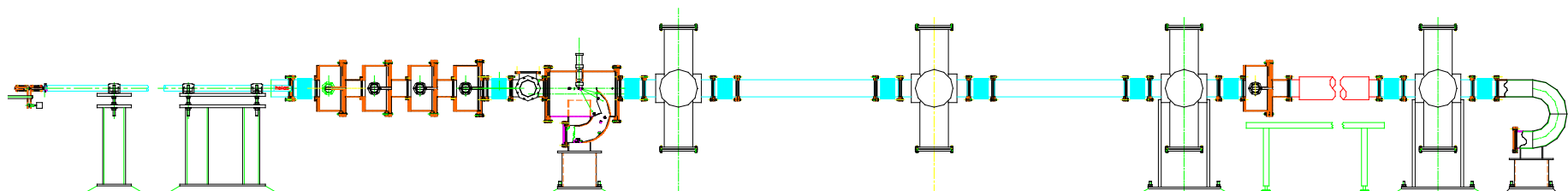


Status of Inertial Fusion Energy Target Injection & Tracking System

Ronald Petzoldt, Dan Goodin, Mike Hollins, Tom Drake, Dennis Lieurance,
Kevin Jonestrask, Chuck Gibson, Neil Alexander, Joe Wellhouse, and Gottfried Besenbruch



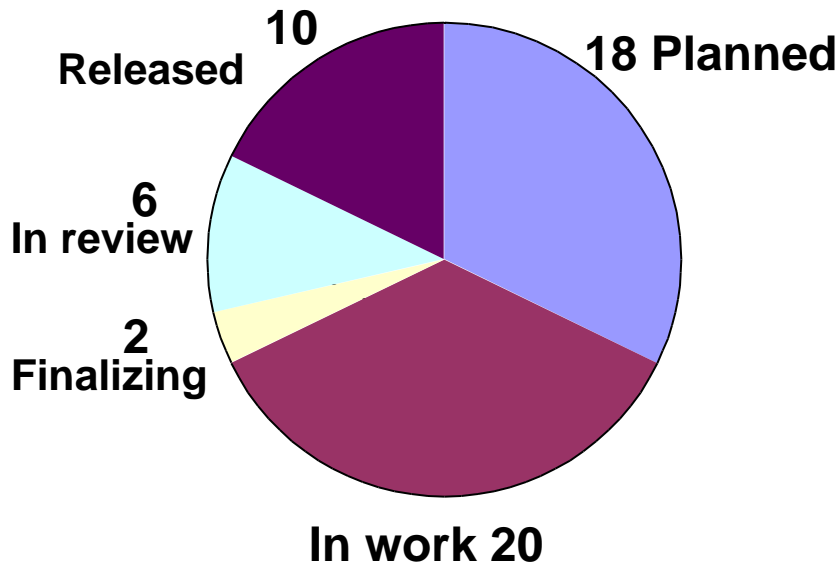
LASER IFE Program Workshop
Naval Research Laboratory

1 June 2001



Injector design documents are on track

Document Status 05-15-01
- Drawings and word doc's



Recently released documents:

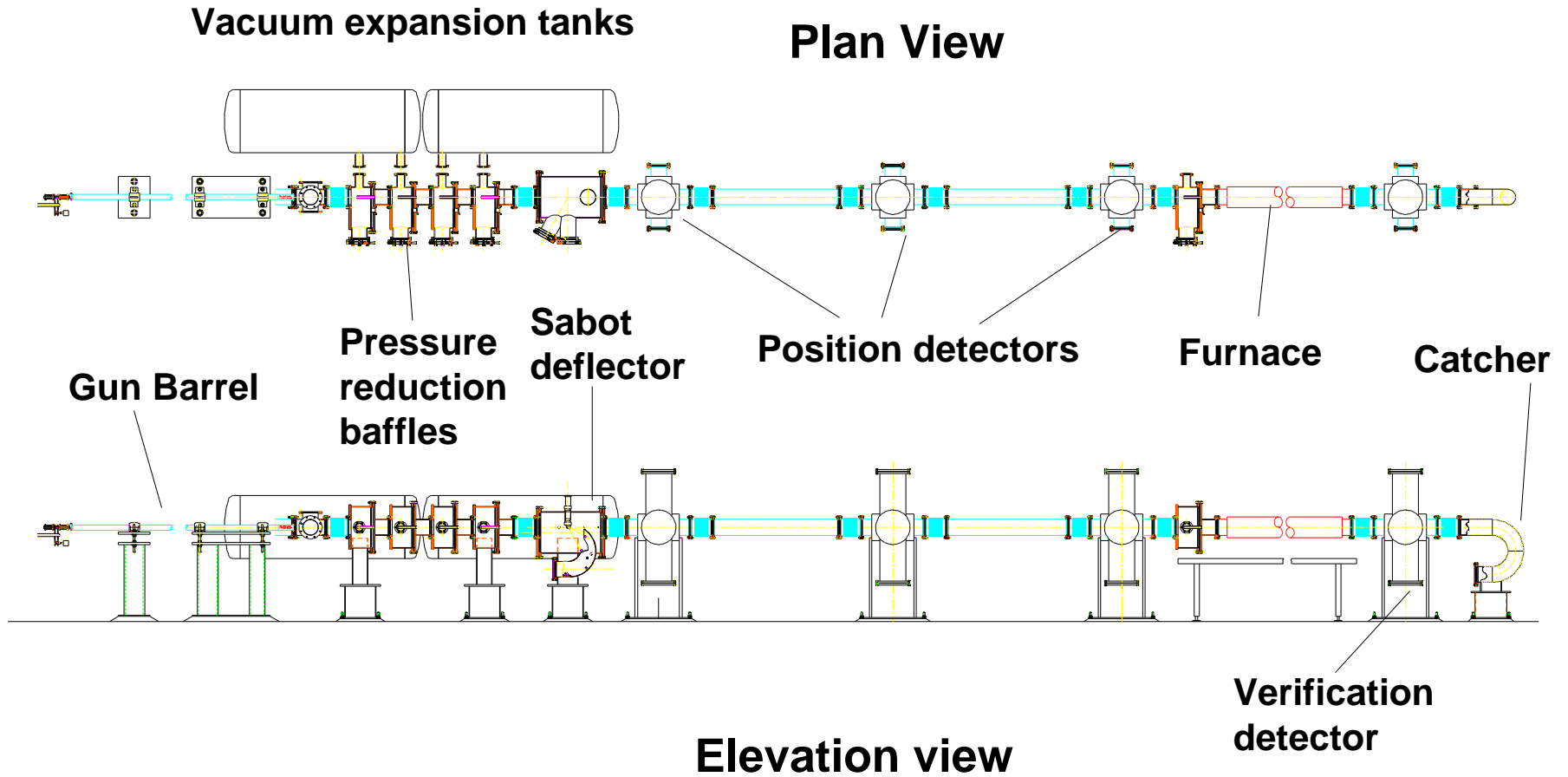
- Preliminary sabot test plan
- Sabot assembly drawing
- Baffle chamber specification
- Sabot deflector chamber specification
- Target catcher chamber specification

Current emphasis:

- Target tracking real time computation
- Gun barrel design
- Sabot loading design
- Sabot performance testing
- Propellant valve design and test
- Control system work to resume in June

