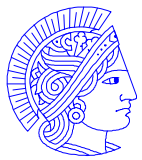

The monopole transition to the Hoyle state in ^{12}C in electron scattering: Is there an α-condensate? *

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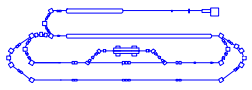
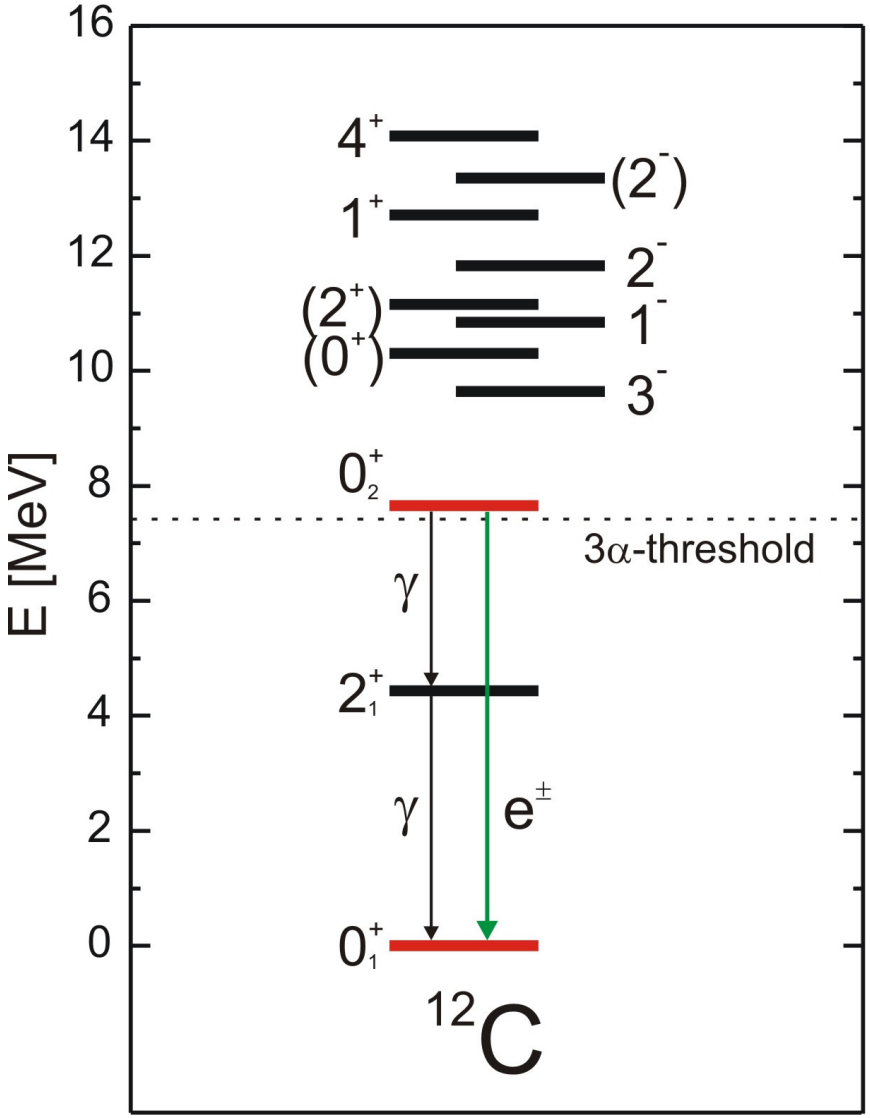
* Supported by DFG under contract SFB 634



Content

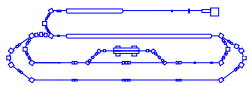
- Motivation
- FMD vs. α-cluster model
- Measurements at the S-DALINAC
  - $^{12}C(e,e')$
- Systematics and comparison with theory
- Conclusion and outlook

Motivation



$$3\alpha \leftrightarrow {}^{12}C^*(7.65) \xrightarrow{\gamma, e^{\pm}} {}^{12}C$$

- Important for astrophysics
- Partial width $\Gamma_{e^{\pm}}$?
- 0^+_1 (ground) and 0^+_2 (7.65 MeV) :
  - information about shape ?
  - density distributions (FMD, α-cluster)
  - electron scattering form factors



