

# "Stochastically Induced GRB Wakefield Processes"

"Cool Discs, Hot Flows" -- Funäsdalen, March 2008



Acknowledgement of collaborators & mentors

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# Outline

Launching new tool for detailed numerical  
plasma physics

Synthesizing a GRB prompt flash

Stochastically induced wakefield processes

ABOUT

CW DB  
PIC - MC

"PHOTON PLASMA"  
CODE

simulations of the

GRB-CBM

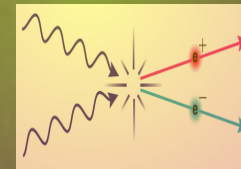
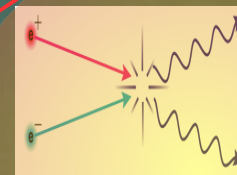
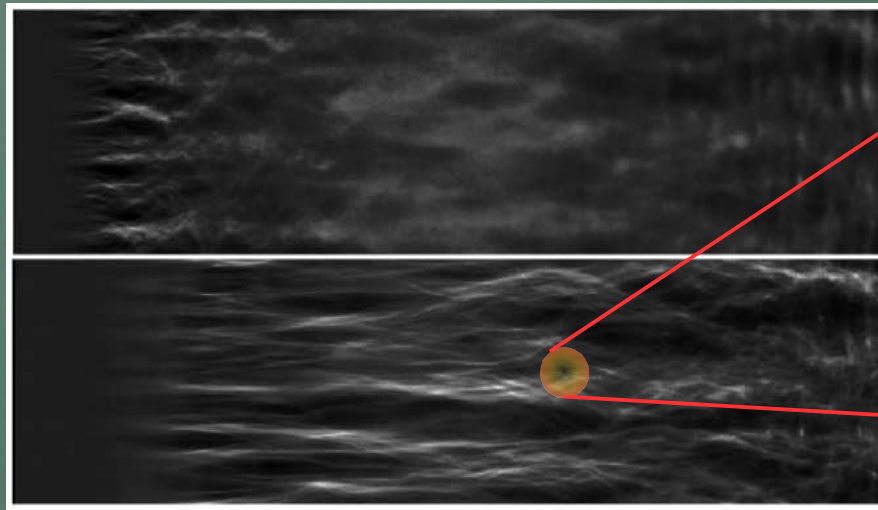
interaction

lots of acronyms...



# CWPIC-DBMC: motivation for the "PhotonPlasma" code

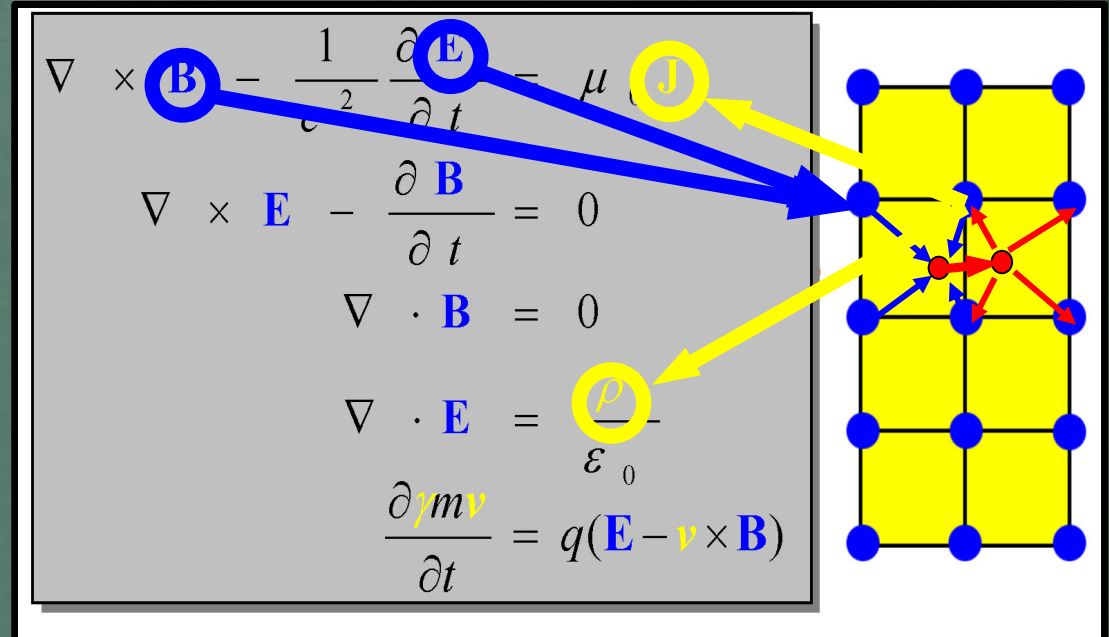
all the sub-Debye 'stuff'



