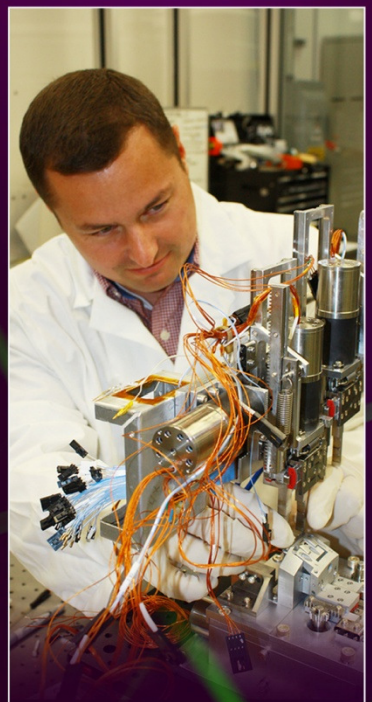
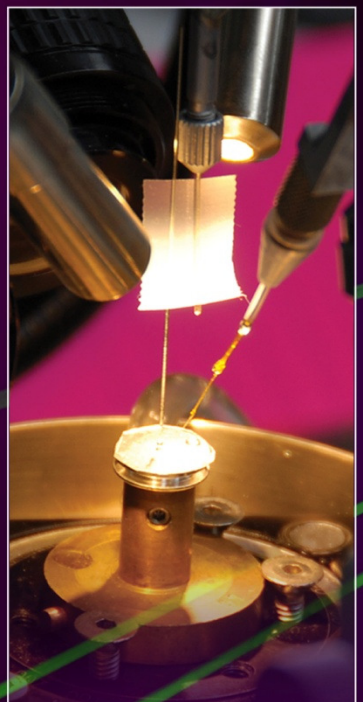
Target Basics

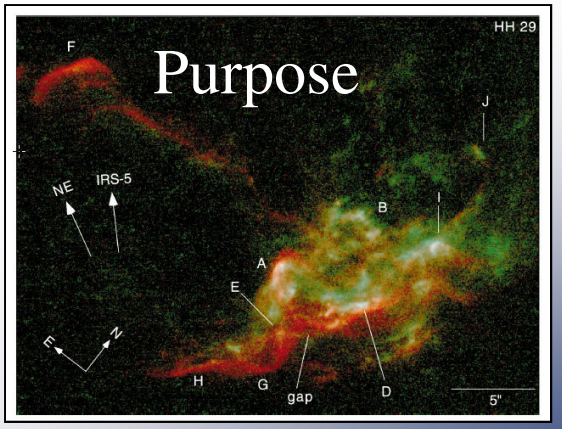
Brent Blue, General Atomics

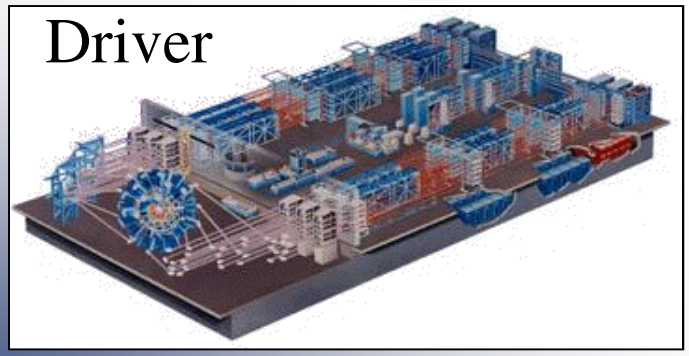



Omega Laser Facility Users Group
April 26th, 2012

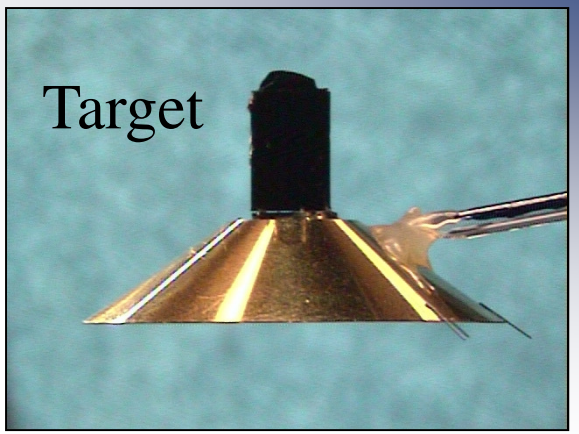
GENERAL ATOMICS

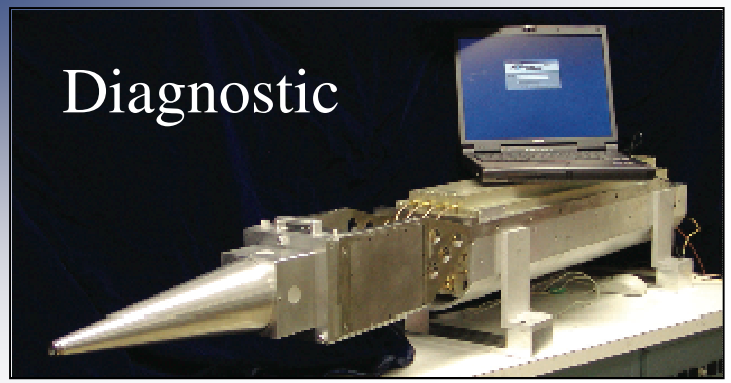
What makes a successful experiment?





