

What has been done.

# How i understand the code:

- CUPRAD ----> IR propagation in the medium

$$\partial_z U = \frac{\mathbf{i}}{2k_0} \mathcal{T}^{-1} \Delta_{\perp} U + \mathbf{i} \mathcal{D}_2 U + \mathbf{i} \frac{\omega_0}{c} n_2 \mathcal{T} |U|^2 U - \frac{\mathbf{i} e^2 k_0}{2 n_0^2 \omega_0^2 m_e \varepsilon_0} \mathcal{T}^{-1} (\varrho_e U) - \frac{e^2 \nu_e}{2 m_e \varepsilon_0 n_0 c (\nu_e^2 + \omega^2)^2} \varrho_e U$$

- TDSE -----> Dipole at each points in the medium

$$H_L^{(1D)} = -\frac{1}{2} \frac{d^2}{dx^2} - \frac{1}{\sqrt{a^2 + x^2}} + \mathcal{E}(t)x$$

- Hankel ----> XUV in the far field

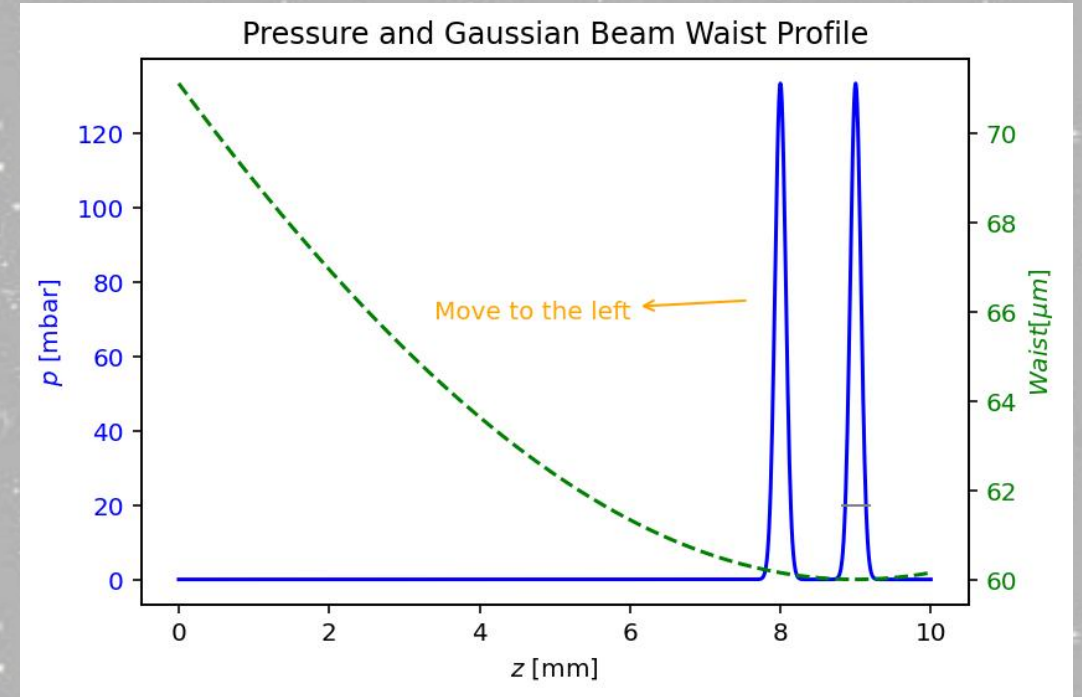
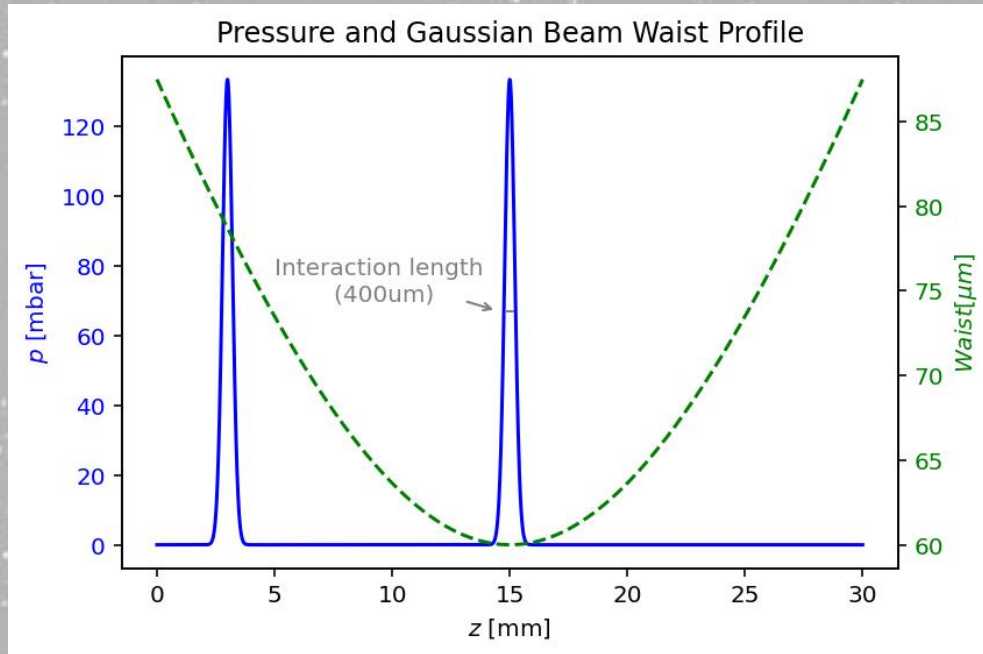
$$\hat{\mathcal{E}}(\omega, \rho, z) \approx -\frac{\mu_0 e^{\mathbf{i}k(\omega)z}}{4\pi} \int_{z_{\text{entry}}}^{z_{\text{exit}}} \frac{e^{-\mathbf{i}k(\omega)z'} e^{\mathbf{i} \frac{k(\omega)\rho^2}{2(z-z')}}}{z-z'} \int_{\Delta_T} e^{\mathbf{i} \frac{k(\omega)(\rho')^2}{2(z-z')}} \left( \widehat{\frac{\partial \mathbf{j}_Q}{\partial t}} \right) J_0 \left( \frac{k(\omega)\rho\rho'}{z-z'} \right) \rho' d\rho' dz'.$$

