

# Report 12/12/19

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**HELMHOLTZ**  
RESEARCH FOR GRAND CHALLENGES



 **EUROfusion**

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## Basic procedure

- + two sets of 1D simulations modelled after particular discharge XPID: 20181010.032, incorporating 4 scenarios where  $f_{rad} = P_{rad}/P_H = \langle 0.33, 0.66, 0.9, 1.0 \rangle$
- + each point in time trace with individual Thomson scattering profiles of  $n_e$  &  $T_e$  as input for STRAHL
- + both sets distinguished by different decay lengths, transport profiles of  $D/v$  and  $D$  as well as profile shapes from TS (measured vs. Gaussian process fit)

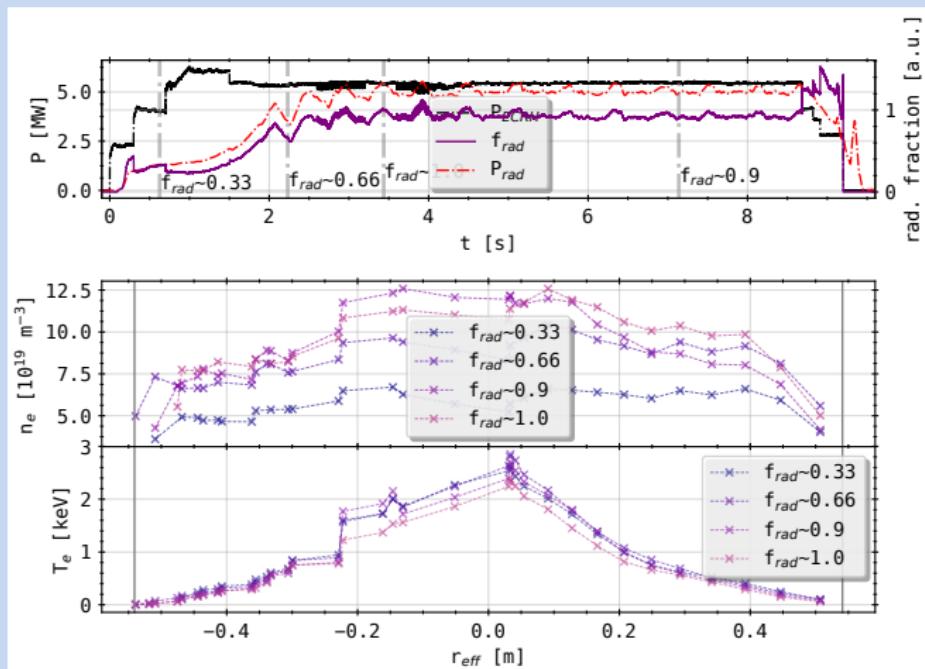
## Basic procedure

- + set No.1 of simulation # 2-5  $\lambda_{n,T,e} = 3\text{ cm}$  in alignment with profiles across plasma islands; set No.2 # 6-9  $\lambda_{n,T,e} = 0.5\text{ cm}$  for 'free' SOL regions
- + first set with measured and corrected data points from TS; second set based off of Gaussian process fits from measured data with most likely profile shape
- + set No.1 constant  $D = 0.5 \text{ m}^2 \text{s}^{-1}$  and null  $D/v$  profile; set No.2 constant  $D = 2.0 \text{ m}^2 \text{s}^{-1}$  and conservative electron root  $D/v$  profile (see later)

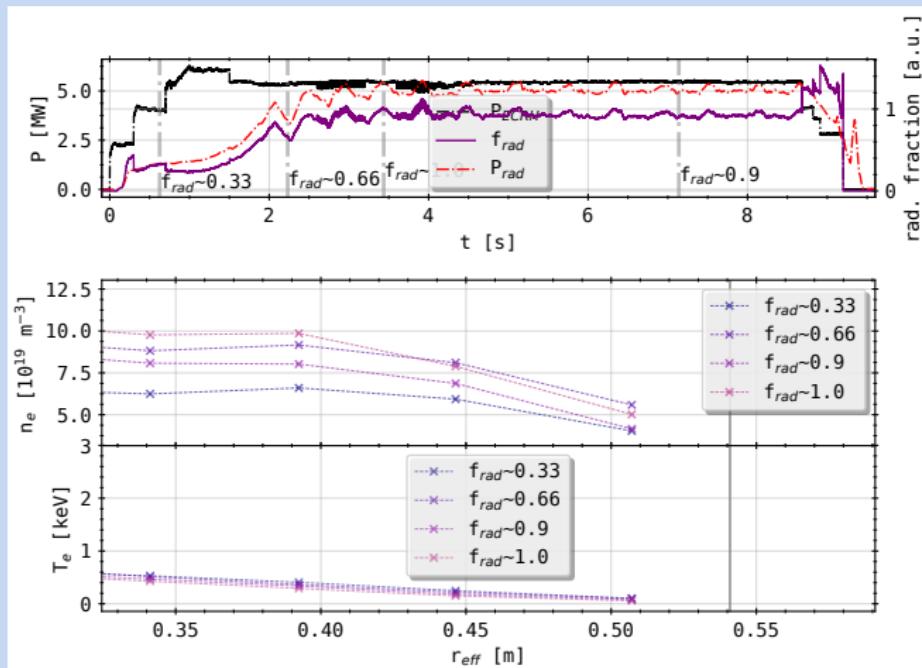
## Basic procedure

- + otherwise equal  $T_i$  profiles (none specified), neutral/pressure  $n_n$ ,  $p$  profiles (none given) and magnetic configurations (standard EJM)
- + also both constant impurity sources located at  $r_{LCFS}$  with intensity of  $3 \times 10^{17} \text{ s}^{-1}$
- + same connections lengths to LCFS, divertor/limiter for both sets
- + relaxation time in simulation 1 s, convergence steps per time 1000

## Radiation fractions



## Radiation fractions



## Chordial profiles & 'best' channels

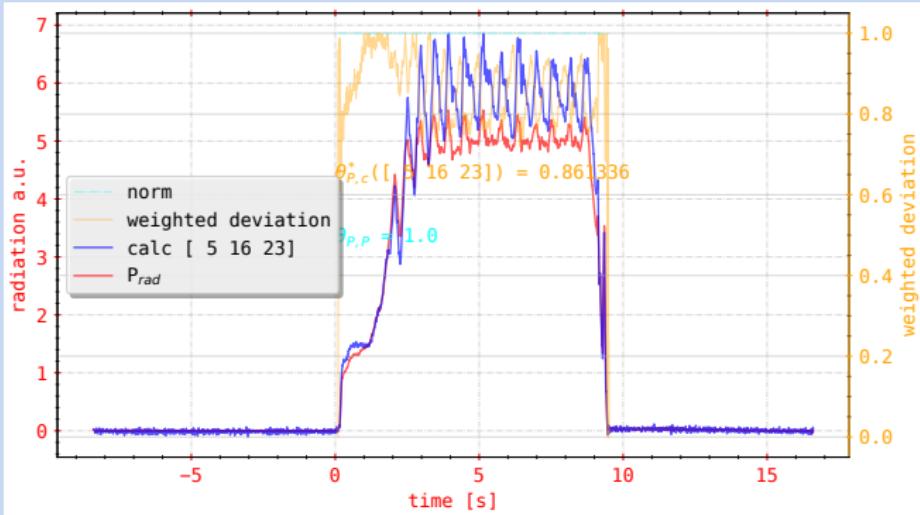
- + 'best' = most sensitive to this particular radiation trace
- + method for quality evaluation used:

$$d_{diff}(t) = \|P_{rad}(t) - P_{prediction}(t)\|$$

$$\varepsilon(t) = \begin{cases} 1 - \frac{d_{diff}(t)}{P_{rad}(t)} & , \quad d_{diff} < P_{rad} \\ 0 & , \quad \text{else} \end{cases}$$

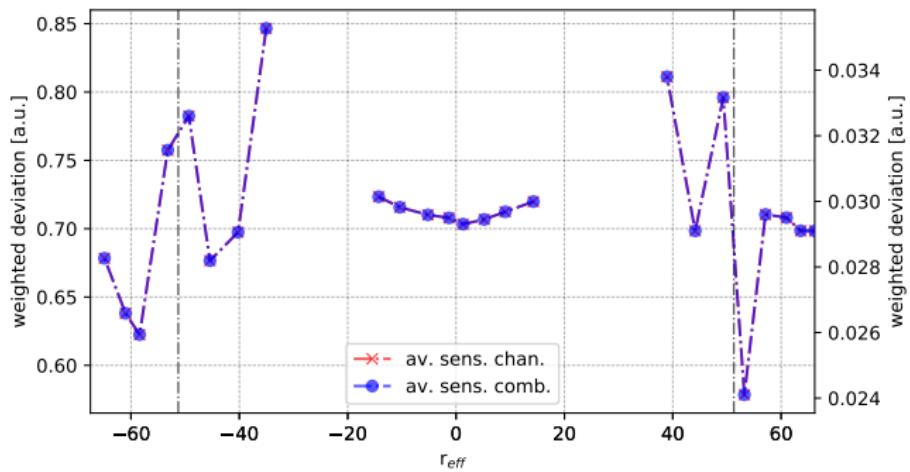
$$\vartheta = \overline{\varepsilon(t)}$$

