

# Combustion parameters of ethene-air mixture

**Computational methods in combustion**

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## 1 Introduction

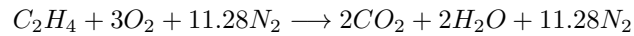
The aim of this project was to show how composition of fuel-air mixture, as well as its initial temperature and pressure influences the time of auto-ignition, maximum pressure and temperature. The simulation was conducted using "Cantera" package and reaction mechanism called "GRI-Mech 3".

## 2 Model

In order to simulate auto-ignition, the reactor mechanism of Cantera was used and following assumptions were made:

- The fuel was perfectly mixed with air
- The air consisted only of oxygen and nitrogen in 1:3.76 ratio
- Reactor's walls were non-conductant and non-reactive

The stoichiometric reaction of complete combustion of ethene in air:



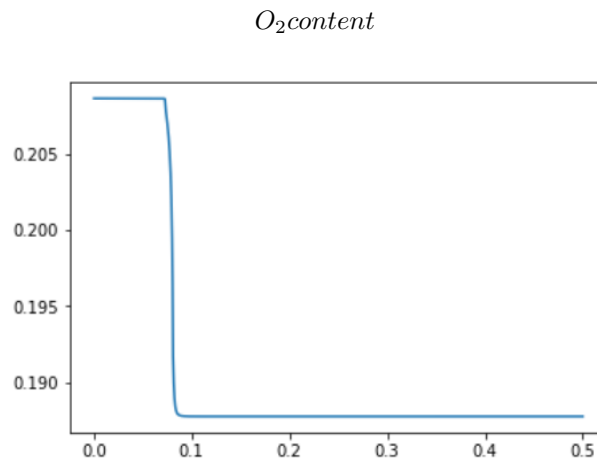
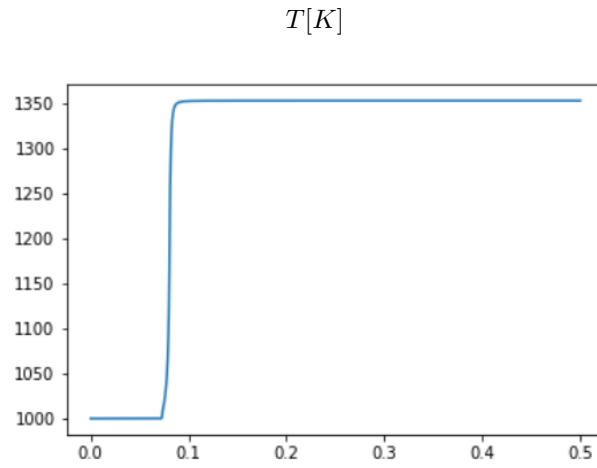
Calculations were performed for various initial parameters

