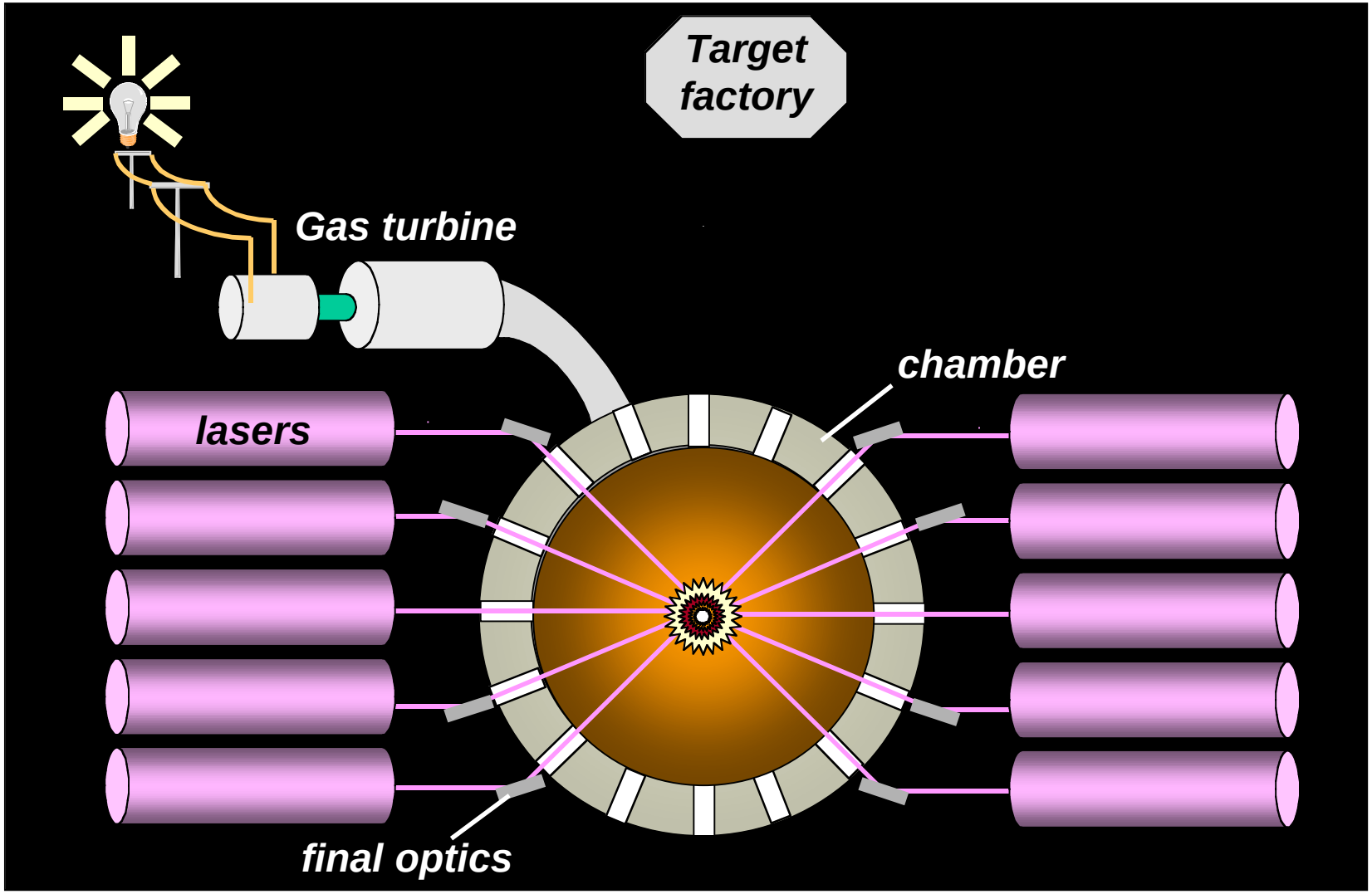
The High Average Power Laser Program in DOE/DP