<http://arxiv.org/abs/astro-ph/0308104>

# CWPIC = Continuous Weight Particle-In-Cell

- 'Conventional' PIC code (...except of course TSC scheme, fully staggered, highly optimized, MPI parallelized)



- Now make particles carry continuous weights!

$$q_\alpha w_i \delta_i(\mathbf{r} - \mathbf{r}_0) \equiv q_\alpha \sum_j w_j \delta_j(\mathbf{r} - \mathbf{r}_0).$$

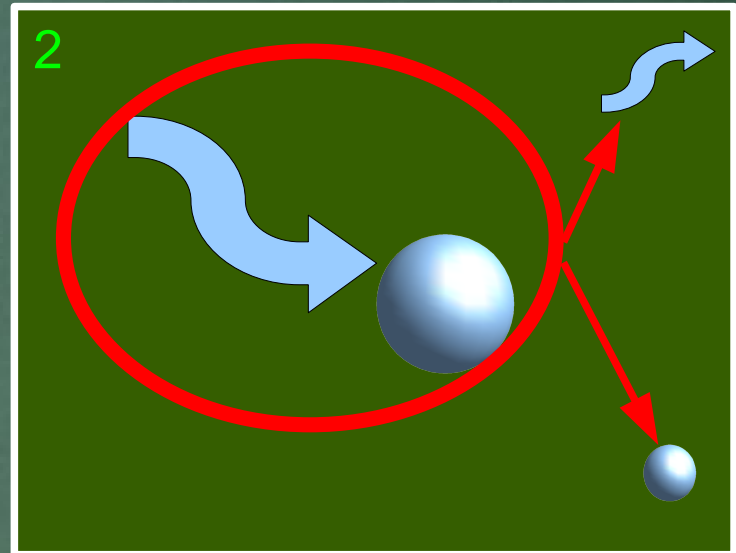
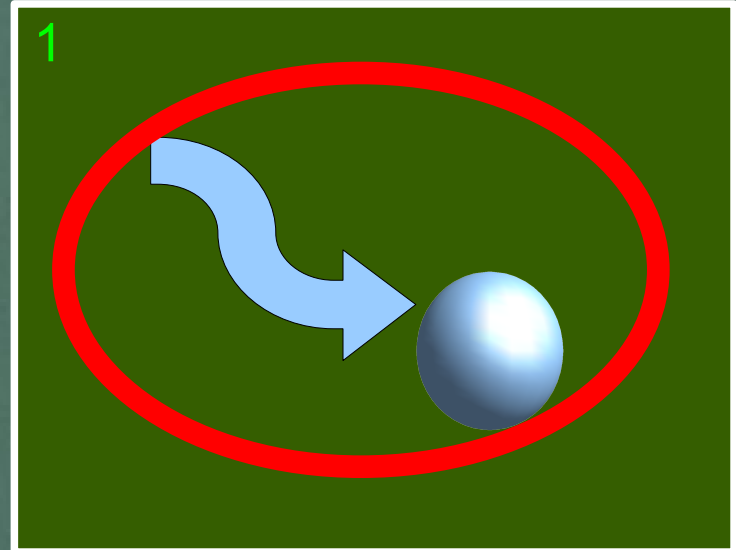
$$\rho_c(\mathbf{r}, t) \equiv \sum_\alpha q_\alpha \sum_i w_i \delta_i(\mathbf{r} - \mathbf{r}_0, t).$$

