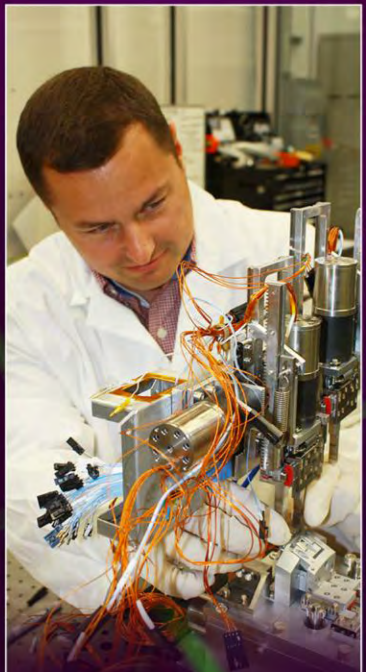
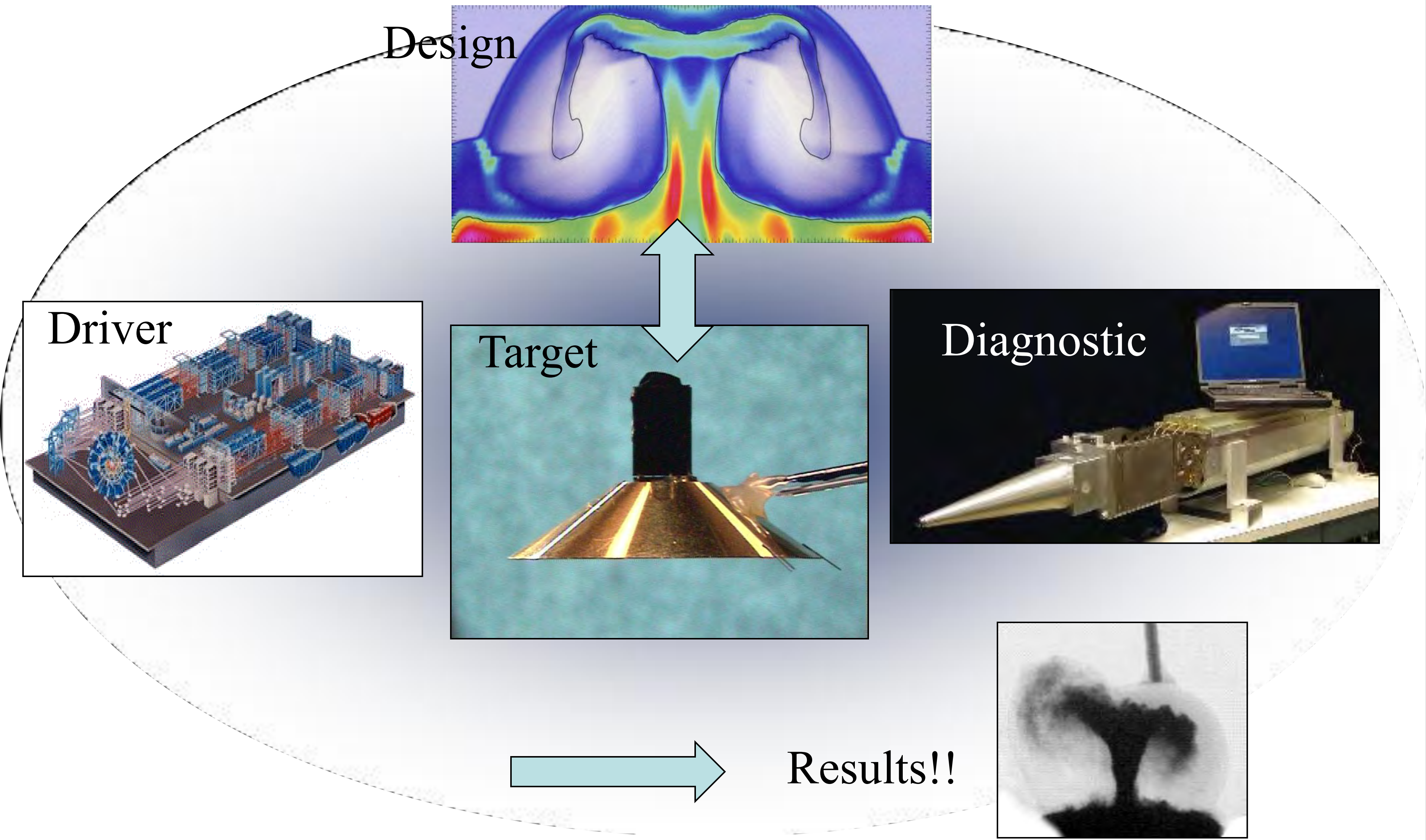
Target basics
Abbas Nikroo, General Atomics



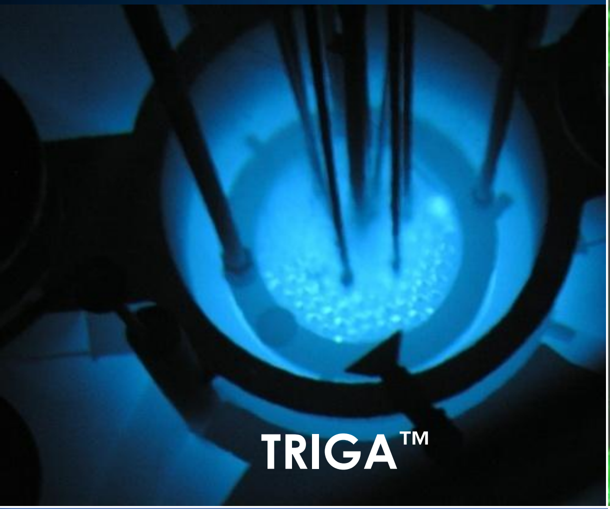
Omega Laser Users Group meeting, April 28, 2011