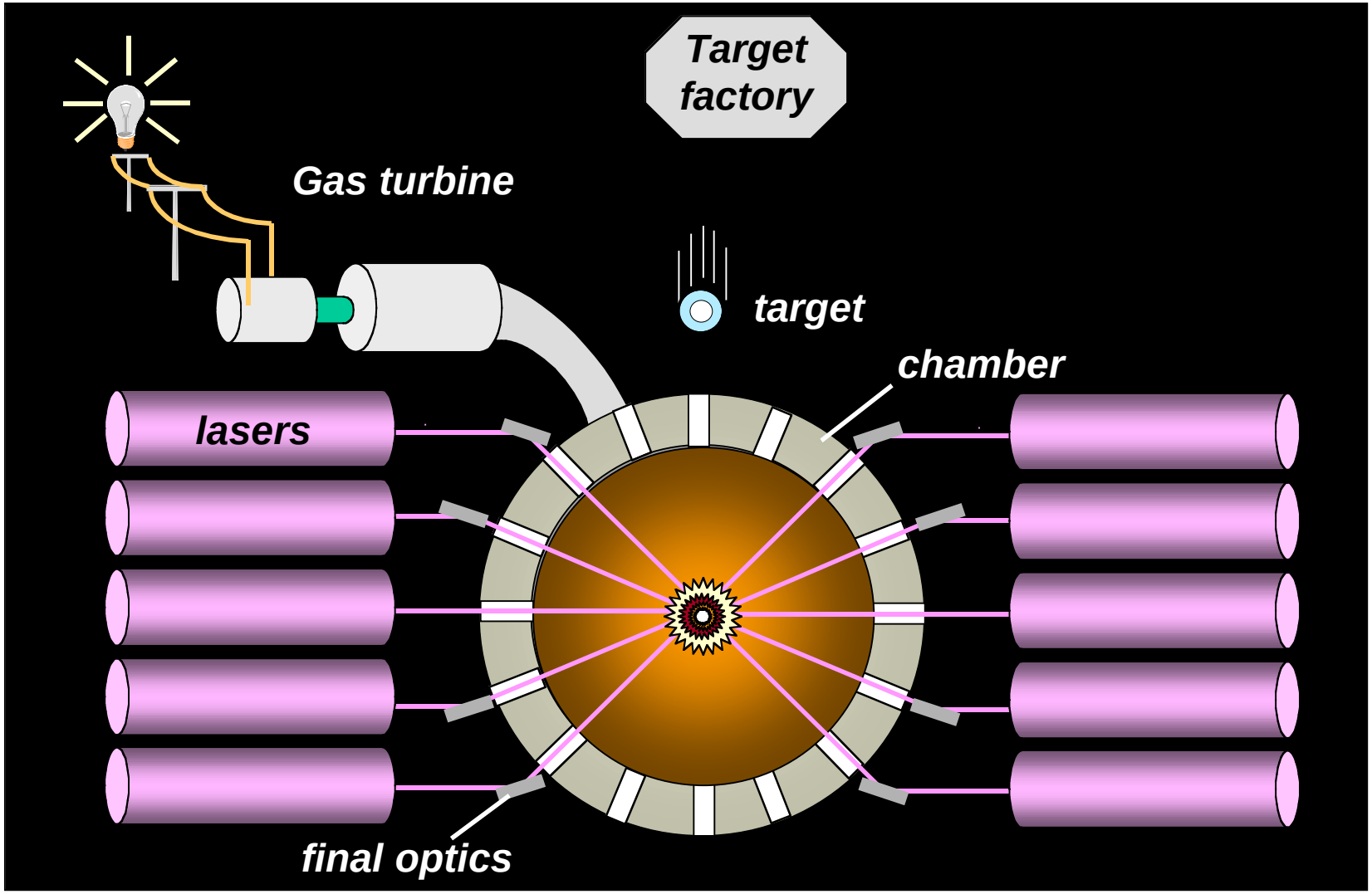
Coordinated, focussed, multi-lab effort to develop the science and technology for Laser Fusion Energy

- **Based primarily on direct drive with lasers**
- **Builds on advances in target design and lasers in DP program**
- **Focussed on Dry Wall Chamber concept**

