Electronic Configurations of Isolated Guest Atoms

IS 425

ISOLDE Workshop and Users meeting 2009

18-20 November 2009

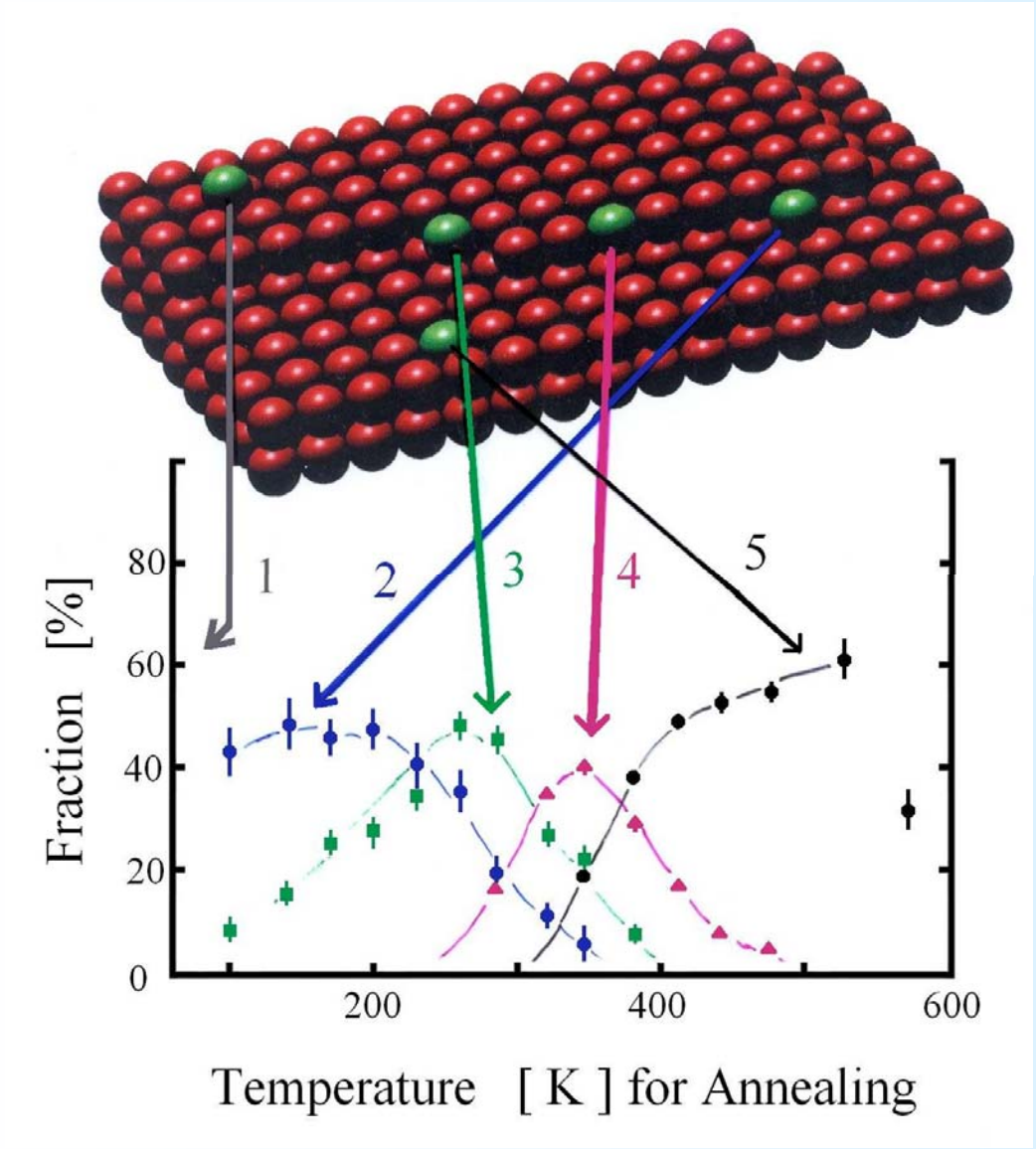
ASPIC Group

Helmholtz Zentrum Berlin

für Materialien und Energie,

Freie Universität Berlin

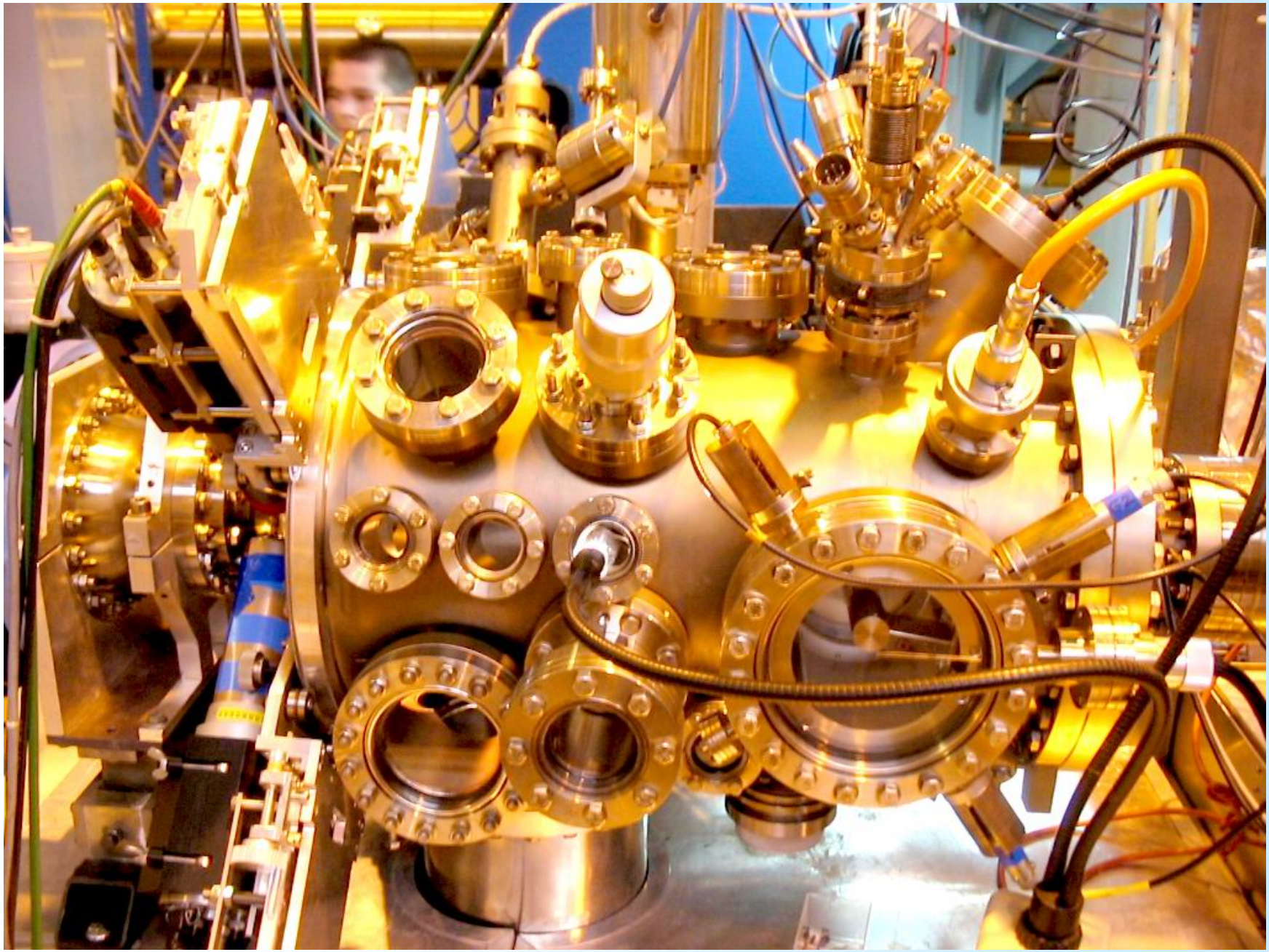
Preparation of Sites of Guest Atoms



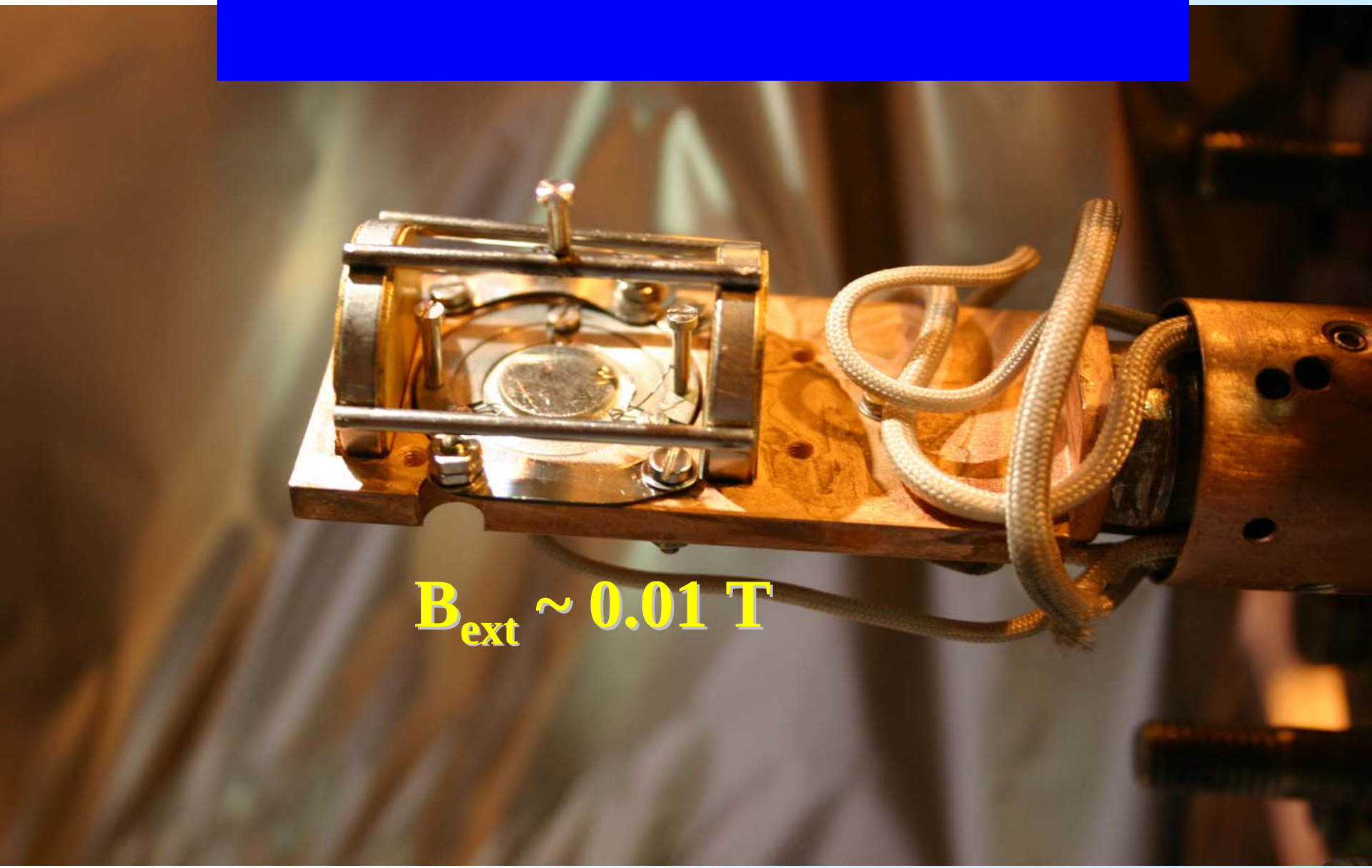