## Chordial profiles &amp; 'best' channels

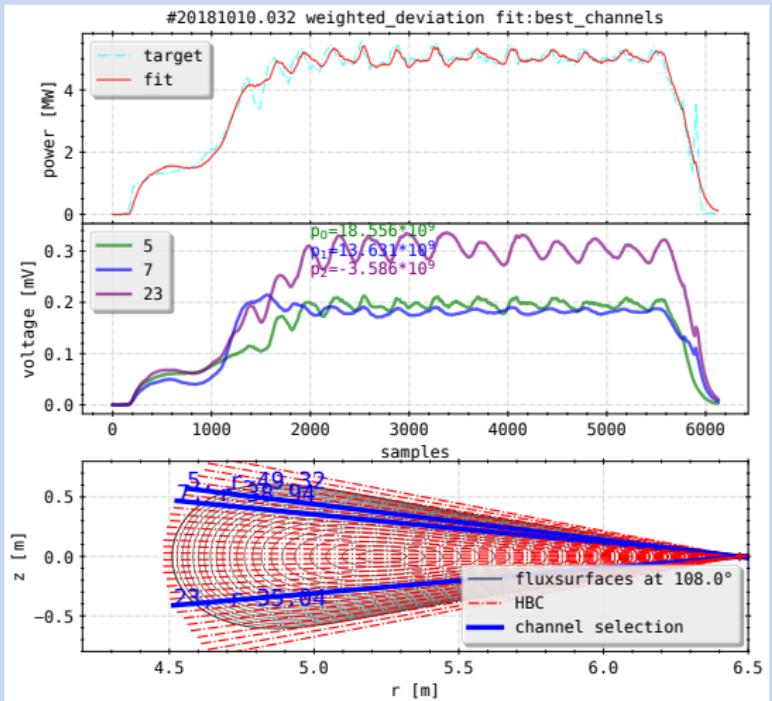


## Chordial profiles &amp; 'best' channels

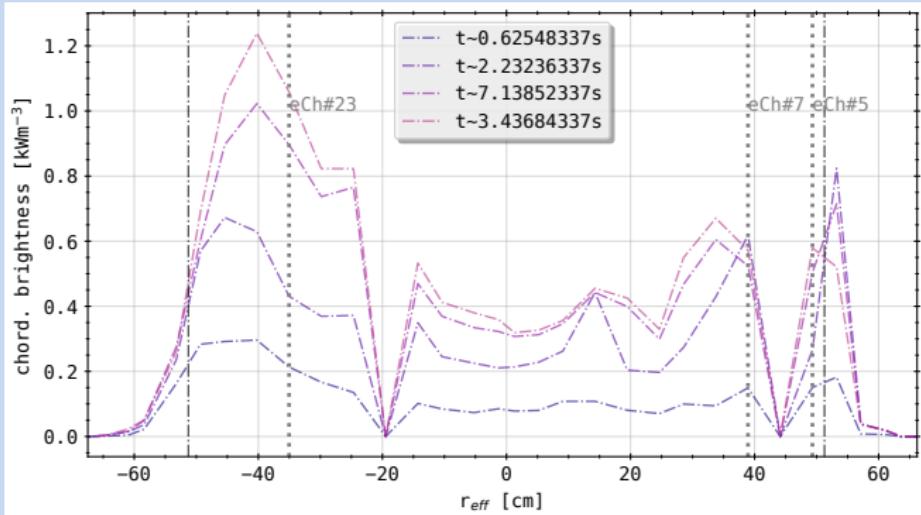
20181010.032 HBC combinations:3



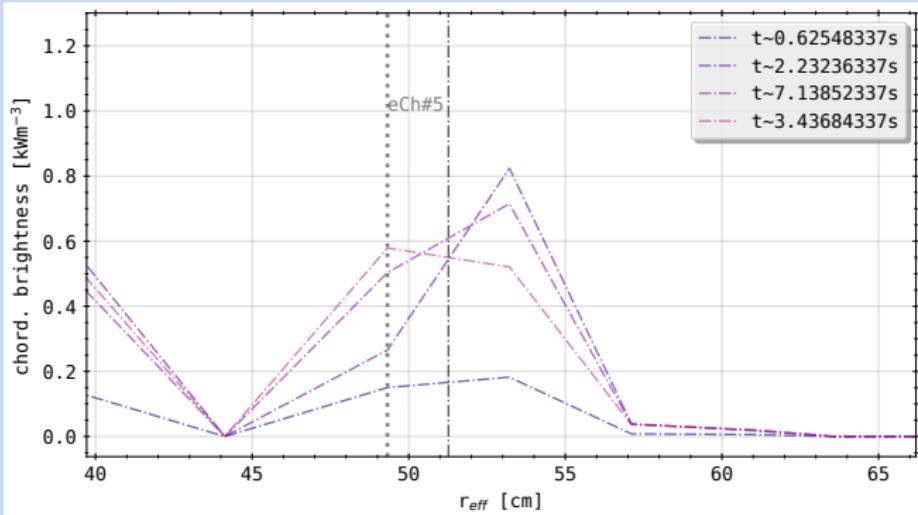
## Chordial profiles &amp; 'best' channels



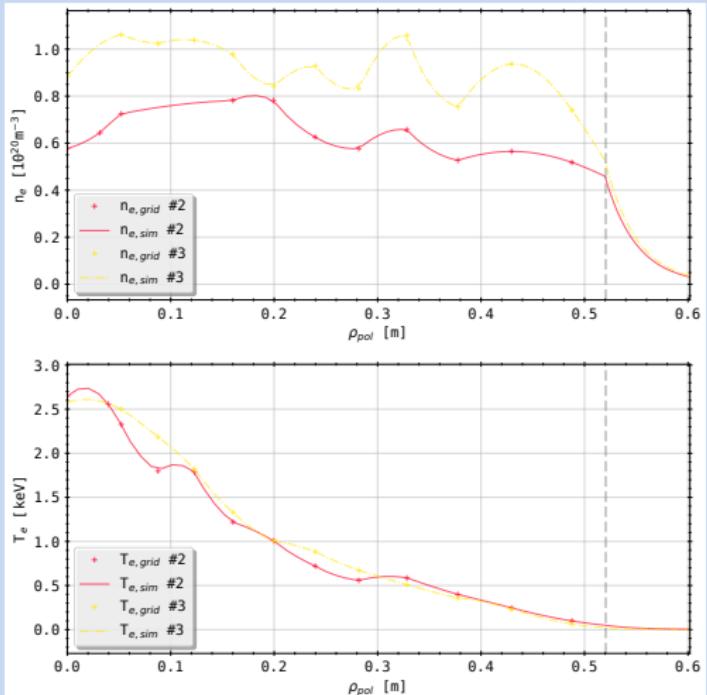
## Chordial profiles &amp; 'best' channels



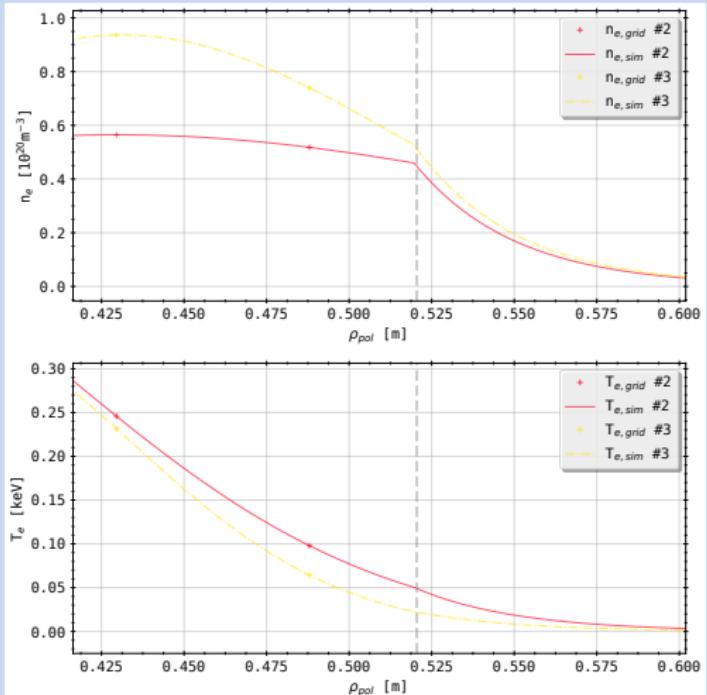
## Chordal profiles &amp; 'best' channels