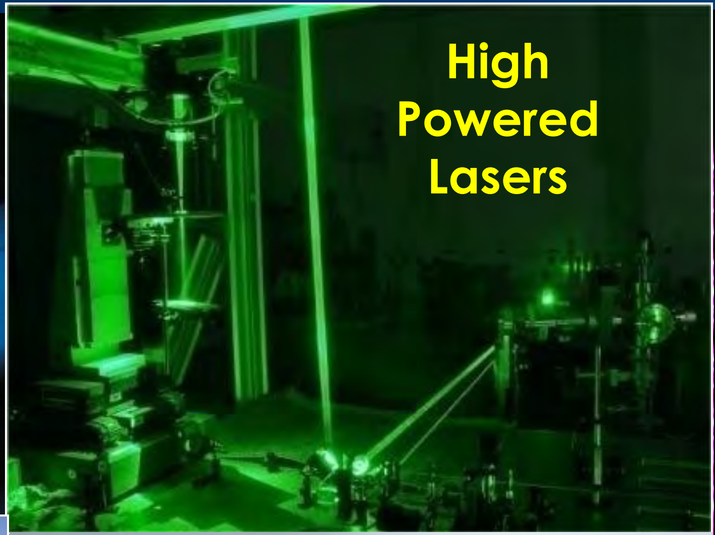
GENERAL ATOMICS

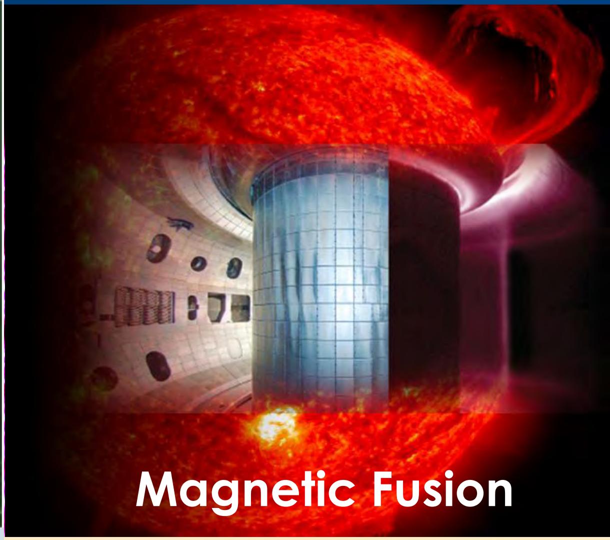
The target is one of the key elements of a successful experiment

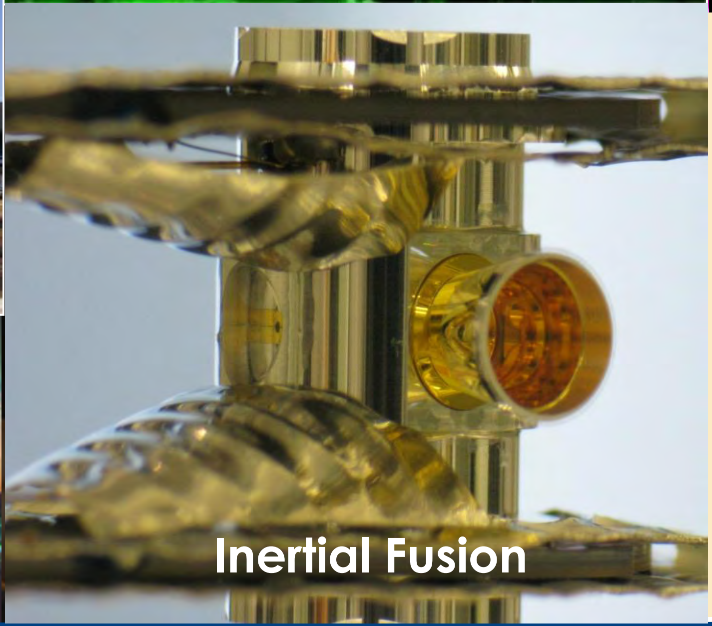


GA's major infrastructure has made it a natural choice for development and production of targets

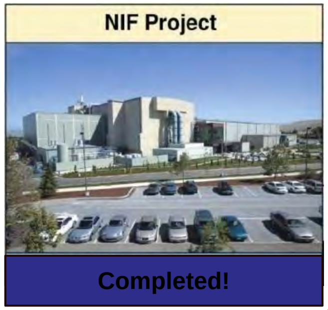




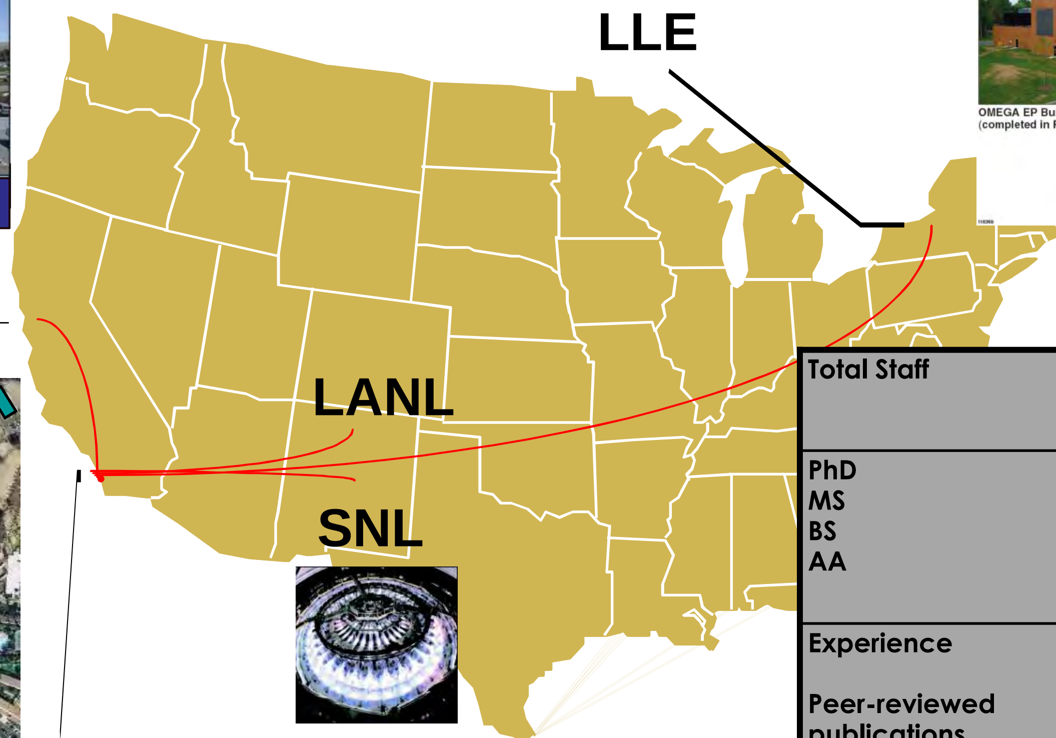




Components and targets for ICF program are primarily made at GA and the national labs



