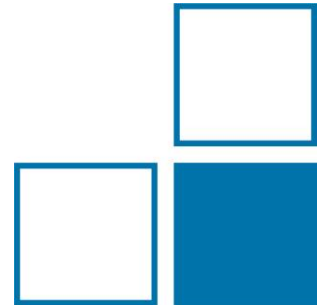


Heat correction factor of the PTB water calorimeter in ultra-high pulse dose rate electron beam

Alexandra Bourgouin¹, Thomas Hackel¹, R.-P. Kapsch¹

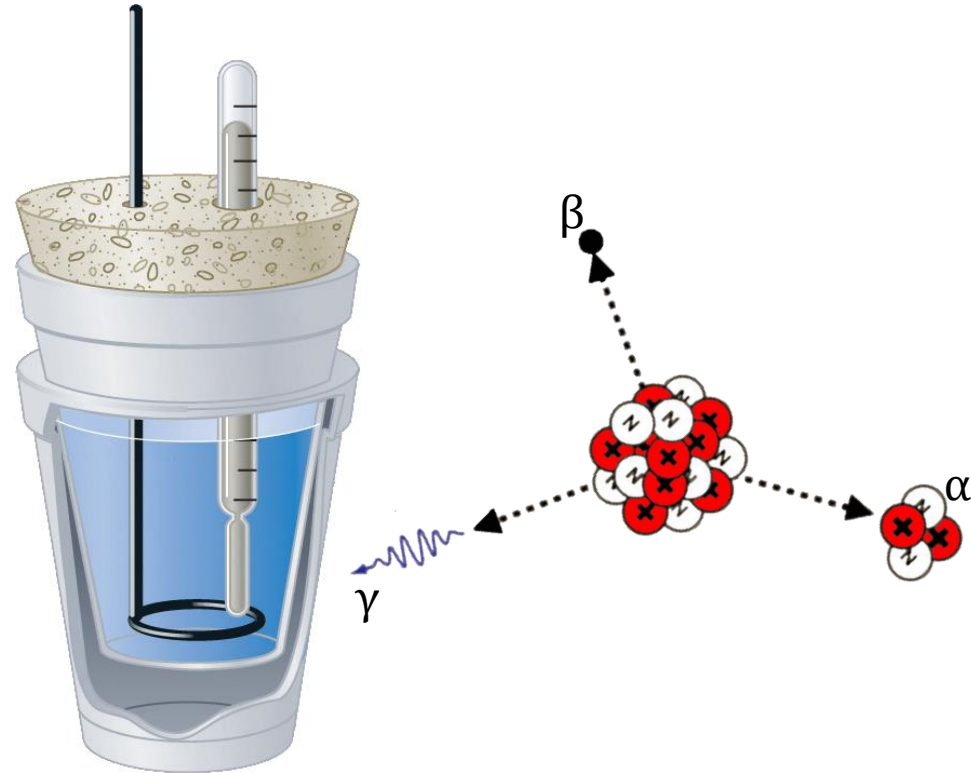
(1) *Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Lower Saxony, Germany*



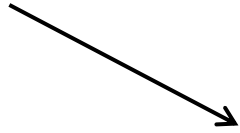


No, nothing to disclose

Measurement of temperature increase, ΔT ,
due to radiation for a specific medium

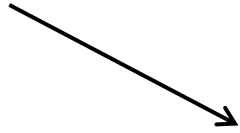


Dose to water



$$D_w \propto \Delta T \cdot c_w \cdot k_{HC}$$

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Temperature change
Measurement

