

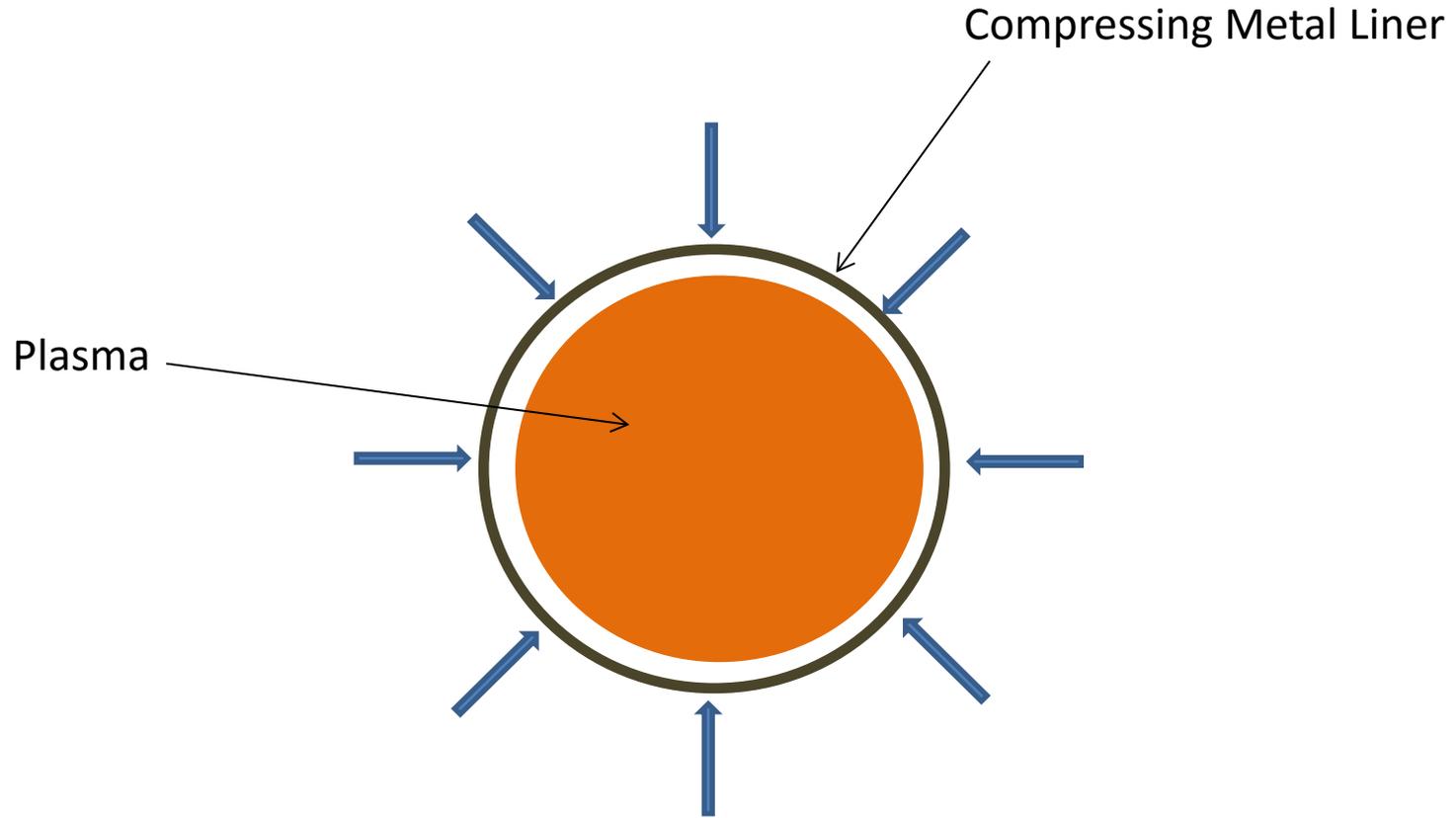
Prototype Tools to Establish the Viability of the Adiabatic Heating and Compression Mechanisms Required for Magnetized Target Fusion

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Hui Li (LANL)

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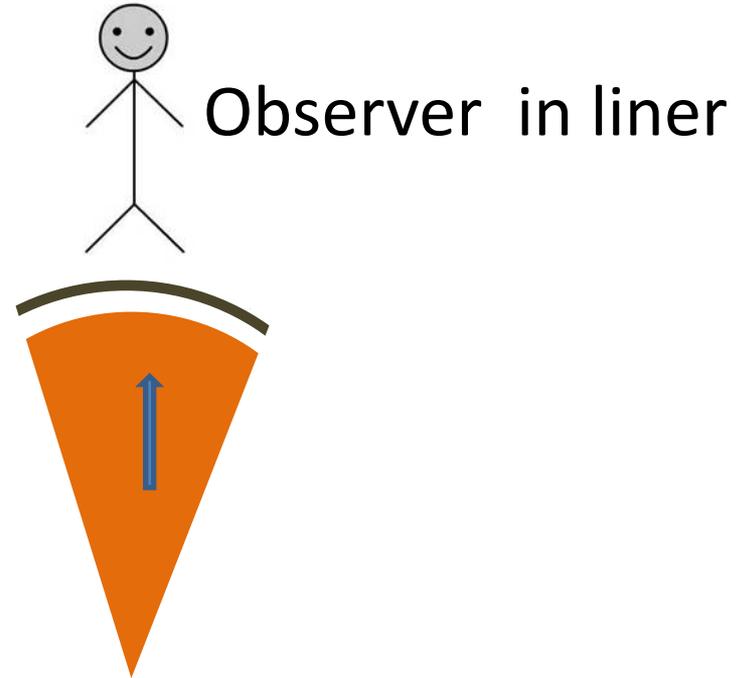
Magnetized target fusion (cylindrical liner compresses cylindrical plasma)



