




Status of R³B – Technical developments and experiments

Quasi-free knockout reactions in inverse kinematics at R³B

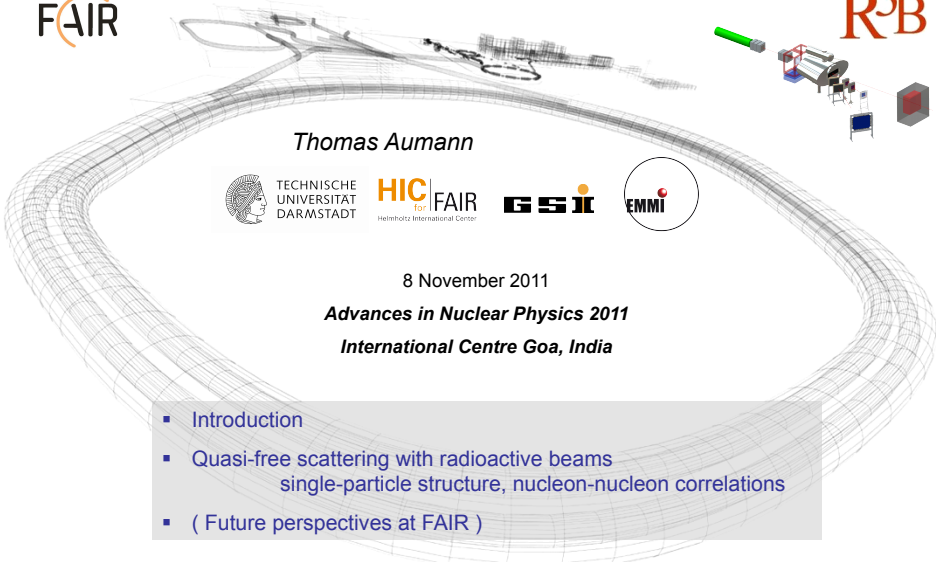
Thomas Aumann



8 November 2011

Advances in Nuclear Physics 2011
International Centre Goa, India

- Introduction
- Quasi-free scattering with radioactive beams
single-particle structure, nucleon-nucleon correlations
- (Future perspectives at FAIR)



Beams of neutron-proton asymmetric nuclei

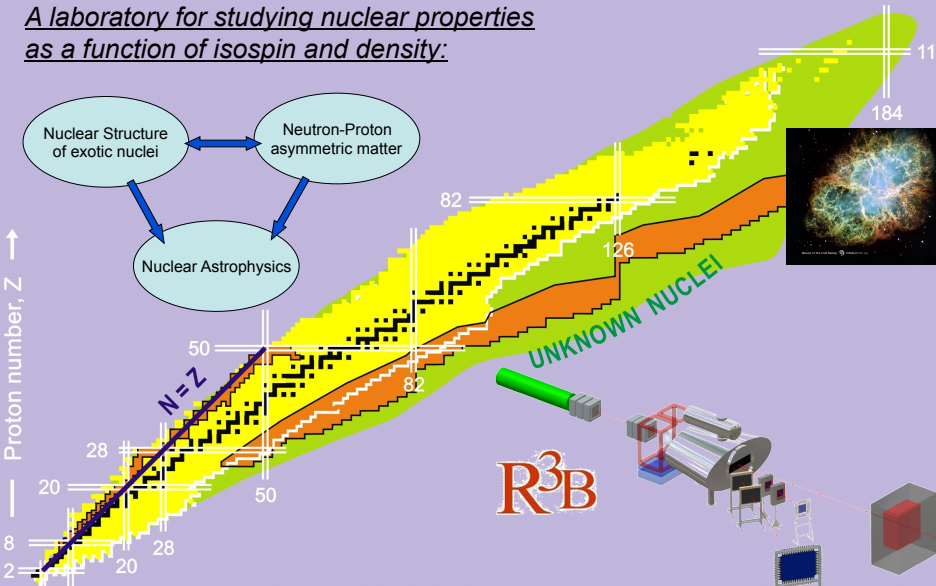
A laboratory for studying nuclear properties as a function of isospin and density:

Nuclear Structure of exotic nuclei

Neutron-Proton asymmetric matter

↔

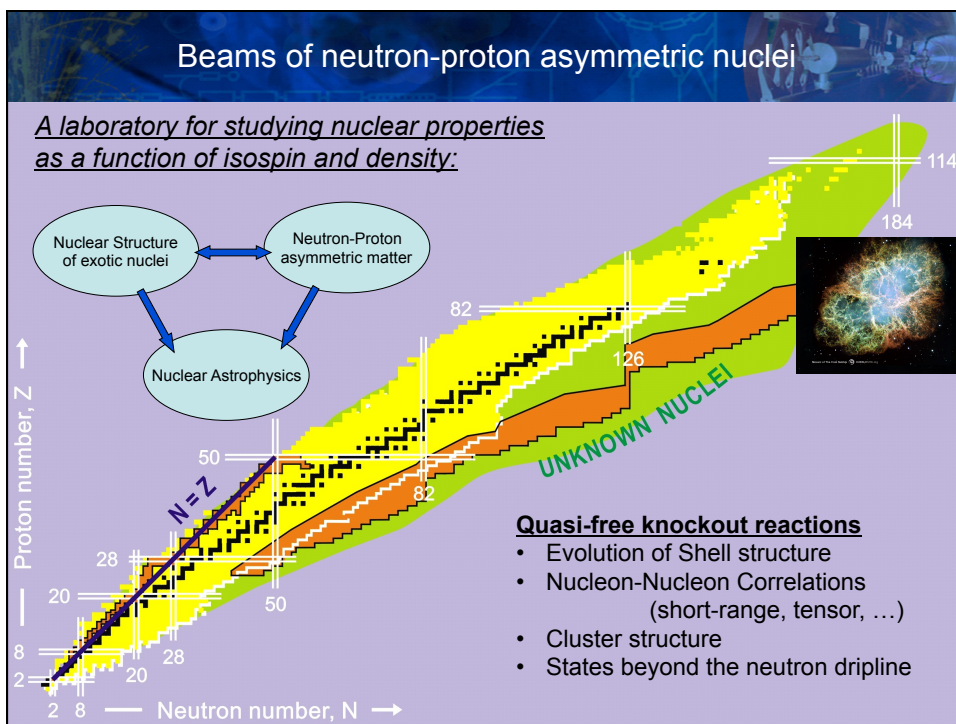
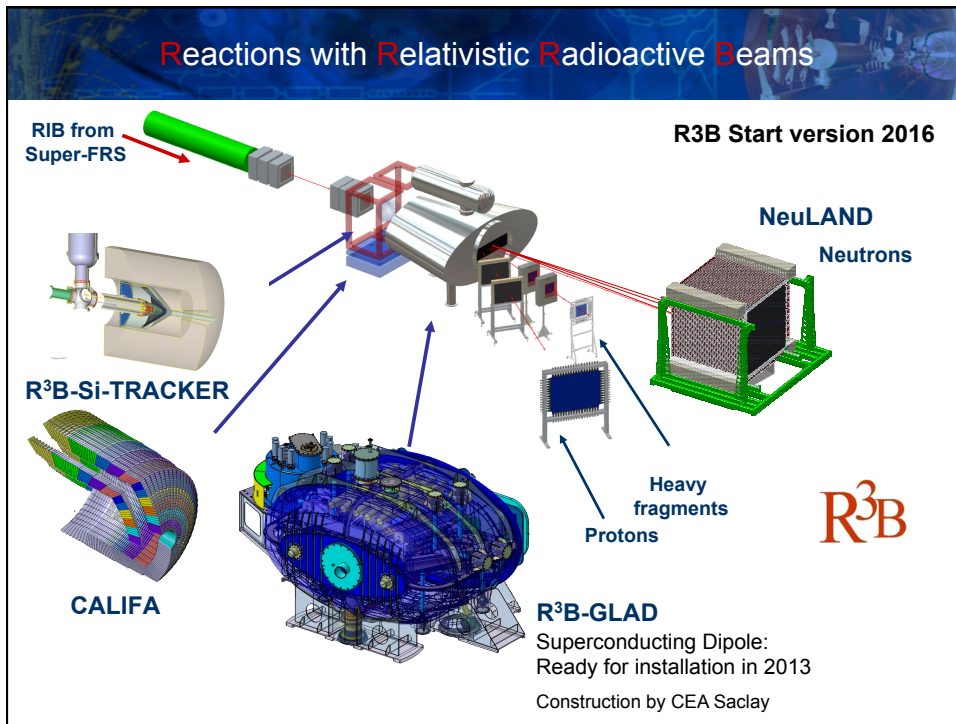
Nuclear Astrophysics



