Microfluidic on-chip PCR : BIO F376: Presentation of latest progress

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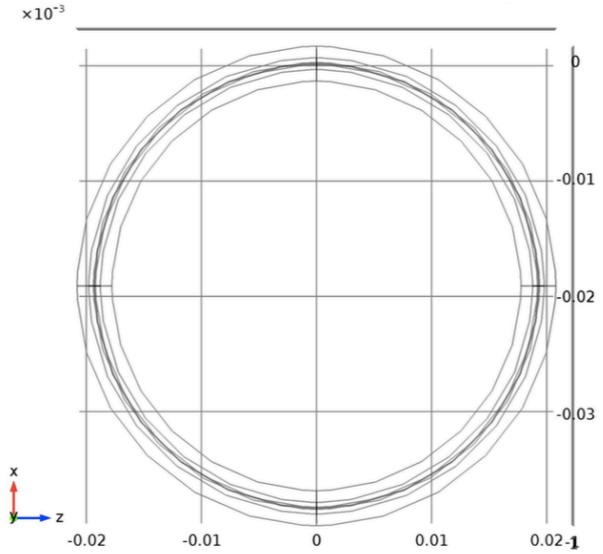
Change in geometry

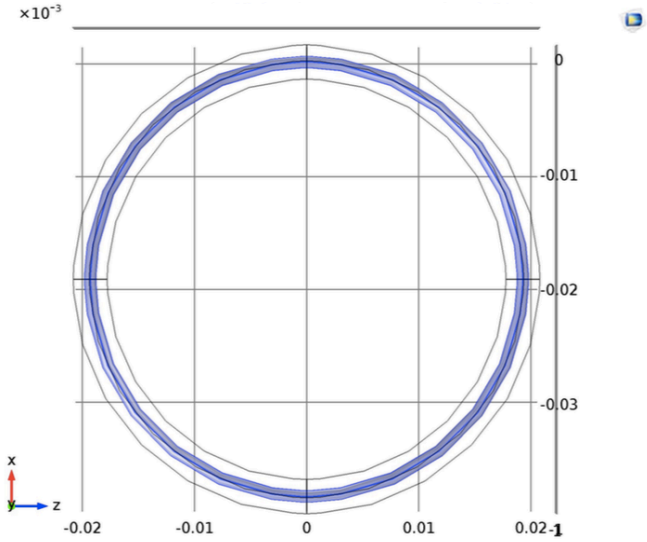
Heat transfer in outer silicone tubing

Geometry

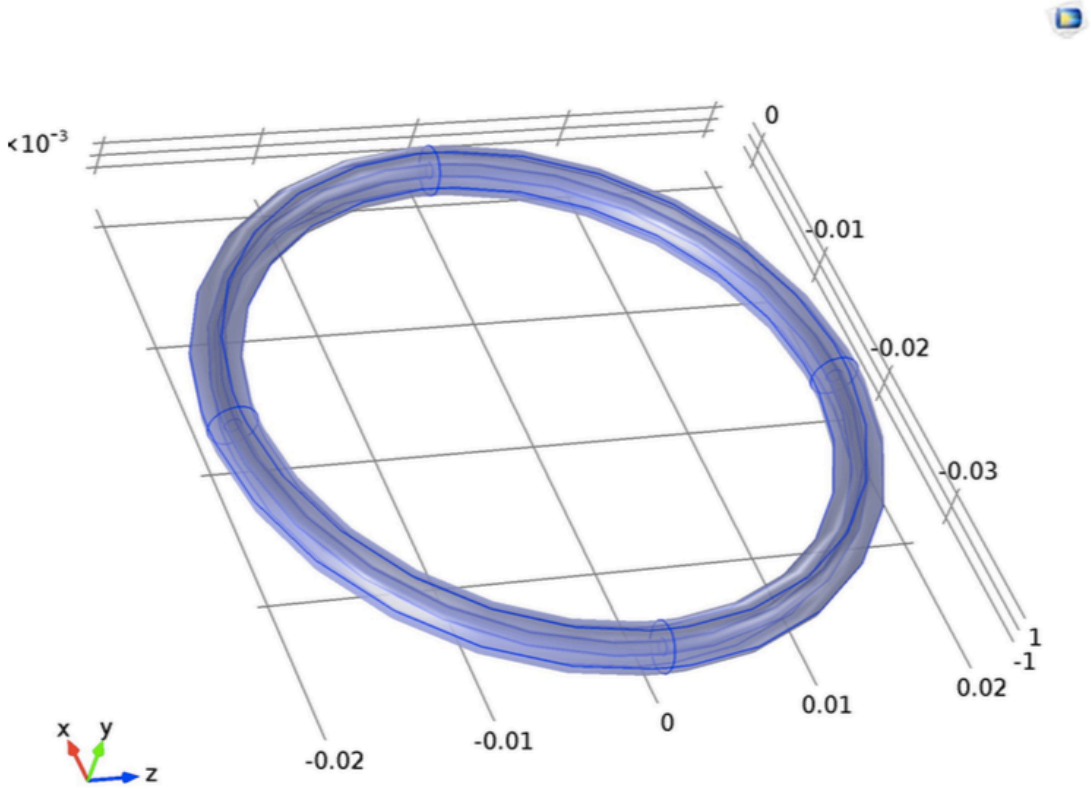
The toroidal geometry was modified to include the silicone tubing as the outer layer of the toroid
The inner layer contains our PCR reaction mixture