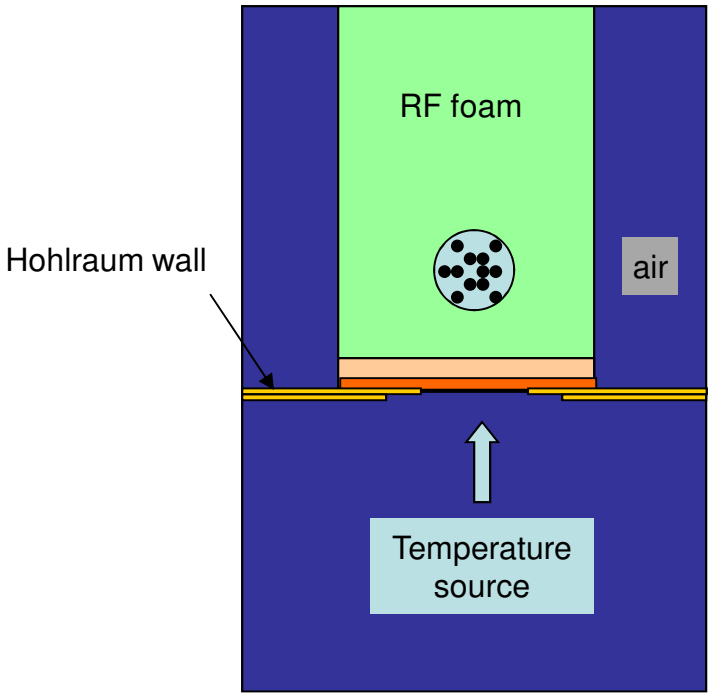
Results



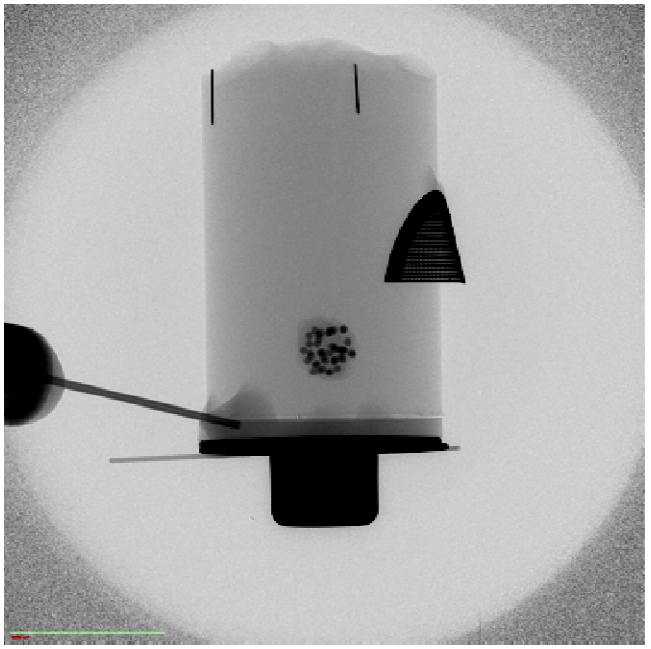


Knowledge of a real target is critical to experimental success

Simulation



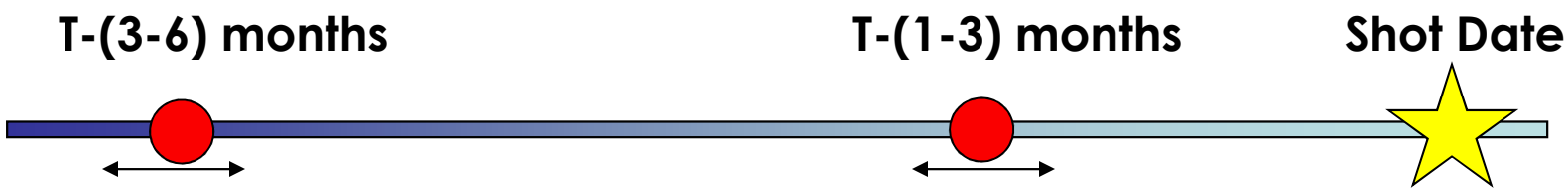
Experiment



Blueprint for a successful target acquisition

Omega scheduling meeting (~ June) …

Next shot too early?



Target R&D

Work with TFE closely!

Have backup plan if R&D target (Type A or B)!

Component Fabrication and Metrology

Don't forget gas fill specs!

Don't forget assembly specs!

Review drawings and specs CAREFULLY!

Sign off on drawings/TRF!

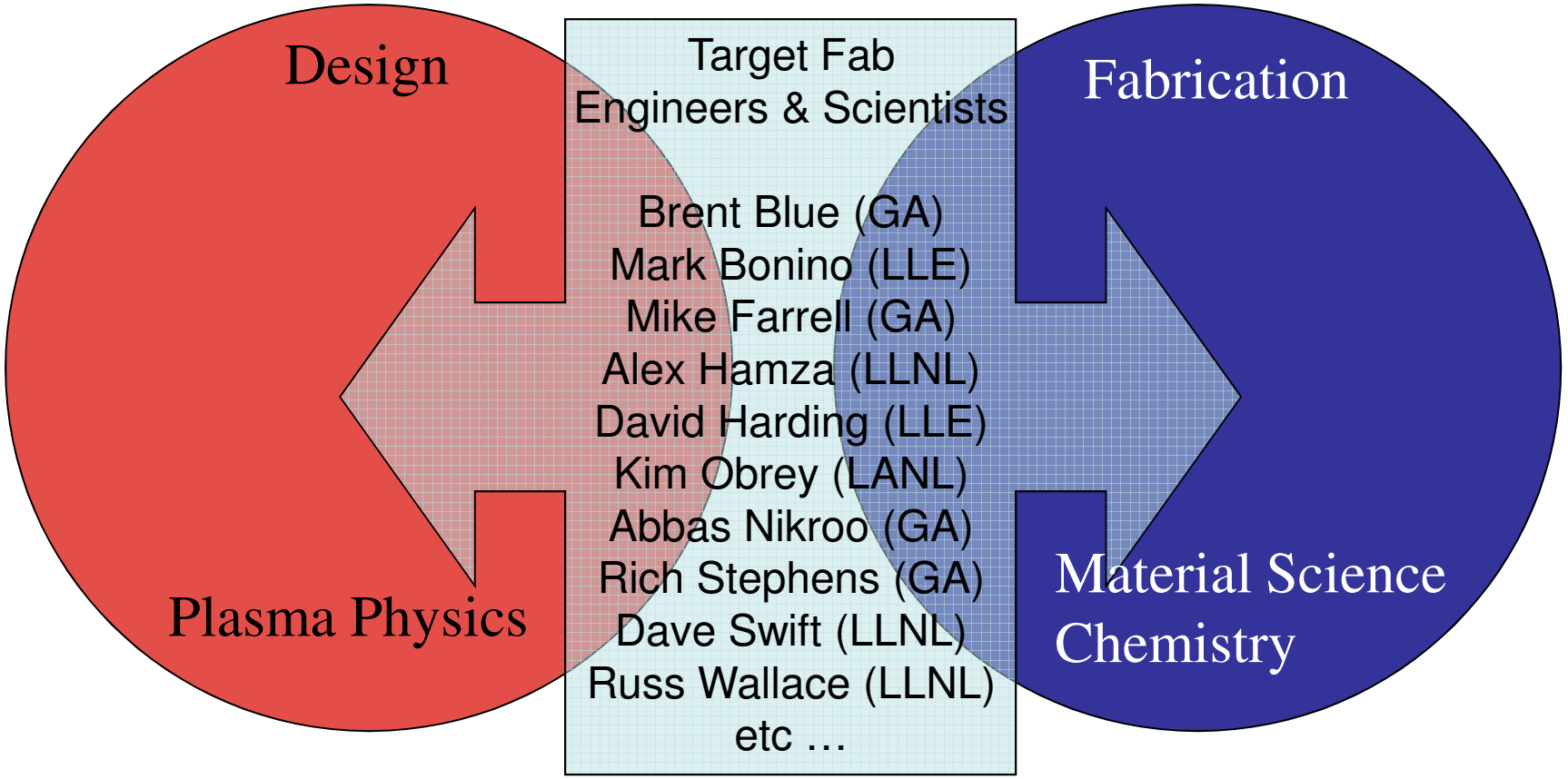
Final Assembly and Metrology

Inspect target!