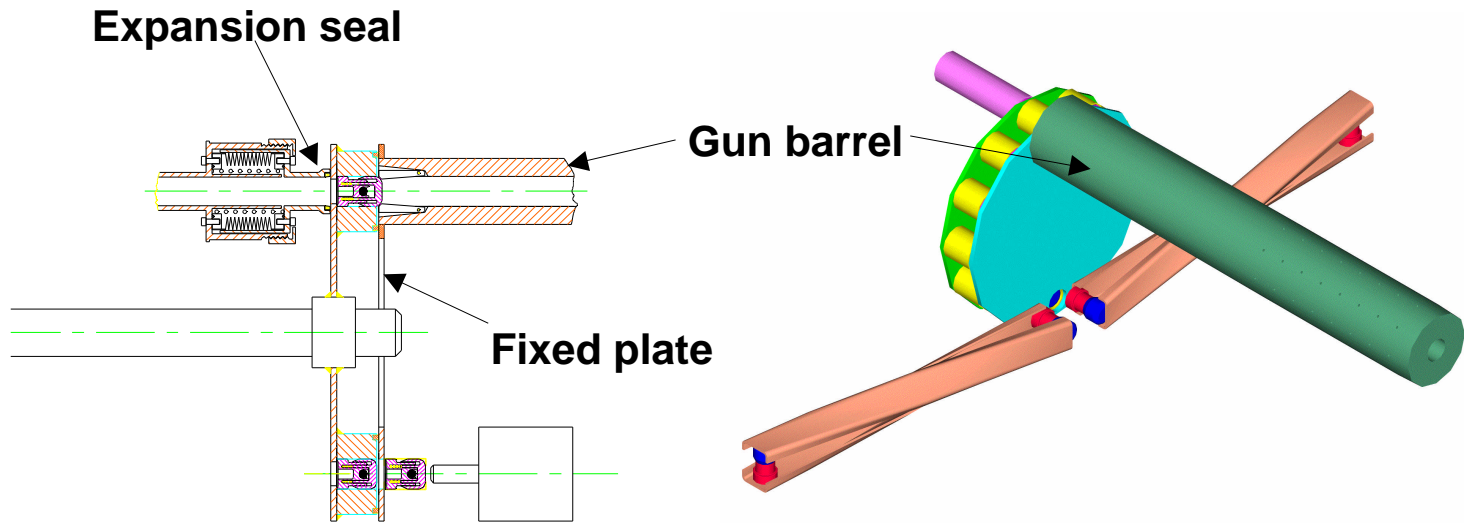
...Design will be completed this year

System mechanical layout is proceeding well



...”End to end” layout completed

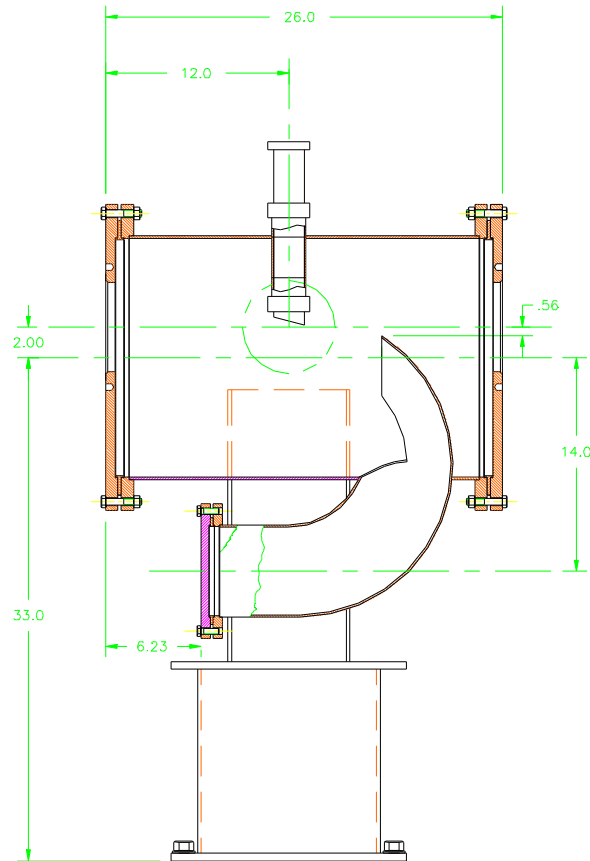
Loading mechanism and process



Sabots are loaded into 12 shot revolver

Cryogenic assembly may require 90° sabot rotation

Simplified sabot deflector design



- Simple and easily adjustable design
- Vacuum vessel
- Deflects sabot to separate from target
- Procurement strategy is procurement spec and spec control drawing.

Sabot separation and deflection was identified as area needing testing in CDR. Preliminary testing is complete.

