# Update on multi-species simulations: SMOG2

## Polarized Gas Target for LHCb

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# Overview

**Motivation and context**
- Scenario

**Buildup parameters**

**Bunch passage evolution**
- Density buildup
- Energy

**The heat load as an observable**
- Effects of density and sey for each species

**Conclusions and Outlook**

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  $\rightarrow$ beam dumps
- beam interaction with gas produce electrons and ions which might cause instabilities

$\rightarrow$ development of new code capabilities to model beam - gas interaction, especially ionizing effects

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- exact coating has not yet been decided on so variability on seys was also integral part of the studies

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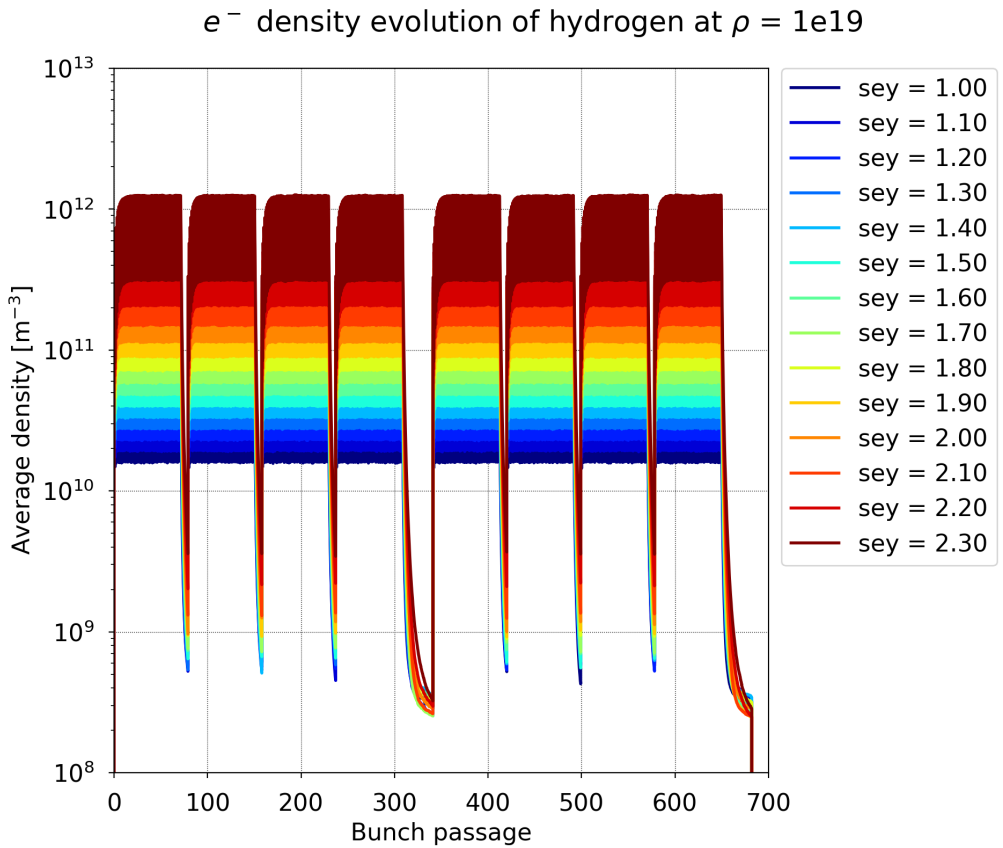
  - SEY (scanned through values of 1.0 to 2.5 in steps of 0.1)
  - Gas species(Hydrogen atom(simplest case), xenon(worst case scenario))