Read metrology sheet!

Plan early and stay engaged throughout the target production timeline

Engage target fabrication early



“3 page” experiment request is an effective tool in communicating the target needs

NIC Campaign: Hydroinstability

Omega FY11

Campaign Name: CHaRM_11

- **Purpose**:
  - Quantify ablator drive from shock speed determination
  - Measure ablative RM growth on CH ablators at long pulse durations
  - Determine effect of initial bump width on growth
- **Specific Deliverable of this campaign :**
  - Measurement of shock speeds in CH ablator during foot
- **What would we do with results:**
  - Validate EOS models
  - Design NIF foot pulse to minimize bump gro
- PI/Designer: E. Loomis/D. Braun
- Major issues: Minimize damage in PAPBL geom

Omega

Summary	Q1FY11	Q2FY11	Q3FY11	Q4FY1
Shot Opps	10	10		
Config #1	5	5		
Config #2	5	5		
Target #1+2, Type: B	5	5		
Target #2, Type: B	5	5		

6/4/10

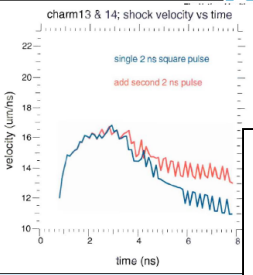
NIC Campaign: Hydroinstability

Omega FY11

Campaign Name: CHaRM_11

Experimental Config #1

Omega “NIC Scale 0.9” halfraum



Laser configuration:

Beams	# CPPs	CPP size	Pulse	Special
9 C3 + 6 C2 (H7)	15	SG4	sg2007	-2.5 ns

Diagnostics required:

Diag	TIM	Priority	Type	Calib
VISAR/SOP	5	1	3	Dove rotati
Dante		1	3	
XRFC	1	2	3	

Experimental set-up: One for each unique illumination AND
e.g. if you change either, requires a different setup
Priority: (1: must have, 2:like to have , 3: ride-along)
Type: (1:New diag, 2:major mod, 3: minor mod or existing)

- Could use C1 also if not driving BL (see next slide)
- Self-emission (SOP) should disappear upon shock breakout
- CH and quartz window anticipated to “blank” until M-band drops to low level

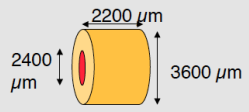
6/4/10

NIC Campaign: Hydroinstability

Omega FY11

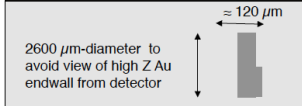
Campaign Name: CHaRM_11

Target #1: Type C



Au, 25 μm wall

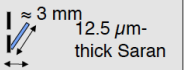
Target #1: Type B



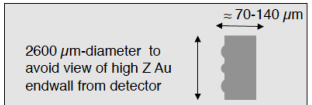
2600 μm-diameter to avoid view of high Z Au endwall from detector

CH sample with steps (≈ 20 μm height difference). Al-coated and quartz windows on some targets

Target #1: Type B



Target #1: Type B



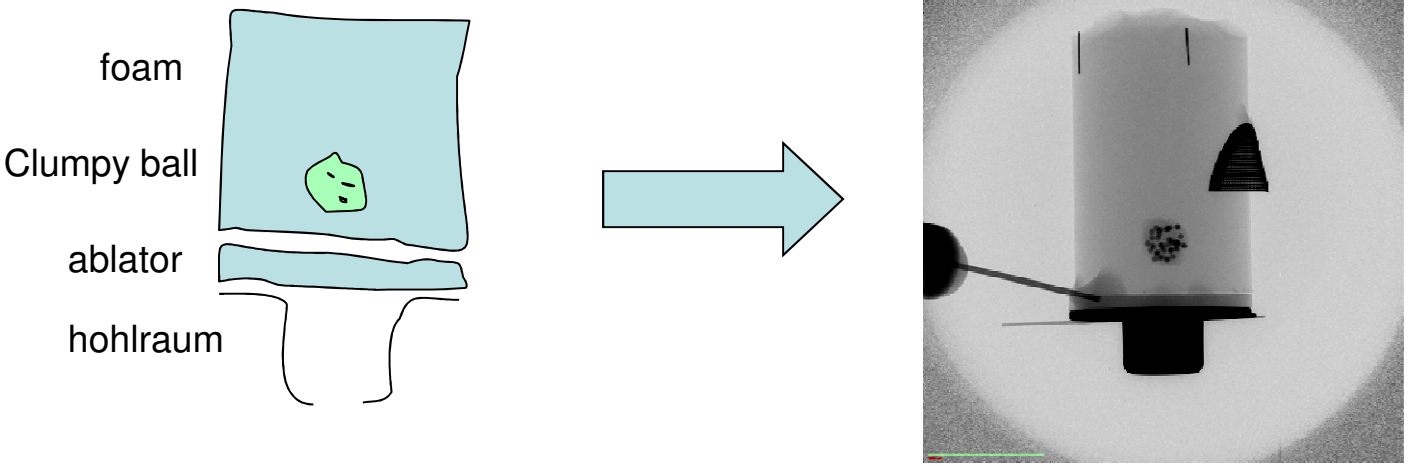
2600 μm-diameter to avoid view of high Z Au endwall from detector

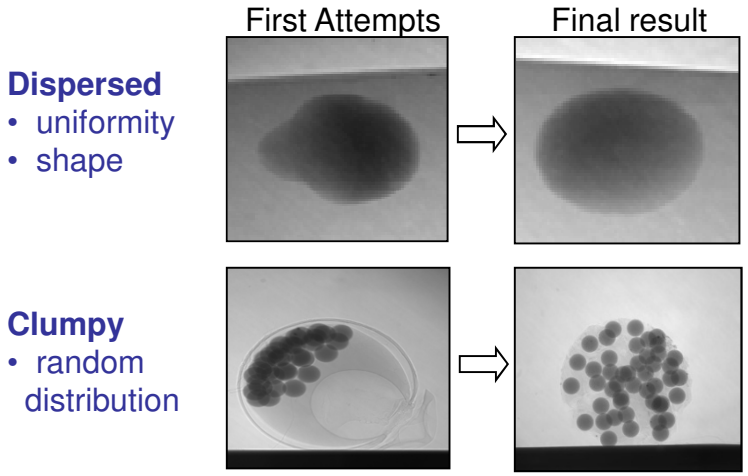
CH sample with isolated bumps (≈ 4 μm high, 20 μm diameter)