As is widely accepted in literature, for simulation purposes, the properties of reaction mixture have been approximated to be the same as that of water under the average conditions of temperature/pressure as seen in the reaction channel.
A CHANGE in heating surfaces was made – instead of heating to 95 and 55 degrees on adjacent faces (practically difficult), heating is now being conducted in diametrically opposite sections.



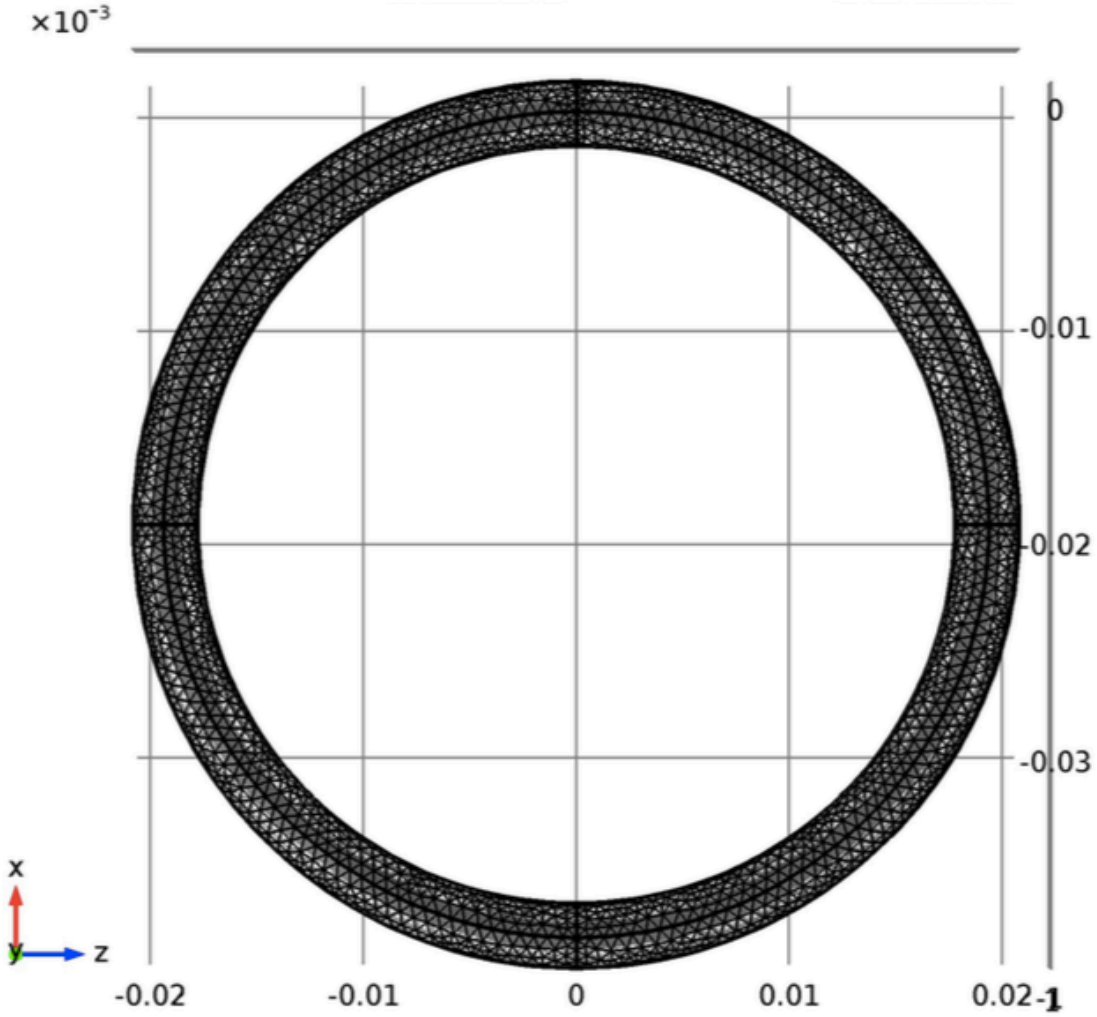
The toroidal geometry as seen in top-view.