↑ Proton number, Z

2 8 20 28 50 82 126 184 114

2 8 — Neutron number, N →



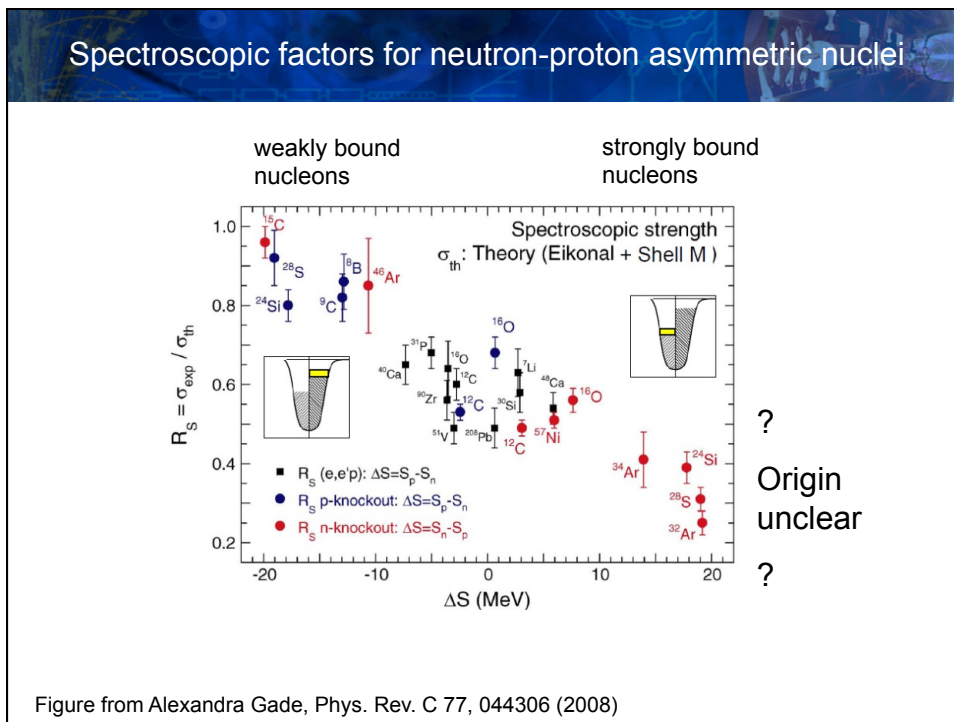