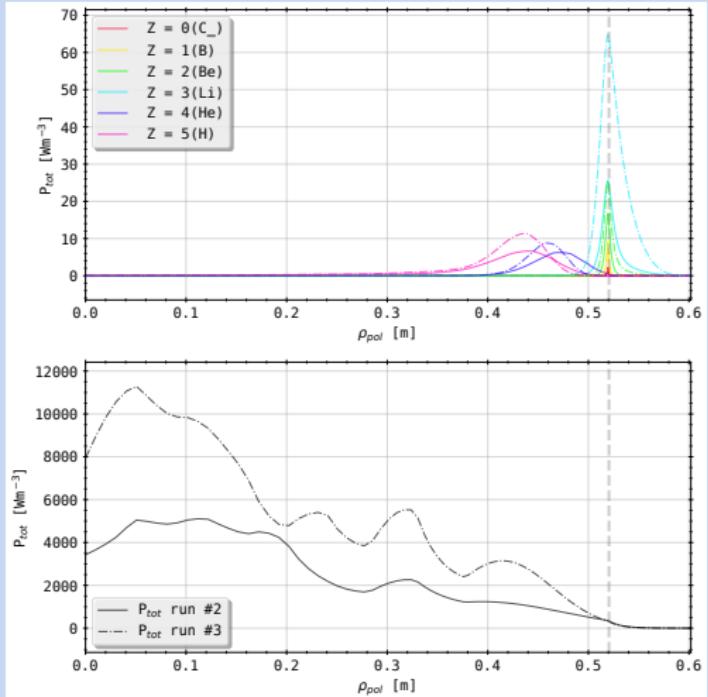
Set No.1,  $f_{rad} = 0.33, 0.66$



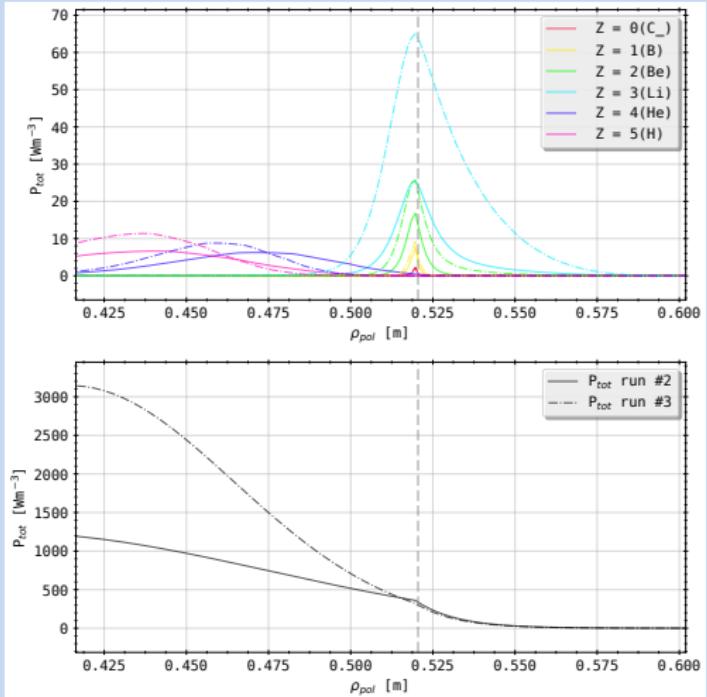
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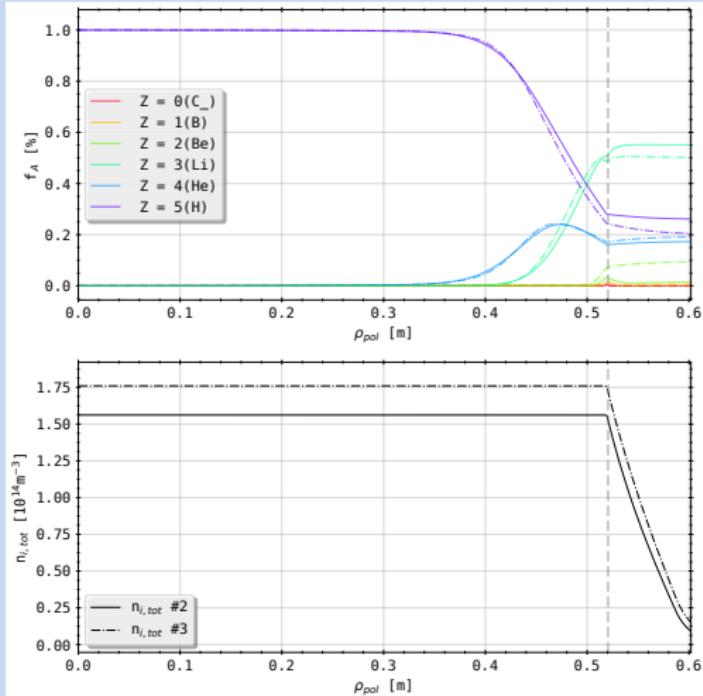
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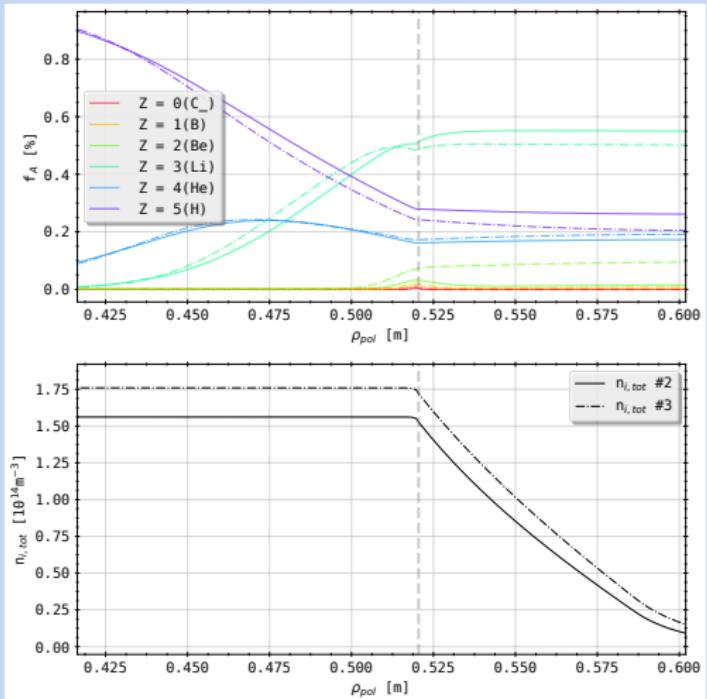
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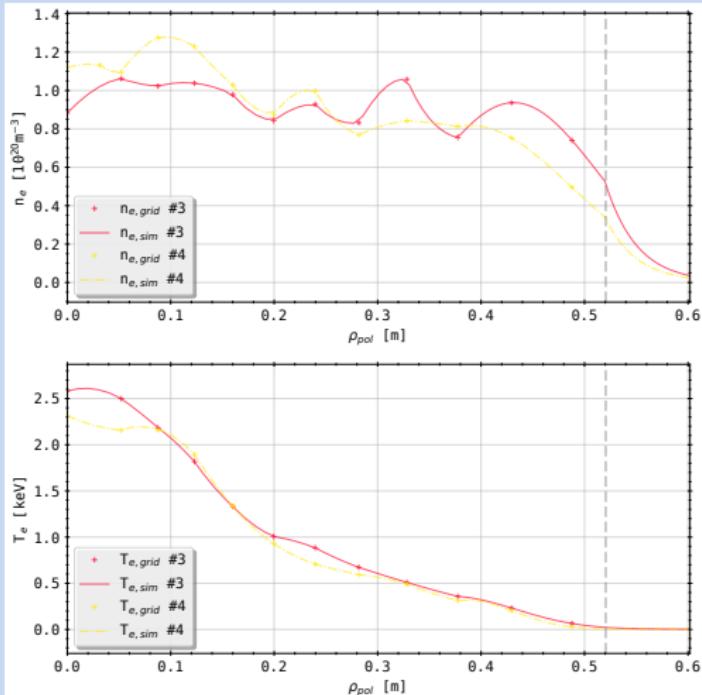
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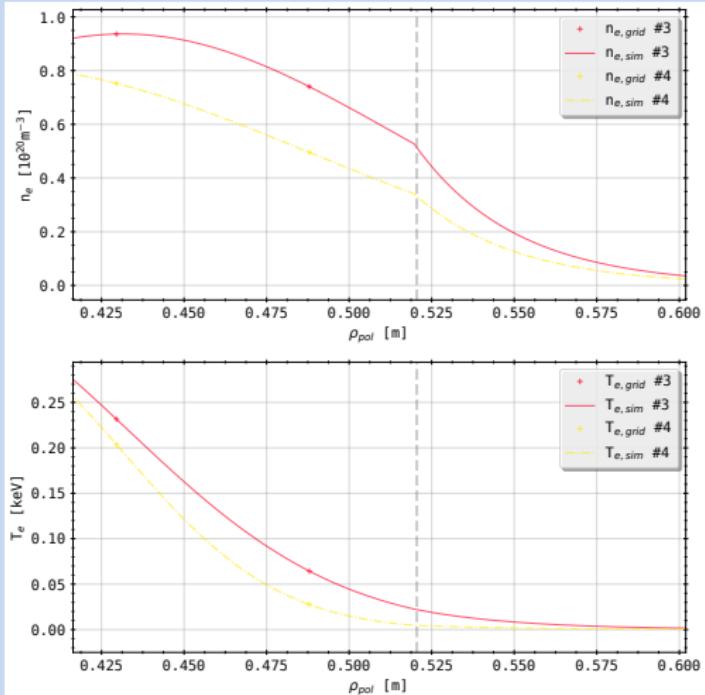
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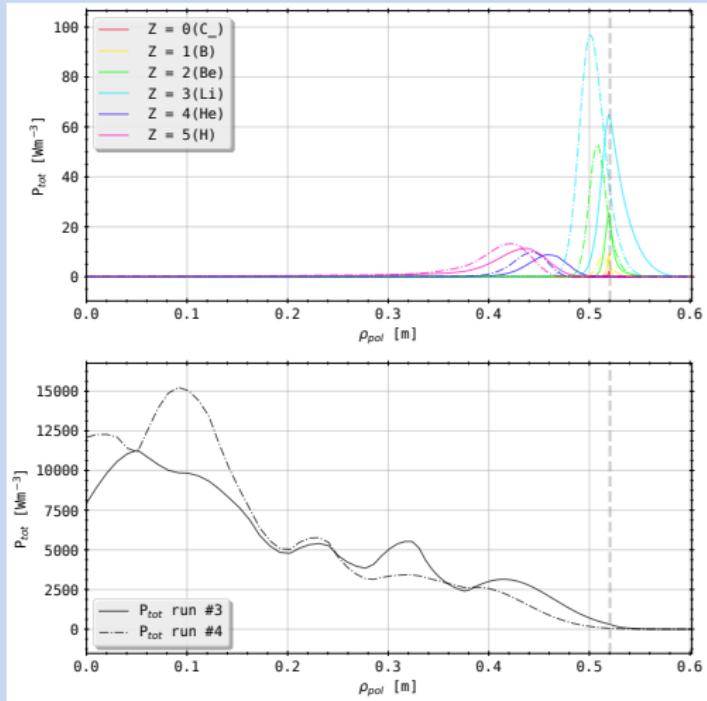
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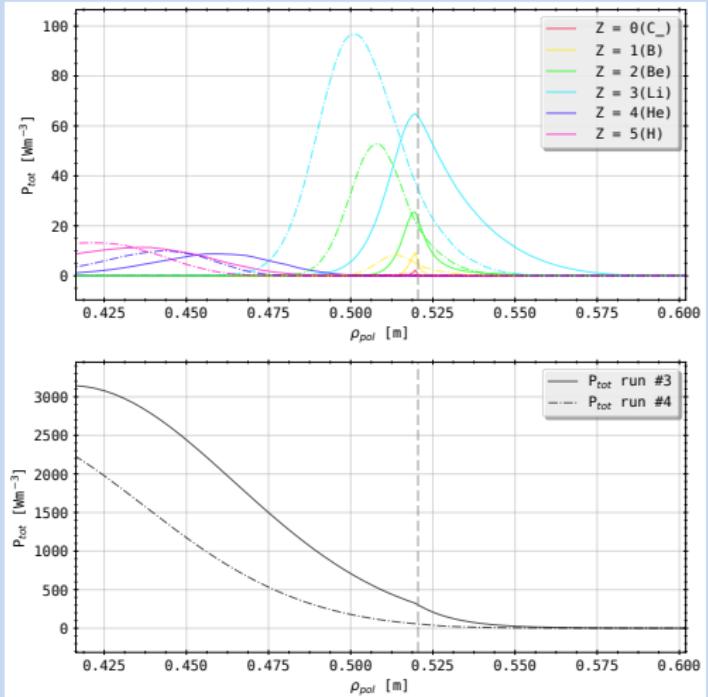
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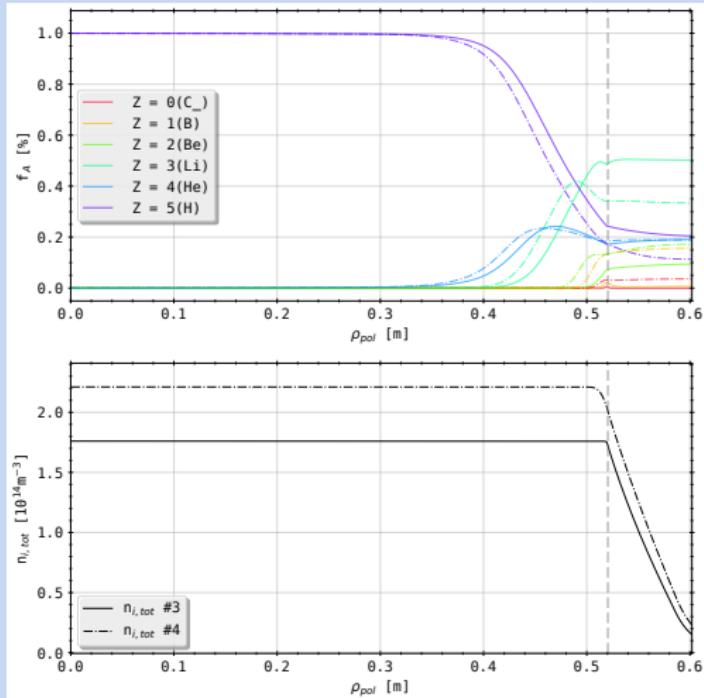