Dose to water

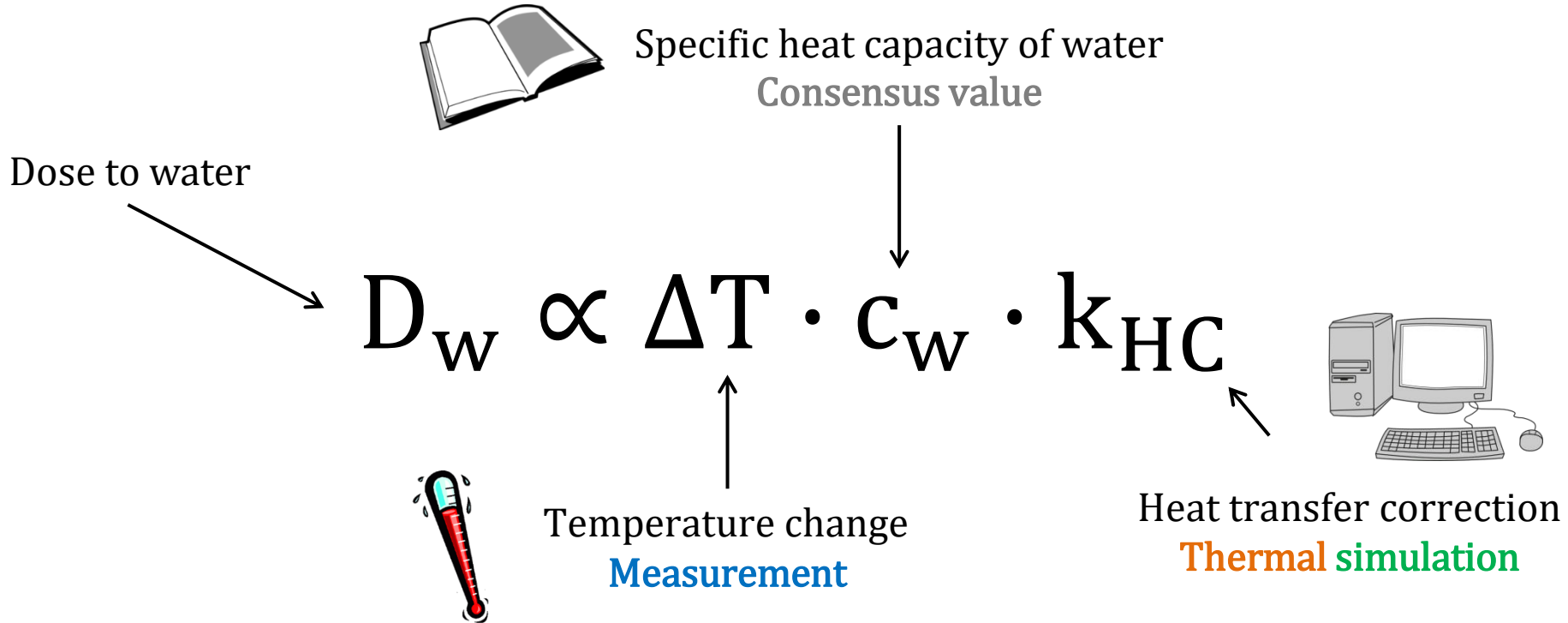


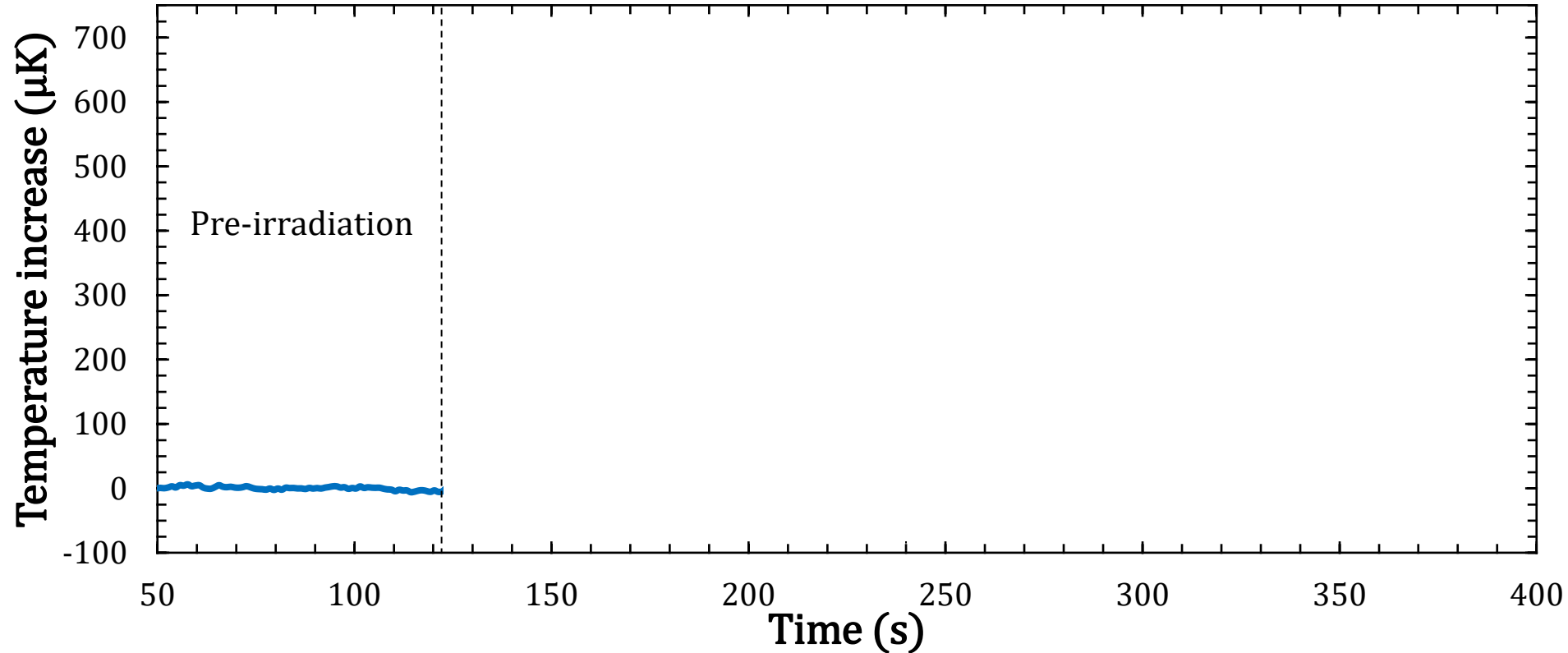
Specific heat capacity of water
Consensus value

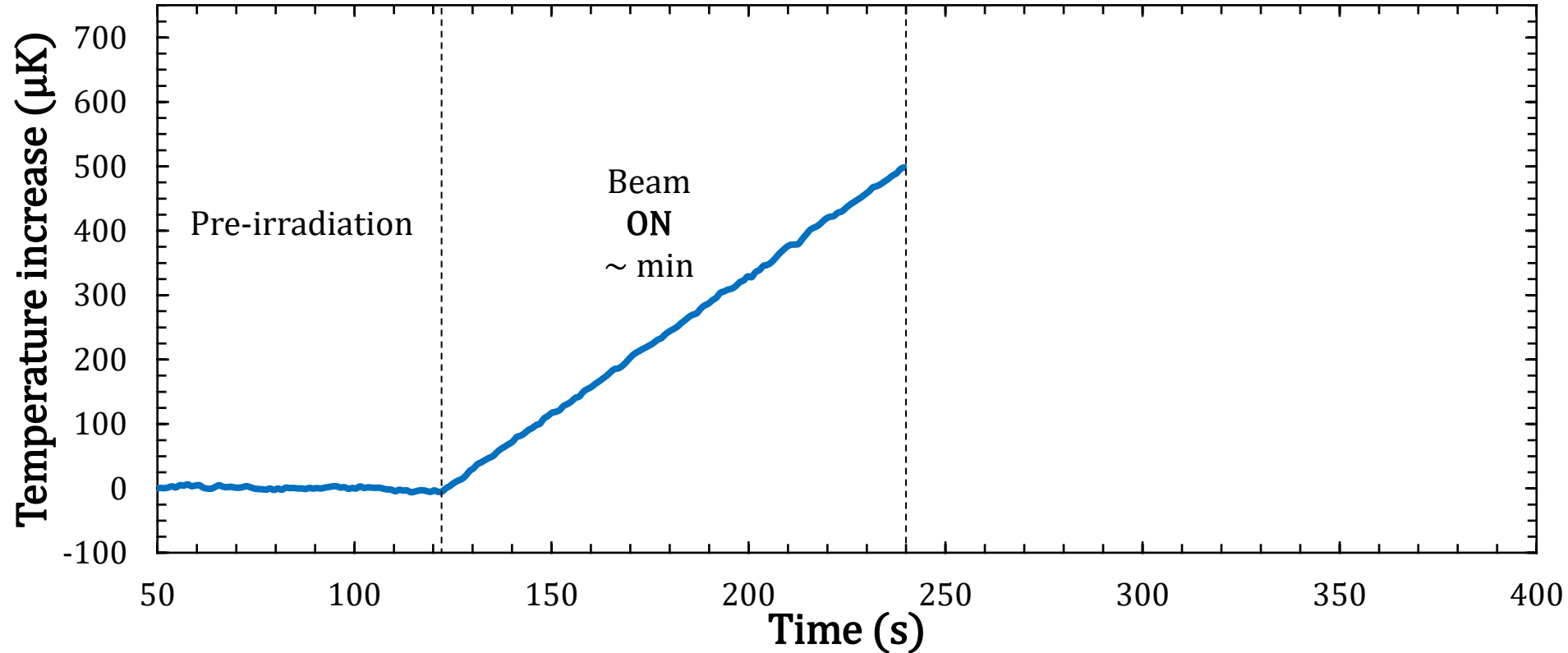
$$D_w \propto \Delta T \cdot c_w \cdot k_{HC}$$


