An Ultrashort Source of Fusion Neutrons

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The “Pisa theory” group

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Prof. Fulvio Cornolti
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Ion acceleration for circular polarization

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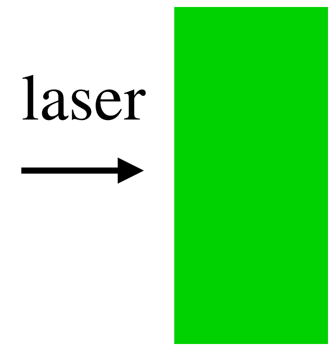
Idea: producing a laser-solid interaction *without* fast electrons



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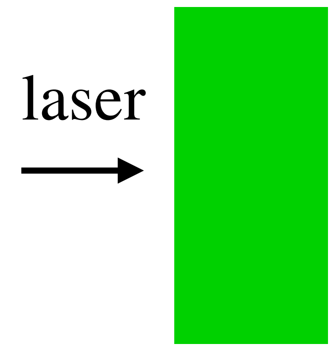

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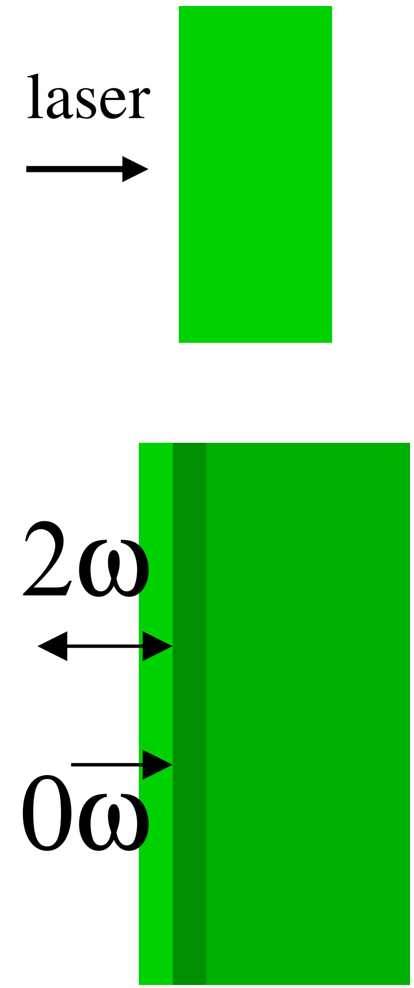

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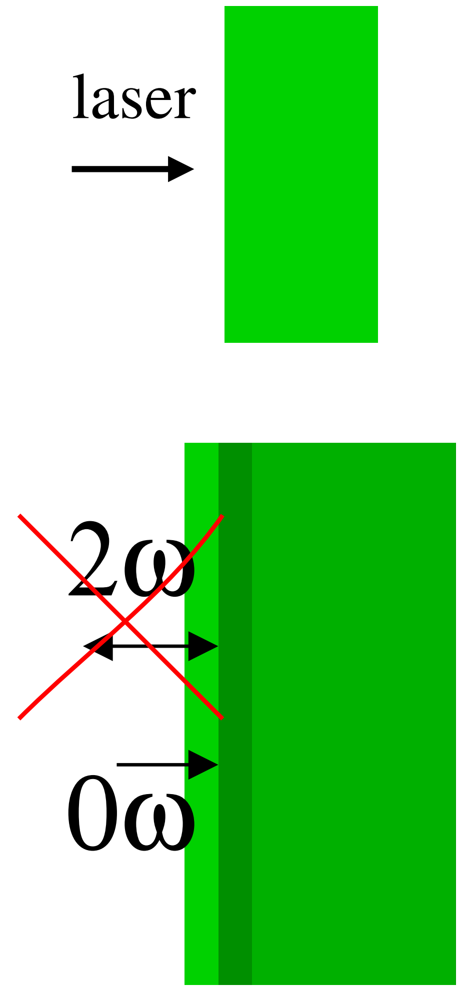

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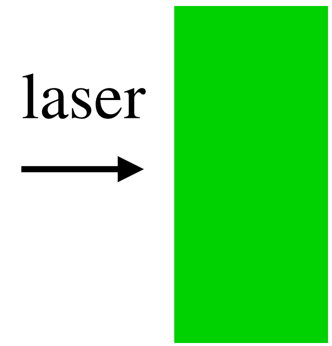

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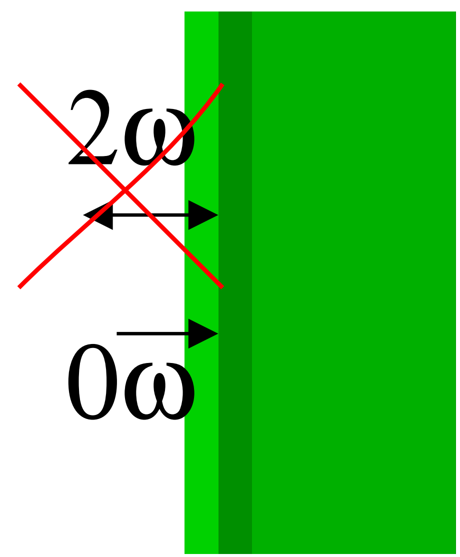
$\Rightarrow$ Ion acceleration is driven directly by the "$0\omega_L$" ponderomotive force



Simulation of ion acceleration

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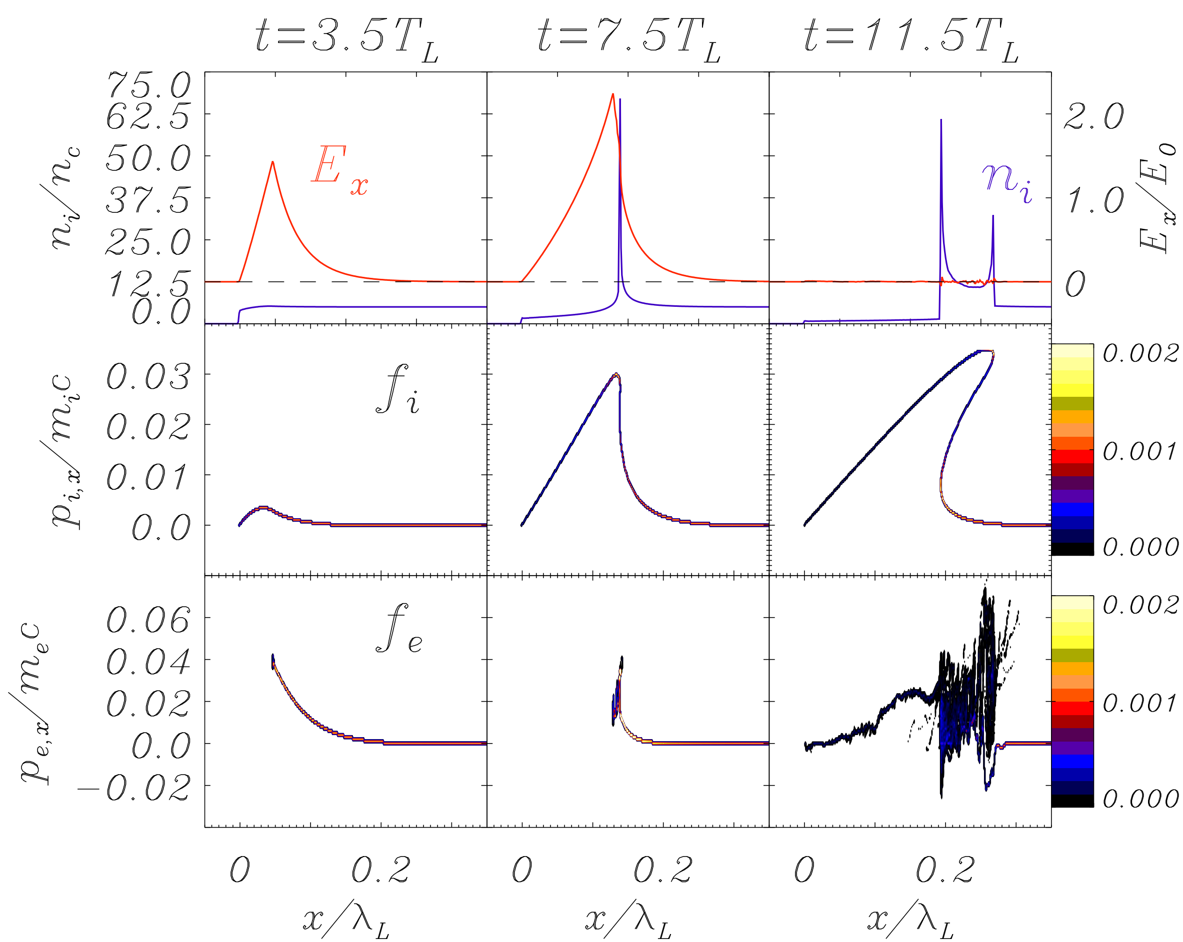
1D PIC simulation, circular polarization

$a = 2.0$, $n_{e0}/n_c = 5$



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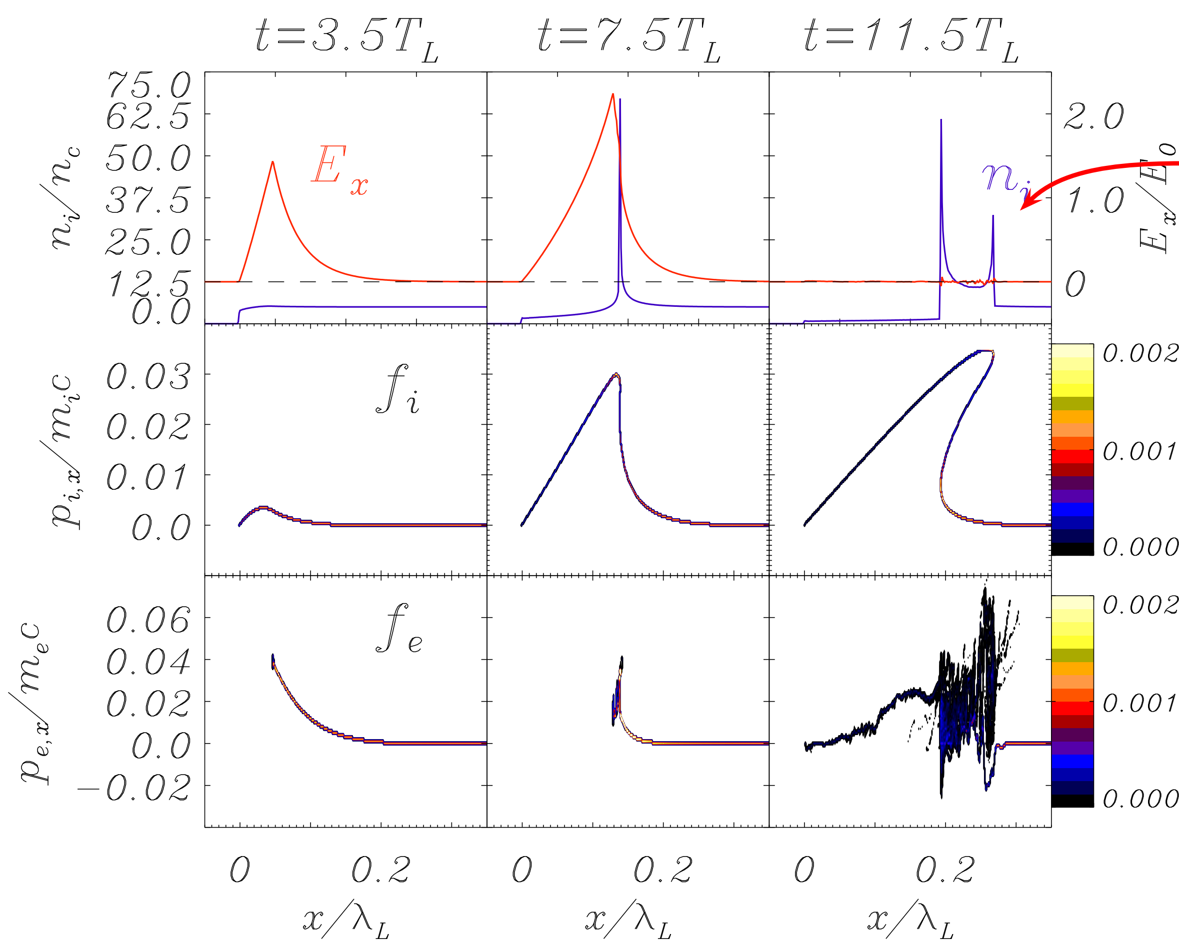

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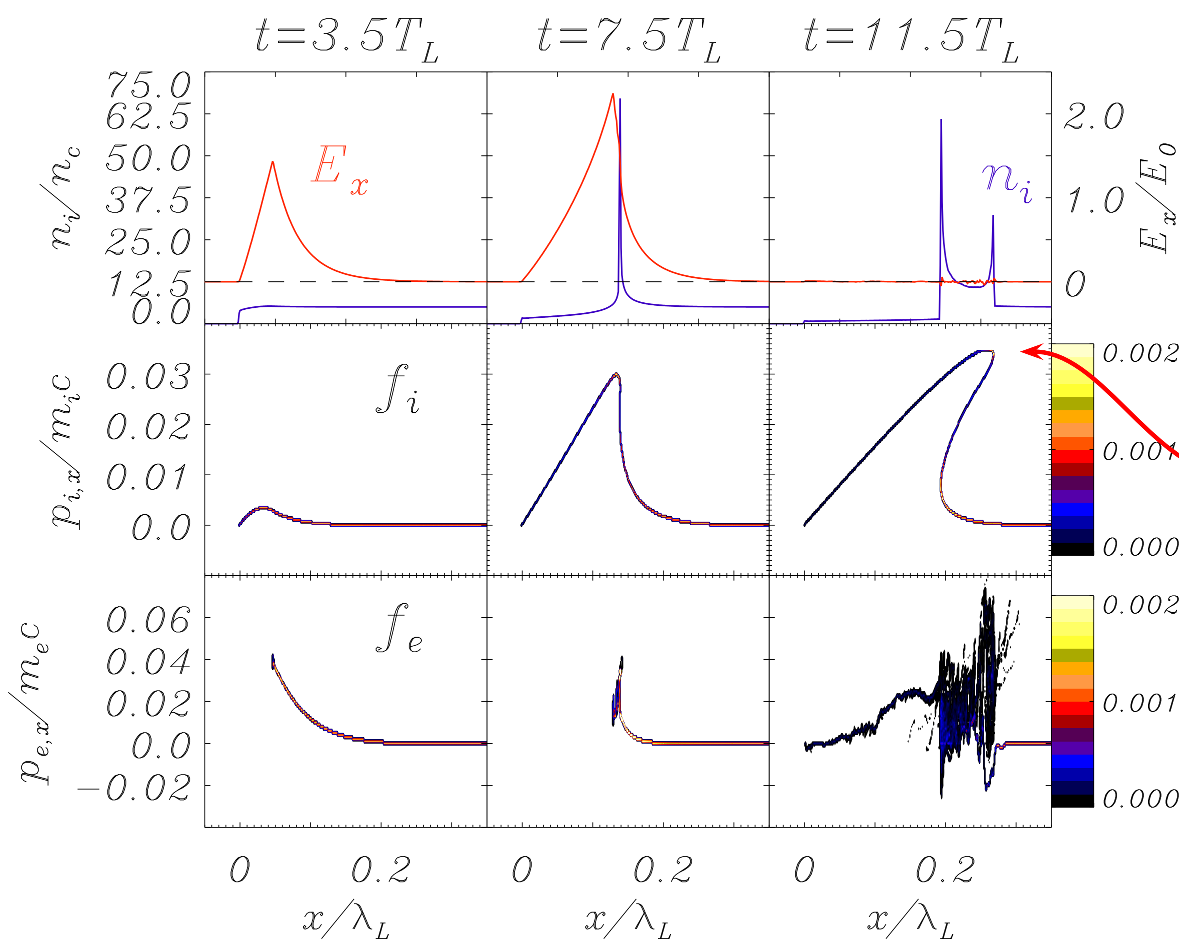

