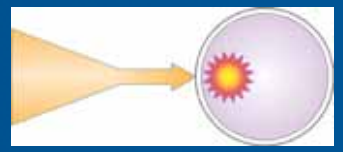
Targets for Benchmark Experiments



Rich Stephens
General Atomics

- Laser Facility - J. Pasley
- Analysis tools - M.-S. Wei
- Diagnostics - L. Van Woerkom, M. Key

Summary - F. Beg

3rd Fusion Science Center meeting
Rochester, NY
27 January 2006

ICFT/P2006-011

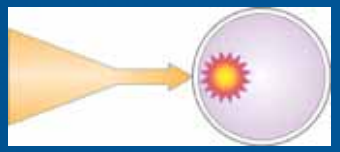
Sandia National Laboratories

UCSD

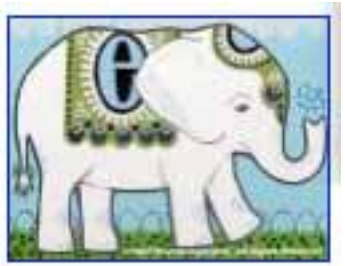
THE OHIO STATE UNIVERSITY

GENERAL ATOMICS

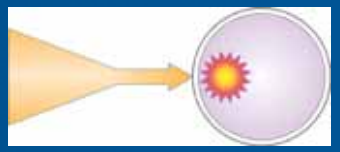
Goal to design and field benchmark expts

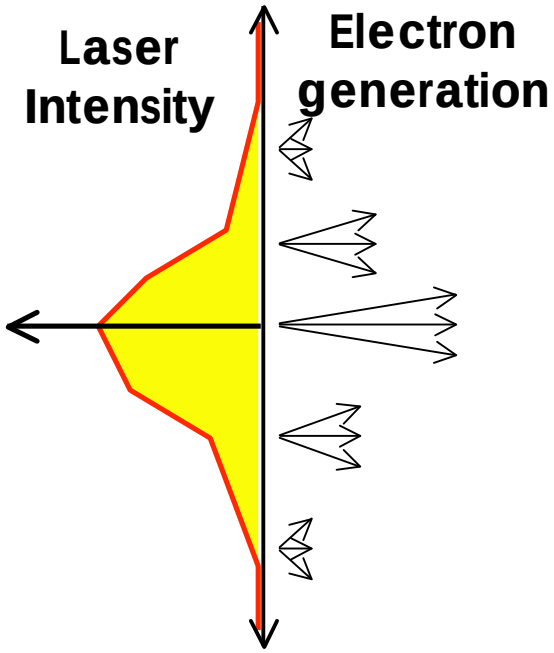


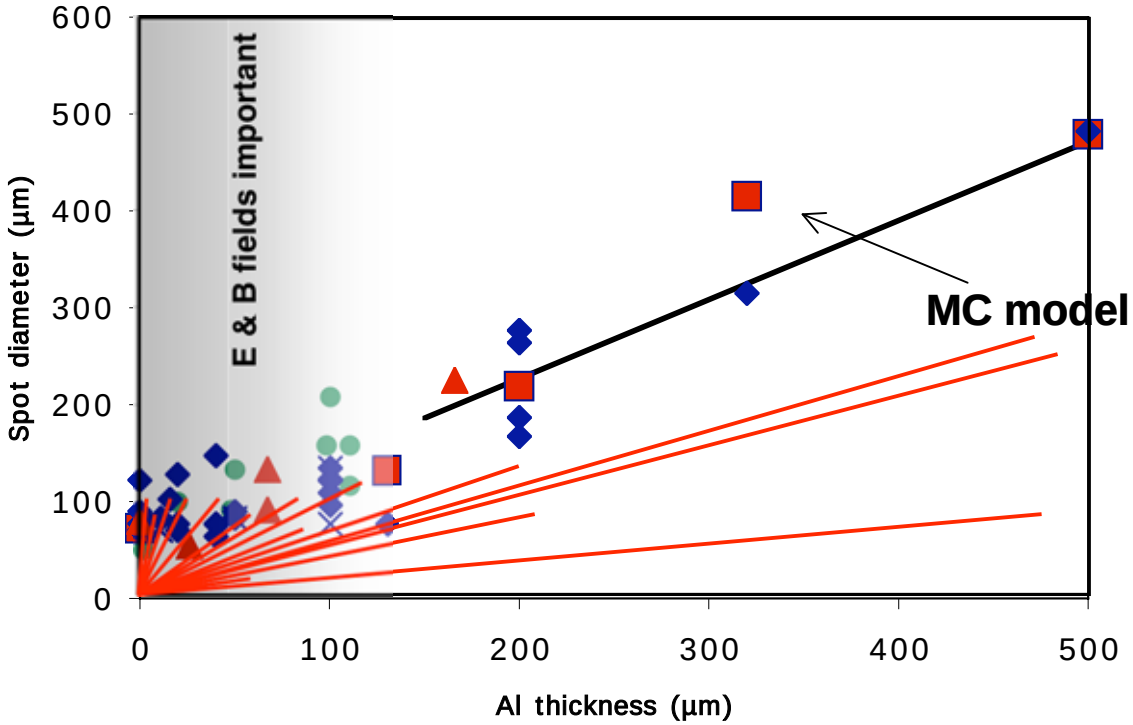
- **Current experiments have been modeled descriptively**
  - **Experiments too complex to model**
  - **Codes can't model at scale length of experiments**
  - **Parameters too uncertain for use in code validation**