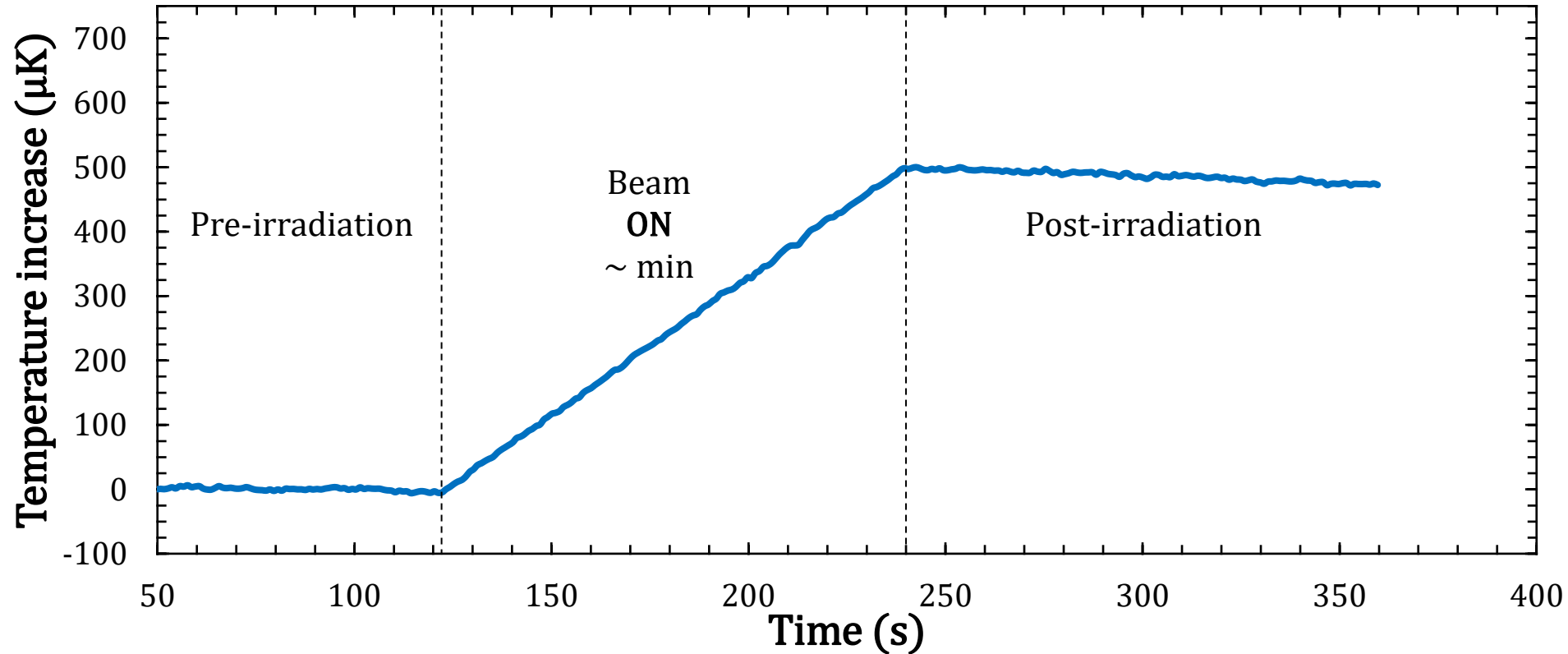
Temperature change
Measurement

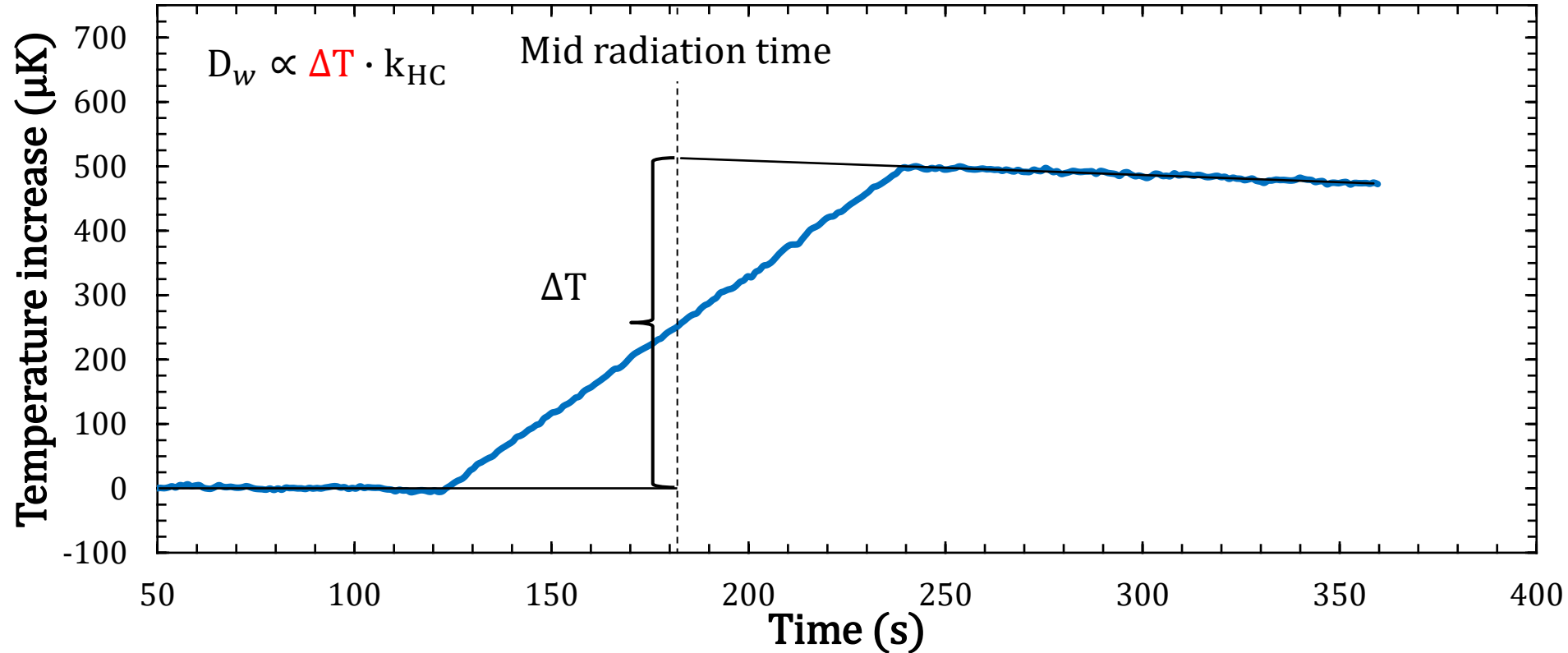
The diagram illustrates the dose equation $D_w \propto \Delta T \cdot c_w \cdot k_{HC}$. An arrow from the text "Dose to water" points to the D_w term. An arrow from the text "Specific heat capacity of water Consensus value" points to the c_w term. An arrow from the text "Temperature change Measurement" points to the ΔT term. The word "Measurement" is highlighted in blue.

