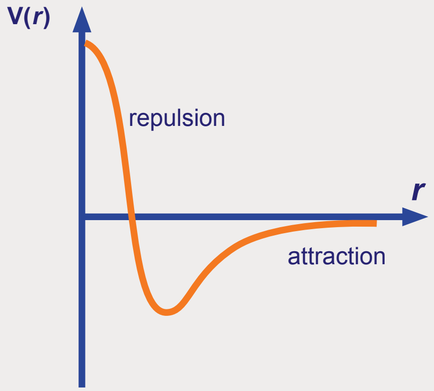
Beyond the Shell Model
Short Range Correlations in Nuclei

Ran Shneor[1], Peter Monaghan[2] and Ramesh Subedi[3]

1 Tel Aviv University, Tel Aviv, 69978, Israel
2 Massachusetts Institute of Technology, Cambridge, MA 02139, USA
3 Kent State University, Kent, Ohio, 44242, USA

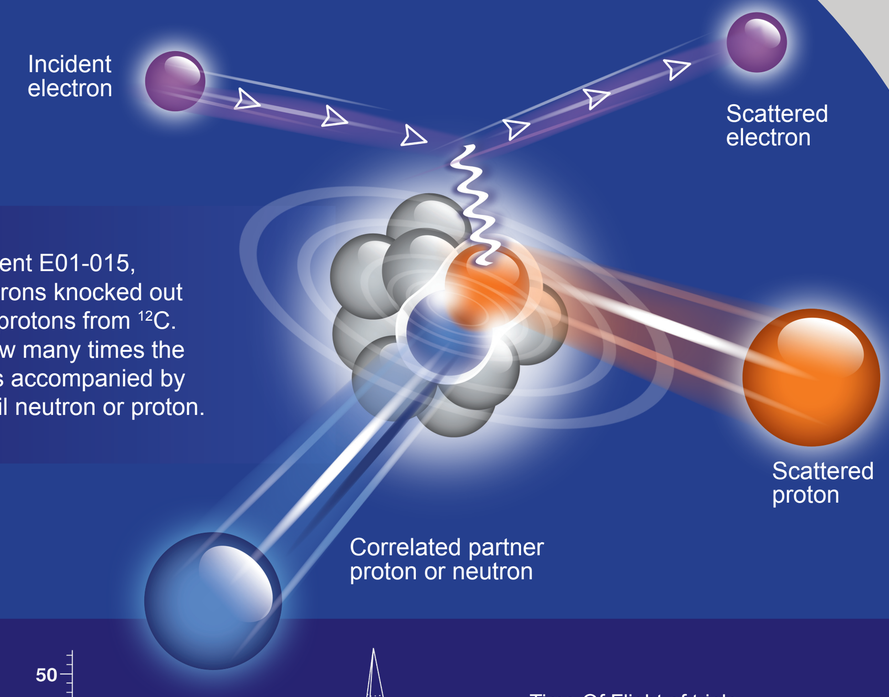
Short Range Correlations

In the shell model, nucleons move independently in well-defined quantum "orbits" in the nuclear mean-field. The mean field is dominated by the long-range attractive part of the N-N interaction.

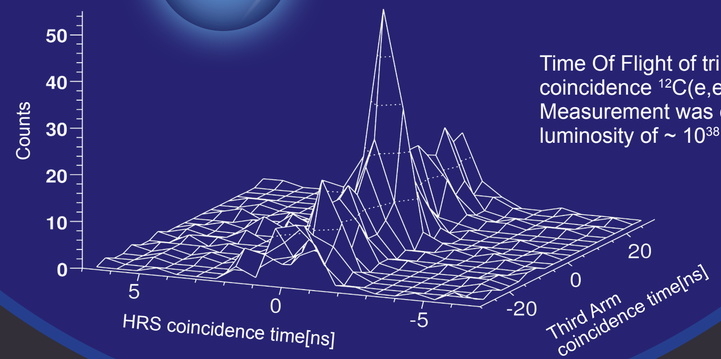


Due to the N-N interaction at short distances, a significant fraction (~20%) of nucleons form pairs instead of moving independently. The dominant repulsive part of the interaction at these distances, causes high relative momentum between the nucleons in the pair.

The Experiment



In Hall-A experiment E01-015, high-energy electrons knocked out high-momentum protons from ^{12}C. We measured how many times the struck proton was accompanied by a coincident recoil neutron or proton.

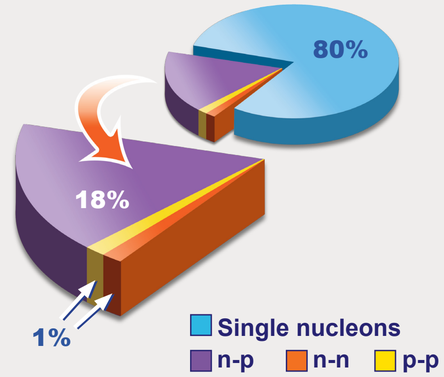


Time Of Flight of triple coincidence ^{12}C(e,e'pp) events. Measurement was done at luminosity of ~ 10^{38} [cm^{-2}sec^{-1}]

Results

We identified p-p and n-p short range correlated pairs in ^{12}C and showed that :

- **Almost all nucleons with momentum above the Fermi momentum in ^{12}C are paired.**
- **n-p pairs are nearly 20 times more prevalent than p-p pairs.**



The dominance of n-p over p-p SRC pairs is a clear fingerprint of the short-range N-N tensor force. This has far-reaching implications for modeling and understanding cold dense nuclear matter such as neutron stars.