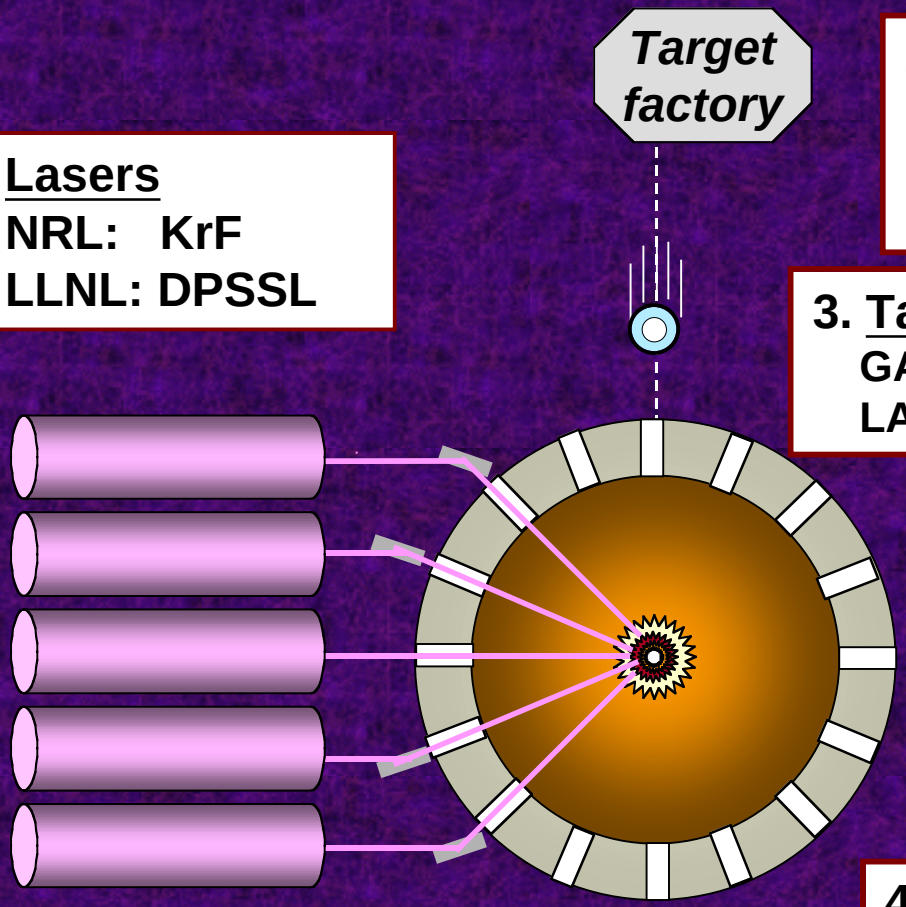
Fusion with direct drive and lasers is a simple concept..



But a challenge to make work



We are developing Laser IFE as an integrated system.



1. Lasers
NRL: KrF
LLNL: DPSSL

2. Target Fabrication
GA: Fab, charac, mass production
LANL: Adv mat, target fab, DT inv
SCHAFER: Foams, cryo layering

3. Target Injection
GA: Injector, Injection & Tracking
LANL: Materials prop, thermal resp.

4. Direct Drive Target Design
NRL- target design (Nike Prog)
LLNL: Yield spectrum
WISCONSIN: spectrum

4. Chambers
WISCONSIN: Dry wall, integrate design
LLNL: Other walls, neutron damage
UCSD: Chamber clearing, materials
SNL et al: Materials resp x-rays / ions
ORNL/UCLA: materials

5. Final Optics
LLNL: X-rays, ions, neutrons
UCSD: Laser, debris mitigation
LANL: Neutrons

ip

Laser IFE Program Phases

Phase III
start ~2014

Engineering Test Facility (ETF)
- 2-3 MJ, 60 laser beam lines
- High gain target implosions
- Optimize chamber materials & components.
- Complete thermal management

?