Preliminary sabot deflection hardware has been assembled

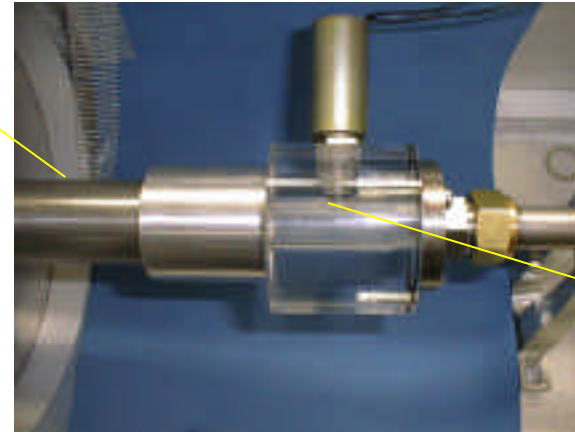


Gas supply

Gun barrel

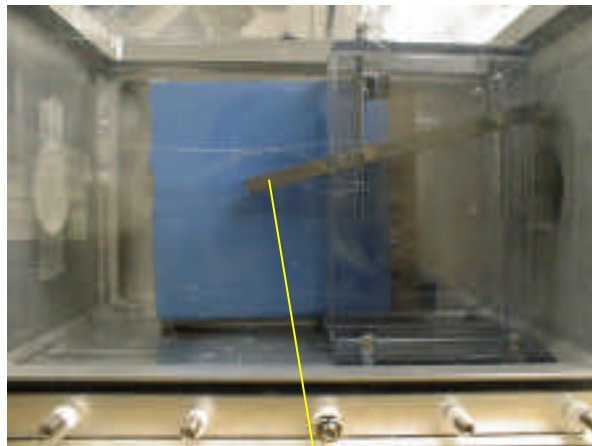
Pressure transducer

Injector from propellant end



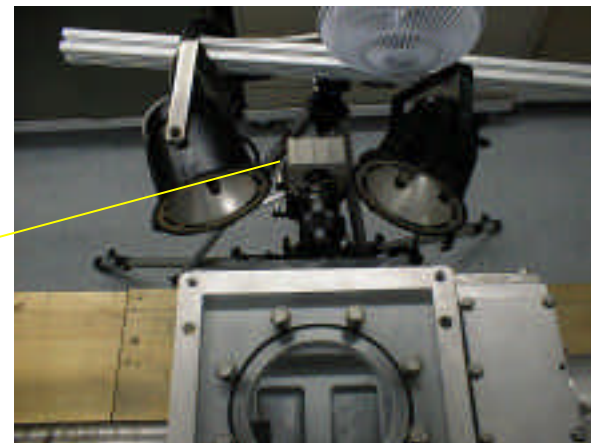
Latch

Sabot latch



Test sabot deflection plate

Fastcam
Ultima 1024
16,000 fps
1/128,000 s
Shutter speed



High speed camera setup

Stationary sabot separation testing was successful



4 mg capsule separation from sabot in vacuum (2000 fps)

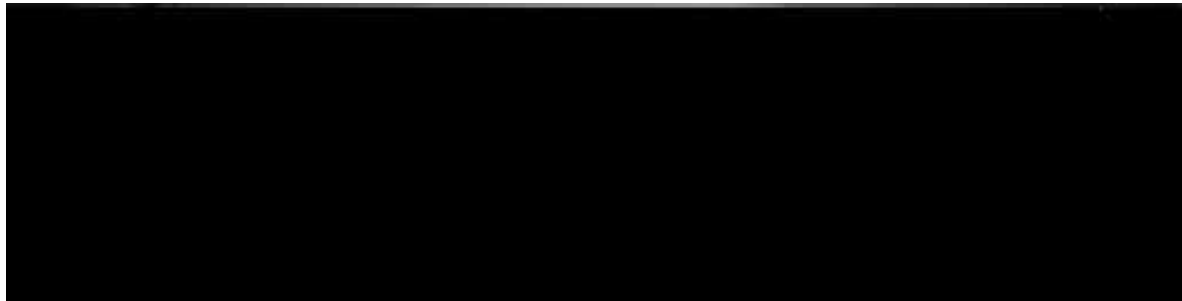
We experienced early sabot separation in latch