# Overview

# Bunch passage evolution

## Density buildup

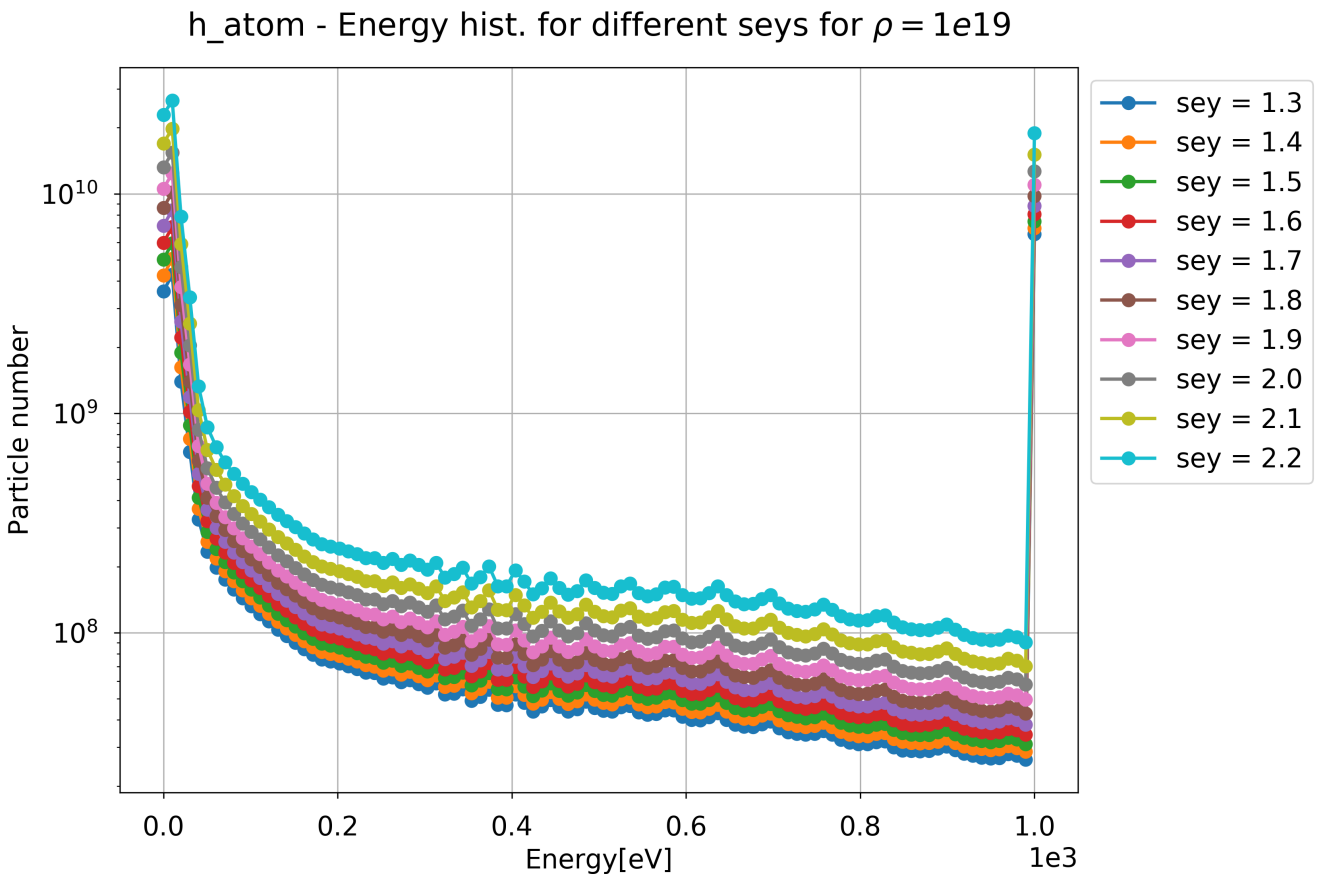
Looking at a typical buildup one sees the expected evolution:



# Bunch passage evolution

## Energy

As well as the energy evolution:



# Bunch passage evolution

## Energy

$\rightarrow$ for a combination of either relatively low sey and a relatively low density we get a smooth dependence on sey and initial gas density

