INTERESTING STATES IN A=10 MASS REGION, POPULATED IN $^{10}\text{B} + ^{10}\text{B}$ NUCLEAR REACTIONS

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NUCLEI AROUND A=10

- Shell model states
- Cluster states
- Nuclear molecules
- Bose-Einstein condensates
- ...

$^{10}\text{B}$: spin 3$^+$ in the ground state!

Ivano Lombardo (INFN - Catania, Italy) - Analysis of excited states in $^{13}\text{C}$ and their cluster structure
10B + 10B MEASUREMENT

Beam: $^{10}\text{B}$, 4+, $I\approx 5\text{enA}$
Energy: 50 and 72.2 MeV

3 detector setups:

- $40^\circ$, $20^\circ$, $30^\circ$, $50^\circ$
- $40^\circ$, $20^\circ$, $20^\circ$, $40^\circ$
- $46^\circ$, $26^\circ$, $33^\circ$, $53^\circ$
nuclei form $^1\text{H}$ up to $^{13}\text{C}$ detected

at both beam energies the number of detected $\alpha$-particles was remarkably higher than any other detected nuclei

double and triple $\alpha$-particle coincidences
A coincident detection of three $\alpha$-particles enabled reconstruction of the $^{10}\text{B} + ^{10}\text{B} \rightarrow 5\alpha$ reaction, and associated $^{12}\text{C}$ spectra of intermediate states.
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Rarely seen state at $E_x = 30.3$ MeV is found to be strong in the $d + ^{10}\text{B}$ decay channel, reinforcing the previous suggestions that it has the exotic $2\alpha+2d$ molecular structure.
In four nucleons transfer reaction channel, excited states of the $^{14}\text{N}$ at $E_x = 13.2$ and $15.39$ MeV were measured. Both of them fit nicely to a recent AMD calculations as the head and the $5^+$ state of the $^{10}\text{B}(3^+) + \alpha$ rotational band ($K^\pi = 3^+$).


RESULTS FOR $^{14}\text{N}$
A very strong α-decaying state is seen at the $E_x = 18.9$ MeV in $^{13}$C. This state has pronounced $^9$Be + α structure, and is a good candidate for molecular state with one valence nucleon orbiting around 3 α centers.
AND MANY OTHER CHANNELS...

States that nicely fit into ground state rotational bands of $^9$B and $^9$Be these nuclei are clearly observed as their $9/2^-$ members.

The most interesting states in $^{11}$B and $^{11}$C inclusive spectra are 10.74 MeV in $^{11}$C and 11.42 MeV in $^{11}$B, which are populated in one nucleon transfer reaction for the first time.
Results were obtained for the $^{8,9}$Be, $^{9,10,11}$B, $^{10,11,12,13}$C, $^{14}$N, and $^{16}$O nuclei.

Analysis of another experiment: $^{7}$Be + $^{6,7}$Li on E = 45MeV beam.

Future experiments to reveal characteristics of the new states populated here.
THANK YOU FOR YOUR ATTENTION!

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