Theory

- Fermionic Molecular Dynamics*
  - microscopic *ab initio* calculations
  - system is described as A nucleons with effective NN interaction (UCOM)

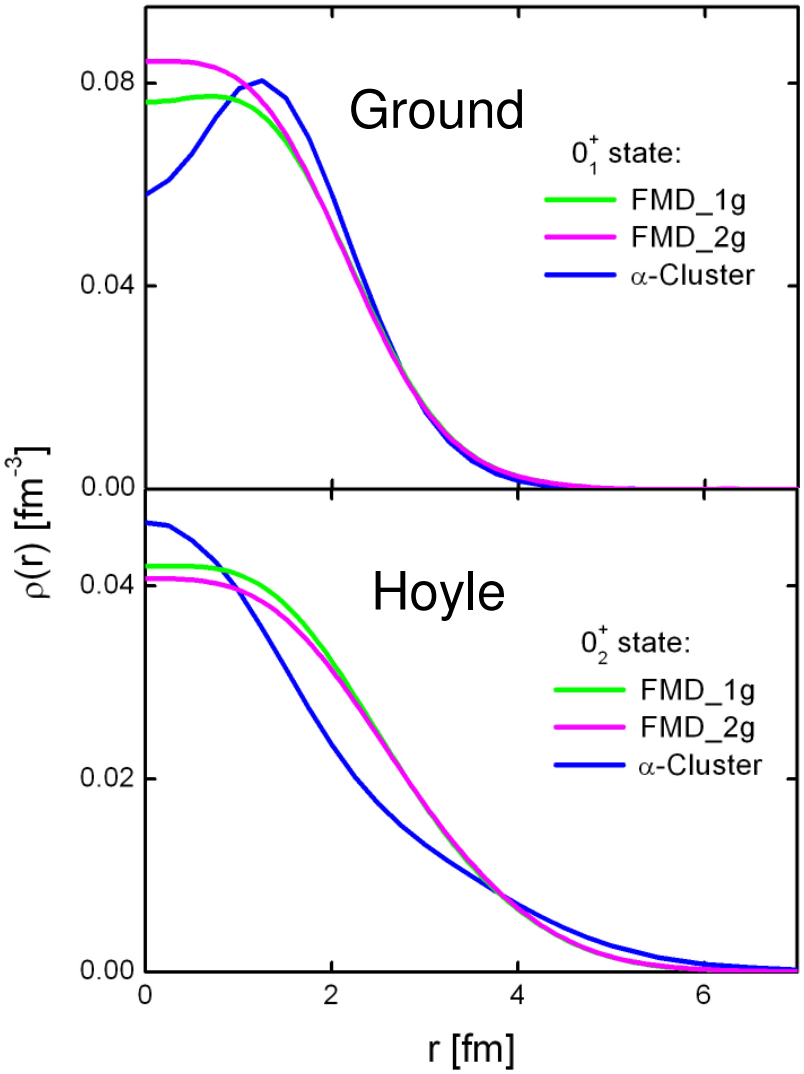
HK 18.4

- α-cluster model**
  - system is described as n α–particles in 0s state (α-condensate)
  - Hoyle state is a dilute gas of α-particles

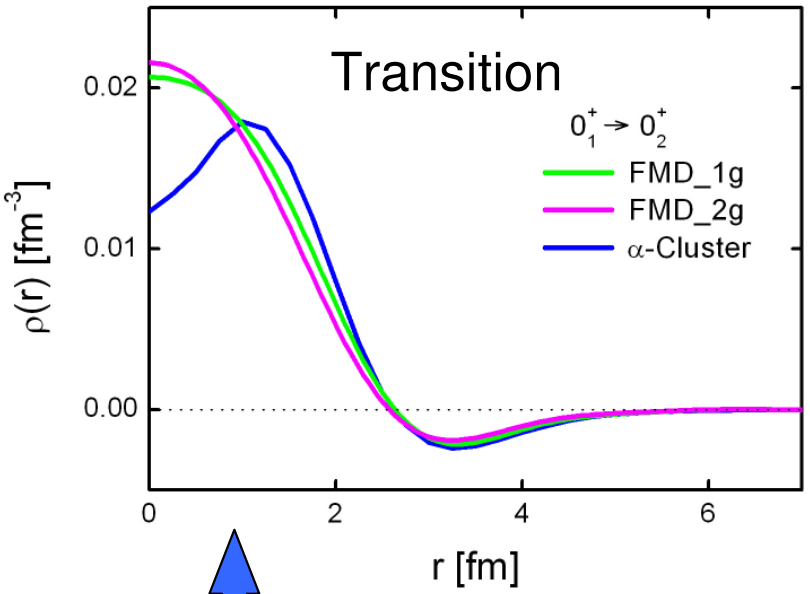
* R. Roth, T. Neff, H. Hergert, and H. Feldmeier, Nucl. Phys. A745 (2004) 3