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## Effects of density and sey for each species

Screening for the dependence of the heat load on the sey and the density gives rise to heatload profiles for each respective species:

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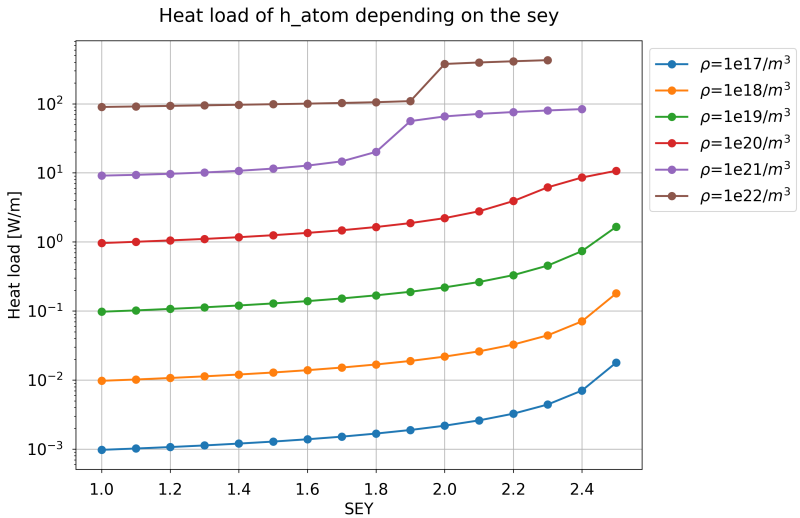