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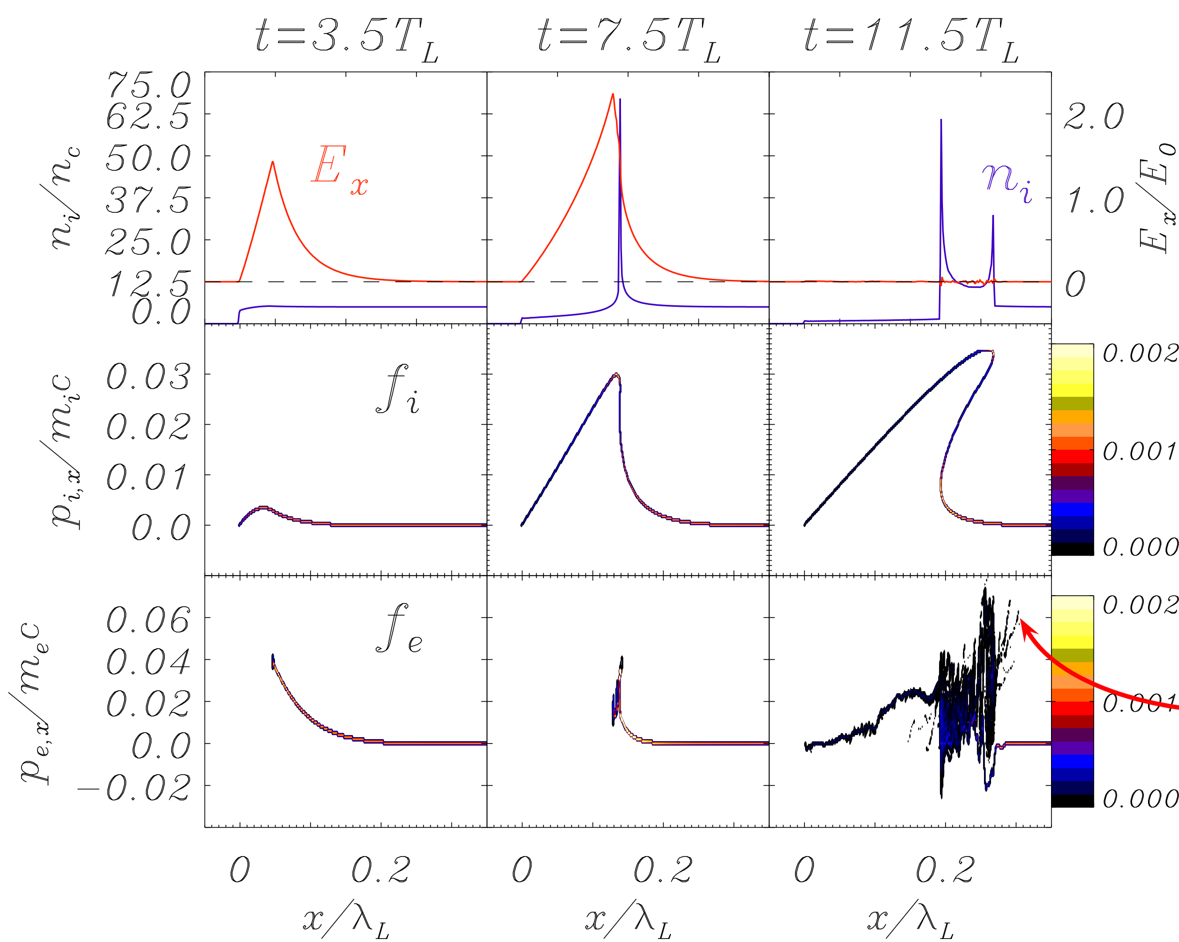

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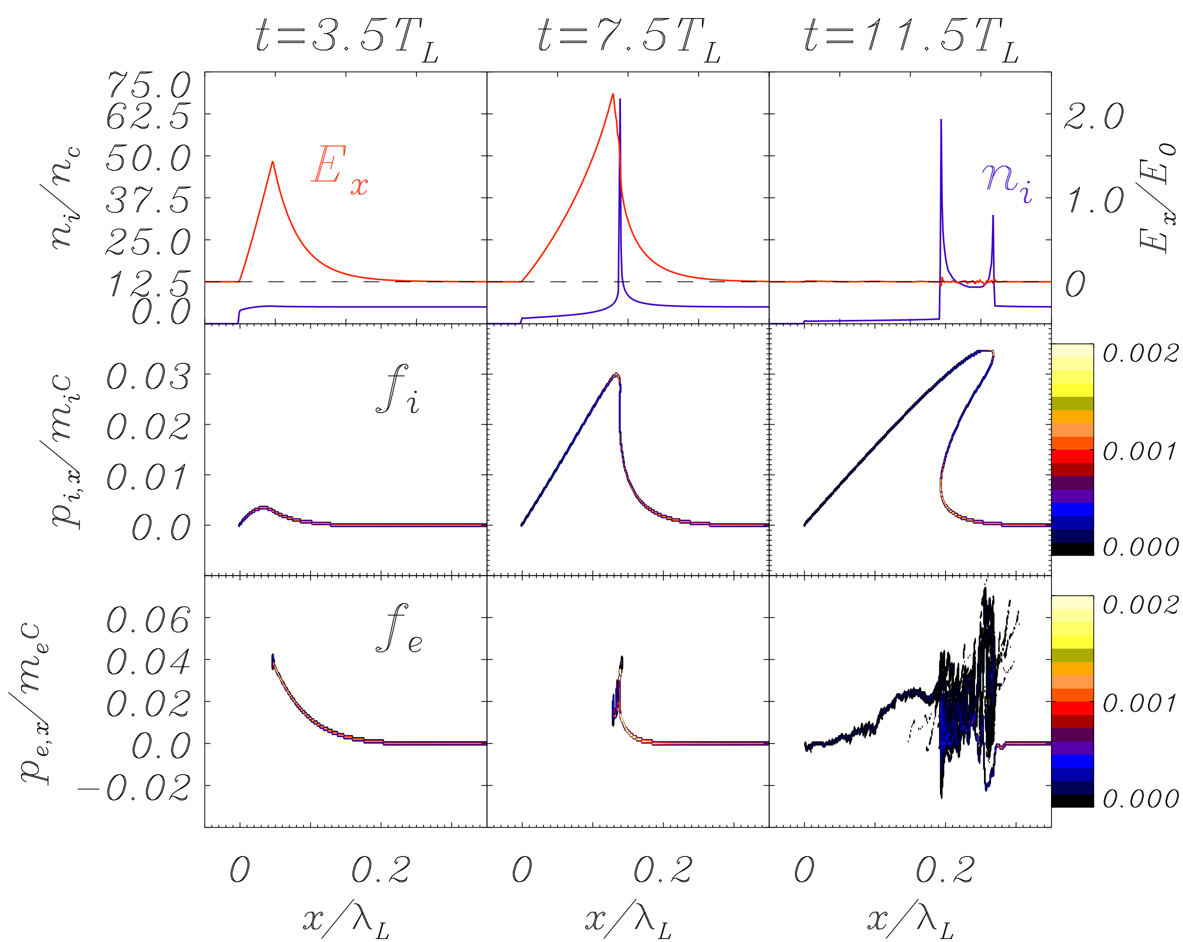

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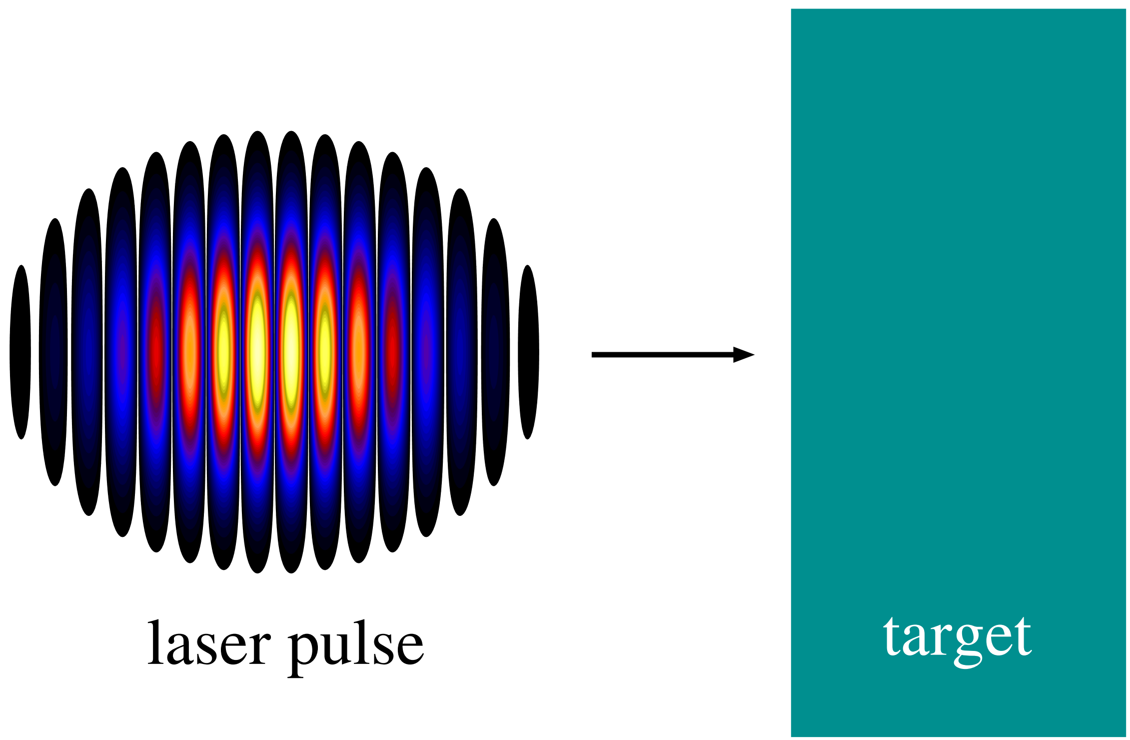

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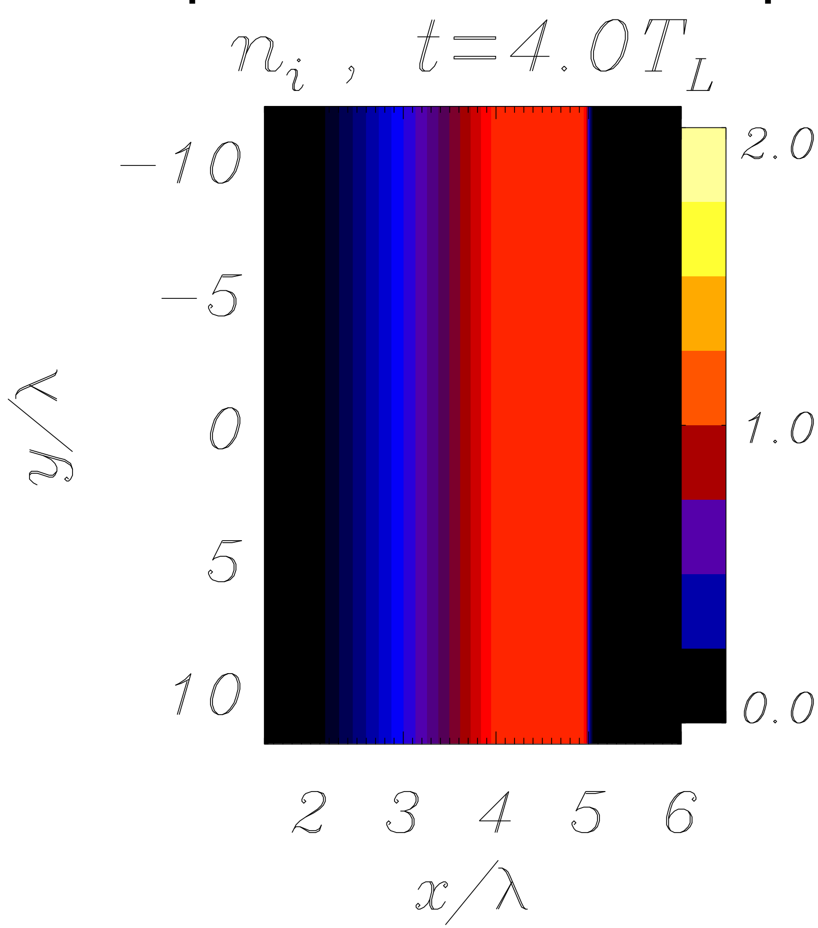

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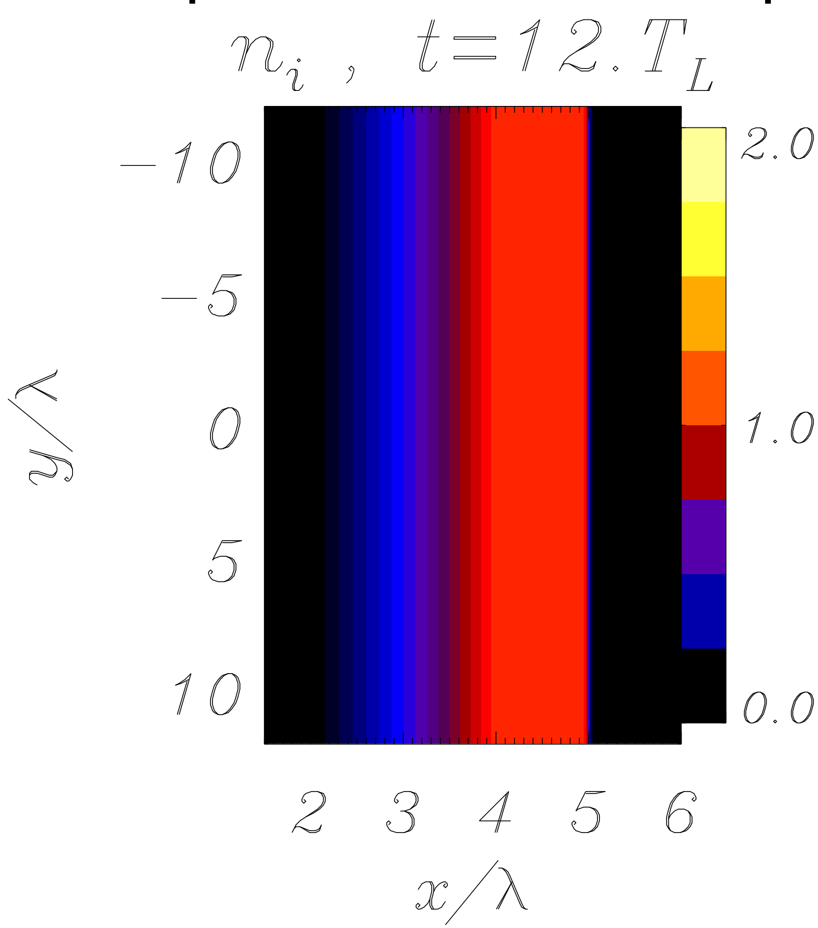

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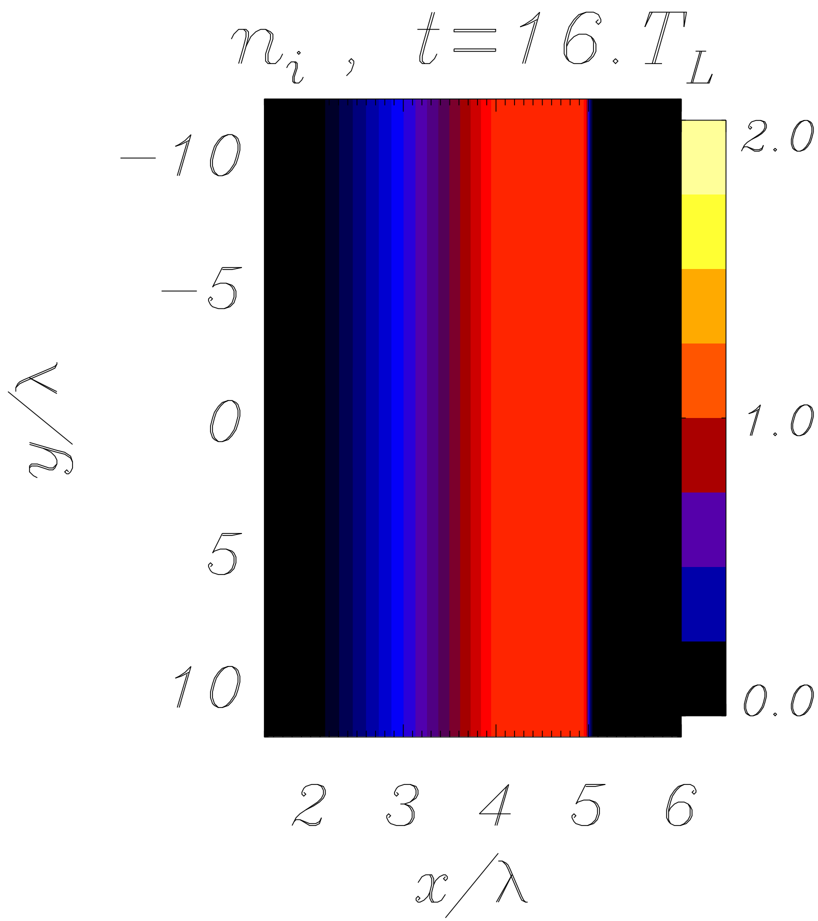