### 3 Results

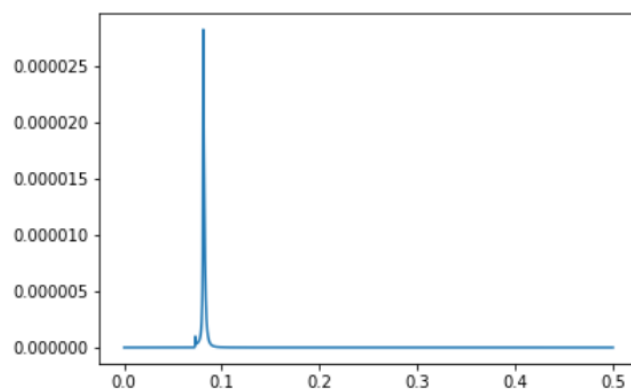
#### 3.1 Variable equivalence ratio

$$T_0 = 1000K, p = 101325Pa$$

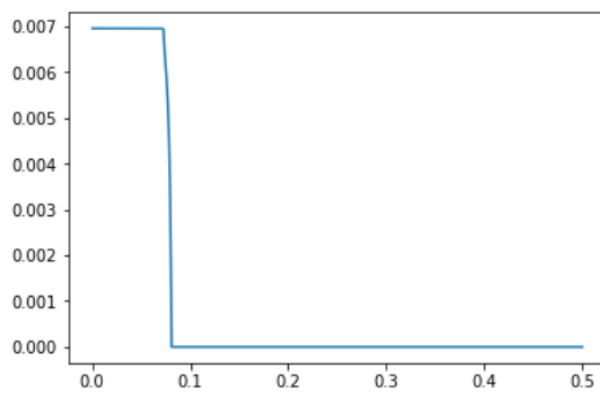
##### 3.1.1 $\phi=0.1$



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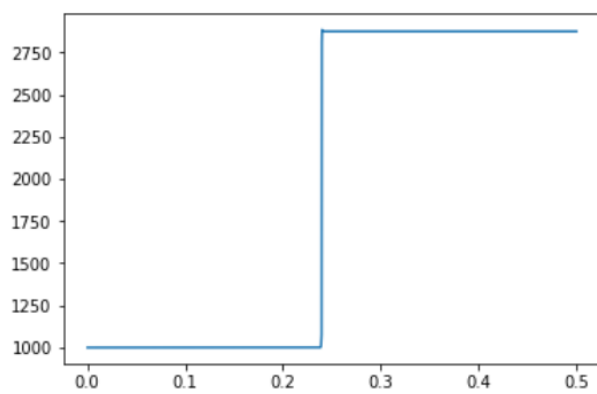