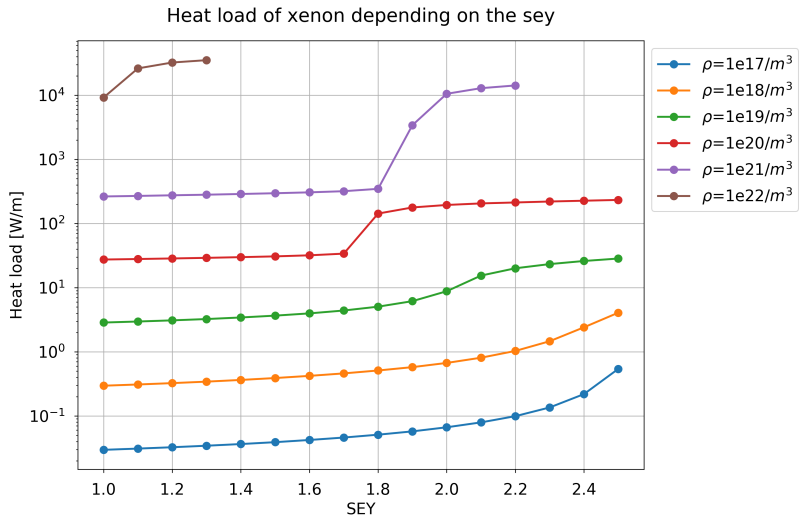

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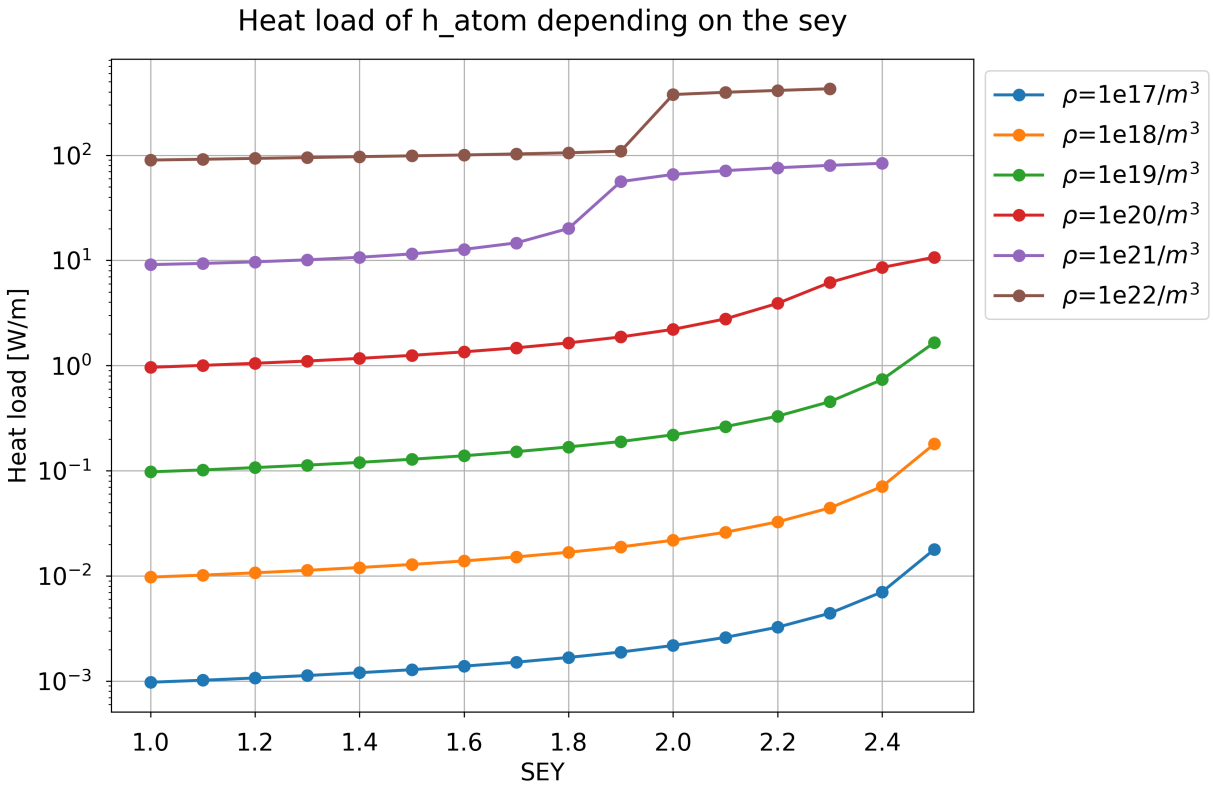

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## Effects of density and sey for each species

$\rightarrow$ we see the heat loads show a transition behaviour
$\rightarrow$ they are visibly strongly increasing for high densities
$\rightarrow$ the set threshold seems to be decreasing for increasing density, but for some density this behaviour turns around

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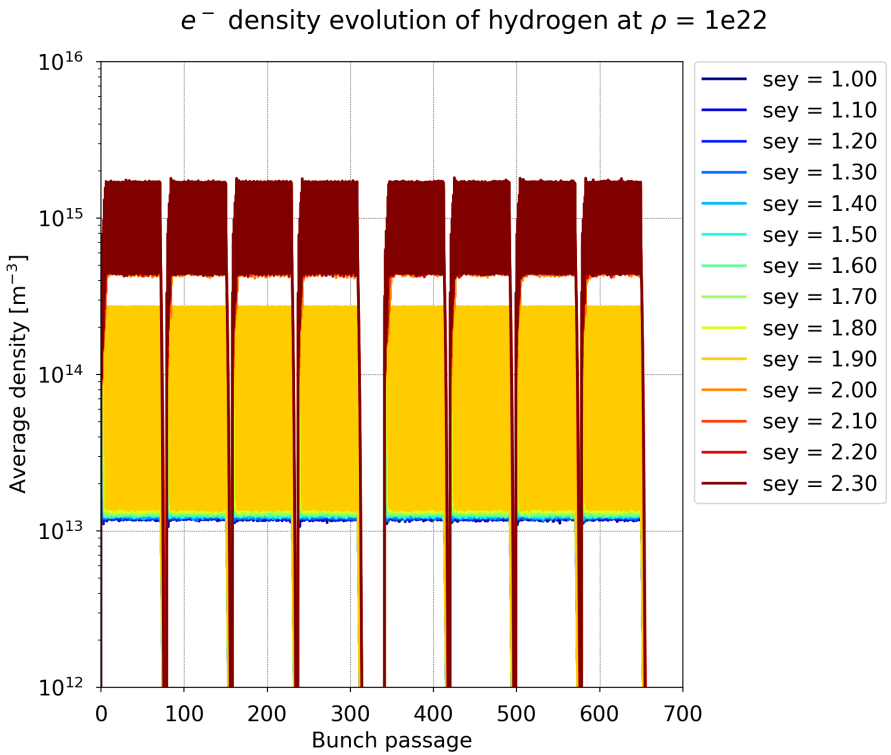
- number density
- energy distribution