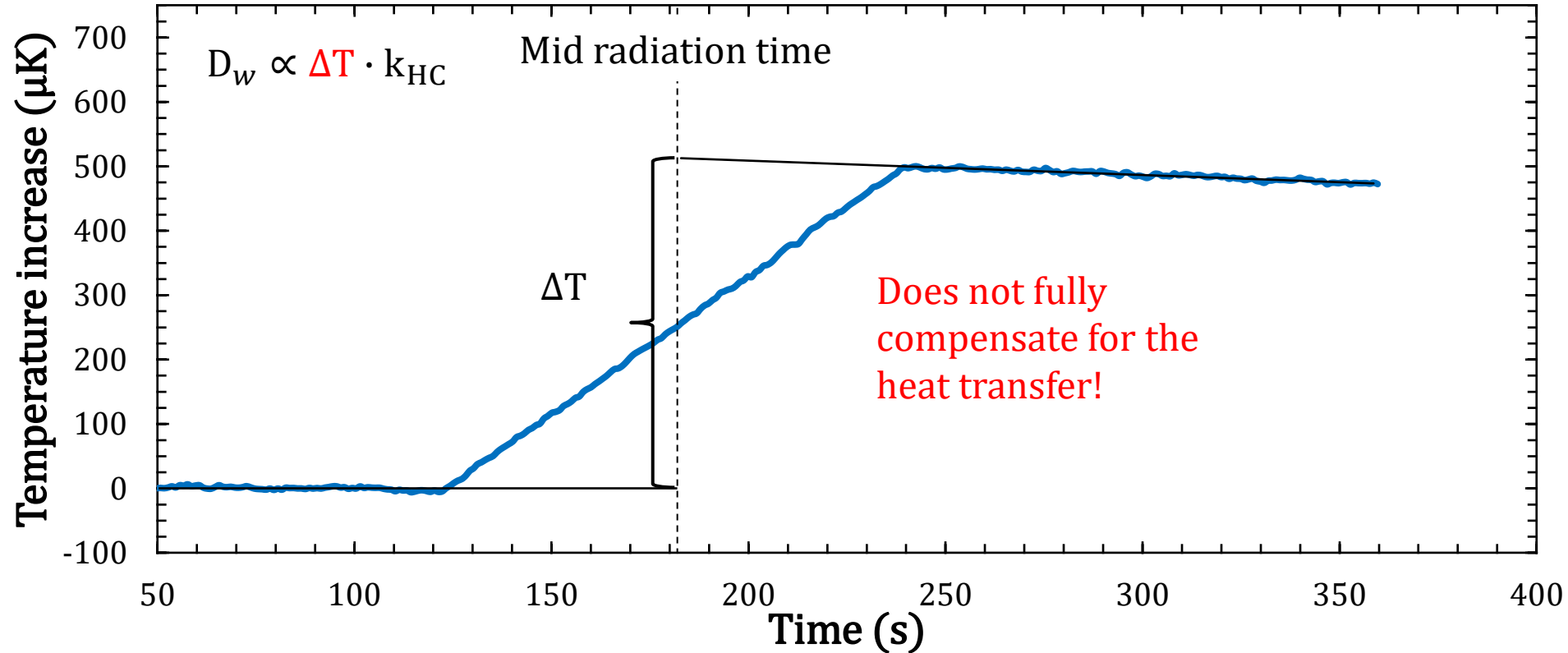


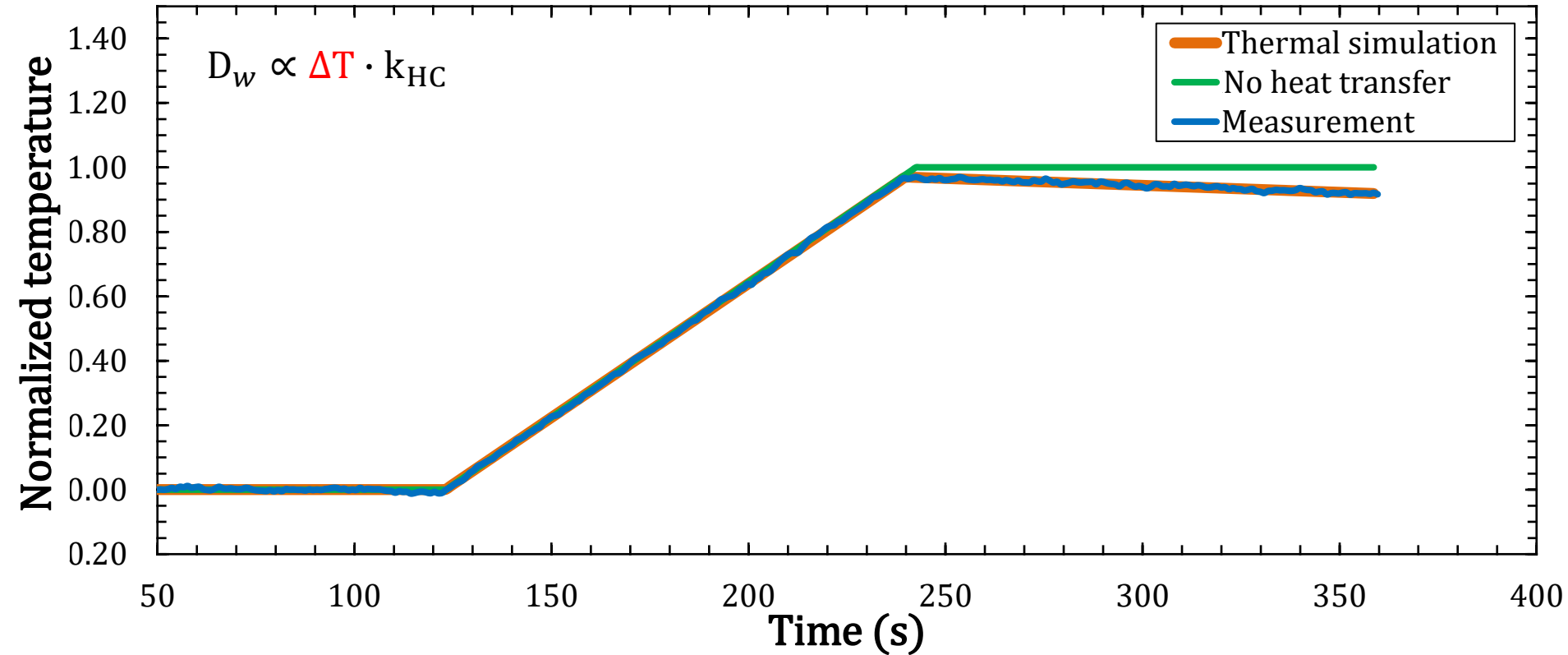


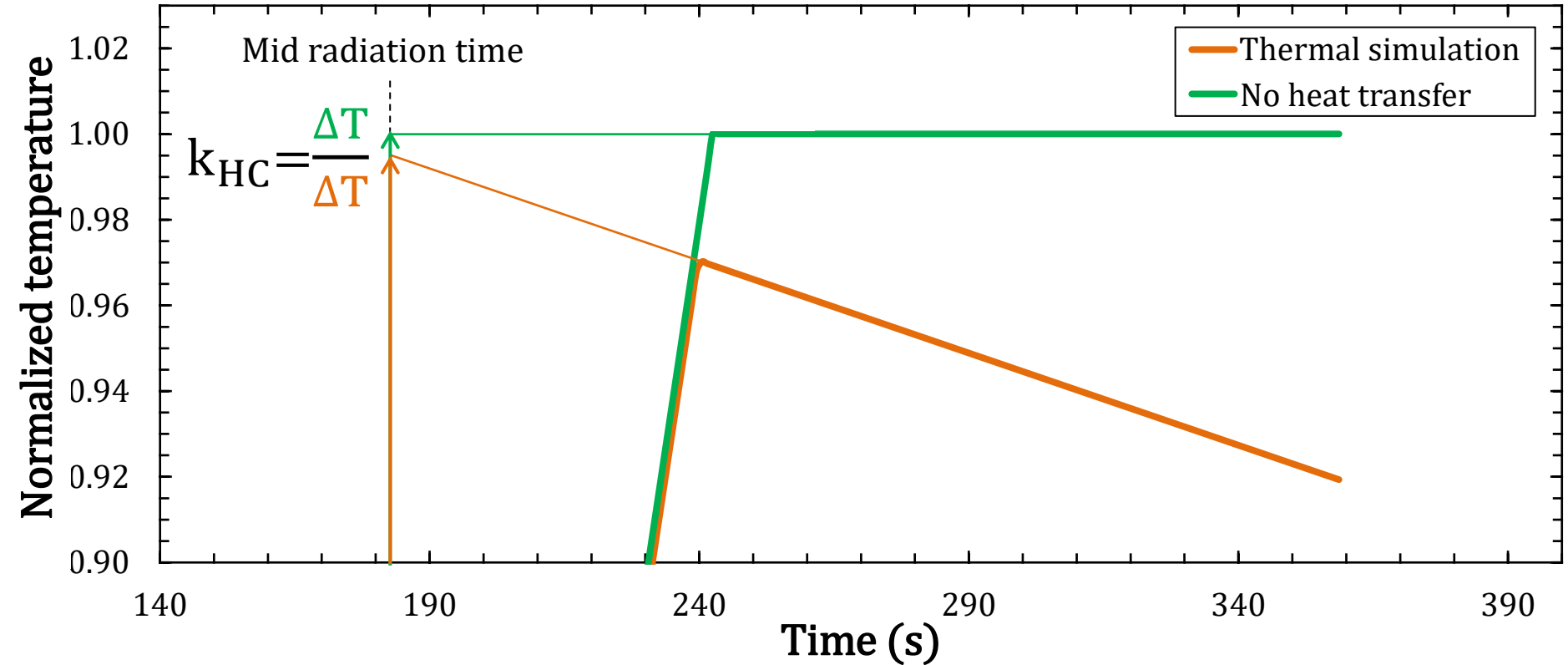


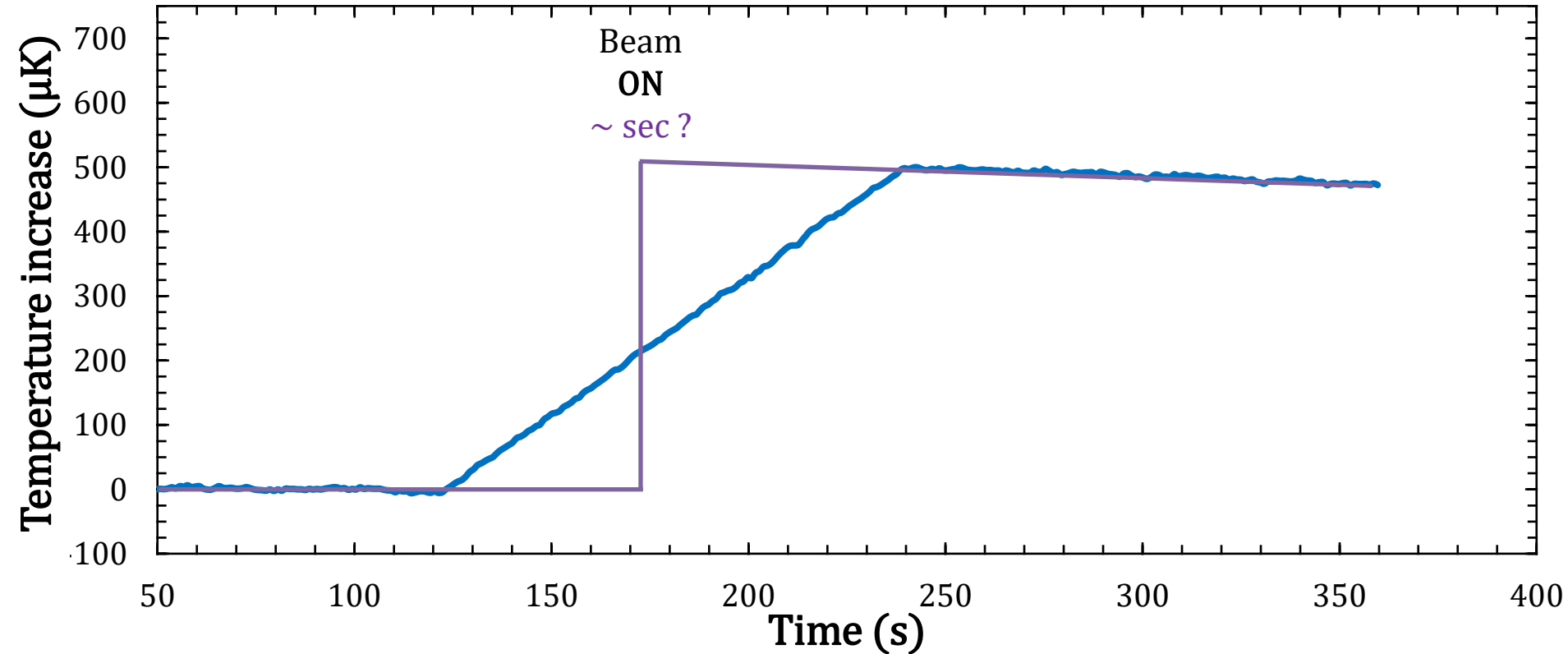




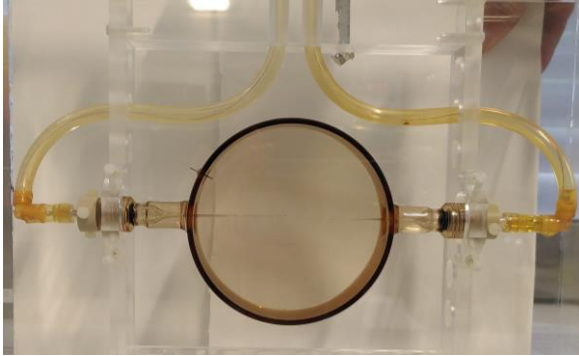






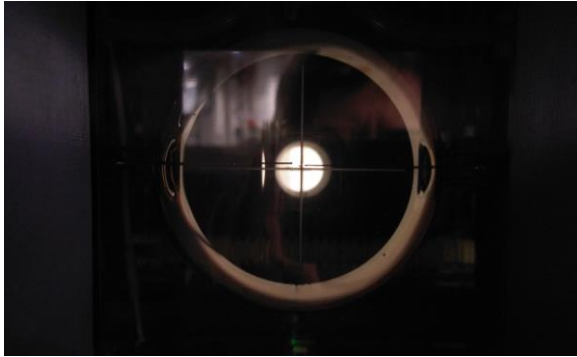


➤ Glass vessel “plane-parallel” type



- Developed in the early 2000s
- Same design as the primary standard
- Quasi-adiabatic mode