*C<sub>2</sub>H<sub>4</sub>content*

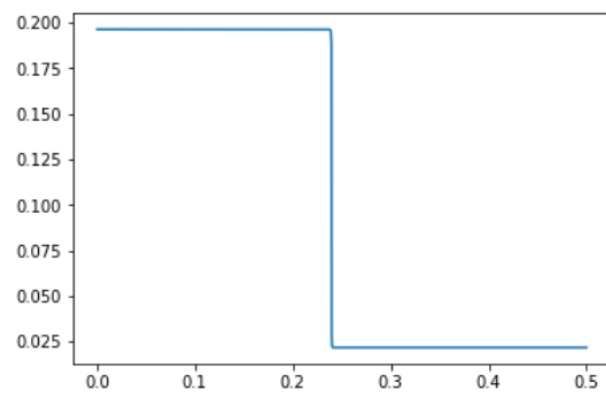


### 3.1.2 $\phi=1$

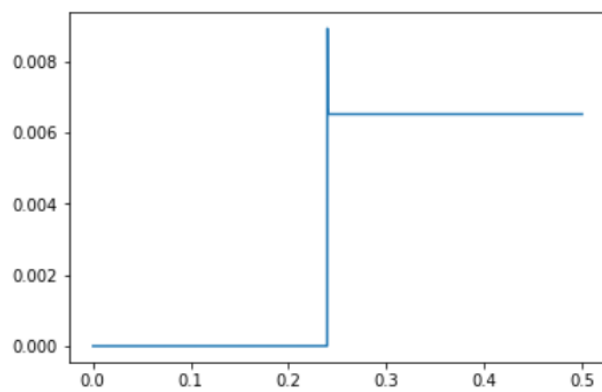
$T[K]$



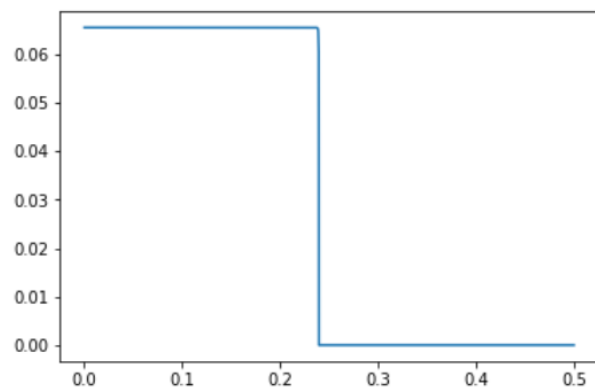
$O_2 content$



$Hcontent$

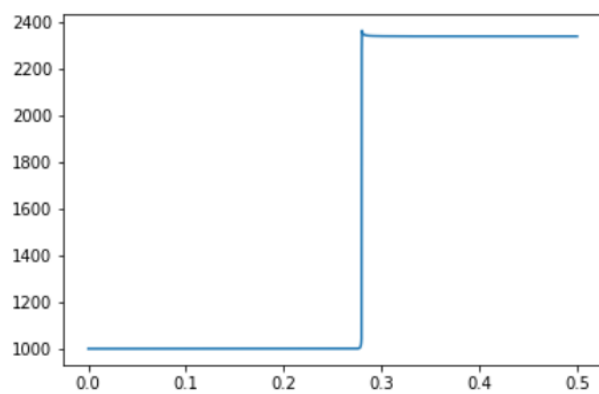


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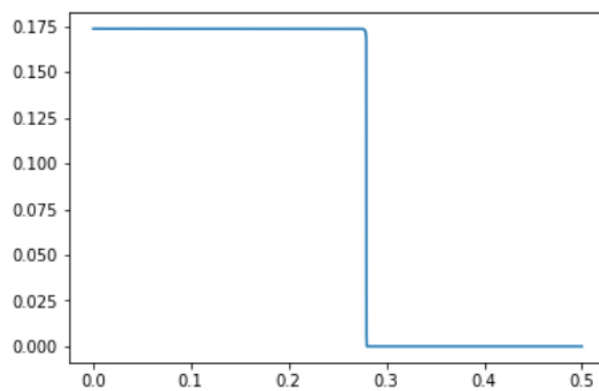