noabsorbtion considered in the second jet?

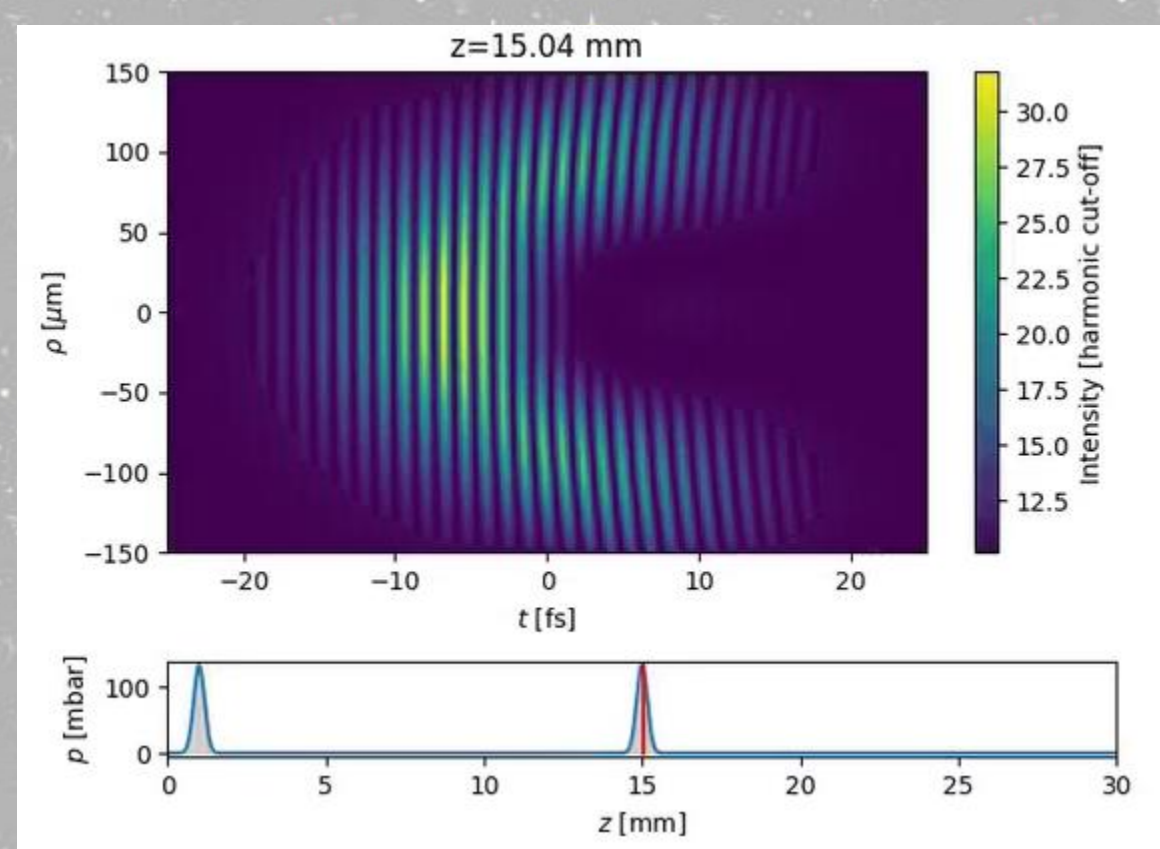
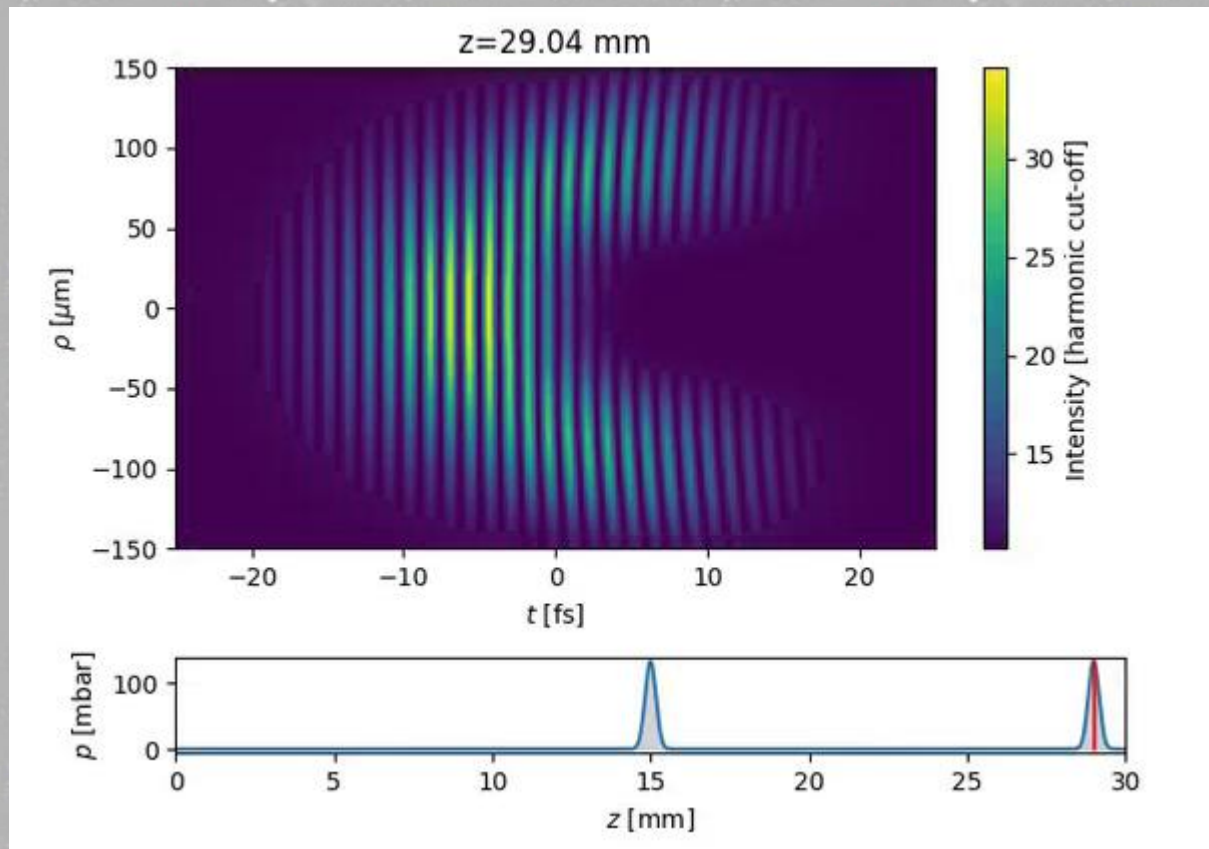


# Main Inputs for our purpose

- Medium (Gas, Length, **pressure profile**)
- Laser (Waist, duration, focus position)



- Dcretization in  $r$  and  $z$
- (Computational time)  
( $z_{\text{step}}$  always  $\sim 10\mu\text{m}$ )
- ( $r_{\text{step}}=10$ ,  $Nr_{\text{max}}=200$ )

