

# Monitoring Programme of the Wigner Energy at the BR1 Reactor

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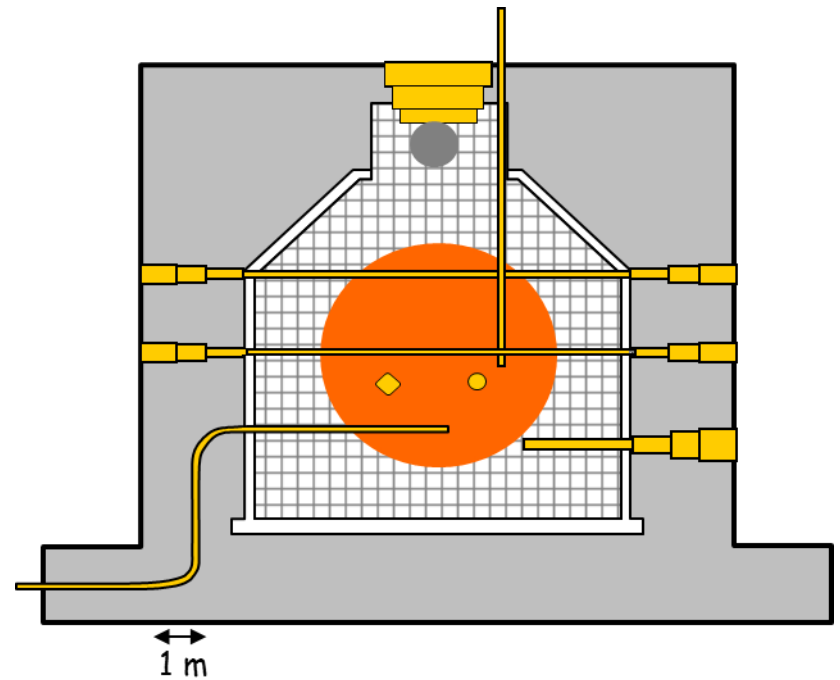
# The BR1 reactor (1)

- 4 MW Research reactor
- Natural uranium – graphite – air
- In operation since 1956
- Large cylindrical reactor core
  - Low flux gradients
- Current operation
  - 8 h @ 700 kW
  - Flexible power settings, 10 W - 1 MW
- Concrete shielding



## The BR1 reactor (2)

- Graphite matrix
  - Nuclear grade
  - $\sim 7 \times 7 \times 7 \text{ m}^3$  matrix
  - 70 experimental channels
- Reactor core
  - Natural metallic U in Al cladding
  - Very low burn-up
  - Original fuel
  - 21 cm rodlets



# Wigner energy: Safety limits

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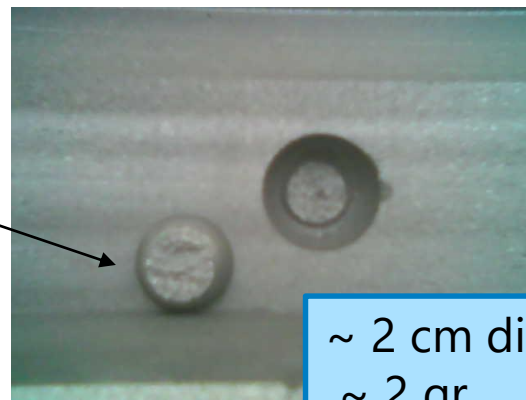
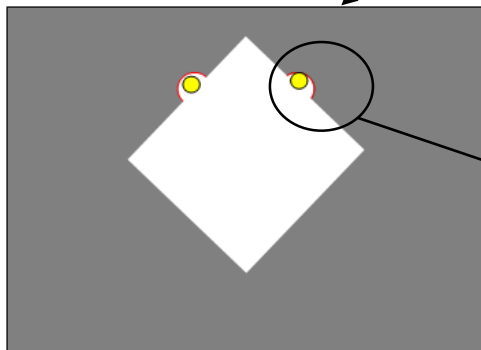
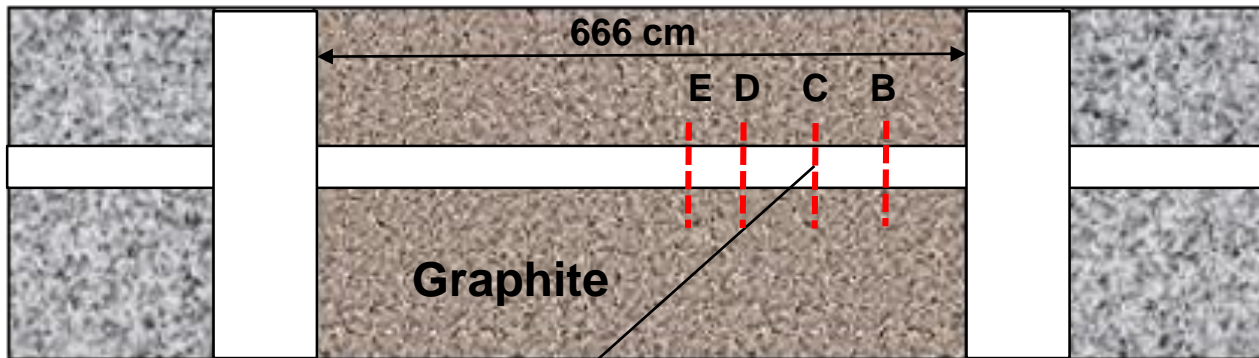
- Max Wigner Energy: 250 J/g
  - Possible damage of the fuel in case of release of the Wigner Energy
- Temperature limit for the graphite: 104 °C
  - Low probability of exothermal release

