# From single dots to arrays

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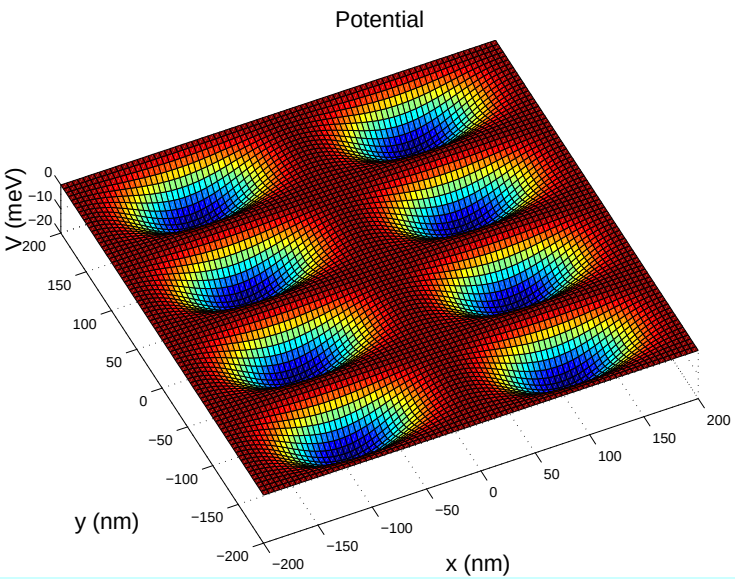
# Effects of an array - Interaction

1. Periodicity
2. Interaction between dots
3. Shape changes

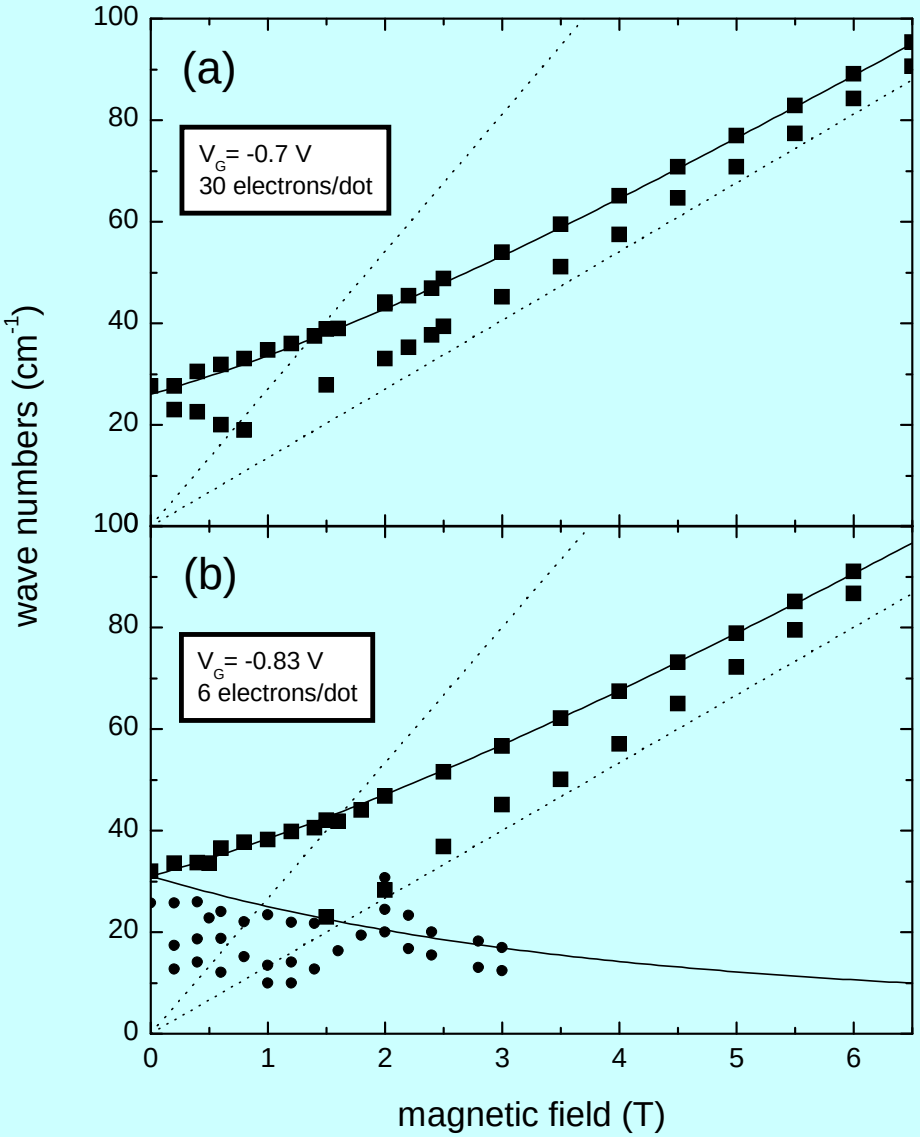



- FIR-absortion
- Magnetization
- Model results
- Intra-dot, inter-dot interaction
- 0D $\rightarrow$ 2D transition
- Field induced dots

Measurement of field induced dots:

6 or 30 electrons

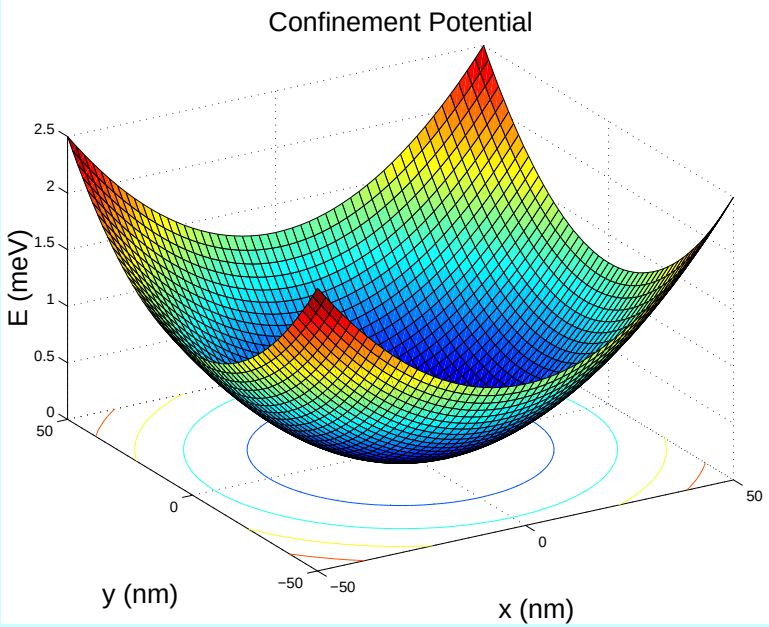
Mode below the upper Kohn mode

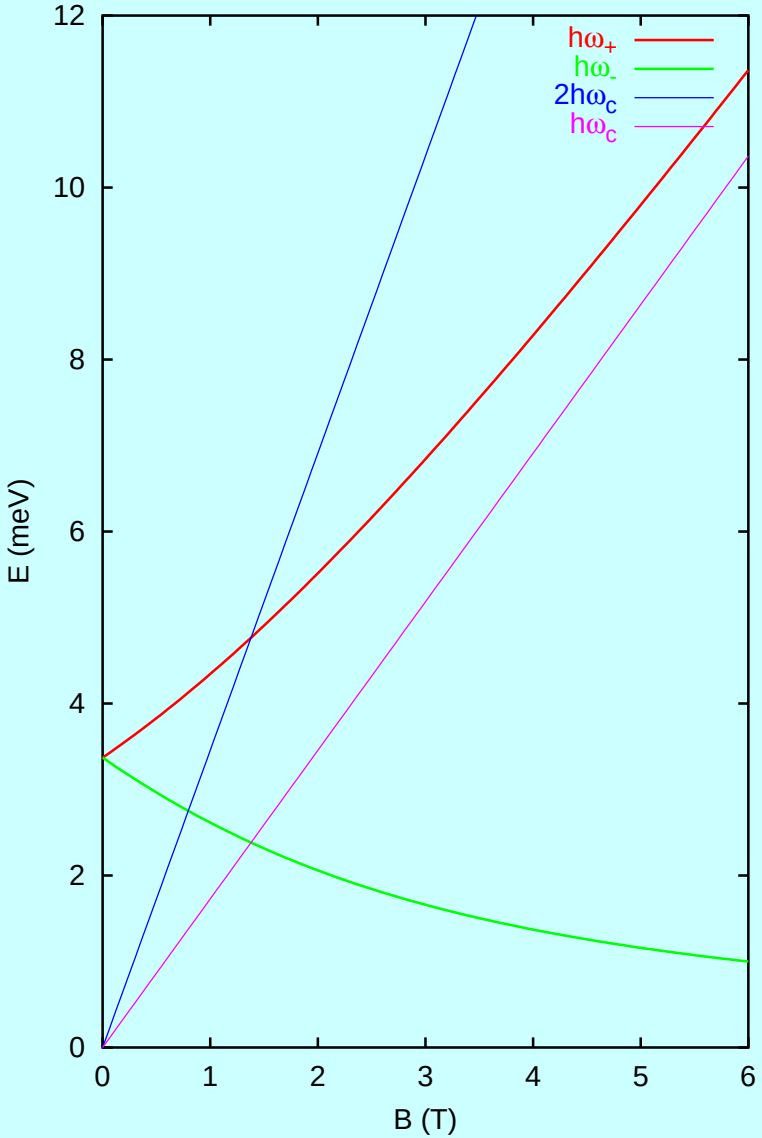


## Kohn's Theorem

- FIR-radiation
- Parabolic confinement

→ Only stiff CM-motion



How is the confining potential in field induced dots?

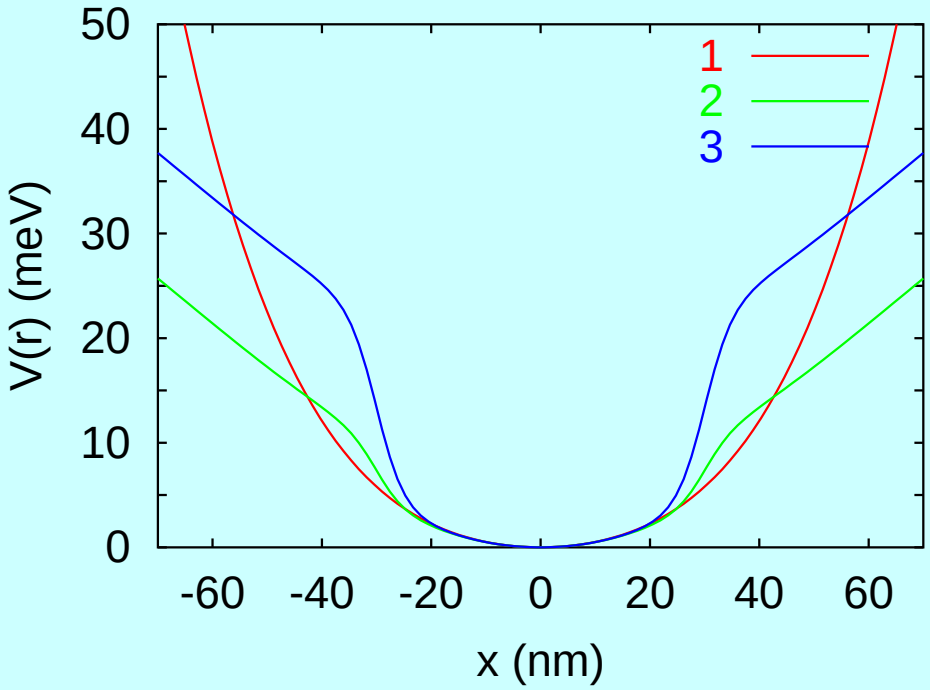
- Must soften for large radii
- Periodic potential + $\mathbf{B}$ $\rightarrow$ trouble