# DBMC = "Detailed Balance Monte-Carlo"

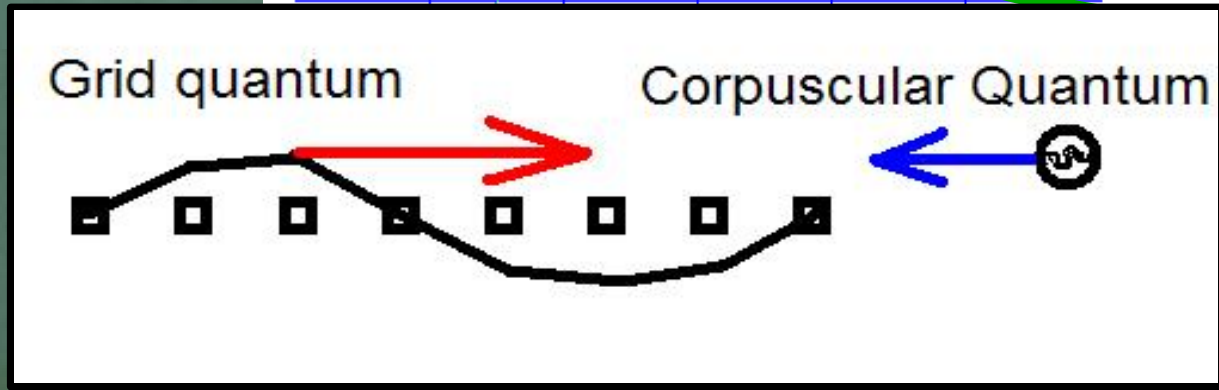
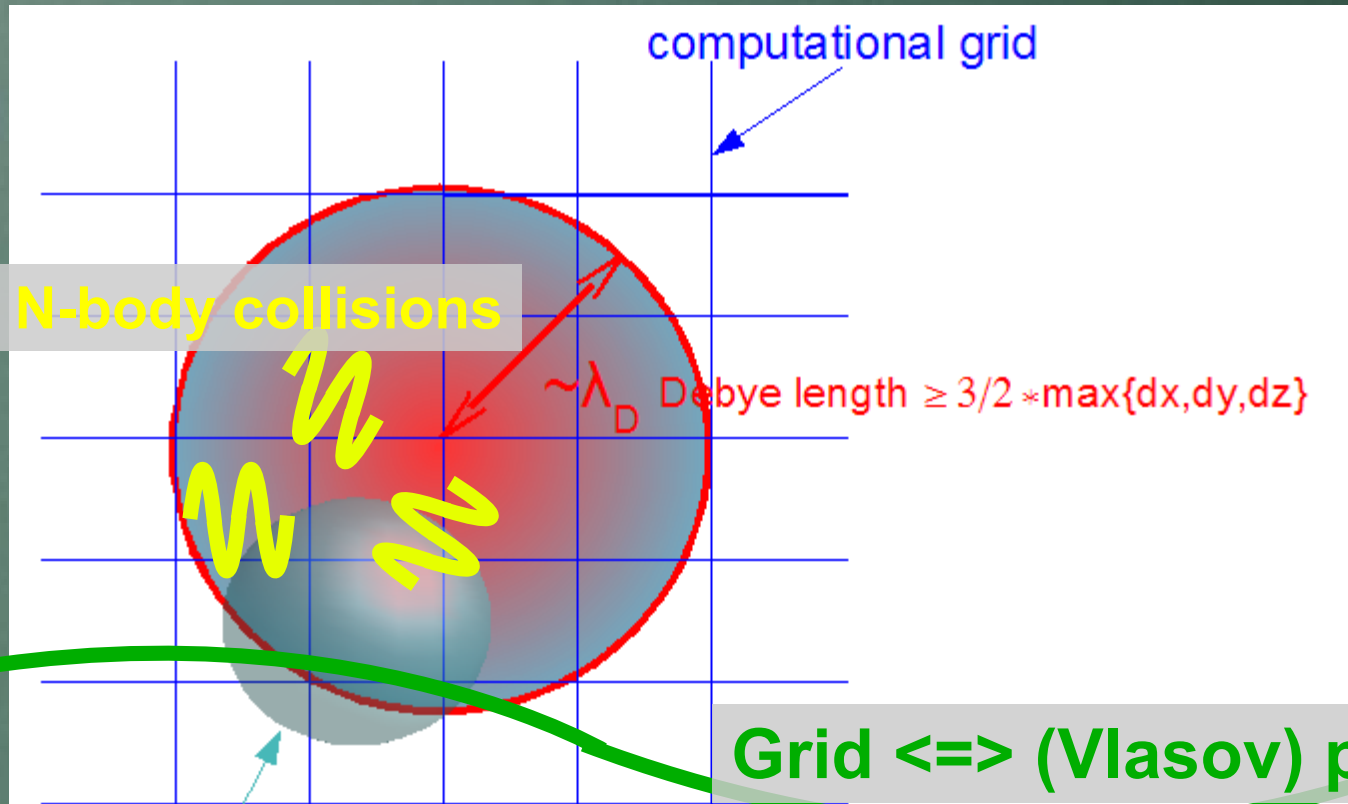
\* (Solve PIC problem)

\* Then Compute  
interaction PROBS

\* Scatter / decay /  
produce / etc... By  
splitting, reducing,  
merging



... and we get: a "PhotonPlasma" code.