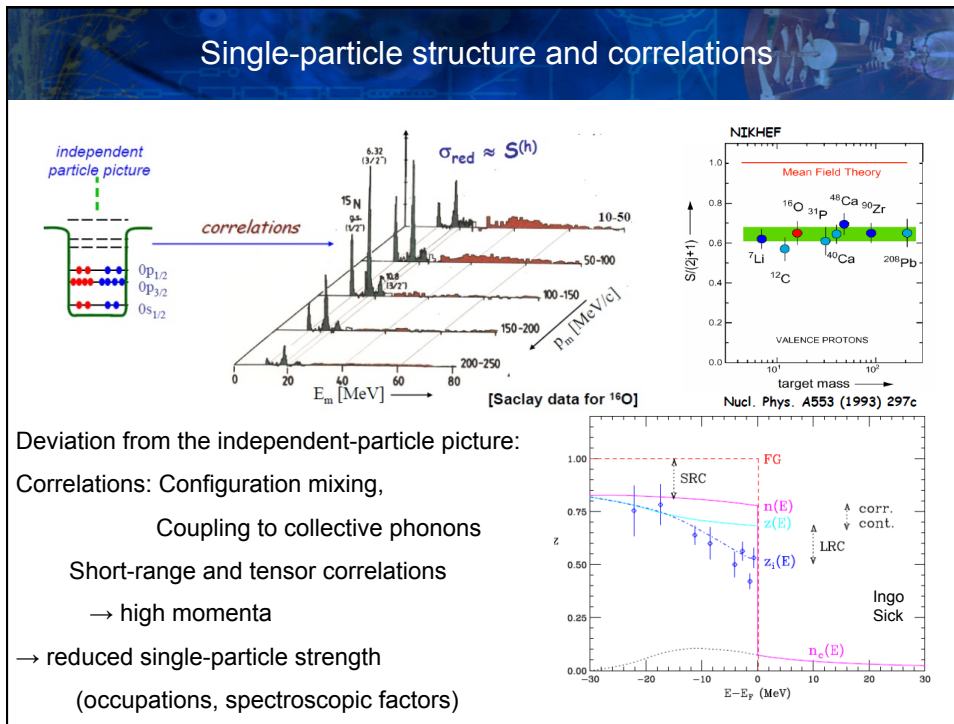
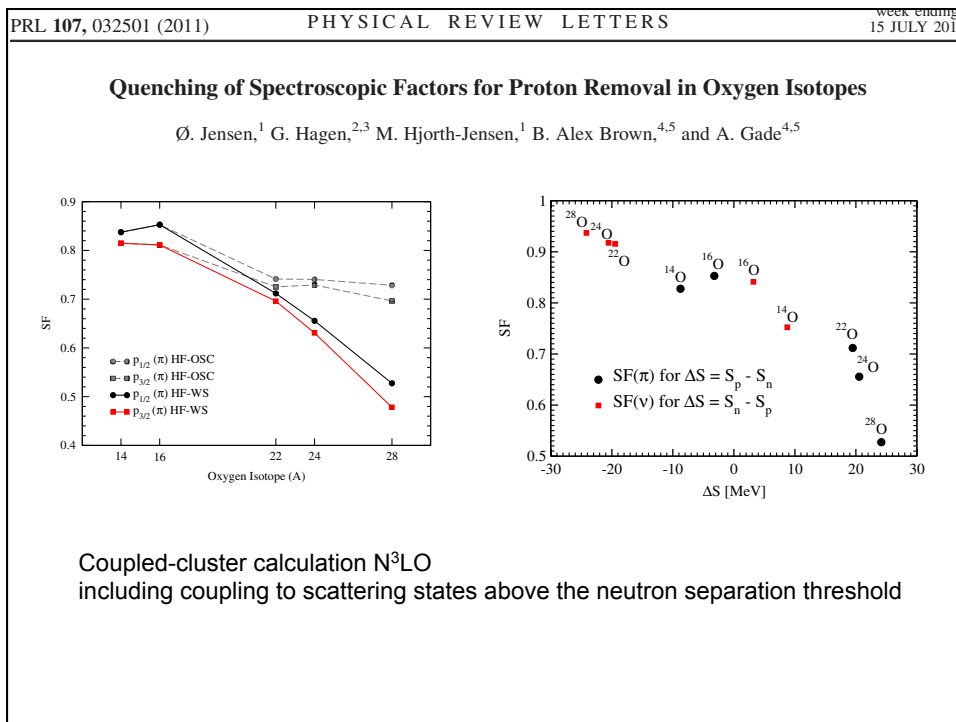
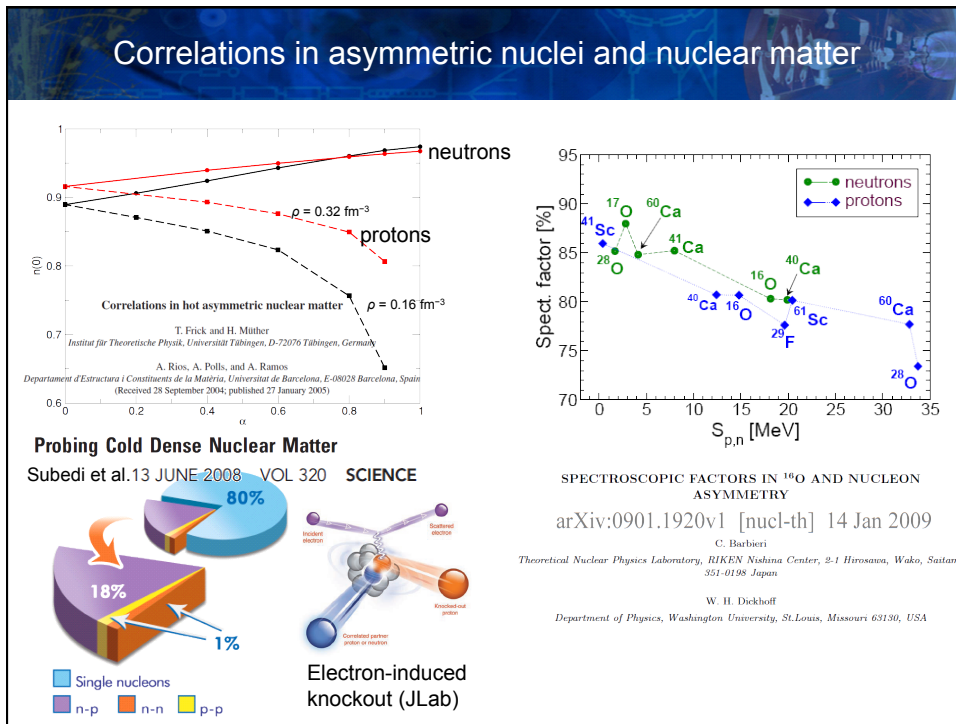