### 3.1.3 $\phi=3$

$T[K]$

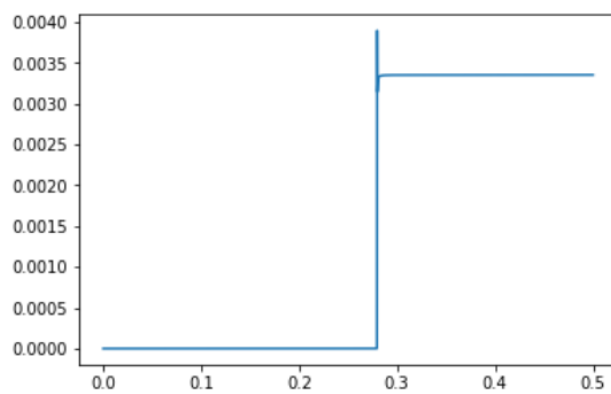


$O_2$  content

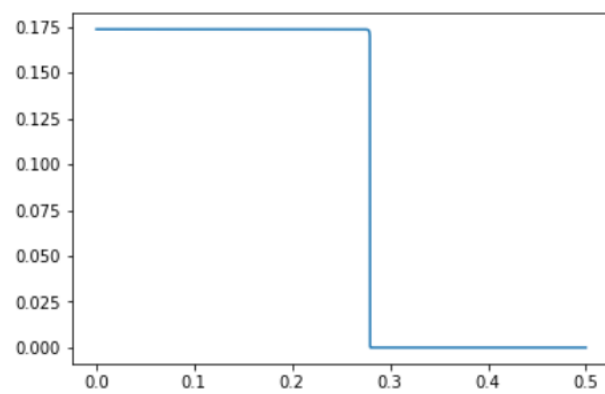




$H_{content}$



$C_2H_4_{content}$

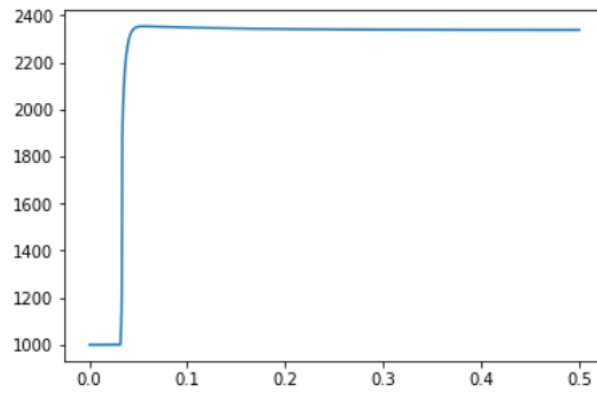


## 3.2 Variable initial pressure

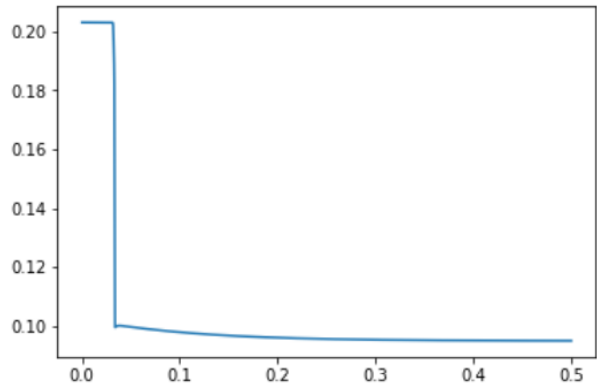
$$\phi = 0.5, T_0 = 1000K$$

### 3.2.1 $p=10000\text{Pa}$

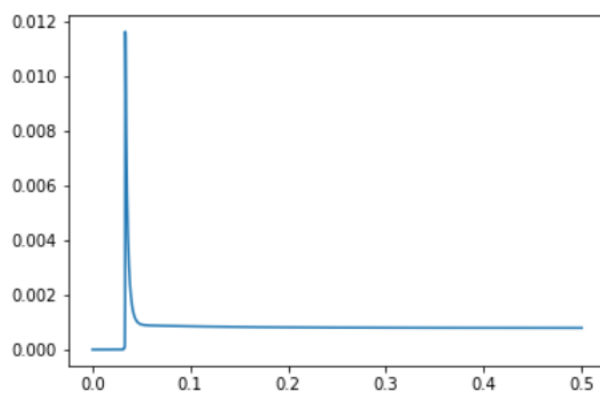
$T[K]$



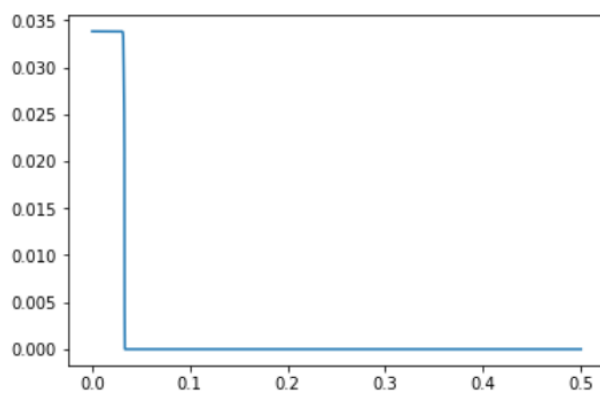
$O_2\text{content}$



*Hcontent*