Cadmium Guest Atoms on Nickel Surfaces

Data in Figure are taken from:

^{111}In/ ^{111}Cd on Pd(111)
E. Hunger Ph.D. thesis (1989)



Picture of the Sample Holder

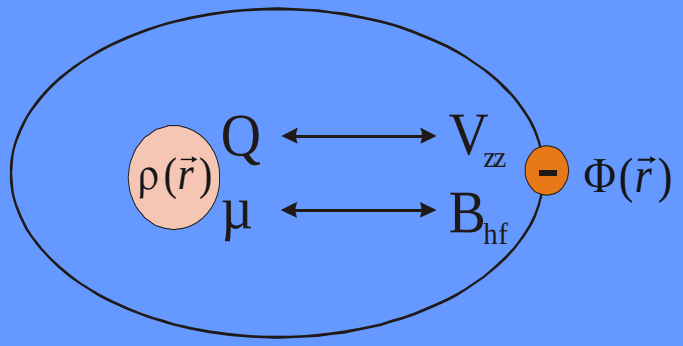


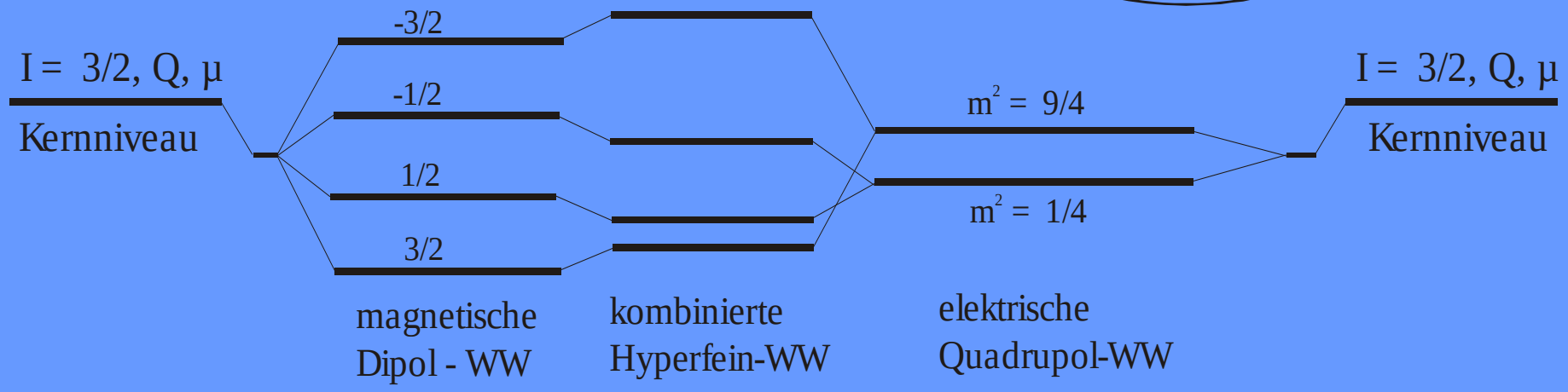
$B_{ext} \sim 0.01$ T

Hyperfeinwechselwirkungen

Elektronen wirken auf den Kern (und umgekehrt)

