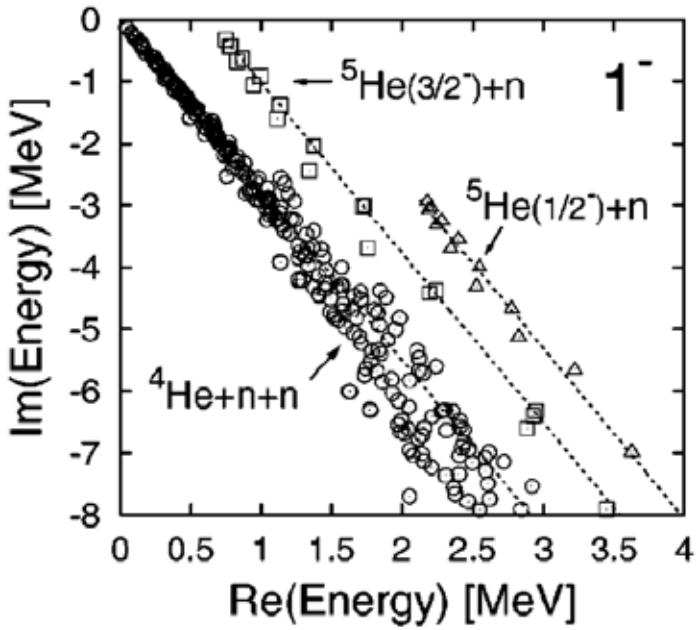
  ⇒ spatially localized and strongly correlated

  Di-neutron correlation

  ⇒ spatially localized but weakly correlated

Di-neutron correlation in excited state

- Soft dipole mode of ^{6}He
  - If we can consider the di-neutron as the cluster, soft dipole mode must exist.