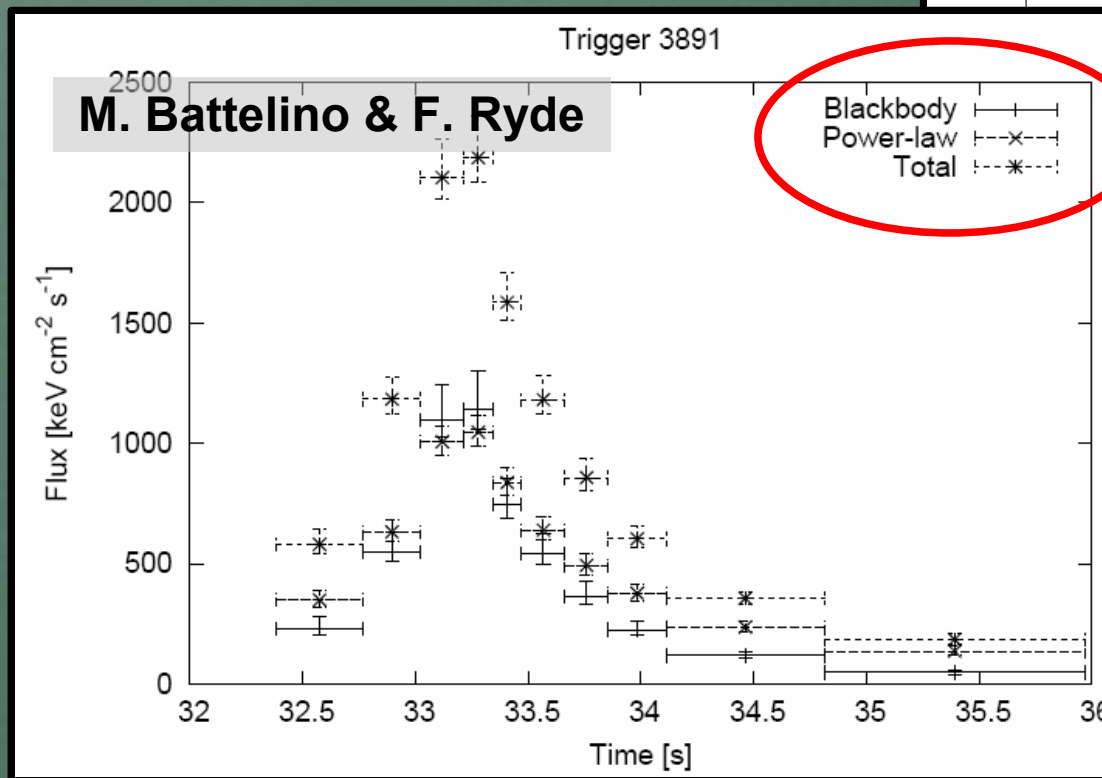
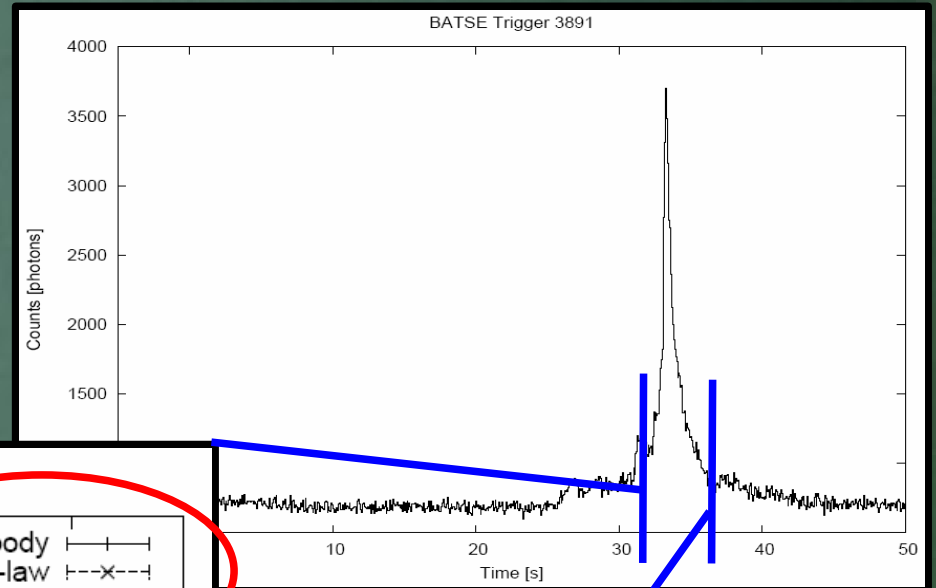