# Wigner energy: Monitoring program

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- Measurement of the Wigner energy each 5 GWh reactor work
- Sampling of the graphite in the channels of central region
- Measurement of the amount of Wigner energy in the sample with DSC

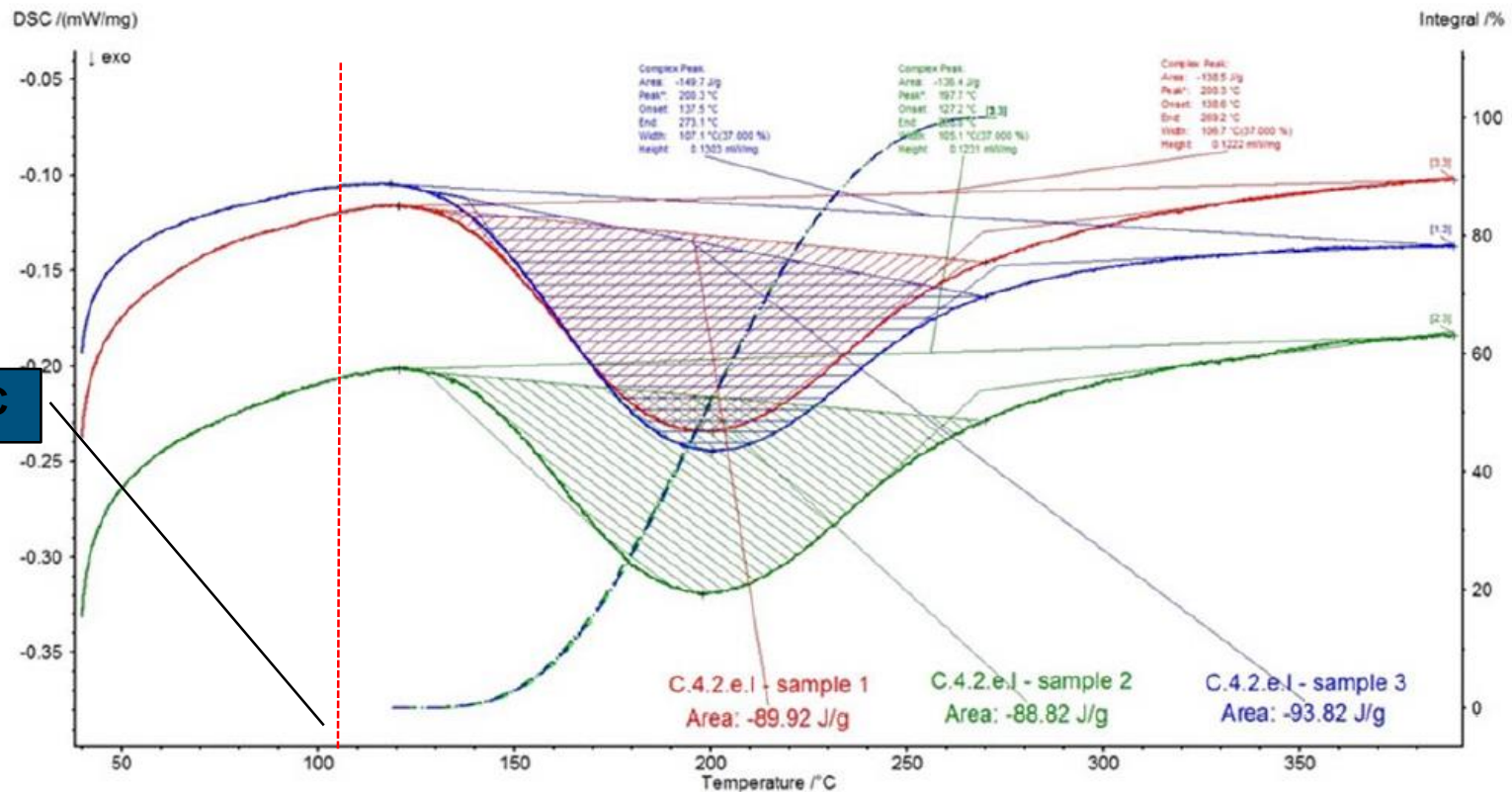
# Monitoring Wigner energy: Graphite sampling