Das Atom





$$\Delta E = -g\mu_N \cdot \boldsymbol{B_{hf}}$$

$$\omega_L = -g\mu_N/\hbar \cdot \boldsymbol{B_{hf}}$$

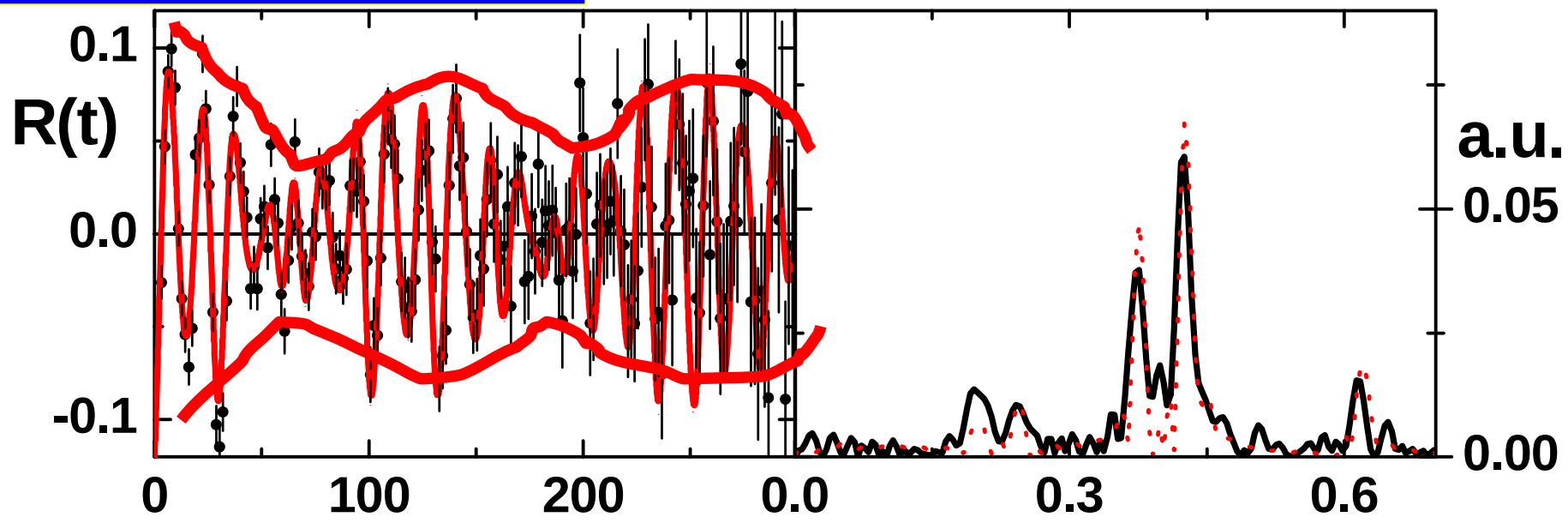
$$\Delta E = (V_{zz}, B_{hf}, \ldots)$$

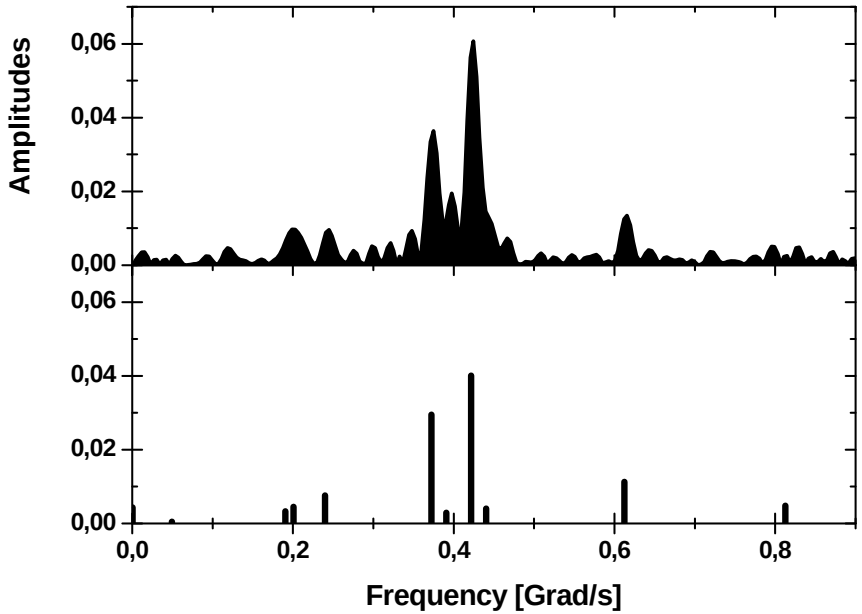
$$\omega_c = f(\omega_Q, \omega_L)$$

$$\Delta E = \frac{3}{4}\frac{\left|m_i^2 - m_j^2\right|}{I(2I-1)} eQ \cdot \boldsymbol{V_{zz}}$$

$$\omega_Q = \frac{eQ}{4I(2I-1)\hbar} \cdot \boldsymbol{V_{zz}}$$

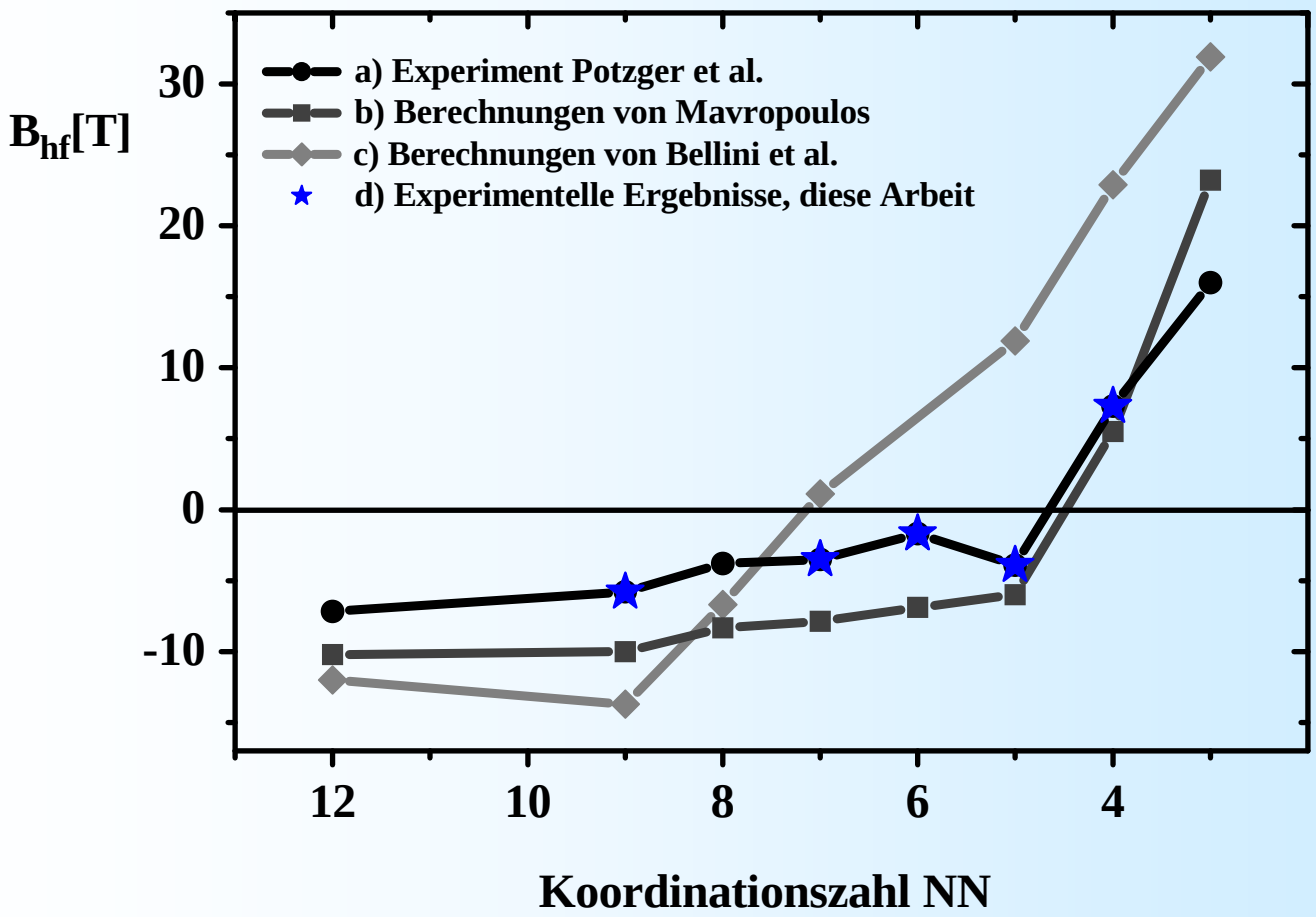
NN=9 $^{111}In/^{111}Cd$ auf Ni(111)