# "A synthetic GRB"

Demonstrating the PhotonPlasma code's  
capabilities

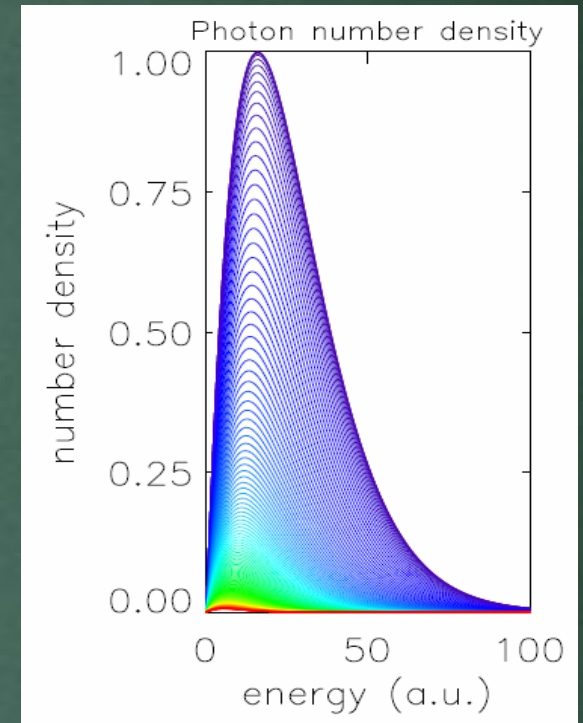
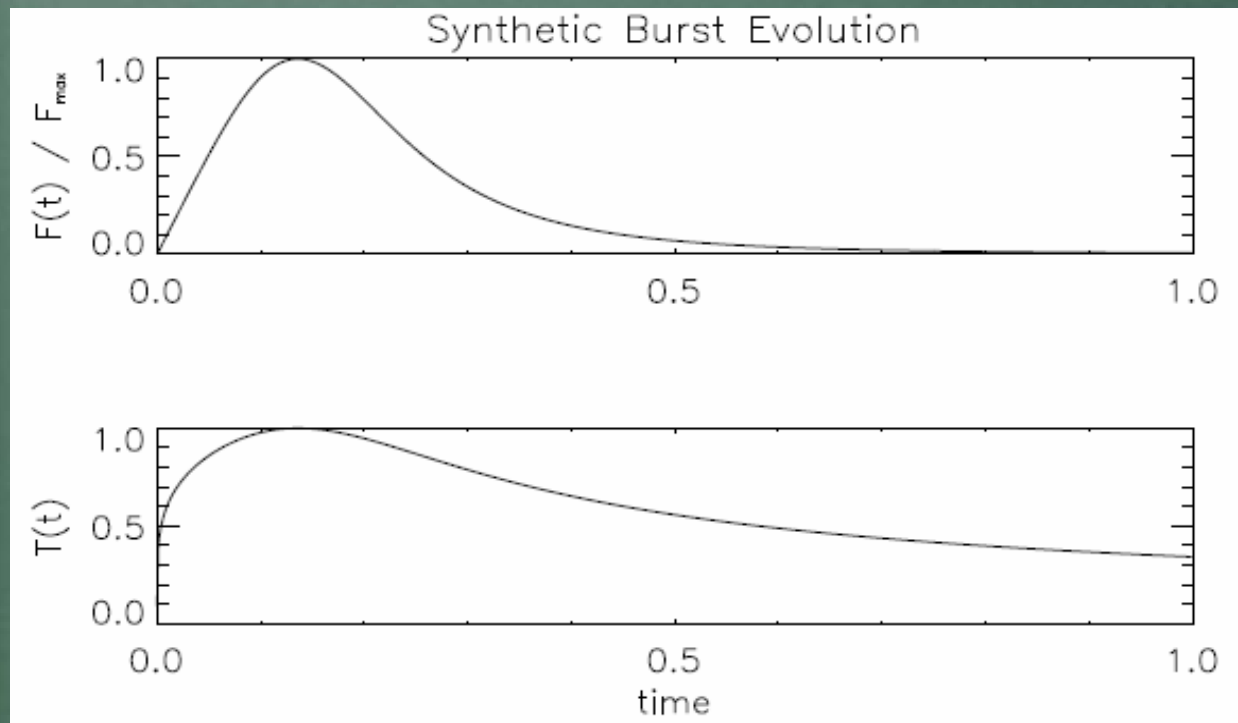
See also:  
<http://arxiv.org/abs/0803.3618> (submitted to ApJL)