Magnetized target fusion segment of cylinder

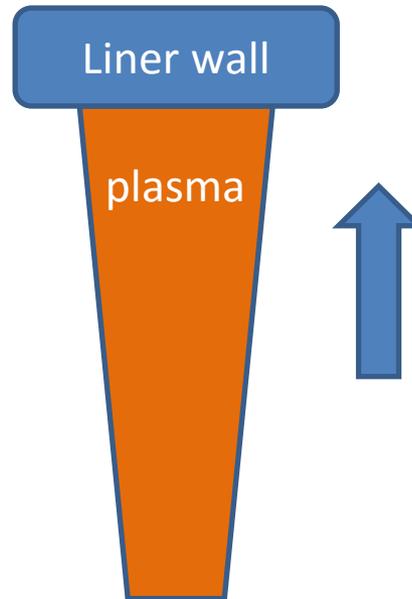


Magnetized target fusion segment of cylinder



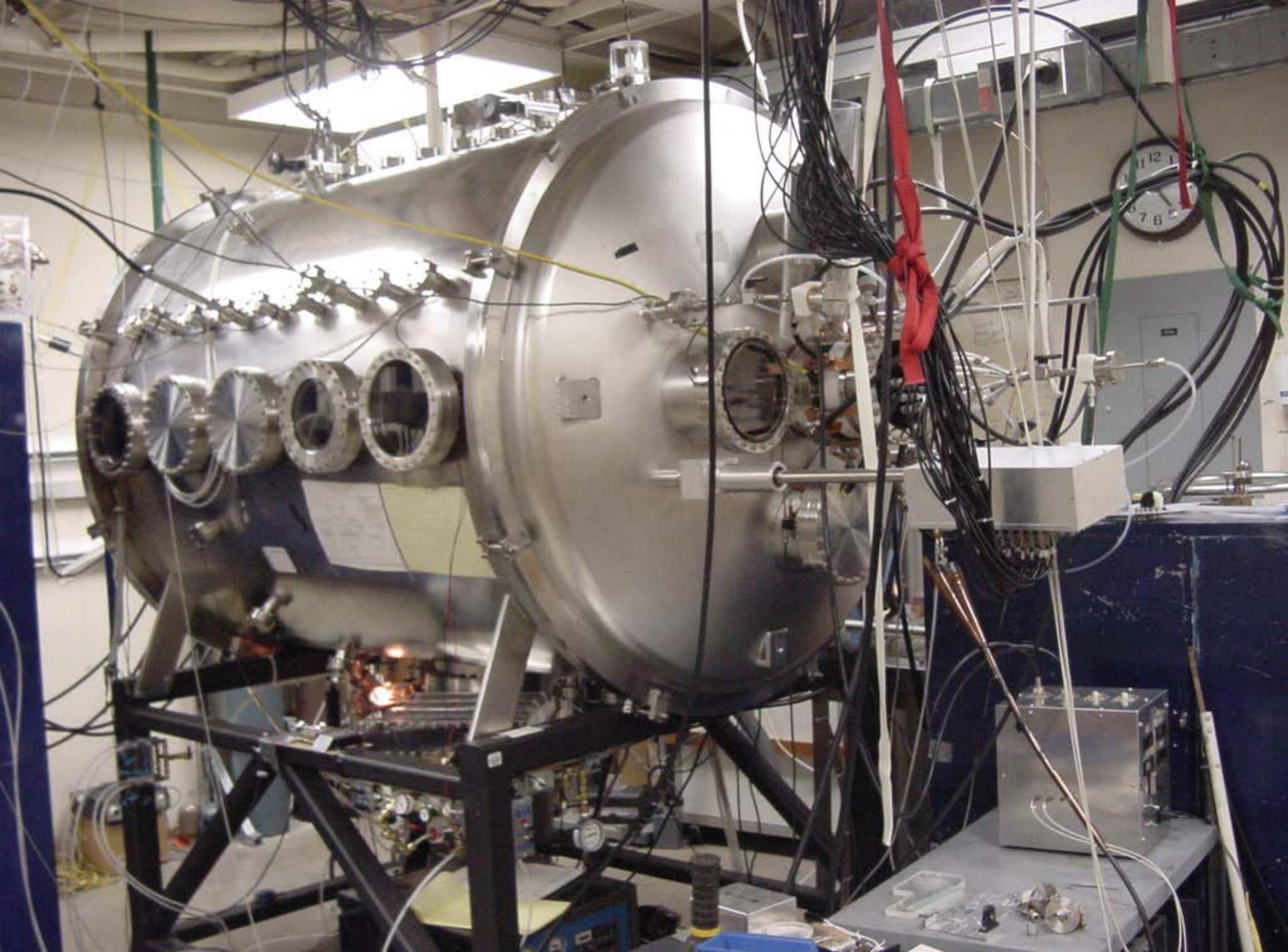
Concept of Caltech experiment

Suppose observer is in the wall,
then plasma is moving up