e⁻ transport described w/o E/M fields!



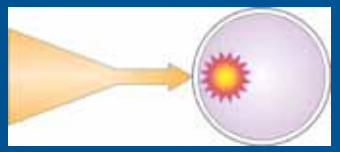




- e⁻ generation efficiency & energy from local intensity (Beg scaling)
- Random transverse momentum independent of location
- Includes scattering, but no fields.

Physics hidden in heuristic rules

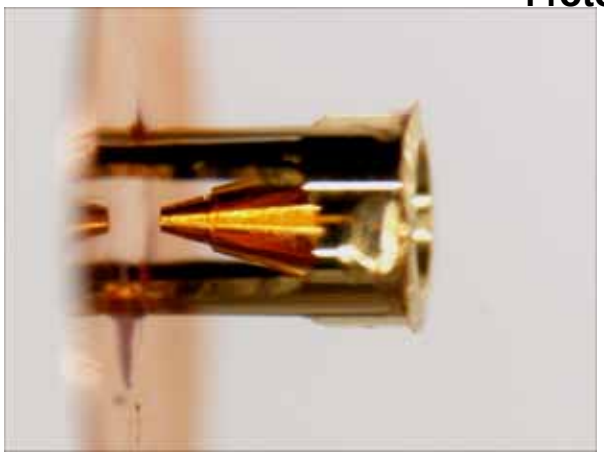
Targets integrate several components

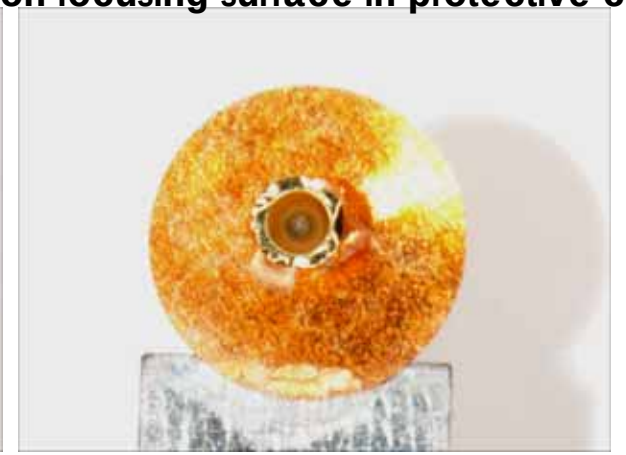


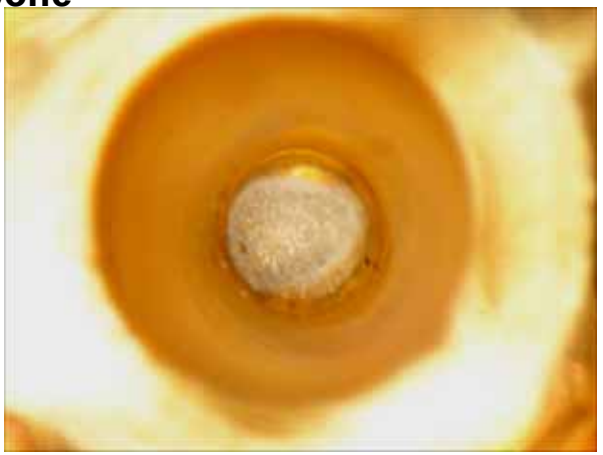
Previous targets

- **Designed to show FI performance specs**
- **Complicated geometry**
- **Intertwined phenomena**