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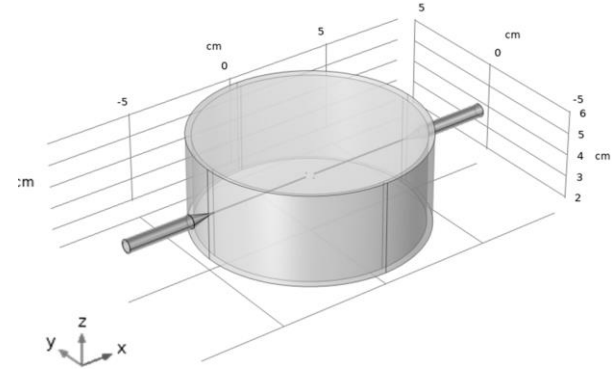
➤ MR-linac compatible calorimeter

- Developed in the late 2010s
- Metallic materials were avoided during its construction



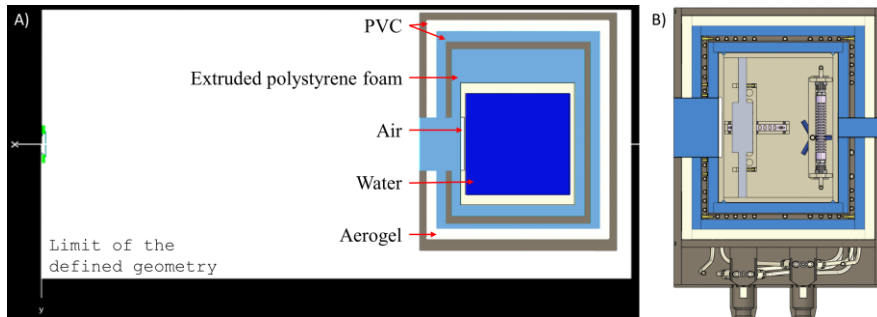
➤ Thermal simulation

- FEM simulation (COMSOL)
- Based on model from Dr. Krauss
- Validated by comparing result for ^{60}Co beam source

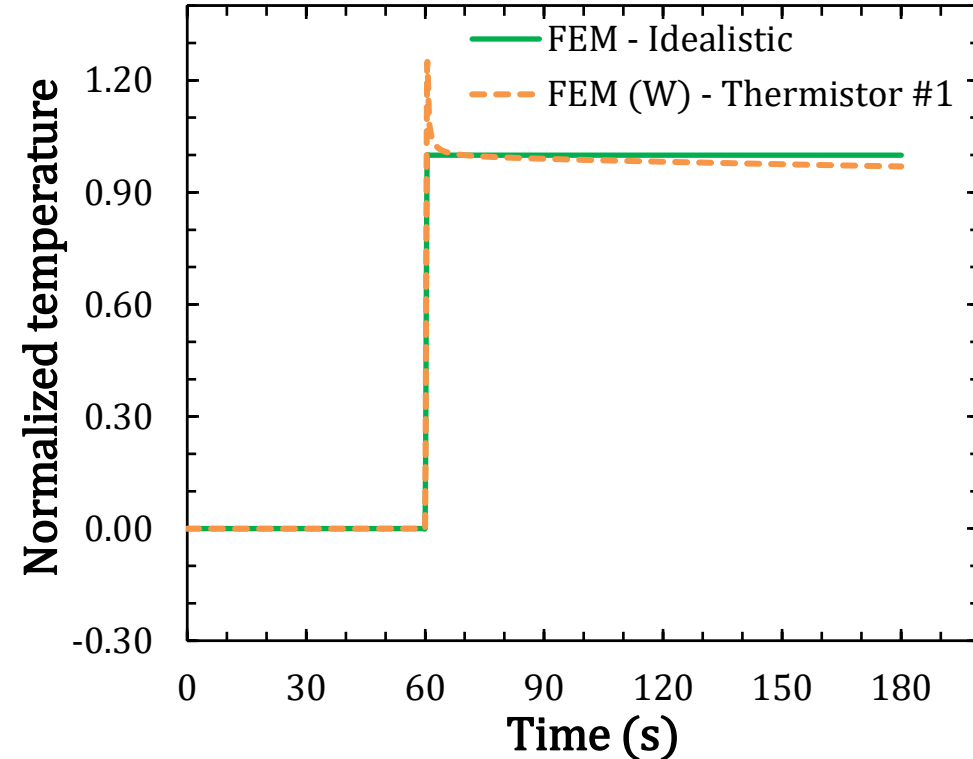


➤ Monte Carlo simulation (EGSnrc)

