



Shock-turbulence interaction with plasma viscosity

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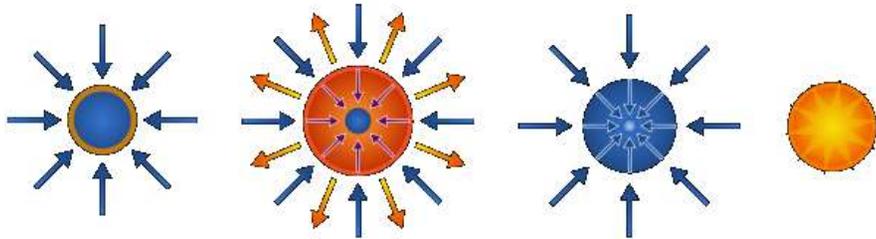


LLNL-PRES-813037

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

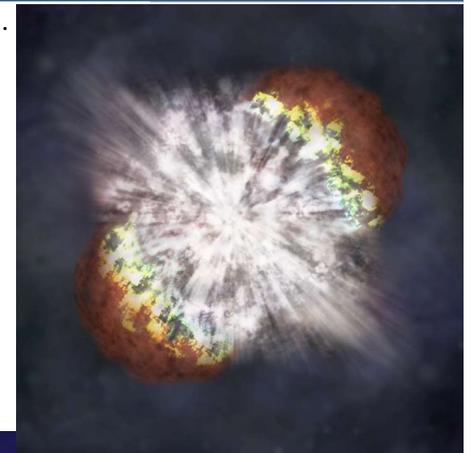


Is turbulence viscously dissipated in both ICF and supernovae?

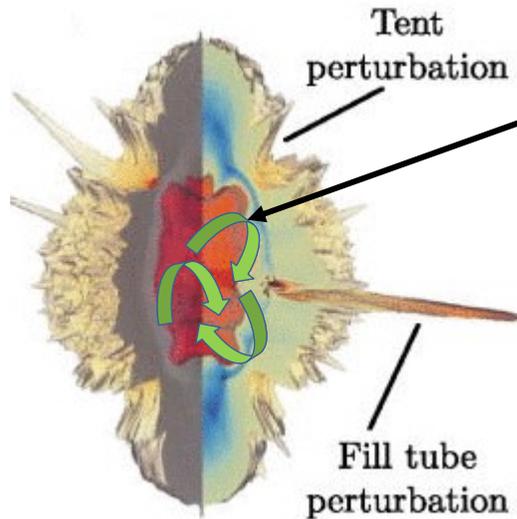


Stages of ICF. Credit: <https://www.interstellarresearchcentre.com/blog/shock-ignition-icf>

Supernova illustration. Credit: NASA/CXC/M.Weiss



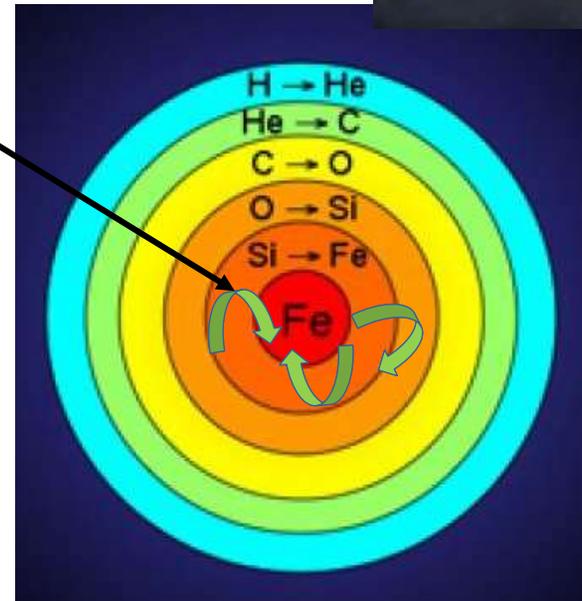
Are these plasma regimes potentially viscous enough for a shock to dissipate turbulence?



ICF capsule and hotspot during stagnation phase. C. R. Weber et al., Phys. Plasmas **22** 032702 (2015).

Turbulence?

To estimate this, we see how turbulence and the Reynolds number change across the shock



Before core collapse of a supernova. Credit: Swinburne University of Technology

Estimates of dissipation obtained via analytic calculations and simulation



Analytic estimate of change in Reynolds number

$Re = \frac{\rho u l}{\mu}$
Plasma Viscosity
 $\mu \propto T^{5/2}$

Rankine-Hugoniot relations compute temperature jump across shock (1 post-shock, 0-pre-shock)

$$R = \frac{Re_1}{Re_0} = \frac{\rho_1}{\rho_0} \left(\frac{T_0}{T_1} \right)^{5/2} \frac{u_1 l_1}{u_0 l_0}$$

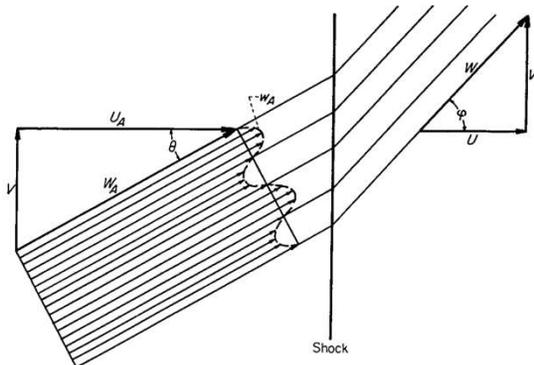


FIGURE 2.—Transformation to equivalent steady-flow problem by superposition of velocity V .