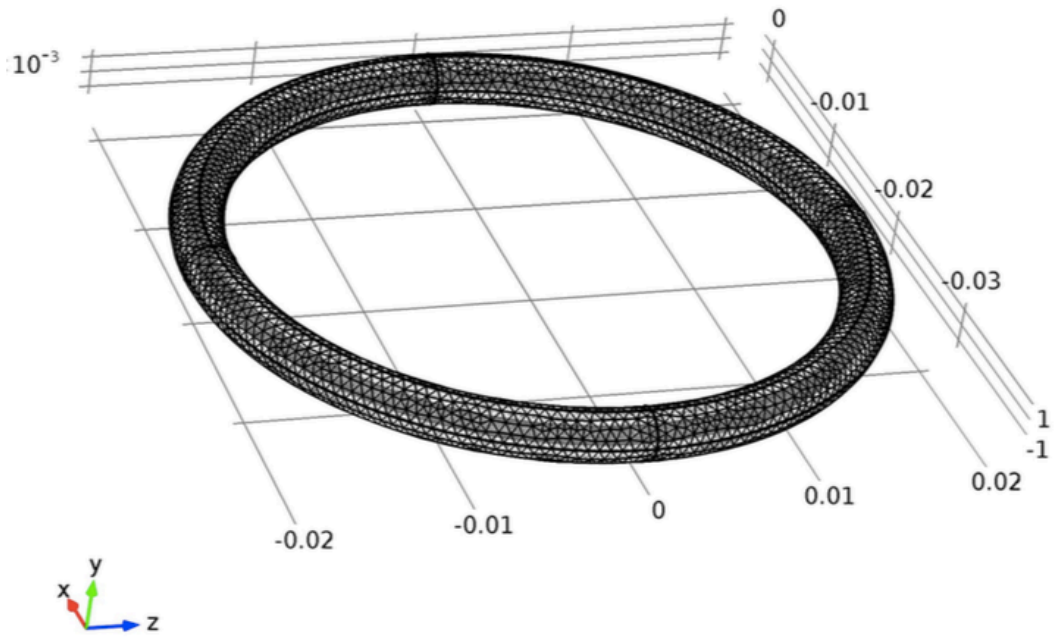
The inner channel contains the PCR mix.



Seen here is the outer layer of silicone tubing, properties of which have been verified from the website “A-to-Z of Materials” and from a manufacturer’s data sheet (reliable sources).