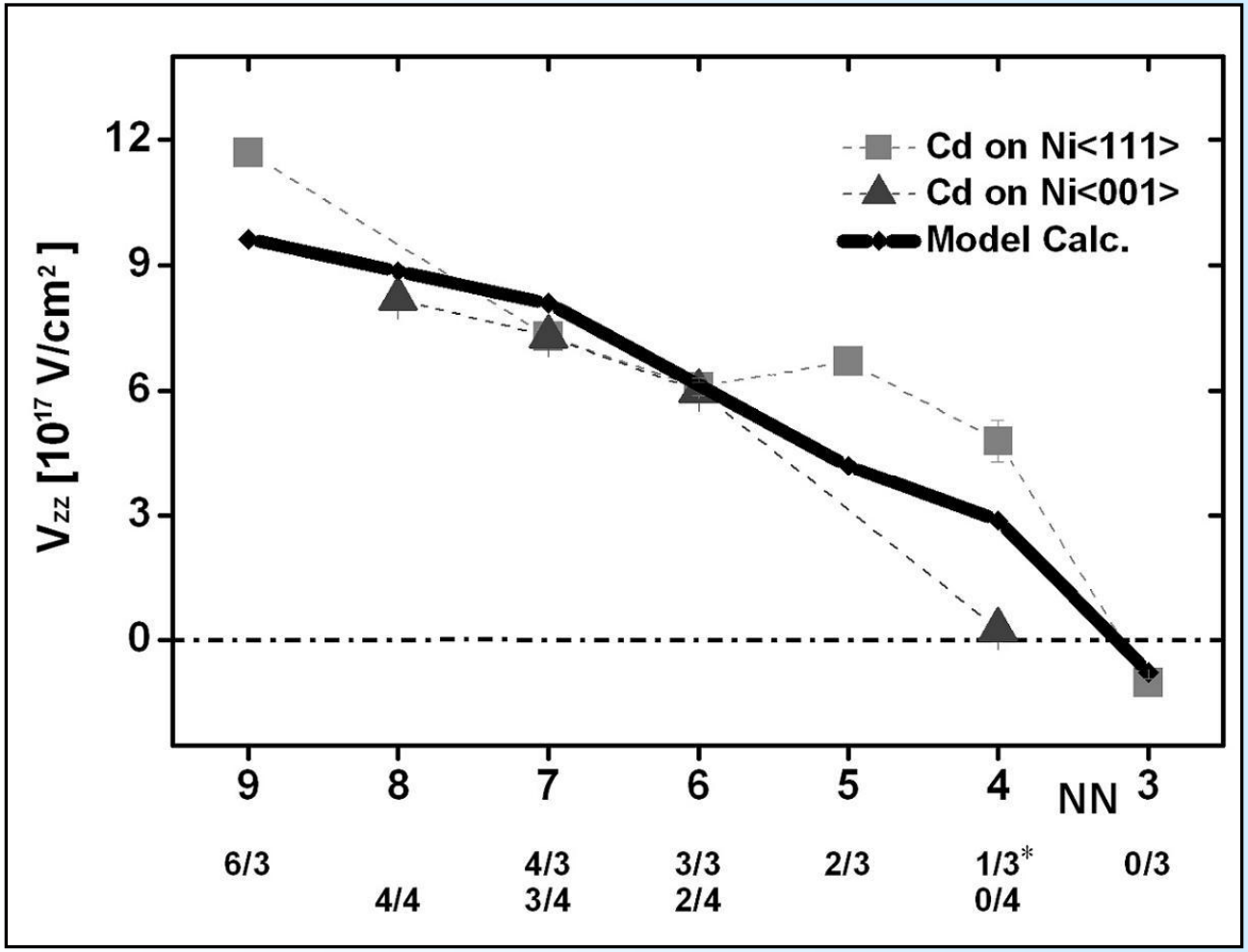
First Result: Magnetic Hyperfine Fields for Isolated Cadmium Atoms on Nickel Surfaces

(and Comparison with Theoretical Calculations)



- V. Bellini, S. Cottenier, M. Çakmak, F. Manghi, and M. Rots, Phys. Rev. B **70** (2004) 155419
- Ph. Mavropoulos, J. Phys.: Condens. Matter **15**, (2003) 8115
- K. Potzger, A. Weber, H. H. Bertschat, and W.-D. Zeitz, Phys. Rev. Lett. **88 24** (2002): 247201.

Second Result: Electric Field Gradients at Cadmium Atoms on Different Sites on Nickel Surfaces