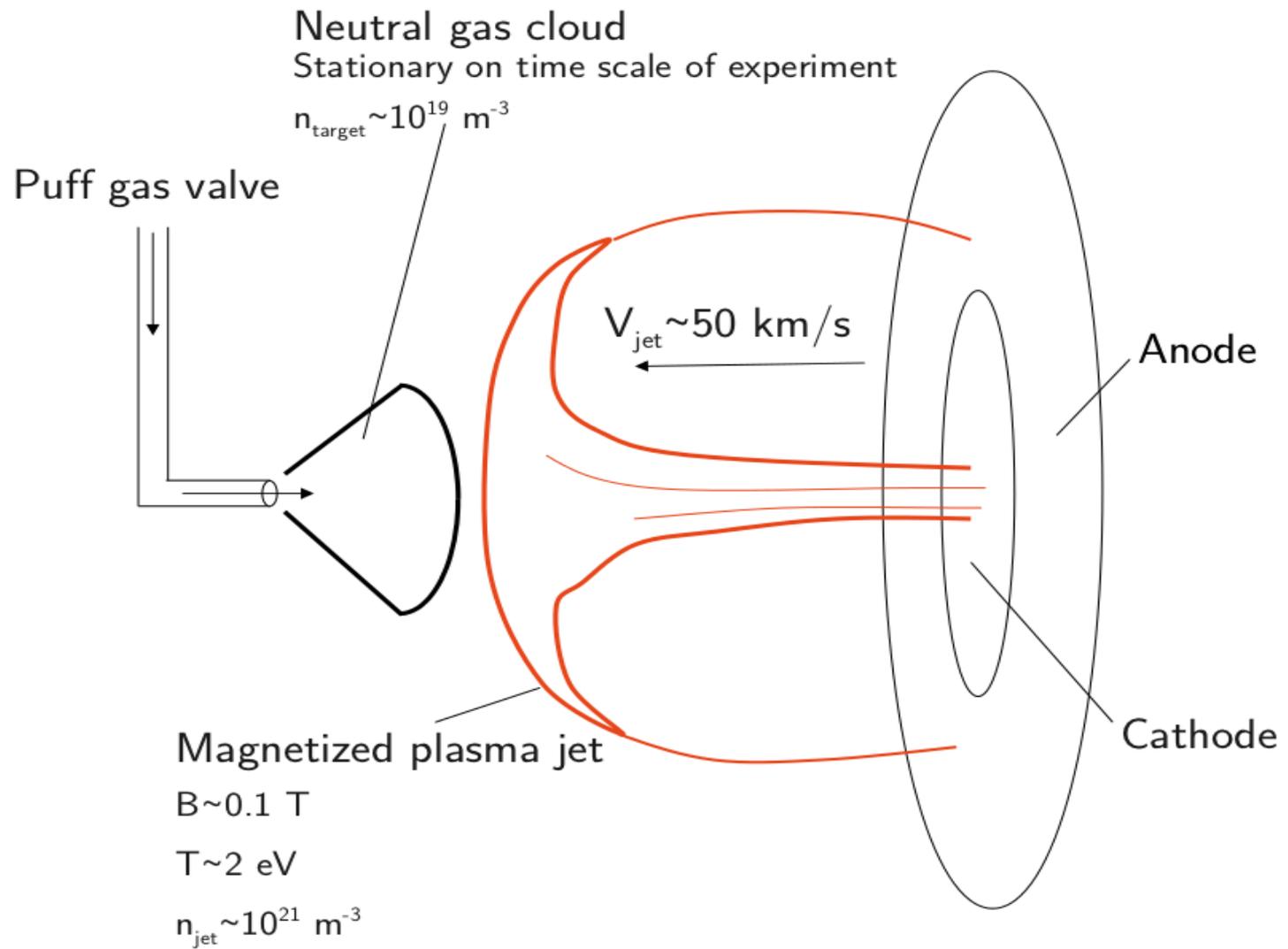


Essentially a change of frames, same physics

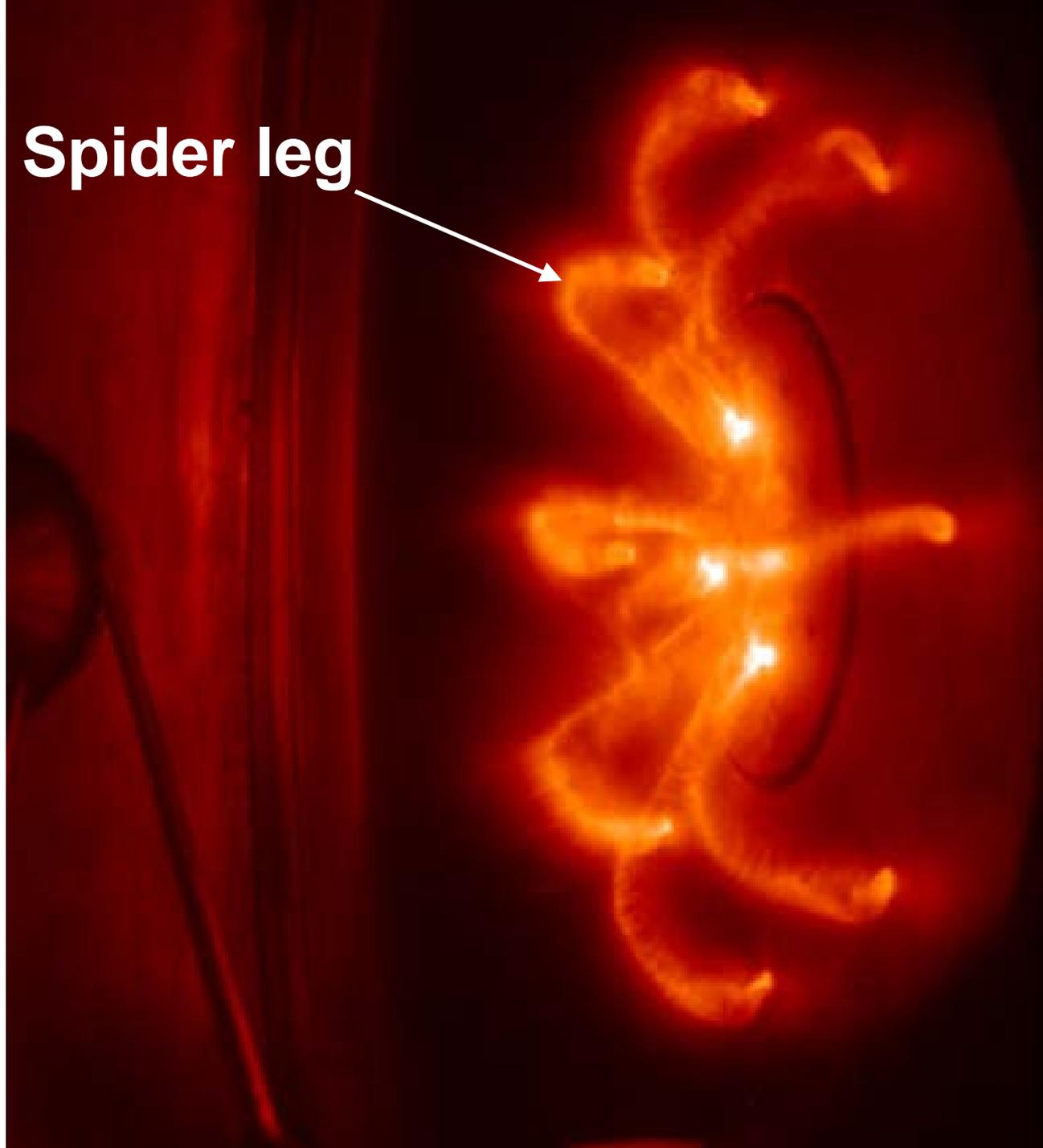
Virtue: non-destructive, lots of shots

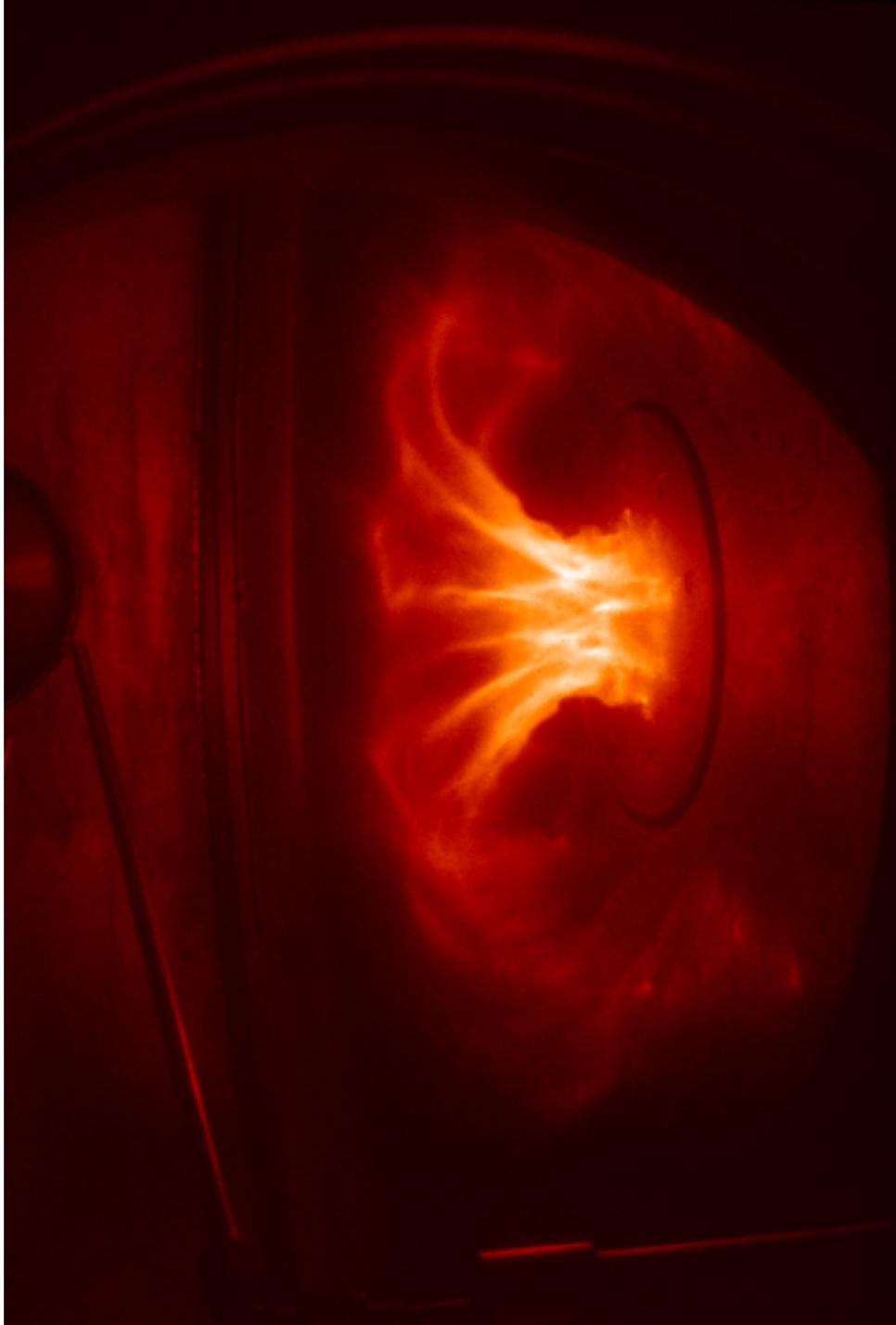


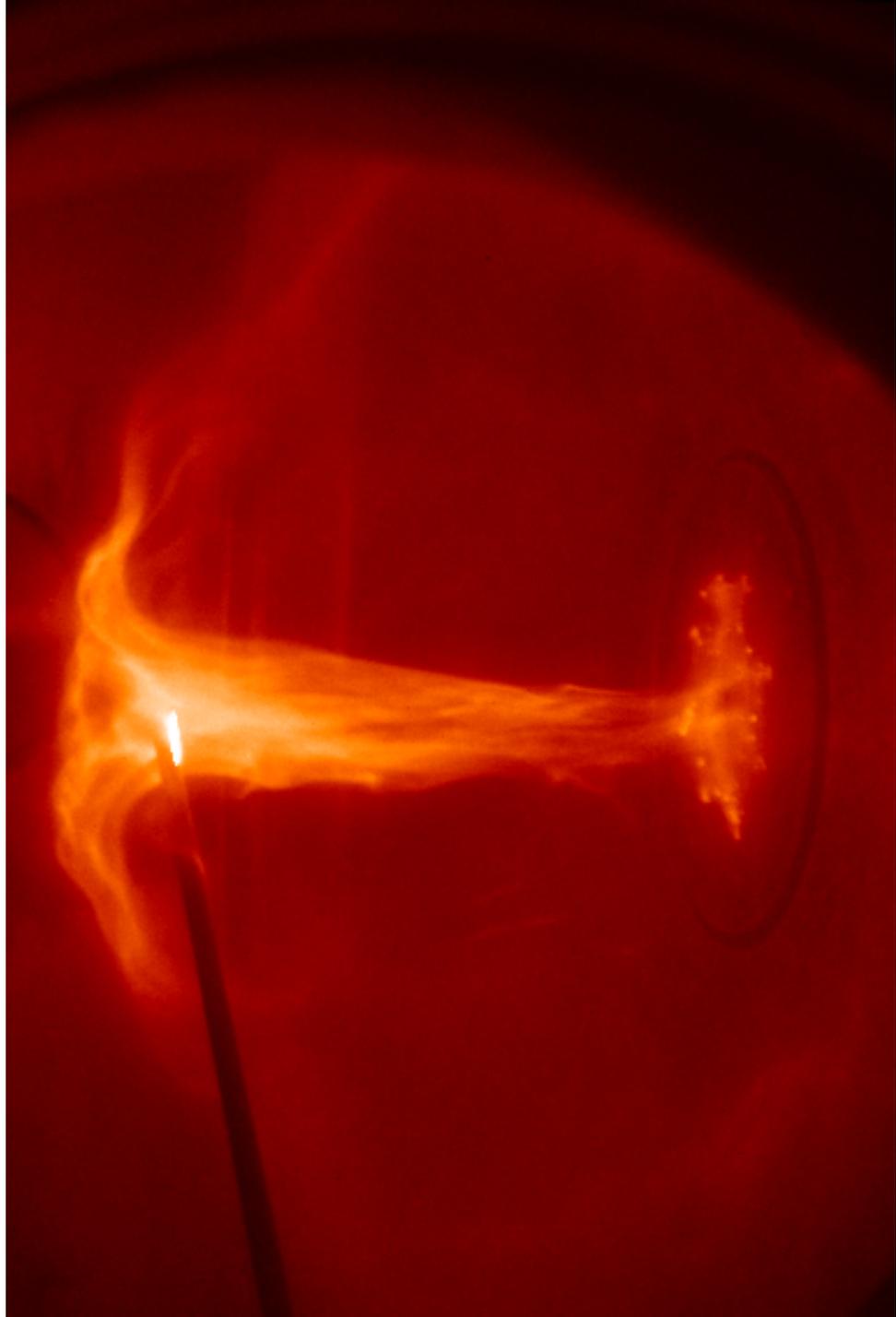
Caltech experiment:



Spider leg







Following diagnostics now operational:

- Fast ion gauge: measure density of neutral cloud
- High speed camera
- Helium-Neon density interferometer
- 12-channel, 1-m Spectrometer to measure density via H Stark broadening
- Axial magnetic probe array consisting of 20 sets of x,y,z Bdot coils
- Radial magnetic probe array consisting of 20 sets of x,y,z Bdot coils

Where we are now

Experiment

Amelia Greig scanned parameter space with hydrogen jet impacting argon cloud

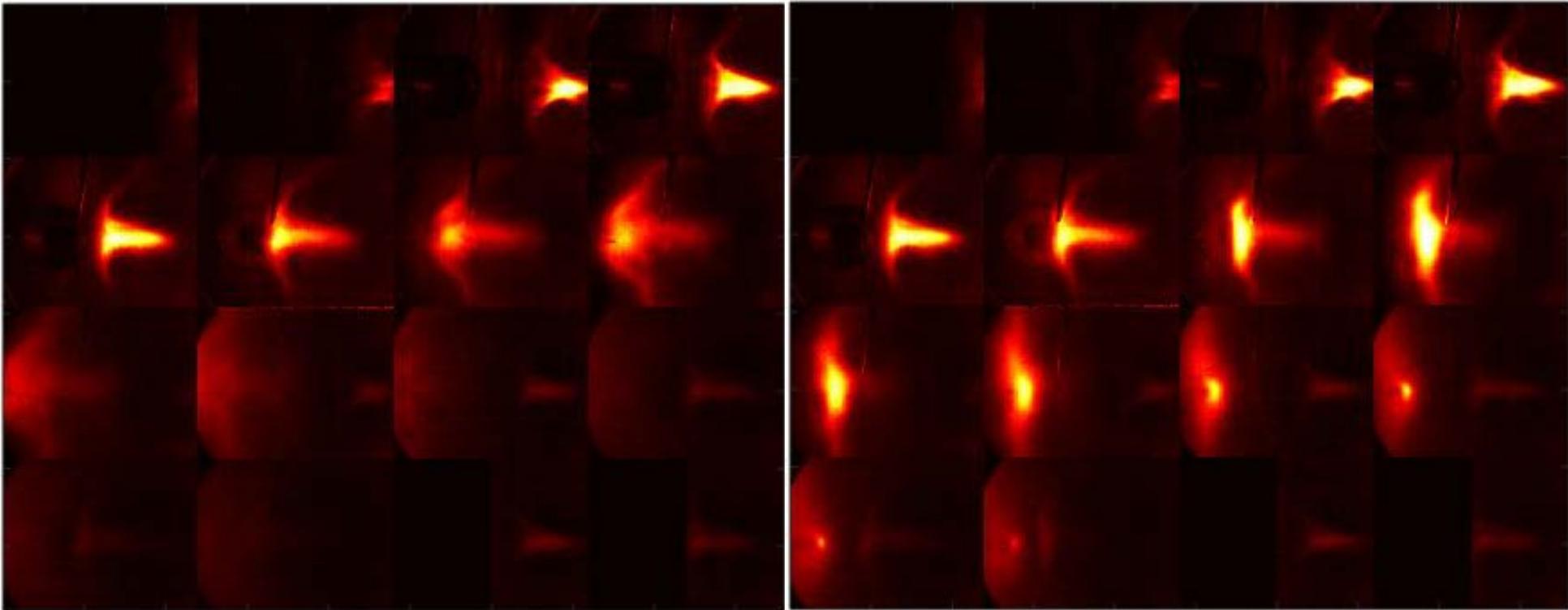
Observe 3-fold line-averaged density increase when jet impacts cloud

- seen by HeNe interferometer, Stark, brightness
- jet splays out so local density increasing less
- modest evidence of magnetic field compression
- no temperature measurements yet

Numerical

- 3D numerical MHD code to model experiment (Los Alamos, Hui Li)
- Li, Greig, Bellan have had detailed discussions to iterate 3D code
- code now in same ball park as experiment (density, magnetic field, speed, size)
- effort underway to reconcile code with experiment