... a real GRB (951102)  
from BATSE catalogue



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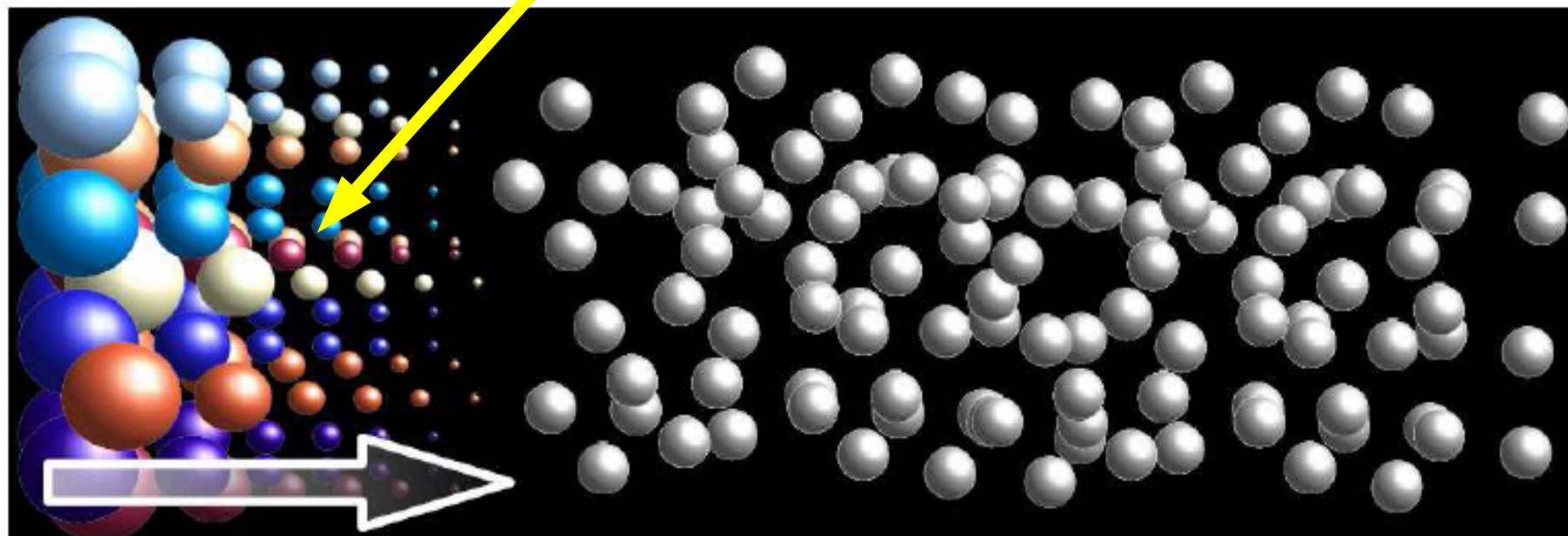
... a synthetic GRB