Try some potentials for single dots

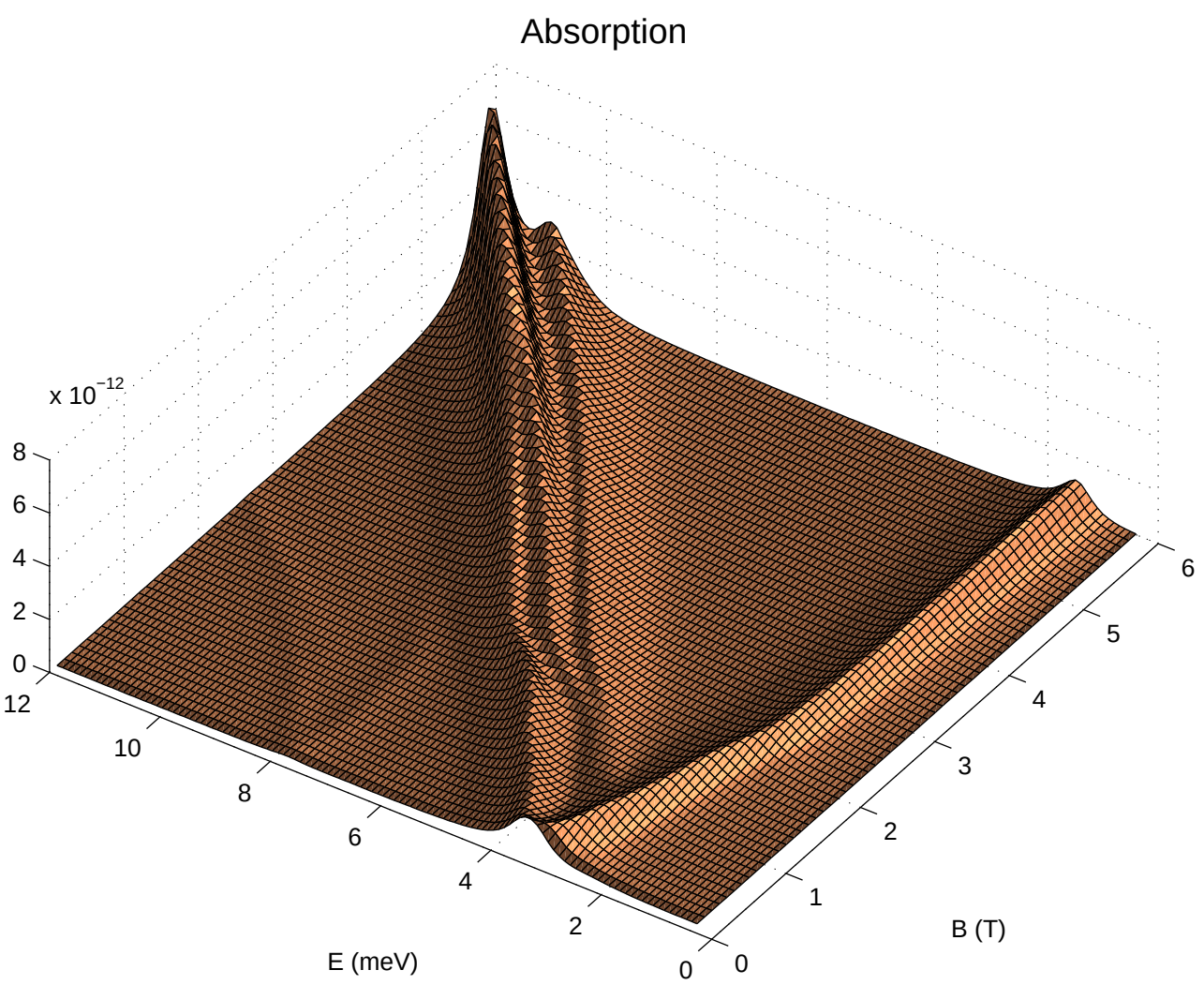
Parabolic + higher terms...