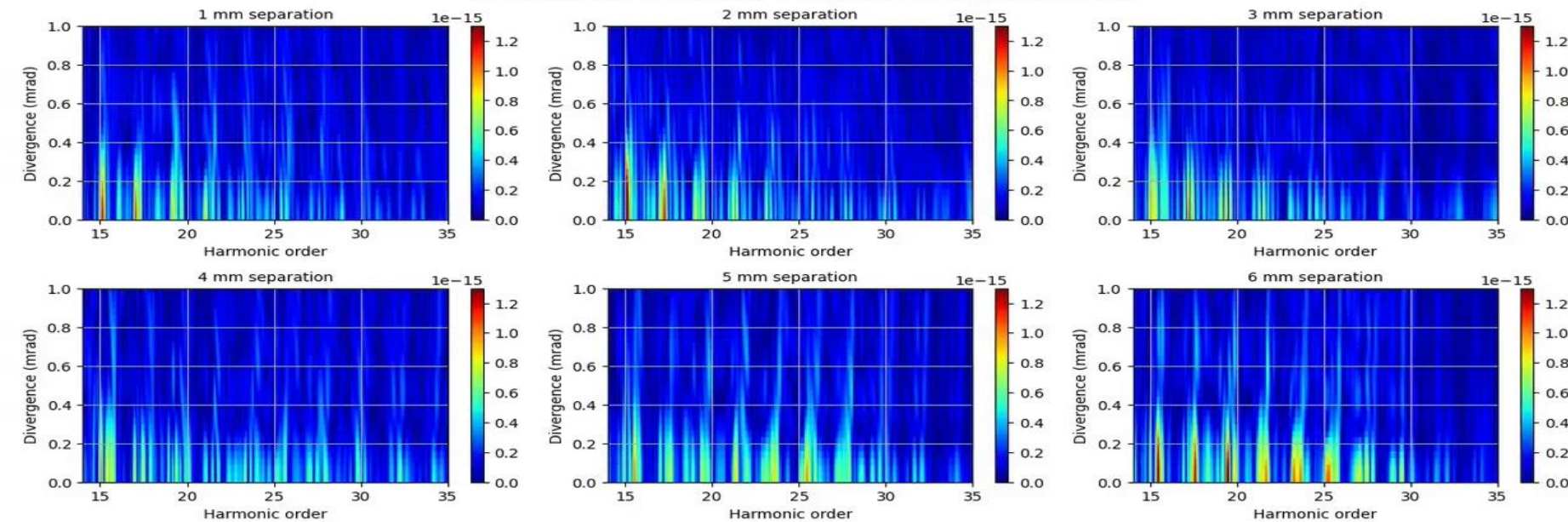


Because I want to reduce the medium length for saving time.

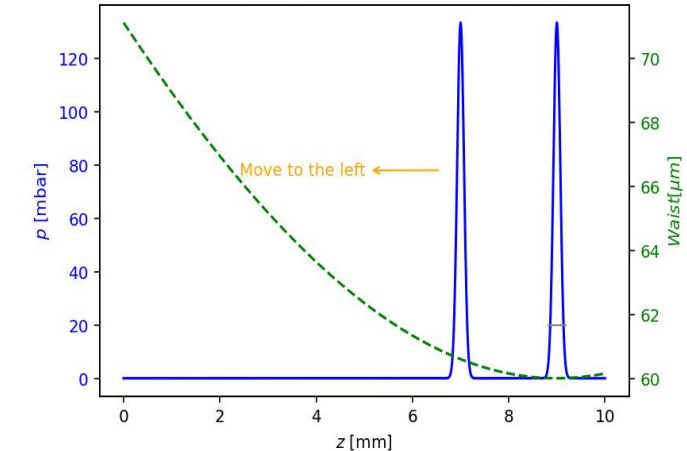
I don't know whether they put the focus in the middle on purpose.  
So I gave some small run parameters and put the focus in different position to test whether the pulse remain the same.