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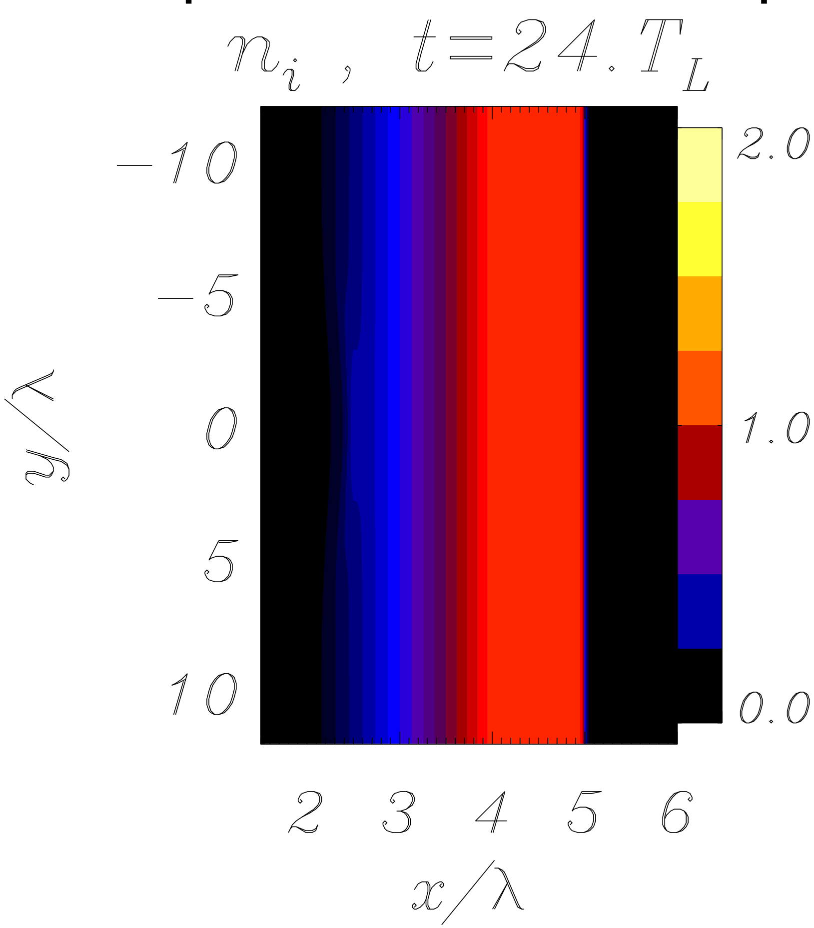

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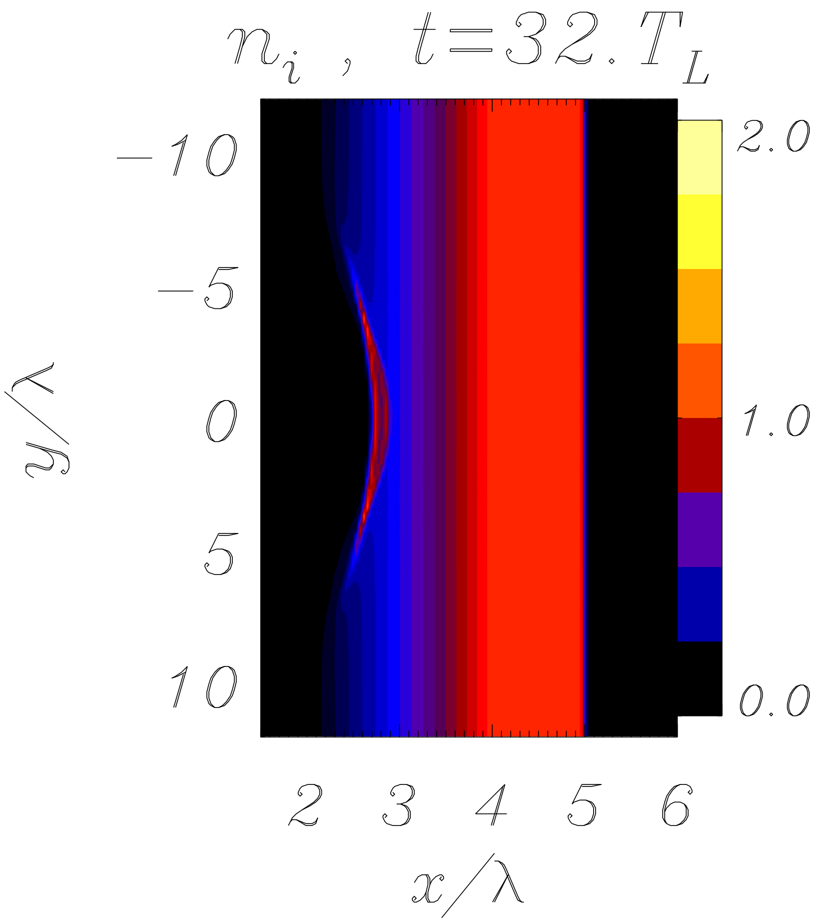

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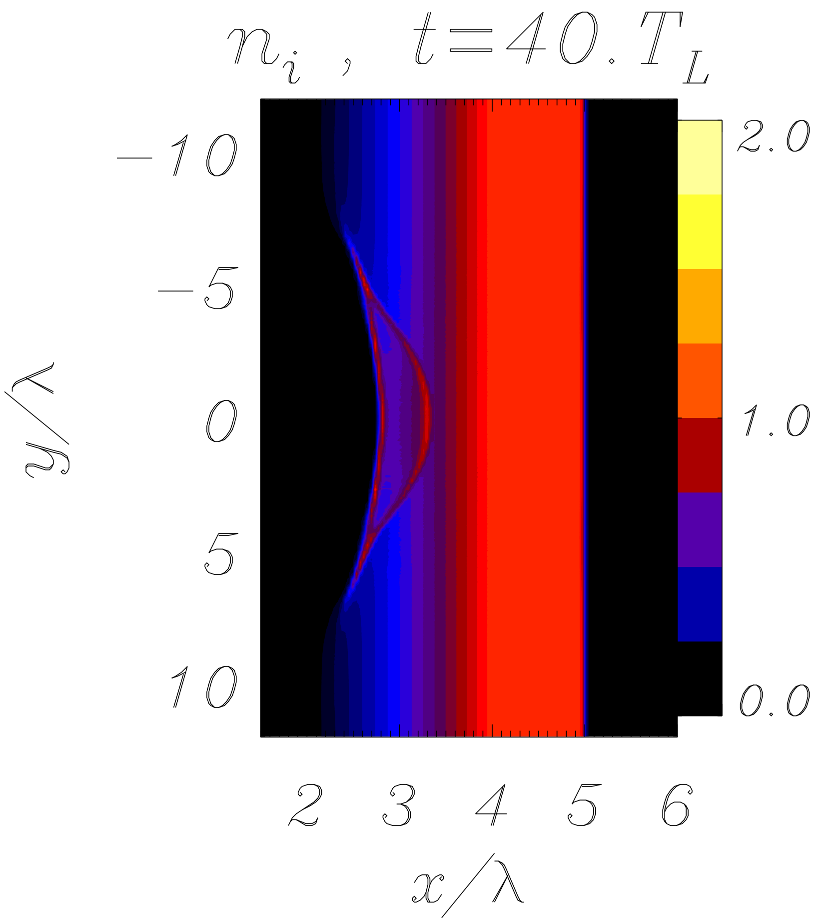

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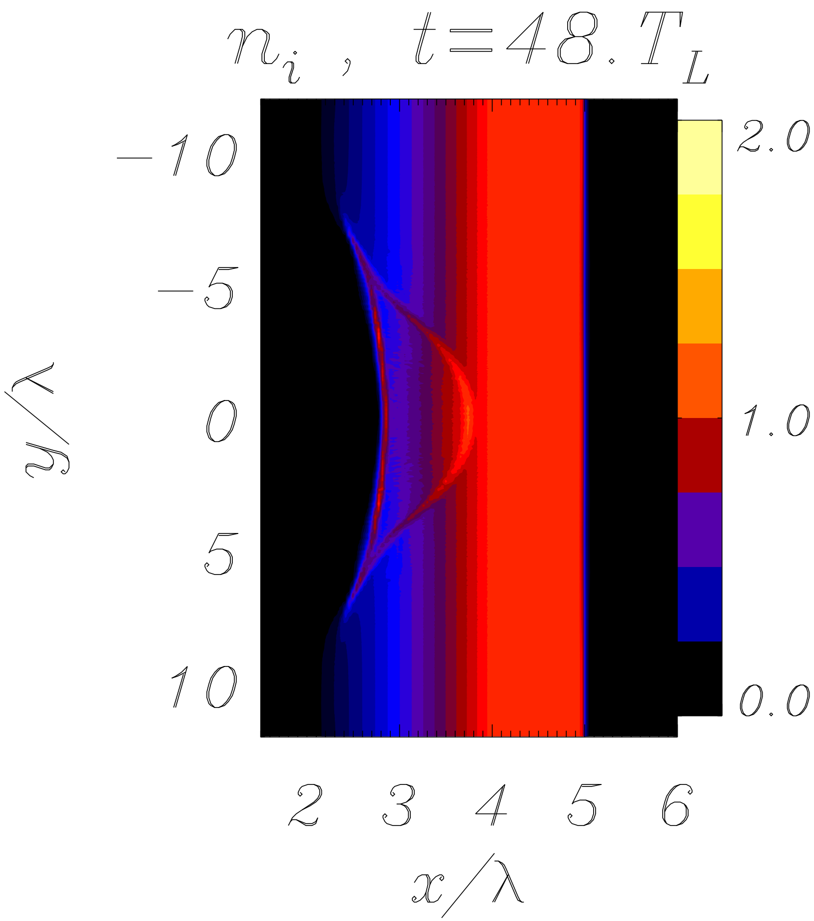

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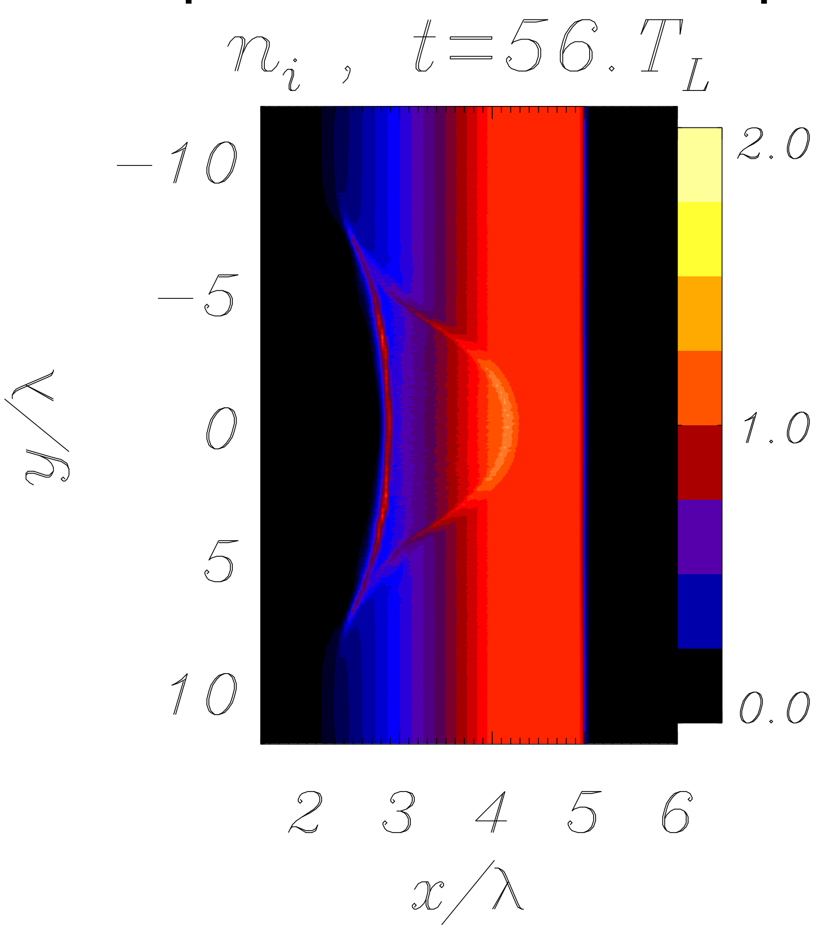

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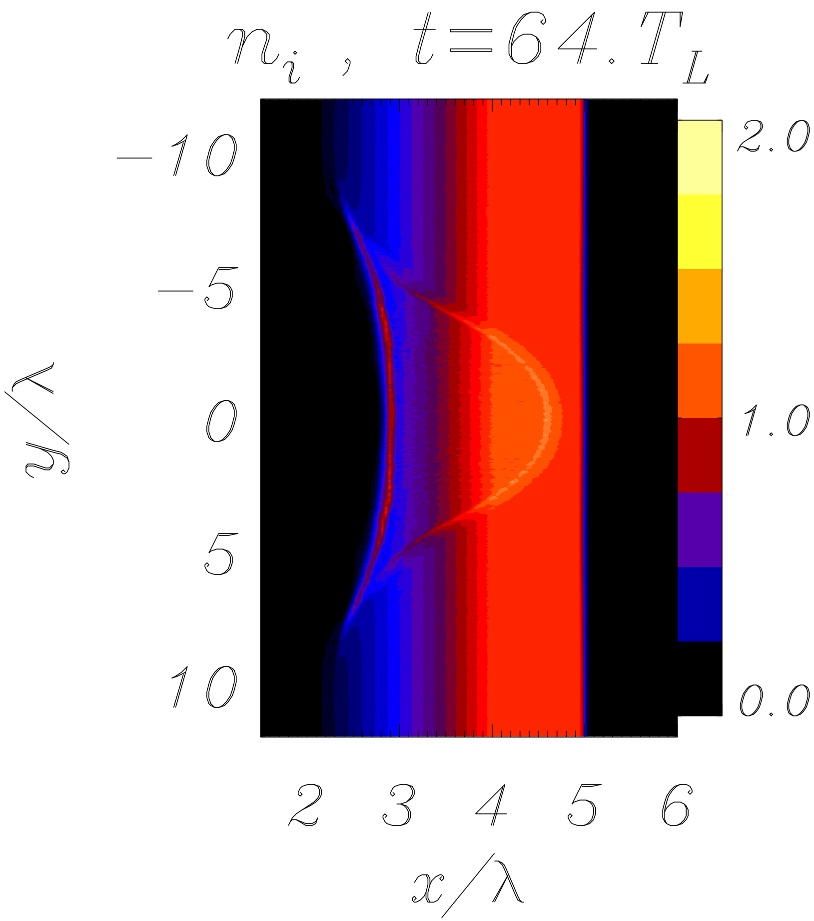

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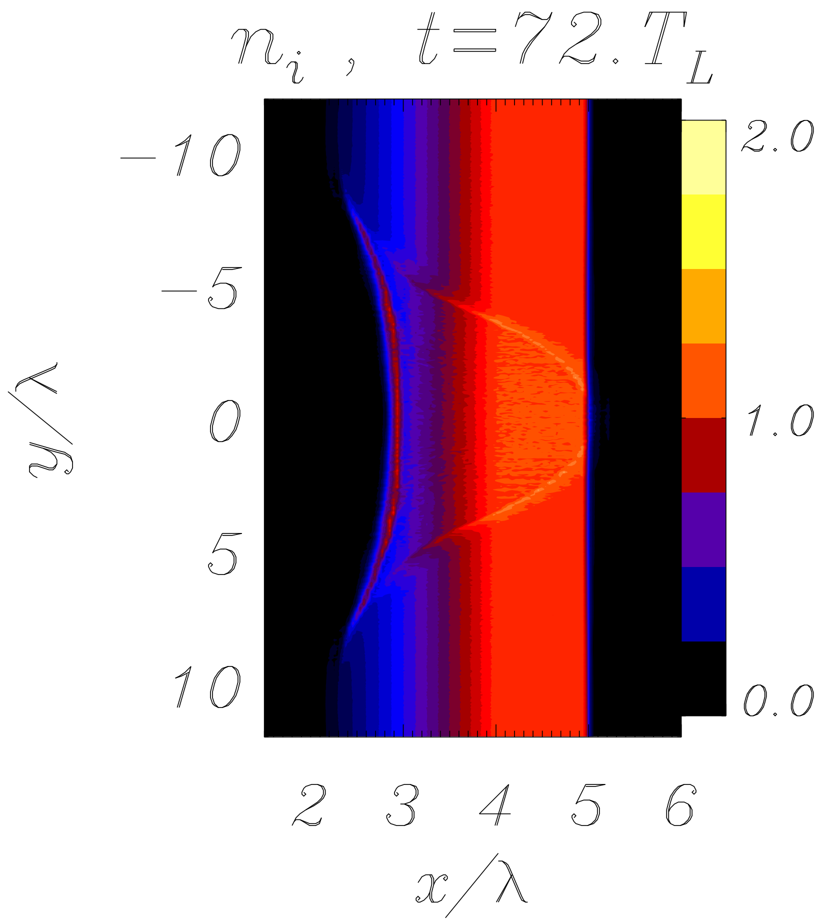