Proton focusing surface in protective cone

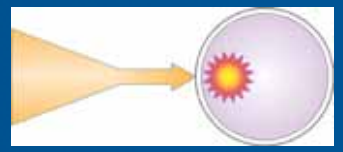




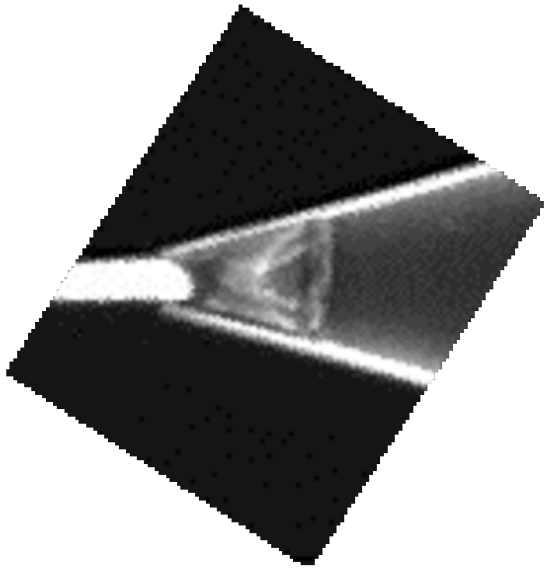


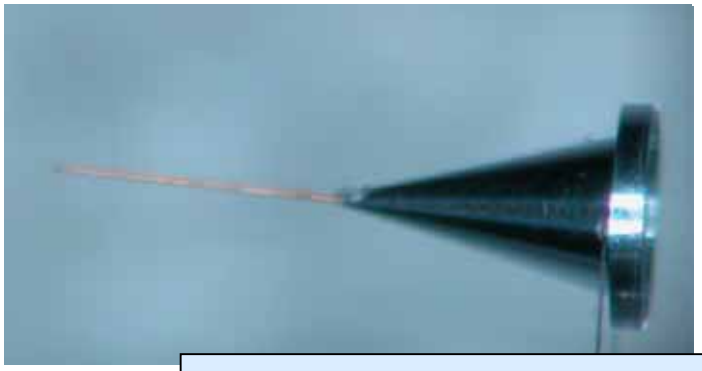
Target should be focused on one phenomenon

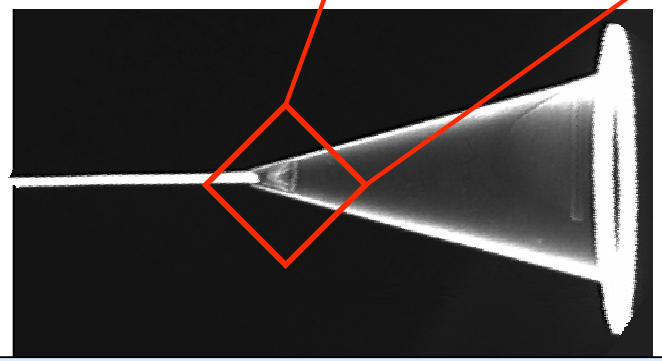
Laser interactions variable and complex



- **Characterize laser pulses**
- **Improve interaction area**
  - Simple geometry
  - Insensitive to pointing errors

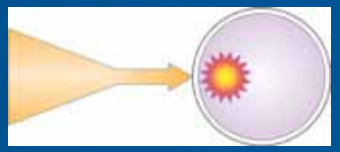






Target simplify laser interaction

Goal to design and field benchmark expts

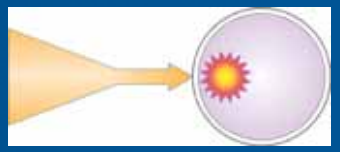


- **Current experiments have been modeled descriptively**
  - **Experiments too complex to model**
  - **Codes can't model at scale length of experiments**
  - **Parameters too uncertain for use in code validation**