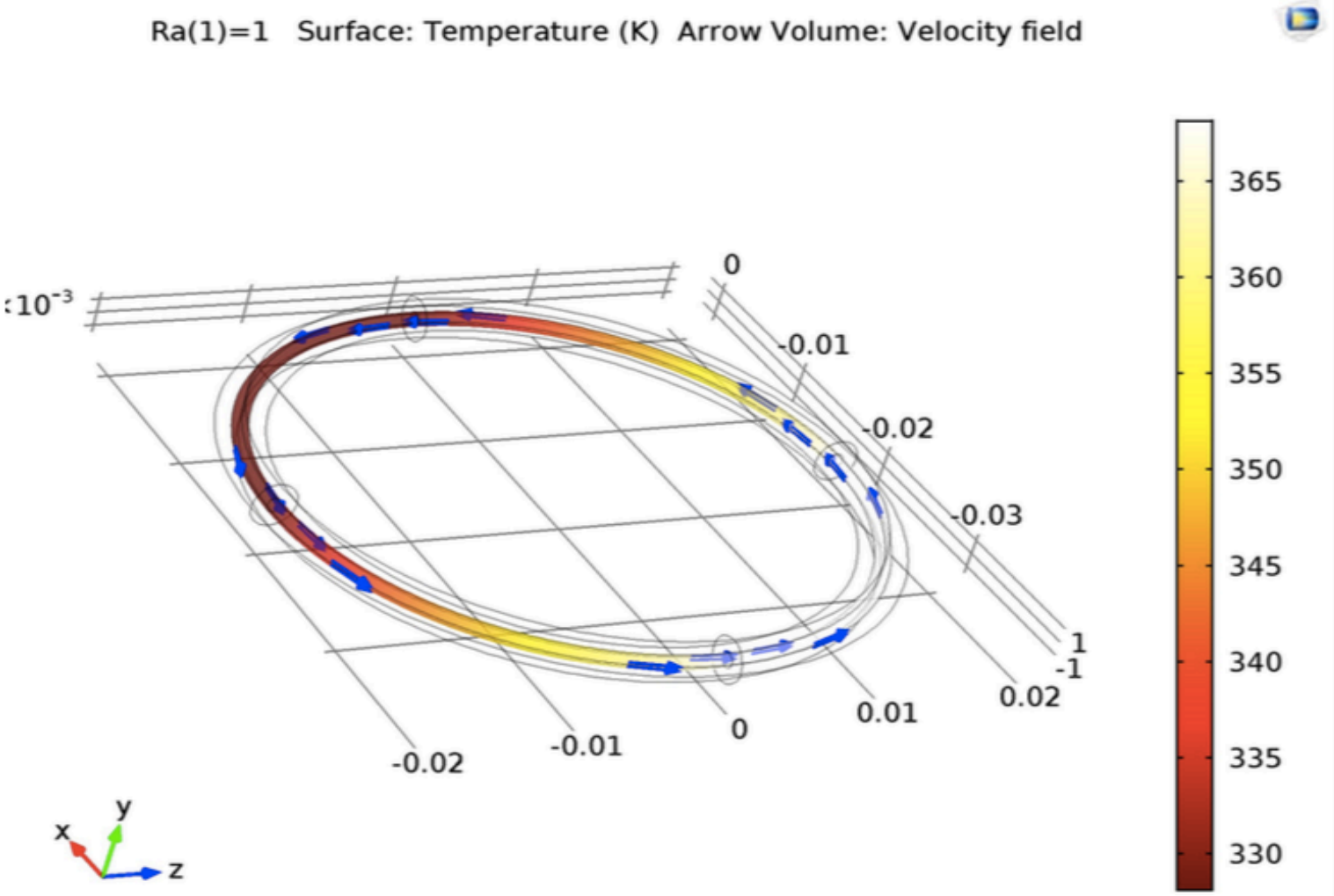


The fine-meshed model used for running the simulation.
Only the outer silicone tubing may be seen here.