$\downarrow$

excitations above the upper Kohn mode

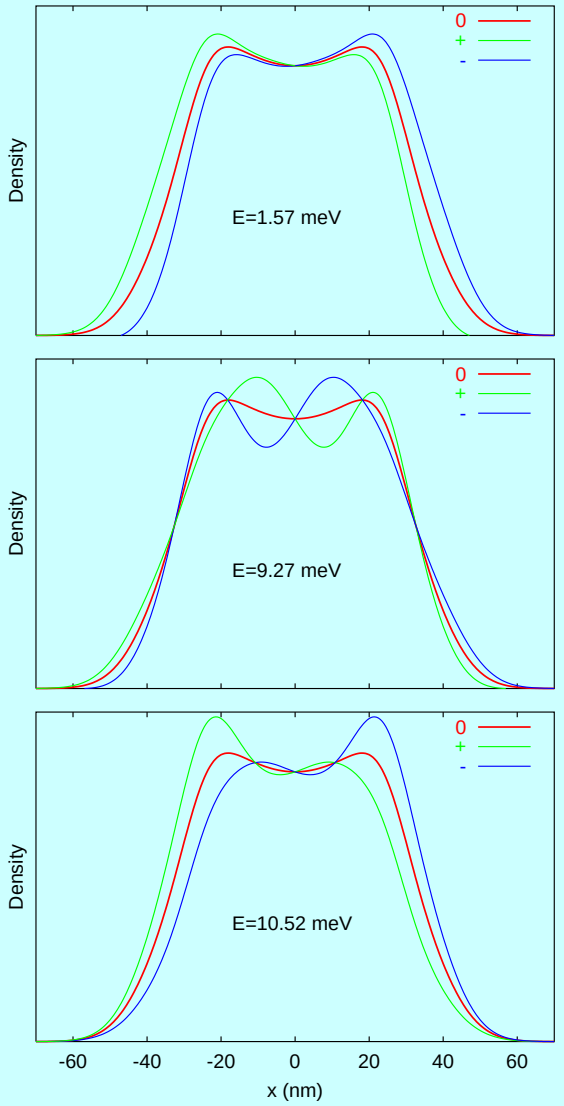


# Calculated power absorption, $(N = 5, T = 1\ \mathrm{K})$

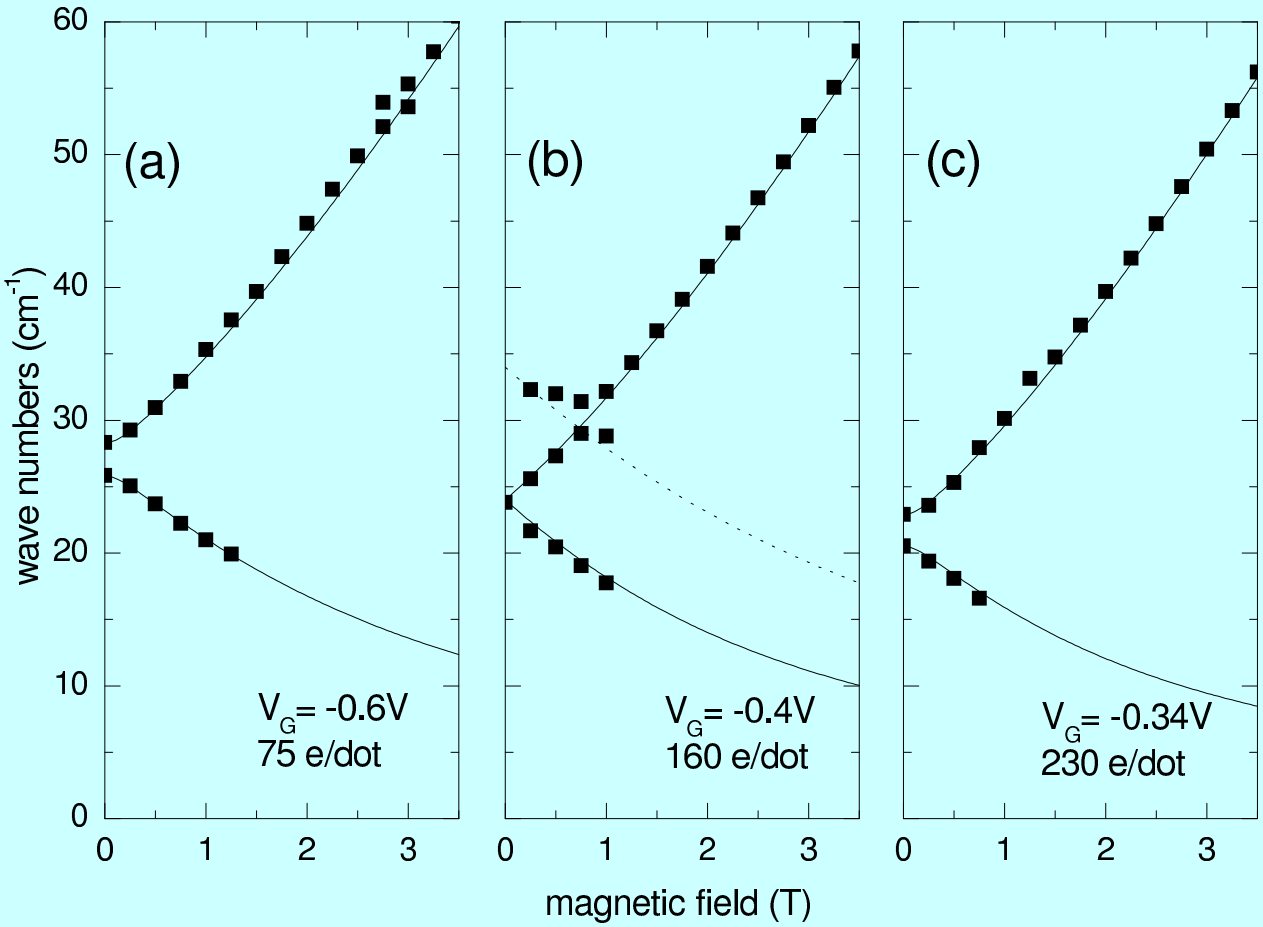


