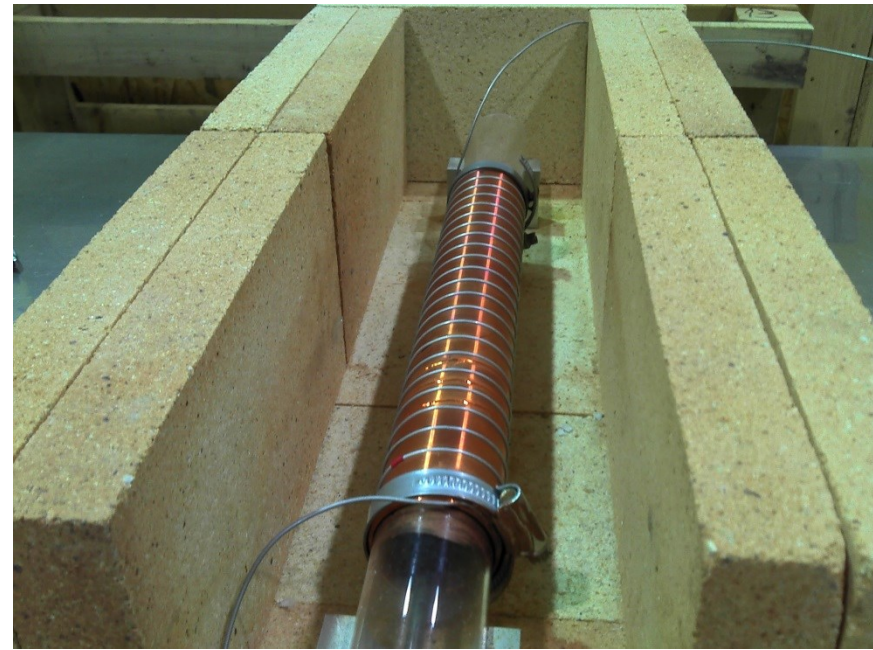
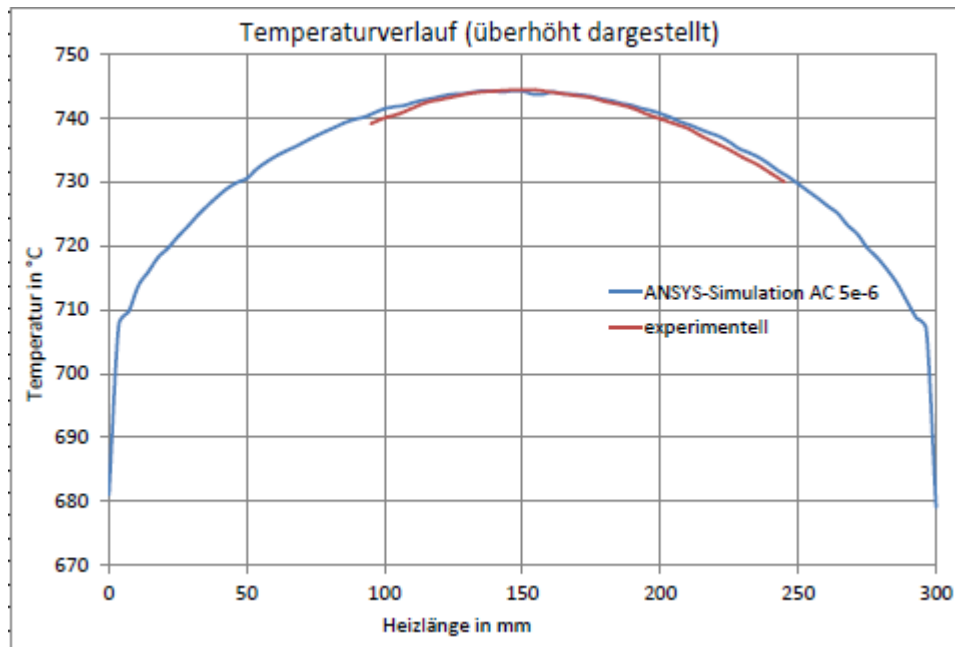