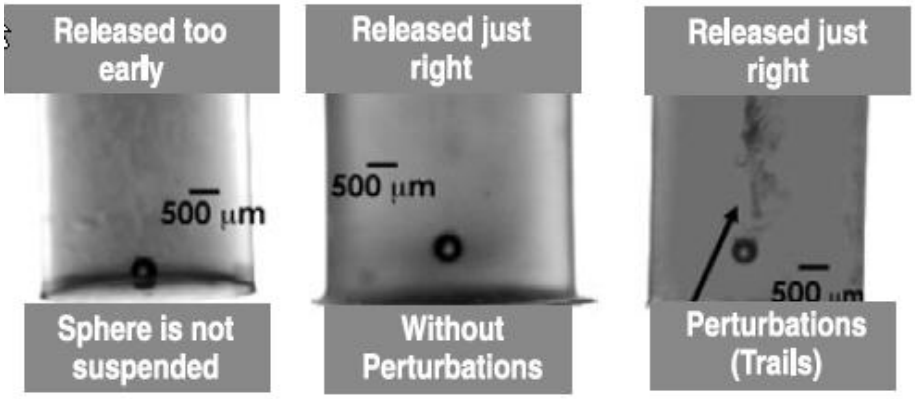
Use vacuum NIC Scale 0.9 halfraum platform to delay Au stagnation

6/4/10

NLUF AstroShock targets required significant R&D to determine if we could even make the targets



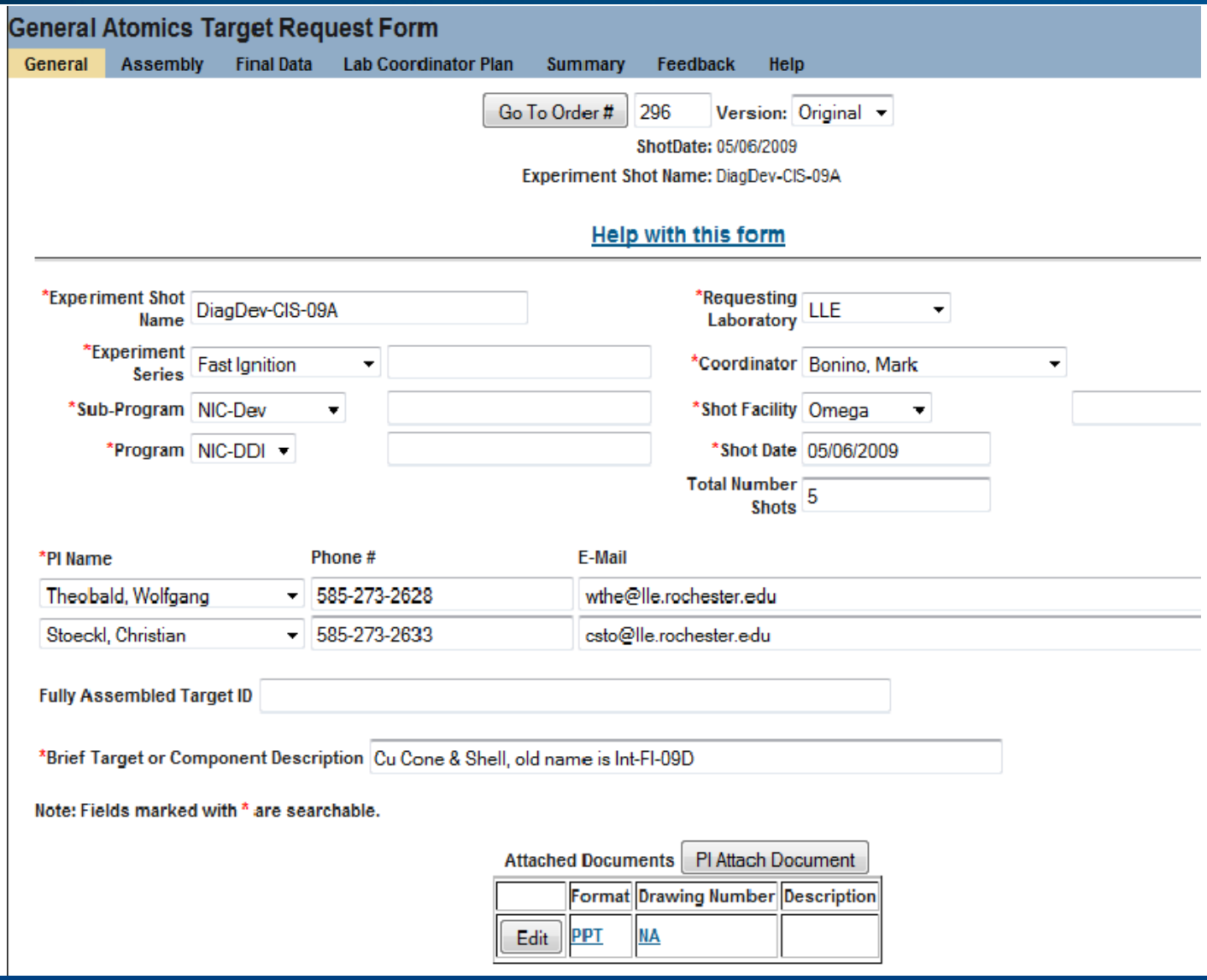




It's now time to specify the target

- **Design Finalized!**
- **We know that we can make it**
  - All R&D completed
- **Enough time to make, nominally 3 months**
  - Can be longer for complex parts
- **All parameters specified**
  - Dimensions
  - Materials
  - Tolerances
  - Metrology

OMEGA target request process starts with the target request form: TRF



General Atomics Target Request Form

General | Assembly | Final Data | Lab Coordinator Plan | Summary | Feedback | Help

Go To Order # 296 Version: Original

ShotDate: 05/06/2009

Experiment Shot Name: DiagDev-CIS-09A

Help with this form

*Experiment Shot Name: DiagDev-CIS-09A

*Requesting Laboratory: LLE

*Experiment Series: Fast Ignition

*Coordinator: Bonino, Mark

*Sub-Program: NIC-Dev

*Shot Facility: Omega

*Program: NIC-DDI

*Shot Date: 05/06/2009

Total Number Shots: 5

*PI Name	Phone #	E-Mail
Theobald, Wolfgang	585-273-2628	wthe@lle.rochester.edu
Stoeckl, Christian	585-273-2633	csto@lle.rochester.edu

Fully Assembled Target ID

*Brief Target or Component Description: Cu Cone & Shell, old name is Int-FI-09D

Note: Fields marked with * are searchable.