# The heat load as an observable

## Effects of density and sey for each species

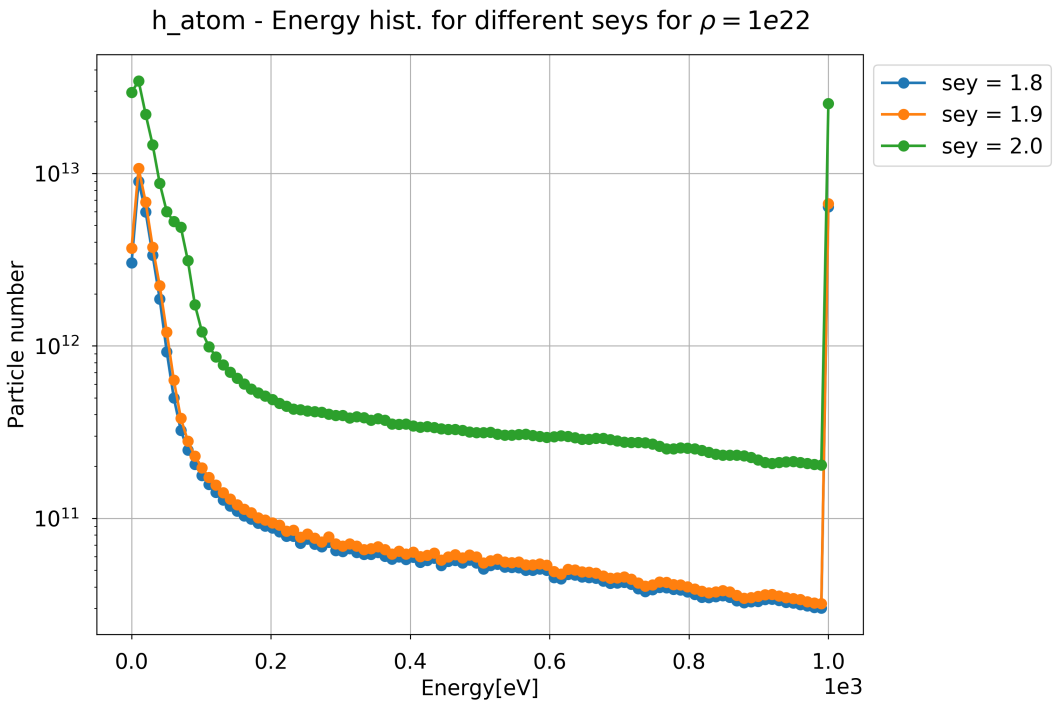
Firstly at our our lower limit regarding species, we see a clear transition between below and above the threshold in the number density for the particular case(sey around 1.9, density at 1e22/m3):



# The heat load as an observable

## Effects of density and sey for each species

But we also see an effect of the threshold in the energy distribution of this respective case:



# The heat load as an observable

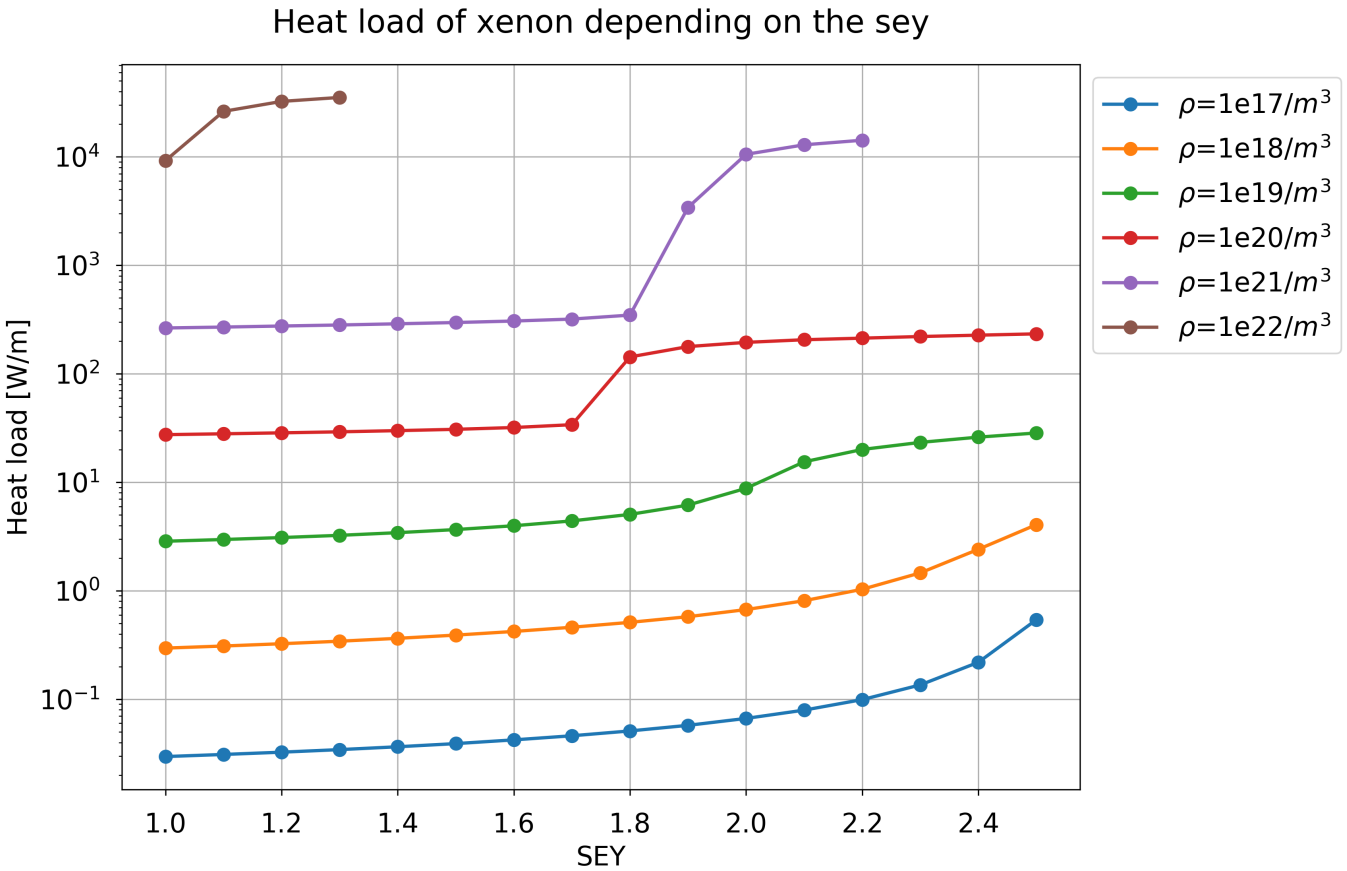
## Effects of density and sey for each species