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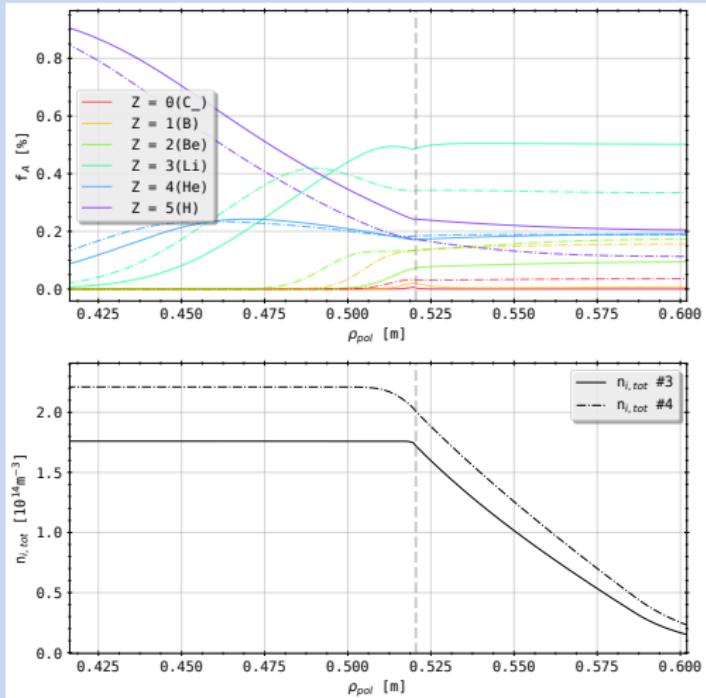
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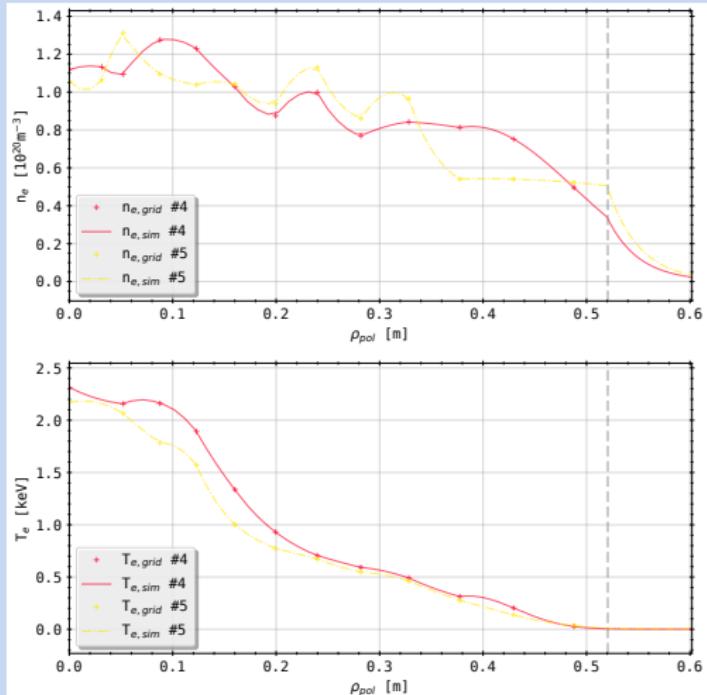
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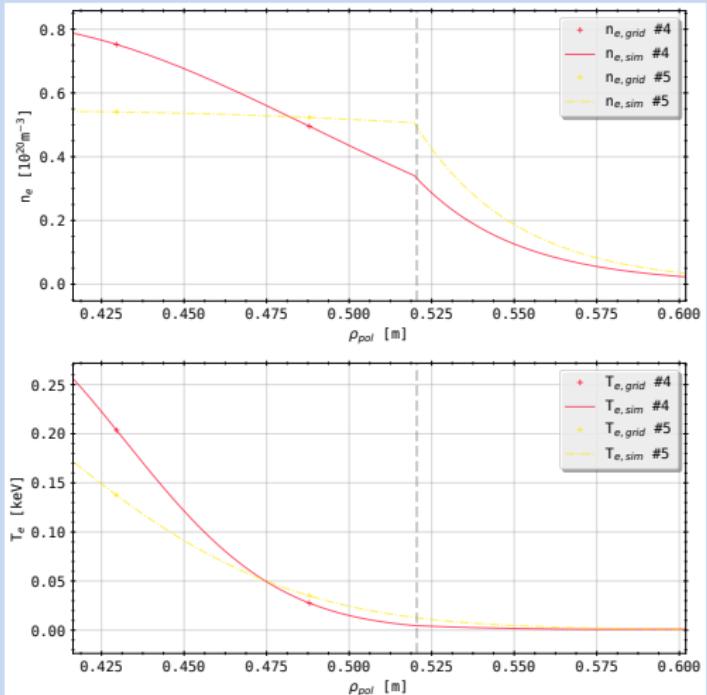
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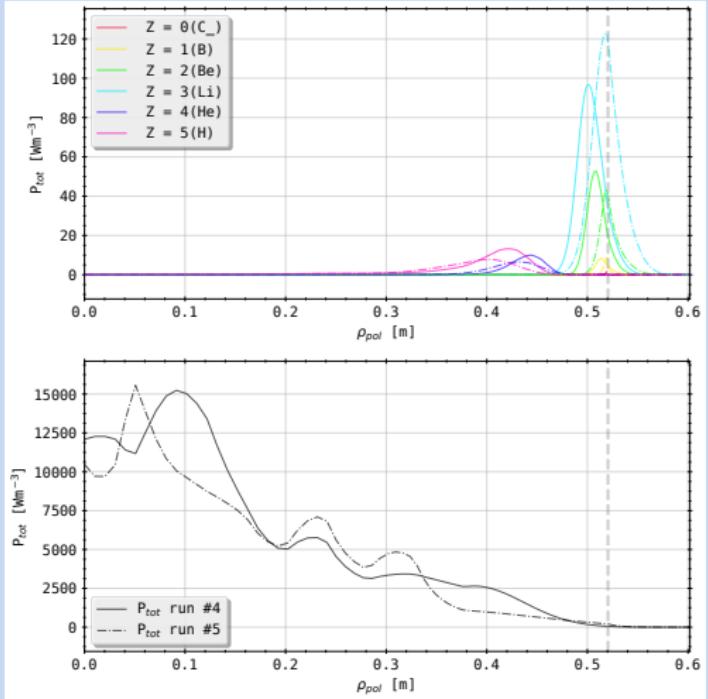
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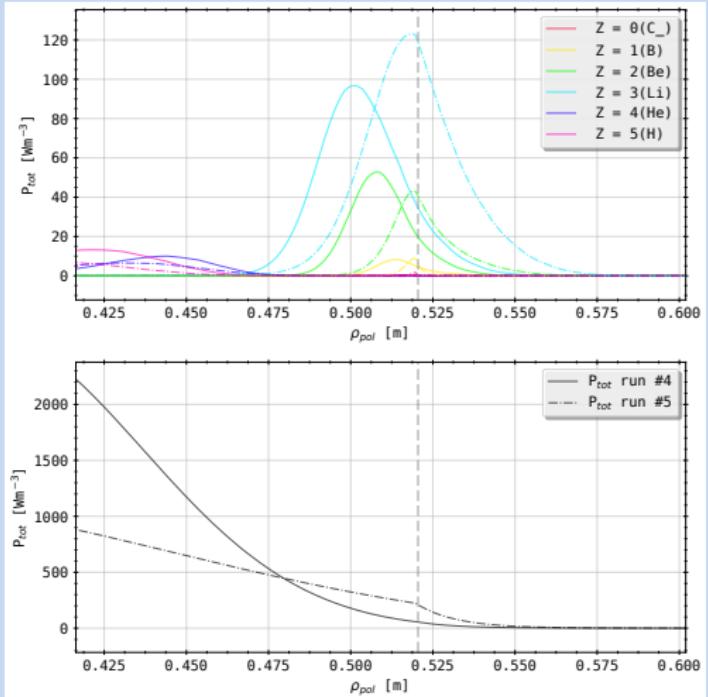
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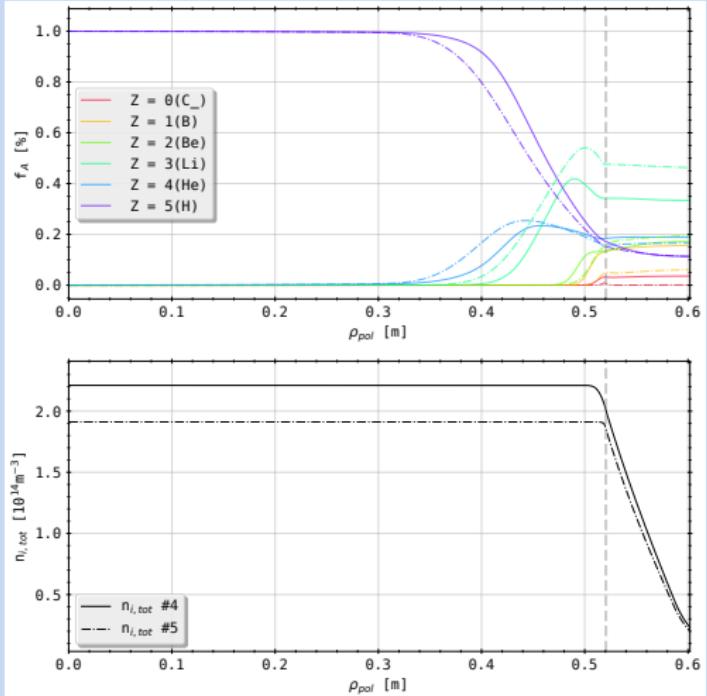
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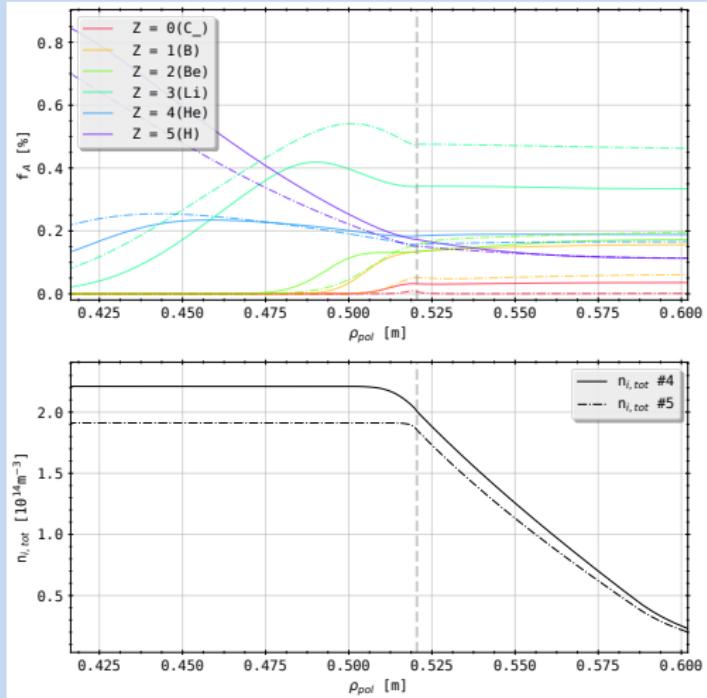
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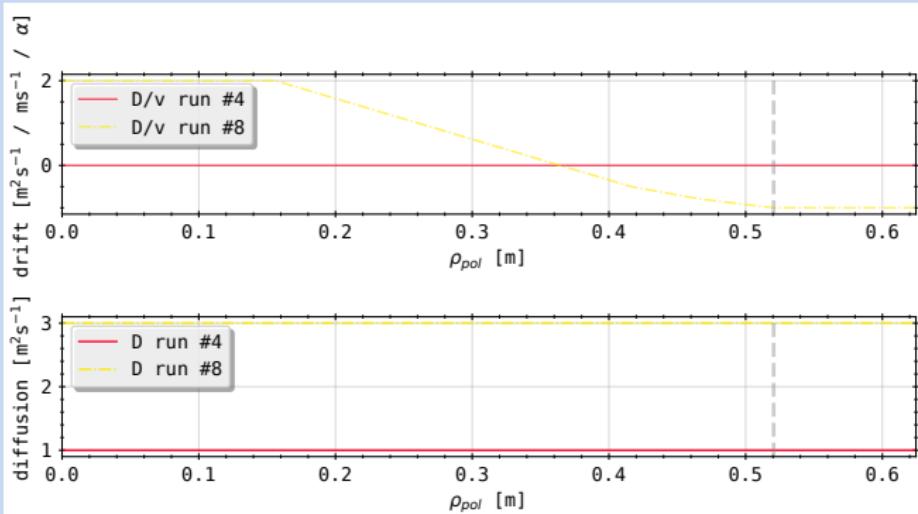