# GRB - CircumBurst Medium interaction;

Idealized model

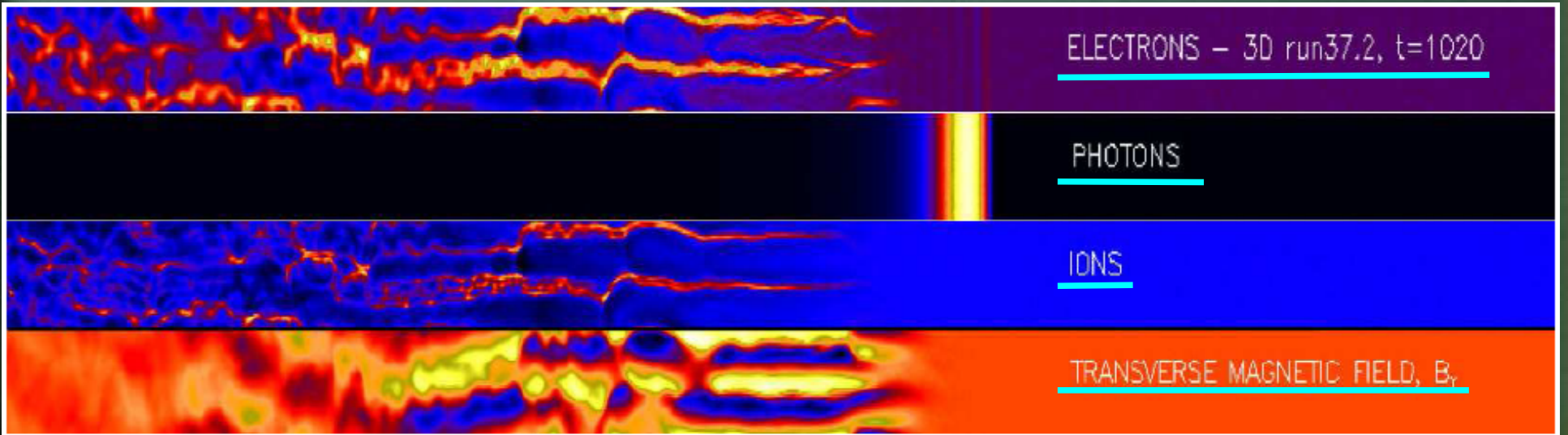
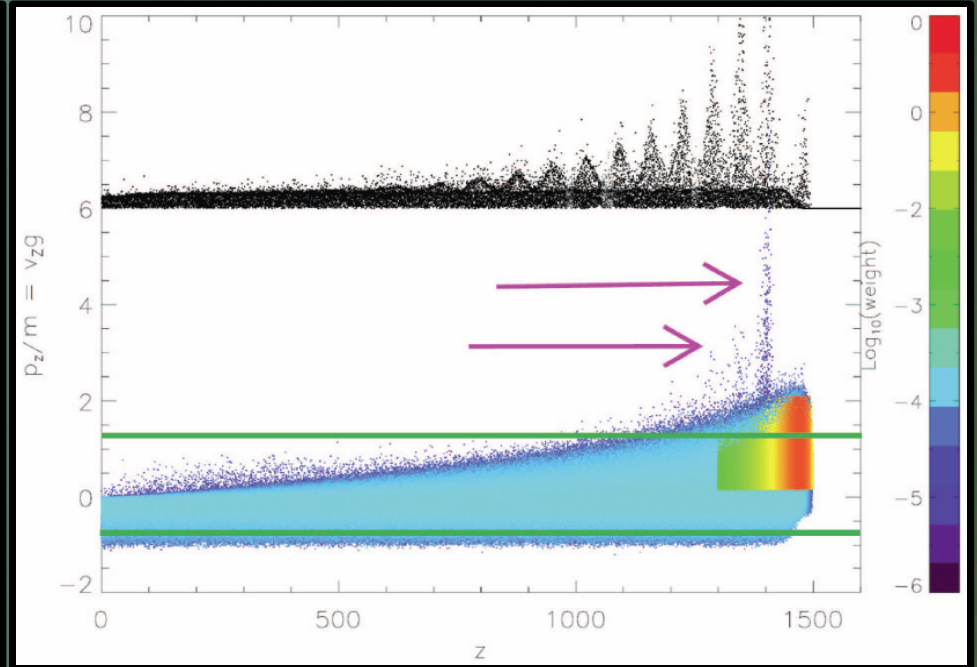
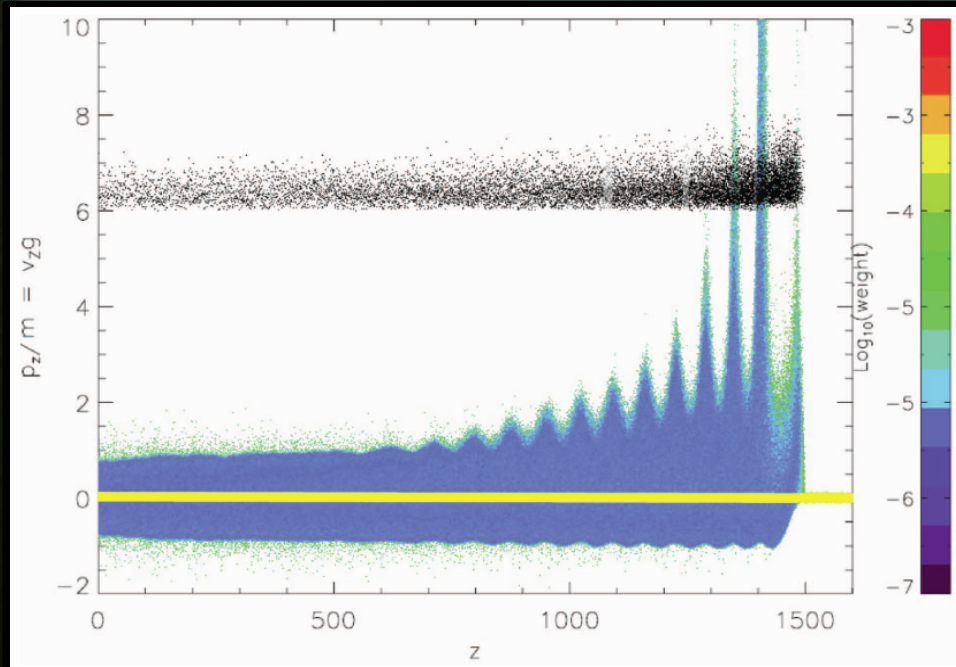
Size = continuous weight  
Color = energy