# Spatially and spectrally resolved harmonic spectrum

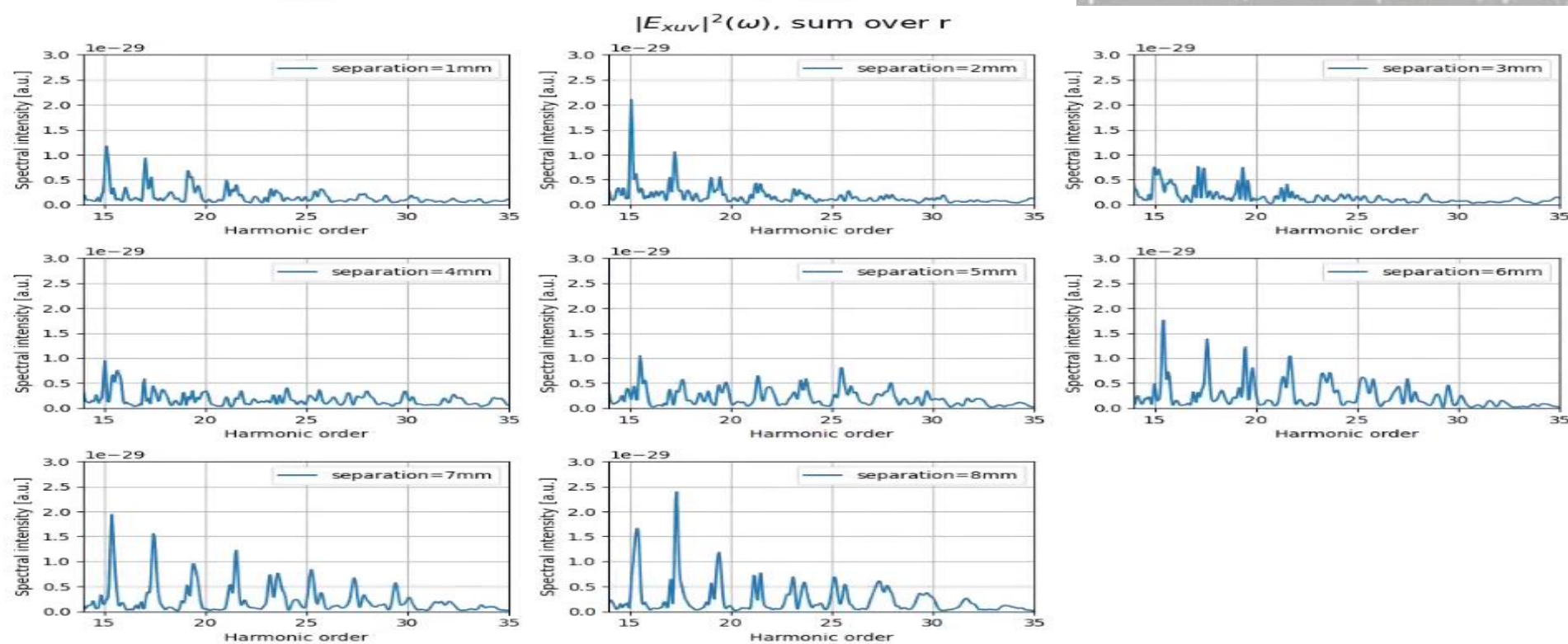
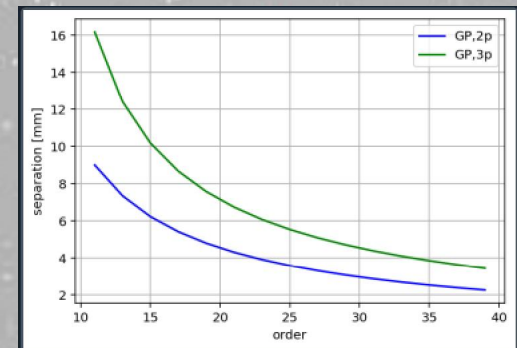


# Pressure and Gaussian Beam Waist Profile



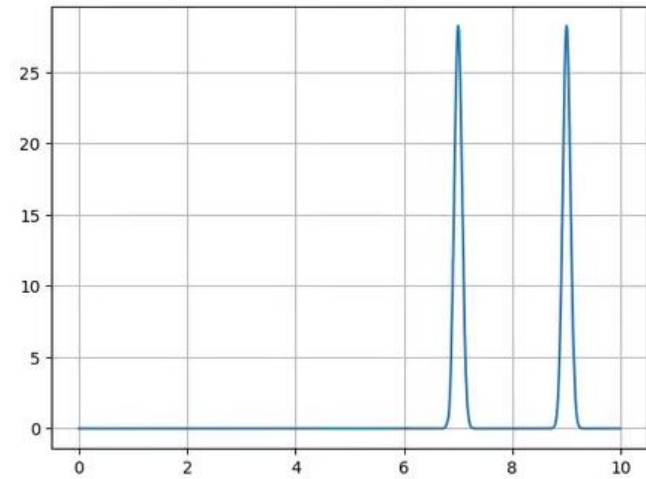
(no residual pressure.)

theoretical:



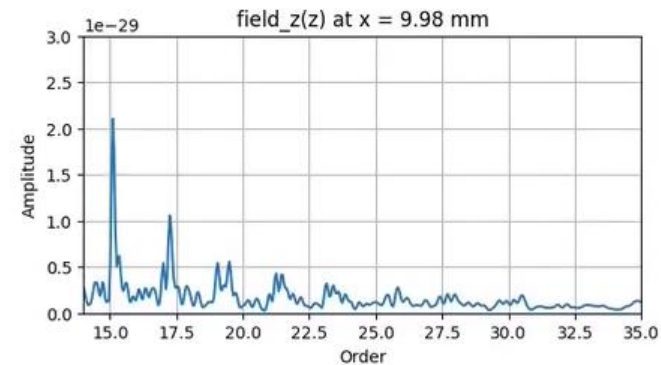
same gas configuration  
different medium length  
Different result  
then which one should i trust?