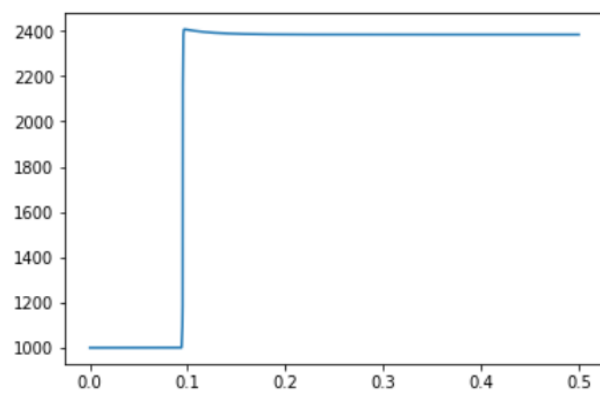


*C<sub>2</sub>H<sub>4</sub>content*

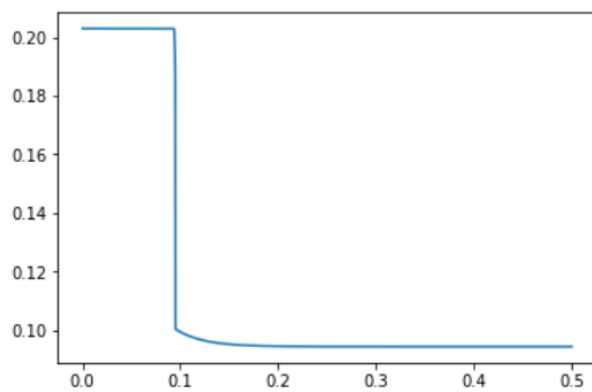


### 3.2.2 $p=50000\text{Pa}$

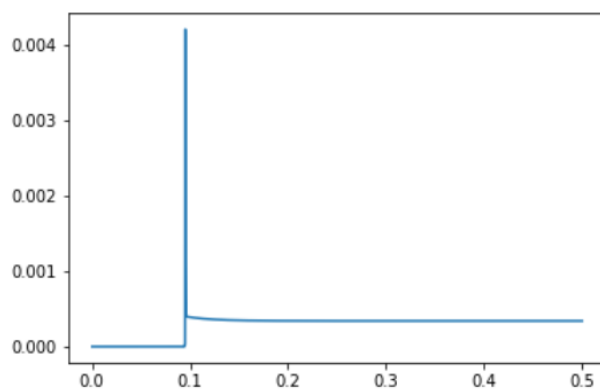
$T[K]$



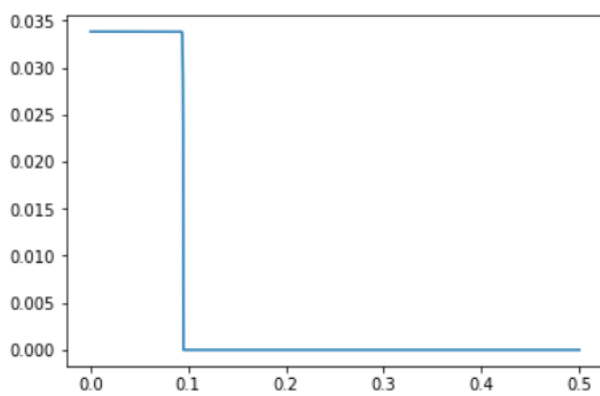
$O_2$  content



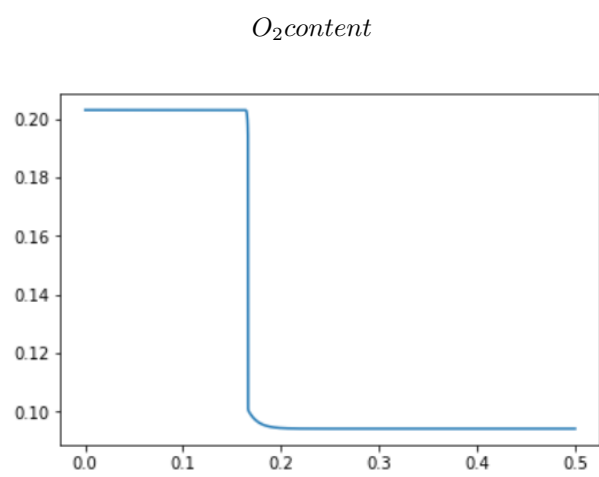
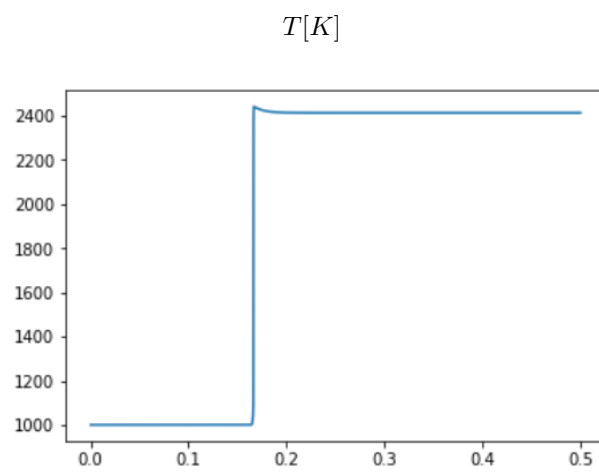
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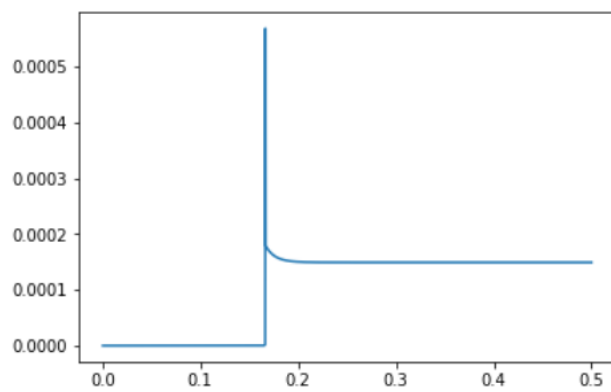
*C<sub>2</sub>H<sub>4</sub>content*