$\rightarrow$ below threshold, distributions are very similar, above threshold, the slope is also different, the particle number does not decrease as fast with higher energy so the effect on the heat load seams to be increased twofold and looks locally parabolic around the threshold

# The heat load as an observable

## Effects of density and sey for each species

This effect is even stronger looking at xenon:



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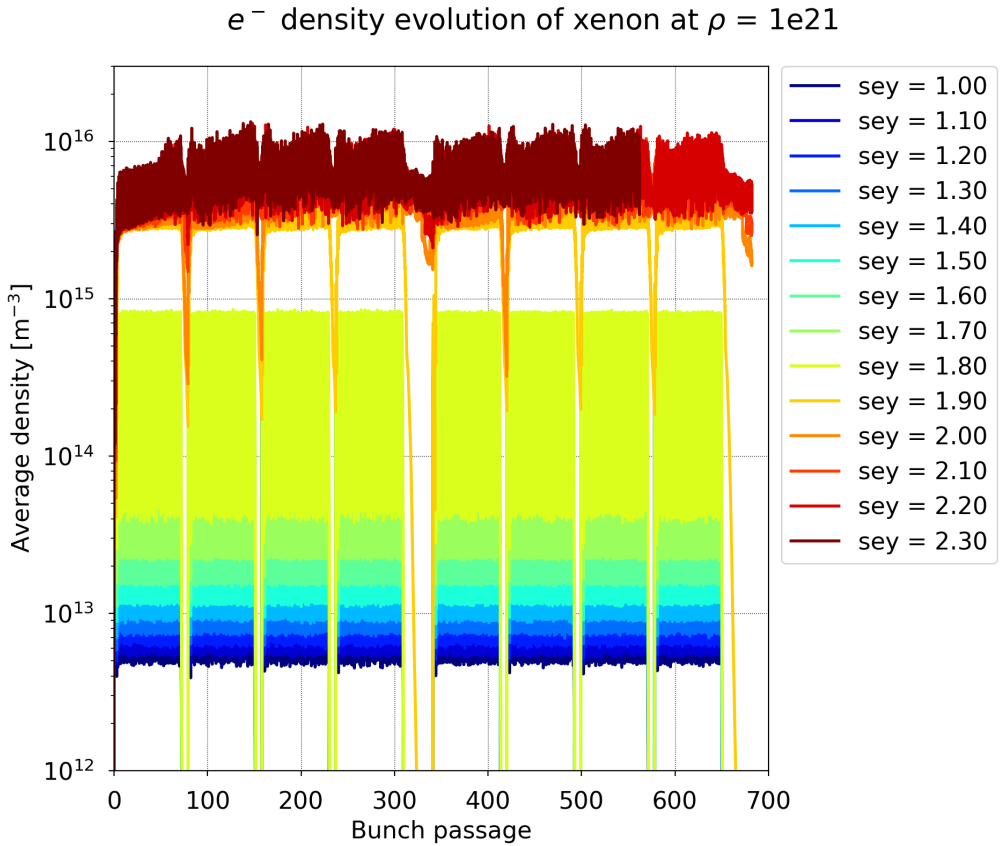
$\rightarrow$ the heat loads for higher densities seem to get very high