** A. Tohsaki, H. Horiuchi, P. Schuck, G. Röpke, Phys. Rev. Lett. 87 (2001) 192501-1

^{12}C densities

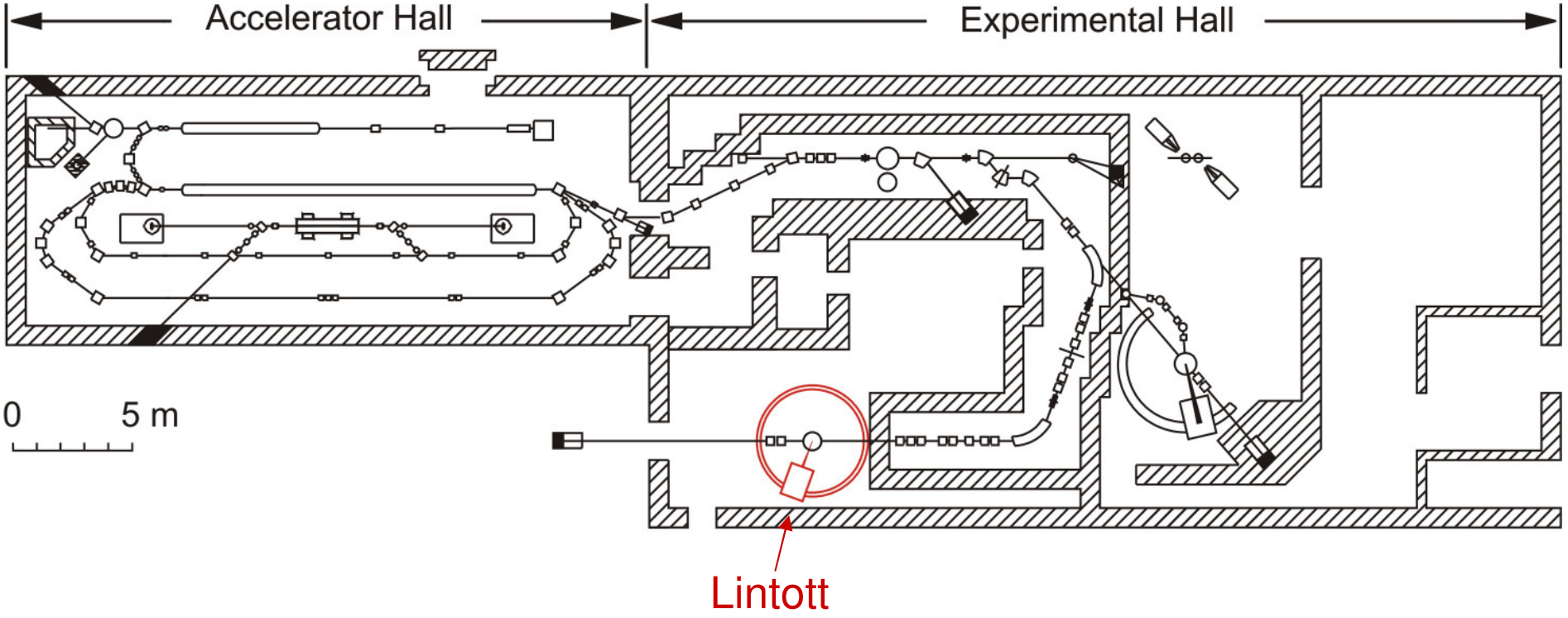


Ground state form factor

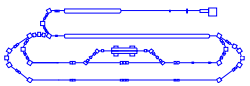