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

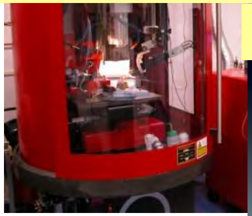
A variety of capabilities are needed for fabrication of various classes of ICF targets

Various coatings

Precision assembly

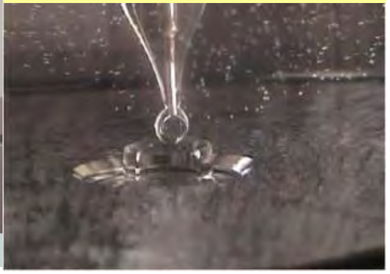
Precision Engineering & design

Diamond turning & laser machining

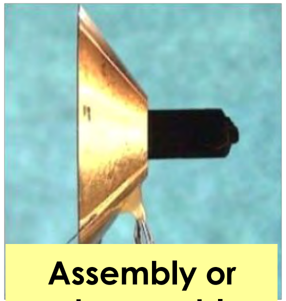


Metrology

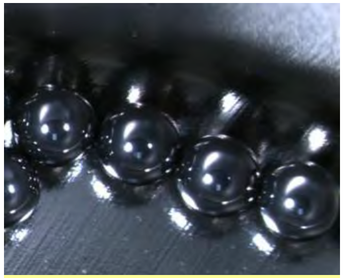
Chemistry & Materials



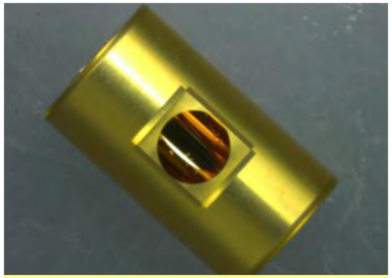
Multiple capabilities are often needed to make a single target



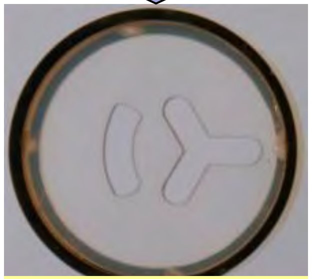
Capsules



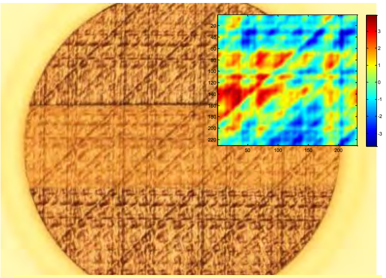
“Hohlraums”



Aerogels



Complex Planar



Assembly or subassembly

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

Commonality of capabilities and equipment at one facility improves efficiency and reduces duplication of resources

- Metal Coatings
- CH/Glass Coatings
- Electroplating
- Polishing
- Diamond Turning
- Milling
- Laser Machining
- Precision Assembly

Characterization

- LLNL
- LANL
- SNL
- U of R
- NLUF
- Others

GA and the labs have this necessary infrastructure

GA produces targets for all the major NNSA ICF facilities

- **NNSA's three major new ICF facilities**

NIF Project

Completed!

OMEGA EP Building
(completed in February 2005)

OMEGA-EP

OMEGA EP
Laser Bay
(Sept. 2006)

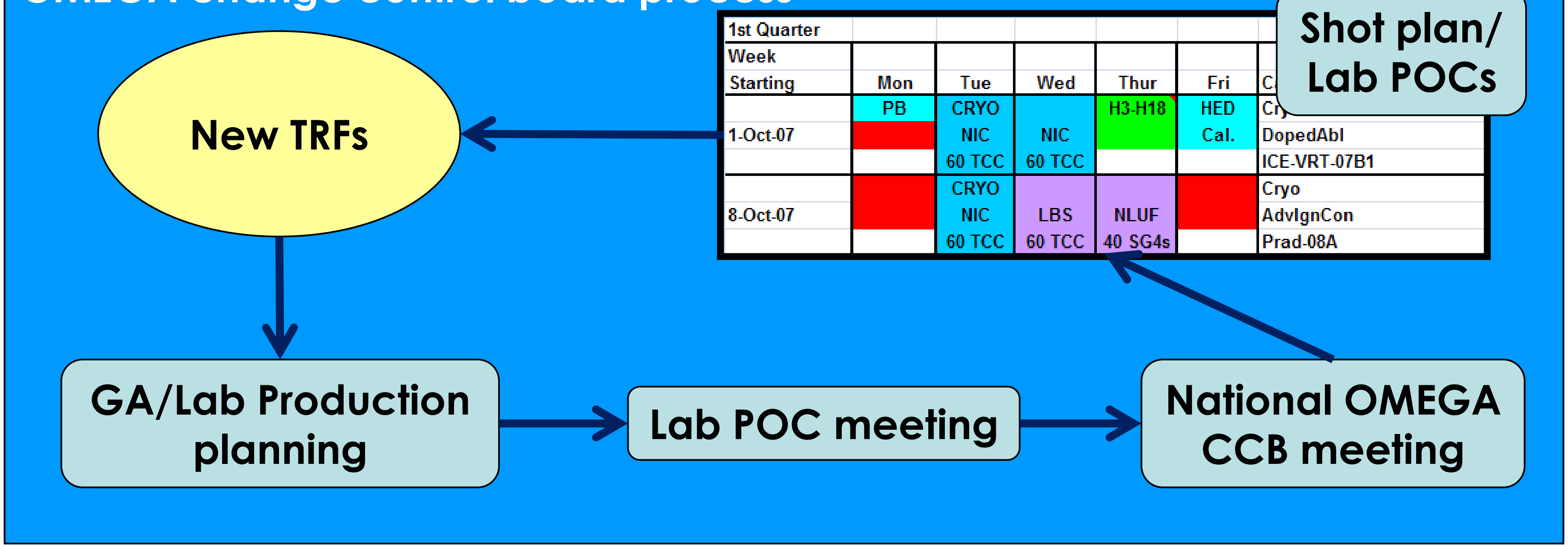
Z-R

- **The facilities use thousands of high precision targets/year**
  - **OMEGA ~ 4000 components and targets/year**
  - ZR ~ 200 targets/year
  - NIF ~ two thousands components/year
  - Other some work depending on complexity

