# Kinetic Modifications to the Threat Spectra on IFE Reactor First Walls

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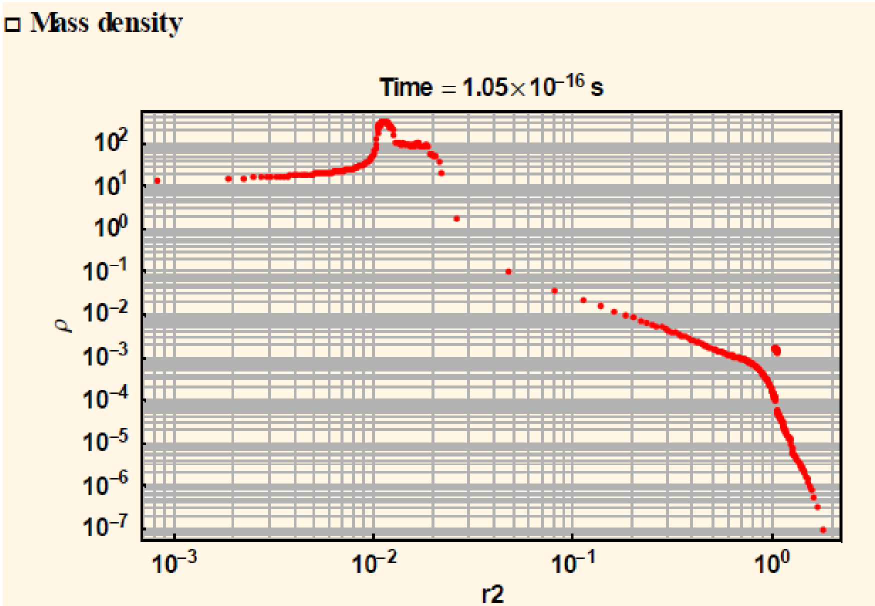
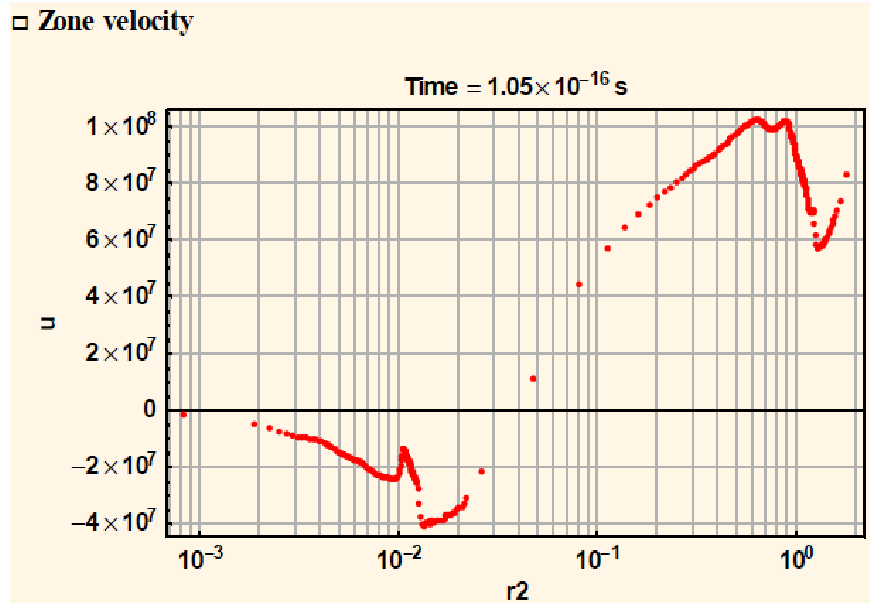
# We use a simple lagrangian hydro model of the HAPL plasma expansion to test long mean free path models




- Model (pure hydrodynamics) equations:
  1) $\partial u/\partial t + \partial p/\partial m = 0$
  2) $\partial e/\partial t + p(\partial V/\partial t) = 0$