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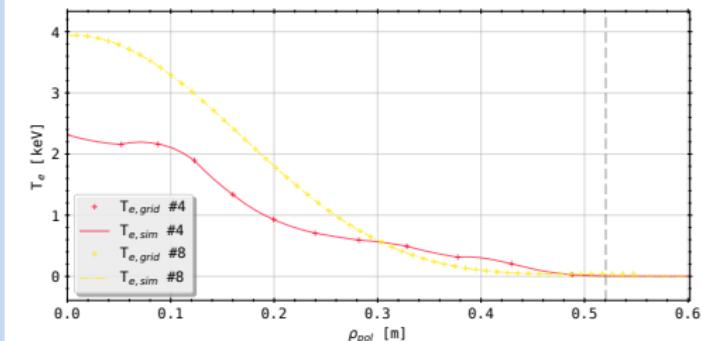
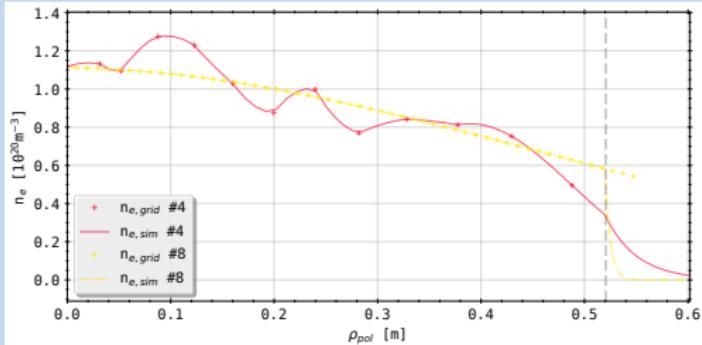