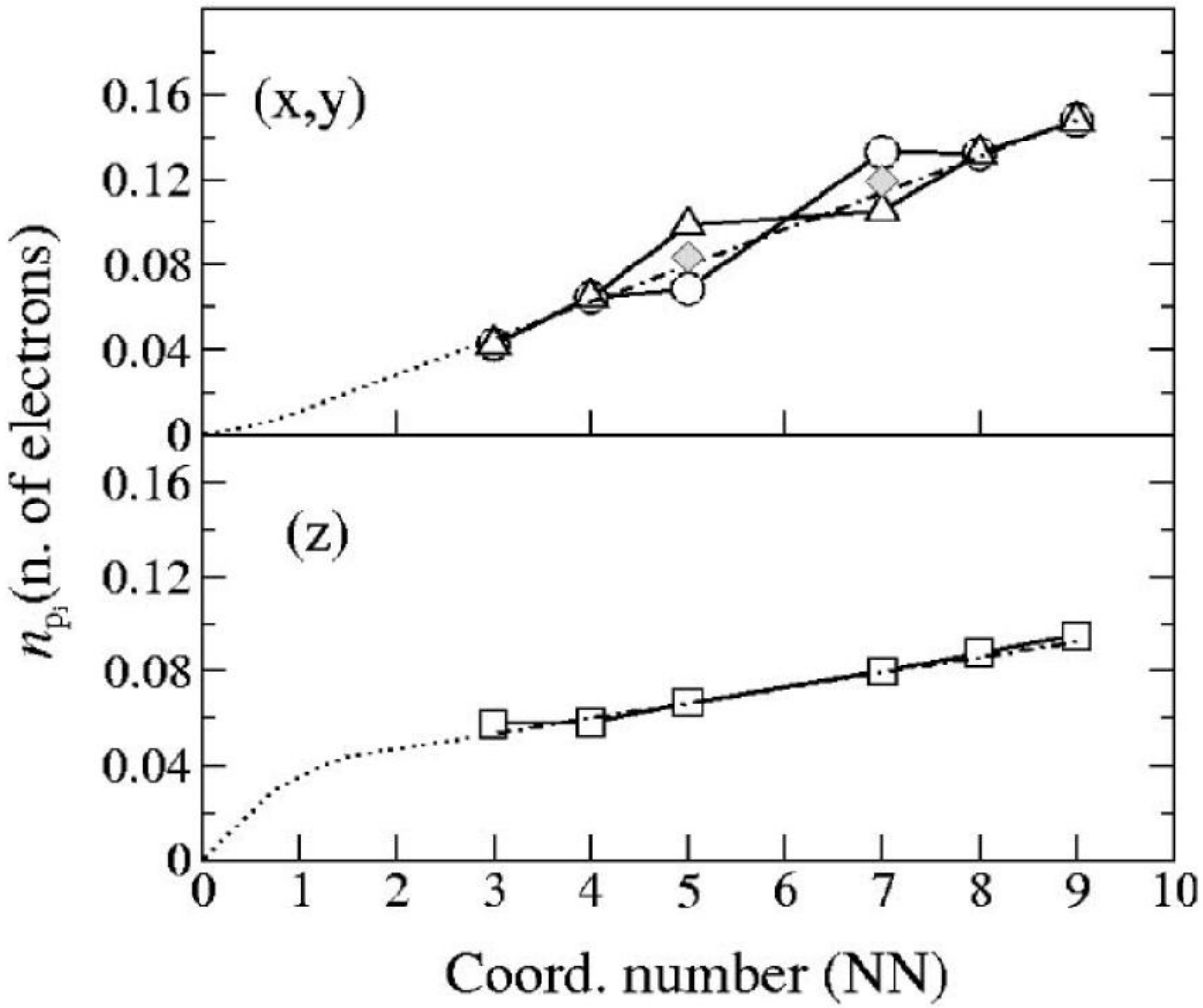


Experimental: Potzger, K. PhD thesis of Freie Universität Berlin, 2001.

Calculations: Cottenier, S., Bellini, V., Cakmak, M., Manghi, F., and Rots, M.. Phys. Rev. B 70 (2004): 155418.