Transition form factor

S-DALINAC

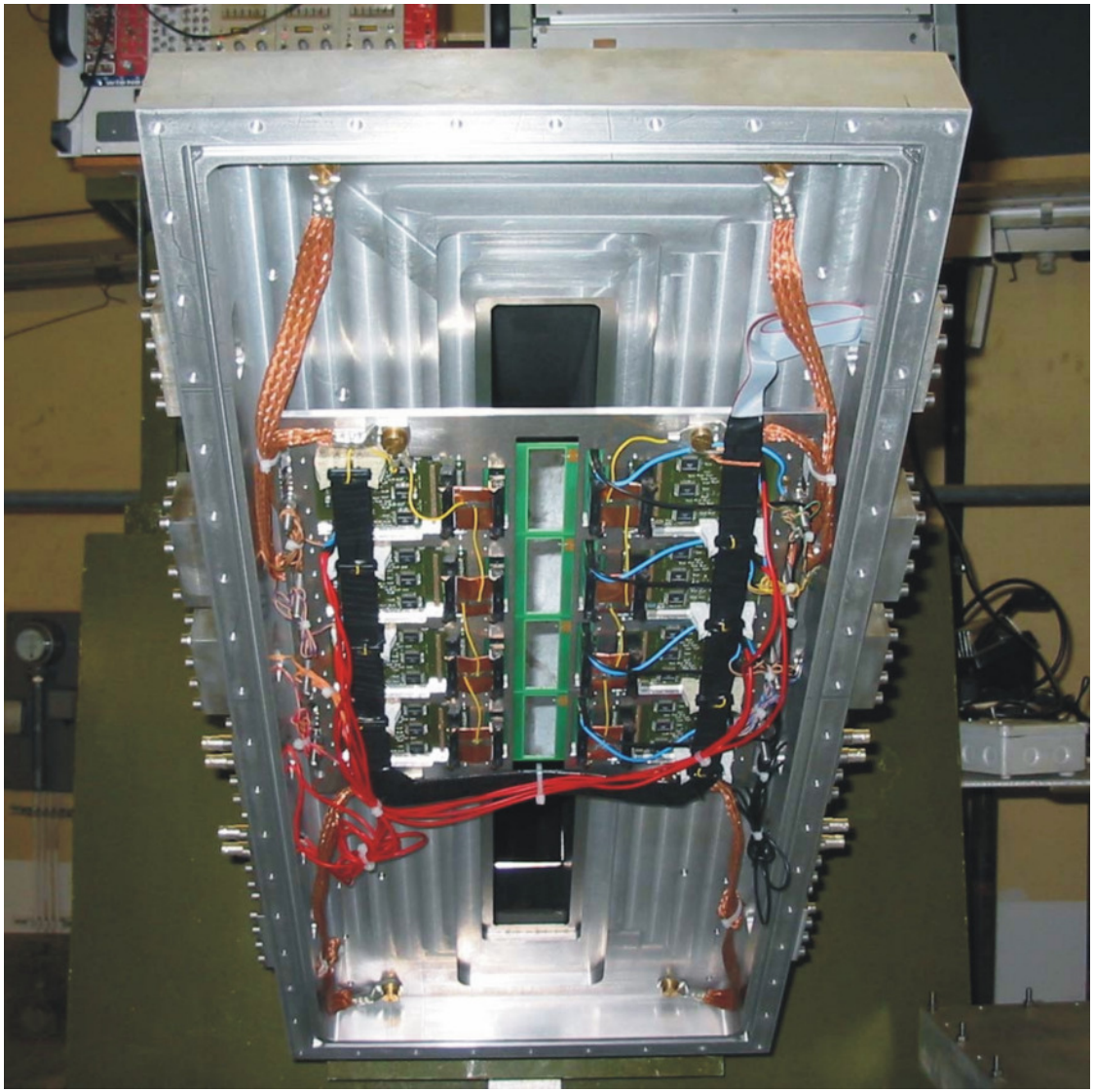


- High-resolution (e,e´) experiments at Lintott spectrometer

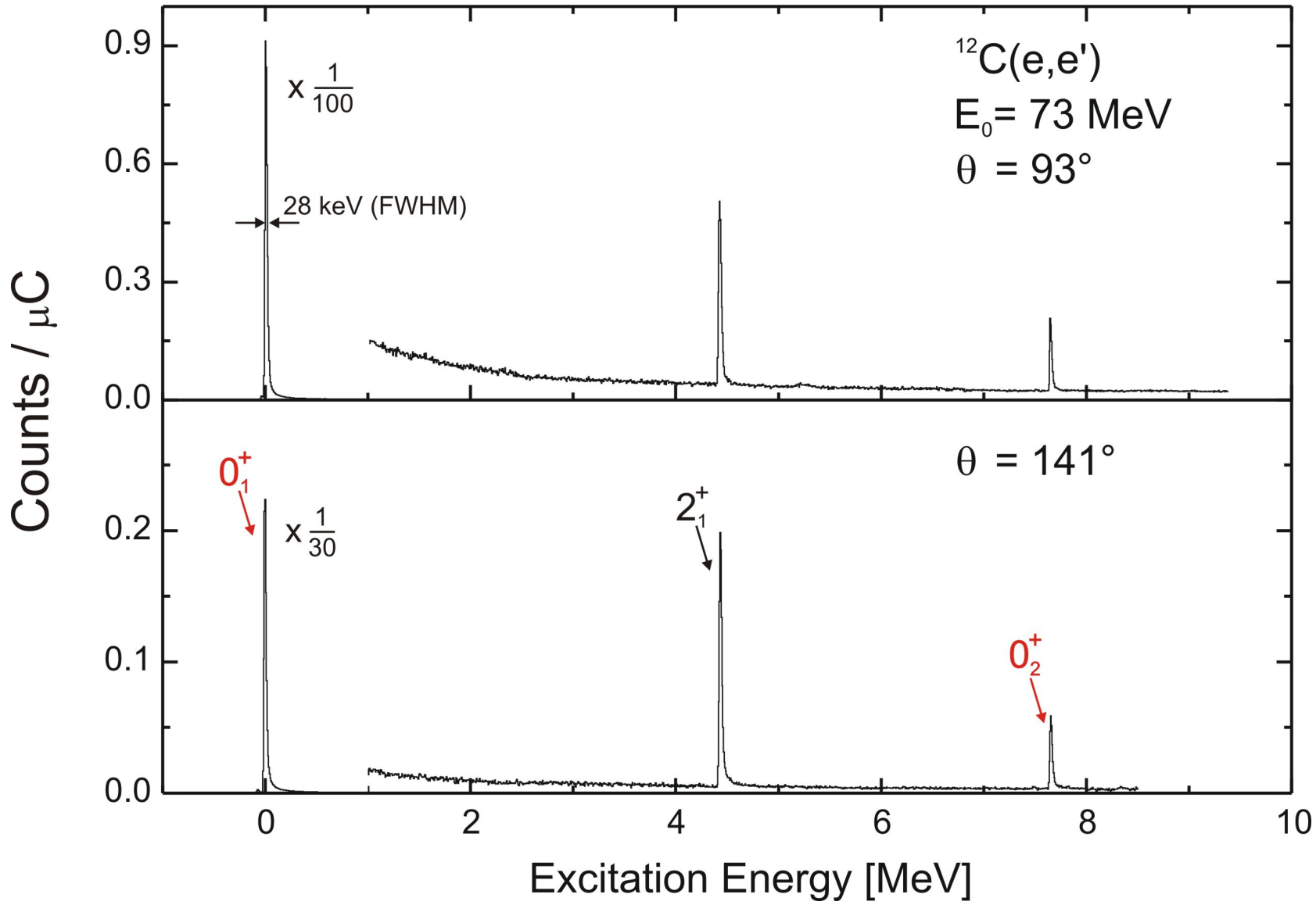