Figure from Alexandra Gade, Phys. Rev. C 77, 044306 (2008)



Quasi-free scattering in inverse kinematics

Measurement of proton recoils after knockout reactions with a CH₂ target

- kinematical complete measurement of (p,pn), (p,2p), (p,pd), (p,α), reactions
- redundant experimental information: kinematical reconstruction from proton momenta plus gamma rays, invariant mass, recoil momentum
- sensitivity not limited to surface
 - spectral functions
 - knockout from deeply bound states
- cluster knockout reactions

[Saclay data for ¹⁶O]

Experimental setup: LAND/R3B@GSI

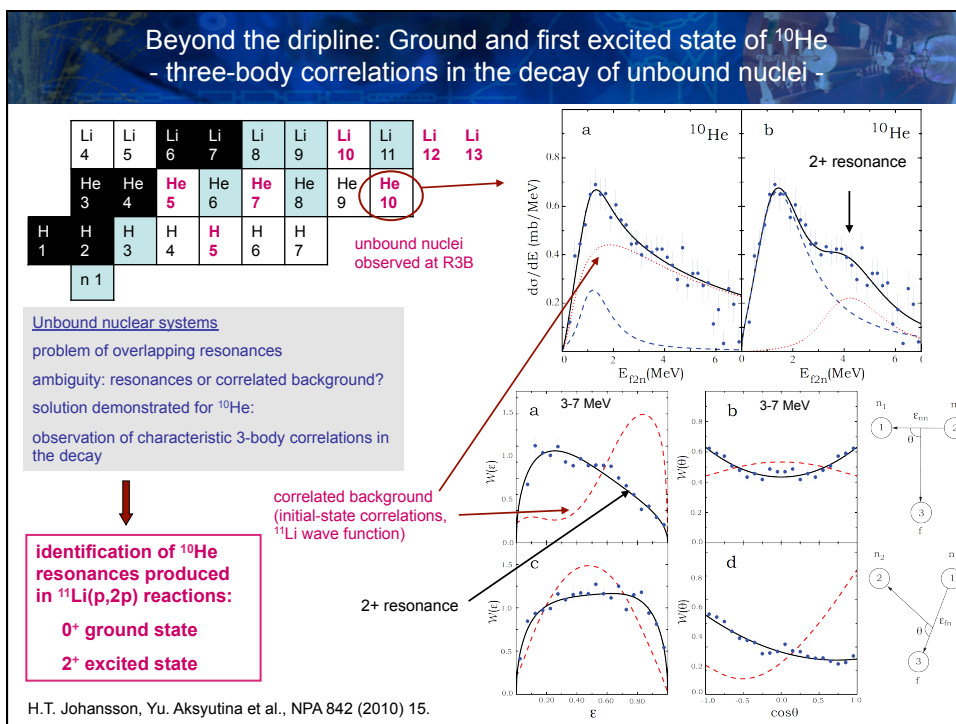
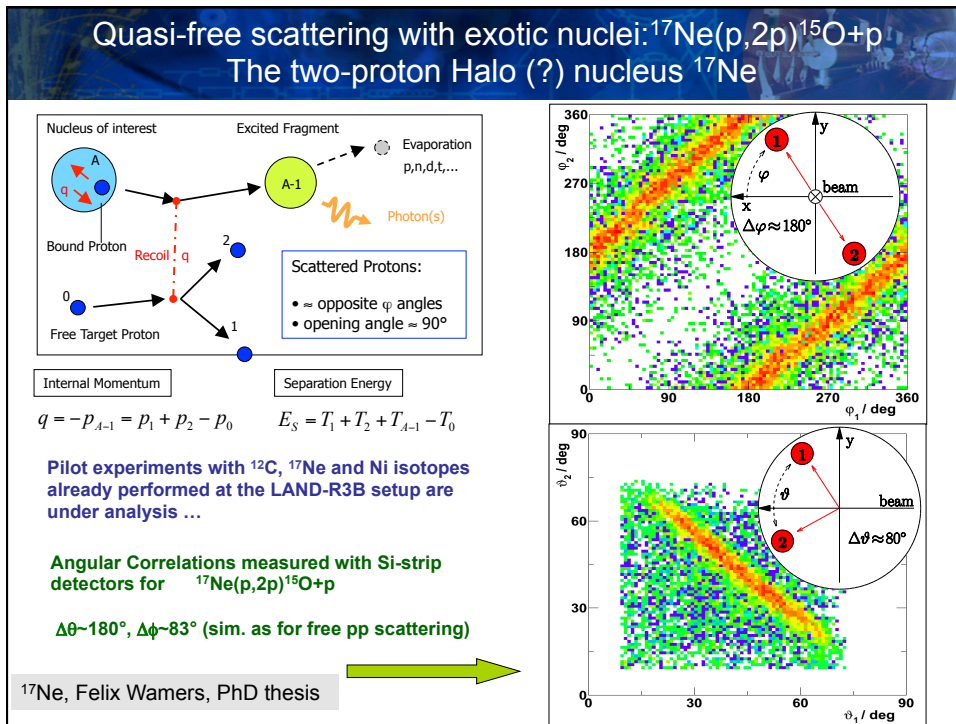
-162 20cm long NaI (TI) crystals

-4π gammas

-2π light particles

- Six DSSDs for tracking

- resolution: Δx ~ 100 μm



The **R³B** Collaboration

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Summary

- **Quasi-free scattering**
 - QFS successfully applied in inverse kinematics
 - Rich physics program: N-N correlations, shell structure, cluster structure, unbound nuclei
- **R3B development**
 - Technical Design Report for neutron detector NeuLAND and calorimeter in 2011
 - Start construction in 2012, physics run with new dipole and 20% NeuLAND and CALIFA in 2014
 - Full R3B detection system operational in Cave C for physics runs 2016
- **FAIR**
 - R3B hall ready for installation in 2017
 - R3B @ Super FRS will start in 2018