2000 fps

Due to excessive gas blow by in latch,
inter-segment pressure buildup, and latch drag on sabot

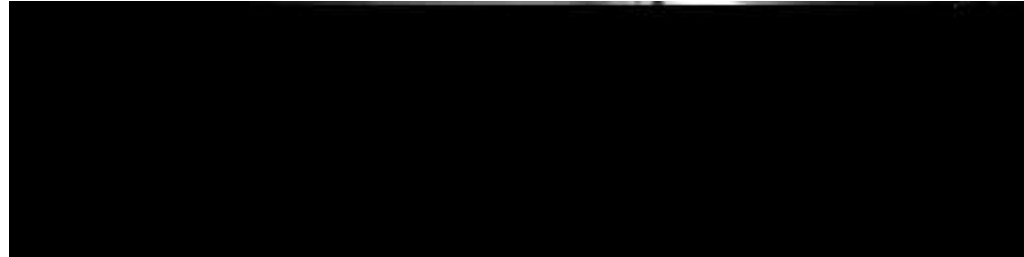
Design modifications corrected early sabot separation



2000 fps

Gas vents in outer forward sabot wall
Solenoid release sabot latch

Sabot deflection tests were successful



**Sabot deflection at ~90 m/s (4,000 fps 1/32,000s shutter speed)
1.3 m from gun barrel
4 consecutive successful tests (2 solid targets, 2 hollow - 4 mg)**

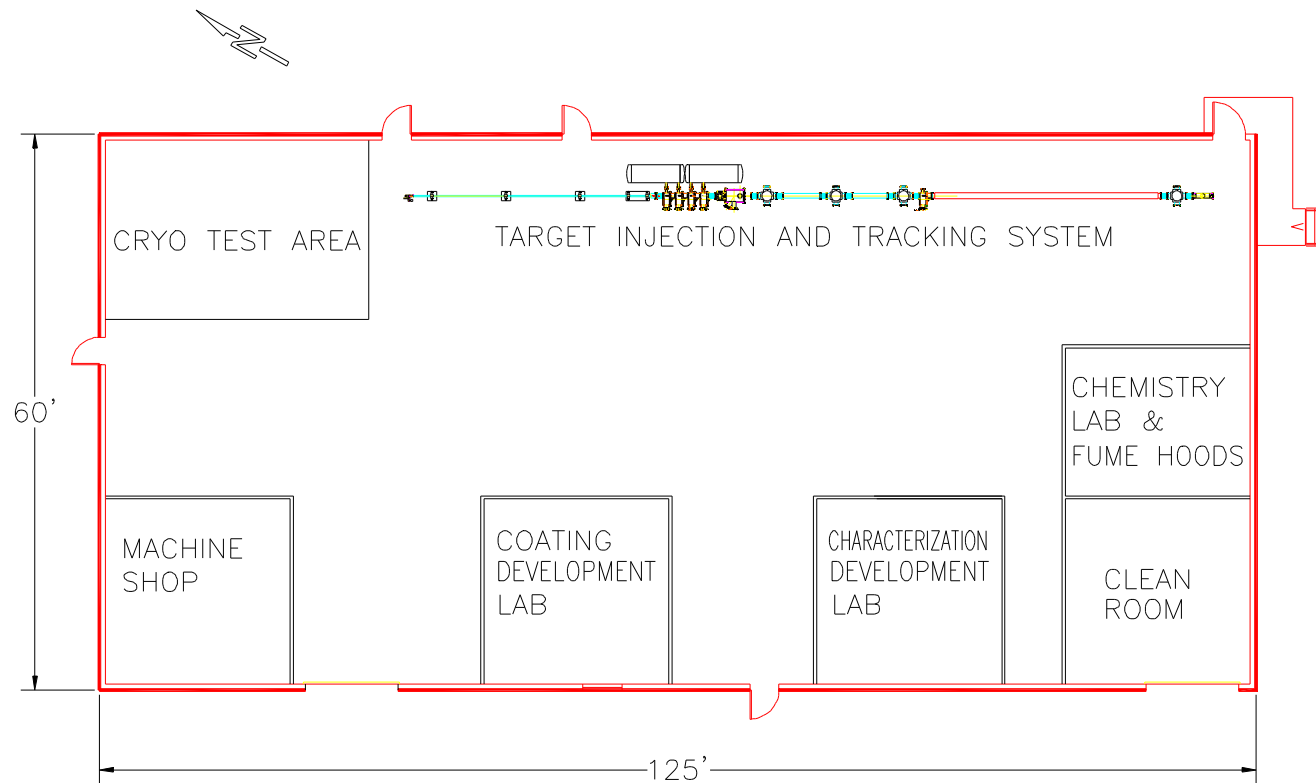
Detector and real time computation design is being updated