Lintott spectrometer

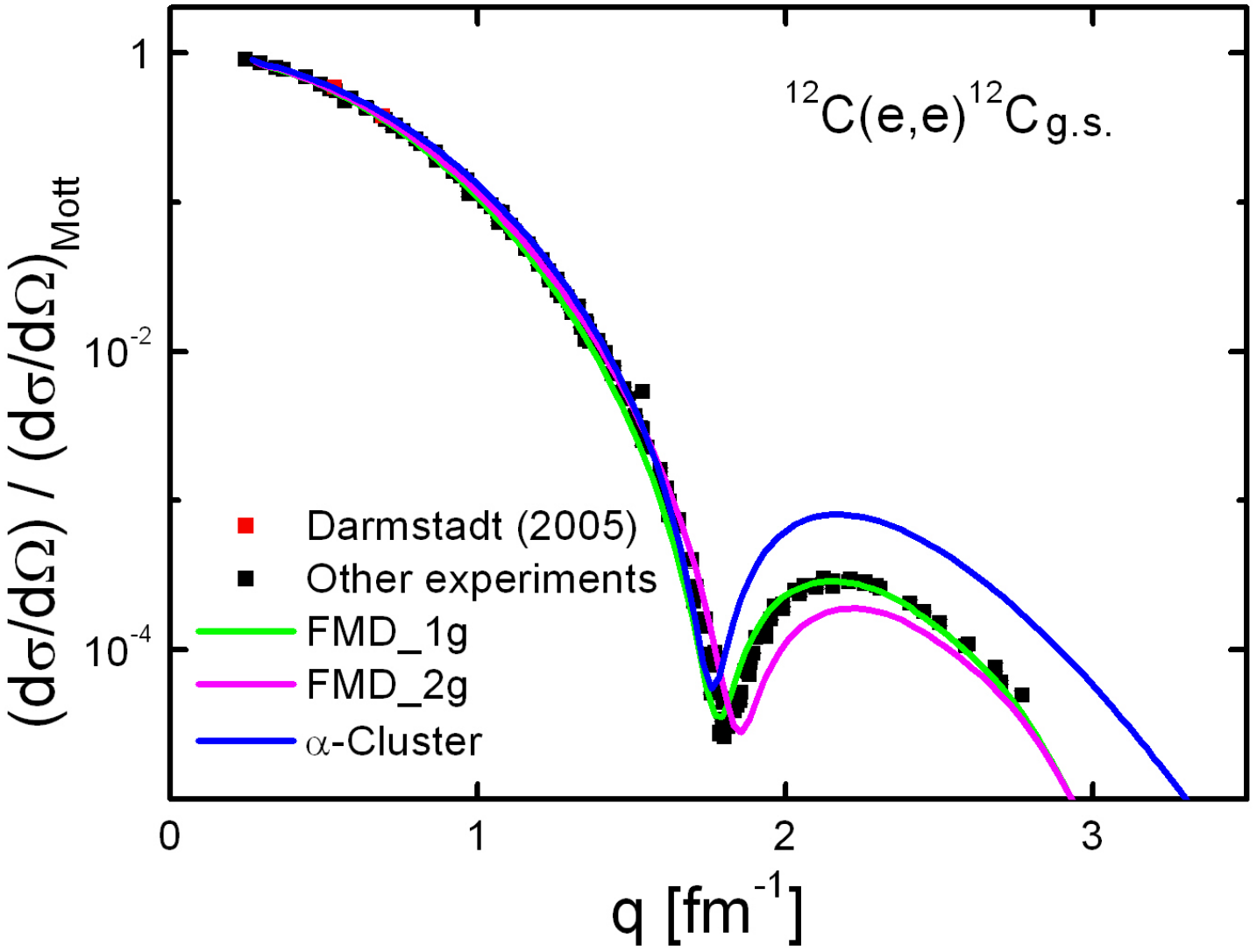
Detector system



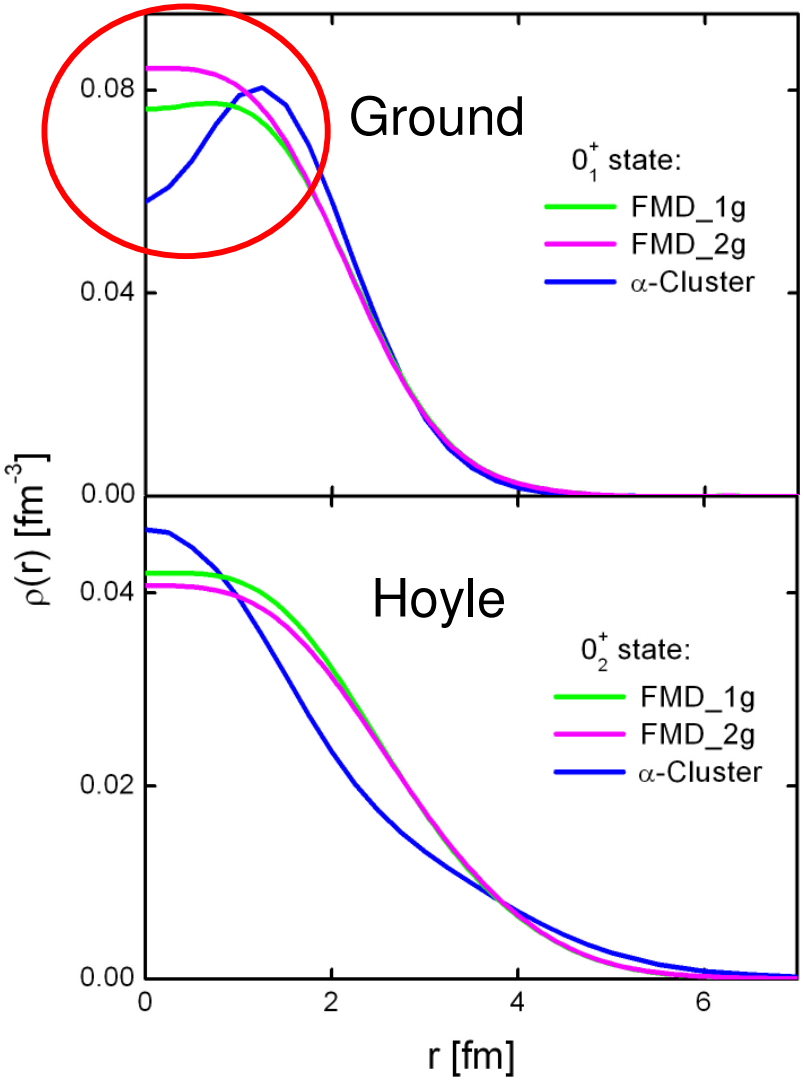
Measured spectra



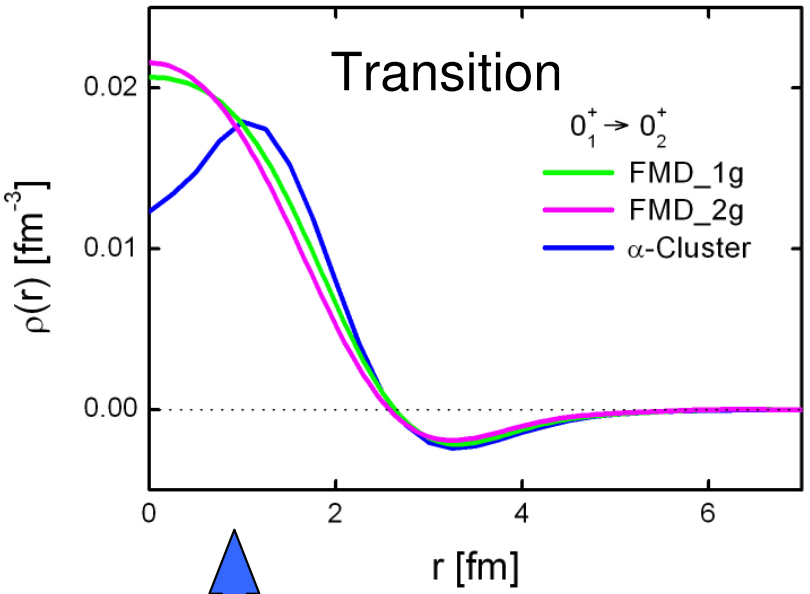
Ground state form factor