10mm length  
2mm separation

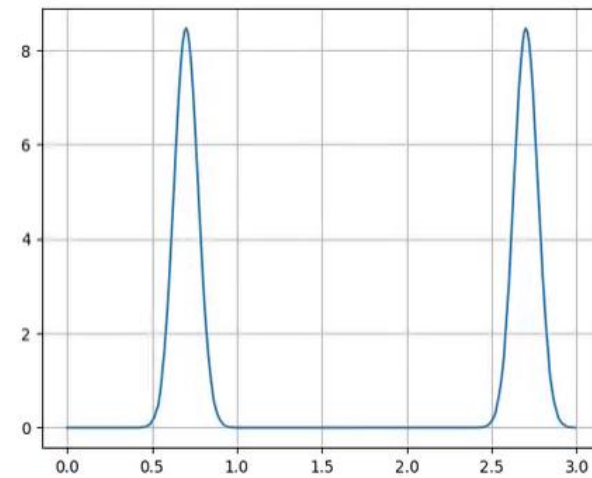


```
# print(len(zgrid)) ...
```

x 998

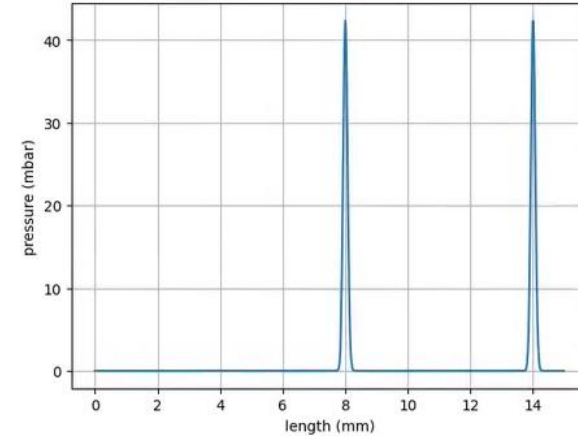
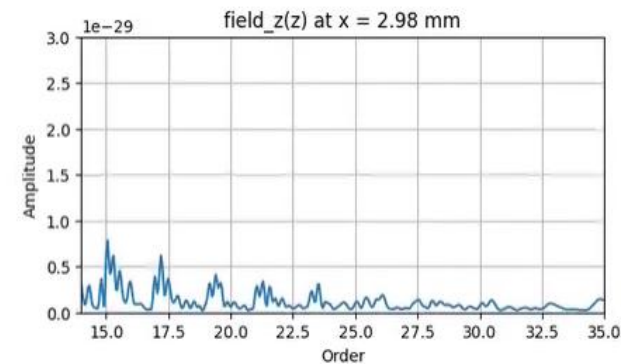


3mm length  
2mm sepa



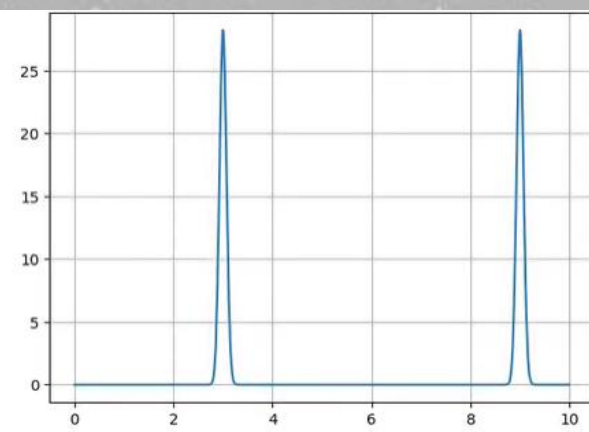
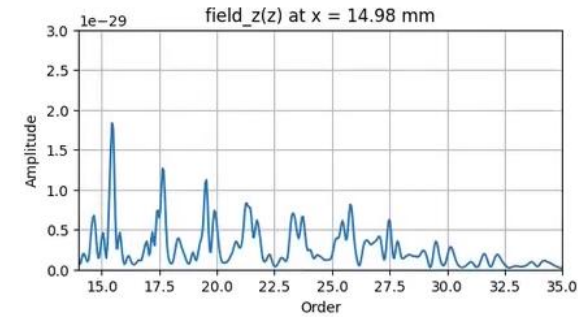
```
# print(len(zgrid)) ...
```