Attached Documents | PI Attach Document

	Format	Drawing Number	Description
Edit	PPT	NA	

Target request form (TRF) documents target types, quantities, specifications

Component Type | Fab. Center | Best Effort

Order: GA / Non-GA | None

General Descriptor | WONO

Primary Descriptor | GA Order

Usage: External / Internal | Customer #

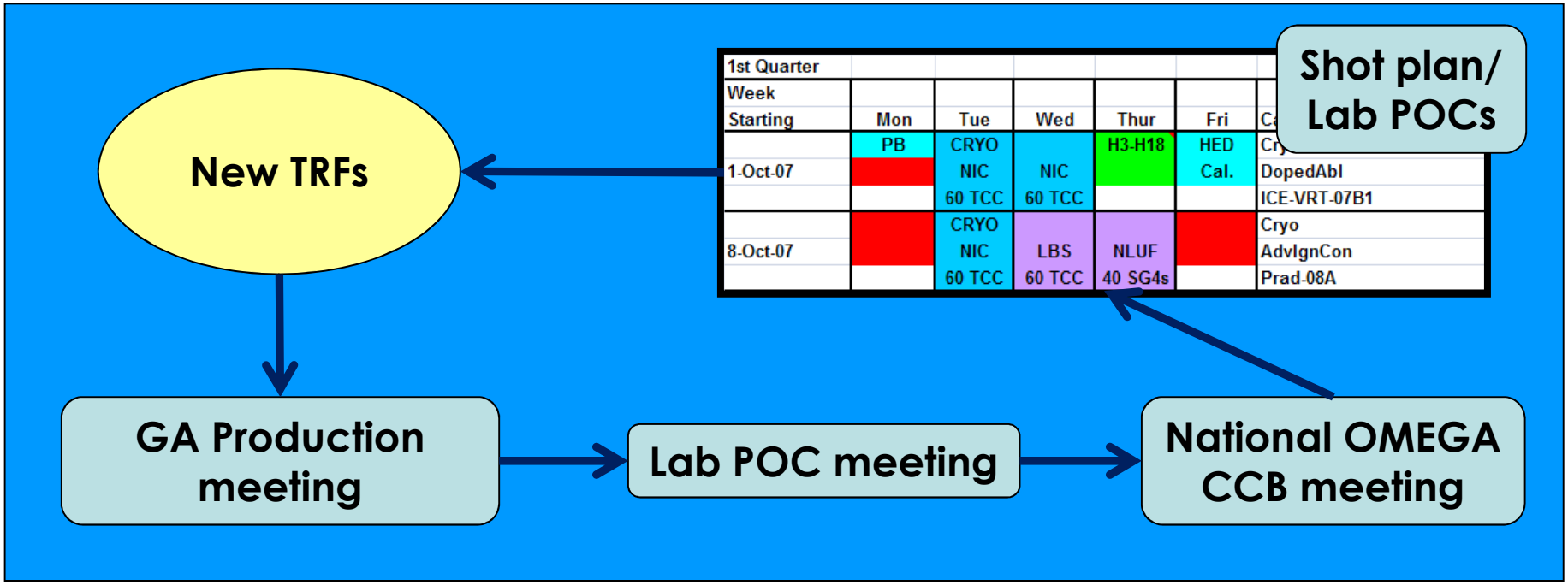
Edit/Add | Remove | Clear Edit Area

Check here if any component requires assembly

	GA	Fab Center	Component Type	General Descriptor	Primary Descriptor	Group	Secondary Descriptor	Due date	Qty.	Usage	Best Effort	WONO	GA Order	Cust. #		
Edit	GA	IDC	Capsule	CH	CHsingle	A	40 micron SCD to CPM, 2 racks of 12	03/06/2009	24	Internal	None	C30272-9570	IDC-LLE-296-Int-FI-09D Rev 0		Order Specs	Status
Edit	GA	IDC	Capsule	CH	CHsingle	A	40 micron SCD for TCC and neutronics reference	04/06/2009	7	External	None	C30272-9570	IDC-LLE-296-Int-FI-09D Rev 0		Order Specs	Status
Edit	GA	CPM	Micromachining	Cone/Shield	Cone	A B C	20 mic thick Cu Cone 25 mic thick Cu Cone 30 mic thick Cu Cone	04/13/2009 04/13/2009 04/13/2009	5 5 5	External	None	C30272.9490	COM-Int-FI-09D Cone & Shell	Int-FI-09D	Order Specs	Status
Edit	GA	DDC	Capsule	Cryo	SCD	A	CD shells	04/16/2009	6	External	None	C30272 3020	DDC 296 DiagDev-CIS-09A		Order Specs	Status

Clear | Query | Update | Save as New

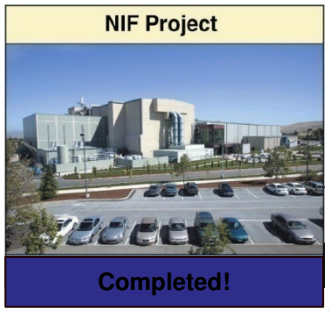
High level scheduling completed in close partnership with laboratory POCs, TFEs, and PIs



