# The Perspectives of Nuclear Structure and Nuclear Dynamics

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The Perspectives of Nuclear Structure and Nuclear Dynamics

- Towards the Drip\_Lines
- Light Nuclei and Resonances
- Changes in shell structure far from stability
- Neutron-Proton pairing
- 2-proton radioactivity
- super-heavy elements
- The Liquid-gas Phase transition
- Fragmentation and ISOL: FAIR and EURISOL





## The Nuclear Chart and Challenges





• Systematic study of light nuclei (A<12) shows the necessity of including a 3-body force



R.B. Wiringa and S.C. Pieper, Phys. Rev. Lett. 89 (2002) 182501

# Superheavy Hydrogen <sup>5</sup>H



E'511 (MeV)

A.A. Korsheninnikov et al. PRL 87 (2001) 092501

### **Predictions for 4-neutron system**

"I show that it does not seem possible to change modern nuclear Hamiltonians to bind tetraneutron without destroying many other successful predictions of those Hamiltonians. <u>This means that, should a recent</u> <u>experimental claim of a bound tetraneutron be confirmed, our understanding</u> <u>of nuclear forces will have to be significantly changed</u>..."

S. C. Pieper, PRL 90, June 2003



## <sup>8</sup>He(d,<sup>6</sup>Li)4n results



# Modification of magic numbers far from stability





# Effect of shell closures on element abundances



# Neutron-proton pairing



• n-p pairing can occur in 2 different states: T=0 and T=1. The former is unique to n-p. It can be best studied in N=Z nuclei through spectroscopy and 2-nucleon transfer reactions. Two-proton radioactivity near the proton drip-line

#### Proton energy and angle correlations → di-proton emission?



J. Giovinazzo et al., PRL89 (2002) 102501







#### Super heavy elements : discovery and spectroscopy



- > Synthesis of new elements/isotopes ( $Z \rightarrow 120$ )
- Shell structure of superheavy nuclei

## Studying the liquid-gas phase transition far from stability Muller Serot PRC 1995

Neutron rich nuclei: isospin distillation

Bonche Vautherin NPA 1984





Proton rich nuclei: vanishing limiting temperatures

From Ph. Chomaz and F. Gulminelli

## A new generation of RIB facilities: more exotic; more intensity(X10<sup>3</sup>)



Beta-decay, mass measurements: A few counts per minute COULEX : 10 pps Knock out :10<sup>2</sup> pps Direct Reactions :10<sup>4</sup> pps Fusion :10<sup>5</sup> pps