A number of target platforms have already been transferred from Omega to NIF

We anticipate target needs through scheduling in close partnership with laboratory Point of Contacts and PIs

OMEGA change control board process

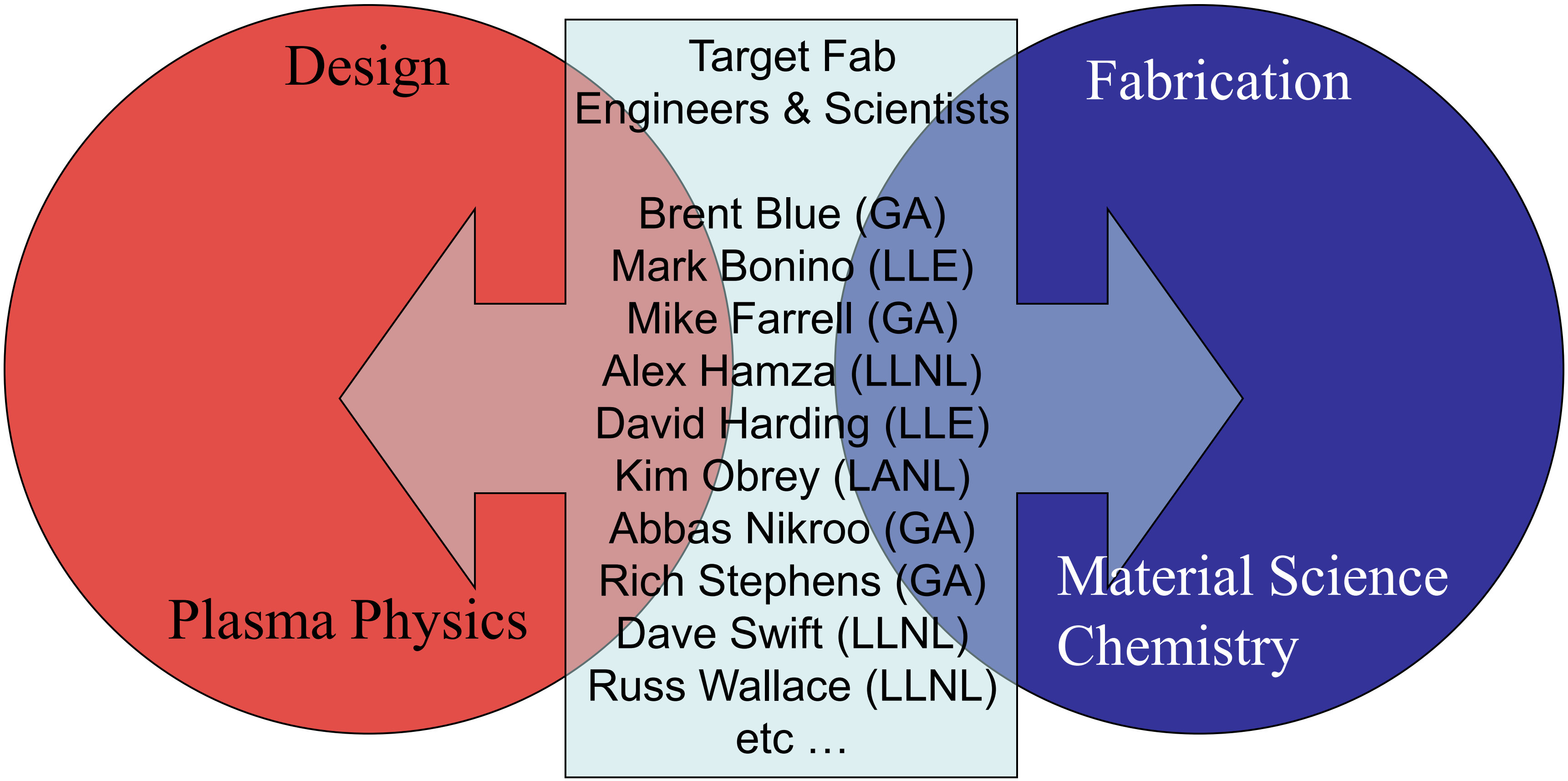


1st Quarter						
Week Starting	Mon	Tue	Wed	Thur	Fri	Ca
	PB	CRYO		H3-H18	HED	Cr
1-Oct-07		NIC	NIC		Cal.	DopedAbl
		60 TCC	60 TCC			ICE-VRT-07B1
		CRYO				Cryo
8-Oct-07		NIC	LBS	NLUF		AdvIgnCon
		60 TCC	60 TCC	40 SG4s		Prad-08A

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

Make sure you know you lab and GA POC's and "Target Fab Engineers"

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

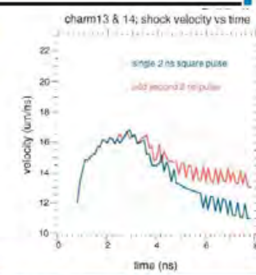
Experimental Config #1

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

- 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



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 c
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)

6/4/10

NIC Campaign: Hydroinstability *Omega FY11*

Campaign Name: CHaRM_11

Target #1: Type C

2200 μm
2400 μm
3600 μm
Au, 25 μm wall

Target #1: Type B

$\approx$ 120 μm
2600 μm-diameter to avoid view of high Z Au endwall from detector
CH sample with steps ($\approx$ 20 μm height difference). Al-coated and quartz windows on some targets