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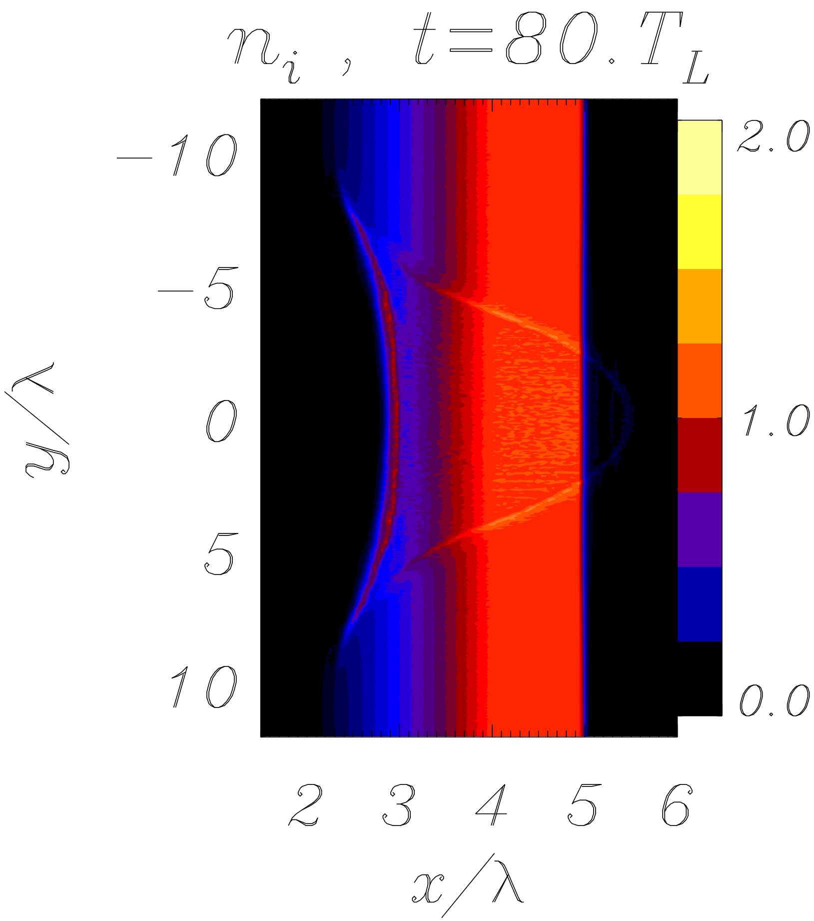

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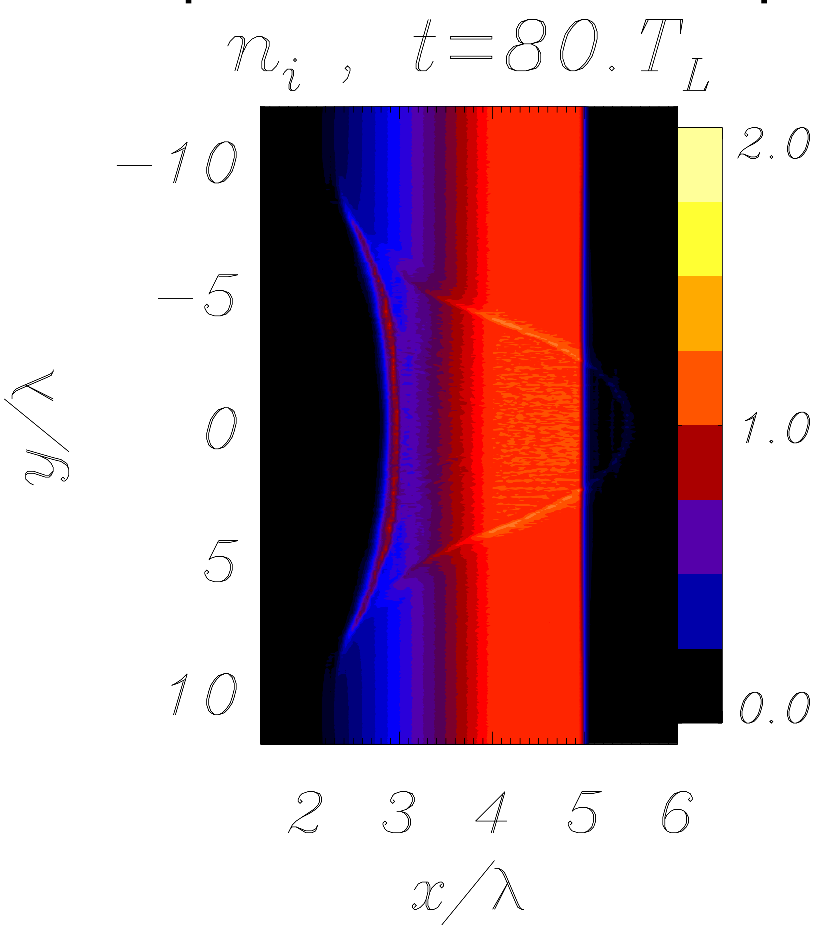

Simulation parameters ($a = 2$, $\tau = 10T_L$) and plasma profile are similar to an experiment at JAERI [Kado et al., Las. Part. Beams **24** (2006)] giving preliminar indications of a collimated ion beam without fast electrons (H. Daido, private communication).

Absorption efficiency: circular vs linear

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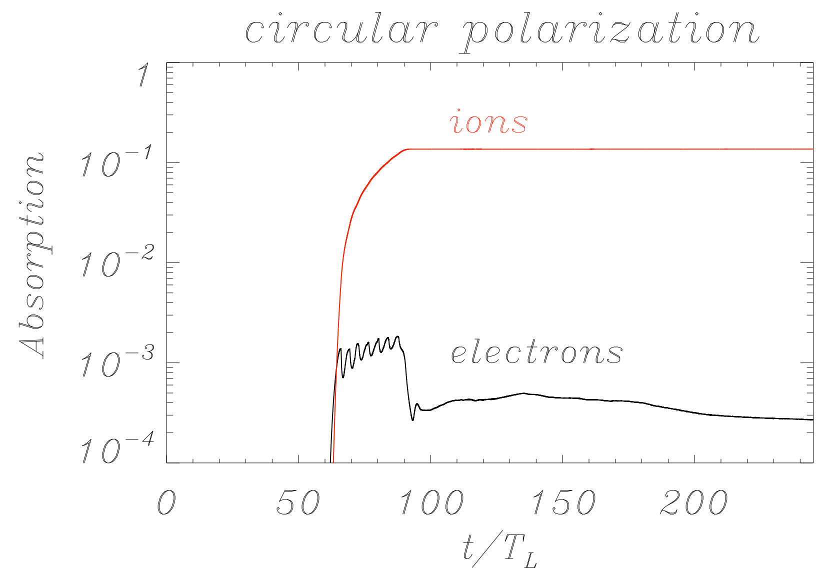

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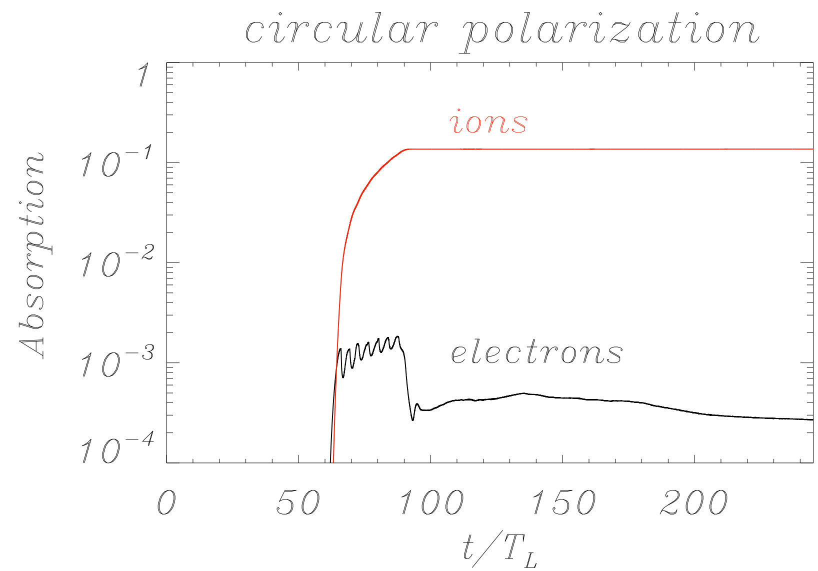

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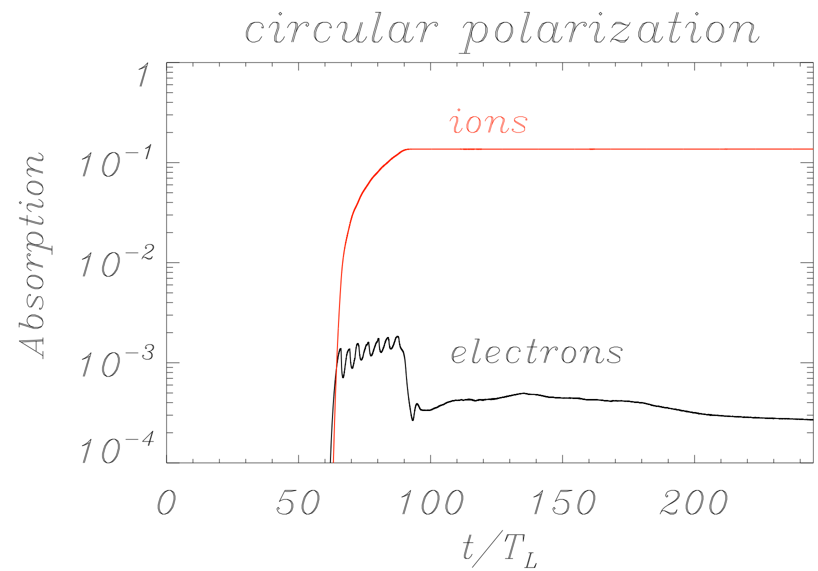

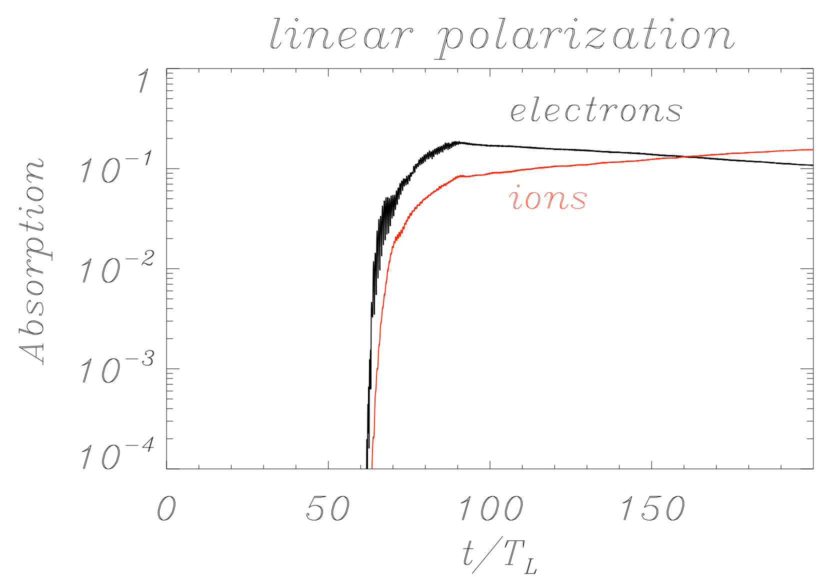

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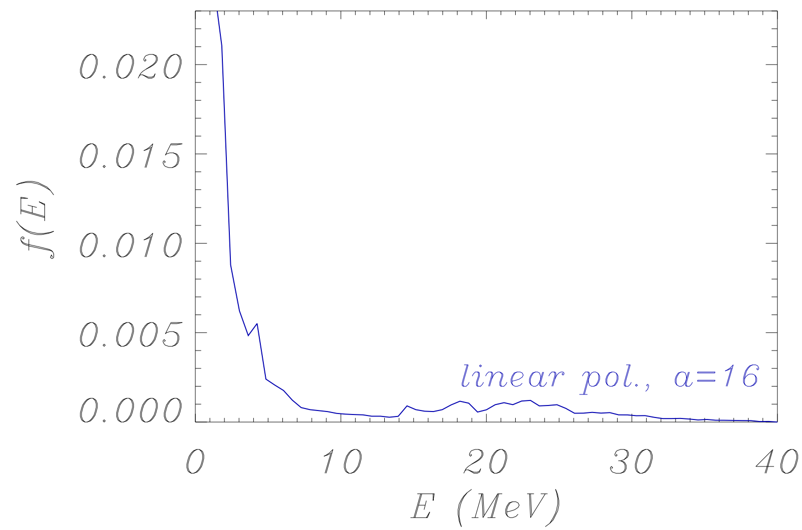

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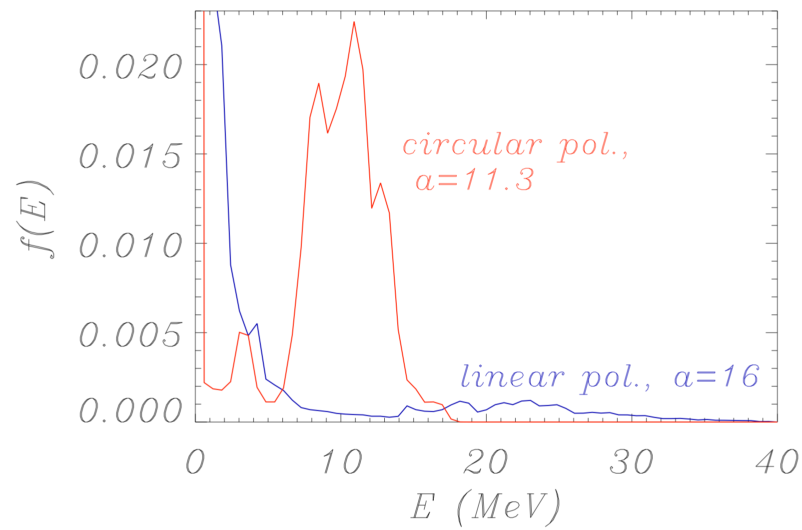

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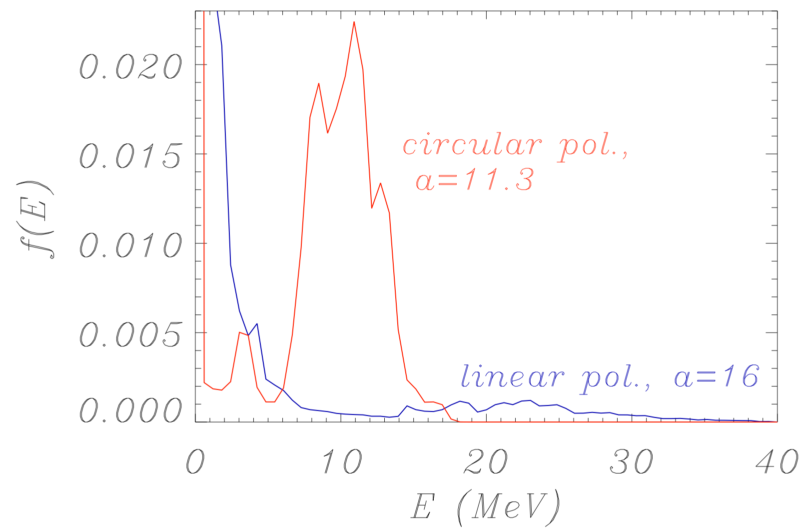

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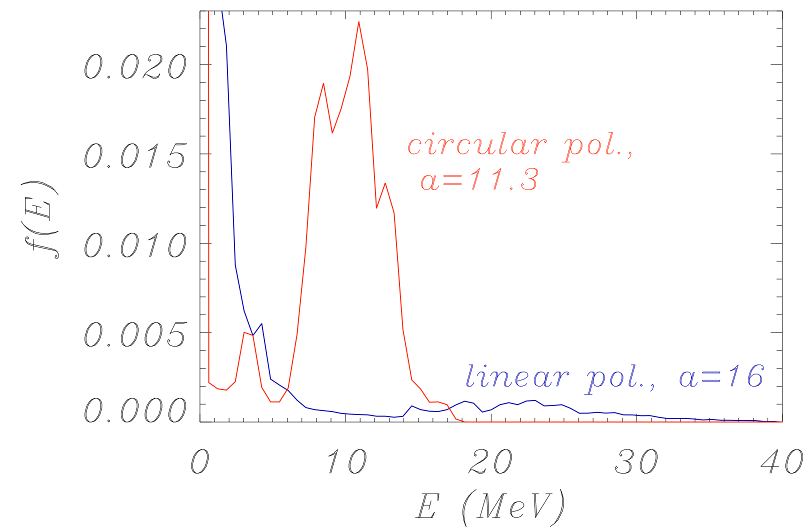

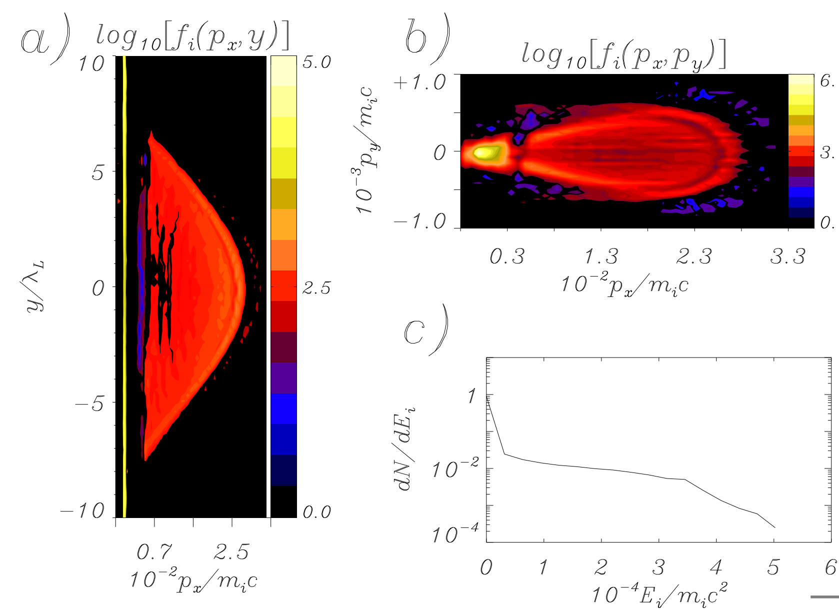

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Experimental investigation seems worth!