An expert in high-speed data handling and instrumentation has been engaged to

- **Review current detector design**
 - Accuracy requirements are challenging (but feasible)
 - Sensor alignment is critical
 - Multiple processors and busses may be required
- **Select operating system, development environment, and program for real time processing of large amounts of data**
- **Complete equipment and instrument lists started in the conceptual design**

The optical components will be evaluated for source of adequate illumination, diffraction, and interference.

Major building upgrade planned for IFE/ICF research

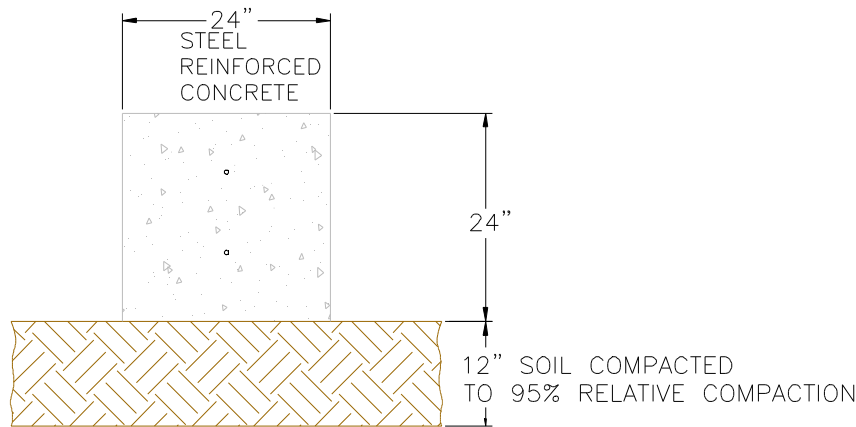


BUILDING #22 CONCEPTUAL LAYOUT

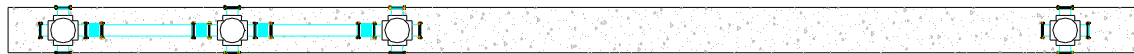
A site meeting the requirements for the injection system has been identified

Measurement/analysis indicate detector vibration is manageable

GEOCON measured building 22 ambient vibration amplitude less than 1 micron. Recommended detection equipment to be founded on separate footing to isolate from gun and other vibration sources.