# The heat load as an observable

## Effects of density and sey for each species

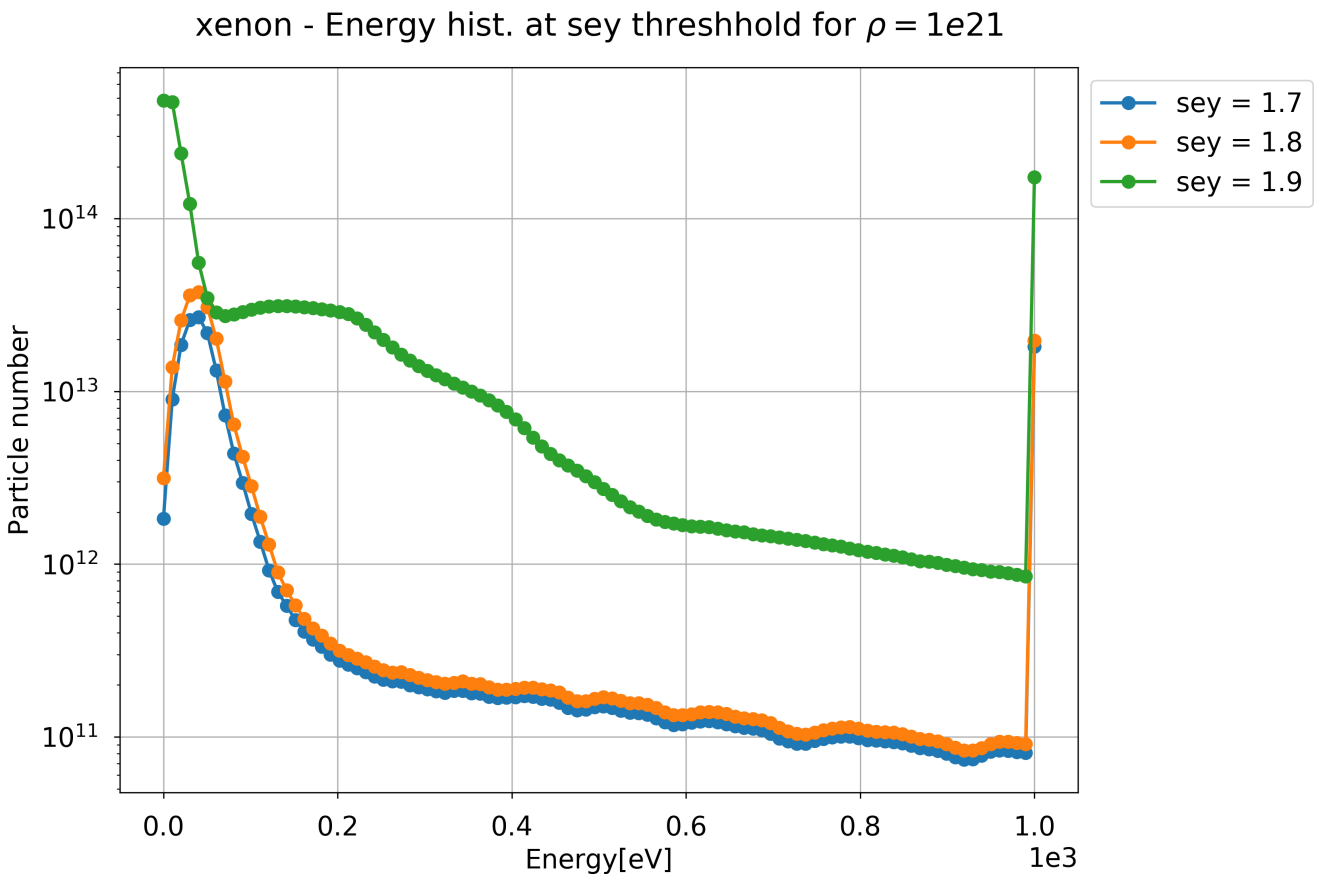
We can explain the huge increase again by the discontinuity in the density as a function of the sey at the critical residual density:



# The heat load as an observable

## Effects of density and sey for each species

The effect on the energy distribution is even more clear this time:



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$\rightarrow$ not only significantly higher number of particles with very little energy but also the the curvature has a different sign in interval [0,0.5]eV
$\rightarrow$ here also the twofold effect causes the threshold to act almost quadratic around the respective sey

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- the effect of the upper and lower case for the requested situation was scanned
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- current studies have been executed with hydrogen and xenon, studies of intermediate elements have started

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$\rightarrow$ the effect of the species in the simulation for the investigated observables is in the tolerable order of a few watts, but increasing either density or sey is not canonical

# Thanks

for

your

attention