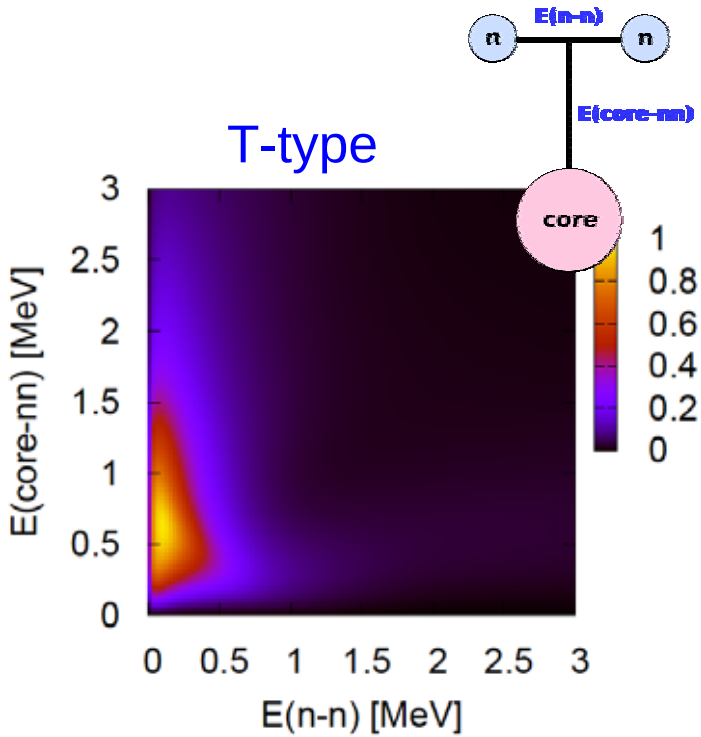


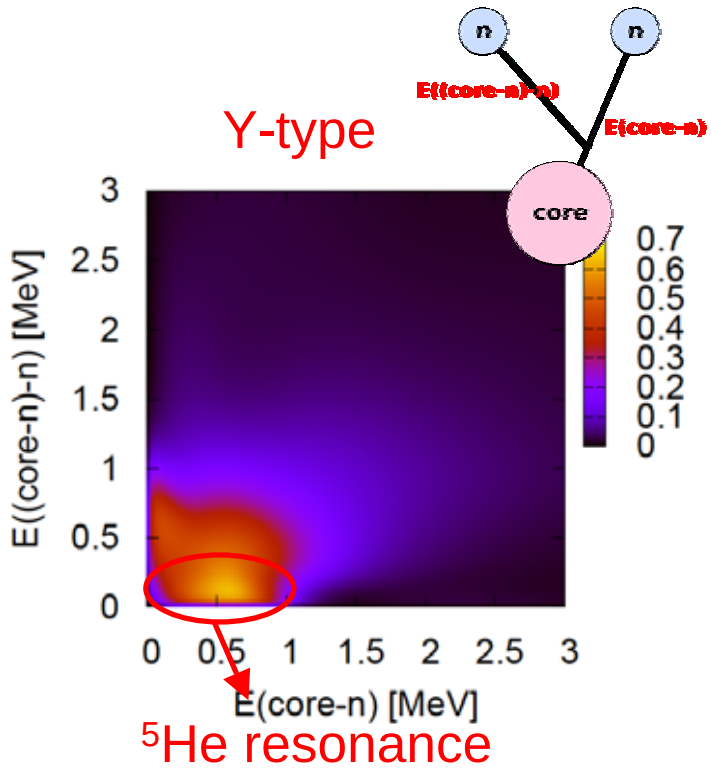
T. Myo, et al., PRC63 054313(2001)

Di-neutron should not be considered as the ordinary cluster.

Coulomb breakup reaction of ^{6}He

- E1 distribution of ^{6}He



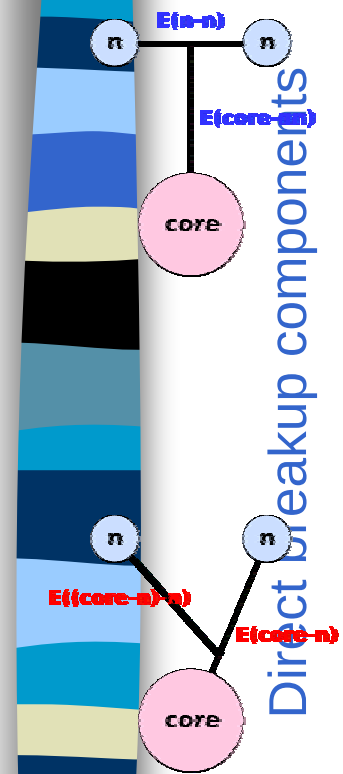


^{5}He resonance

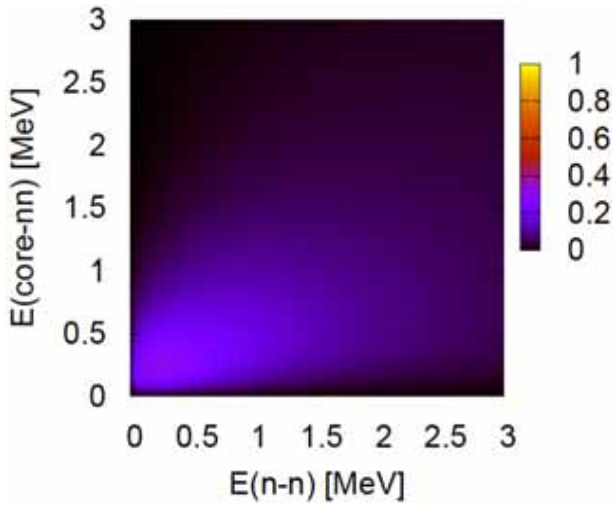
The peak of di-neutron correlation isn't found clearly.