- Solved by finite differences

- Initial conditions shown above

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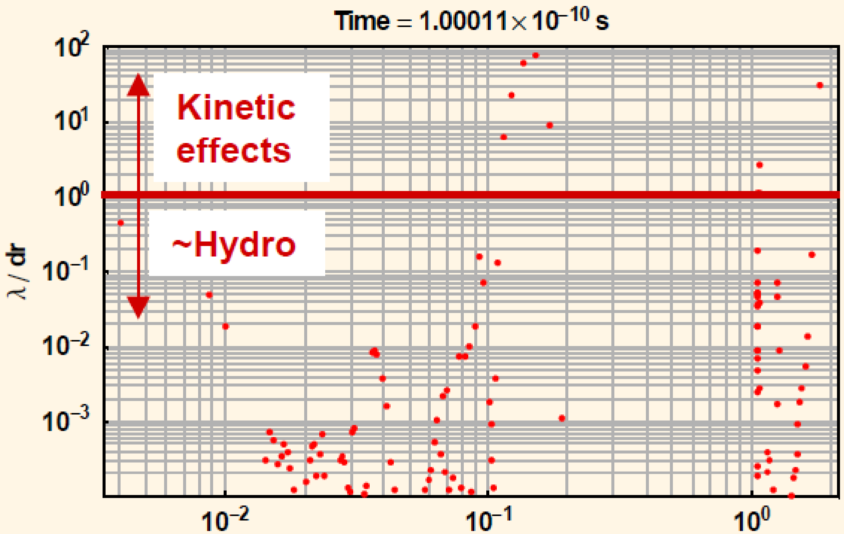
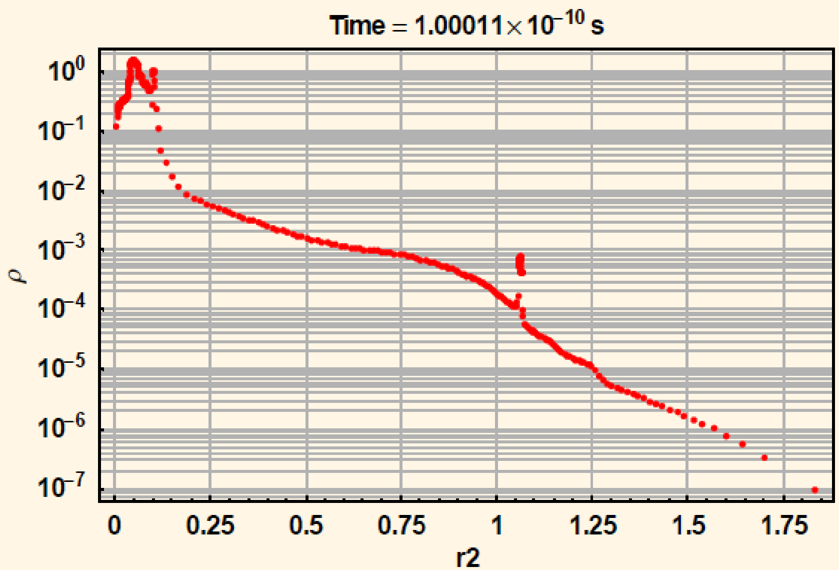
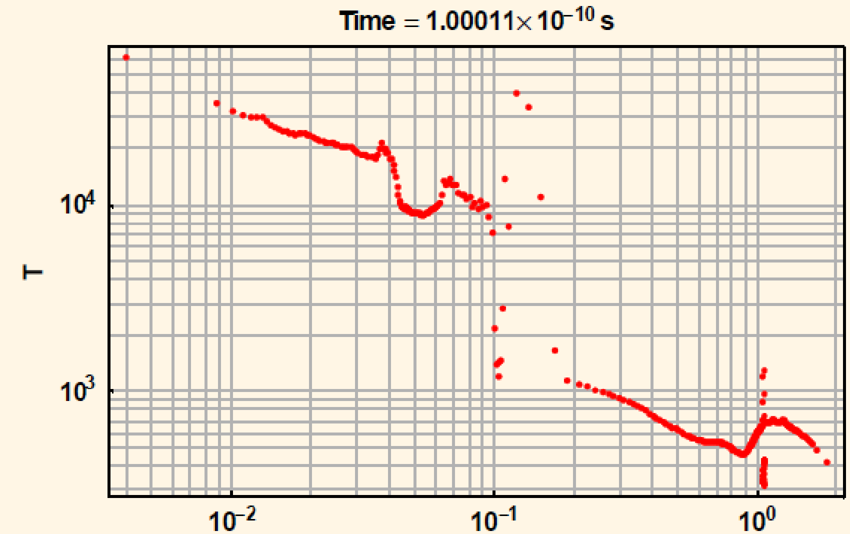
# Simple lagrangian model indicates that kinetic effects are important for HAPL plasmas