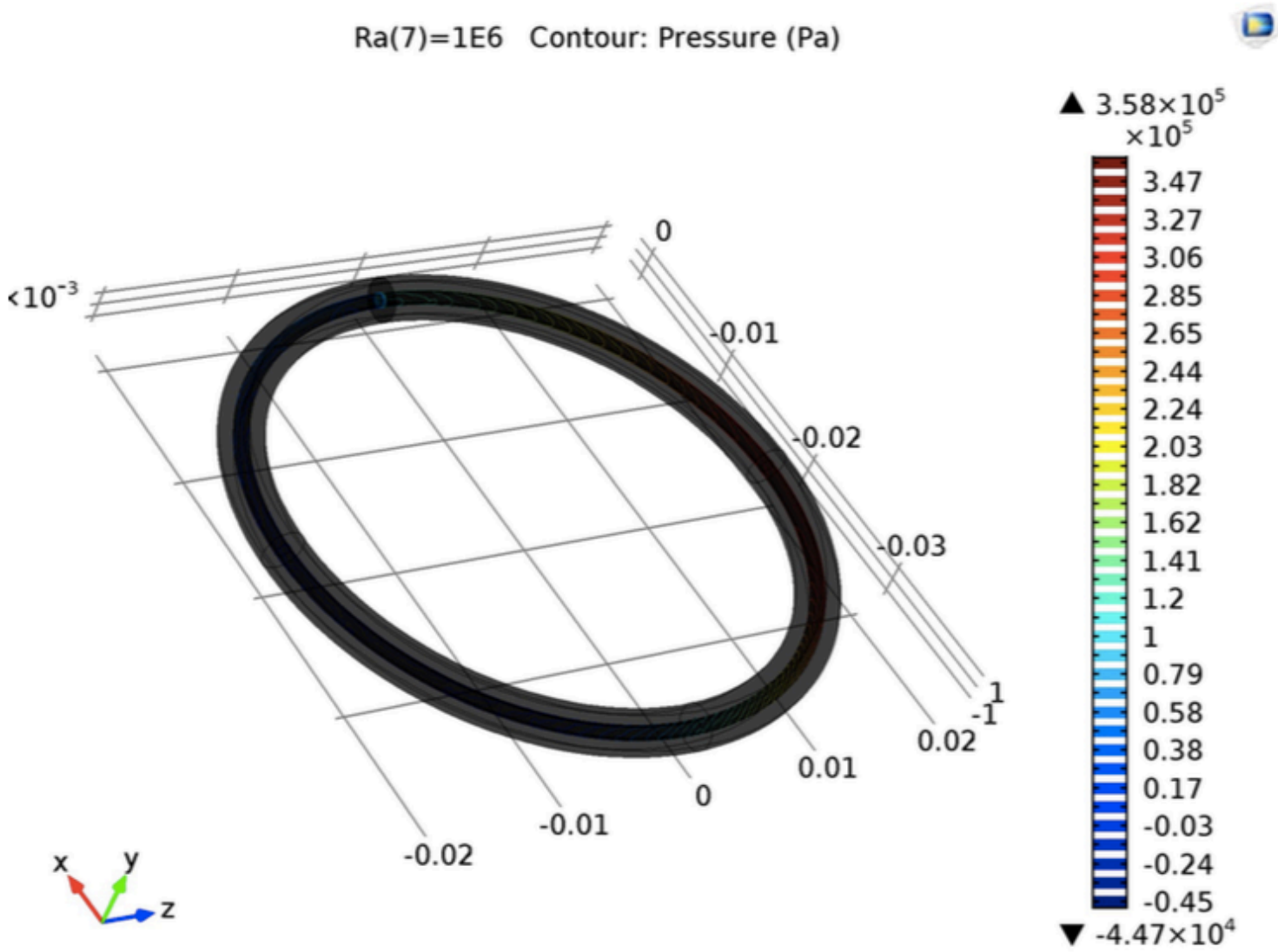


The fine-meshed model used for running the simulation.
The toroid is clearly divided into 4 parts.