What about possible applications?

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$\Rightarrow$ One may obtain a significant neutron yield within the bunch duration ~ 1 fs .

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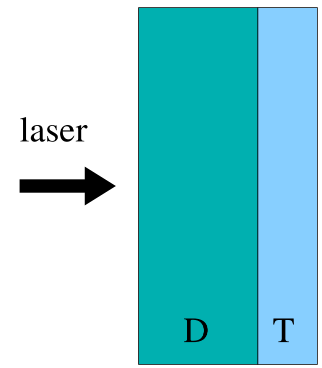
$\mathsf{D} + \mathsf{T} \rightarrow \alpha + \mathsf{n}\ (14\ \mathsf{MeV})$

Double layer target:



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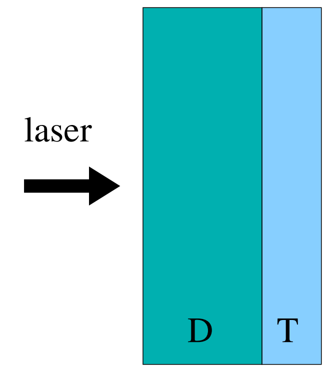

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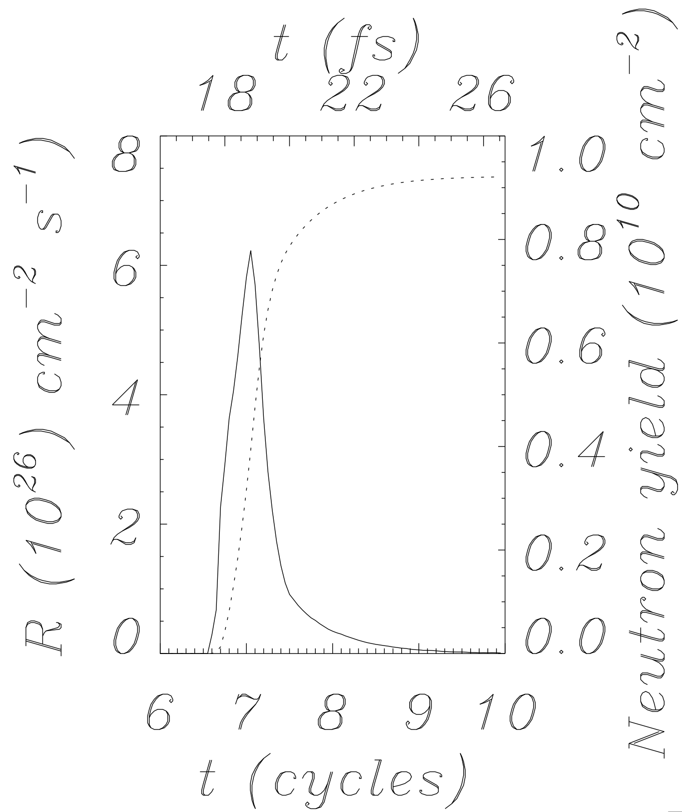
$> 10^6$ neutrons/Joule in $\tau_n \sim 2$ fs
at $I = 10^{19}$ W/cm^2, $\tau_L = 15$ fs



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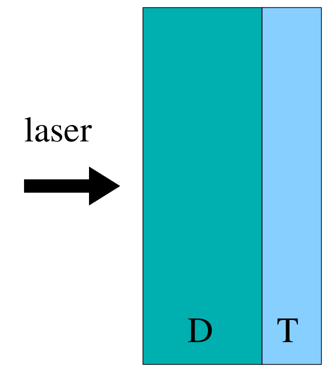

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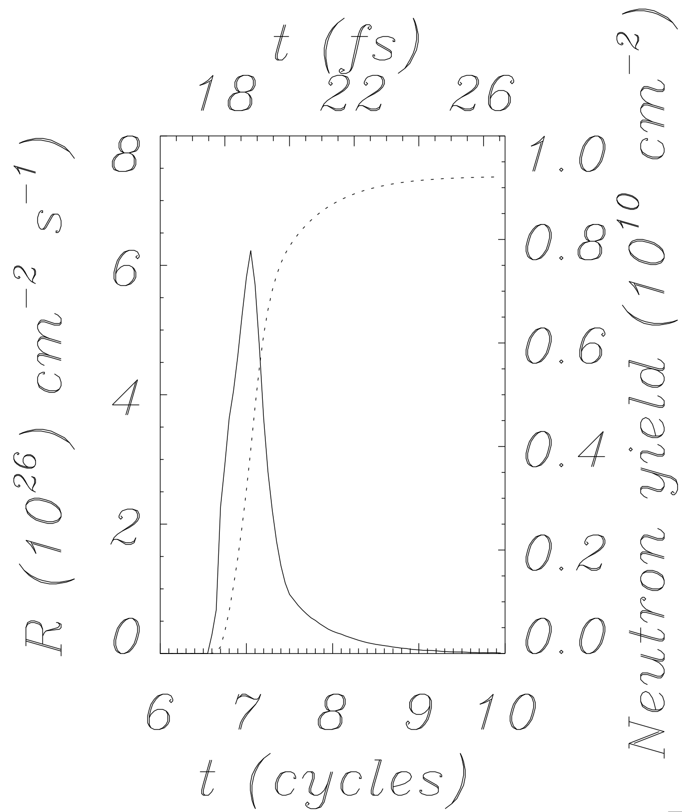
Analytical scaling predicts the maximum rate for intensities in the range $10^{20} \div 10^{21}$ W cm^{-2}



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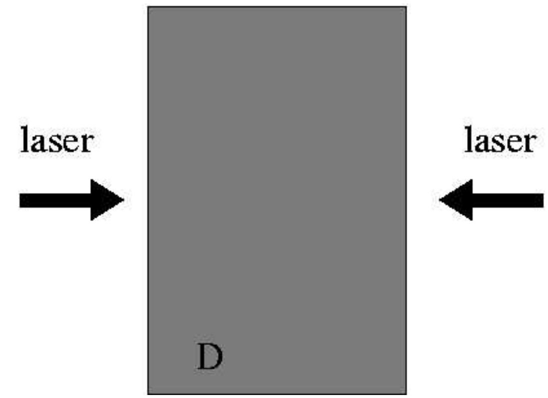

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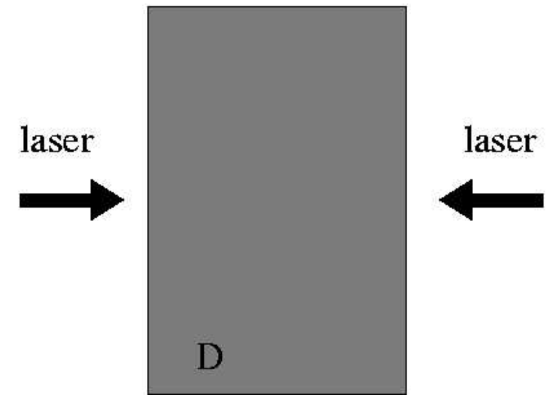

PIC simulation of
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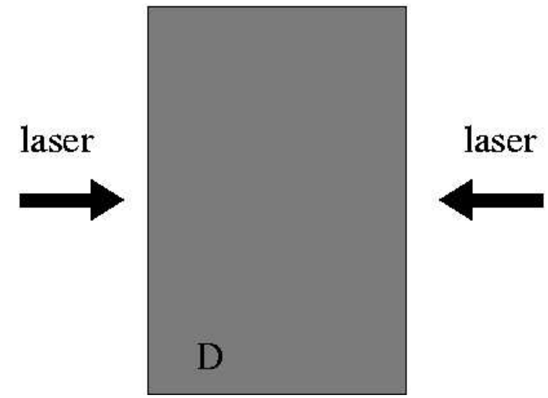

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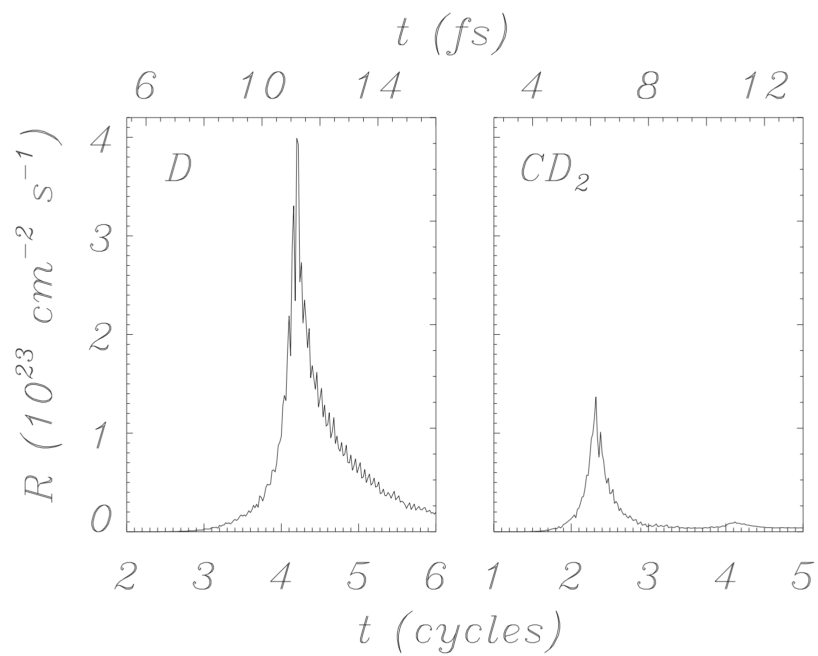

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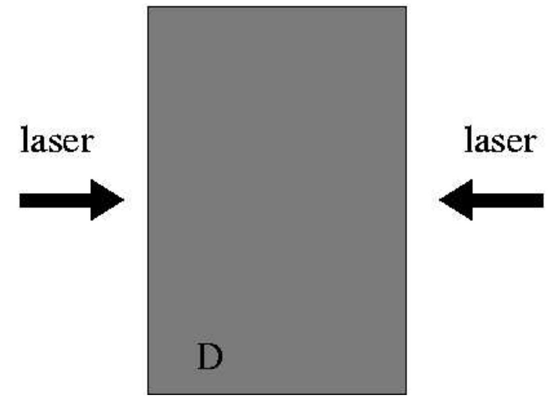

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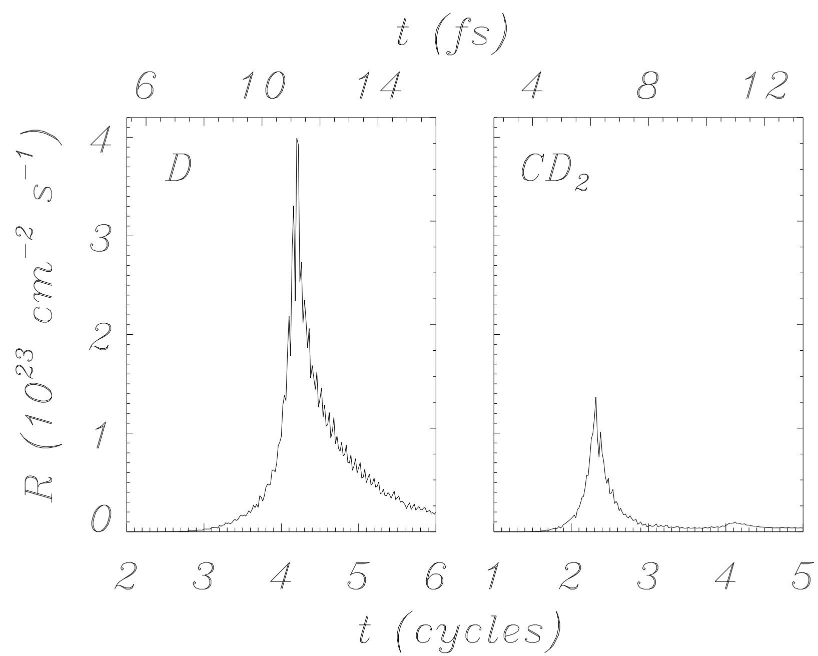

$\sim 10^2\ \text{J}^{-1}$ (CD_2) in $\simeq 0.7$ fs

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EXTRA SLIDES

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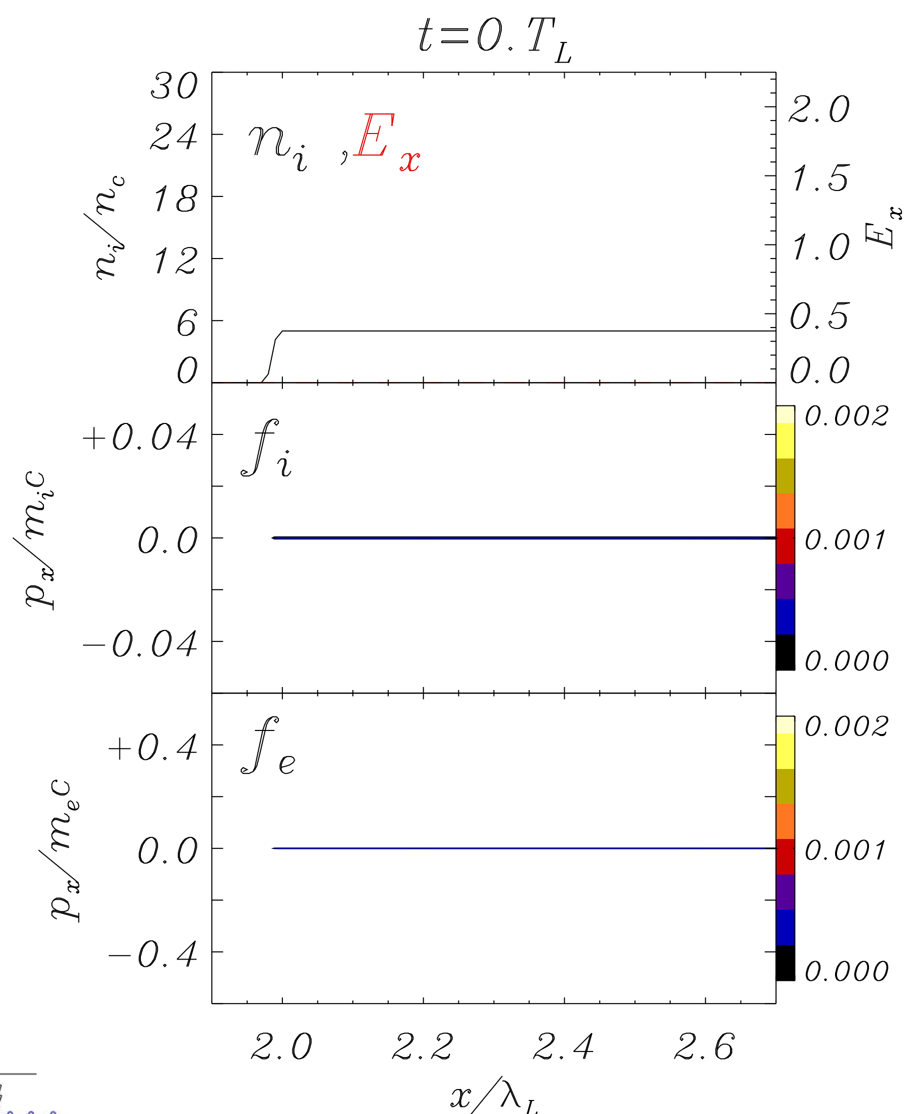