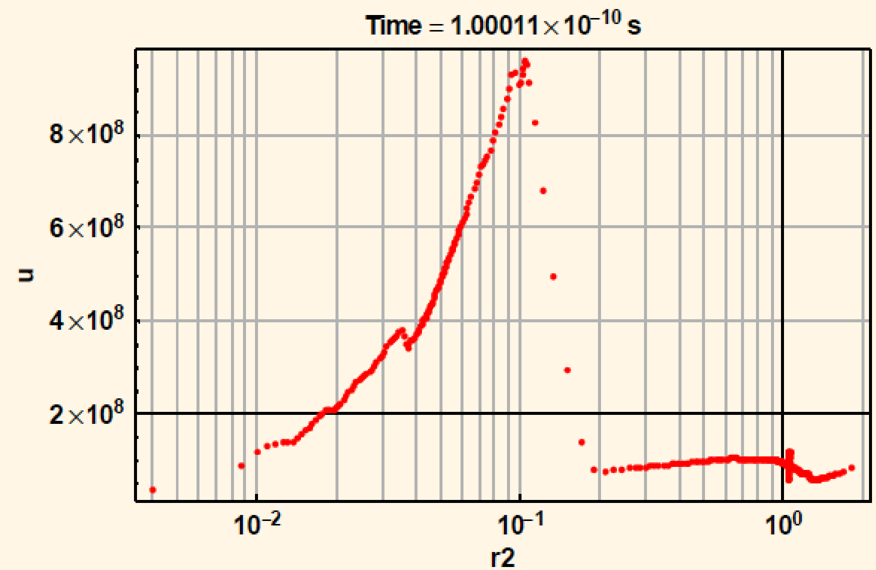
- Mean free path / zone thickness




- Temperature



# Zone overlap will be modeled by conserving zone momenta when adjusting radii

## ◻ Equations

*In[132]:=*

$$\text{eqp1} = m_1 u_1 == m_1 v_1 + \delta p;$$

*In[133]:=*

$$\text{eqp2} = m_2 u_2 == m_2 v_2 - \delta p;$$

*In[136]:=*

$$\text{eqs1} = z_1 == r_2 + v_1 \delta t;$$

$$\text{eqs2} = z_2 == r_1 + v_2 \delta t;$$

$$\text{eqs3} = z_3 == r_3 + v_1 \delta t;$$

$$\text{eqs4} = z_3 == r_2 + v_2 \delta t;$$

## ◻ Zone overlap resolution

*In[146]:=*

$$\text{eqp} = \frac{(s_2^3 - z_2^3)}{(z_4^3 - z_2^3)} m_1 v_1 == \frac{(z_3^3 - s_2^3)}{(z_3^3 - z_1^3)} m_2 v_2;$$

*In[147]:=*

$$\text{sls2} = \text{Solve}[\text{eqp}, s_2];$$

*In[152]:=*

$$\text{sls2}[[1]]$$

*Out[226]=*

$$\frac{\left(m_1 v_1 z_2^3 \left(-z_1^3 + z_3^3\right) + m_2 v_2 z_3^3 \left(-z_2^3 + z_4^3\right)\right)^{1/3}}{\left(m_1 v_1 \left(-z_1^3 + z_3^3\right) + m_2 v_2 \left(-z_2^3 + z_4^3\right)\right)^{1/3}}$$

For a momentum change δp, the middle radius, s1, is chosen by equating the momentum shifted when resolving the overlap.