Experimental: * Prandolini M. et al., Appl. Phys Lett. 85 (2006) 76

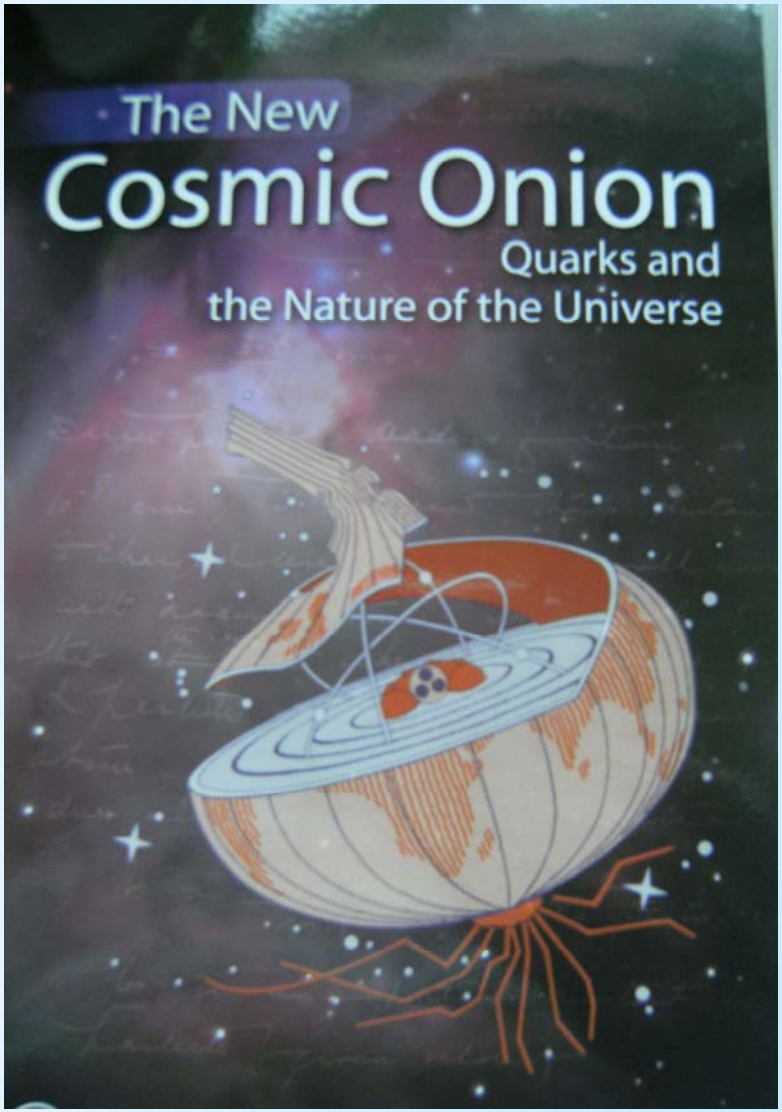
Population of p-sublevels



S. Cottenier et al., Phys. Rev B 70 (2004) 155418

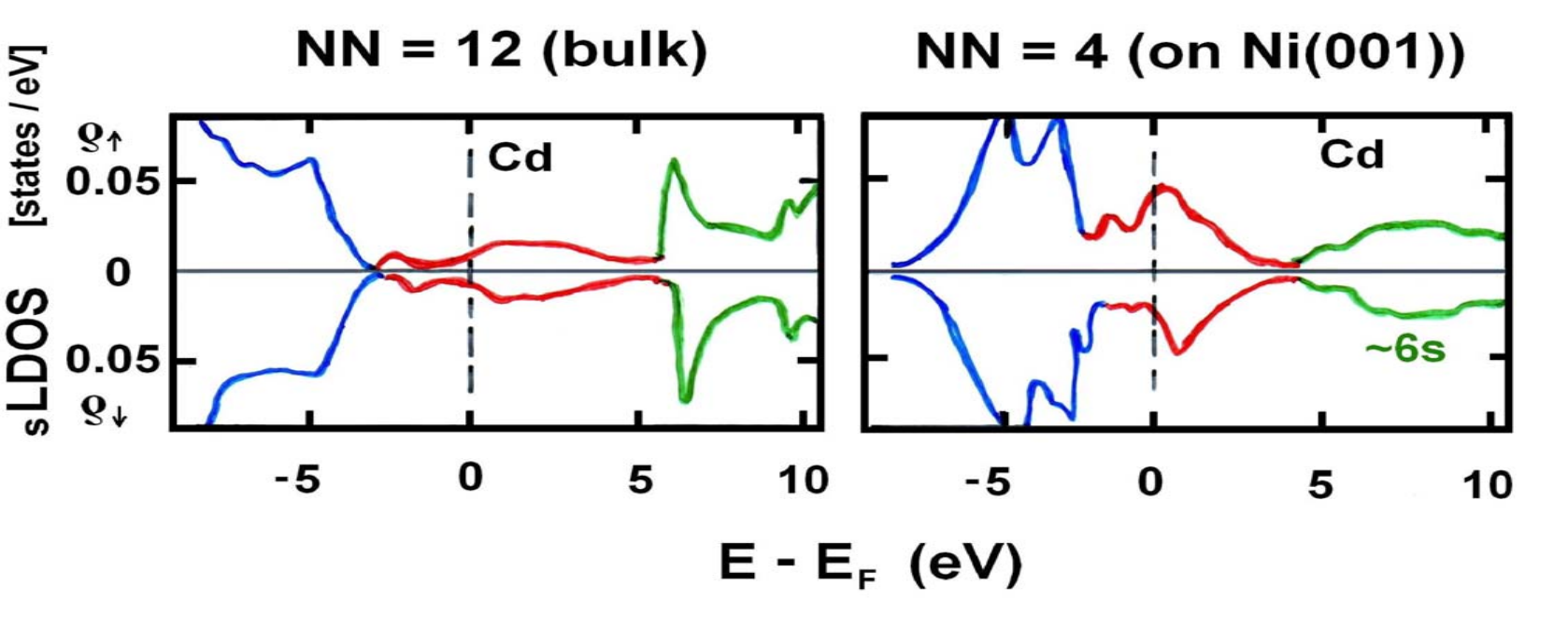
Interpretation with
“Key Word“:

Confinement



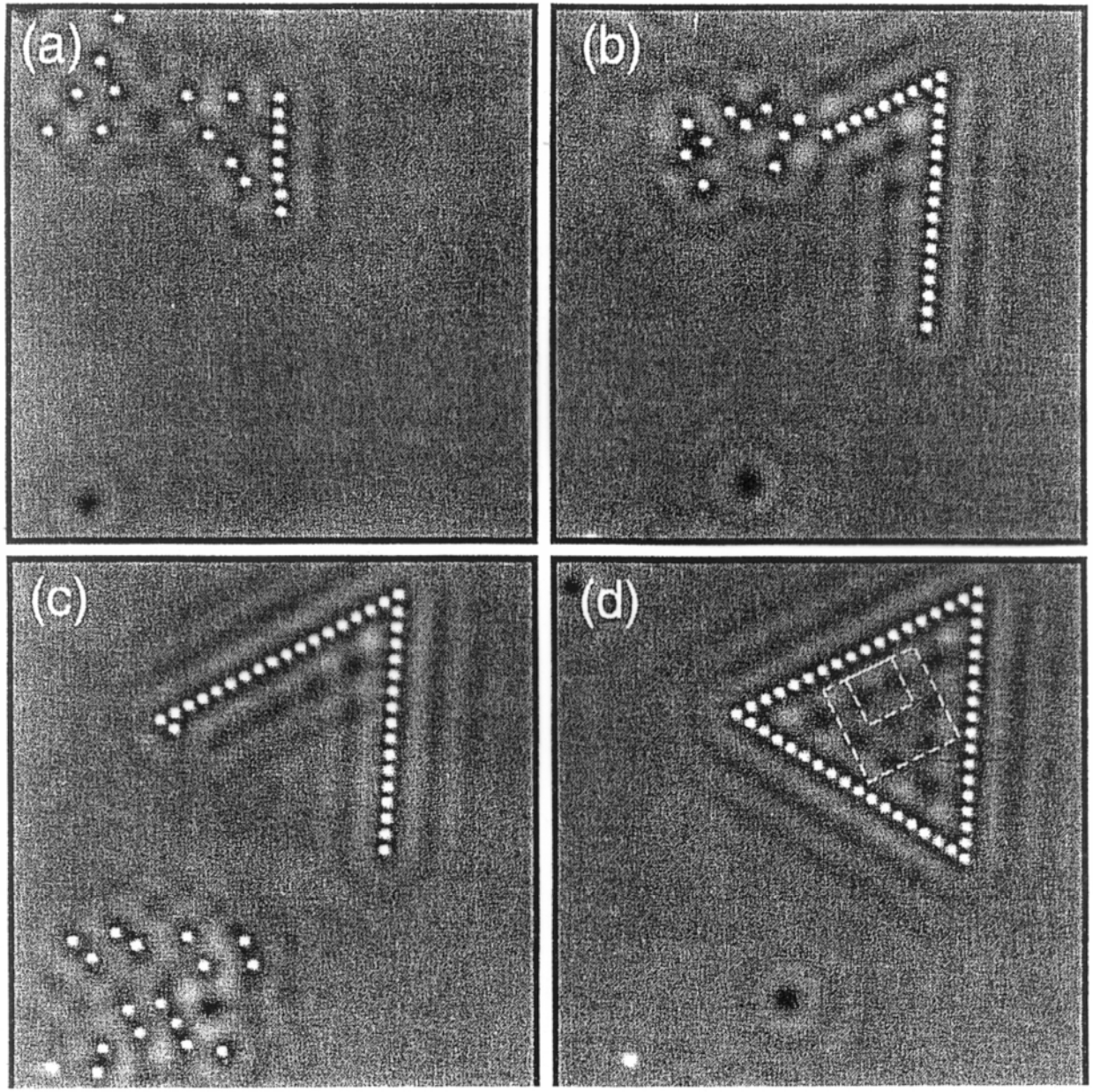
F. Close,
The New Cosmic Onion,
Taylor and Francis, Boca Raton,2007

Local Densities of States (LDOS) of s-Electrons at Cadmium Guest Atoms in Nickel Bulk and on Nickel Surface



Ref:

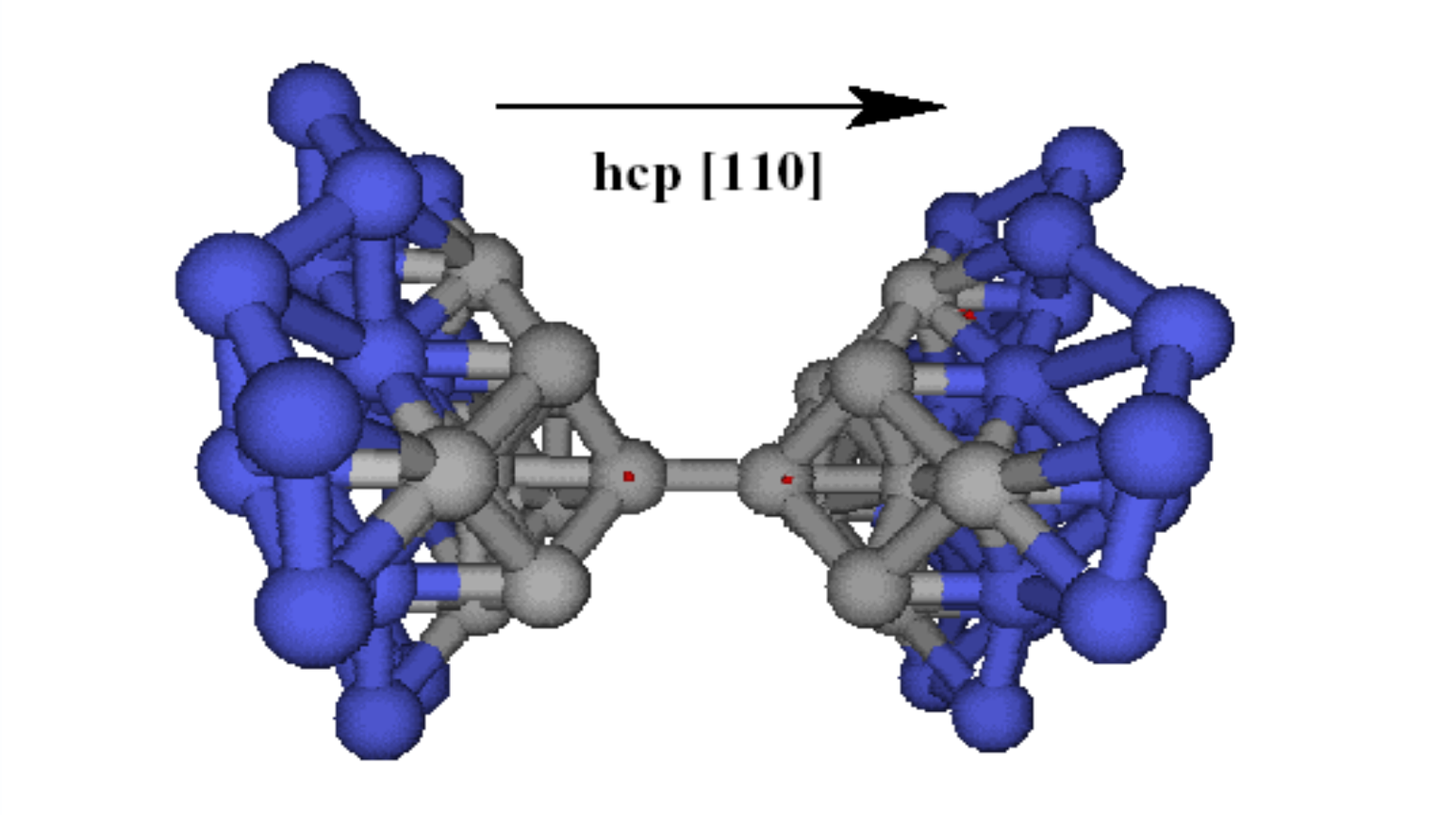
- Ph. Mavropoulos, J. Phys.: Condens. Matter **15** (2003) 8115
- Kanamori et. al. Hyp. Int. **9** (1981) 363



(I) Artificial Atomic Structures

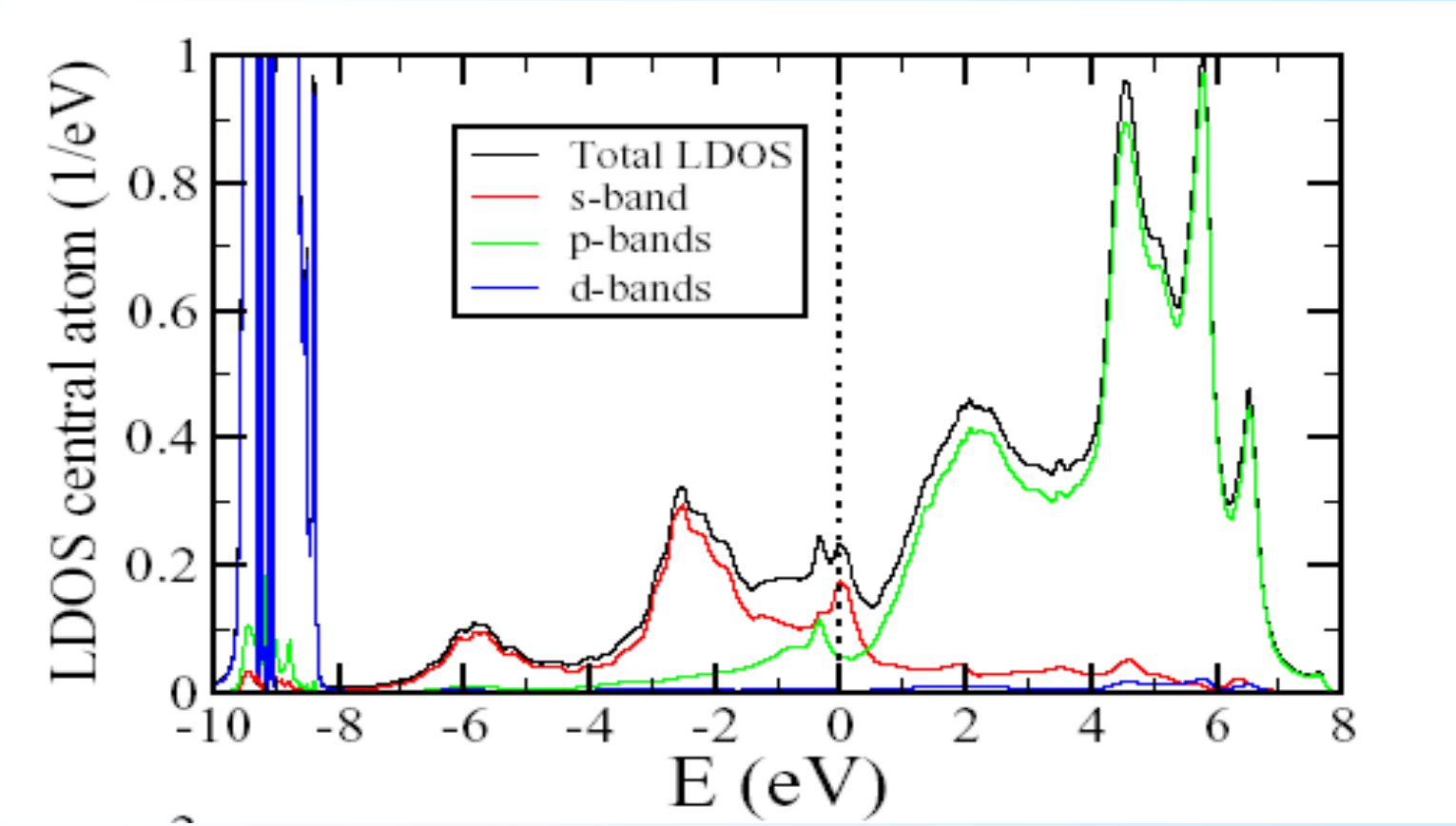
K.F. Braun,
K.-H. Rieder,
Phys. Rev. Lett. 88
(2002) 096801

Example of a contact in a hcp-crystal (001-direction) with Zn dimer central atoms