~ 2 cm diameter,  
~ 2 gr

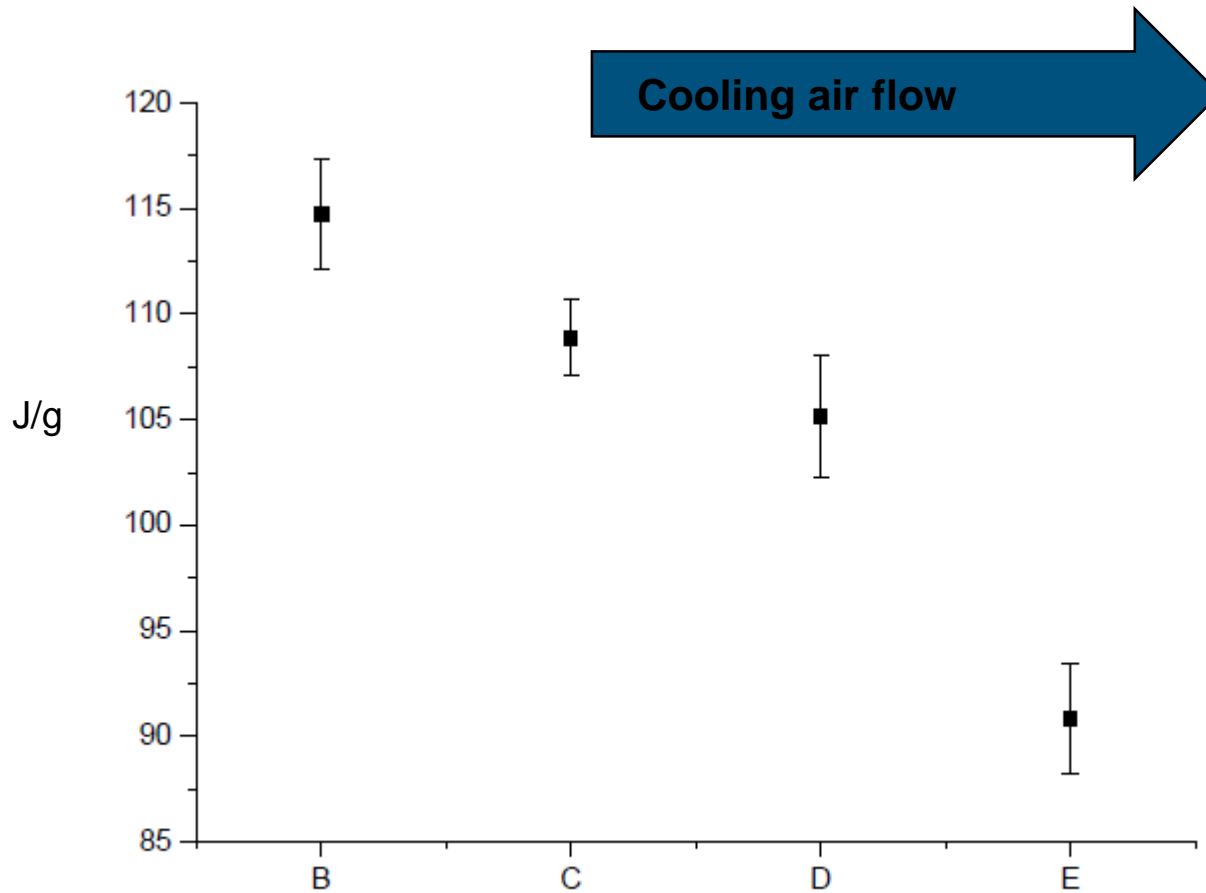
# Monitoring Wigner energy: Sample measurement

- Samples are heated up to 400 °C in a differential scanning calorimeter (DSC) and the heat flux generated by the samples is measured