^{12}C densities

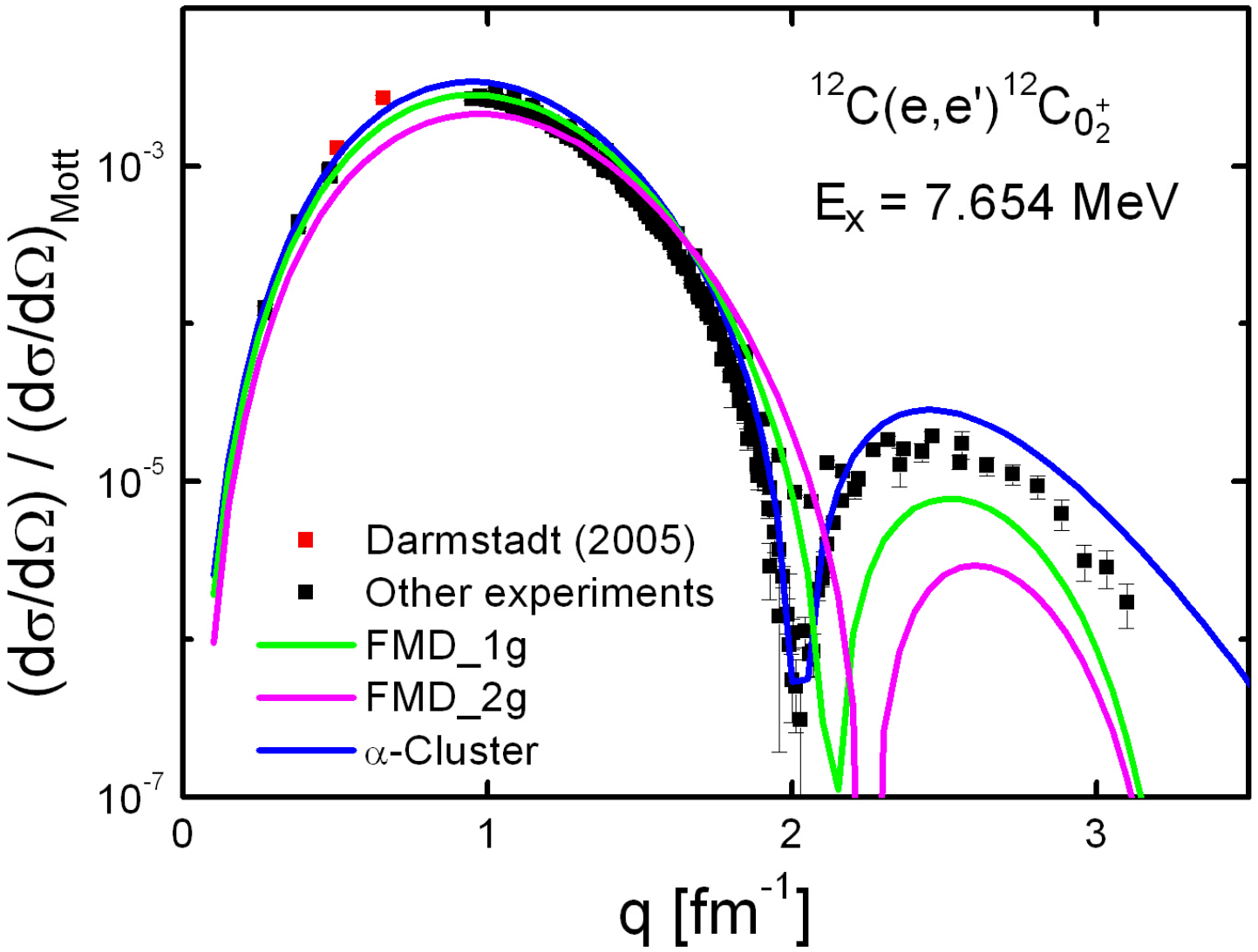


Ground state form factor



Transition form factor

Transition form factor to Hoyle state



Conclusions

- Electron scattering as test of modern nuclear models
- α-Cluster model:
  excellent prediction of transition to Hoyle state, but direct conclusion on the α-condensate questionable
- FMD model:
  good description, but some deviation at higher momentum transfer $\rightarrow$ Interaction?

Outlook

- Measurements at S-DALINAC for $q < 1$ fm^{-1}
- Extraction of monopole matrix element M(E0) and partial level width $\Gamma_{e^{\pm}}$