Target #1: Type B

10-15 μm PH in 25 μm Ta
$\approx$ 3 mm
12.5 μm-thick Saran
$\approx$ 1 mm

Target #1: Type B

$\approx$ 70-140 μm
2600 μm-diameter to avoid view of high Z Au endwall from detector
CH sample with isolated bumps ($\approx$ 4 μm high, 20 μm diameter)

Use vacuum NIC Scale 0.9 halfraum platform to delay Au stagnation

6/4/10

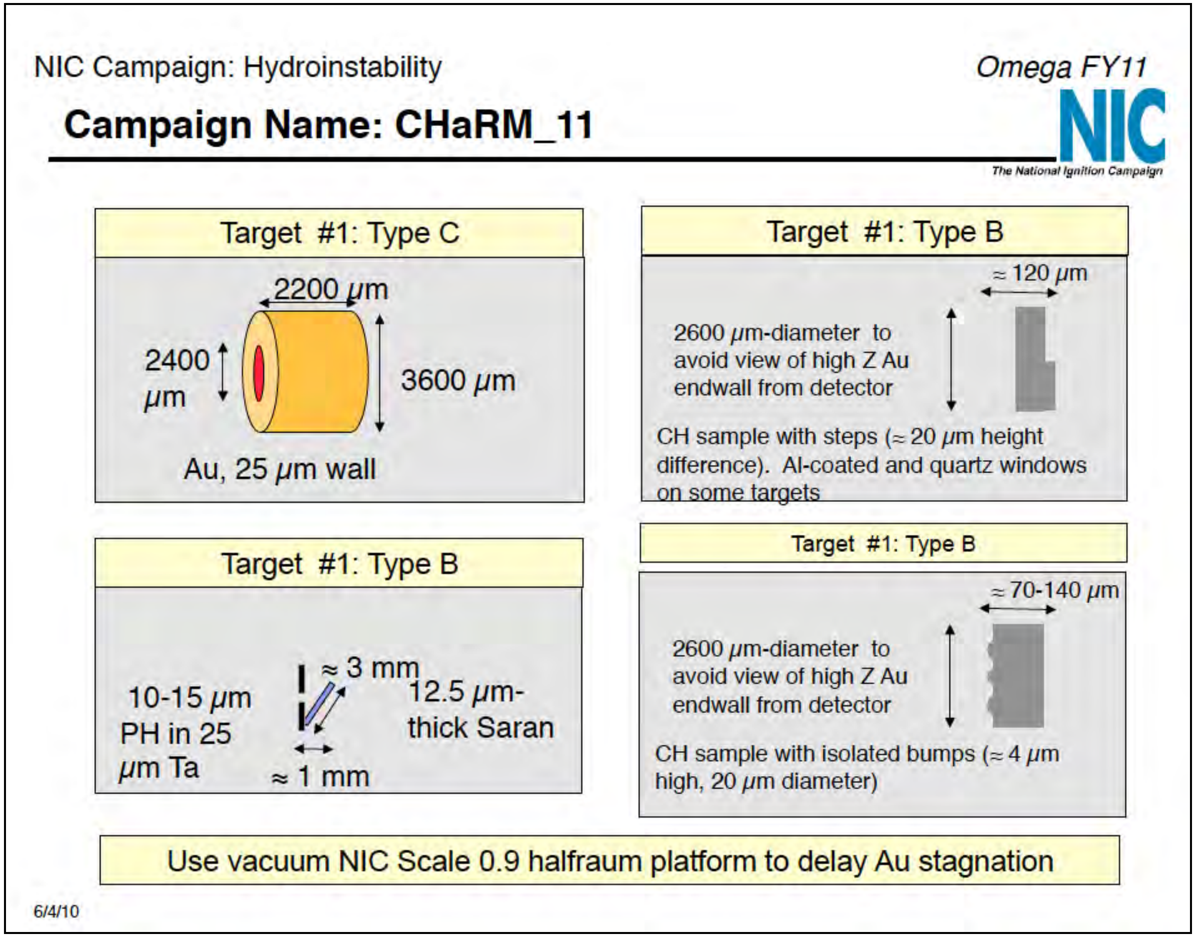
Get to know your target ABC's!

Type A : R&D never done before

Type C: "routine" , made several or more times before

Type B: in between A and C

Consult target fab regarding proper designation!

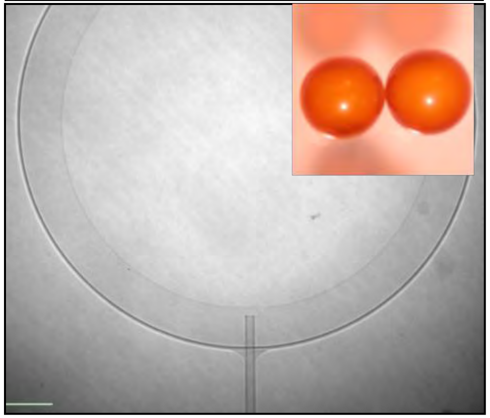


A target may go from routine (Type C) to R&D (Type A) just by changing one of the materials (ask Bob Heeter!)

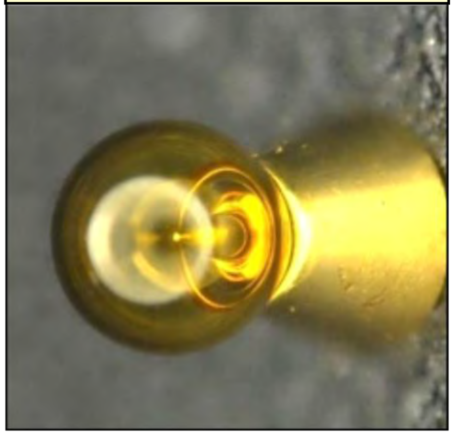
Machined components can come in a variety of flavors

A shell is a shell is a shell …?