⇒ **Remove free parameters:**

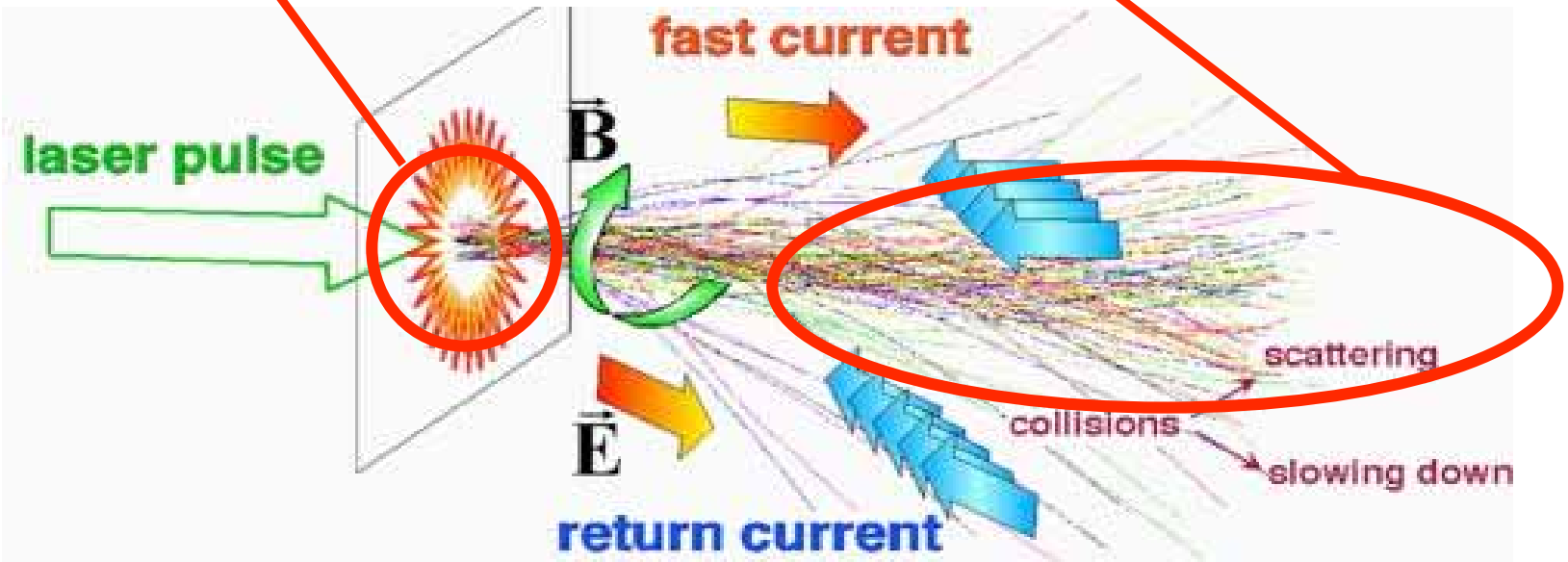
  - **Use simple geometries**
    - **Focus on single phenomena**
    - **Small enough to be modeled**
    - **Compatible with laser pointing errors**
  - **Carefully characterize laser pulse**
  - **Carefully characterize experiments**