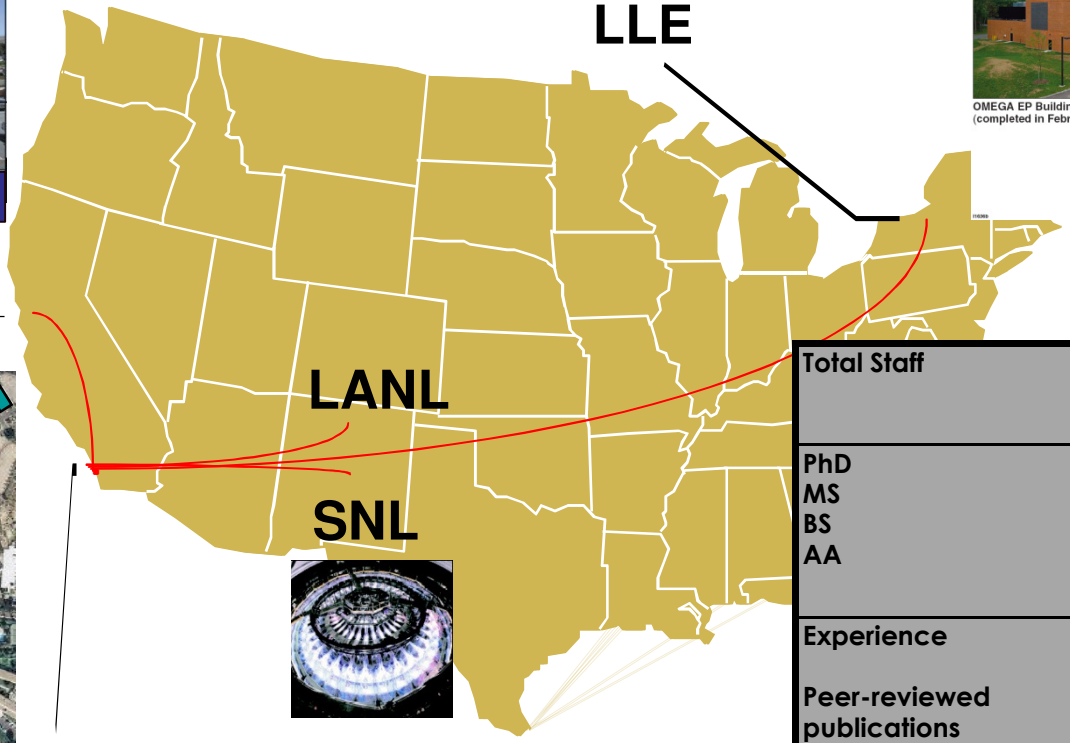
OMEGA change control board process

- Discuss all OMEGA targets:
  - Track status
  - Flag and resolve issues
  - Planning

Components and targets for ICF program are primarily made at GA and the national labs



LLNL



GA, San Diego: staff of 80+
+ ~ 15 students

Total Staff	80+ GA and subs 15 Students/Interns
PhD MS BS AA	22 10 27 27
Experience Peer-reviewed publications	~ 1000 person-years 231 since 2000

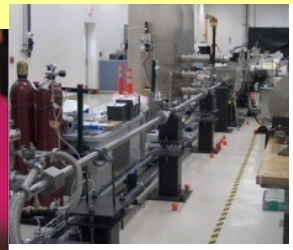
Assembly is performed primarily at the laser facilities

A variety of capabilities are needed for fabrication of various classes of ICF targets

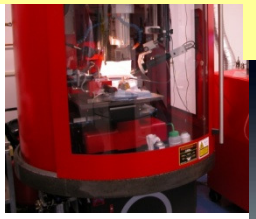
Various coatings

Precision assembly

Precision Engineering & design

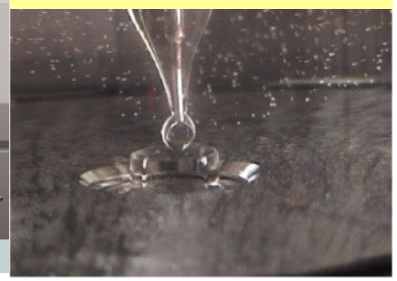


Diamond turning & laser machining



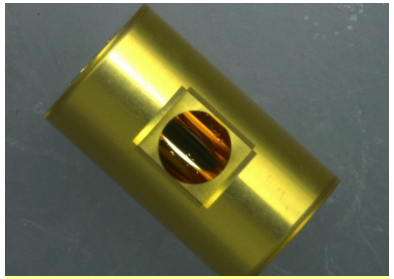
Metrology

Chemistry & Materials



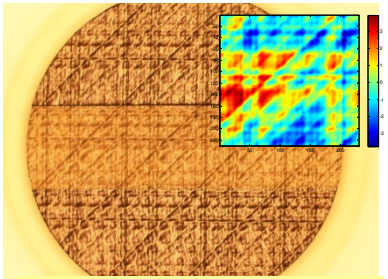
Multiple capabilities are often needed to make a single target

Capsules

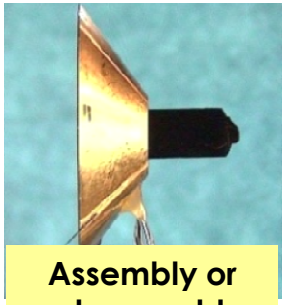


"Hohlraums"

Aerogels



Complex Planar



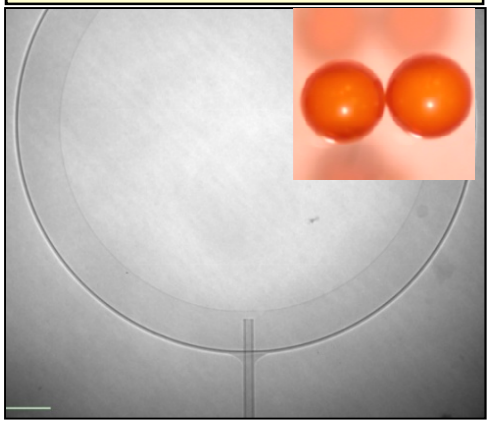
Assembly or subassembly

Simpler components (e.g. simple planar foils) are simply purchased

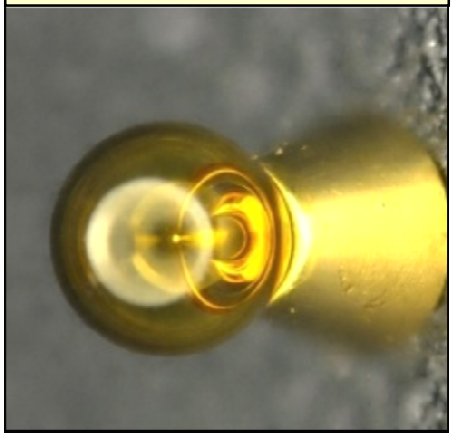
Machined components can come in a variety of flavors

Not all shells are alike (but they are all round)!

