Meteoroids provide Earth’s primary source of extraterrestrial materials from the various nebular and planetary environments of the Solar System and beyond. These naturally delivered samples bring 50 to 100 tons of material daily.

A community of researchers devotes themselves to study the meteor phenomenon, and their interest lies in a quest for answers in fields such as aeronomy, astronomy, geophysics, and planetology.

The meteor phenomenon is a complex problem since it involves many physical aspects, such as multi-phase and non-equilibrium flows.

The understanding of this phenomenon usually derives from the correlation between observations and simplified models. However, these models lump most of the physics, incapacitating the in-depth comprehension of the phenomena.

This thesis aims to build models that describe the multi-physics phenomena of a meteoroid entry and compare them with observations.

We leverage engineering models developed for re-entry space vehicles and extend them to meteoroid applications.

We focus on the different flow aspects — high-temperature effects and radiation — and material analysis — evaporation and shear ablation.

These models are valid within the continuum regime, meaning that they can be employed to derive flow characteristics of fireballs and to study bolide ablation.