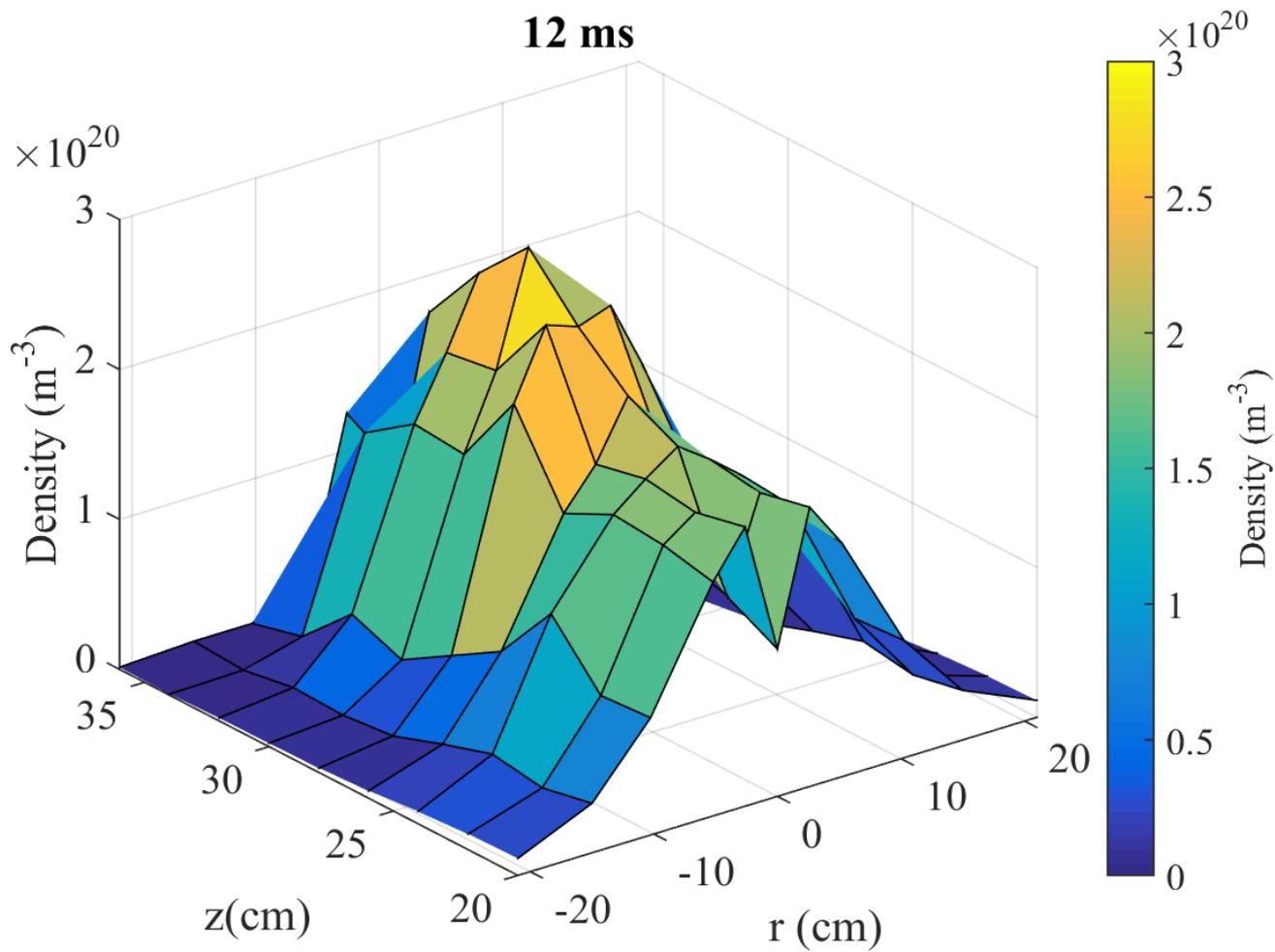
Typical data



Jet without target gas cloud

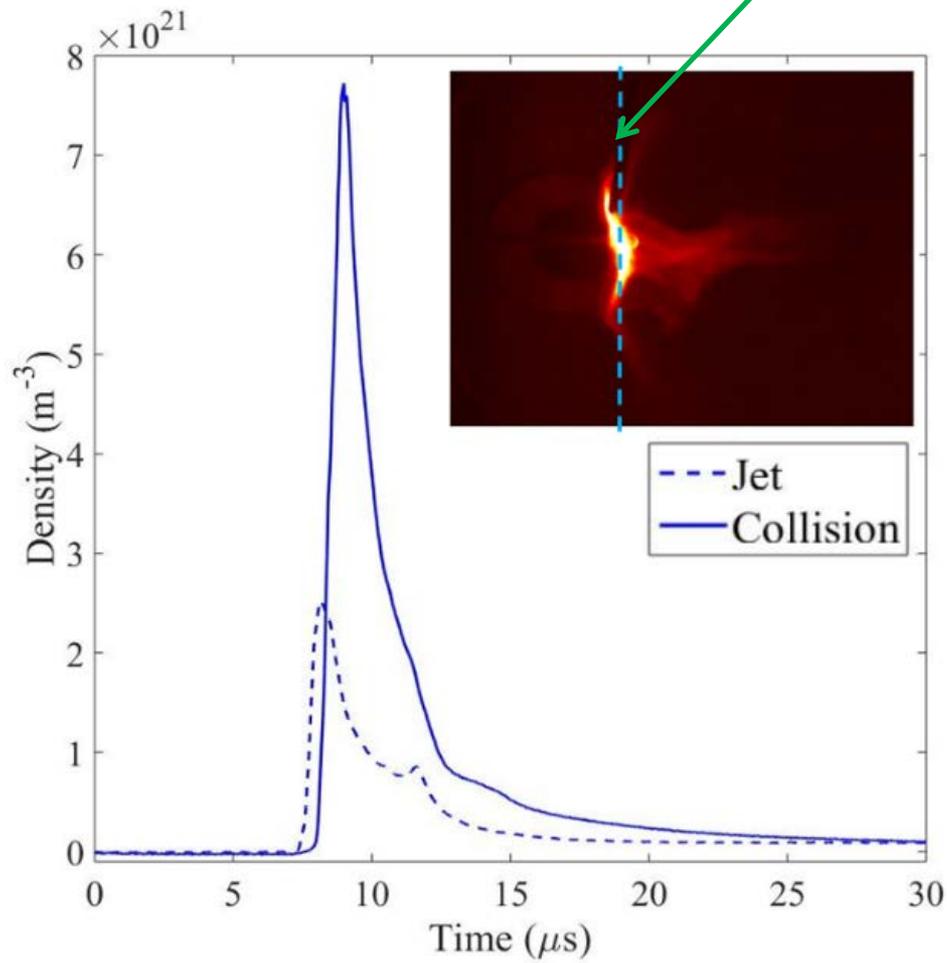
Jet with target gas cloud

Fast ion gauge measurements of neutral cloud density at the time of jet firing

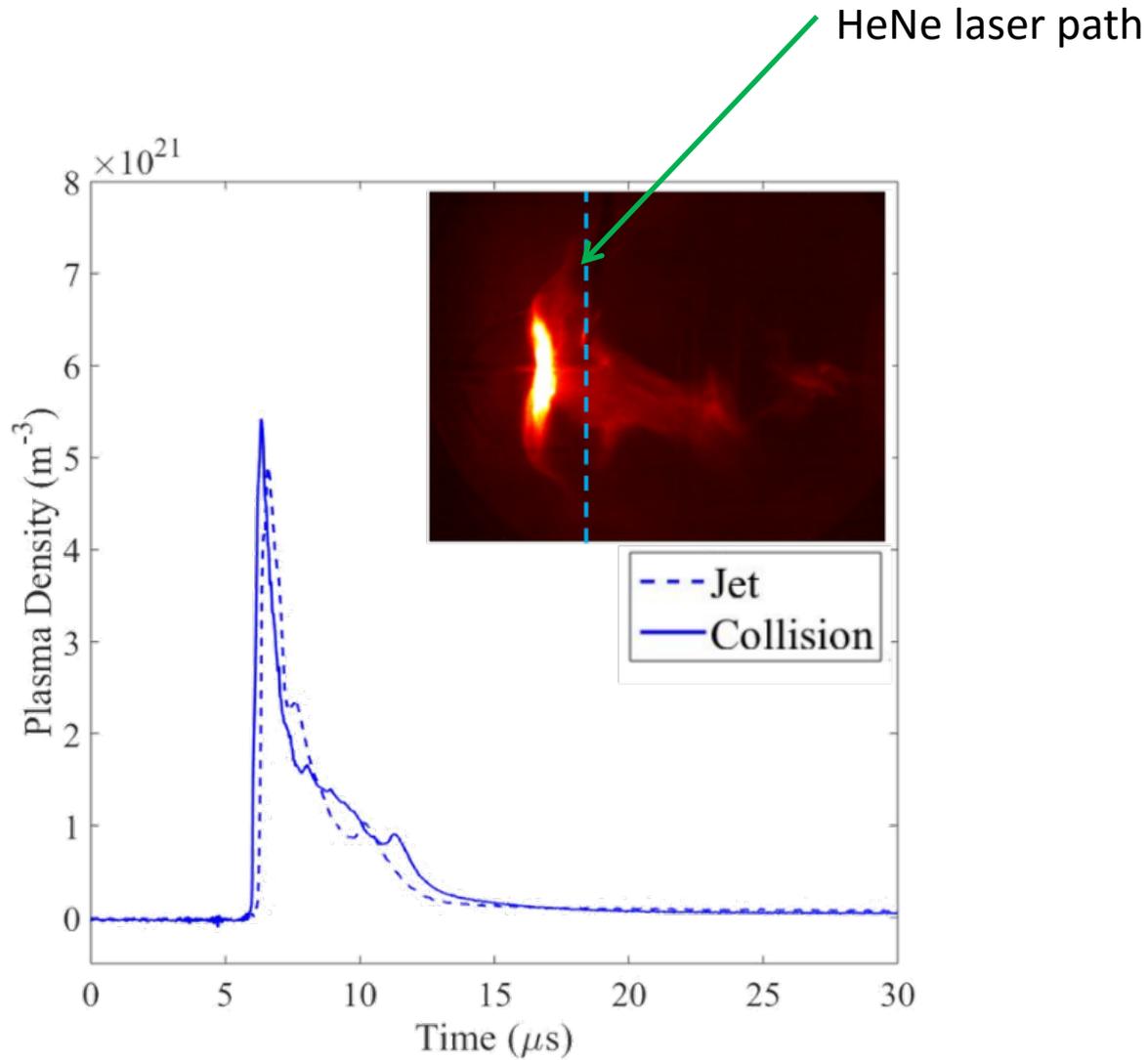


Line averaged density measured with HeNe interferometer
-laser beam passes through collision region