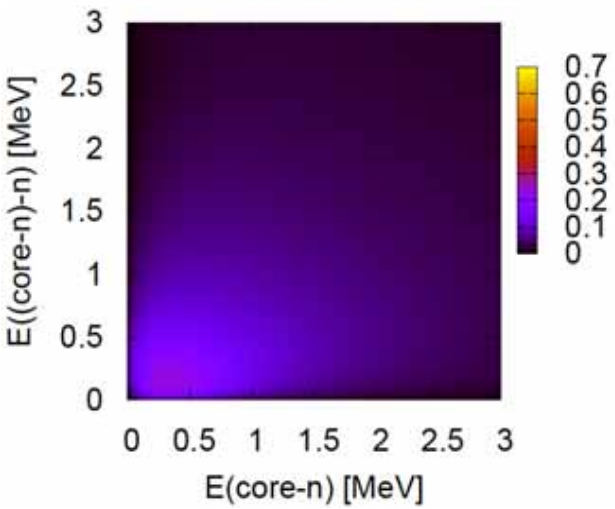
Contributions from ground state

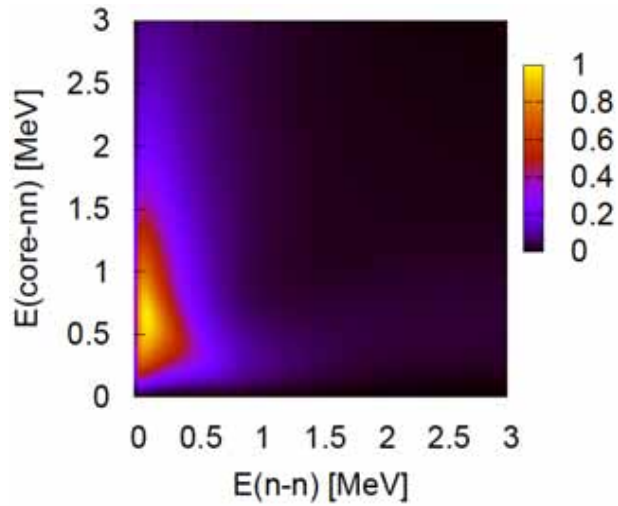
- Comparison – direct breakup vs. total strength –

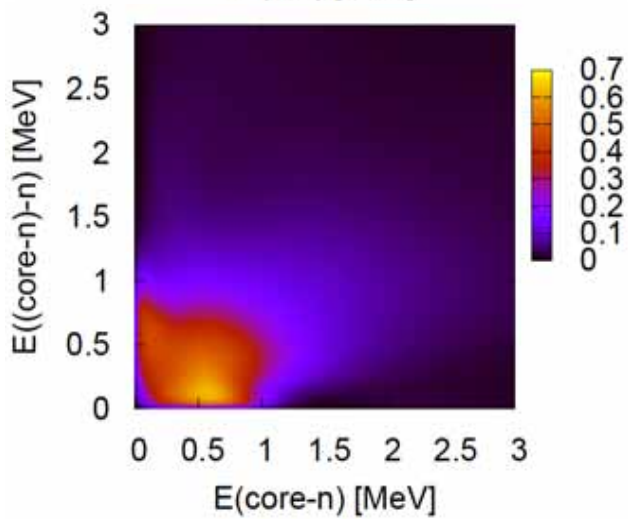


Direct breakup components









Total strength

Energy distributions to find di-neutron

- Di-neutron correlation in E1 transition
  - Di-neutron correlation is weakly interacted in nuclei and much smaller than the ^{5}He contributions.
  - Energy distributions do not show the two-peaked structure of di-neutron and cigar-like.

Energy distribution may not be a good tool to determine the spatial correlation which is weakly interacting?

Summary

- Di-neutron correlation

  ⇒ It can be understood as the precursor of clustering

  – Mainly $^1S_0$ neutron pair is formed as shown in momentum and density distributions.
  – Density distributions of two-neutron clearly show the two-peaked structure.
  – However, momentum and energy distribution cannot decompose into di-neutron and cigar-like

We should consider what is di-neutron correlations.

⇒ Spatial correlations? or Interactions between neutrons?