x 298



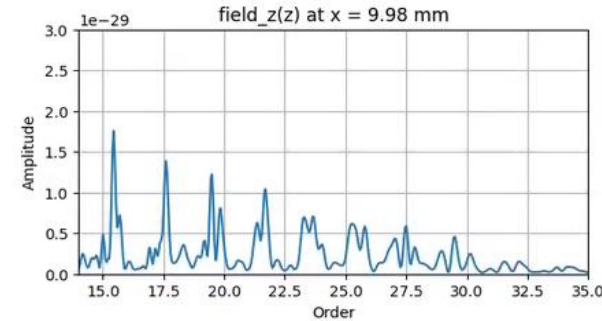
```
# print(len(zgrid)) ...
```

x 1498



```
# print(len(zgrid)) ...
```

x 998

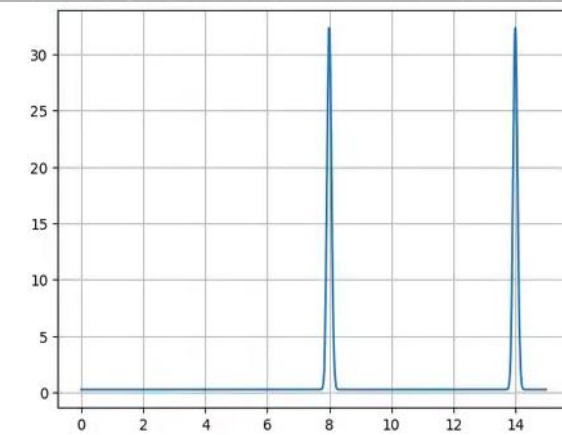
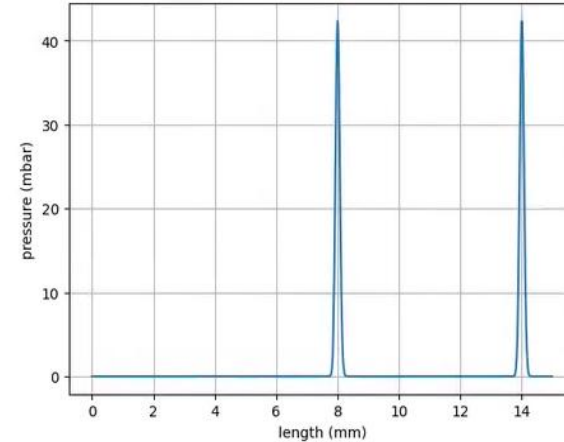
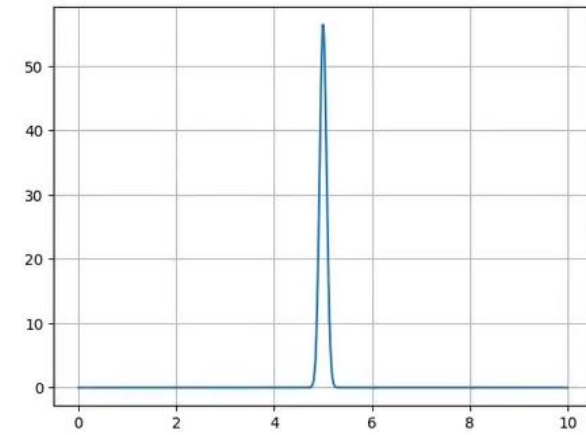
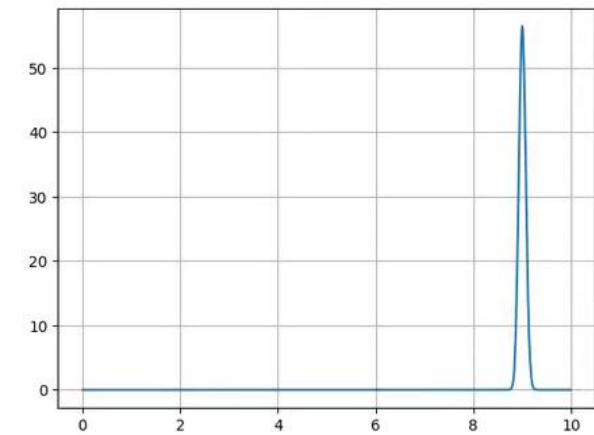


15mm length  
6mm sepa

10mm length  
6mm sepa

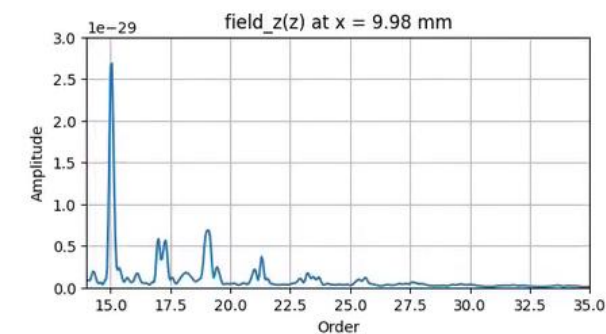
only average p differs?





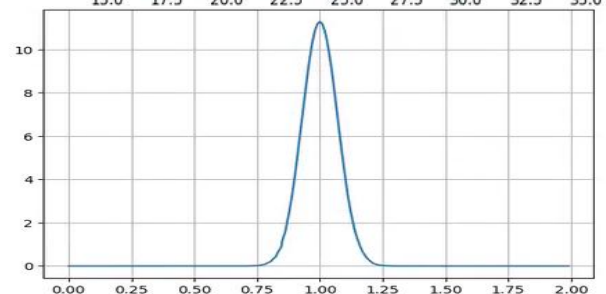
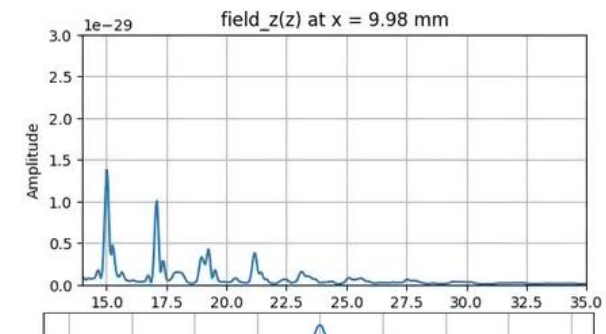
```
# print(len(zgrid)) ***
```