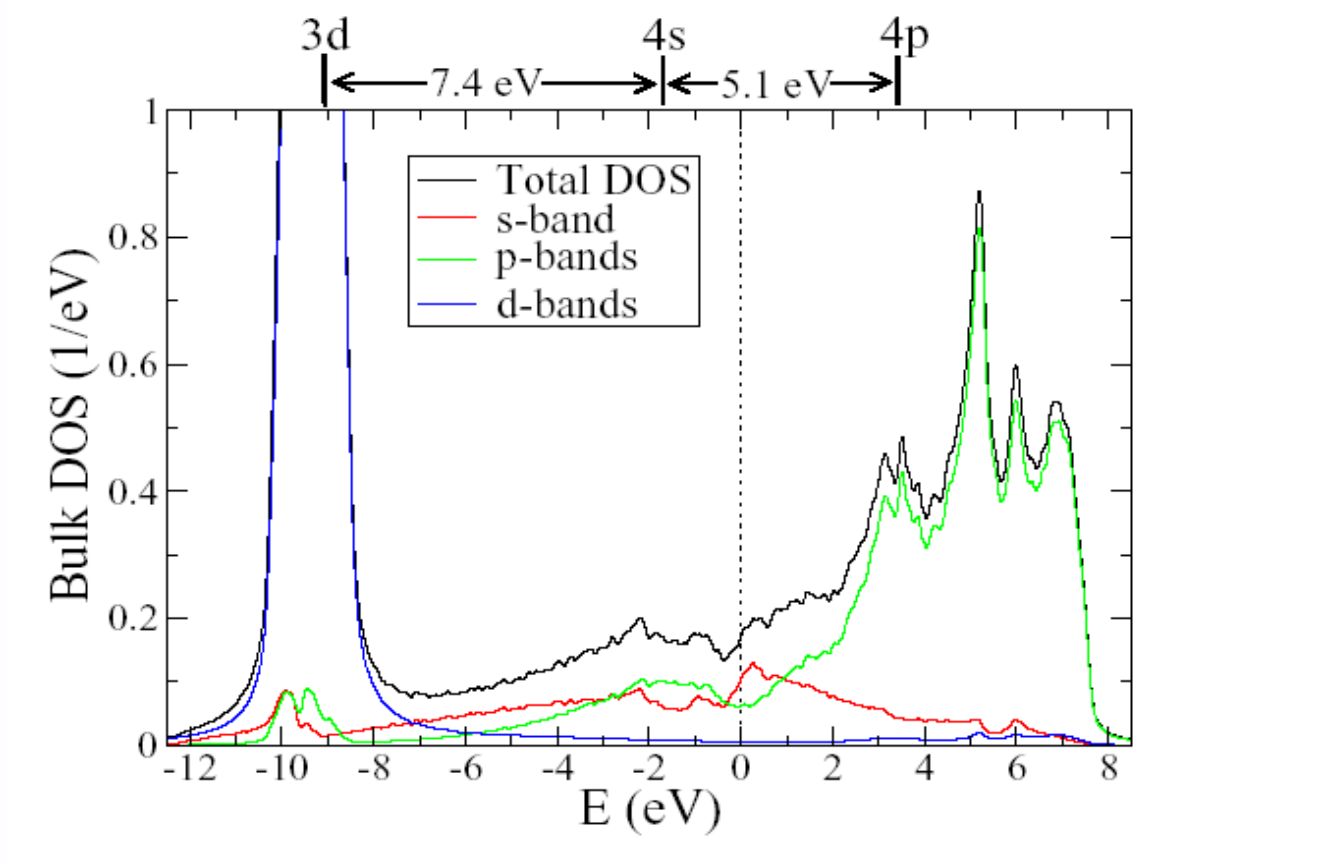
Ref.: M. Häfner, thesis, University of Karlsruhe, April 2004

(II) Local Level Densities of the Zn Dimer in the Gap (110 crystal direction)



Ref.: M. Häfner, thesis, University of Karlsruhe, April 2004

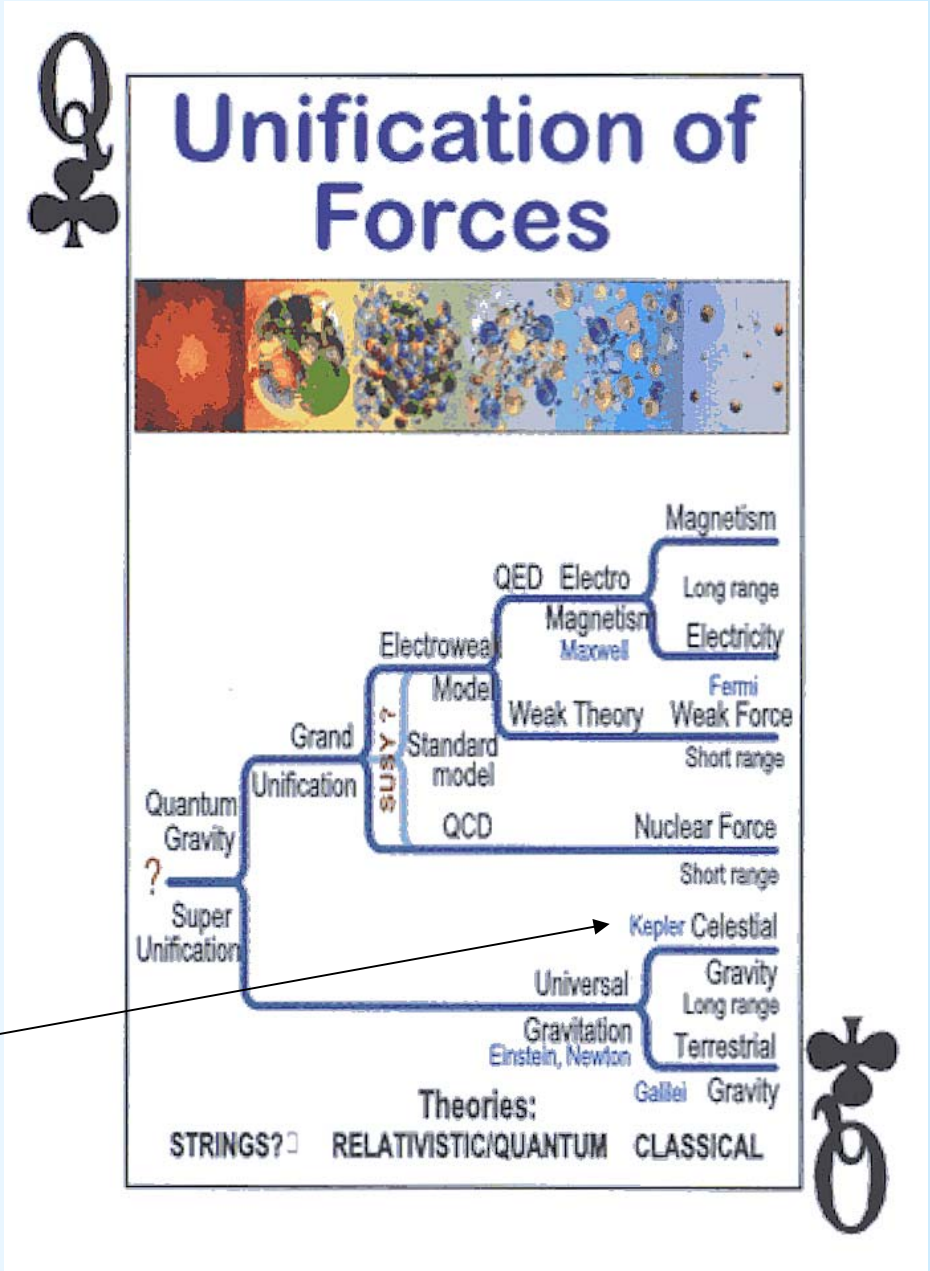
(II) Level Densities (DOS) in Zn Bulk (hcp crystal)



Ref.: M. Häfner, thesis,
University of Karlsruhe, April 2004

Key Word:

Unification



Tycho (Tyge) **Brahe** (1546 -1601)

Measurements done at Uranienborg on Ven

Playing Cards, www.cern.ch, 2006

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  K. Potzger, S. Seeger, A. Weber
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  and the ISOLDE staff

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