Establish: Target physics, Full scale Laser technology, Power Plant design

Phase II
start ~2005

Integrated Research Experiment (IRE)s
(Show essential components work together)
- Laser facility: Full scale reactor beam line, Hit injected targets, mat'ls & chamber dynamics
- Target facility: mass prod + injection into chamber.
- Power Plant Design

NIF Implosions
- 1.5 MJ laser
- Demonstrate ignition and gain

?

Viable: Target designs, scalable laser tech, target fab/ injection, final optics, chamber

Phase I
2001

KrF Laser
Electra (NRL)

DPPSL Laser
Mercury (LLNL)

Reactor Comp
- target fabrication
- target injection
- final optics
- chamber

Target Design
- Modeling
- Laser/Target Expts @1-30 kJ

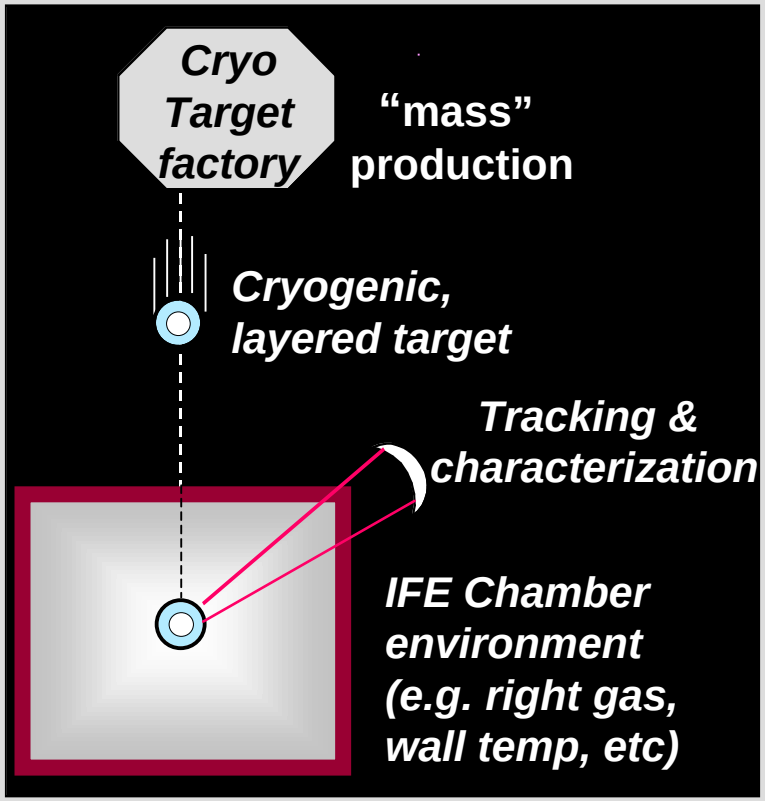
The IRE will be composed of two separate facilities

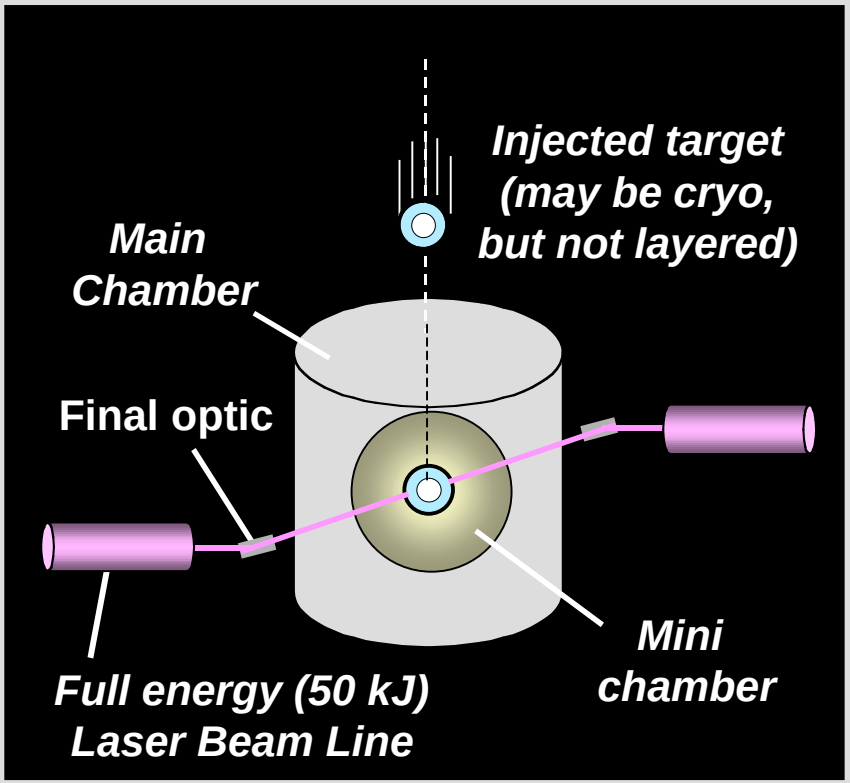
1. Target Facility:

demonstrate target injection and tracking in an IFE chamber environment

2. Laser Facility:

Full energy laser beam line
Steer beam to hit injected target
Test materials in "mini' chamber
Evaluate chamber dynamic models
Test final optics





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Laser IFE Program guidelines

Coordinated Integrated Approach…
- **Make sure we are indeed operating together**[bp]

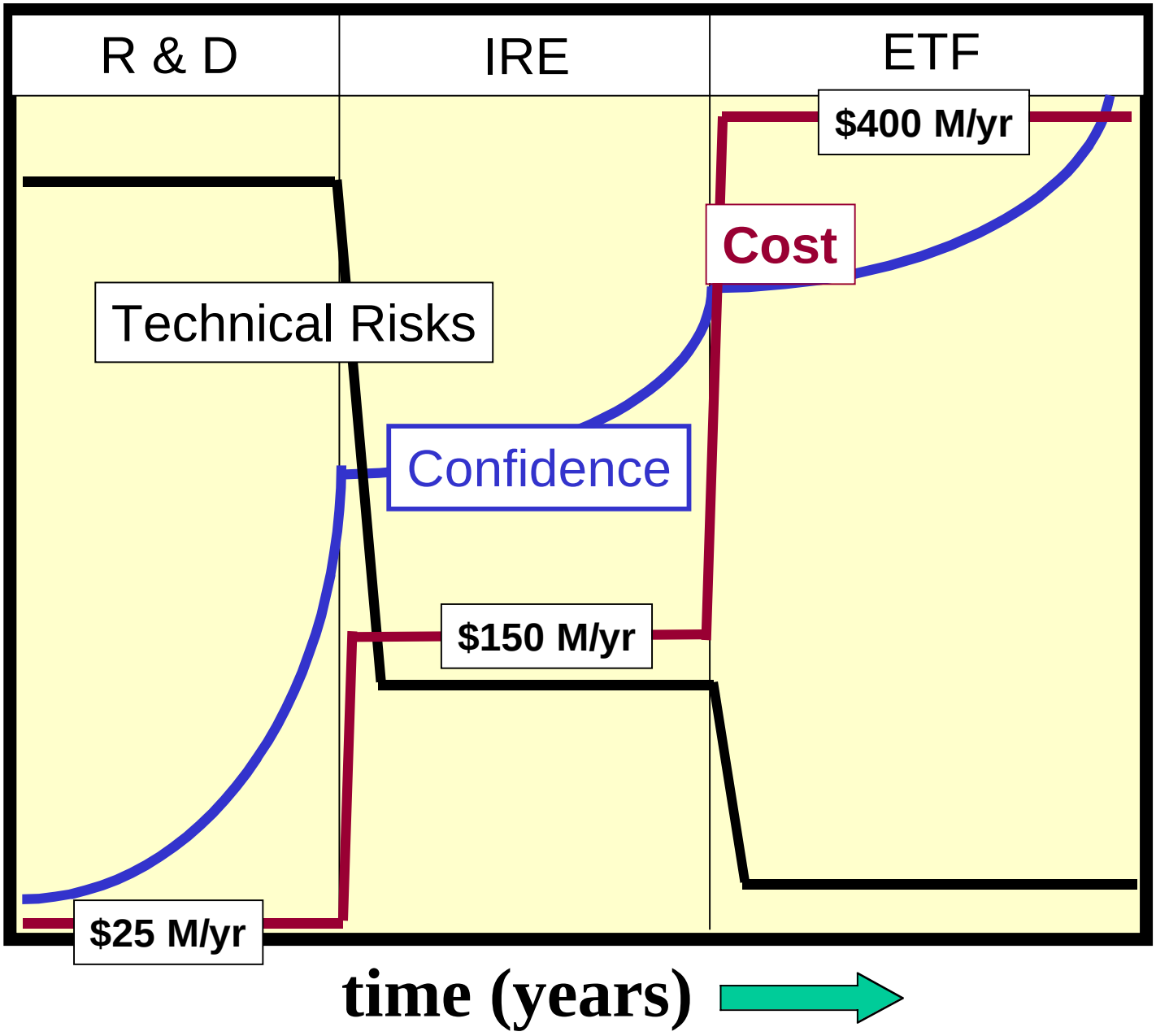
Address the important stuff first.. what is needed to go to the next step (IRE)?
- ***Target designs, scalable laser tech, target fab/inj, final optics, chamber***