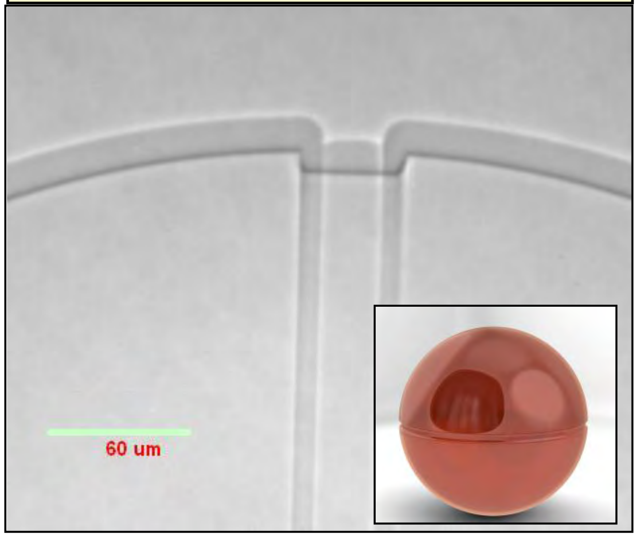
Foam capsules with fill tube for FoamImp



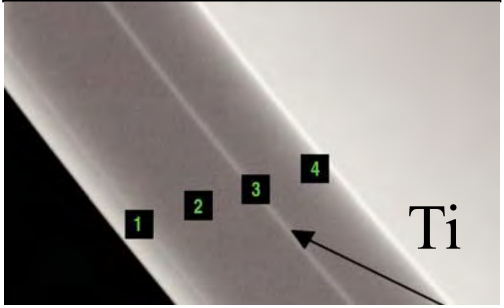
Capsule and cone for Fast Ignition



Inner trenched capsule for DImE

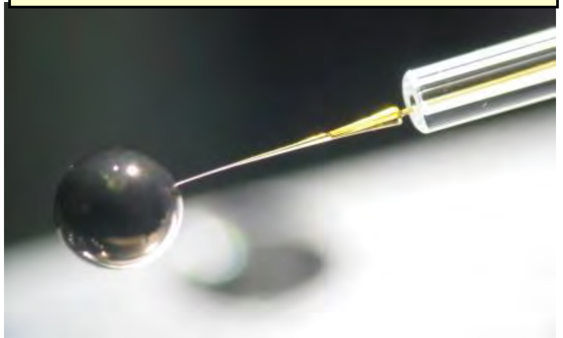


Buried doped layer



Double Shell for DynHohl

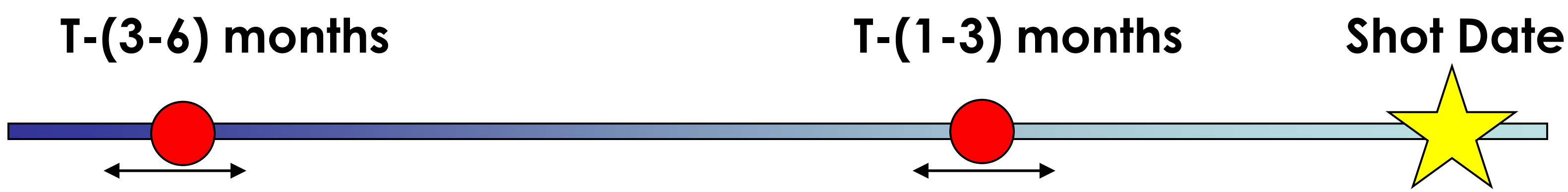
Beryllium fill tube shell



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!

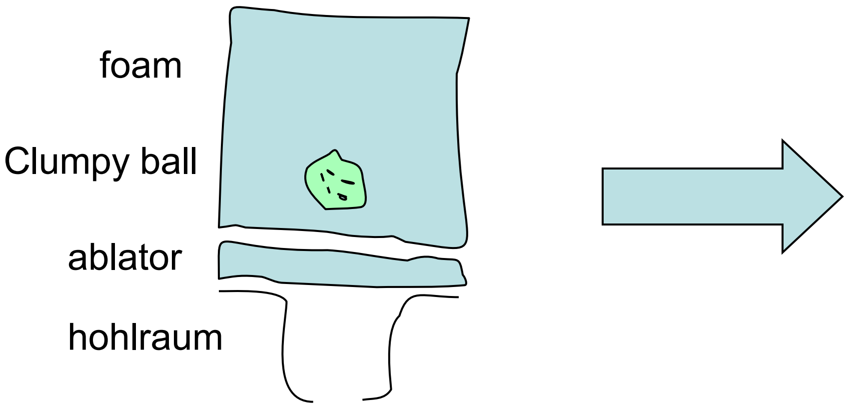
Final Assembly and Metrology

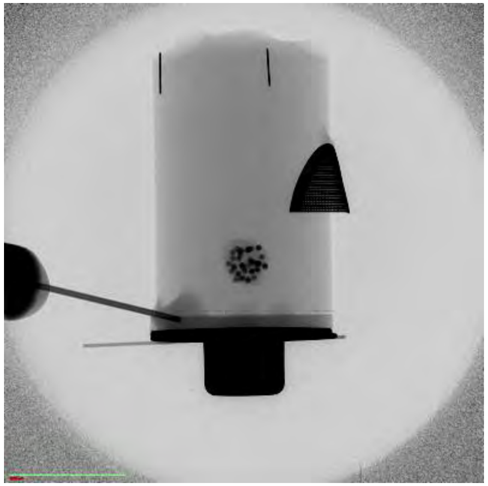
Inspect target!

Read metrology sheet!