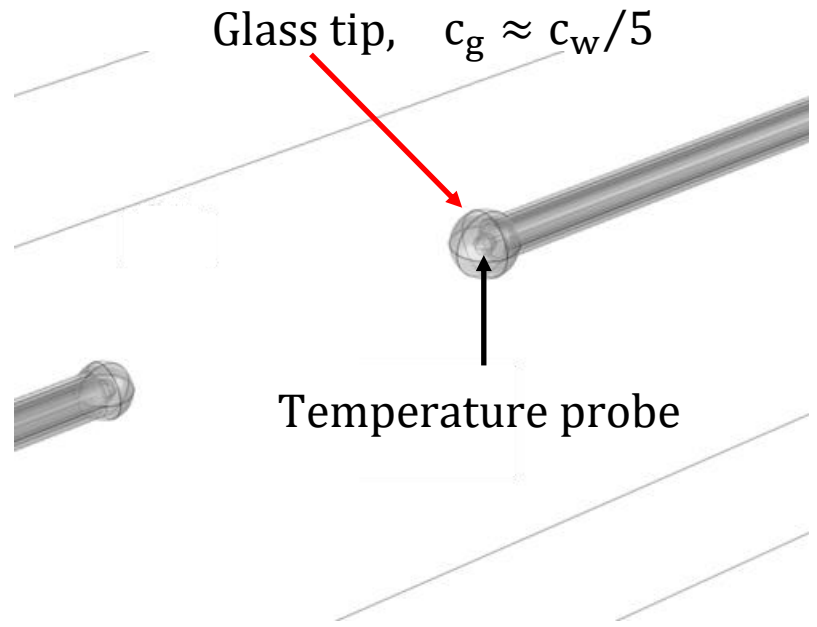
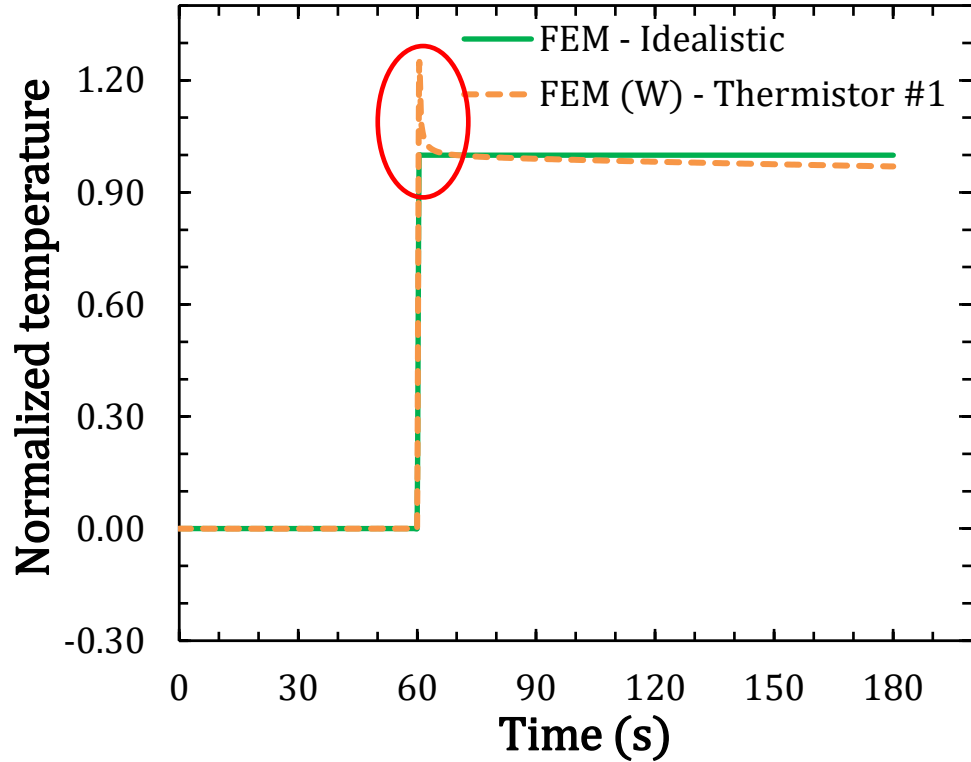
- Energy mapping for thermal simulation
- Two models: In a water cube
Simplified MR-linac geometry