↑
 Ribner's Linear Interaction Analysis gives turbulent velocity amplification across shock.

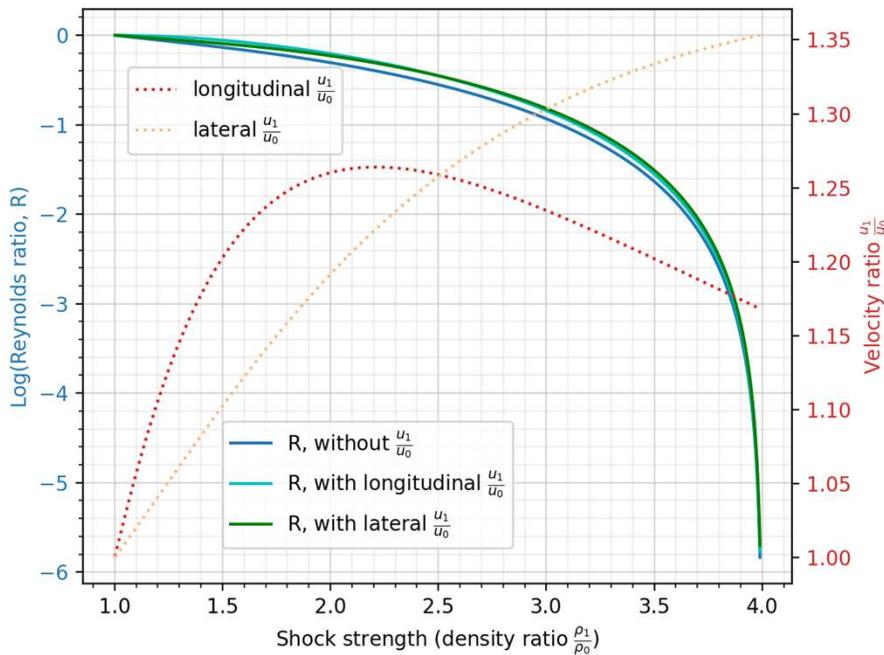
Credit: Ribner HS. Convection of a Pattern of Vorticity Through a Shock Wave. NACA Rep. 1164, 1954.

Simulations of turbulence passing through a shock in pyramda will allow for direct comparison of viscosity jump

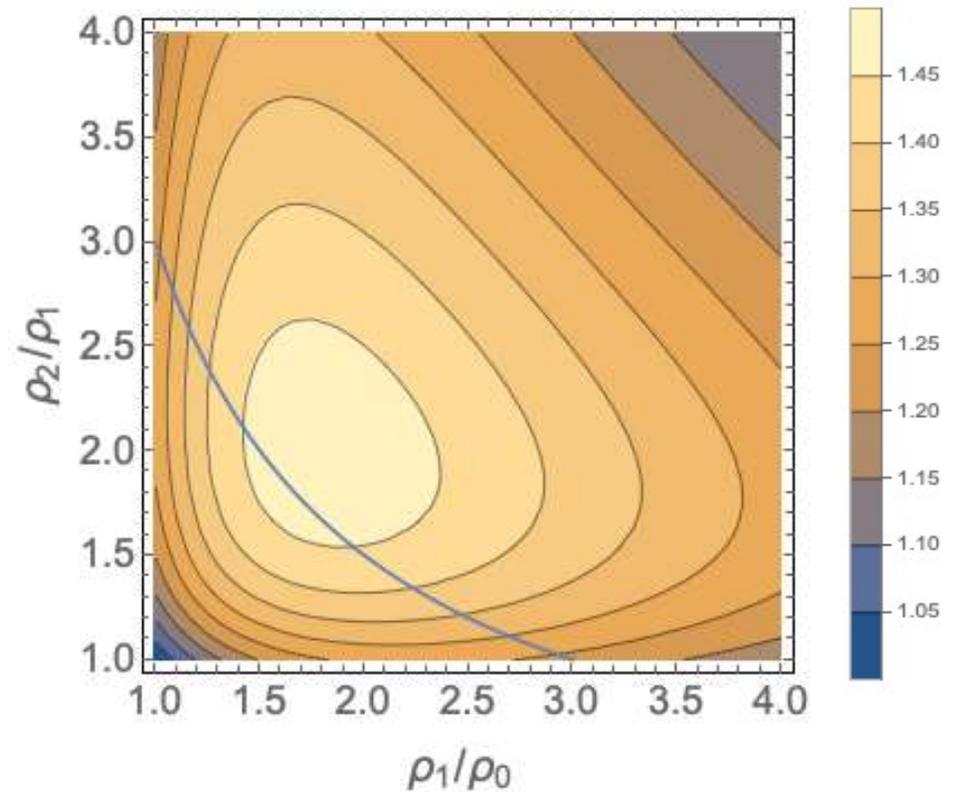
Significant decrease in Reynold's number predicted for stronger shocks



Decrease in Reynolds number across a shock, R , is greater for stronger shocks



Amplification of longitudinal turbulence for two shocks is impacted by the order of shocks of different strengths



Amplification of longitudinal and lateral turbulence across a shock, $\frac{u_1}{u_0}$, is anisotropic and non-monotonic with shock strength



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