Have to focus experiments on specific regions



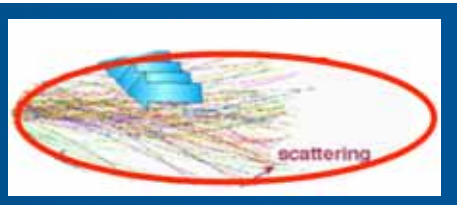
Laser plasma Interaction

Electron Transport

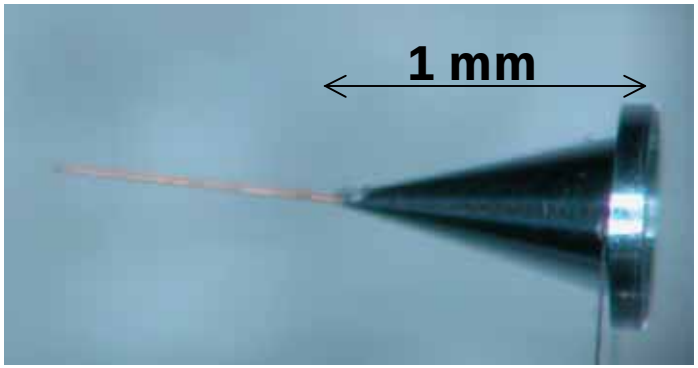


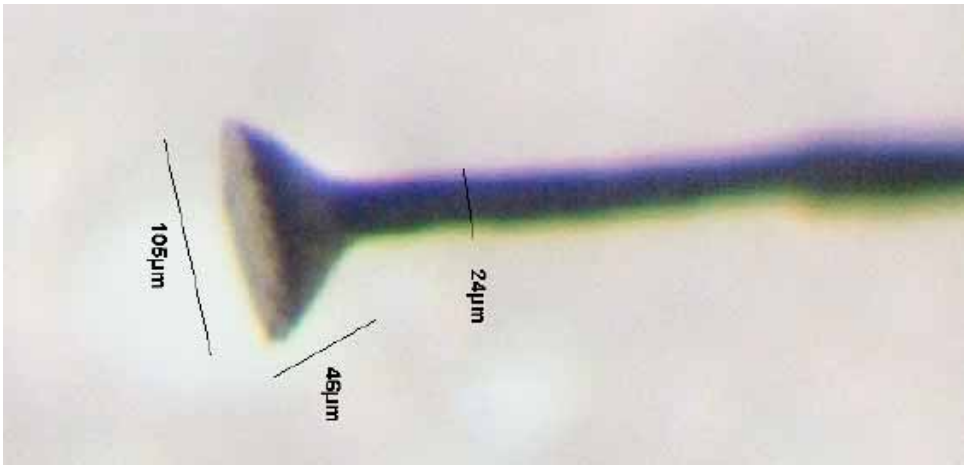
Hybrid PIC model (Paris) (C Toupin et al. In Inertial Fusion Science and Applications 99 Publ. Elsevier p471 (2000)

Electron transport at high current density



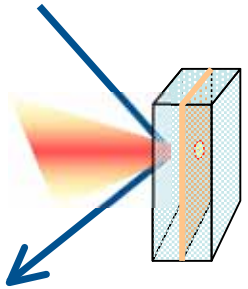
- **Test modeling by PIC-hybrid codes**
- **Go to 1-D geometry -- But simplify**
  - Simplifies electron paths
  - Improves diagnostic access
  - Maximizes signal?
  - Cheaper



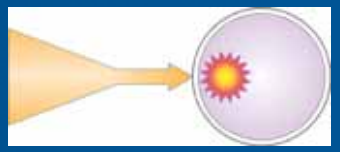


Laser plasma interface

- **Test PIC codes description of electron generation**
- **Targets are flat foils**
  - Micromachined flat surface
  - Slightly buried fluorescent layer
- **Look directly at interface**
  - Time sensitive reflectivity
  - Electrons injected into metal
- **Control plasma gradient with controlled prepulse**

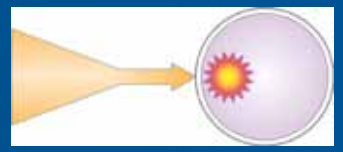


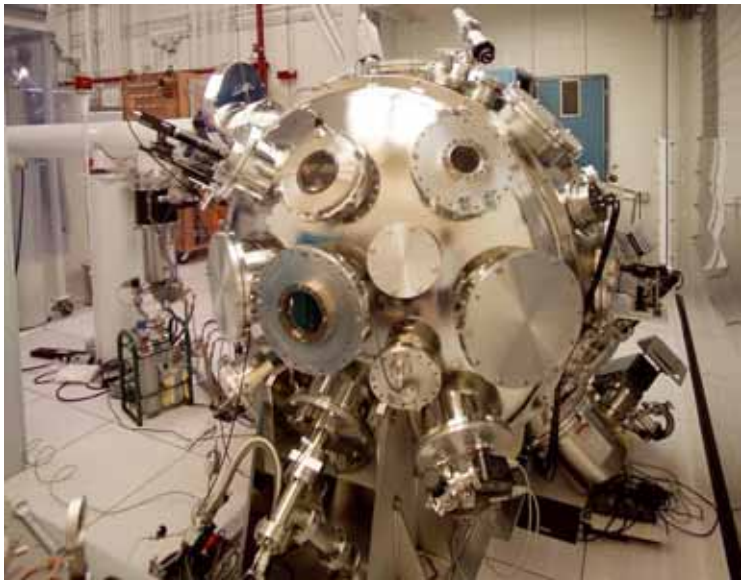
Experiments to define plasma conditions



- **Future benchmarking experiments will need well defined hot plasma**
  - Density, temperature for useable scale length
- **Aerogel/Foam experiments will be used to develop proper characterization**
  - Titan, EP are suitable platforms

These targets are part of carefully defined experiments on ZPW





- **Laser - Pasley**
- **Analysis - Wei**
- **Diagnostics - Van Woerkom**