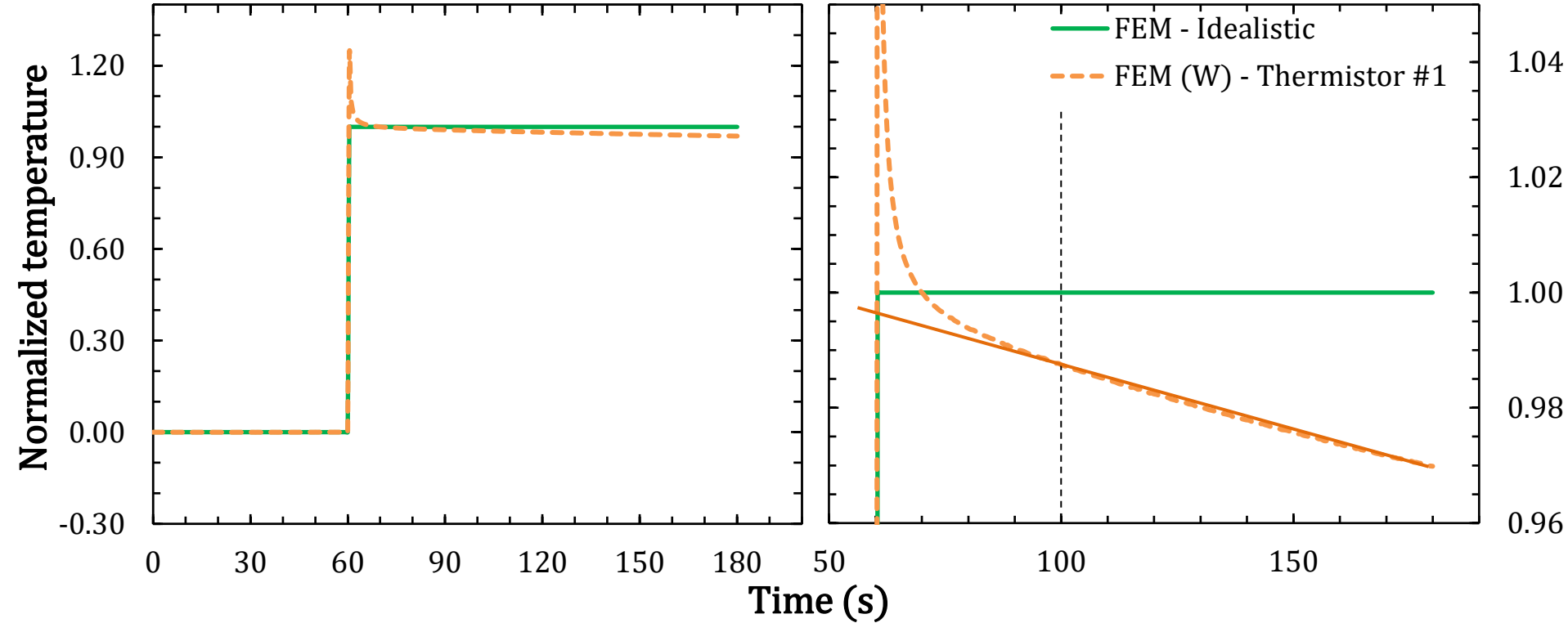
SSD70-00: 1 to 6 Gy per pulse



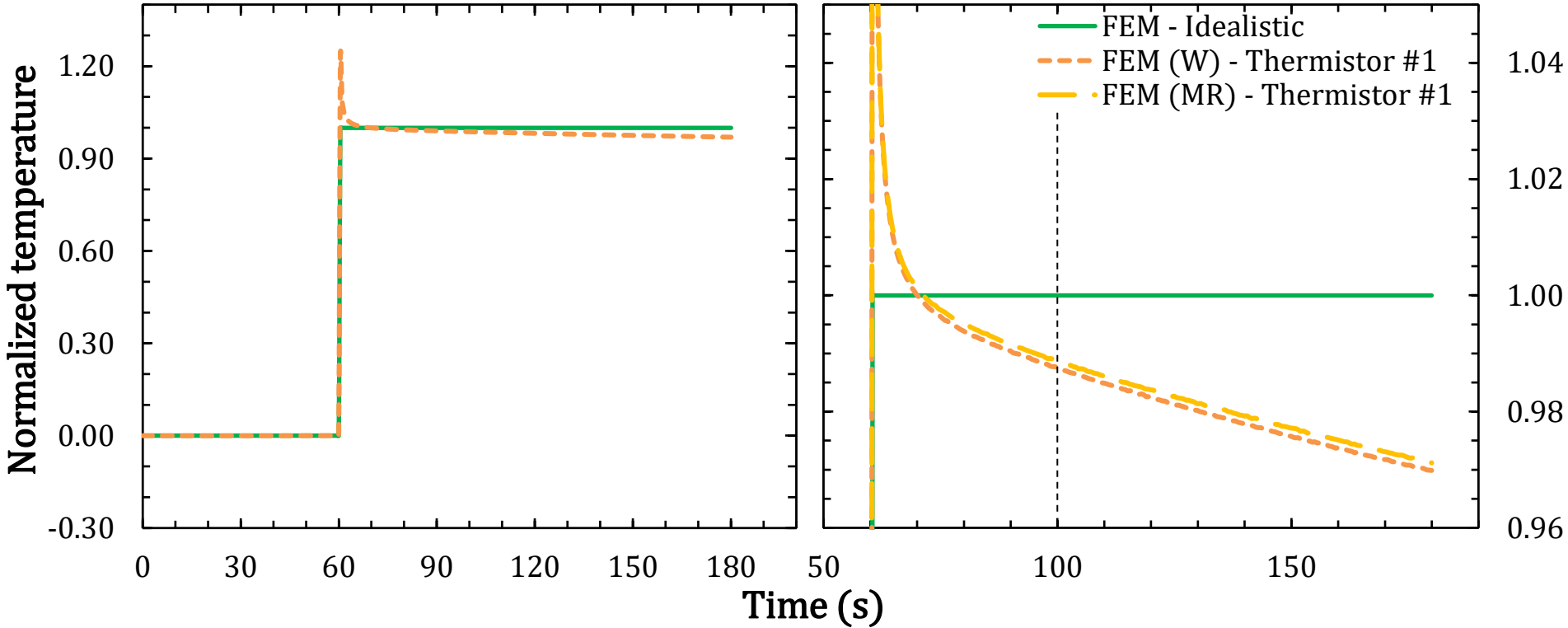
SSD70-00: 1 to 6 Gy per pulse



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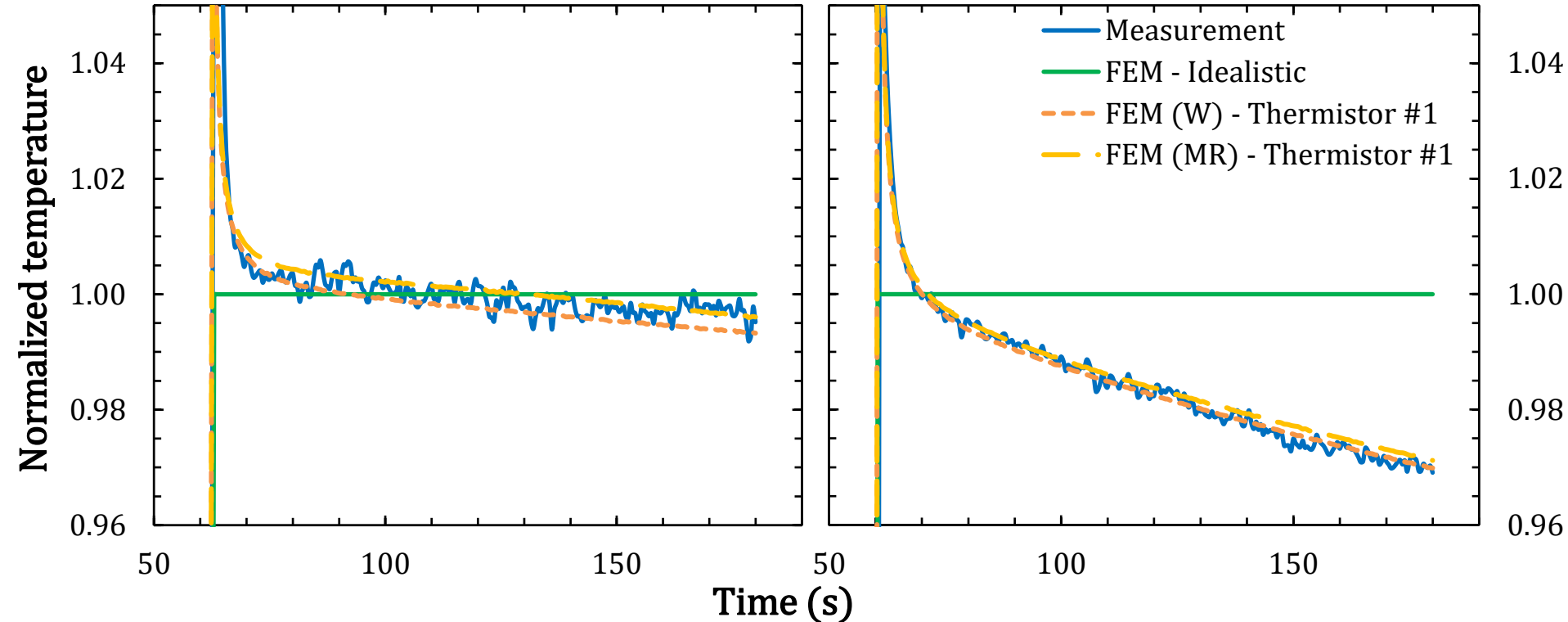