# Plasma Cell Update

Matthias Gross  
Plasma cell update  
Zeuthen, 04.12.2014

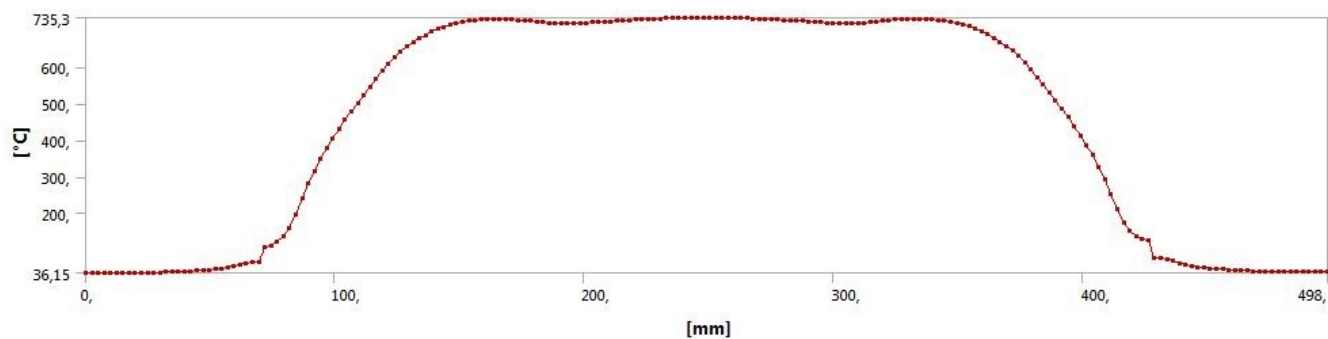
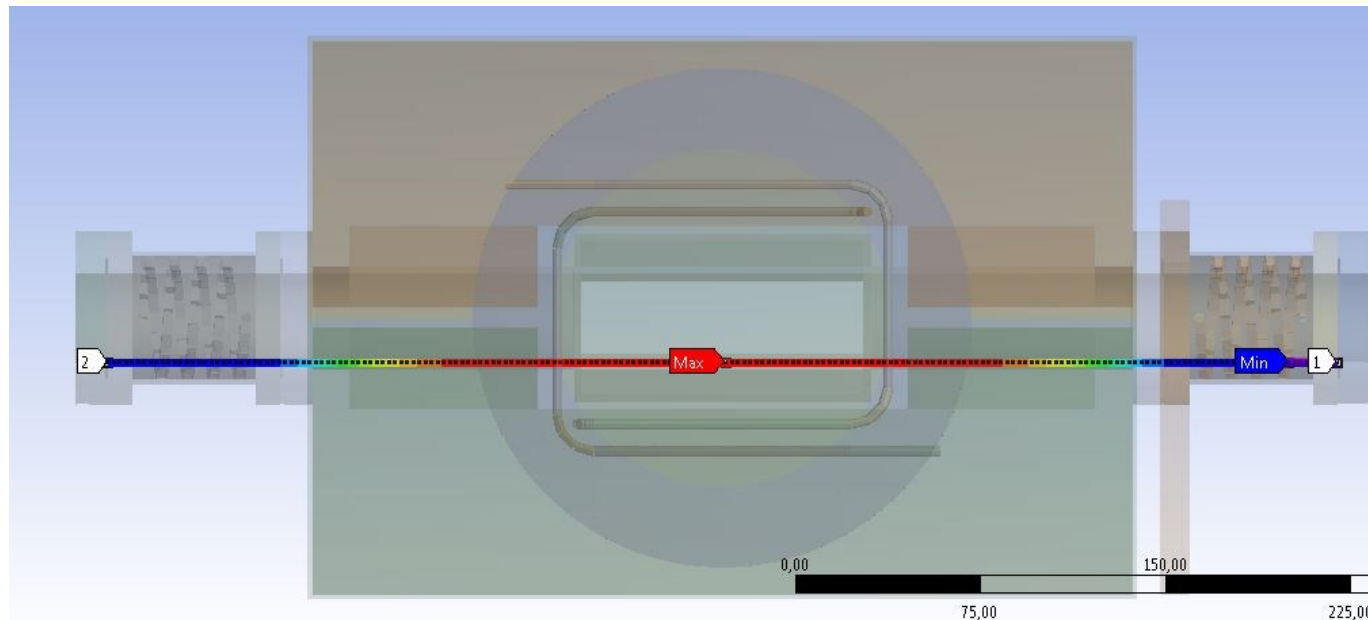
# Comparison ANSYS Simulation to Experiment (Prototype)

- Quartz tube (simple pipe), no cooling (high edge temperature)
- Heating power: 305W; Max. temperature: 745C
- Simulation and experiment in agreement



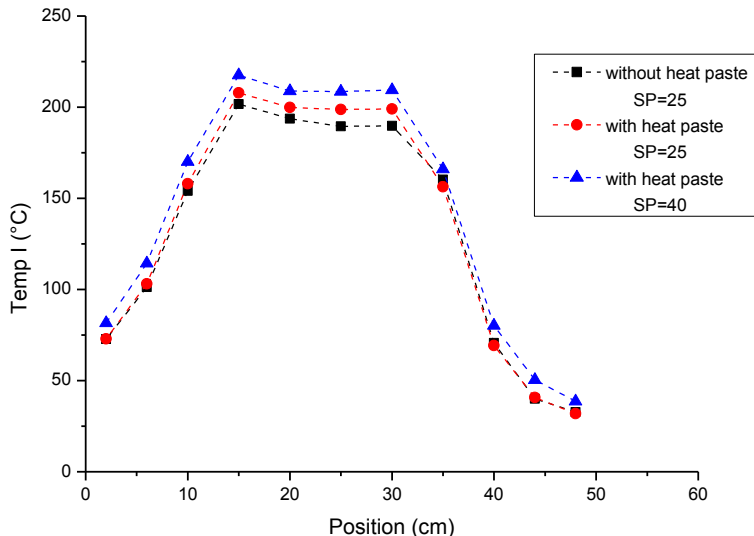
# ANSYS Simulation of Plasma Cell (Full heating power)