## Induced density

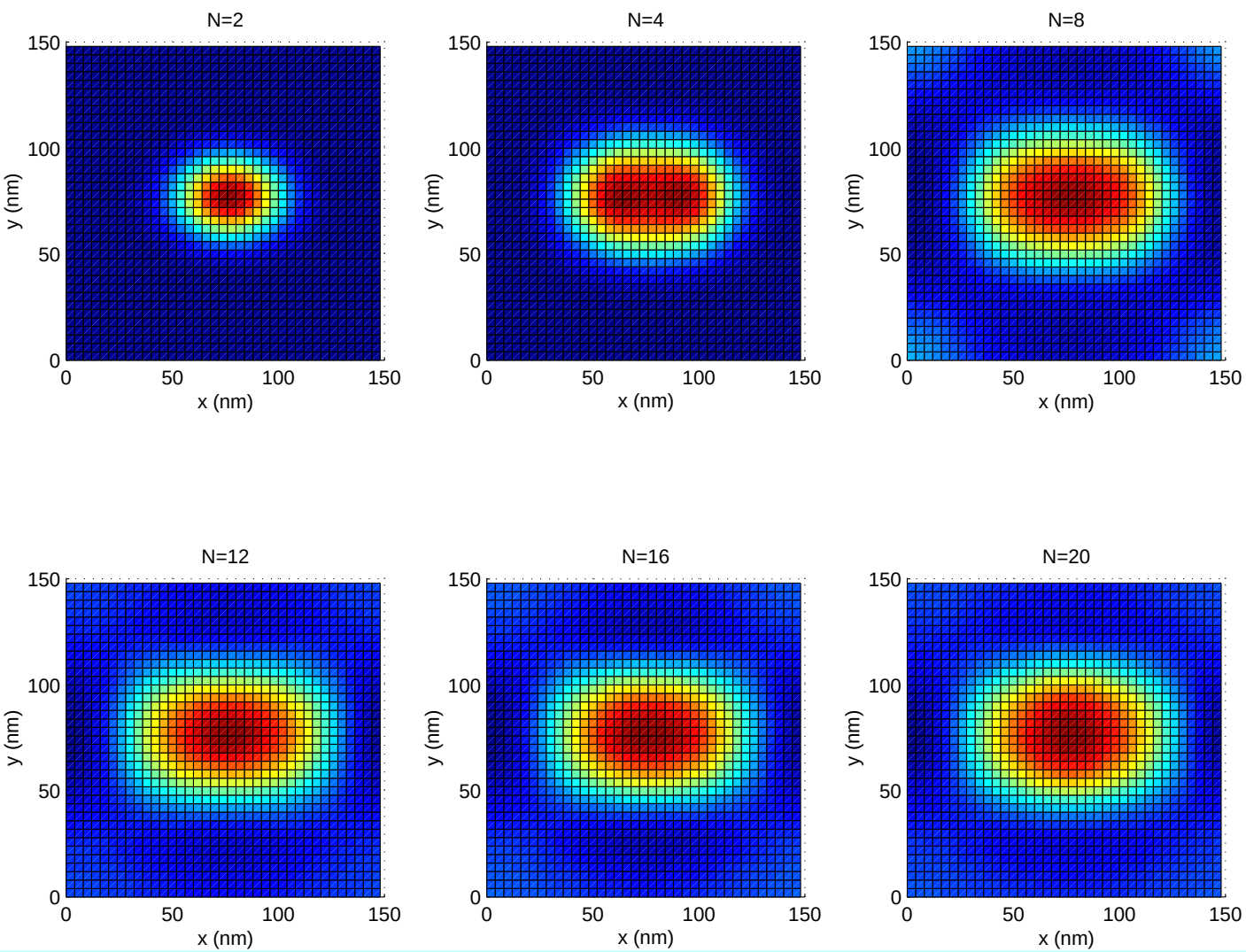
- Mode recognition
- $B = 5$ T,
  three lowest modes
- CM $\leftrightarrow$ relative motion