Address issues that are unique to laser IFE…
- **leave more generic issues to larger world wide fusion program and NIF**

Phase I: understanding and predictive capability
- **Emphasize experimental validation**
- **Need to establish "operating windows" for chamber/target/final optic…**
  ….. Would like a suite of concepts to be evaluated
- **Not ready for systems designs (just yet)**

Value Simplicity
- **final optics, chamber materials, cryo layering, etc**

Program “Philosophy”



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Agenda for Laser IFE Meeting

Crowne Plaza Hotel
Pleasanton, CA
November, 13 + 14, 2001

TUESDAY MORNING, NOVEMBER 13, 2001—MODERATOR STEVE PAYNE

INTRODUCTION

8:00 - 8:20	Coffee, pastries, bagels, etc	All
8:20 - 8:30	Welcome	Steve Payne (LLNL)
8:30 -9:00	Introduction	John Sethian (NRL)

TARGET DESIGN

9:00 -9:20	Advanced High Gain Target Designs	S. Bodner

LASERS

9:20 - 9:45	Mercury Diode Pumped Solid State Laser	C. Bibeau (LLNL)
9:45 - 10:10	Electra KrF Laser	J. Sethian (NRL)

10:10-10:30	**BREAK**	

TARGETS

10:30-10:40	Overview of GA Target Fabrication Effort	D. Goodin (GA)
10:40-11:15	High-Z Coatings and Properties	E. Stephens (GA) A. Nikroo (GA)
11:15-11:35 ***11:35-12:00***	Tritium Inventories of IFE Target Fab Facilities Foam Shells by Injection Molding	A. Schwendt (LANL) W. Steckle (LANL)

12:00 - 1:30	**LUNCH**	

TUESDAY AFTERNOON, NOVEMBER 13, 2001—MODERATOR JOHN SETHIAN

1:30 - 2:00	Divinyl Benzene (DVB) foam production	D. Schroen (Schafer)
2:00 - 2:30	Rapid Cryogenic Layering for IFE targets	C. Halvorsen (Schafer)

TARGET INJECTION

2:30 -3:00	Status of Target Injector, In-Chamber Tracking, Electromagnetic Injector	R. Petzold (GA)
3:00 - 3:30	Thermal and stress analysis of a solid DT test specimen	J. Hoffer (LANL) G. Swadener (LANL)

3:30 - 3:40	**BREAK**	

FINAL OPTICS

3:40 - 4:10	Final Optics	S. Payne (LLNL) J. Latkowski (LLNL)
4:10 - 4:30	Dust & LIDT threat modeling and planned expts	M. Tillack (UCSD)
4:30 - 5:00	Absorption, Reflectance, & Luminescence of Optical Components: Pre-Neutron Irradiation Results	Wayne Cooke (LANL)
5:00 - 5:15	Activation of Optics Irradiated in LANSCE	G. Kulcinski (Wisc) M. Sawan (Wisc)

