Experiments relevant to understanding the interaction of stellar radiation with nearby gas clouds

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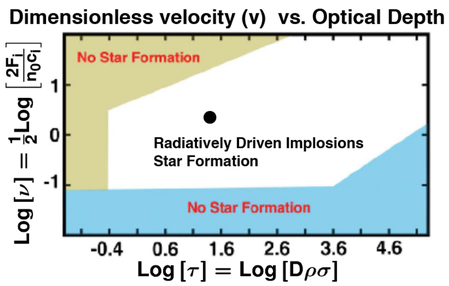
Stellar radiation compresses or explodes nearby gas clouds

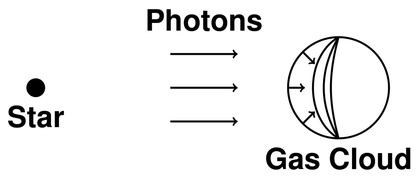


[1] P. A. Keiter et al.: "Design of laboratory experiments to study radiation-driven implosions," High Energy Density Physics, Volume 22, p. 37-40 (2017)

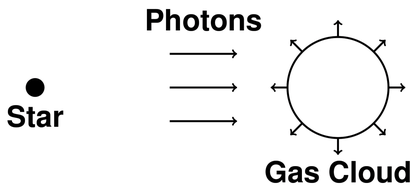
[2] F. Bertoldi: "The Photoevaporation of Interstellar Clouds. I. Radiation-Driven Implosion," Astrophysical Journal, vol. 346, p. 735-755 (1989)

Interaction dependent on photon flux, photon energy, cloud thickness, and cloud density

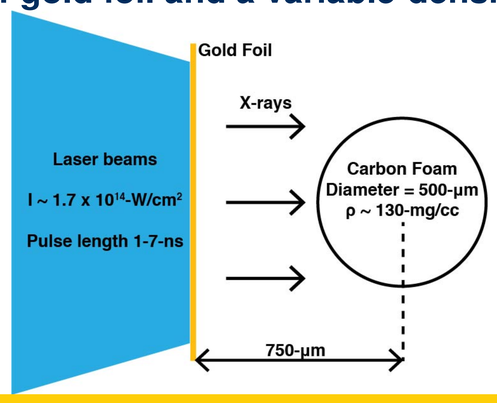
- Optically thick: Photons absorbed at one cloud edge
  - Drives asymmetric shock into cloud



- Optically thin: Photons permeate and heat cloud
  - Cloud explodes

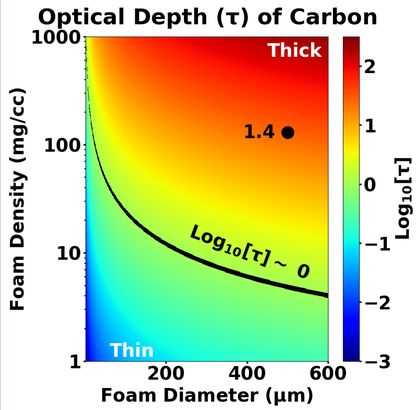


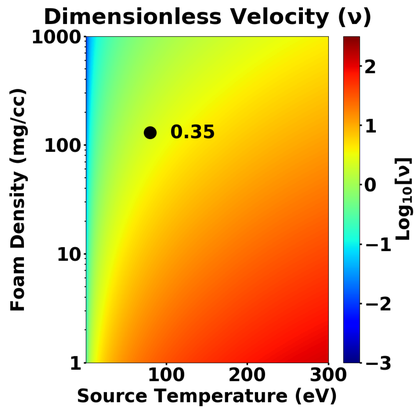
The platform is driven by laser-irradiated thin-gold foil and a variable-density foam sphere



[3] J. Davis et al.: "Soft X-ray emission from laser-irradiated gold foils," Physics of Plasmas25, 073304 (2018)

Foil temperature, and foam parameters determine the optical depth (τ) and dimensionless velocity (ν)



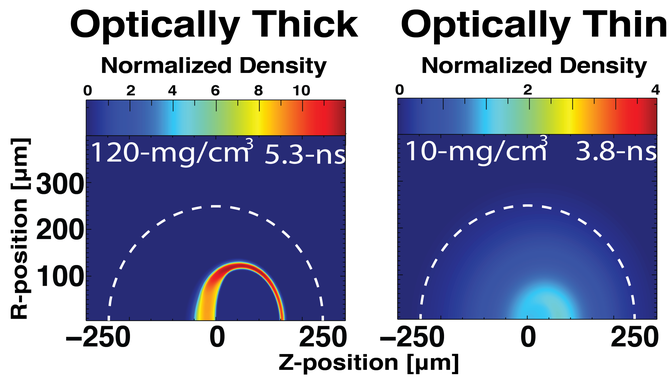


- $\tau \sim D\rho\sigma$
- D = foam diameter
- ρ = foam density
- σ = mass attenuation coeff.
- Photon Source ~ 80-eV

- $\nu = \frac{v_s}{c_i} \sim \sqrt{\frac{2F_i}{n_0 c_i}}$
- F_i = photon number flux
- n_0 = cloud number density
- c_i = intercloud sound speed

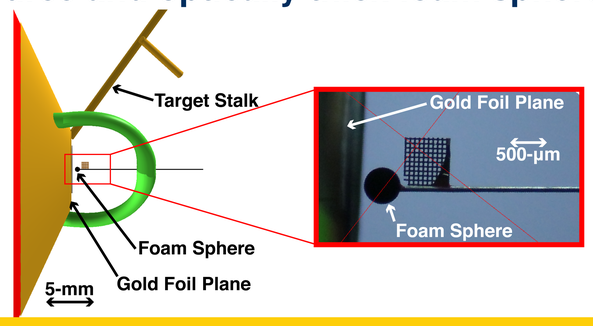
[4] τ estimated from http://henke.lbl.gov/optical_constants/filter2.html

2D CRASH radiation hydrodynamic simulations show both compression and explosion limits

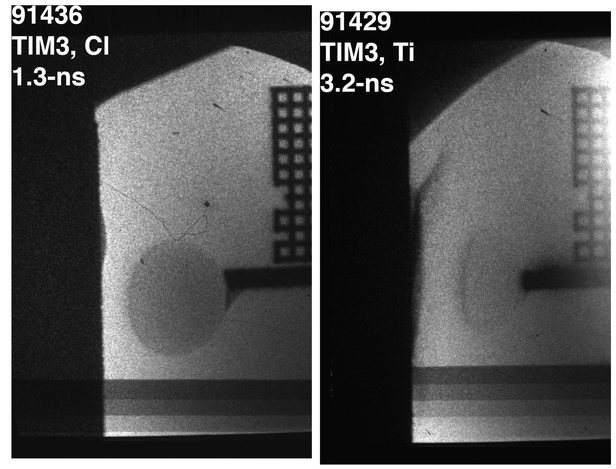


[5] B. van der Holst et al; "CRASH: A Block-adaptive-mesh Code for Radiative Shock Hydrodynamics-Implementation and Verification"

OMEGA-60 experimental package combines x-ray source and optically thick foam sphere



Backlit-pinhole radiography imaged the asymmetric collapse of the sphere



We are exploring conditions relevant to when stars irradiate nearby gas clouds

- Hot, massive stars cause nearby gas clouds to explode or compress
  - Gas cloud fate dependent on initial optical depth
- Simulations show the platform can reach optically thin and thick limits by changing foam density
- Initial optically thick experiments show an asymmetric compression of the sphere
- Radiographic data sets are under analysis

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