# STRAHL comparison

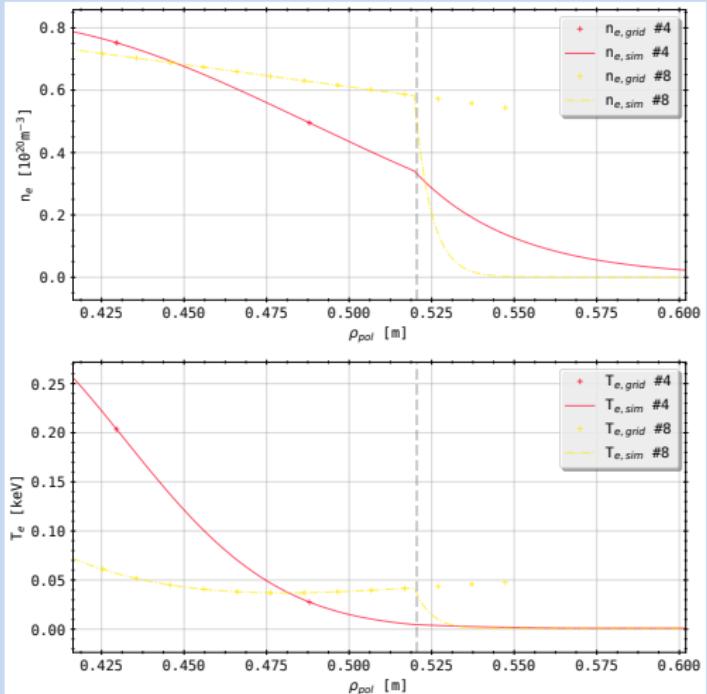
Set No.1&2,  $f_{rad} = 0.9$



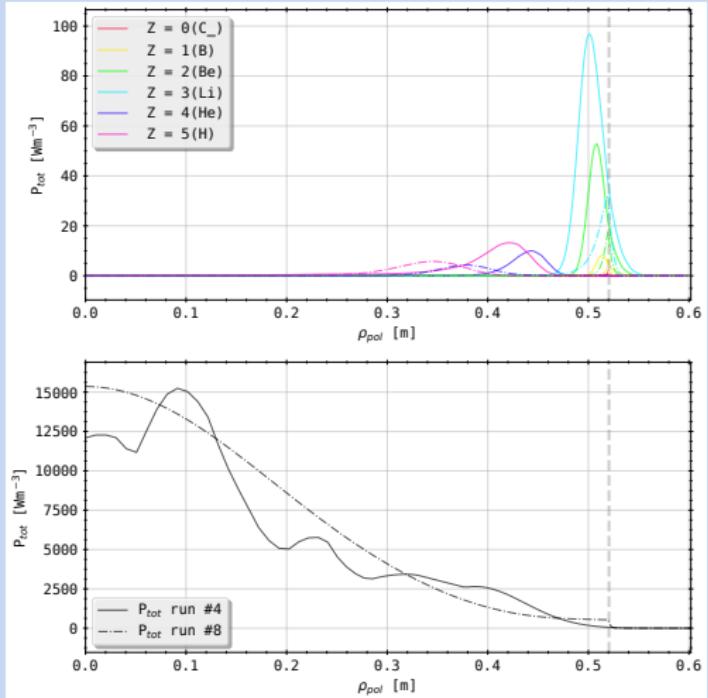
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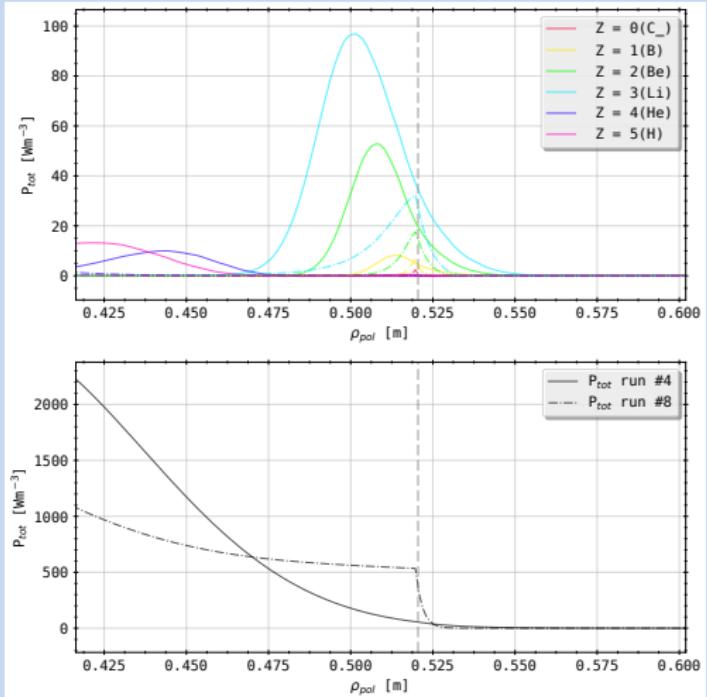
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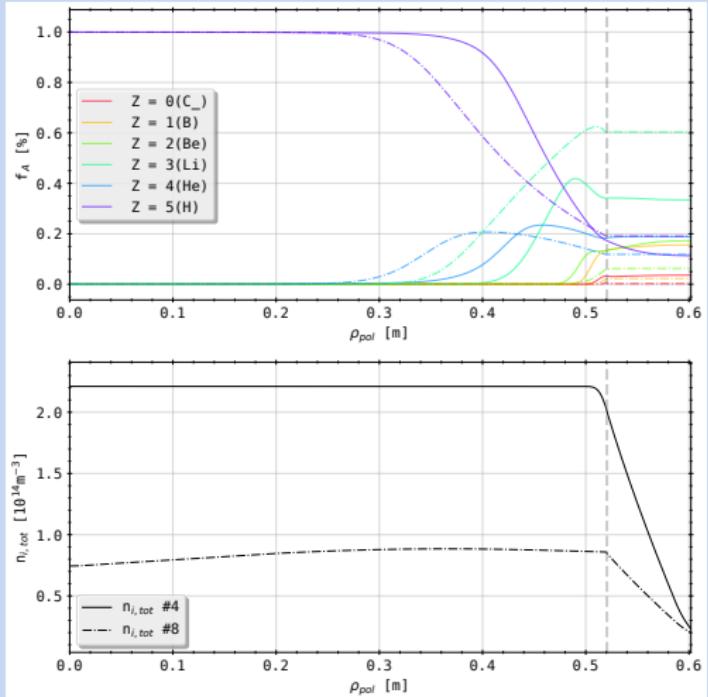
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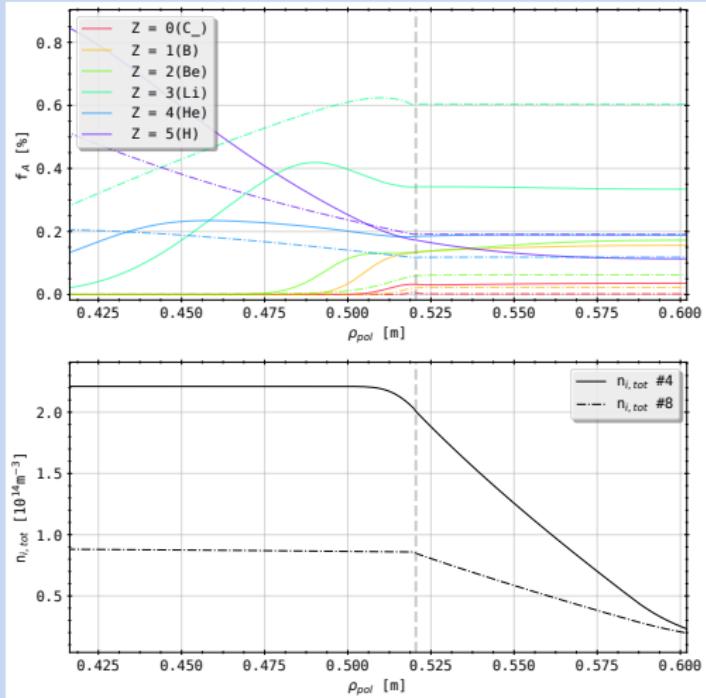
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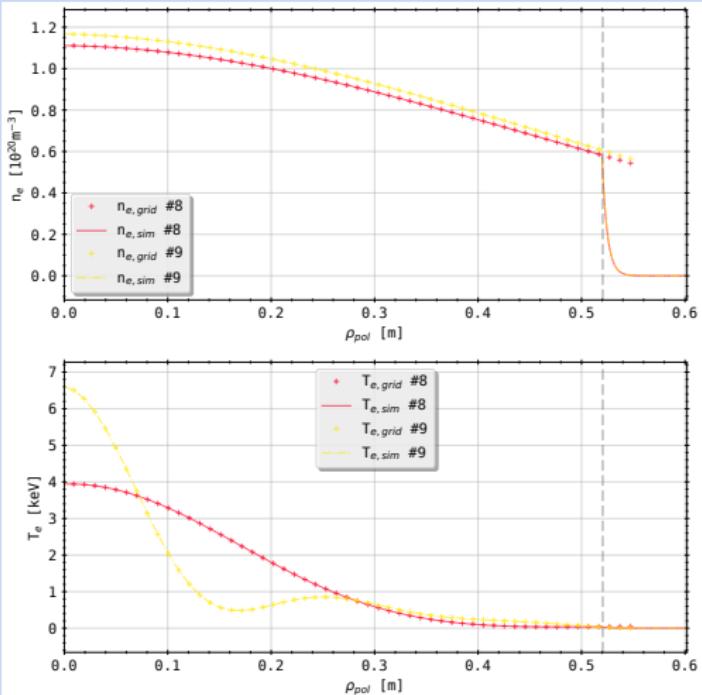


