# Thermal stresses on the rotating target wheel

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# The Geometry

## The current geometry being analysed

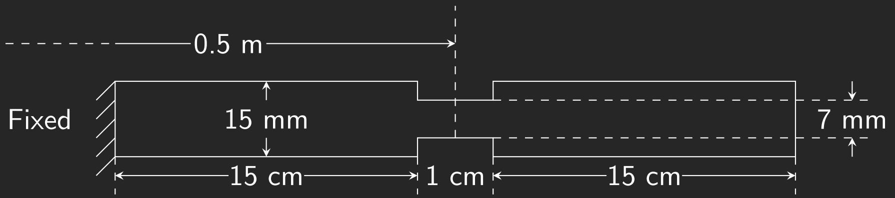


**Figure 1:** Cross section of the target wheel being analysed (Figure Not To Scale)

# The Model

# The Heat Source

- Currently only a steady state analysis was done so the pulsed beam is modelled as a 2.07 kW power source
- The heat distribution is modelled as a Gaussian with peak at $r = 0.5$ m. The diameter of the beam spot ($\sigma$) is set to 1.325 mm.
- Two methods of heat distribution are used
    - As heat flux on top surface.
    - As a heat source on the 7 mm thickness.

## Cooling

- Radiative Cooling with a water cooled cooler is used.
- Power Radiated is calculated as:

$$P = \sigma \epsilon A(T^4 - T_c^4)$$

- Effective emissivity($\epsilon$) is calulated from disc emissivity($\epsilon_d$) and cooler emissivity($\epsilon_c$) as:

$$\epsilon = \frac{\epsilon_d * \epsilon_c}{1 - (1 - \epsilon_d)(1 - \epsilon_c)}$$

- Both $\epsilon_d$ & $\epsilon_c$ are set to 0.5 and cooler temperatue ($T_c$) is maintained at $293.15K$.