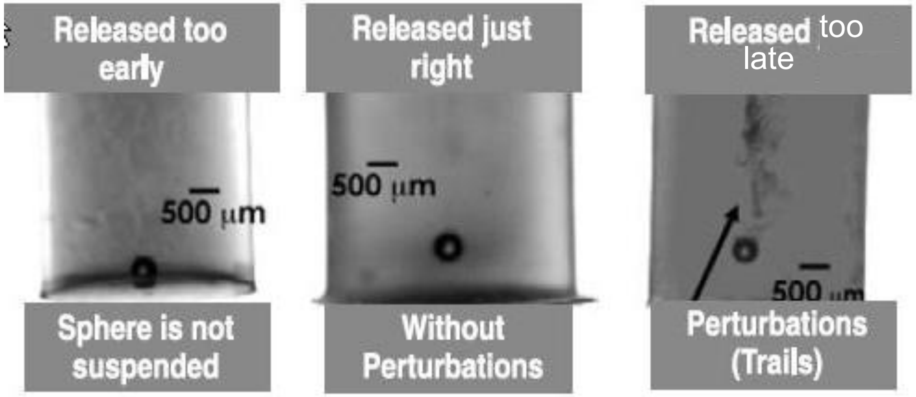
Plan early and stay engaged throughout the target production timeline

Target design and fabrication techniques may evolve significantly during the course of a campaign



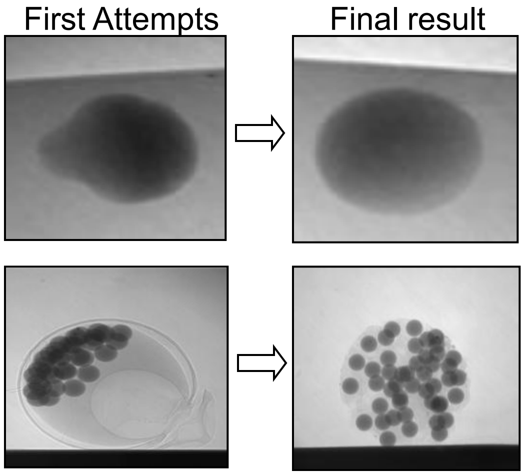


NLUF AstroShock targets as an example



Dispersed
- uniformity
- shape

Clumpy
- random distribution



Significant R&D may needed to determine if we could even make the targets

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

Component Type Fab. Center Best Effort

ORIGINATOR: E. GIRALDEZ

COMPONENT SHIPMENT DATA

ORDER #: CPM-AWE HohlDyn-10A 1.150 Au Halfraum
CUSTOMER: AWE
DATE: 12/8/09
WebTRF: 512

SPECIFICATION: AWE-HohlDyn-10A 1.150 Au Halfraum

PAGE: 1 of 1

PART ID	SPECS.	1	2	3
Hohlraum Length (mm)	1.150 ± 0.005	1.150	1.150	1.150
Wall Thickness (mm)	0.025-0.050	0.035	0.035	0.035
Diagnostic Hole 1 Radius (mm)	0.400 ± 0.010	0.400	0.400	0.401
Diagnostic Hole 2 Radius (mm)	0.400 ± 0.010	0.400	0.400	0.400
LEH Diameter (mm)	1.200 ± 0.005	1.200	1.200	1.200
Hohlraum ID Diameter (mm)	1.600 ± 0.005	1.600	1.600	1.600
Flange Diameter (mm)	1.800 ± 0.005	1.798	1.800	1.800
Hohlraum Radius (mm)	0.125 ± 0.013	0.125	0.125	0.125
Flange Radius Max (mm)	0.050 MAX	0.030	0.030	0.030
Flange Hole Radius (mm)	0.050 ± 0.010	0.050	0.050	0.050

#1

COMMENTS:

GENERAL ATOMICS

Read final metrology sheet!

http://gatrf.lle.rochester.edu/

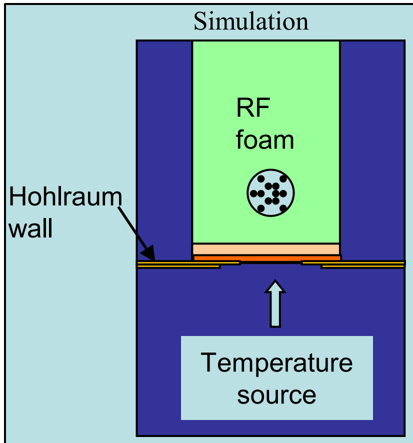
											Best Effort	WONO	GA Order	Cust. #		
											None	C30272-9570	IDC-LLE-296-Int-FI-09D Rev 0		Order Specs	Status
											None	C30272-9570	IDC-LLE-296-Int-FI-09D Rev 0		Order Specs	Status
											None	C30272.9490	COM-Int-FI-09D Cone & Shell	Int-FI-09D	Order Specs	Status
Edit	GA	DDC	Capsule	Cryo	SCD	A	CD shells	04/16/2009	6	External	None	C30272 3020	DDC 296 DiagDev-CIS-09A		Order Specs	Status

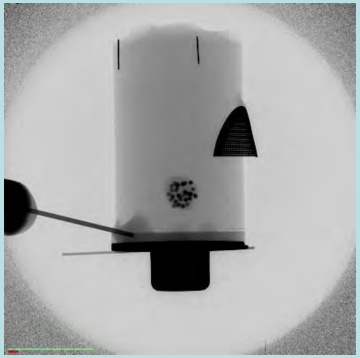
Clear Query Update Save as New

2008 Laboratory for Laser Energetics

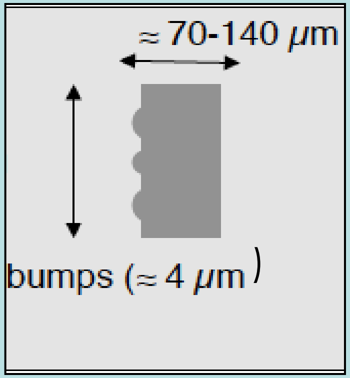
TRF is starting and ending point for ensuring targets for your experiments

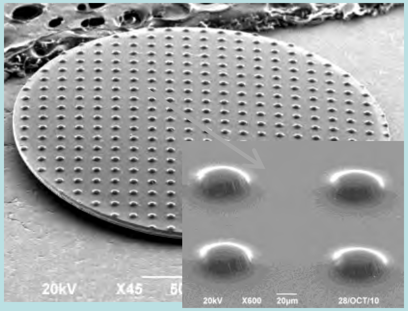
Early planning, close communication and iteration with target fab allows fabrication of complex targets …