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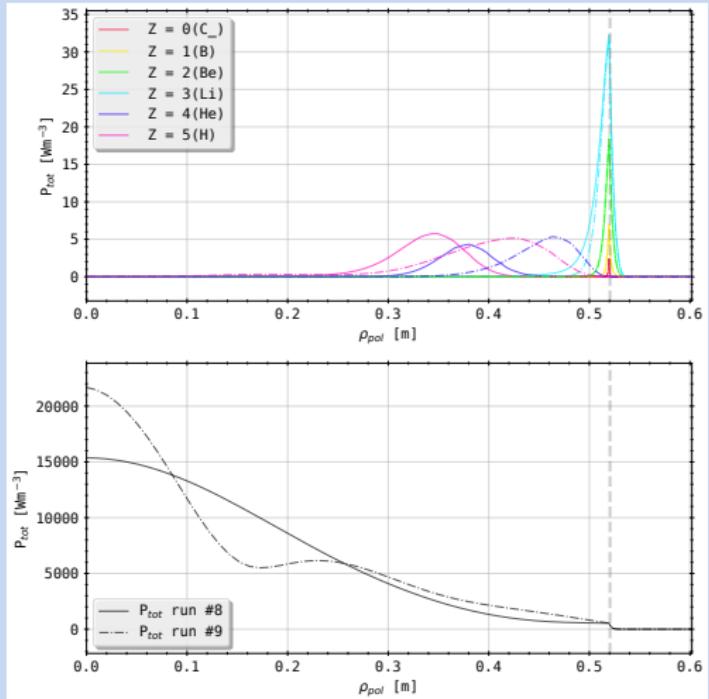
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Set No. 2,  $f_{rad} = 0.9, 1.$

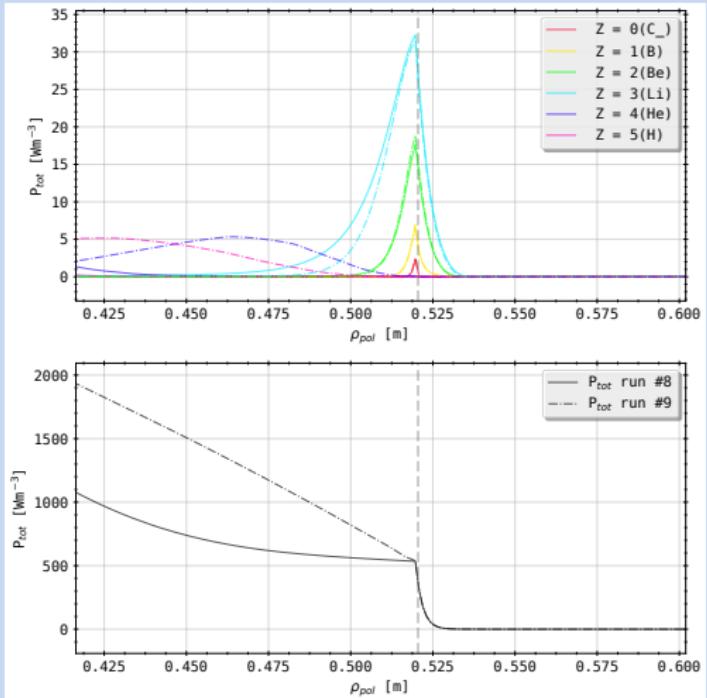


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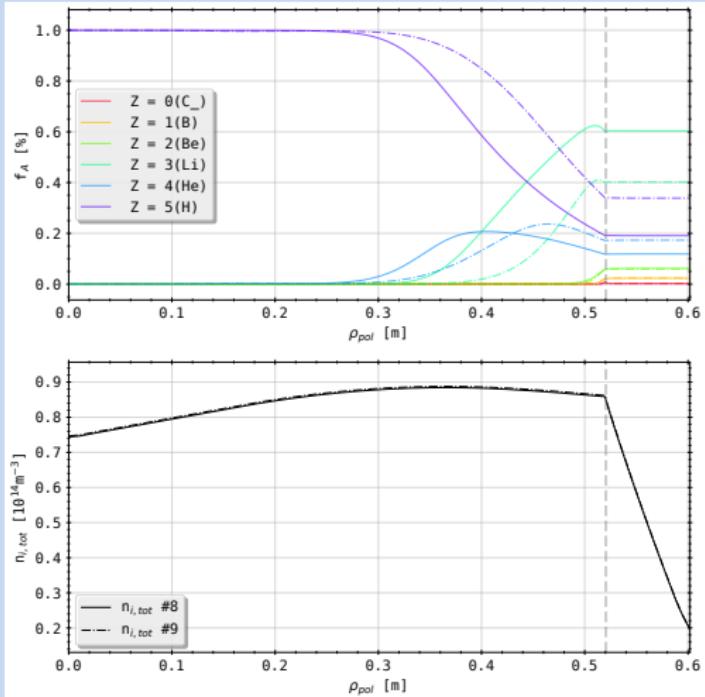
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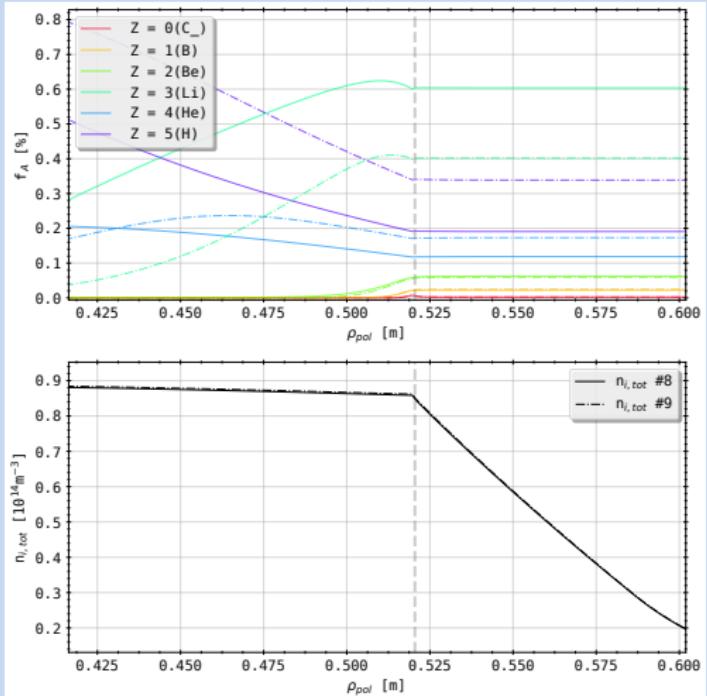


