

# CADFEM Consulting

## Conjugated Heat Transfer Analysis with ANSYS® CFX®

Thermal Analysis of a Calibration Target installed in an Antenna of the ALMA (Atacama Large Millimeter Array)

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### Task

The Calibration Target is installed inside an antenna of the ALMA (Atacama Large Millimeter/submillimeter Array) project. Because of a HVAC system (heating, ventilation and air conditioning) turbulent air flow is predicted. But for the absolute accuracy of the astronomical observations a specified operating temperature of the structure and its stability is essential.

Different load cases were performed to simulate the environmental air conditions with its influence on the operating structure.

### Solution

The air flow velocity is low in the inner regions of the Calibration target. Therefore the air is heated up significantly by the hot walls of the target. But the turbulent flow around the Calibration Target causes a cooling effect of the housing structure. To resolve this influence on the temperature gradients on the solid structure a conjugated heat transfer analysis was performed. For the foil heaters a specified heat generation was considered.

Both, fluid volume and the solid structure had to be modeled and meshed. Because of symmetry a half model was adequate.

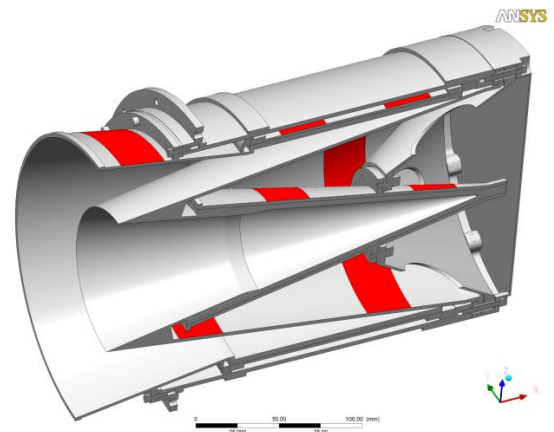
### Benefit for the customer

Usually only an vague estimated heat exchange with the environment (e.g. convection coefficients) is used as boundary condition for the thermal structure model.

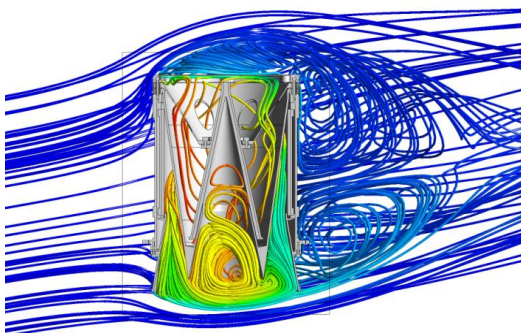
Simulating the interaction between the flow field and the temperature directly within one coupled analysis may save costs for additional simulation loops and leads to more reliable results.



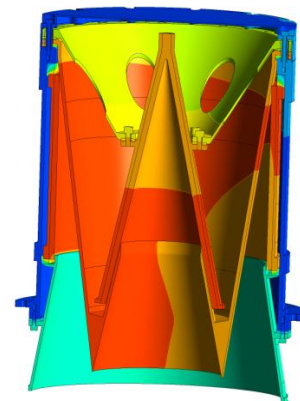
ALMA antenna at an altitude of 5000m  
([www.almaobservatory.org](http://www.almaobservatory.org))



Solid structure of the Calibration Target with foil heaters (red)



Streamlines with local air temperature



Temperature distribution on the solid structure  
(blue: cold, red: hot)

Figures Courtesy of ESO (European Organisation for Astronomical Research in the Southern Hemisphere), [www.eso.org](http://www.eso.org)