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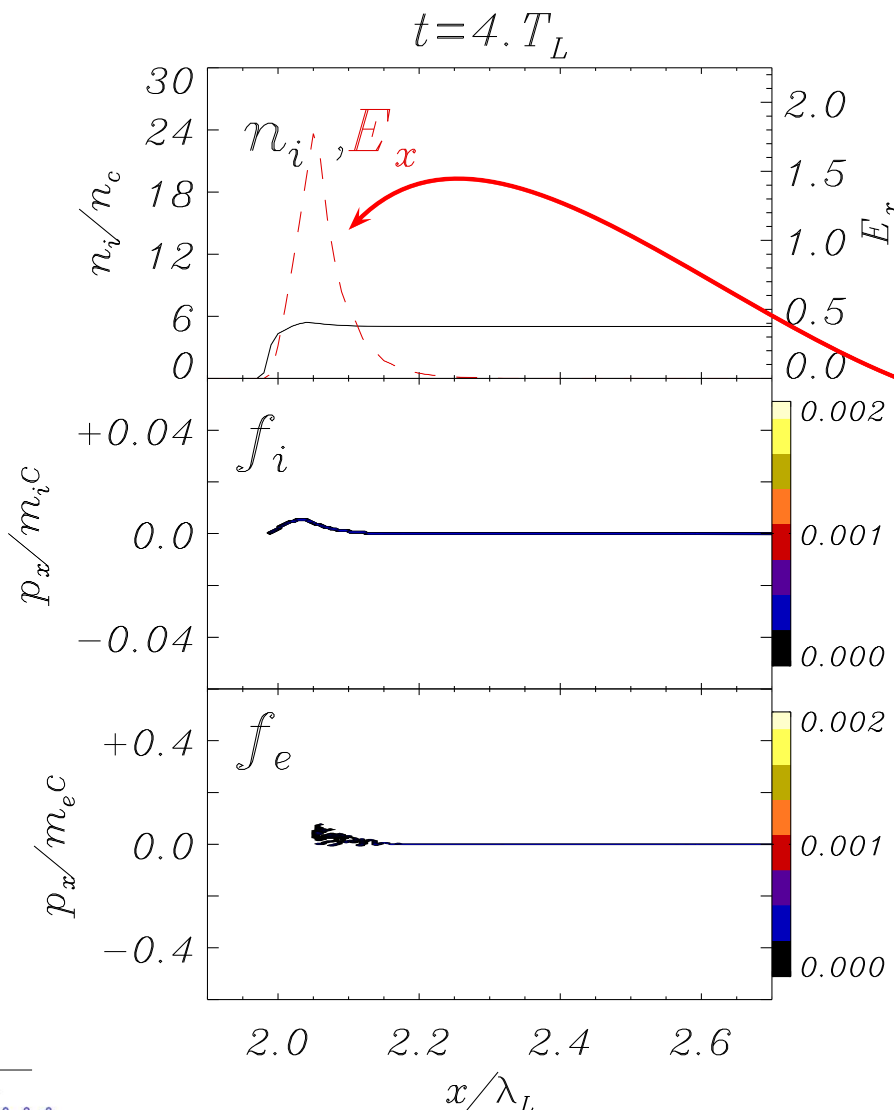

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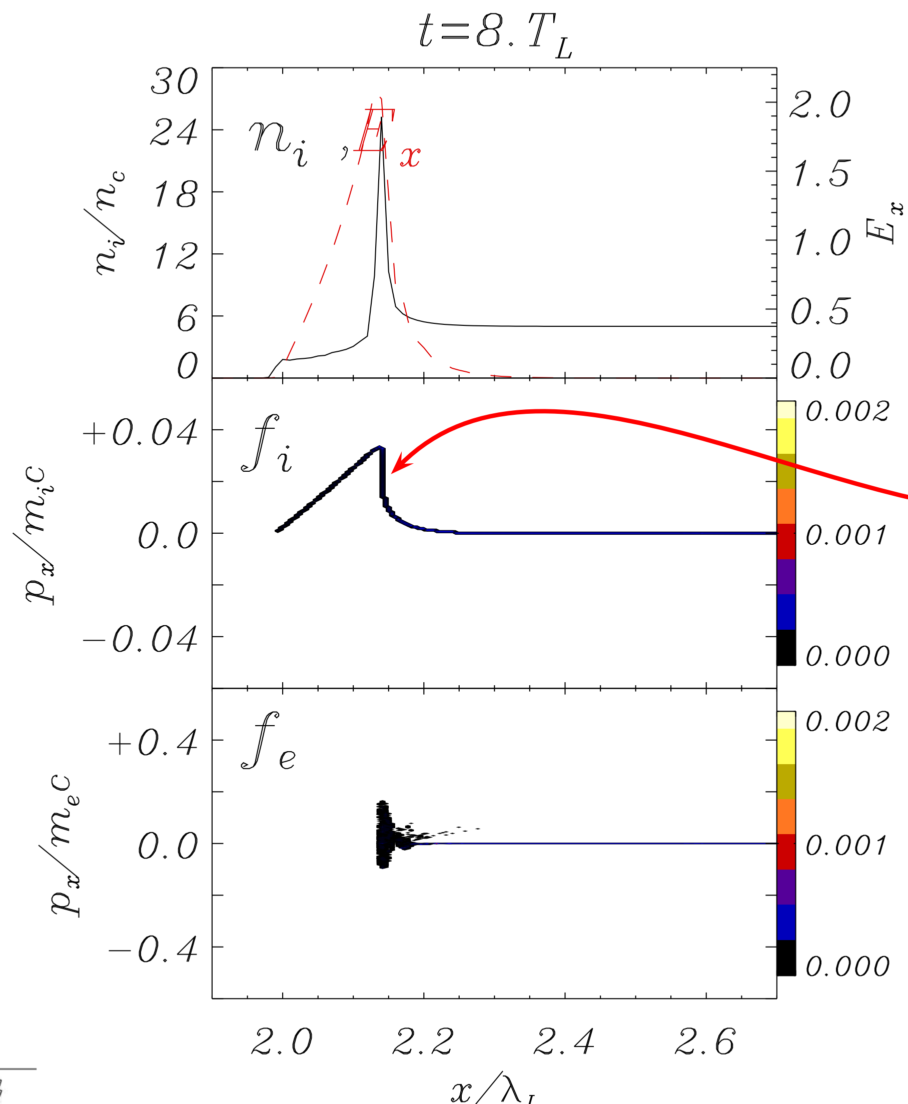

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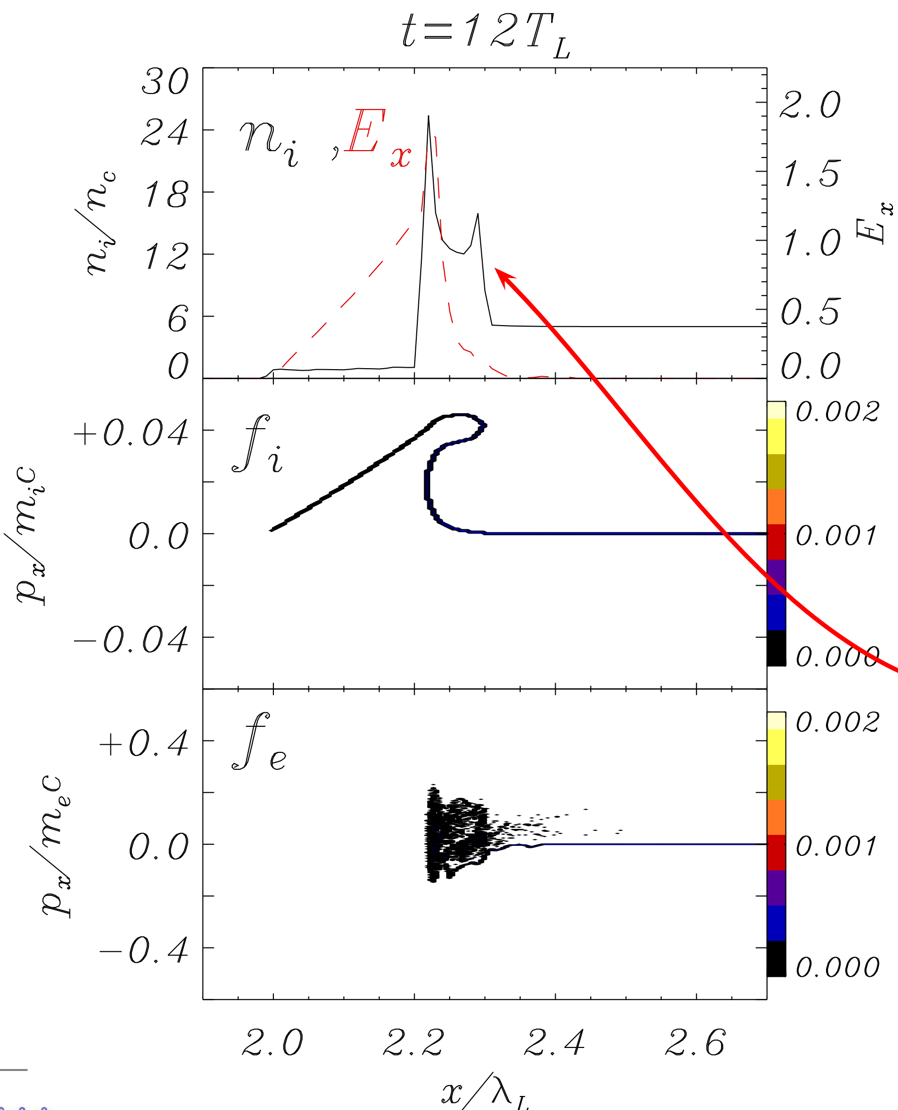

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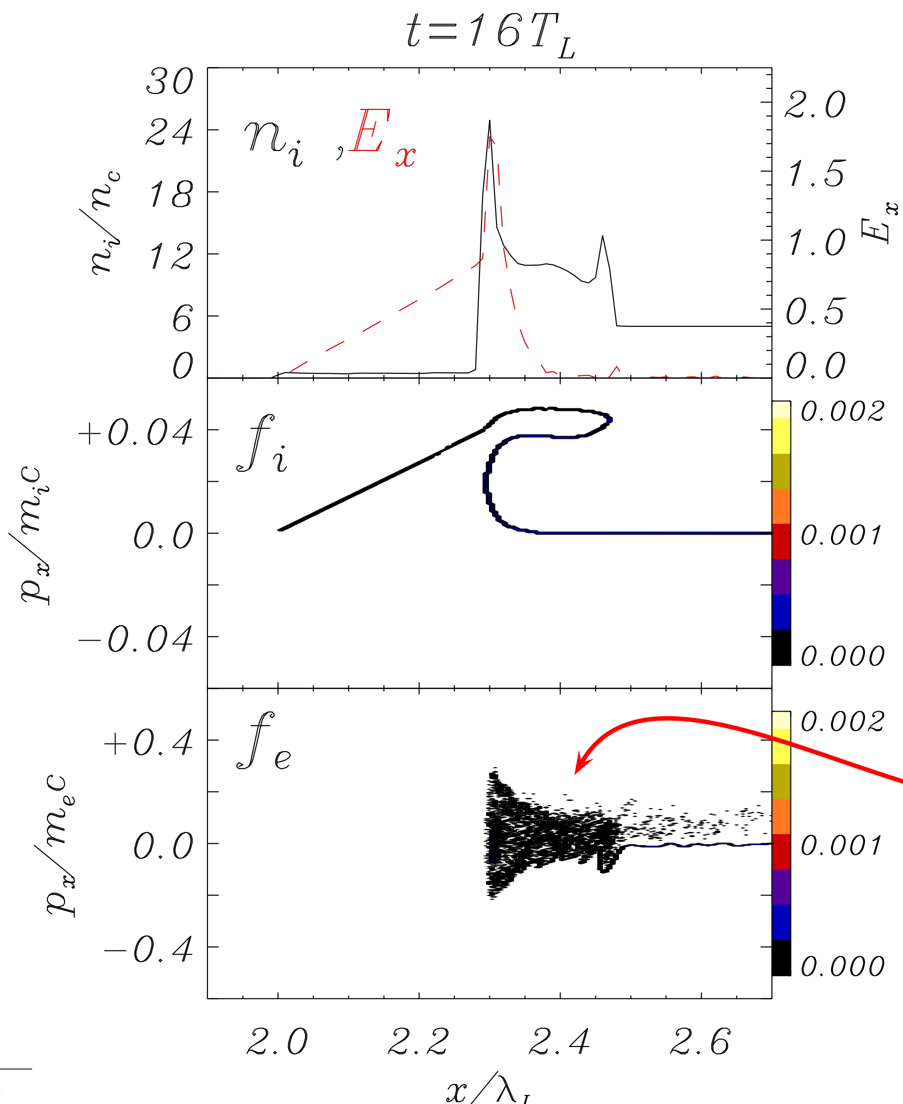

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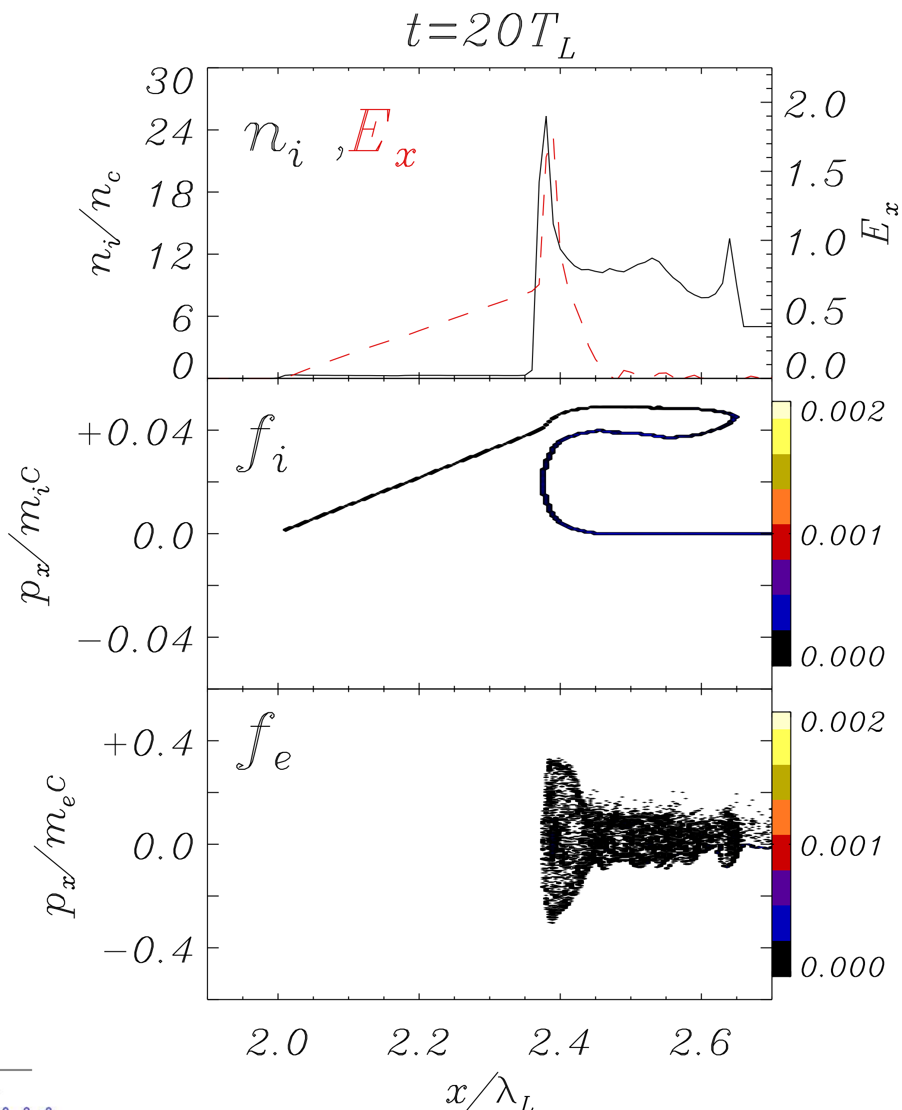