➤ Maximum temperature: 735C

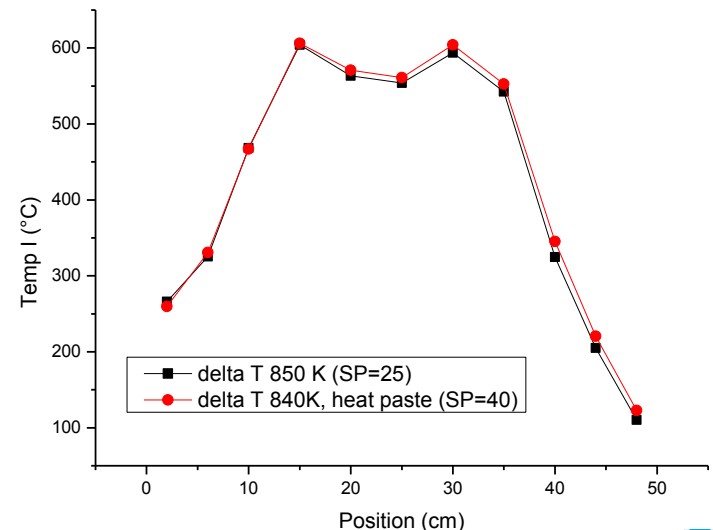


# Measurement with Plasma Cell: Much lower temperature

- Mid level power
- Apply heat paste and increase cooling water temperature from 25C to 40C
- Temperature difference: 15 to 20 degrees



- Maximum power
- Max temperature only  $\approx 560\text{C}$  to 600C
- Temperature difference (heat paste; water): 5 to 10 degrees



# Comparison: Plasma Cell at SLAC (Simple pipe!)

## > Plasma Cell Parameters: (PITZ)

- Max. temperature: 690C (605C)
- Inner tube diameter: 25.2 mm (36 mm)
- Heater length: 40 cm (23 cm)
- Heat insulation length: 46 cm (33cm)
- Distance between cooling jackets: 52 cm (35 cm)
- Heating power (no Lithium): 250 W (740 W)
- 
- With Lithium:
  - He buffer: 0.27 mbar
  - Heating power: 307 W
  - External temperature: 750C