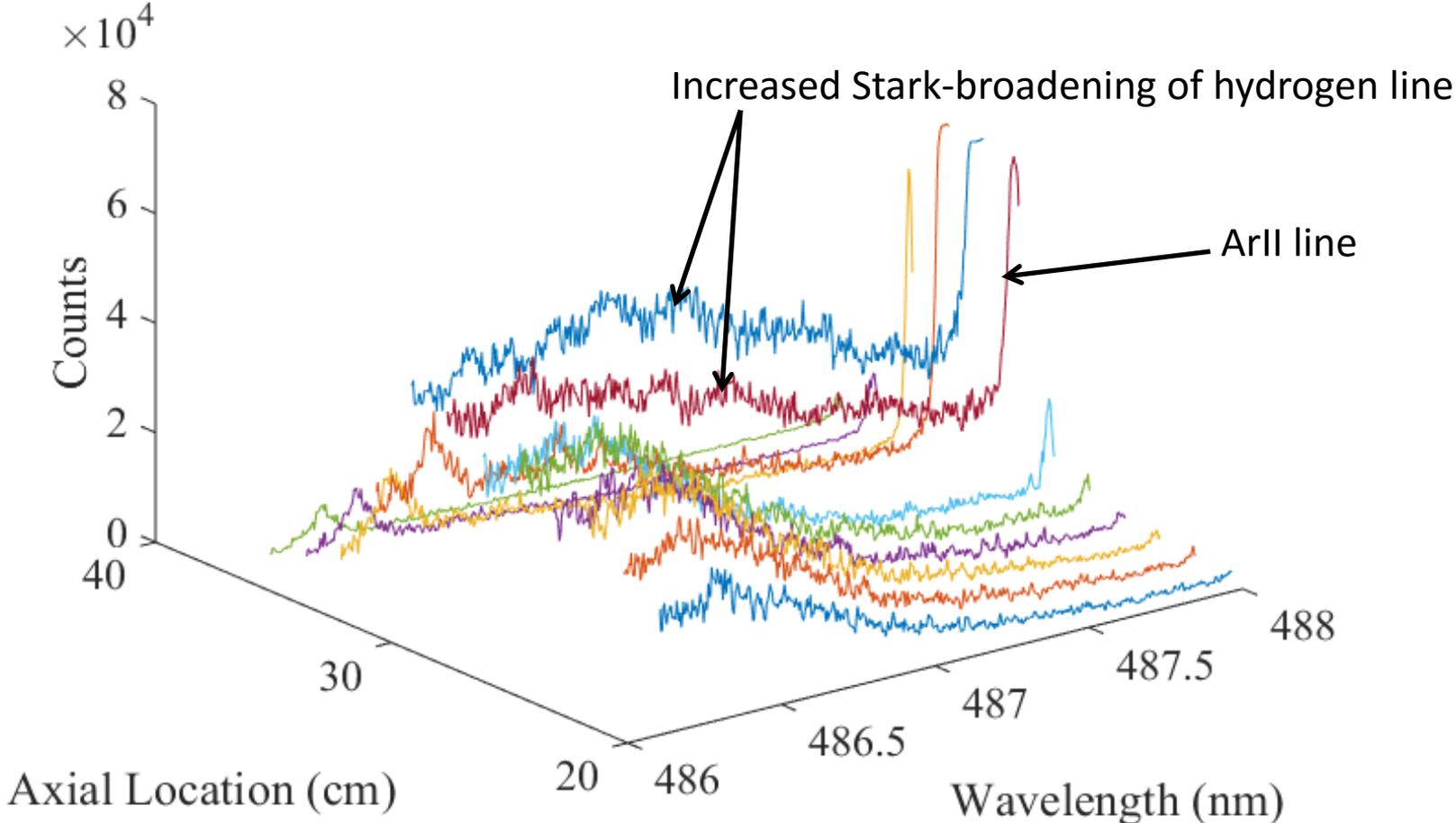
HeNe laser path



Line averaged density measured with HeNe interferometer -laser behind collision region



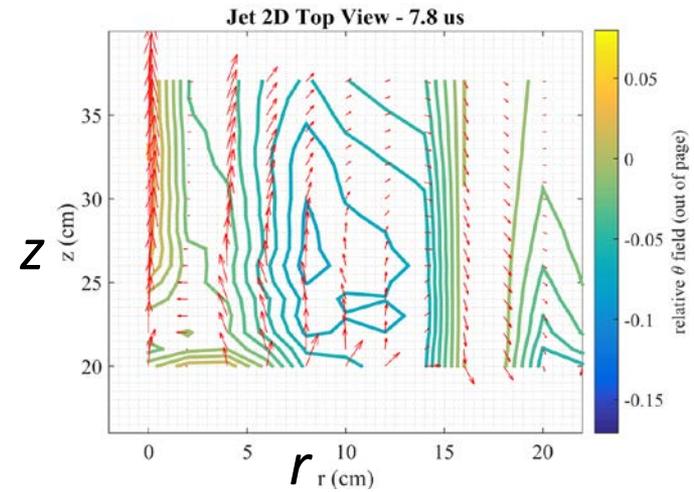
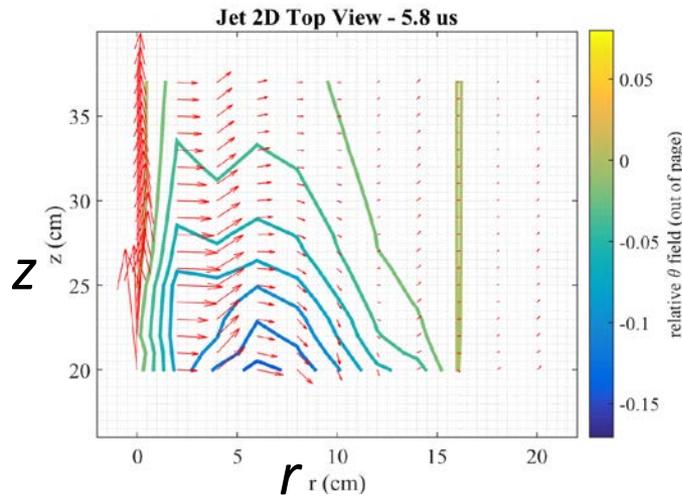
Stark Broadening of 486.1nm Hydrogen line at various axial locations



Magnetic probe array measurements in r - z plane

Arrows = poloidal field; Color contours = toroidal field

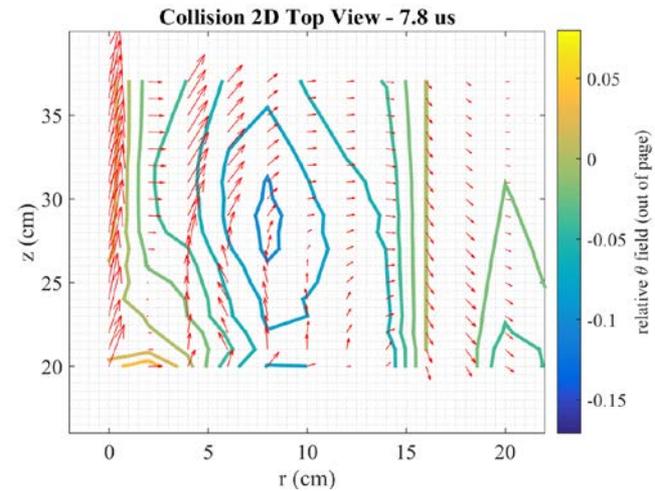
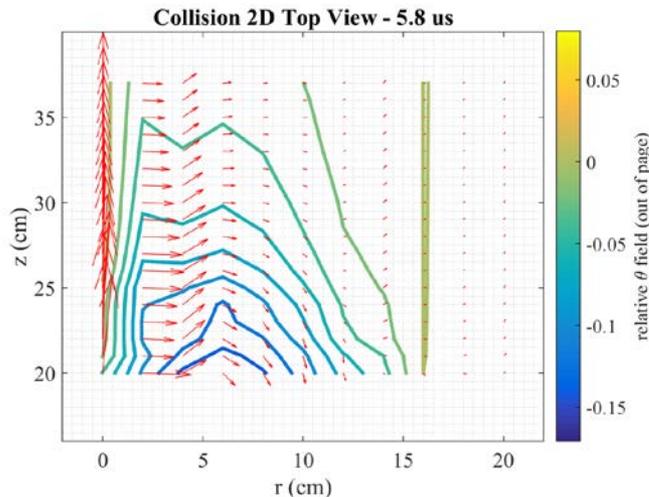
No
Target cloud