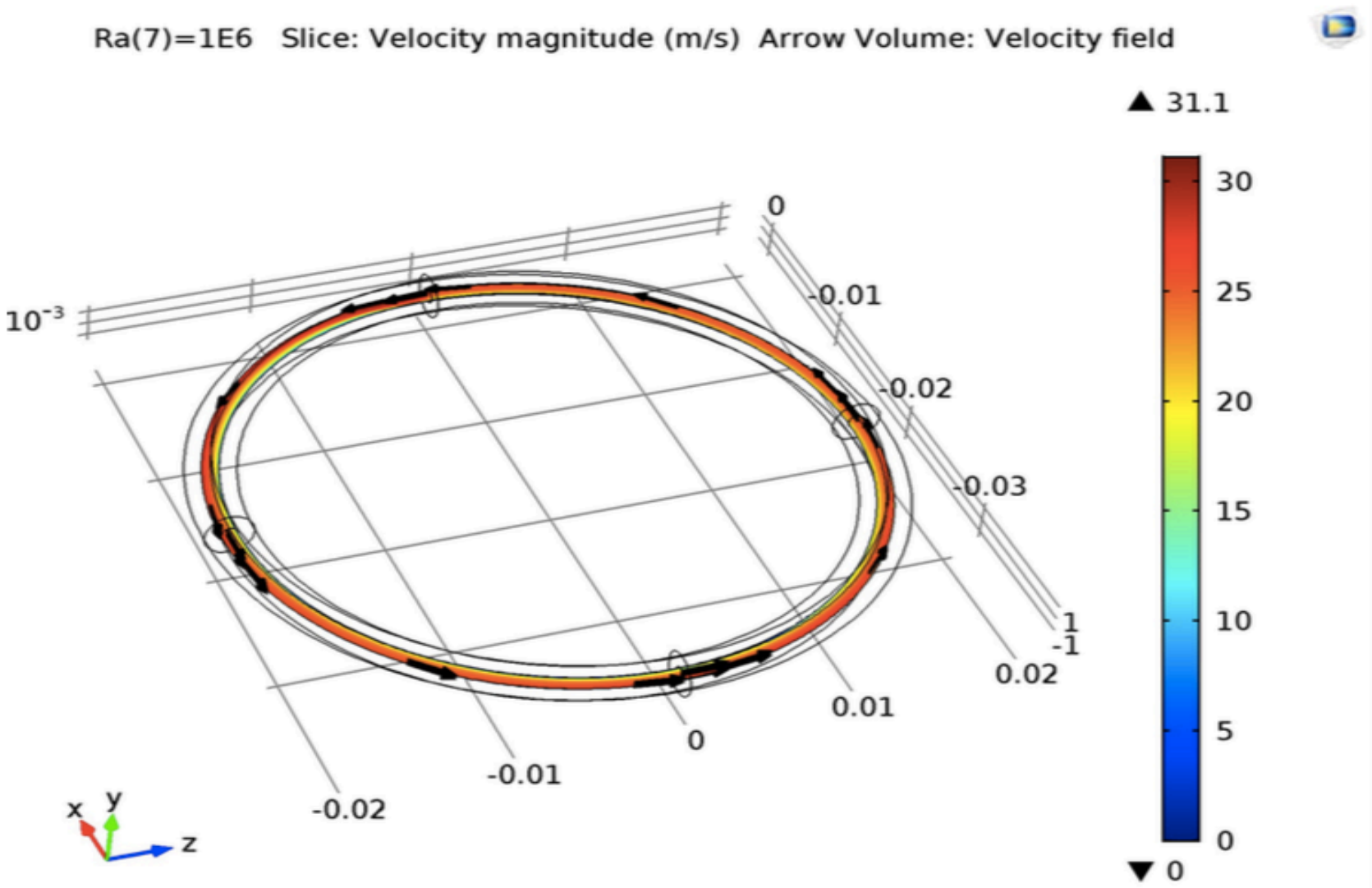
In this view, it is the bottom right and the top left sections which are maintained at 95 and 55 degrees temperature respectively in the model.



The temperature map of the model is shown here.
In this view, it is the bottom right and the top left sections which are maintained at 95 and 55 degrees temperature respectively in the model.
The direction of fluid flow and velocity is shown using blue arrows – NATURAL CONVECTION IS IN PLAY.