# Preliminary Results

# Surface Heat Flux

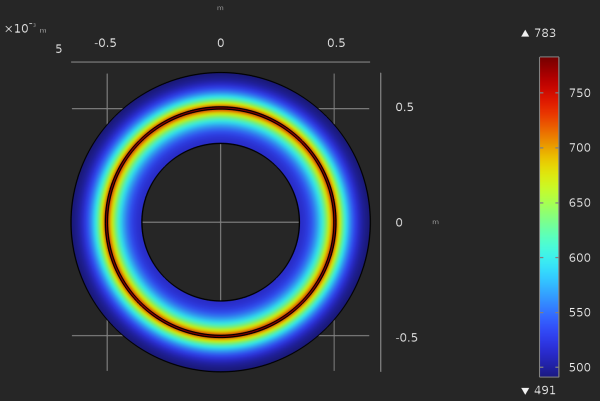


**Figure 2:** Temperatue Variation on Disc (Temperature in Kelvin)

# Surface Heat Flux

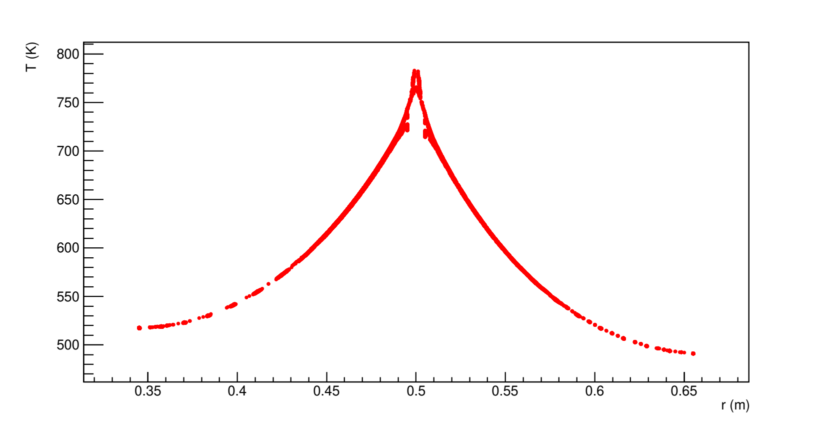


**Figure 3:** Temperatue variation with radius

# Surface Heat Flux

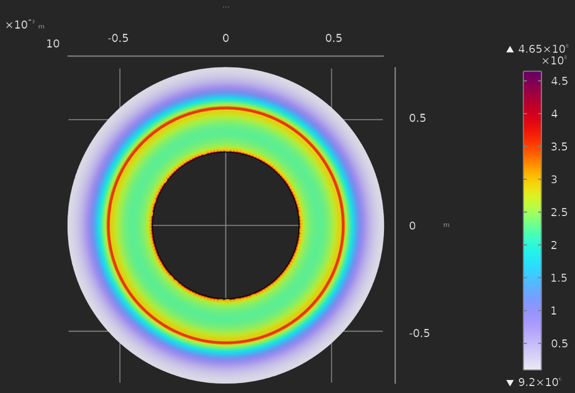


**Figure 4:** Von Mises Stresses on the Disc

# Surface Heat Flux

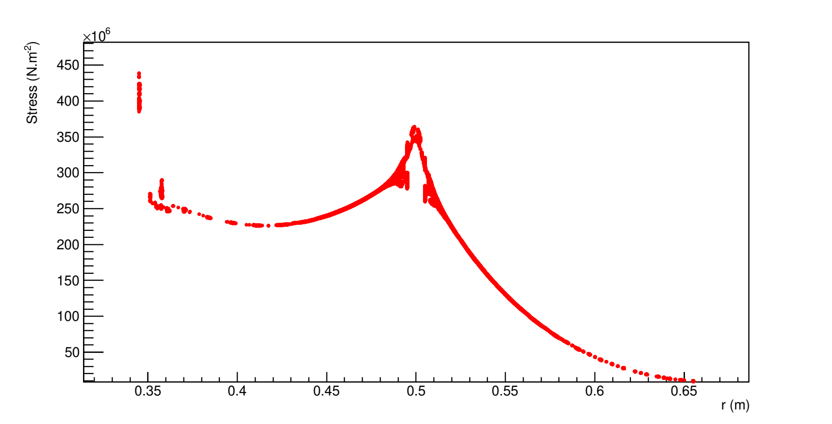


**Figure 5:** Von Mises Stress as function of radius

# Volume Heat Source

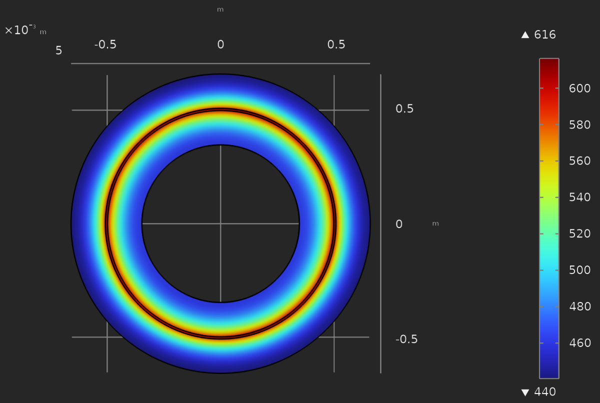


**Figure 6:** Temperatue Variation on Disc (Temperature in Kelvin)

# Volume Heat Source

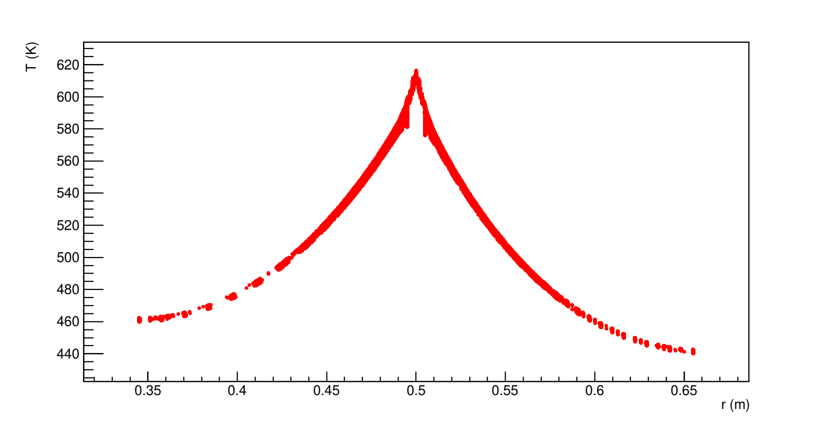


**Figure 7:** Temperatue variation with radius

# Volume Heat Source

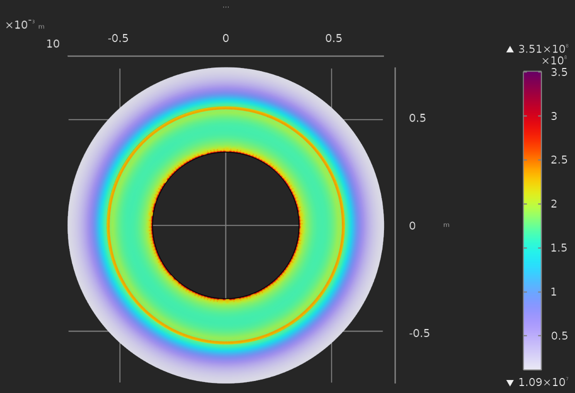


**Figure 8:** Von Mises Stresses on the Disc

# Volume Heat Source

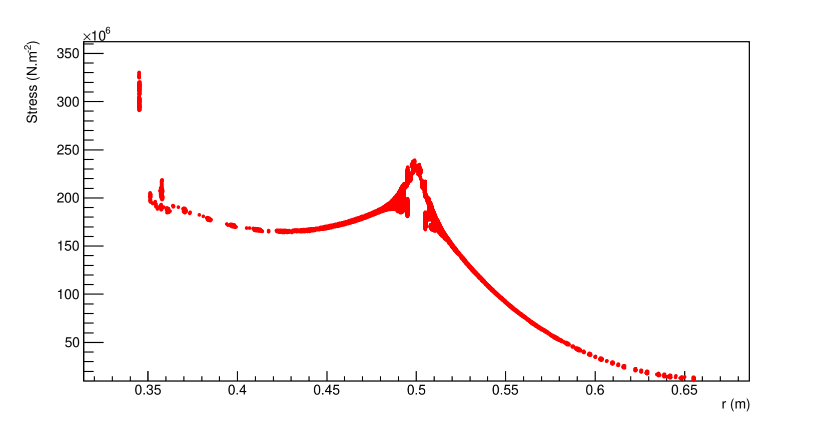


**Figure 9:** Von Mises Stress as function of radius

# Conclusions

- As a counter-intuitive fact, we see that the heat distribution profile has significant effect on the final outcomes. More analysis is required to properly model it.
- All of the material properties should be modelled as a function of temperature. The final outcomes are very highly variable with material properties.
- Expansion slots can be used to reduce stresses. Further analysis Required.

# Thank You!