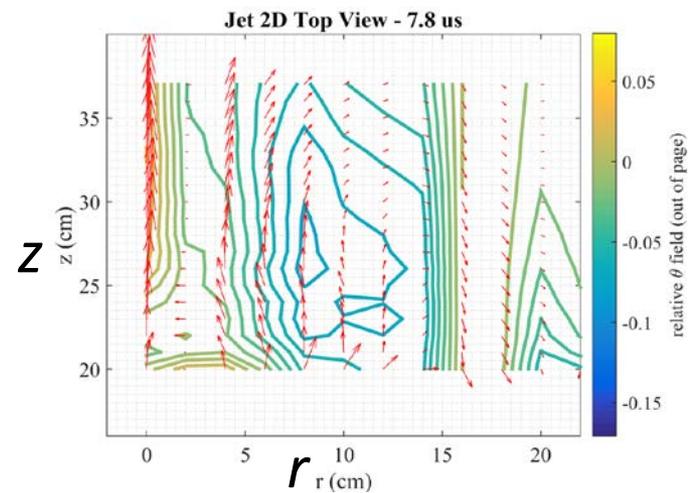
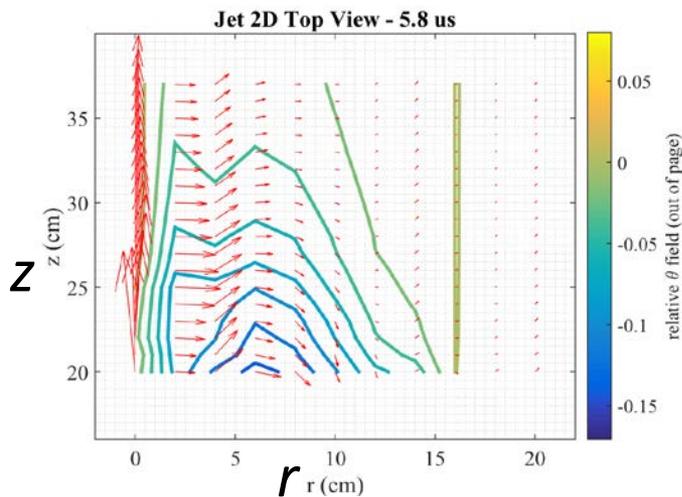
Early time, 5.8 μ s

Later (cloud collision) time, 7.8 μ s

Yes
Target cloud



No
Target cloud

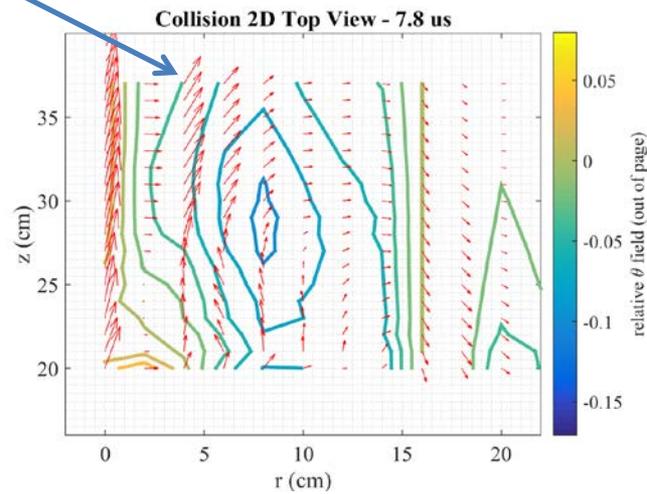
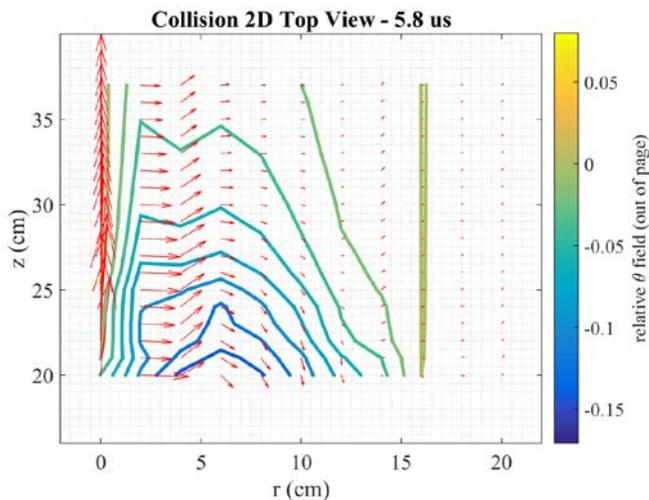


Early time, 5.8 μ s

Longer
arrow

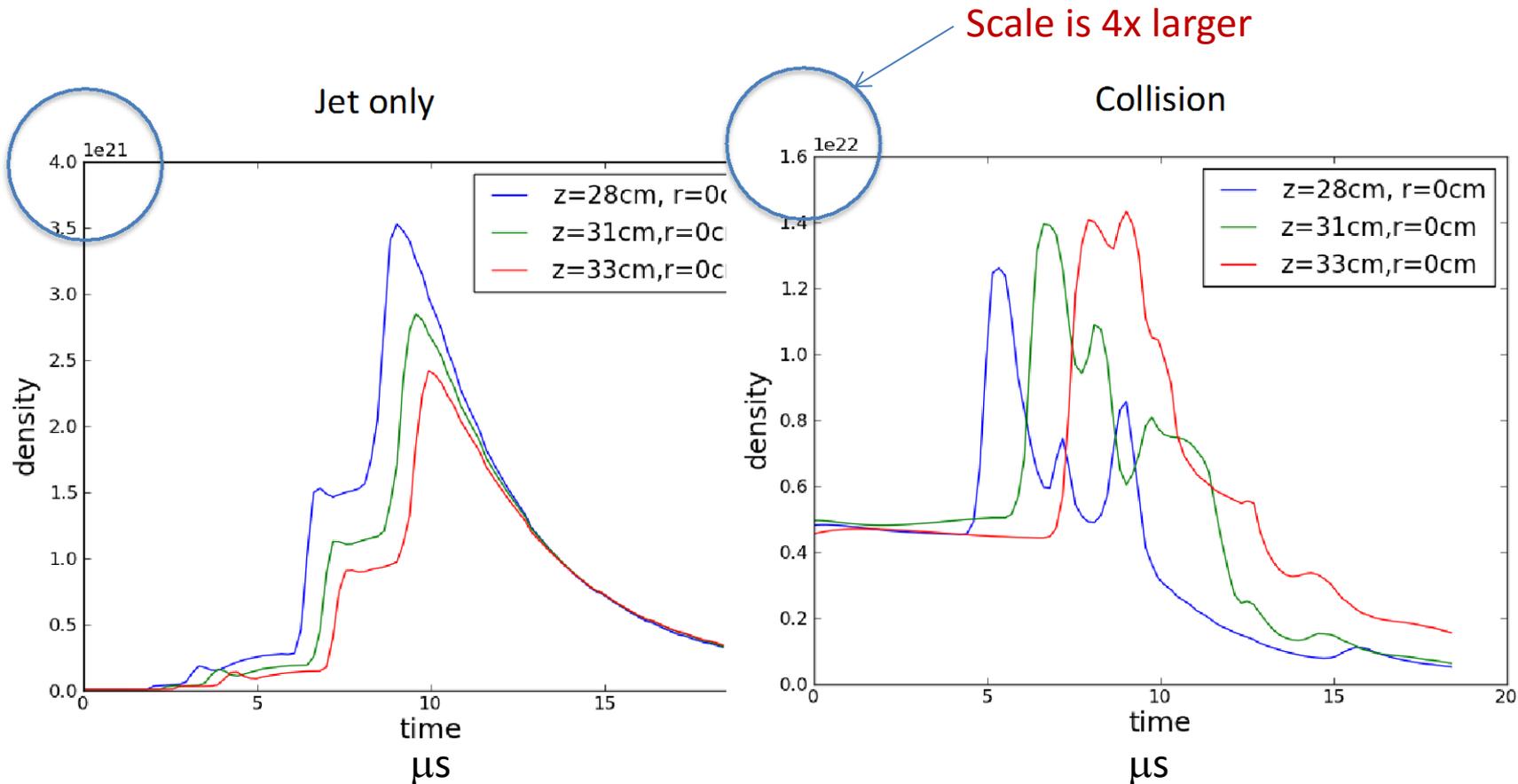
Later (cloud collision) time, 7.8 μ s

Yes
Target cloud



Numerical calculations- Hui Li (3D MHD supercomputer, 800^3 grid)