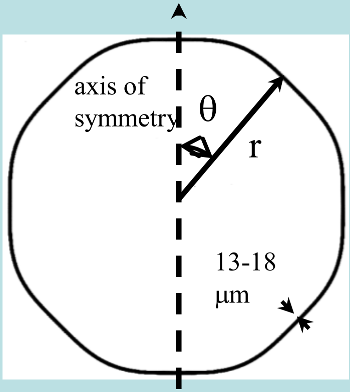


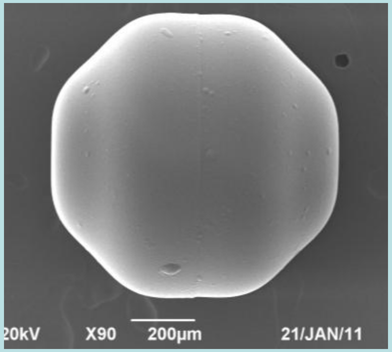
AstroShock- NLUF



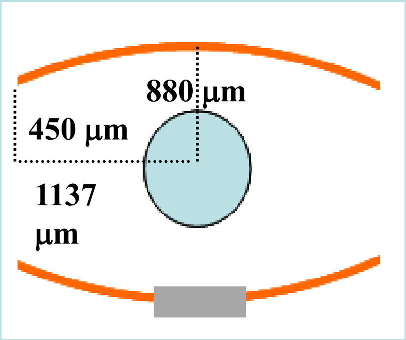


CHaRM- LANL/LLNL





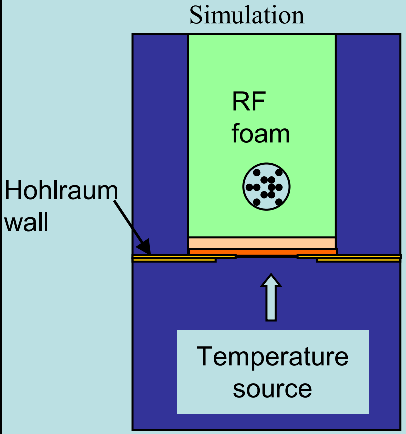
ABEX capsule - LANL

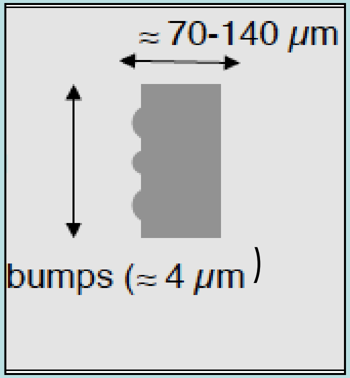


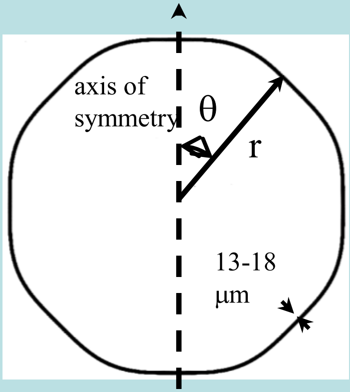
Rugby- LLNL/CEA

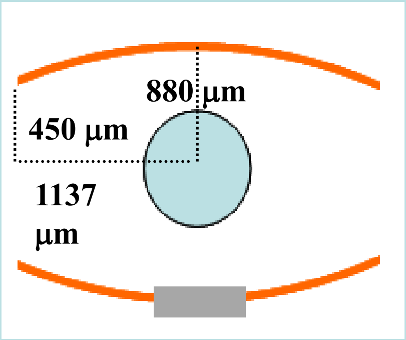
… and a successful experiment

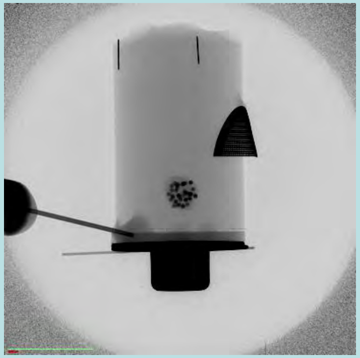
Early planning, close communication and iteration with target fab allows fabrication of complex targets …

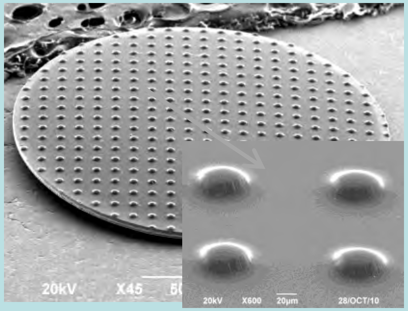


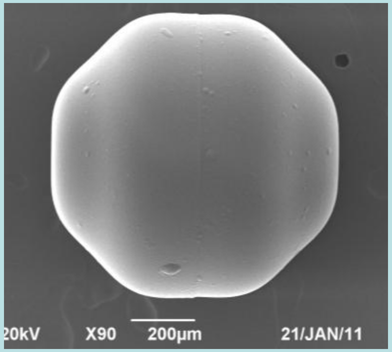












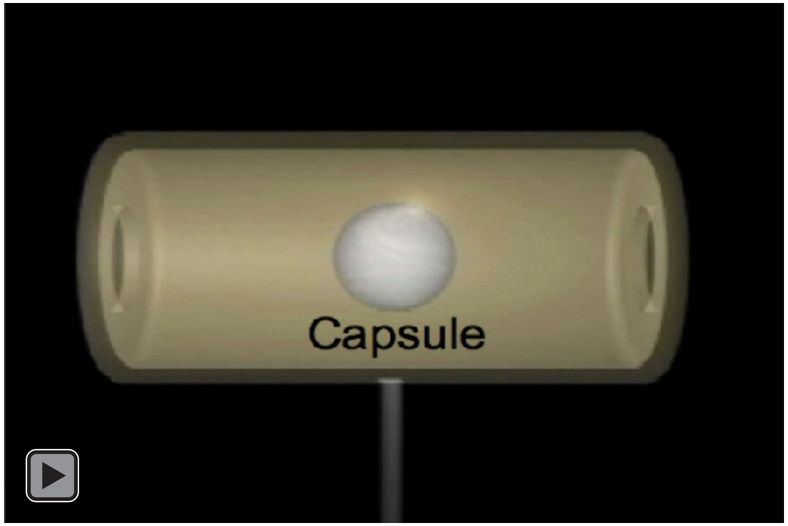
AstroShock- NLUF

CHaRM- LANL/LLNL

ABEX capsule - LANL

Rugby- LLNL/CEA

… and a successful experiment


Capsule