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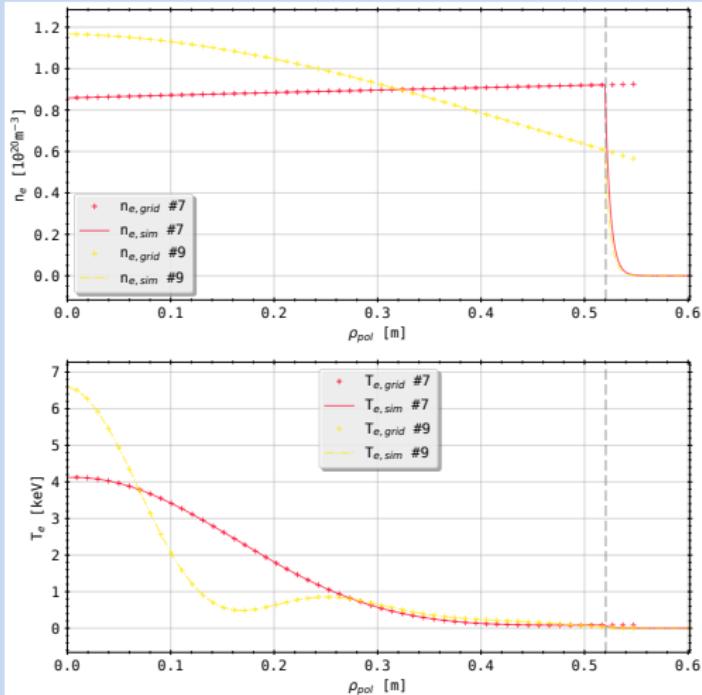
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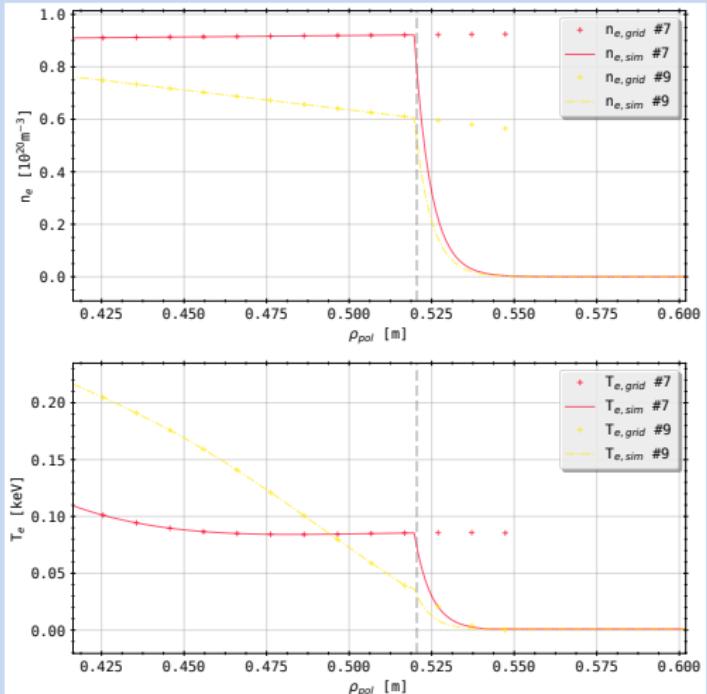
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Set No. 2,  $f_{rad} = 0.66, 1.$

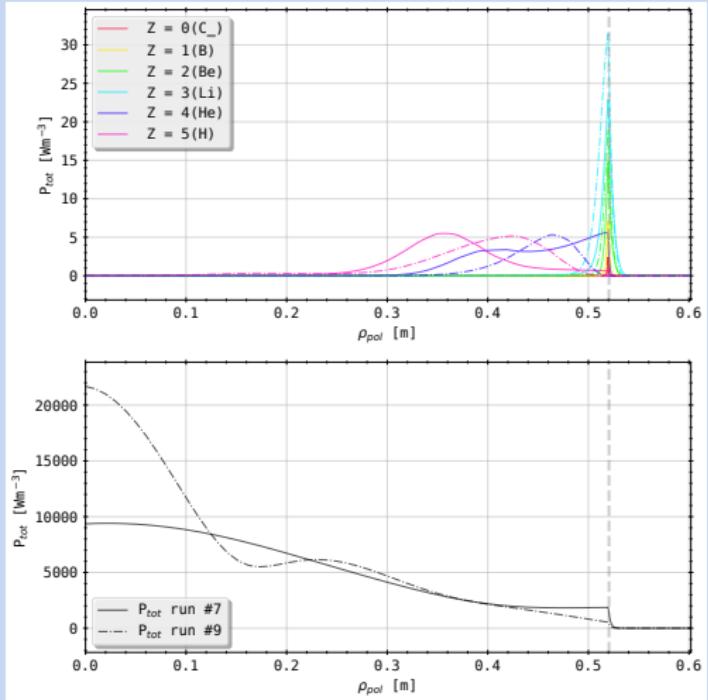


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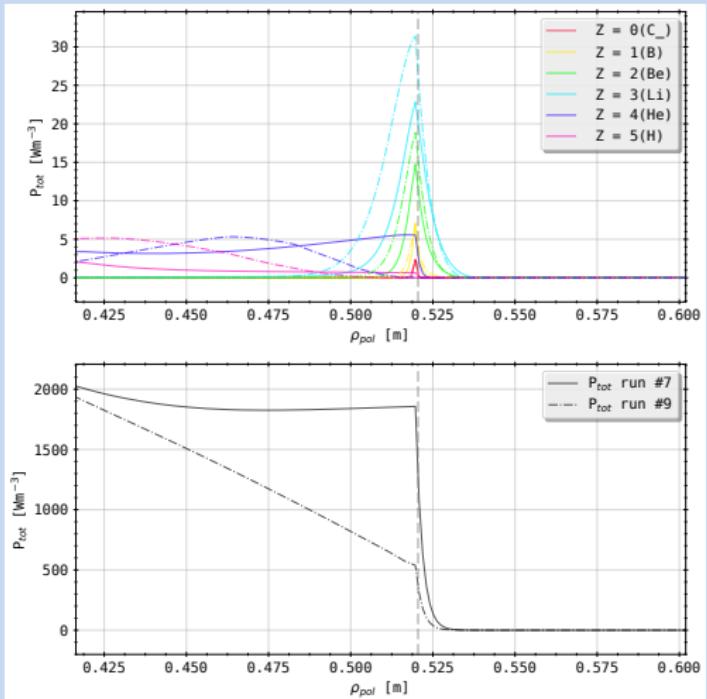
Set No. 2,  $f_{rad} = 0.66, 1.$



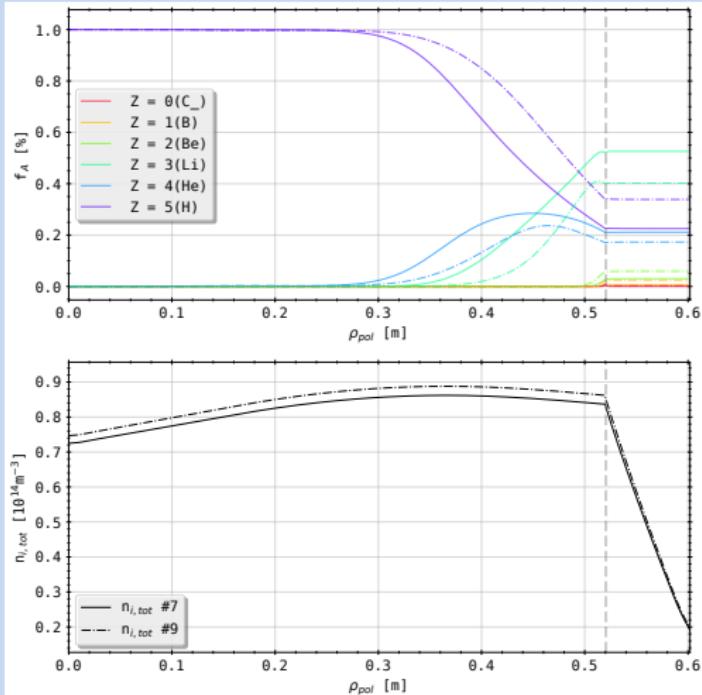
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# STRAHL comparison

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