Density Enhancements

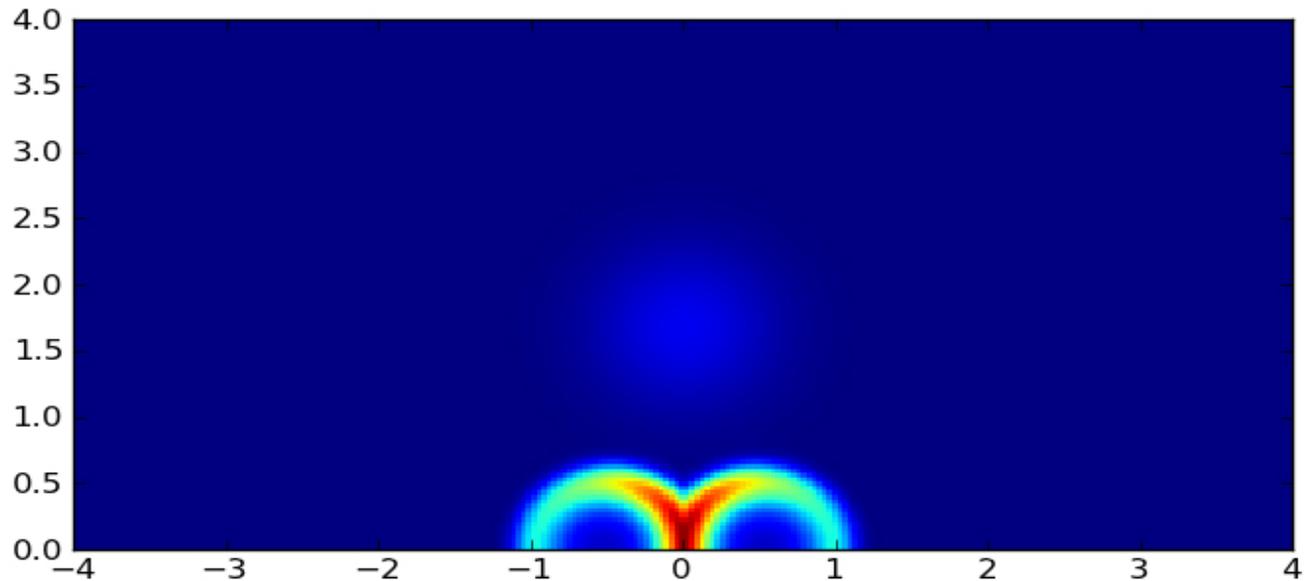


Collision Front Moves Away

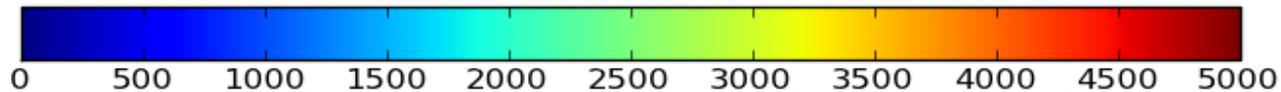
Density density at frame0000

dt = 0.184 μ s

x 18 cm



x 18 cm



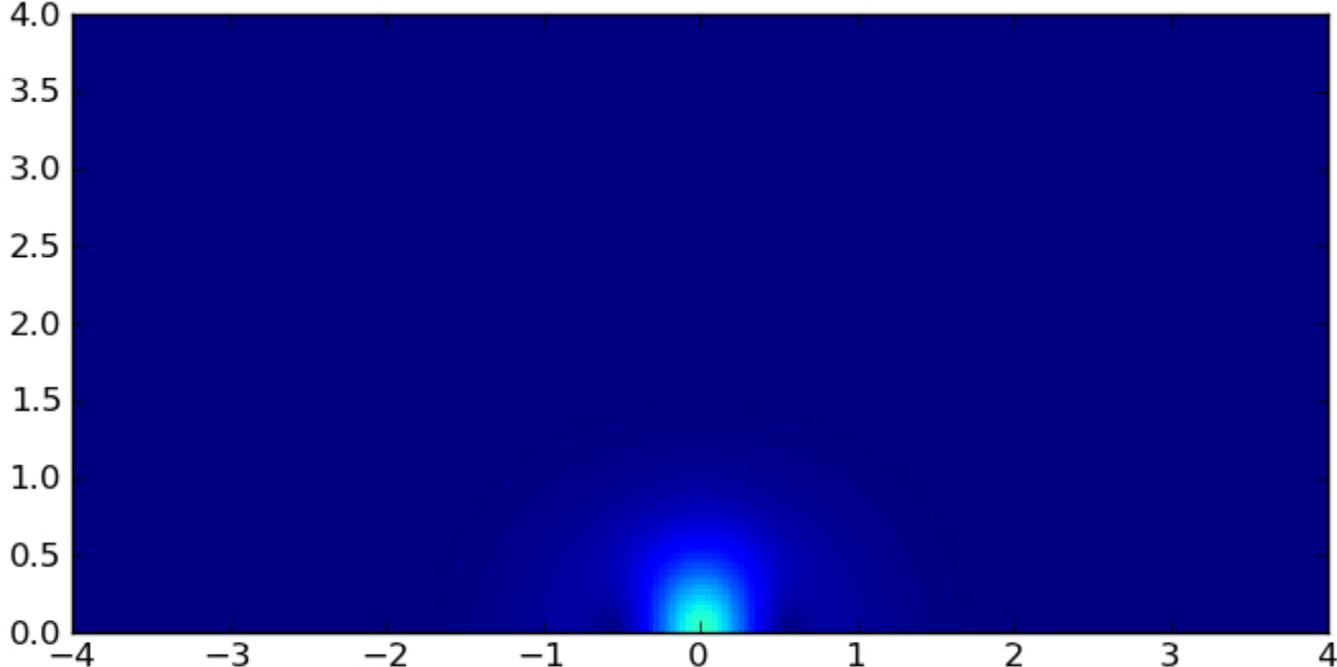
x 10^{19} m⁻³

Magnetic Field Evolution

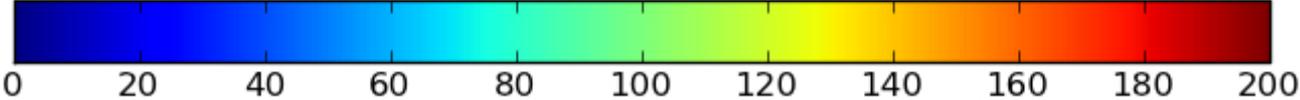
|B field| at frame0000

$dt = 0.184 \mu s$

x 18 cm



x 18 cm



x 20 Gauss

Recent activities:

Tried having jet collide with metal wall instead of gas cloud

- Not particularly different
- Less density increase

Plans

- get Thomson scattering built to measure density, temperature
- inject impurities to look for impurity broadening
- more scanning
- move interferometer beam (tentative)
- compare experiment with numerical code quantitatively

Personnel changes

Amelia Greig has accepted faculty position at Cal State San Luis Obispo starting Sept 1

Byong Hoon Seo will take over, is overlapping 6 weeks with Amelia

- has experience with Thomson scattering diagnostic in high density plasma

- will be setting up Thomson scattering