Light Pulse

Circum Burst Medium

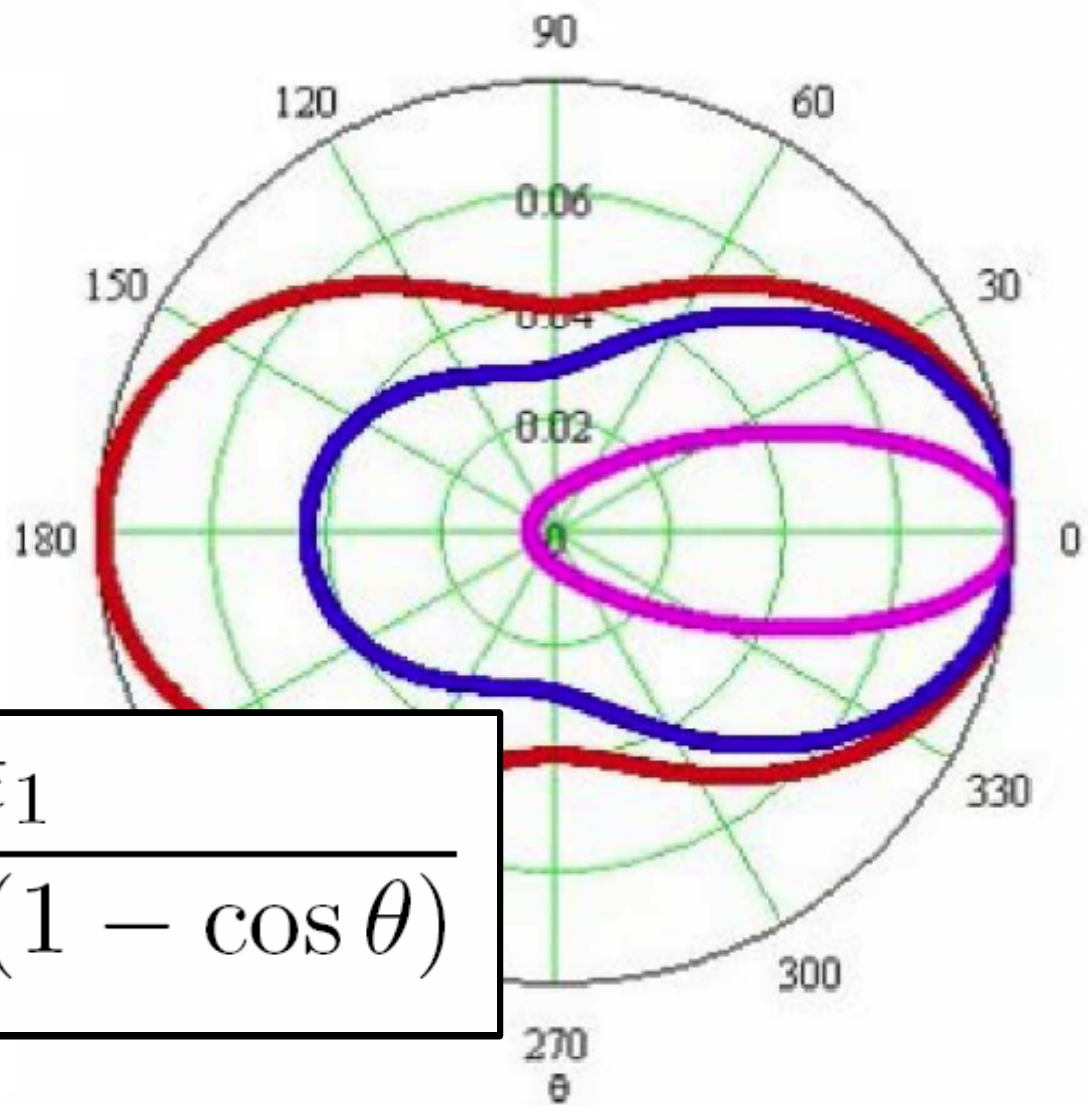
# A few crude results – aBridged



1 keV

100 keV

2 MeV



$$\epsilon_2 = \frac{\epsilon_1}{1 - \frac{\epsilon_1}{m_e c^2} (1 - \cos \theta)}$$

## Questions TO the Audience

1) "Can plasmas undergo magnetic 'hysteresis' -- i.e.: can it magnetize and then stay that way?!?" (to 'some degree')

2) Which process to include next? [presently doing  $\gamma + \gamma \longleftrightarrow e^+ + e^-$ ]

Questions FROM the Audience... ?

References:  
<http://arxiv.org/abs/0803.3618> (weblink)  
(submitted to ApJL) ...and references therein

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