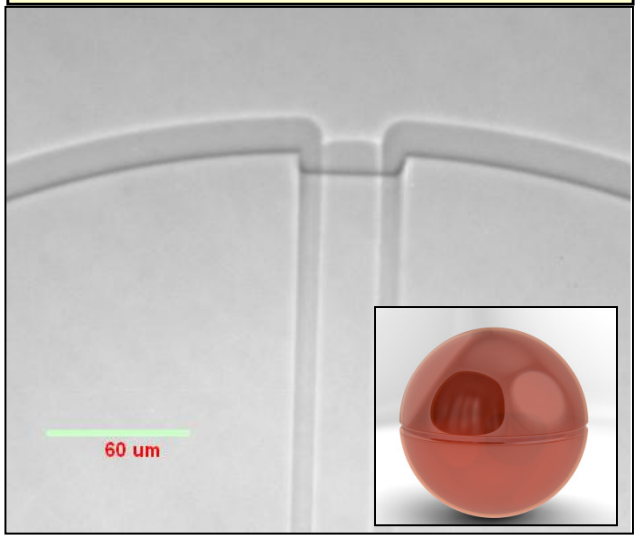
Foam capsules with fill tube for FoamImp



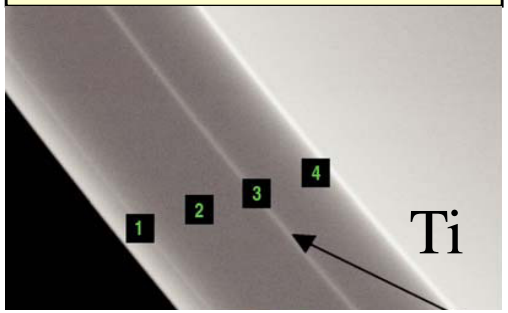
Capsule and cone for Fast Ignition



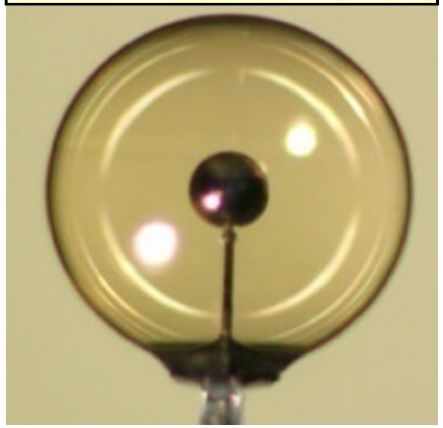
Inner trenched capsule for DImE



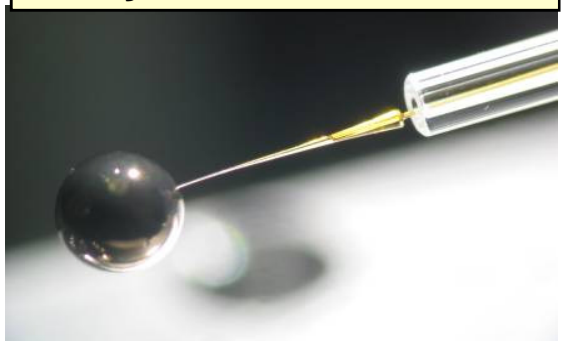
Buried doped layer



Double Shell for DynHohl



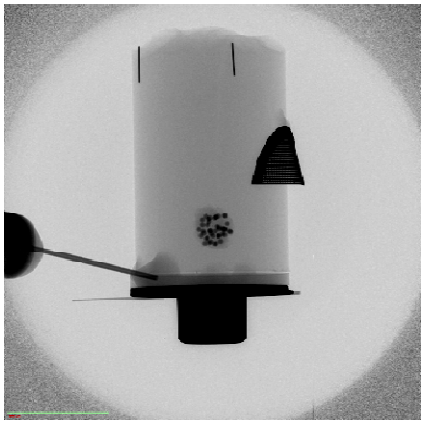
Beryllium fill tube shell

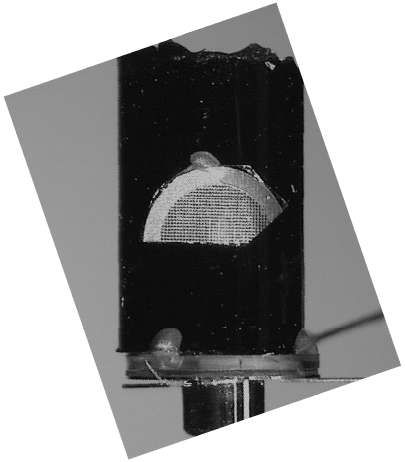


Metrology: the final critical fabrication step

Group B **Clumpy Aluminum Oxide Ball Target**

No.	Specification	Value	Specification Tolerance ±	B1	B2	B3	B4	B5	B6	Meas. Error±	Note
1	Foam Density (mg/cc)	300	30	296	296	296	296	294	294	4	Batch average: Measured on 2 witness pieces of foam for each batch
2	Z Distance from center of ball to drive face (um)	900	200	980	1117	1159	1113	976.3	885.32	10	Measured by radiography
3	Distance of ball center from axis of foam (um)	0	500	346	269	178	82	384.45	254.75	20	Measured by radiography
5	Diameter of Foam Cylinder (mm)	3.9	0.2	3.92	3.84	3.91	3.88	3.69	3.69	0.02	
6	Minimum Length of Foam Cylinder (mm)	5	1	6.0	6.1	5.7	5.8	5.9	5.4	0.1	Length must be >4000um, foam may have rough edge on the end of the foam (but drive face will be smooth)
7	Maximum deviation from Flatness (um)	<30									Best effort; Measured on drive side face on a sampling of targets at Alberquerque
8	Ball clump/distribution diameter (um)	1000	NA	1172	1035	1063	1062	911	903	200	
10	Number of balls in clump (#)	46	5	37	46	21	34	30	43		
11	Ball diameter (um)	130	NA	130	130	130	130	130	130		
	ball material	Ruby (Al_2O_3 + <0.05% Cr)									
	Batch ID Number			RF090616-A	RF090616-B	RF090616-C	RF090616-D	RF090430-B	RF090430-D		