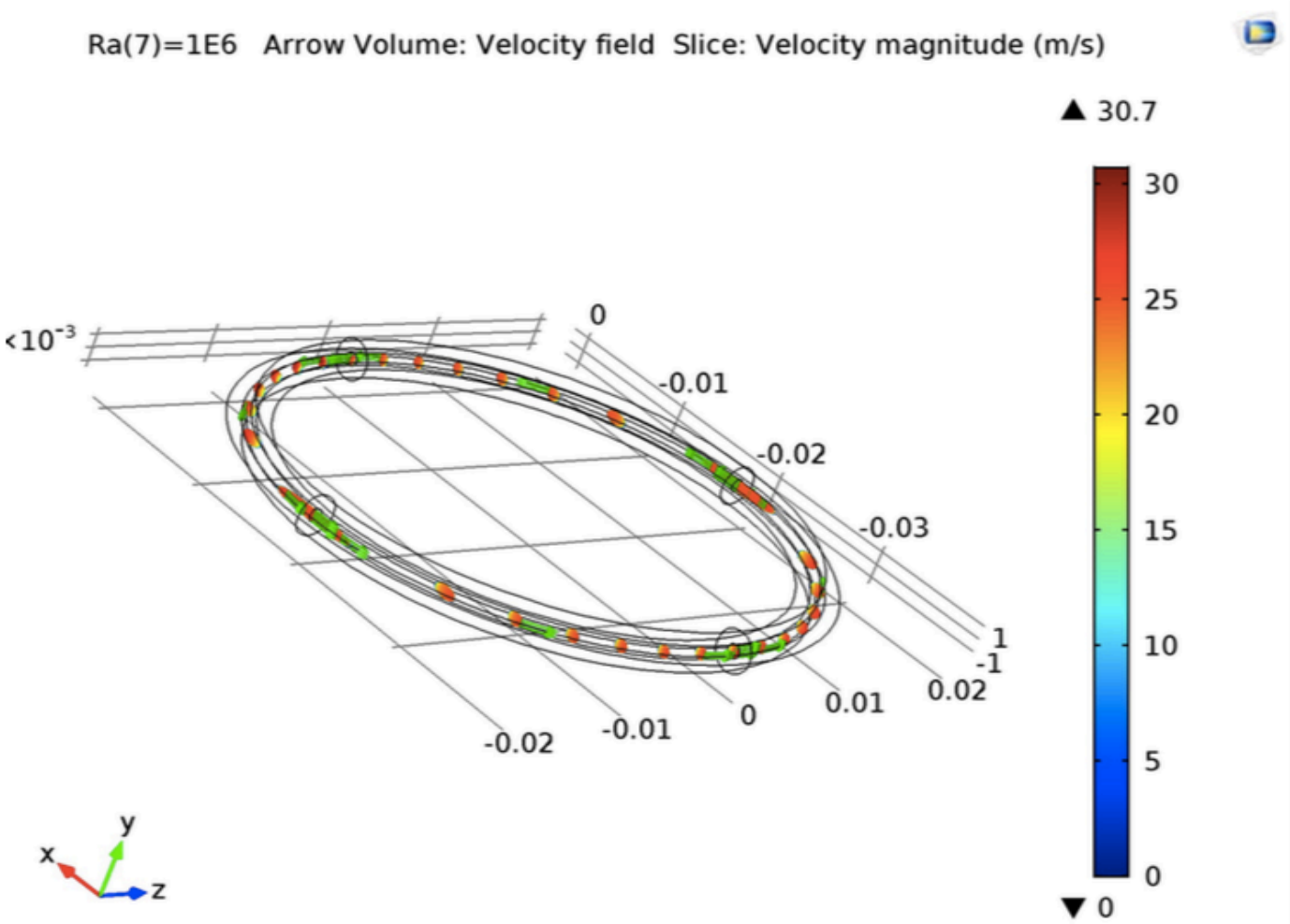


The pressure variation across the channel may be seen (color is a bit faded, but the legend shows the range). The left half constitutes a low-pressure region (hence may appear blue when enlarged) whereas the right half is higher in pressure.