## > Biggest difference: Side wings

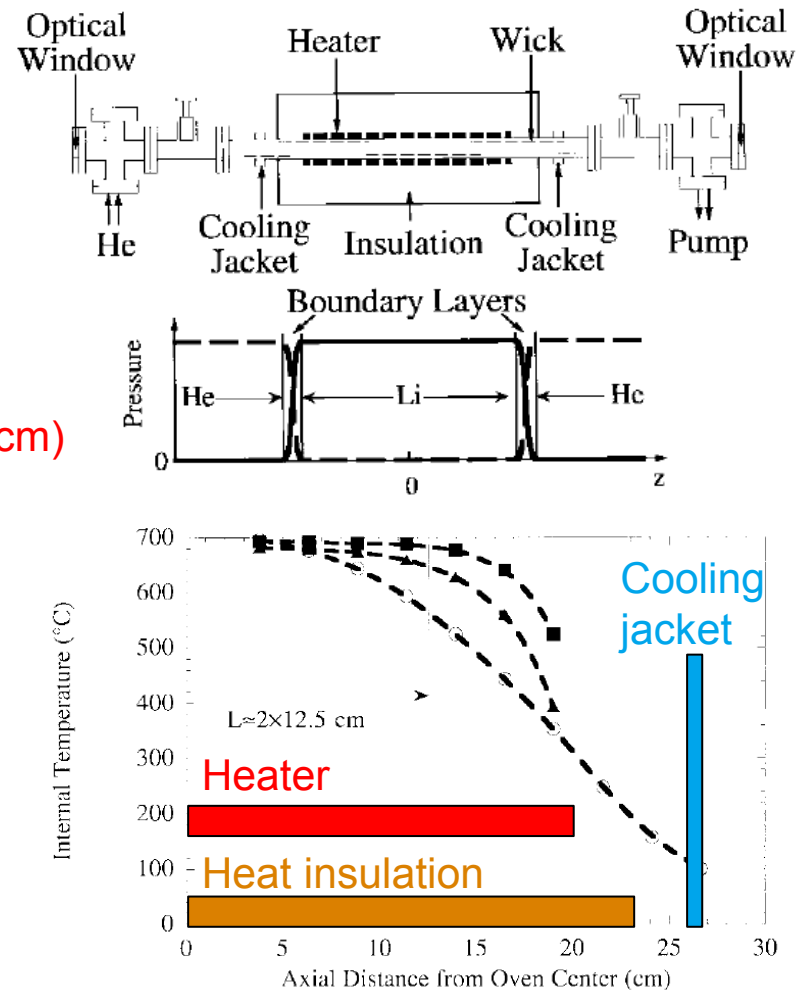
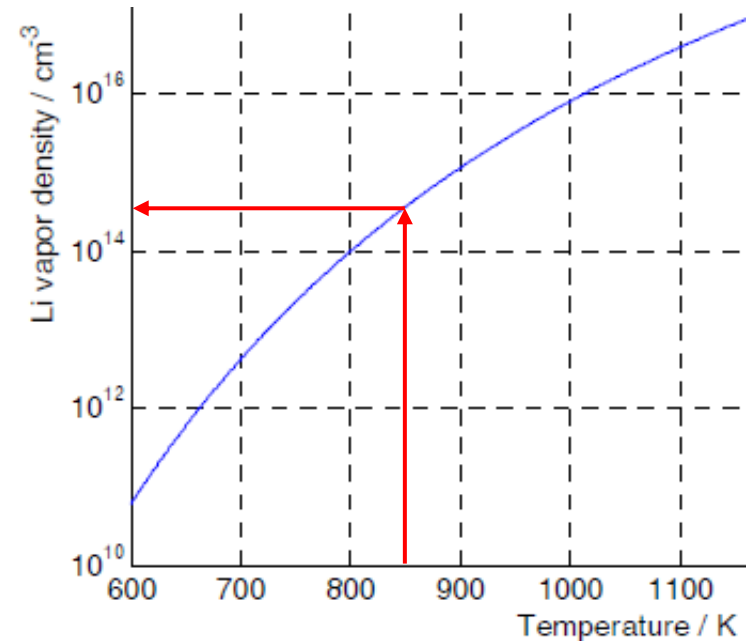


Fig. 4. Temperature profiles along the oven axis without Li in the oven and  $P_{\text{heat}} = 250$  W (open circles) and with Li in the oven and  $P_{\text{heat}} = 265$  W (filled triangles) and  $P_{\text{heat}} = 307$  W (filled squares). The lines are drawn

# What can we do with these parameters?

## > Vaporizing Lithium: vapor pressure curve

- We can reach  $\approx 850$  K
- Max. Li vapor density  $\approx 5 \times 10^{14}$  cm $^{-3}$
- Max. Li pressure: 0.02 mbar
  
- 10% ionization: plasma density  $5 \times 10^{13}$  cm $^{-3}$
- Plasma wavelength  $\lambda_p \approx 4$  mm

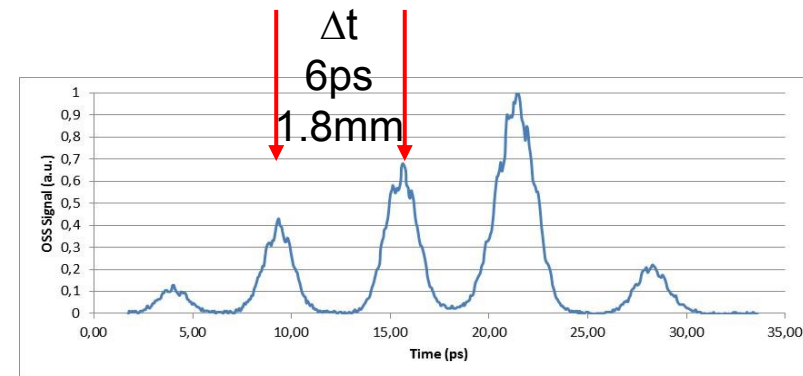


## > Measure gas density with Hook method

## > Self-modulation experiment maybe possible

## > High Transformer ratio: far away

- $\Delta t$  should be  $1.5\lambda_p$ : need  $\lambda_p \approx 1.2$  mm



## > Upgrade plasma cell

- Reduce water cooling in wings
- Stronger heater
- Increase cooling water temperature further (danger to the electron windows!)

## > New plasma cell

- Increase length of wings
- Heating wire around wings
- Other material with less heat conductance, e.g. glass or ceramic possible?
- Wings can have other shapes, e.g. with round or square cross section (no opening angle)



# Newest Results from Today

➤ Reduce water cooling in wings: Big effect!!