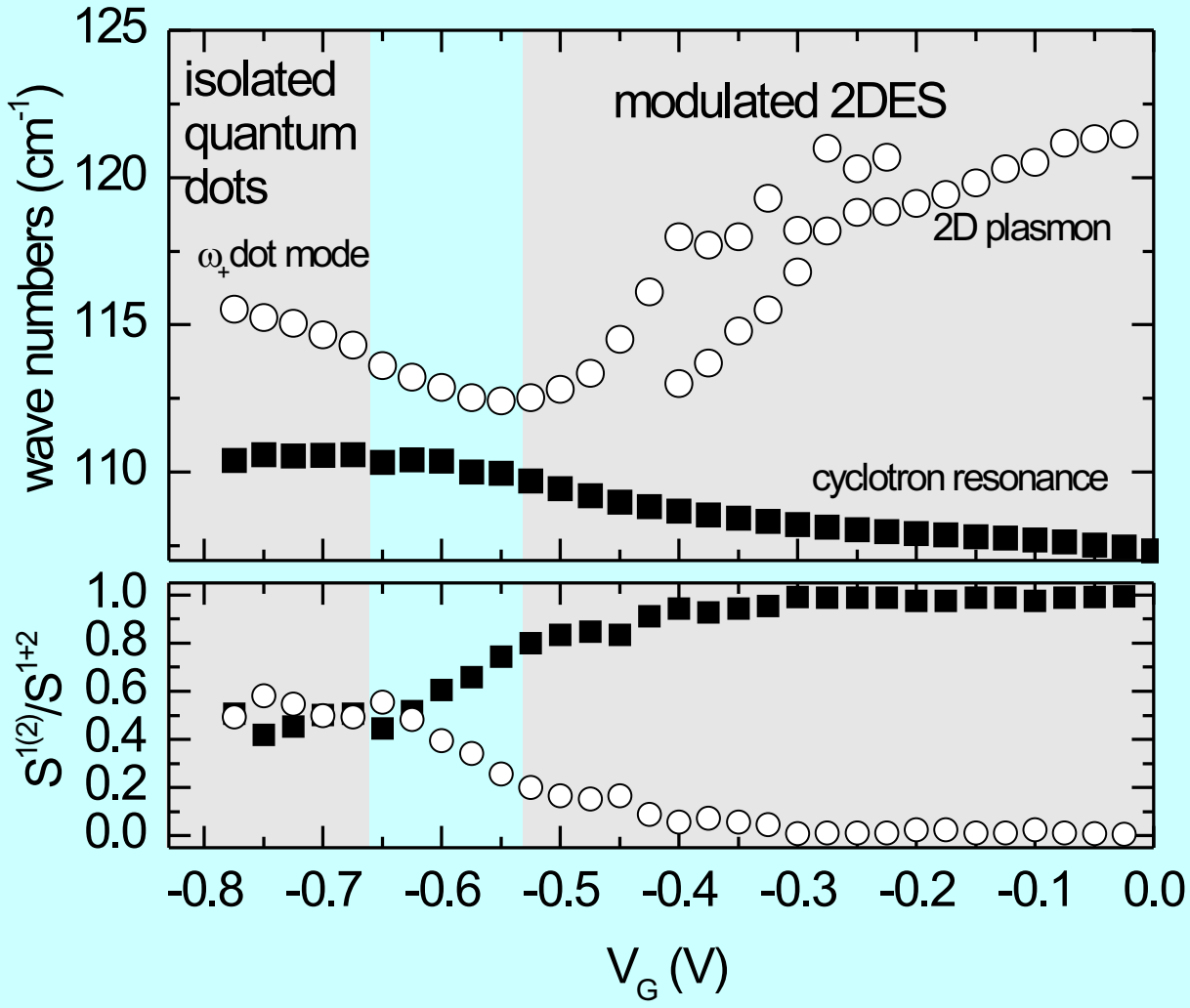
# Change of shape with increasing $N$



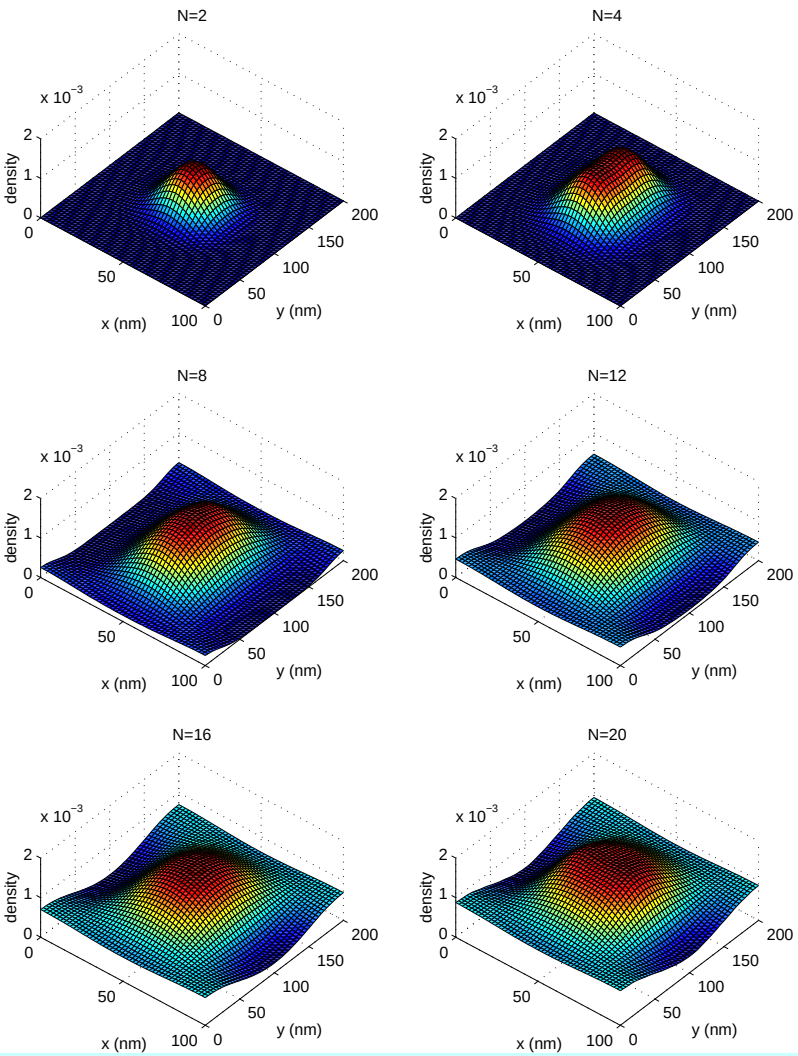
# Calculated shape, LSDA



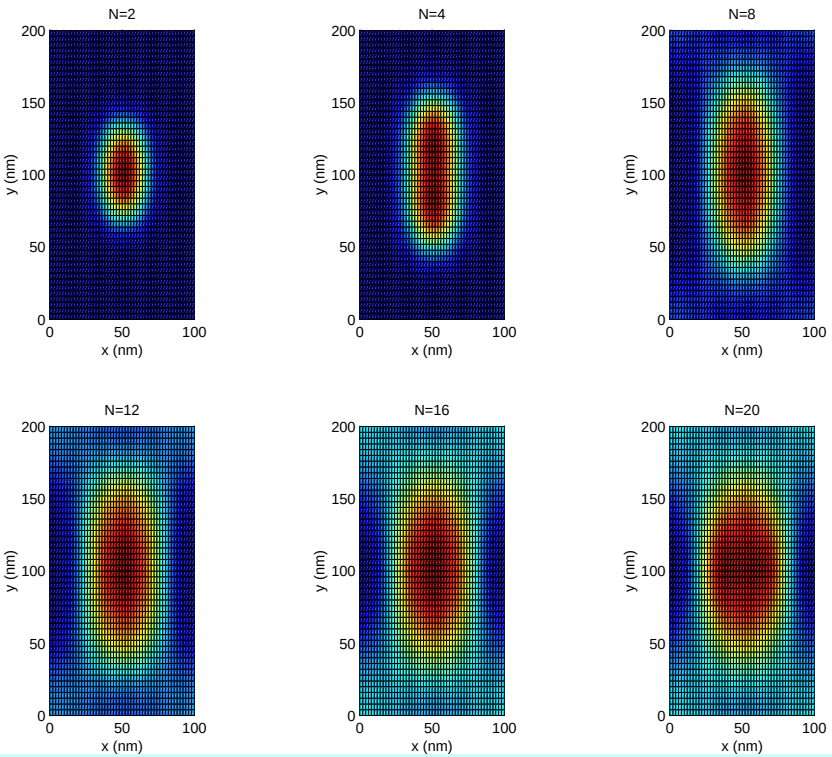
# 0D → 2D


isolated
quantum
dots
modulated 2DES
ω+ dot mode
2D plasmon
cyclotron resonance
wave numbers (cm-1)
125
120
115
110
S1(2)/S1+2
1.0
0.8
0.6
0.4
0.2
0.0
-0.8
-0.7
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0.0
VG (V)