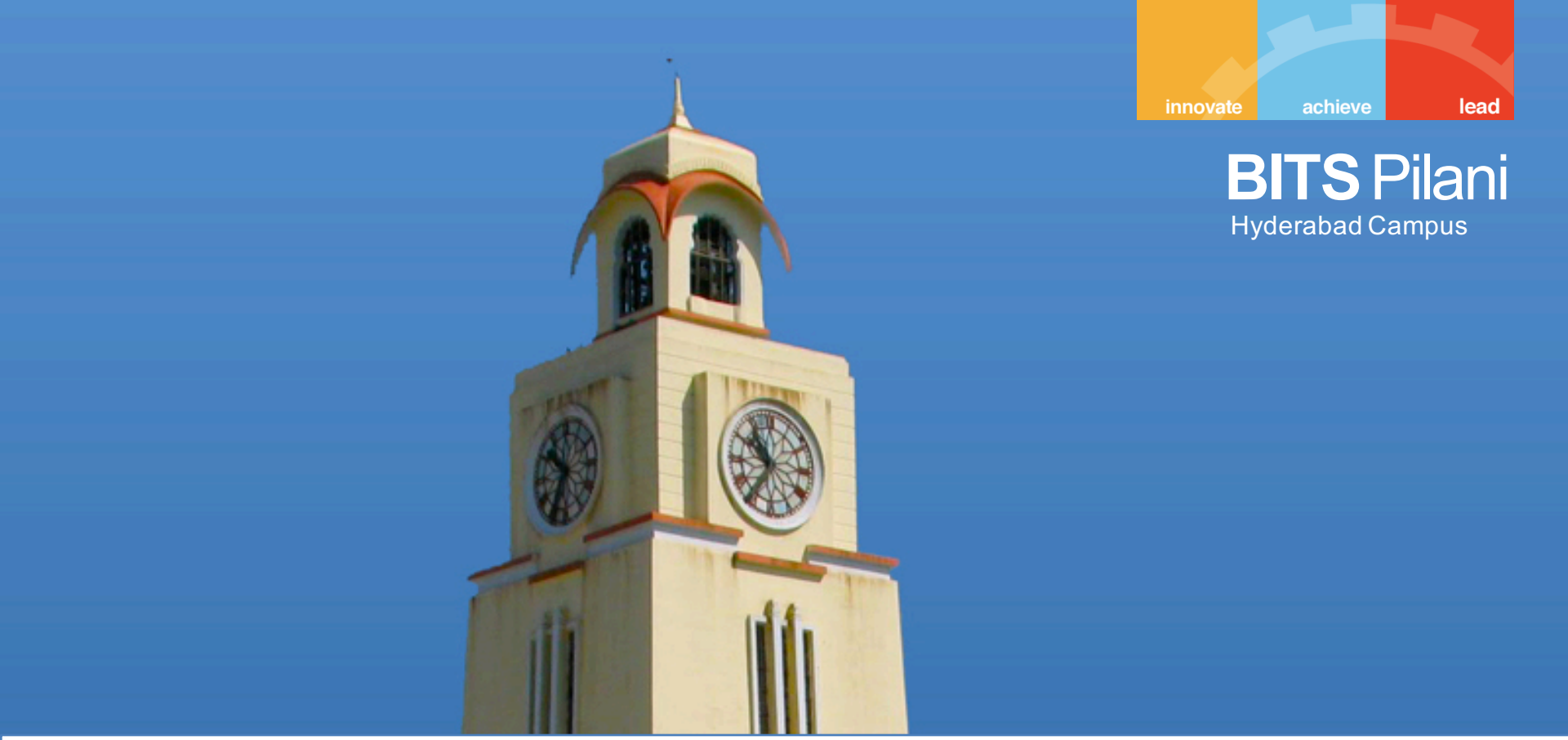


The velocity map is shown here, and the different velocities in different regions of the inner channel are shown.

Clearly, highest velocity is around the center of the channel, while the boundaries have lower velocity profiles.



The velocity map is shown here using slices in different sections of the channel. Clearly, highest velocity is around the center of the channel, while the boundaries have lower velocity profiles.



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Thank You