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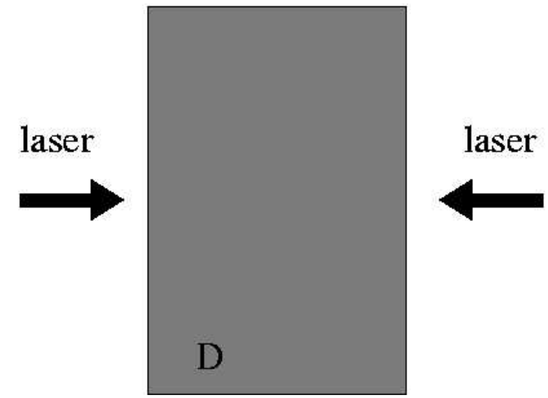

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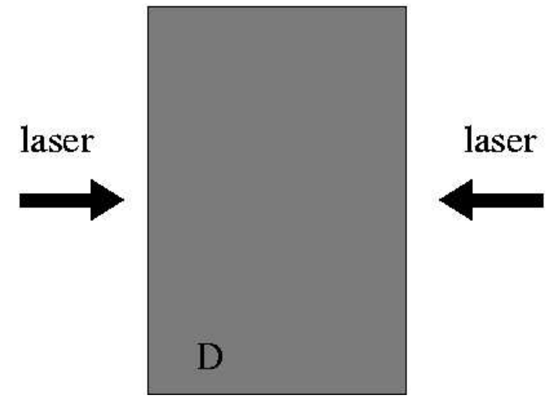

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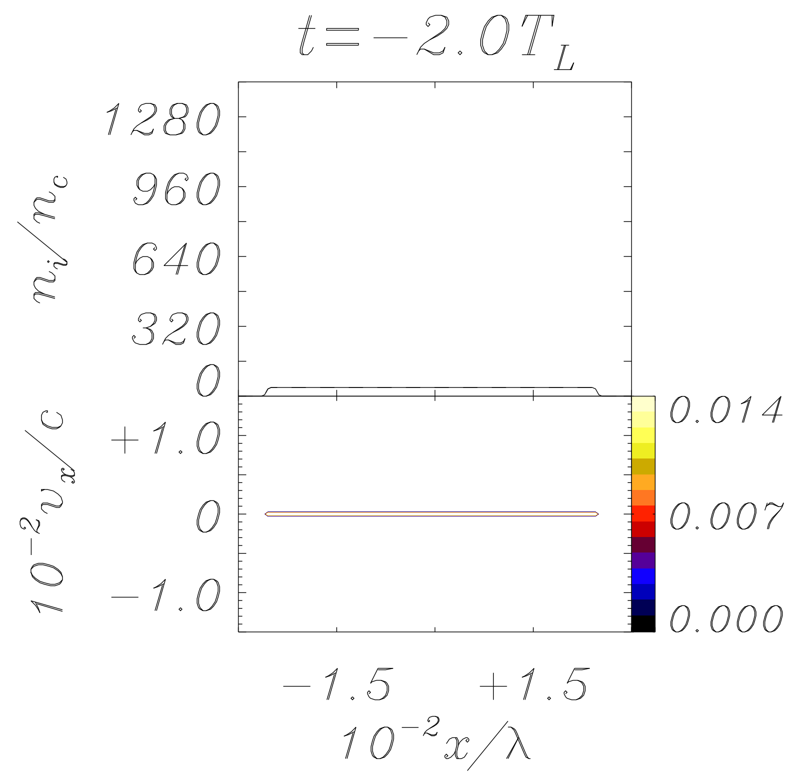

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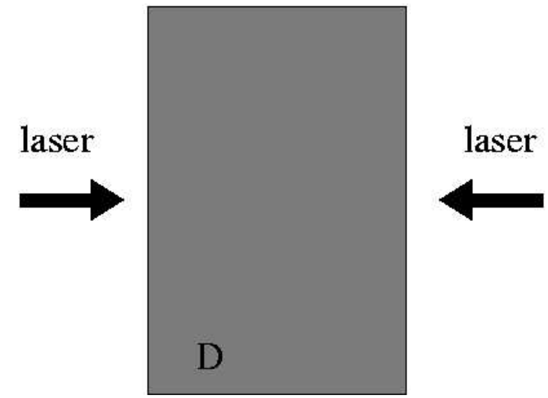

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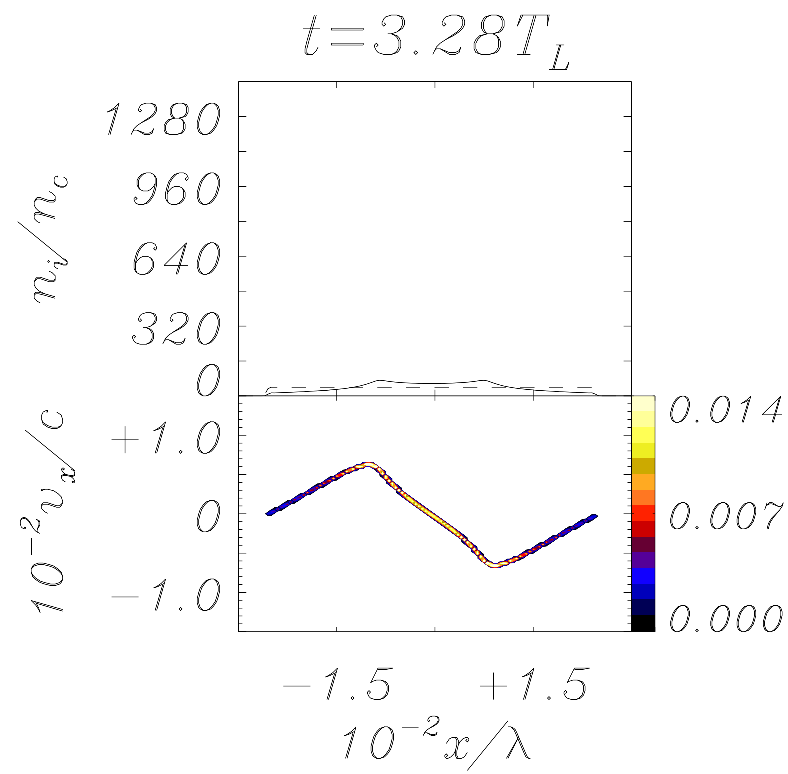

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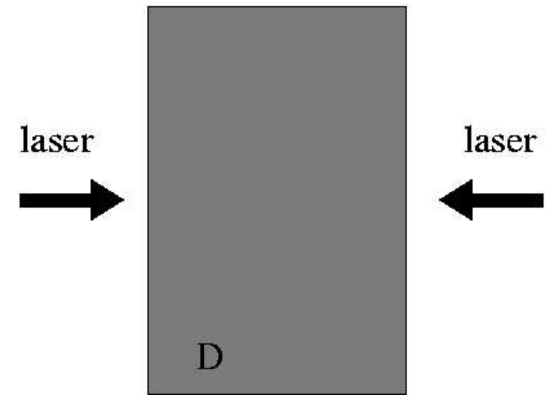

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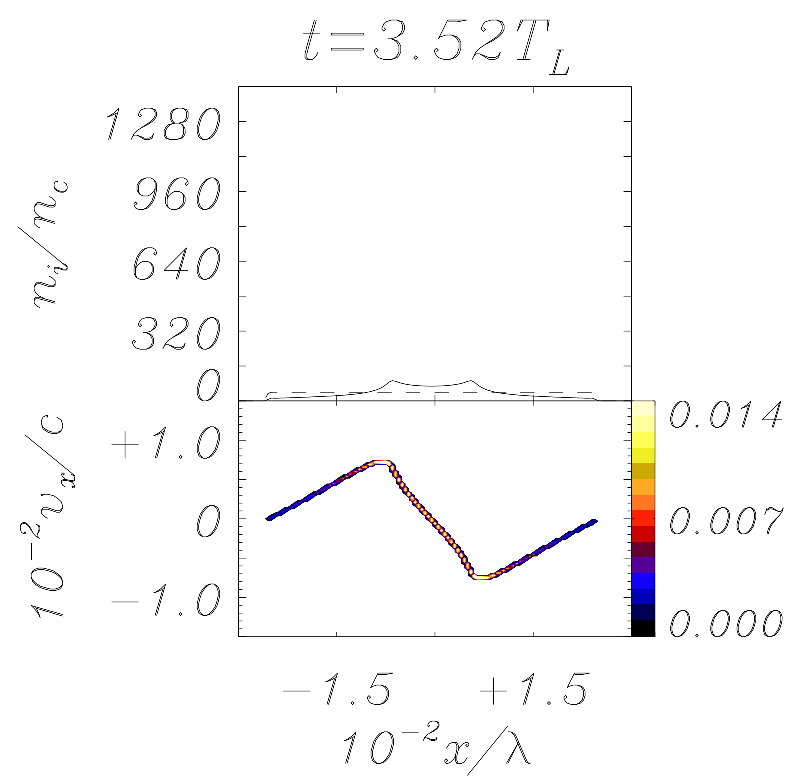

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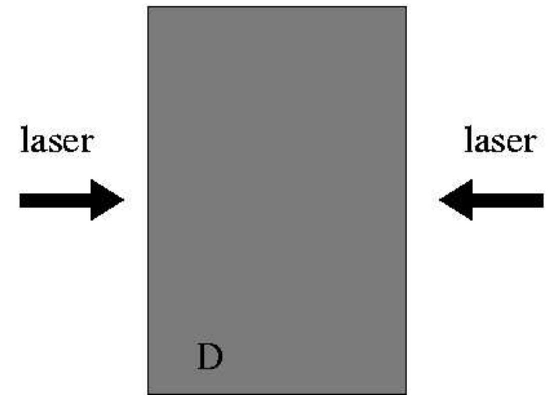

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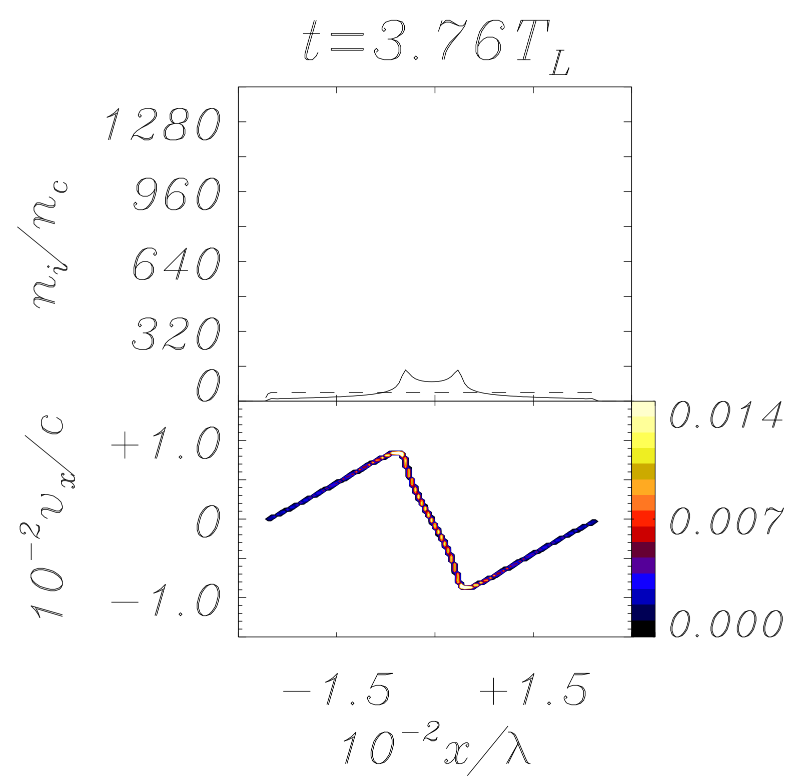

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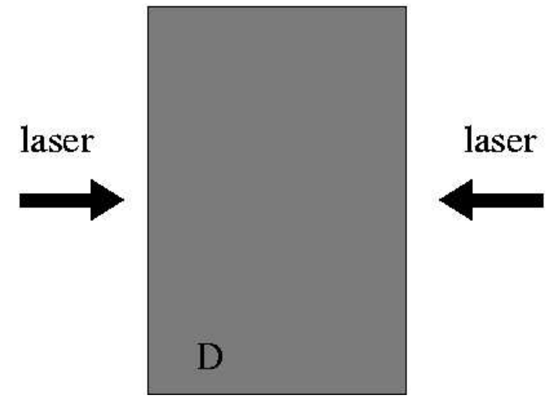

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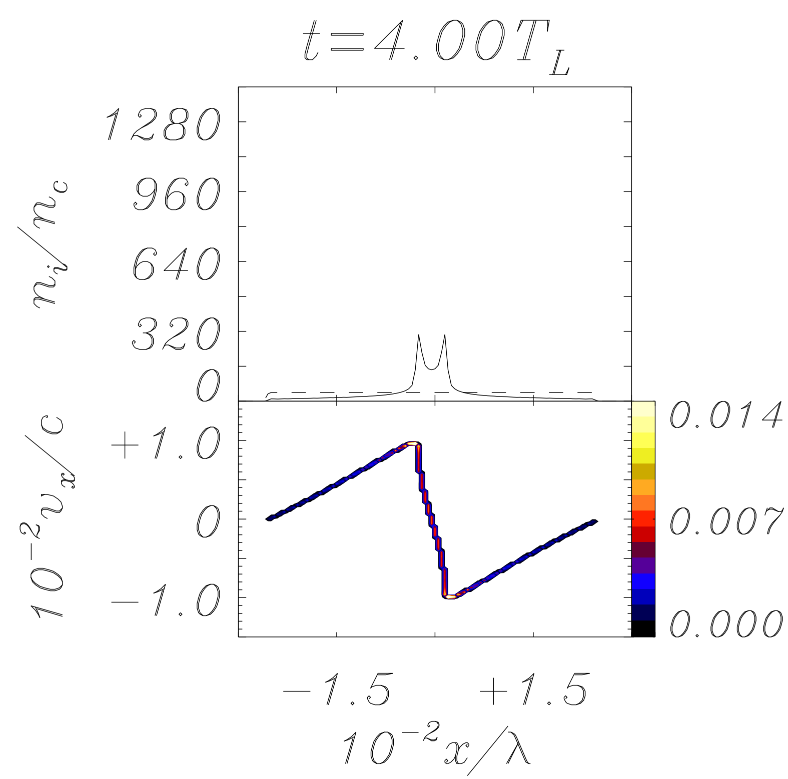

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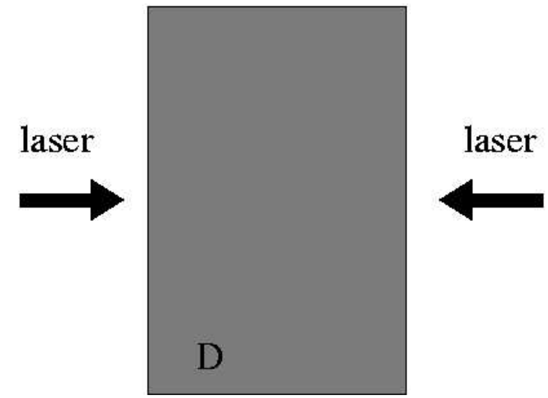

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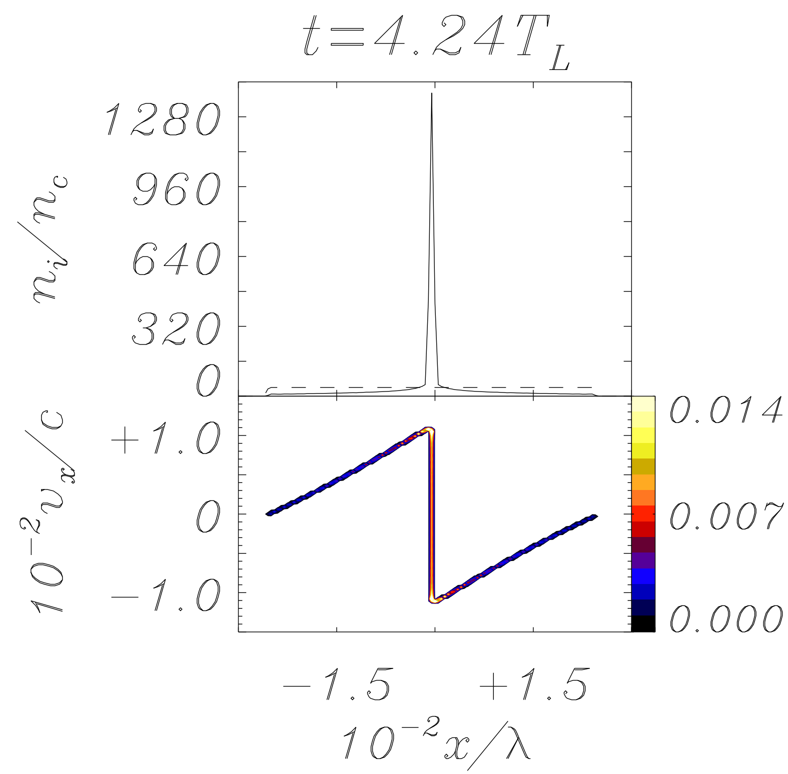