# LSDA




# LSDA, topview

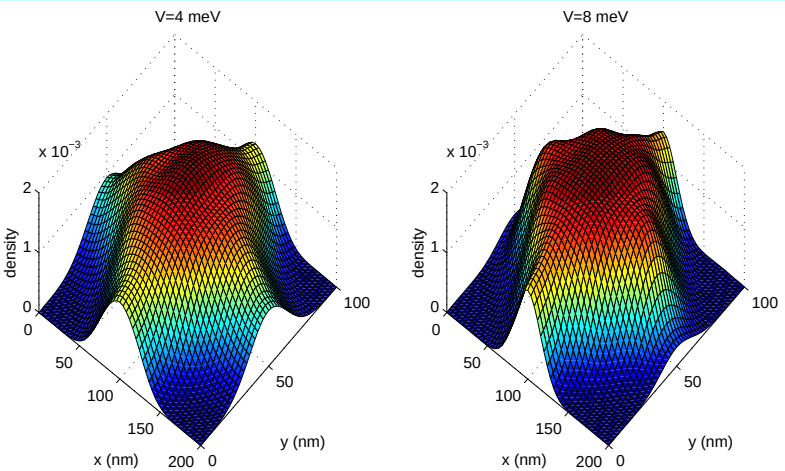


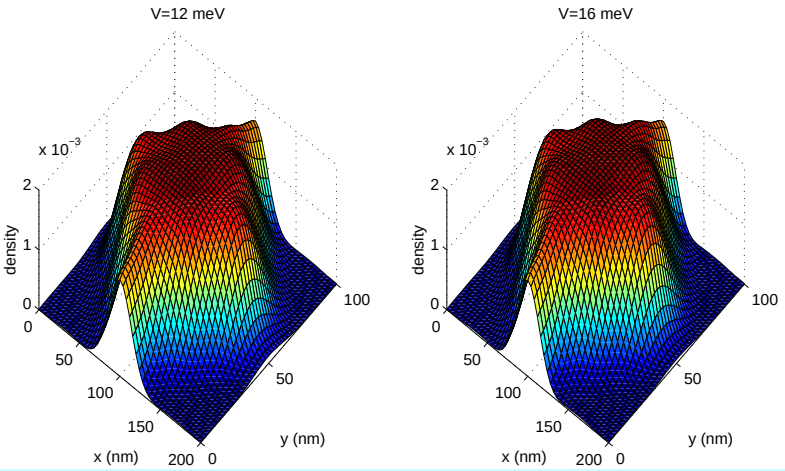

Similar in HA and LSDA

Strong interaction effects

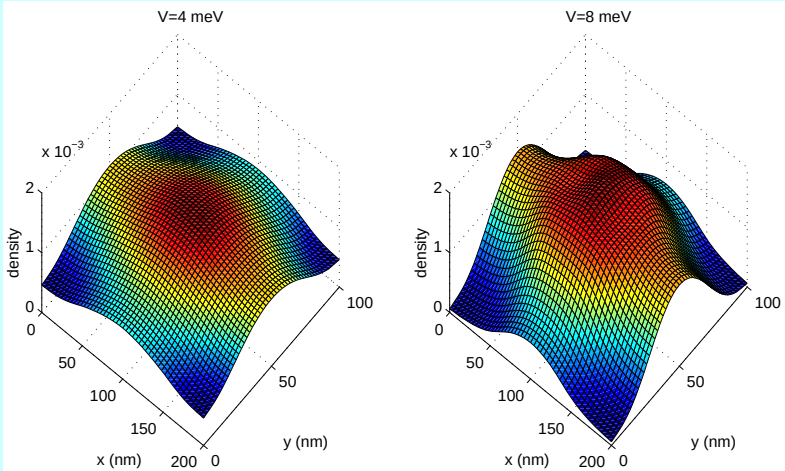
Overlapping in preferred direction

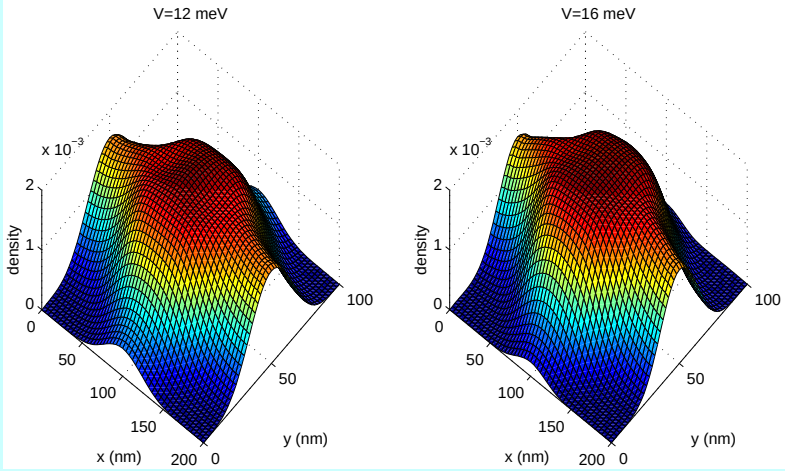
No interaction




LSDA

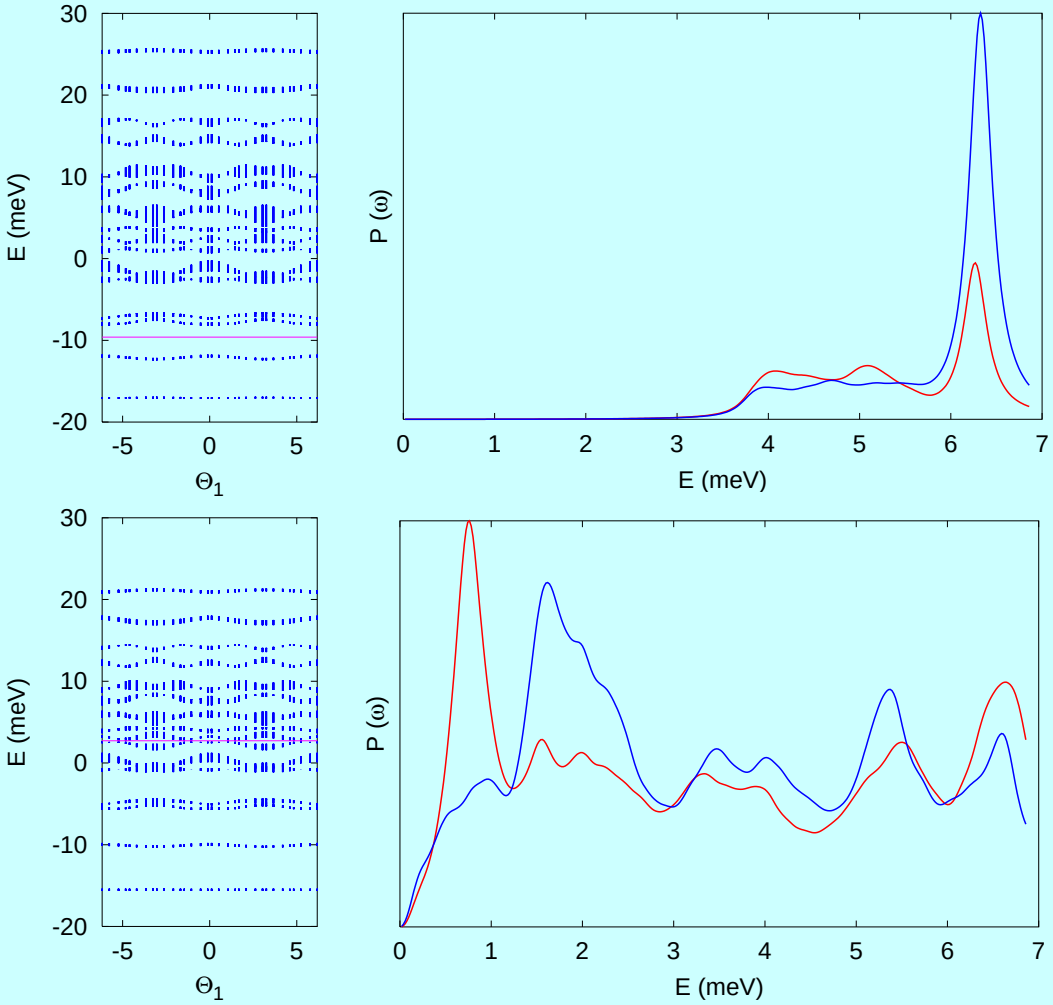


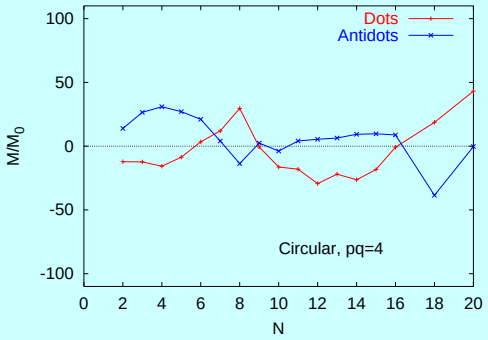

Simple cosine modulation

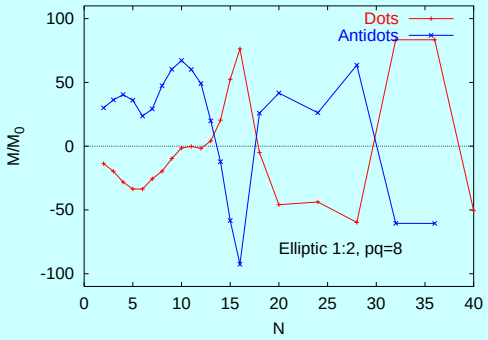