SSD70-00: 1 to 6 Gy per pulse



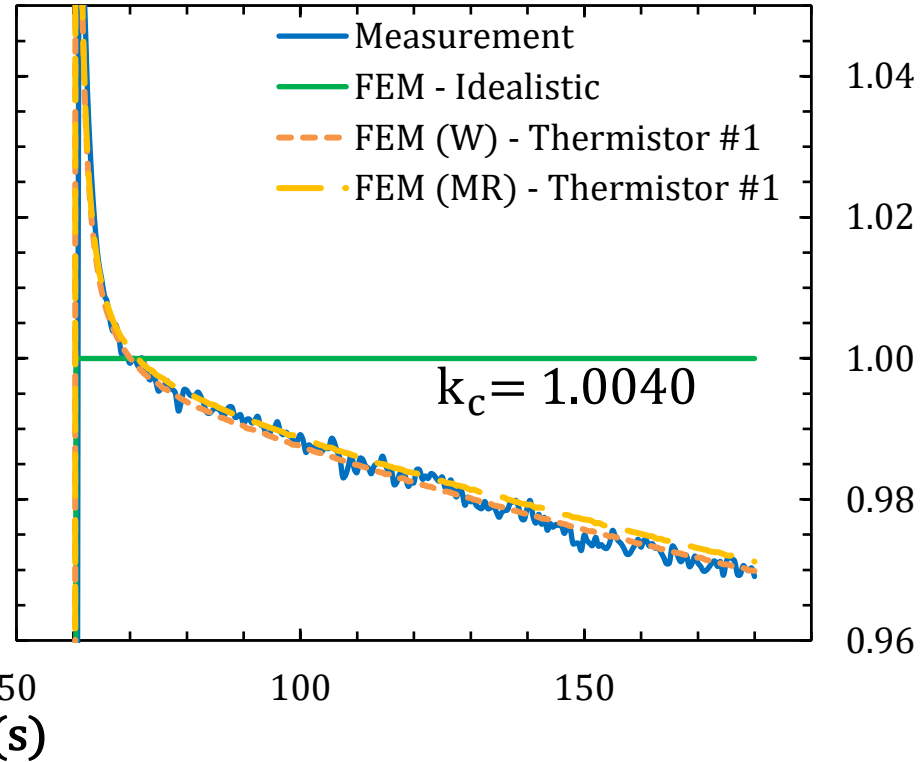
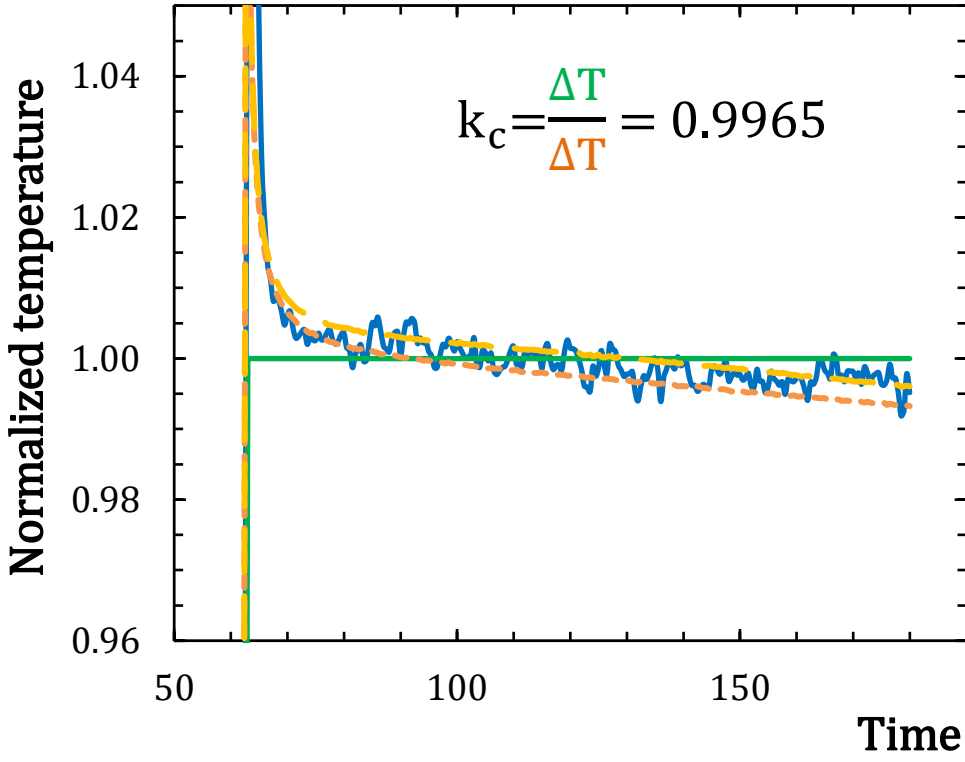
SSD90-02: 0.1 to 1 Gy per pulse

SSD70-00: 1 to 6 Gy per pulse



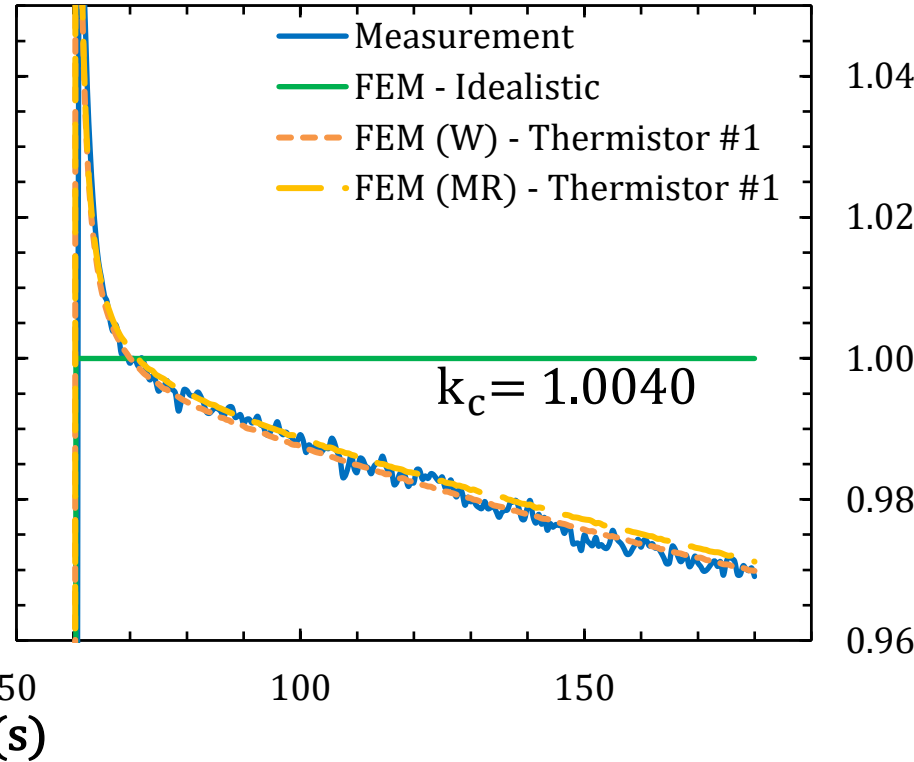
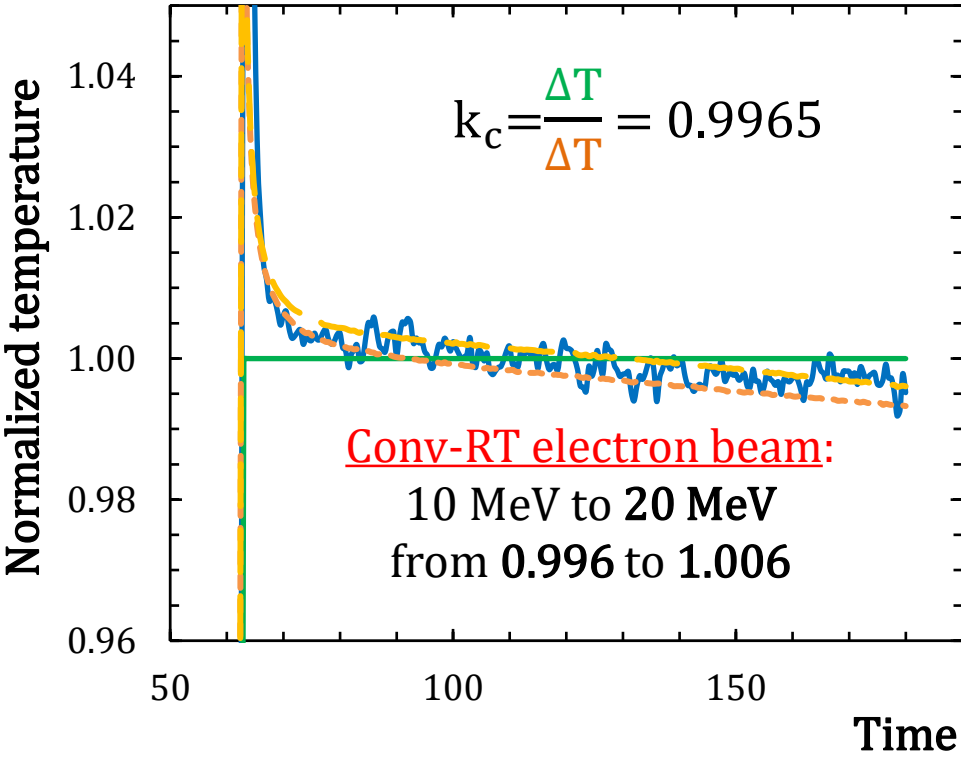
SSD90-02: 0.1 to 1 Gy per pulse

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SSD90-02: 0.1 to 1 Gy per pulse

SSD70-00: 1 to 6 Gy per pulse



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- The difference between the two thermistors simulated
- The difference between the two models of energy mapping
- Position within 2 mm of the reference point of measurement (radial and depth)

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0.20%

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...both the correction factor and the uncertainty remain comparable to those obtained with conventional dose rate radiation.

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...both the correction factor and the uncertainty remain comparable to those obtained with conventional dose rate radiation.

However, the analysis of the temperature-time trace had to be modified!



Acknowledgments

Andreas Schlesner
Christoph Makowski
Achim Krauss

<http://uhdpulse-empir.eu/>

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Merci
Thank you
Danke schön