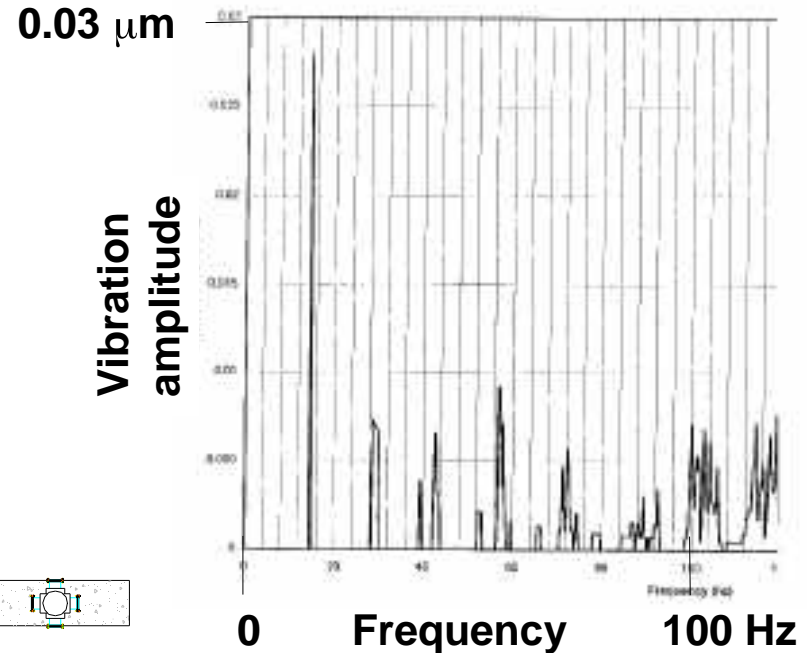


Cross-section view



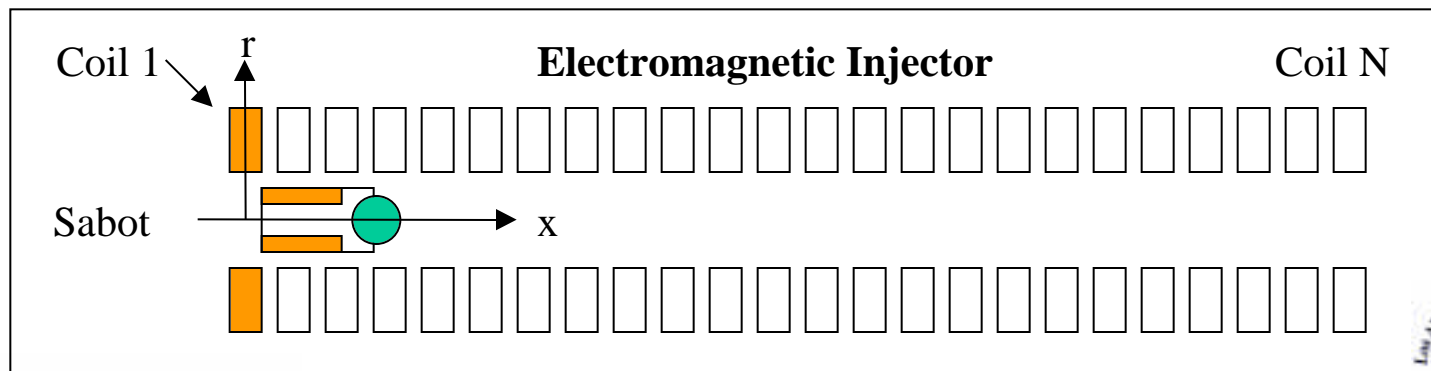
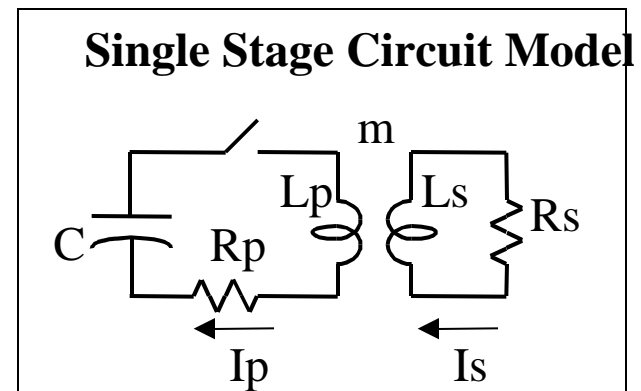
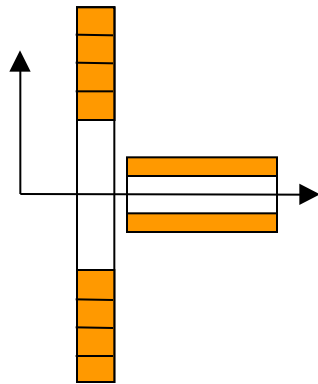
Plan view