x 
998



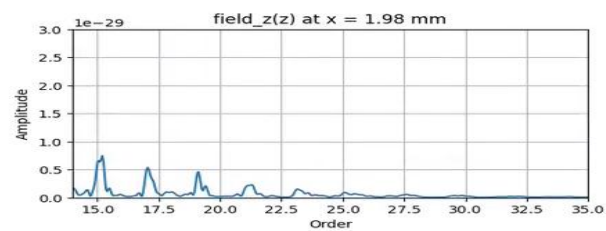
```
# print(len(zgrid)) ***
```

x 
998



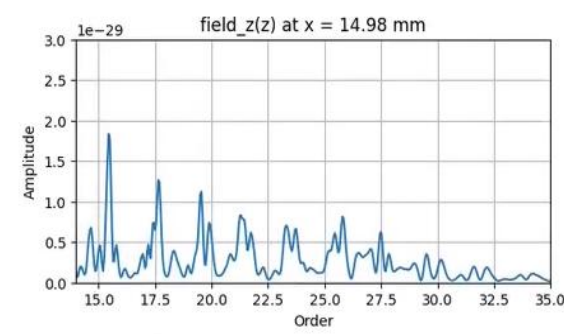
```
# print(len(zgrid)) ***
```

x 
198



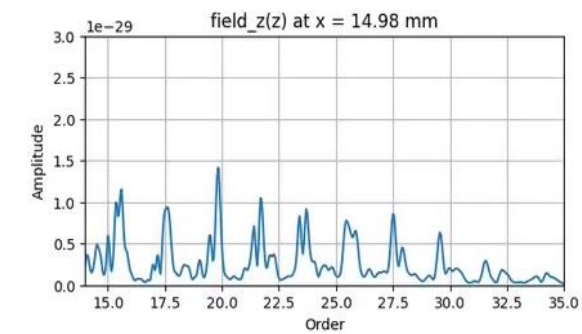
```
# print(len(zgrid)) ***
```

x 
1498



```
# print(len(zgrid)) ***
```

x 
1498



right focus

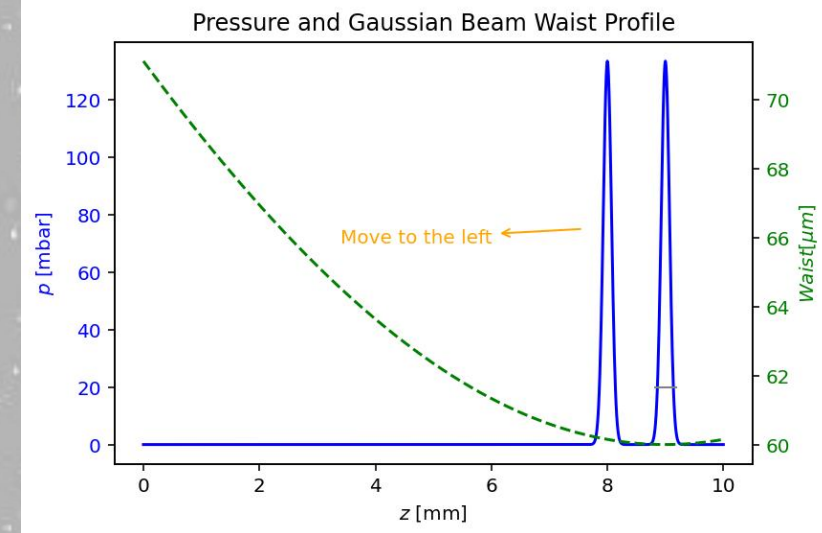
middle focus

15mm,sepa6  
without residual

15mm,sepa6  
with residual

# Questions

- which part not handel well? why residual?
- TDSE:  $Nr_{\text{max}}=200$ ,  $rstep=10$  Reasonable?
- Cutoff~70+ , Hankel 30+ ? Normal?
- e.g 3mm , 10mm, same gas configuration, different Hankel? Make sense?
- Hrange[14,60] takes 30mins , I tried [1,45], more than 20h? is it divergent or ?
- does the Hankel T consider the absorbtion in the second gas jet?
- what do you think the serveral side peaks in one big peak are? error or real?





thanks bye.

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