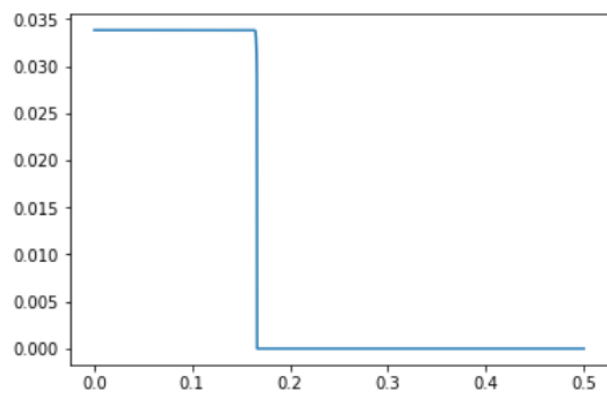
### 3.2.3 $p=200000\text{Pa}$



$Hcontent$



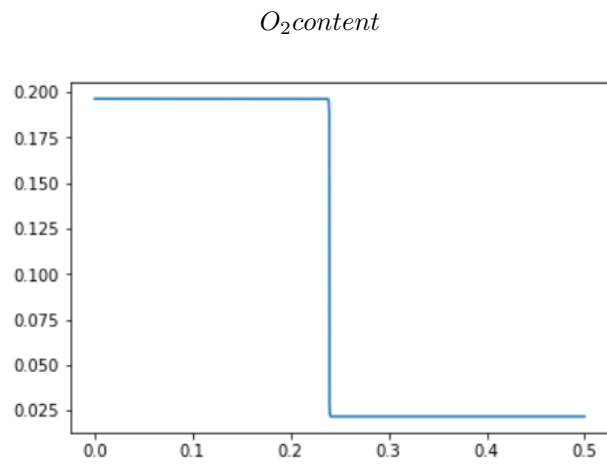
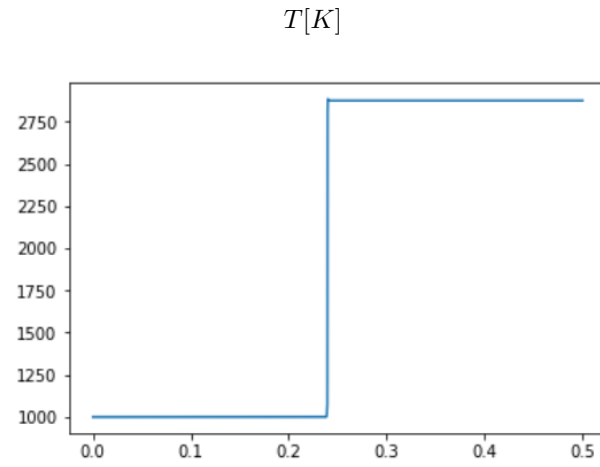
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### 3.3 Variable initial temperature