Jack Hammer in soil at 40 feet



Backup electromagnetic injector study is underway

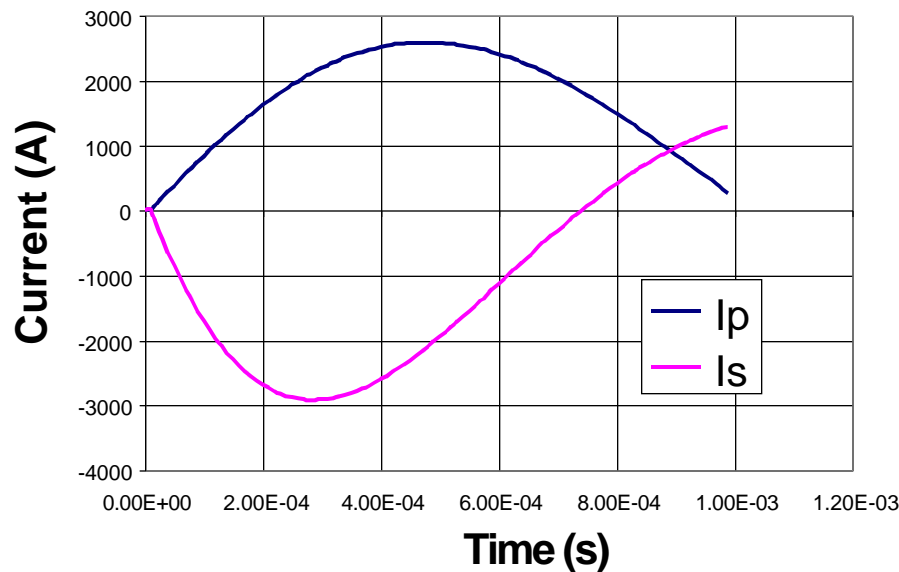
- Simplified single stage model under development in Excel to better understand variations of parameters and relationships.



Results of Preliminary Modeling

- Graph indicates the relationship between the primary and secondary currents with copper coils at 300K.
- Corresponding magnetic fields and forces have also been calculated.

Single Stage Analysis Model



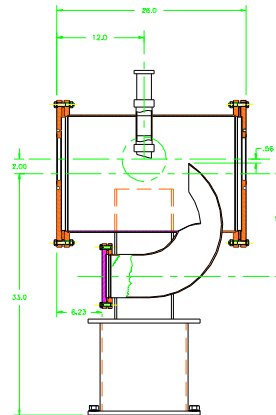
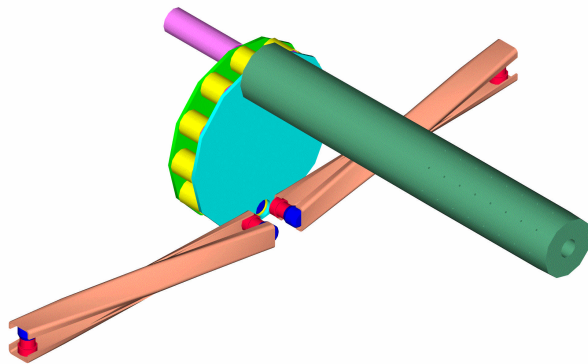
- Example Dimensions:
 - Primary Copper Coil
 - Outer Diameter = 5 cm
 - Inner Diameter = 2 cm
 - Width = 0.5 cm
 - Turns = 4
 - Secondary Coil (Sabot initially copper)
 - Outer Diameter = 1 cm
 - Inner Diameter = 0.5 cm
 - Length = 2 cm

...Models are set up and ready for design calculations

The preliminary design review is planned for 31 July

Primary objectives:

- Assure the design approach has the capability to meet the design requirements
- Assure that development and test projects are structured to resolve design uncertainties and to verify the design
- Identify problems and recommend corrective actions
- Identify the final design remaining work, schedule, and milestones
- Assure that the design is suitably complete and understood, such that the final design can be completed without major changes that could obviate current work being done



Summary and Conclusions

- Design of injection and tracking system is on track
- Sabot separation and deflection has been successfully demonstrated
- High-speed target tracking (data) components are being selected
- Preliminary design review planned for 31 July at GA
- Initial electromagnetic injector models have been developed

Injector schedule	2000	2001	2002	2003	2004
Conceptual design	—————				
Preliminary design		—————			
Final design			—————		
Procure, fabricate, & assemble			—————		
Shakedown & room temperature ops.				—————	
Upgrade to cryo					—————>