# FIR-absorption

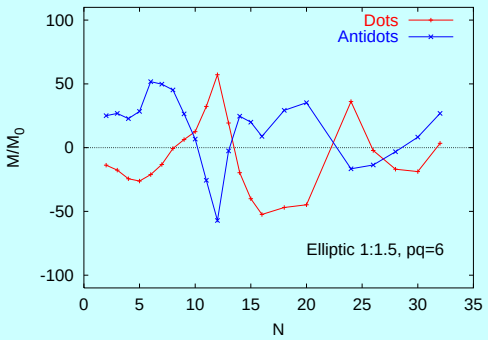
- Periodic:
  - Few $B$-values
  - Hartree approx.
- Results:
  - Isolated QD
  - Overlapping $\rightarrow$ intraband transitions
  - Shape effects?

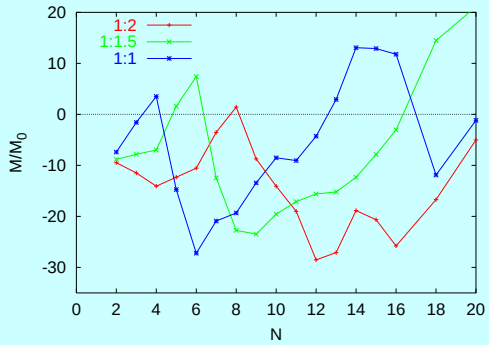


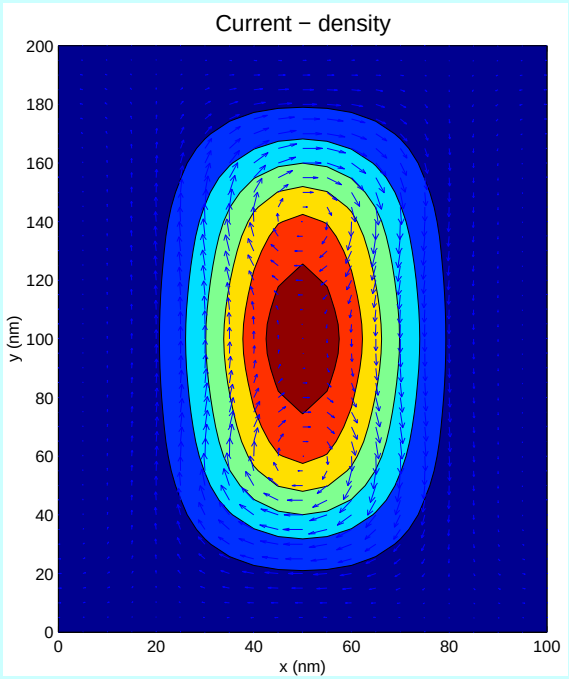
# Magnetization, (orbital)



# Conclusions

- Observed effects of:
  - Periodicity
  - Dot interaction
  - Overlapping density
- To do:
  - Improved absorption
  - Magnetization?