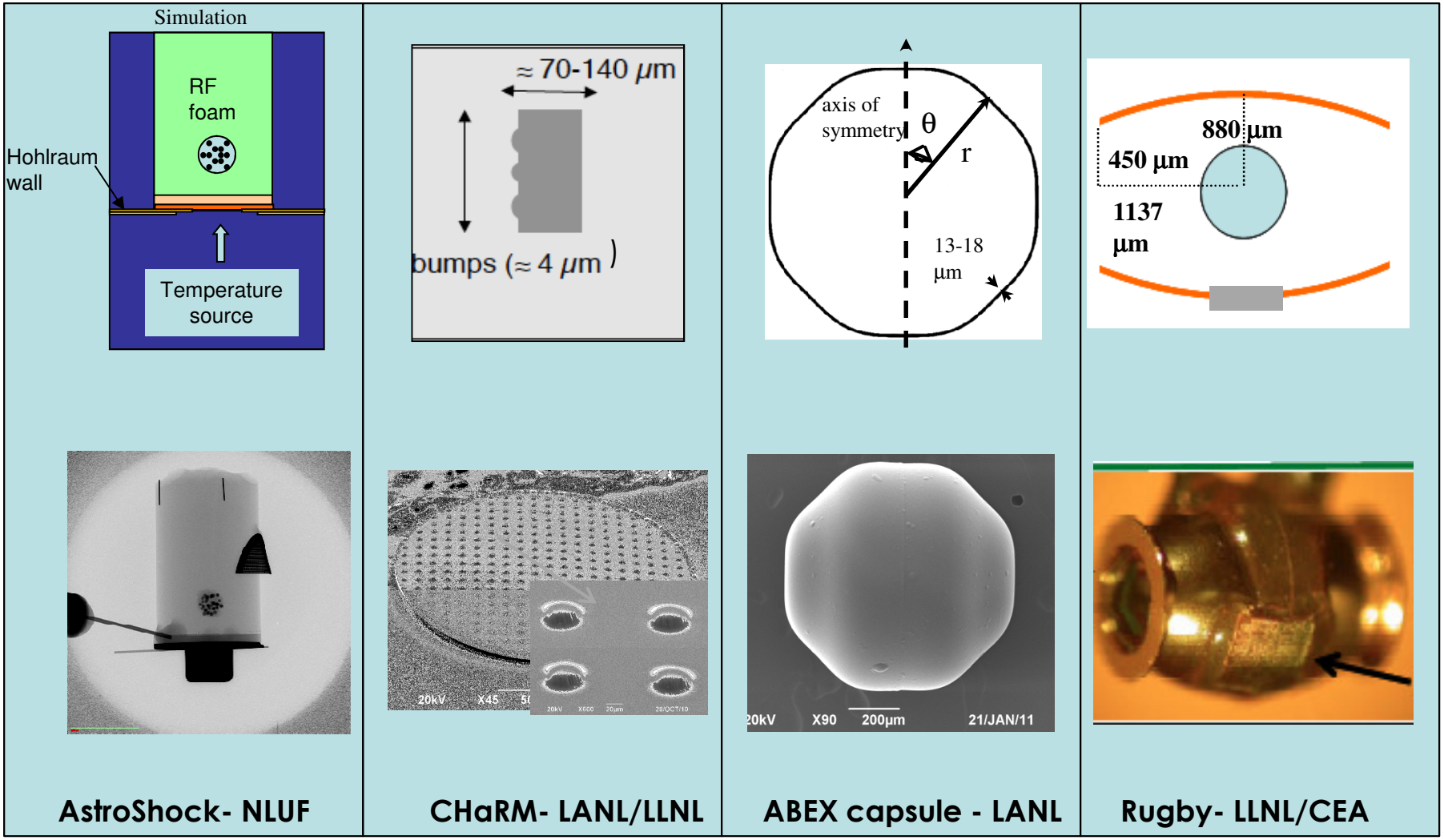


Know what you are shooting before the shot

Target destroyed

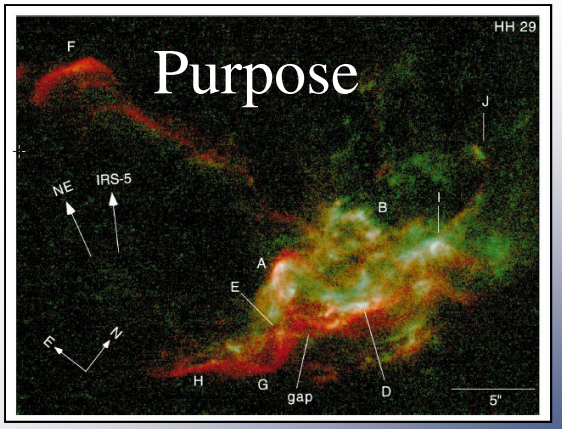
Can't go back

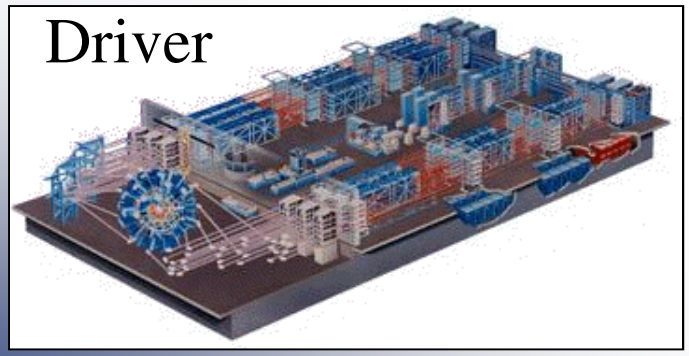
Early planning, close communication and iteration with target fab allows fabrication of complex targets …



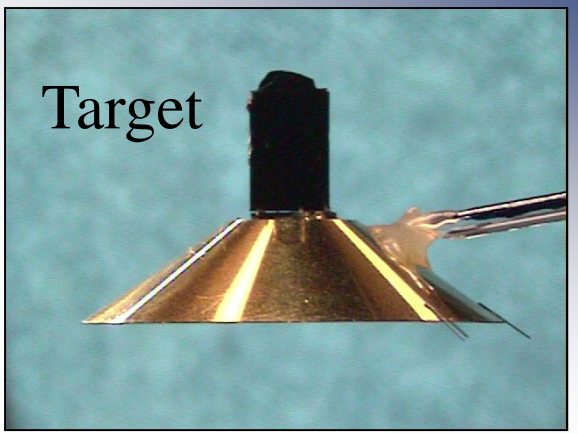
… and a successful experiment

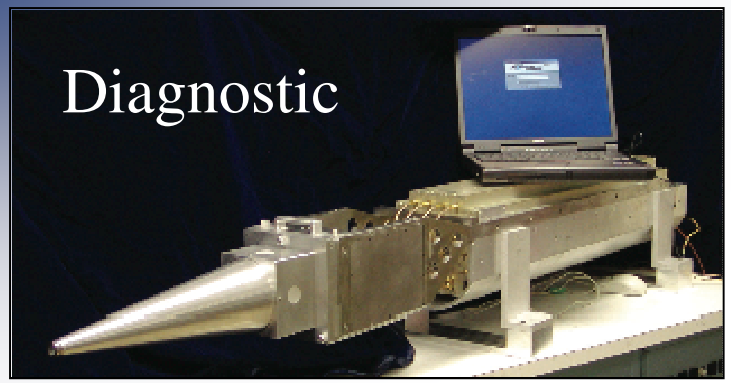
Quality targets for quality experiments!





Results





Questions?

GENERAL ATOMICS

GA's major infrastructure has made it a natural choice for development and production of targets