104 °C

# Wigner Energy: Axial dependence



Axial position in channel C.4.2

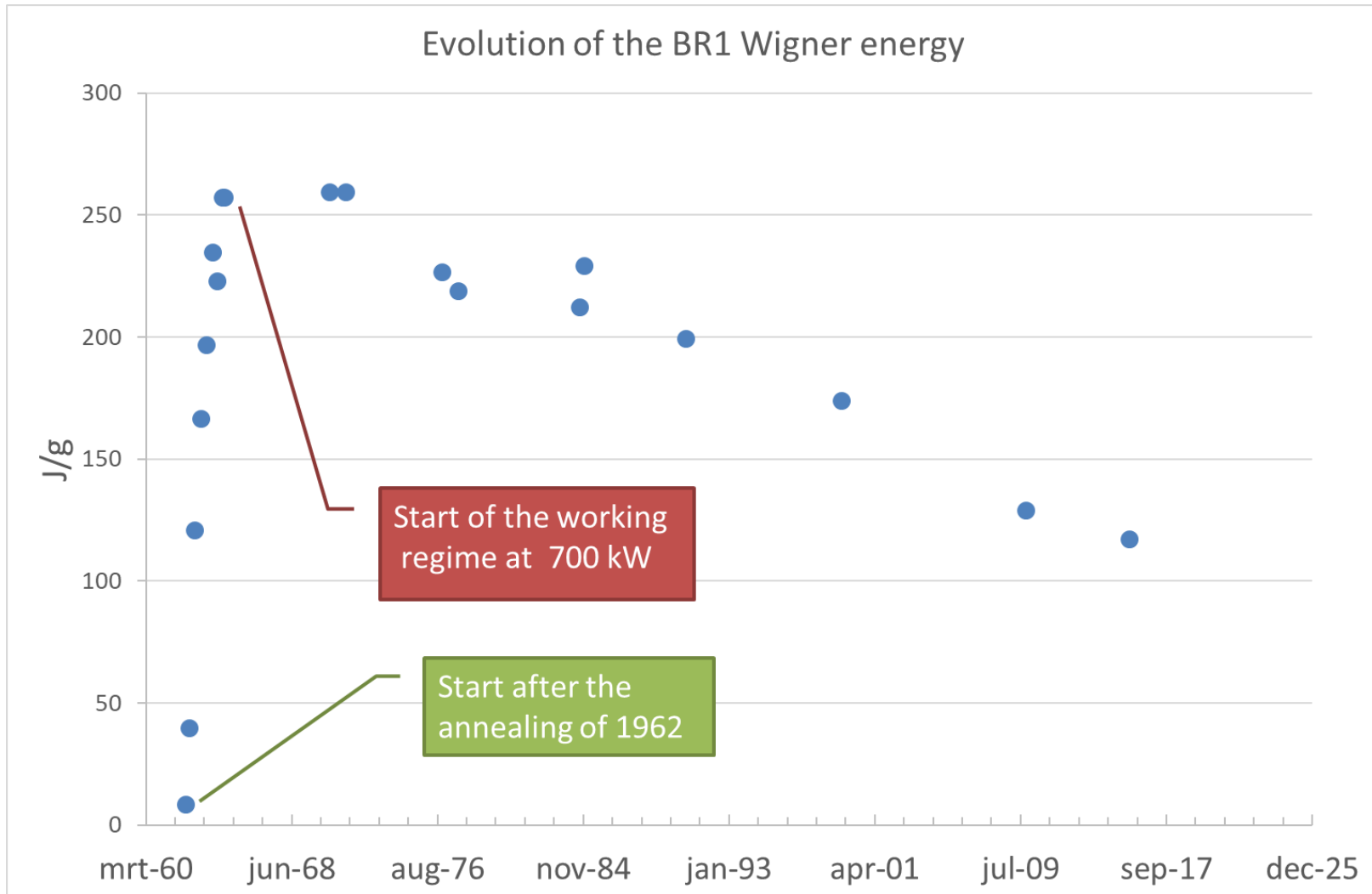


## Wigner energy: Channel load dependence

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- In the last campaign we selected two channels for the sampling of the graphite. One loaded with fuel and one not. Both channels belong to the same radial zone.
- We did not observed a significant difference in the amount of Wigner energy between the two channels.

# Wigner Energy: Evolution



## Wigner energy: conclusion and future plans

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- Since the change of the working regime from 4MW to 700 kW the Wigner energy of the BR1 continuously decrease due to the low flux and a lower ventilation regime.
- In a reactor channel the highest accumulation is found at the cold side of the channel.
- A preliminary study show that the presence of the fuel in the reactor channel does not influence the accumulation of the Wigner Energy
  
- Reevaluate the radial dependence
- Further investigate the influence of the fuel in the channel

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