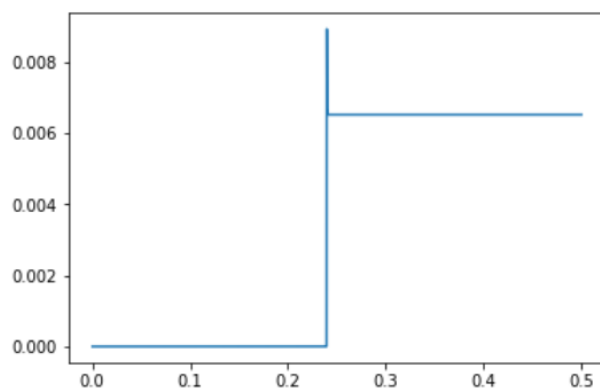
$$\phi = 1, p = 101325 Pa$$

#### 3.3.1 $T_0=1000K$

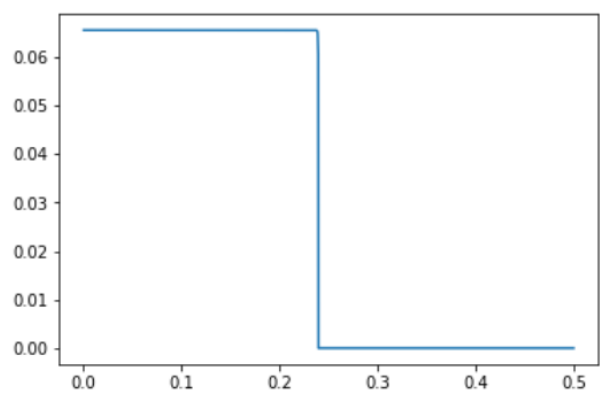




$Hcontent$

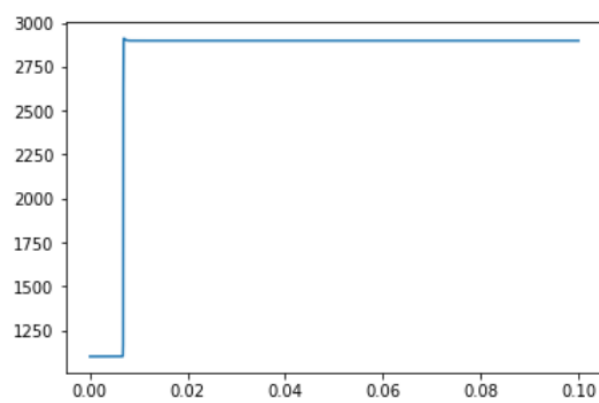


$C_2H_4content$

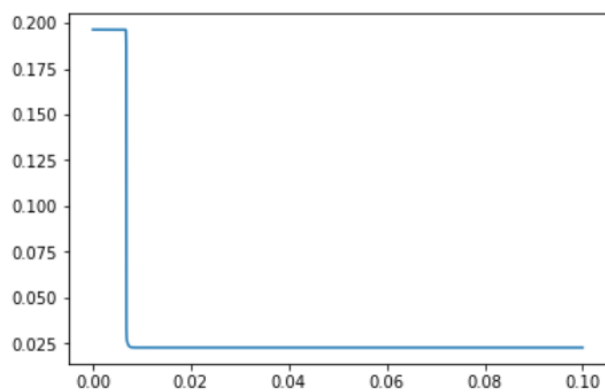


### 3.3.2 $T_0=1100\text{K}$

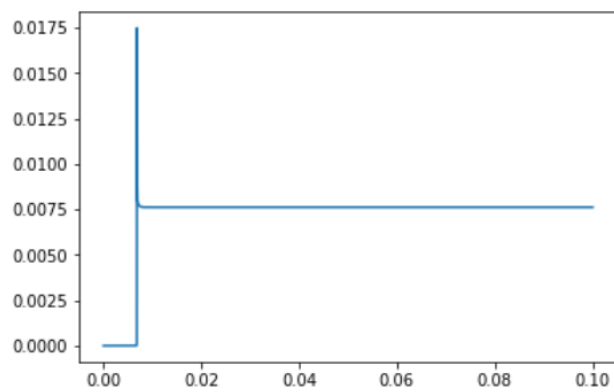
$T[K]$



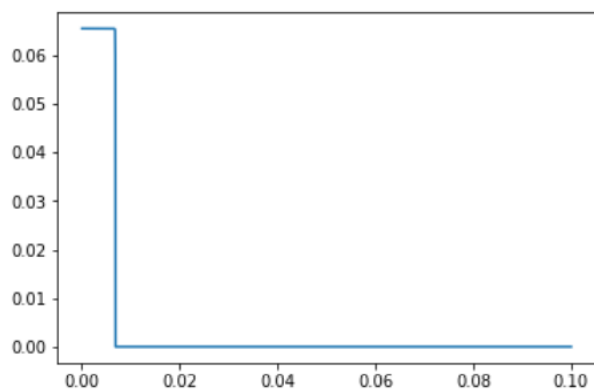
$O_2$  content



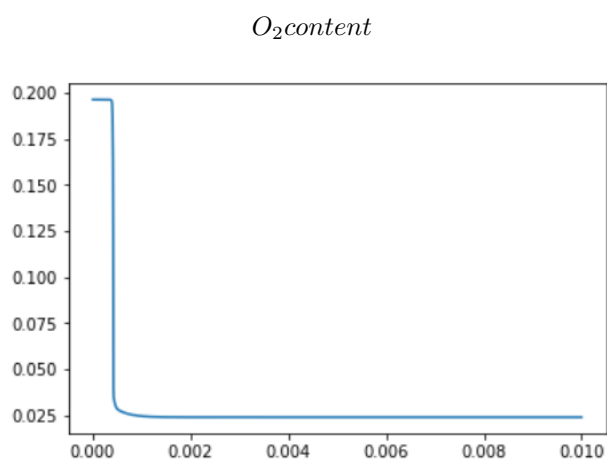
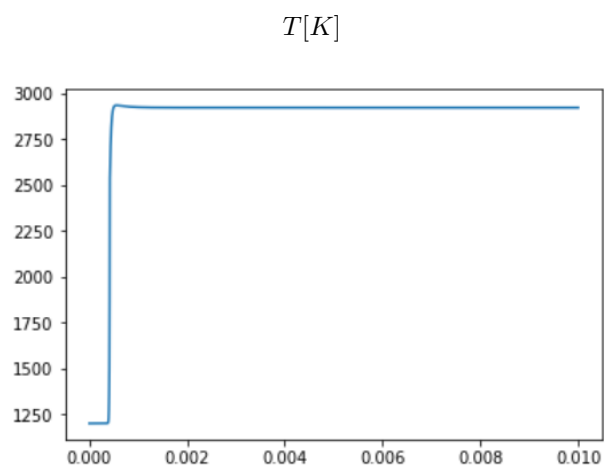
$H_{content}$



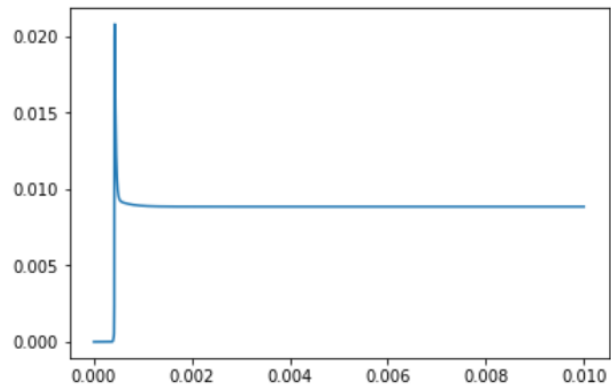
$C_2H_4_{content}$



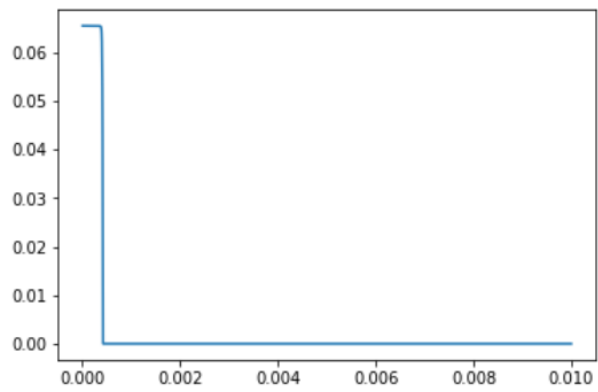
### 3.3.3 $T_0=1200\text{K}$



*Hcontent*



*C<sub>2</sub>H<sub>4</sub>content*



all charts are in function of time [s]

## 4 Summary

The results were as expected; higher initial temperatures resulted in shorter auto-ignition times and the highest temperature was achieved with stoichiometric composition on mixture ( $\phi = 1$ ).

The study was a valuable introduction to both "Cantera" package as well as to "LaTeX" software.