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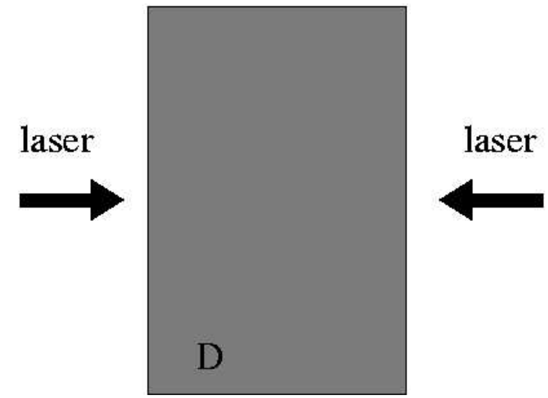

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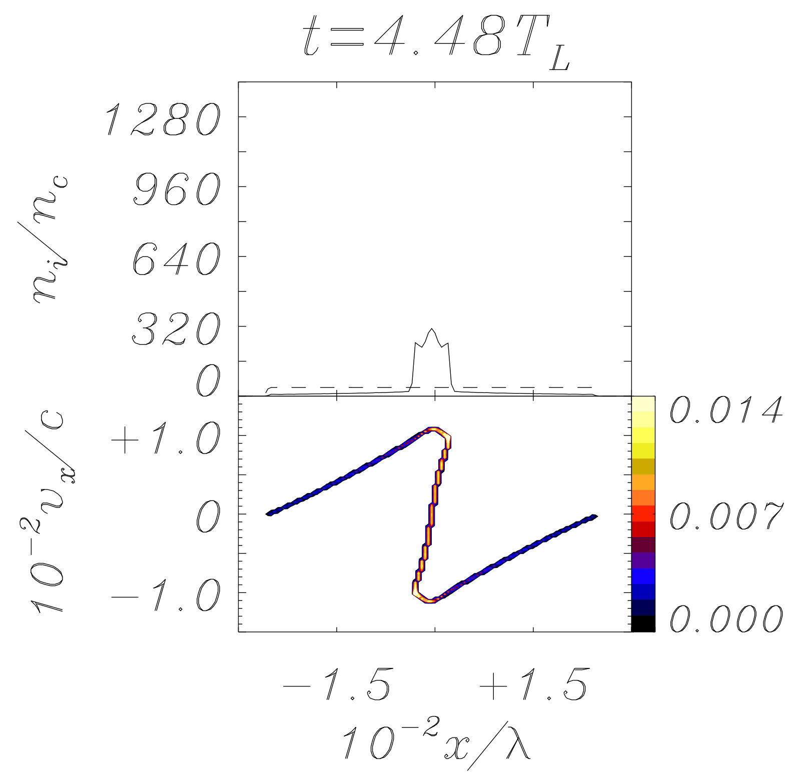

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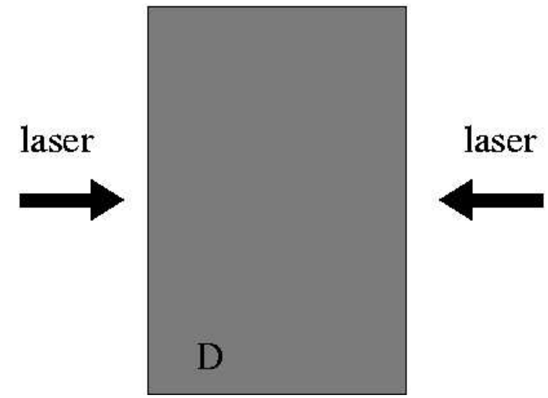

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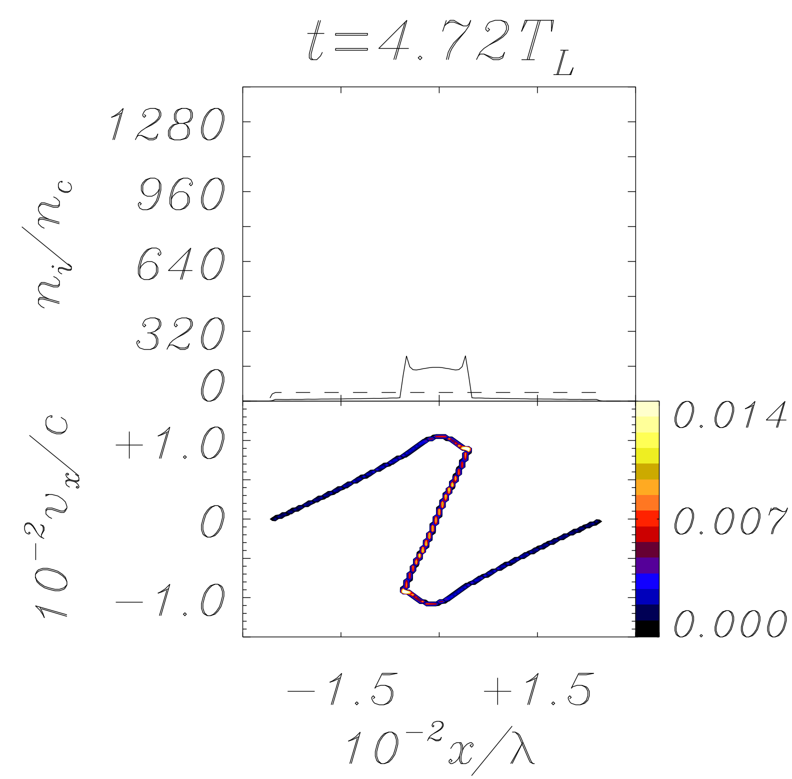

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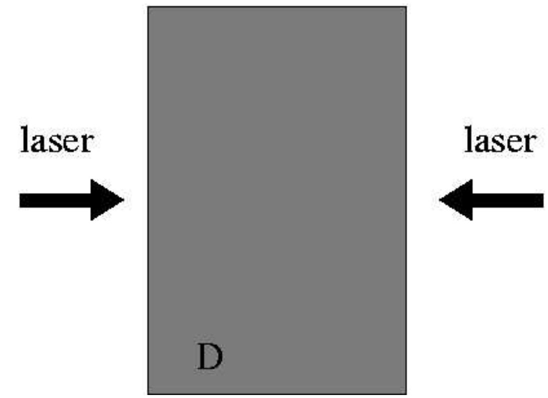

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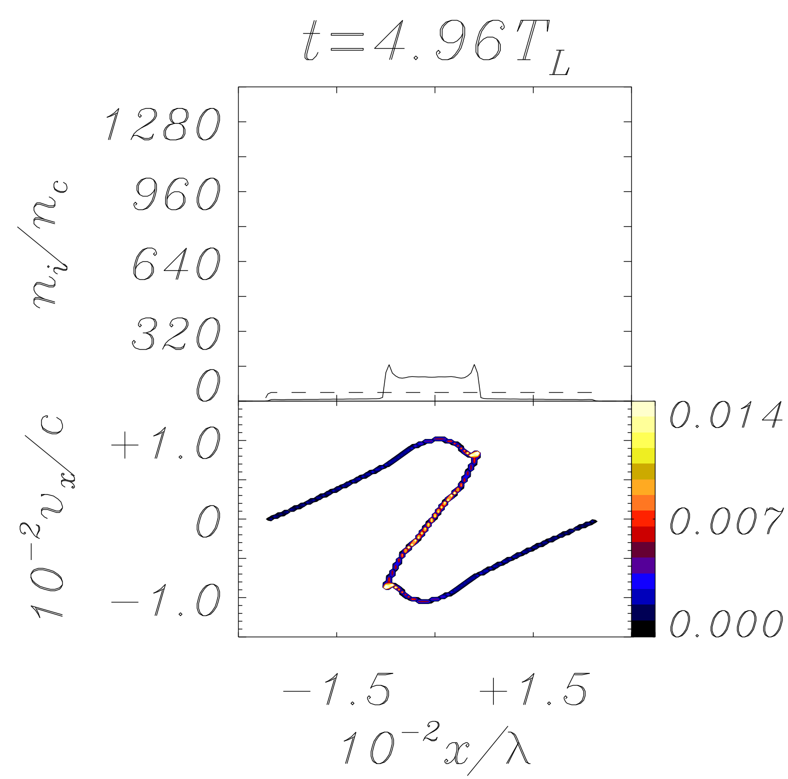

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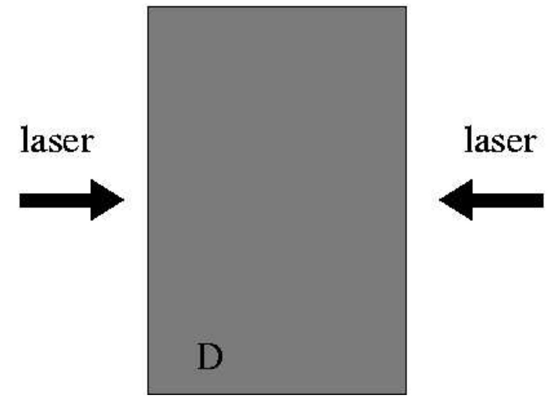

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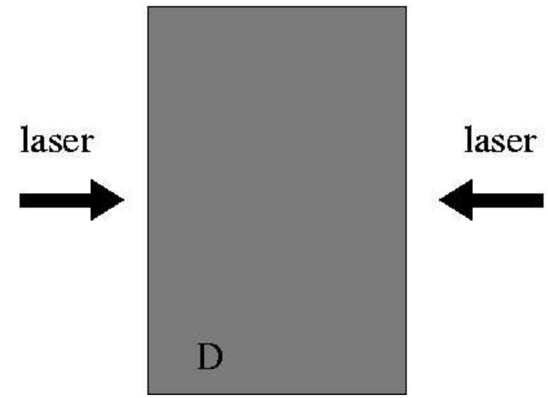

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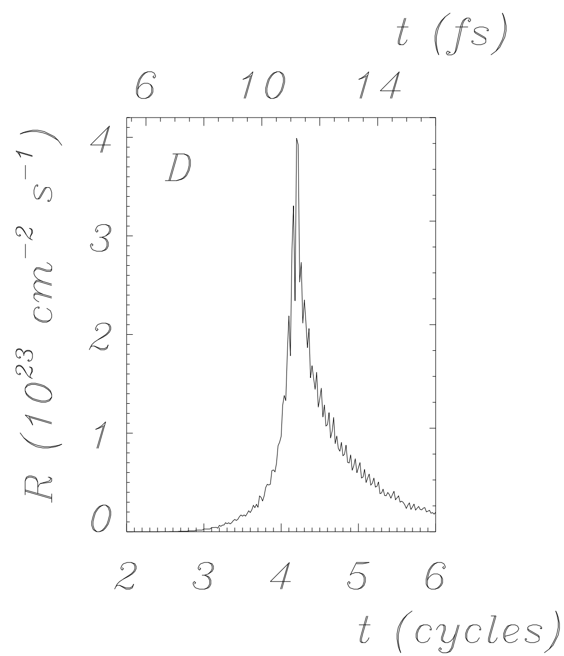

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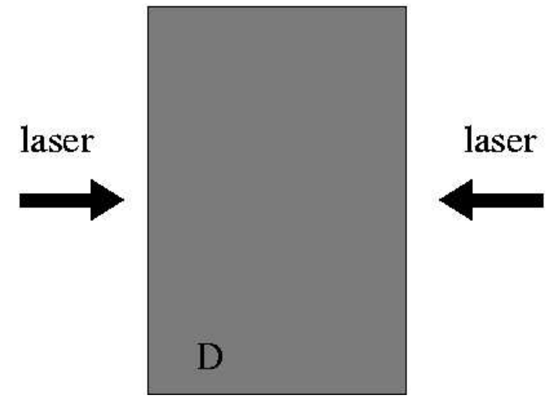

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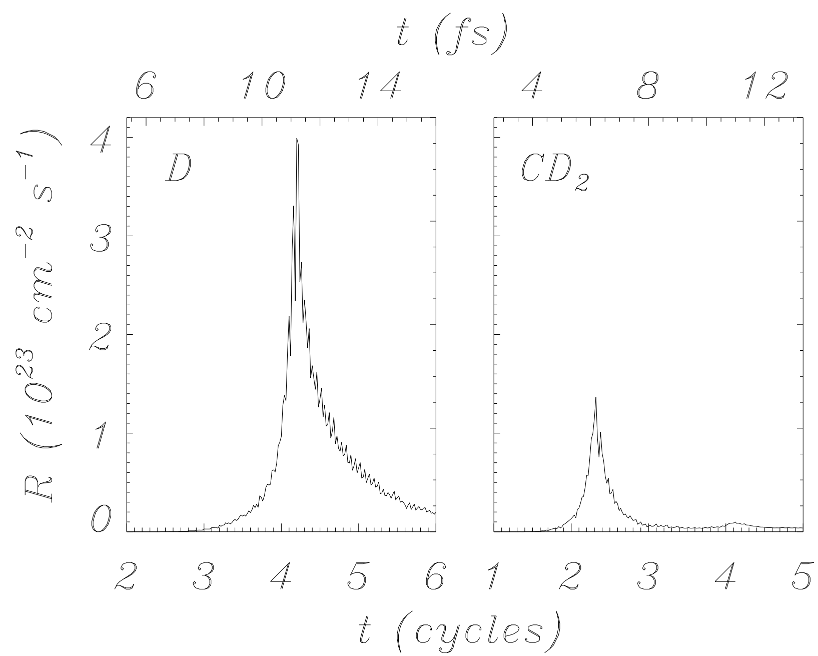

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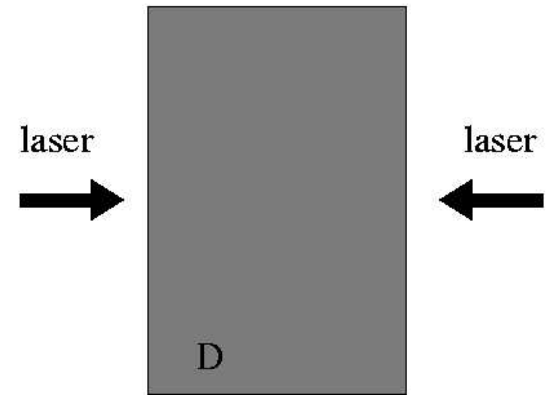

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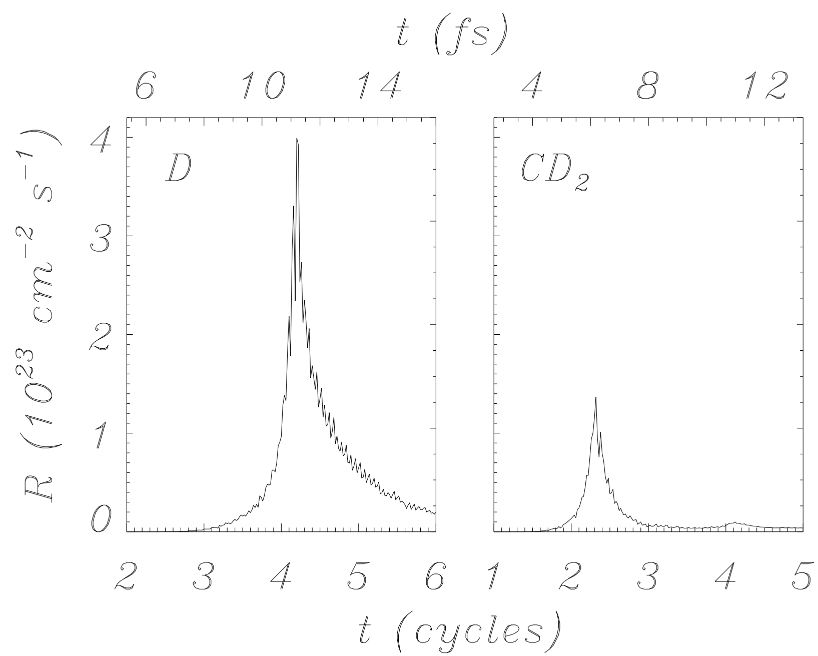

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