POSTER SESSIONS

5:30 - 7:30	Various topics (Details of Laser IFE activities)	All

WEDNESDAY MORNING, NOVEMBER 13, 2001—MODERATOR DAN GOODIN

INTRODUCTION

8:00 - 8:30	Coffee, pastries, bagels, etc	All

CHAMBERS-1

8:30 - 8:35	Introduction to Wisconsin Chambers Work	G. Kulcinski (Wisc)
8:35 - 8:55	Target Output Spectra	R. Peterson (Wisc)
8:55 - 9:15	Dry Wall Chamber Modeling	D. Haynes (Wisc)
9:15 – 9:45	Alternate Chambers Work Chamber threats and materials effects.	J. Latkowski (LLNL) W. Meier (LLNL)
9:45 - 10:00	High Gain Target Output Spectra	J. Perkins

10:00-10:15	**BREAK**	

CHAMBERS-2

10:15-10:45	Chamber dynamics modeling	R. Raffray (UCSD)
10:45-11:00	Chamber Experiments	F Najmabadi (UCSD)
11:00-11:30	Chamber Plan	F. Najmabadi (UCSD)

MATERIALS

11:30-11:35	IFE materials studies at Sandia	C. Olson (SNL)
11:35-11:45	IFE Materials Studies on Z (x-rays)	T. Tanaka (SNL)
11:45-12:00	IFE Materials Studies on RHEPP (ions)	T. Renk (SNL)
12:00-12:15	Modeling of Z-Ablation	I. Golovkin (Wisc)
12:15-12:30	Post-experiment modeling of engineering surface experiment in RHEPP	R. Raffray (UCSD)

12:30 - 1:30	**LUNCH**	

WEDNESDAY AFTERNOON, NOVEMBER 13, 2001-MODERATOR LANCE SNEAD

MATERIALS- Cont

1:30 ***1:45***	Laser IFE Materials Plan	L. Snead (ORNL) N. Ghoniem (UCLA)
1:45- ***3:00***	Materials discussion	Laser IFE Materials Working Group + all interested parties

POST MEETING ACTIVITIES:

TBD	Tours: Mercury (DPPSL) Spheromak	S Payne

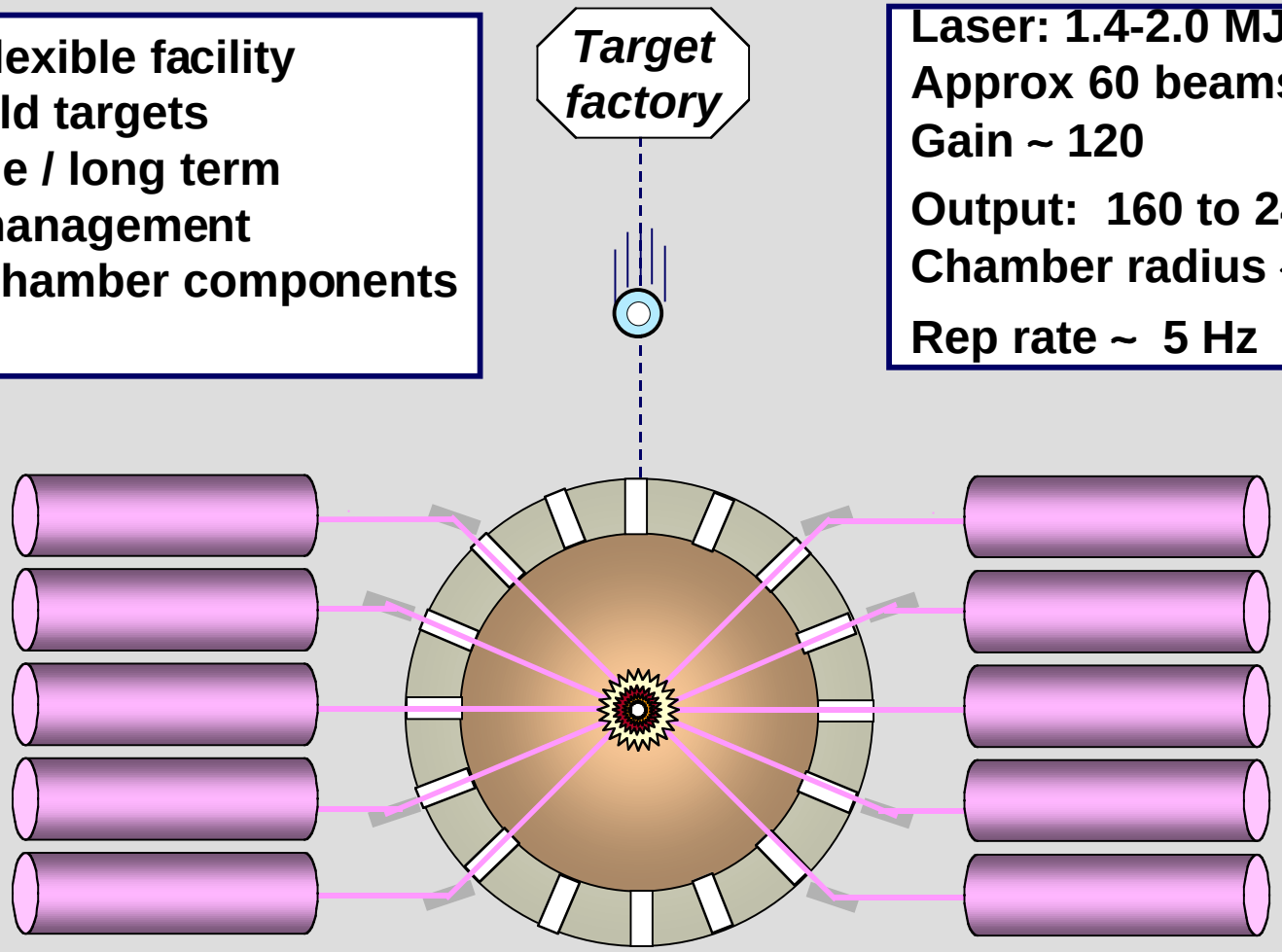
PLEASE TURN IN ELECTRONIC COPIES OF YOUR PRESENTATION TO TAMMY TALOVICH

Tammy Talovich <talovich1@llnl.gov>

And now a word from our sponsor

The ETF

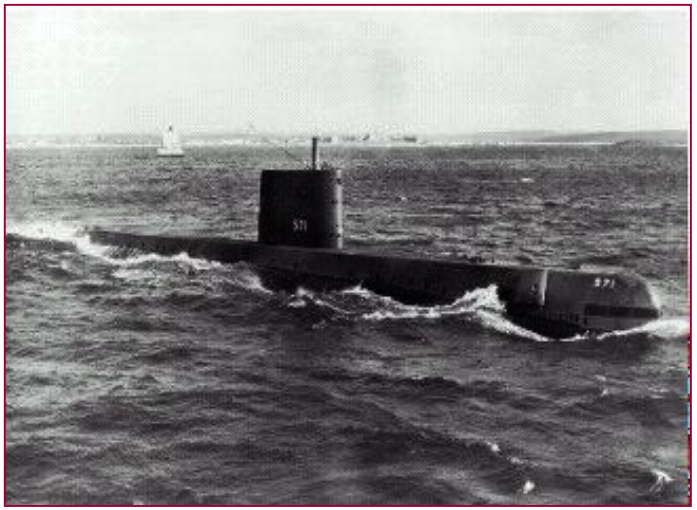
Modular, flexible facility
Fusion yield targets
Burst mode / long term
Thermal management
Evaluate chamber components



Laser: 1.4-2.0 MJ
Approx 60 beams
Gain ~ 120
Output: 160 to 240 MJ
Chamber radius ~ 4-6 m
Rep rate ~ 5 Hz

8-10 years to develop the ETF is realistic...

Lunar Landing: 7 Years
(Kennedy speech to Armstrong lands)



Nuclear Submarine: 6 Years
(Rickover starts to *Nautilus* sails)