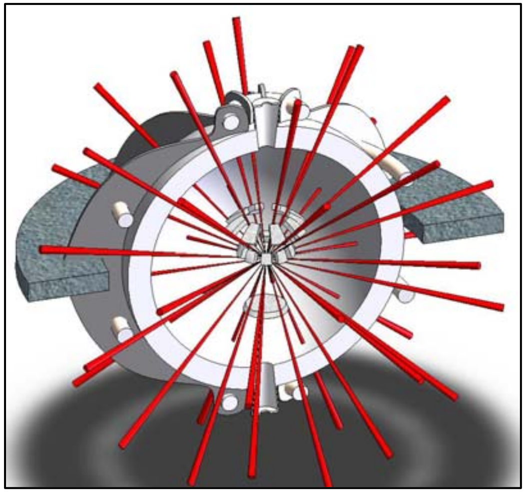
# A Laser Based Fusion Test Facility (FTF)



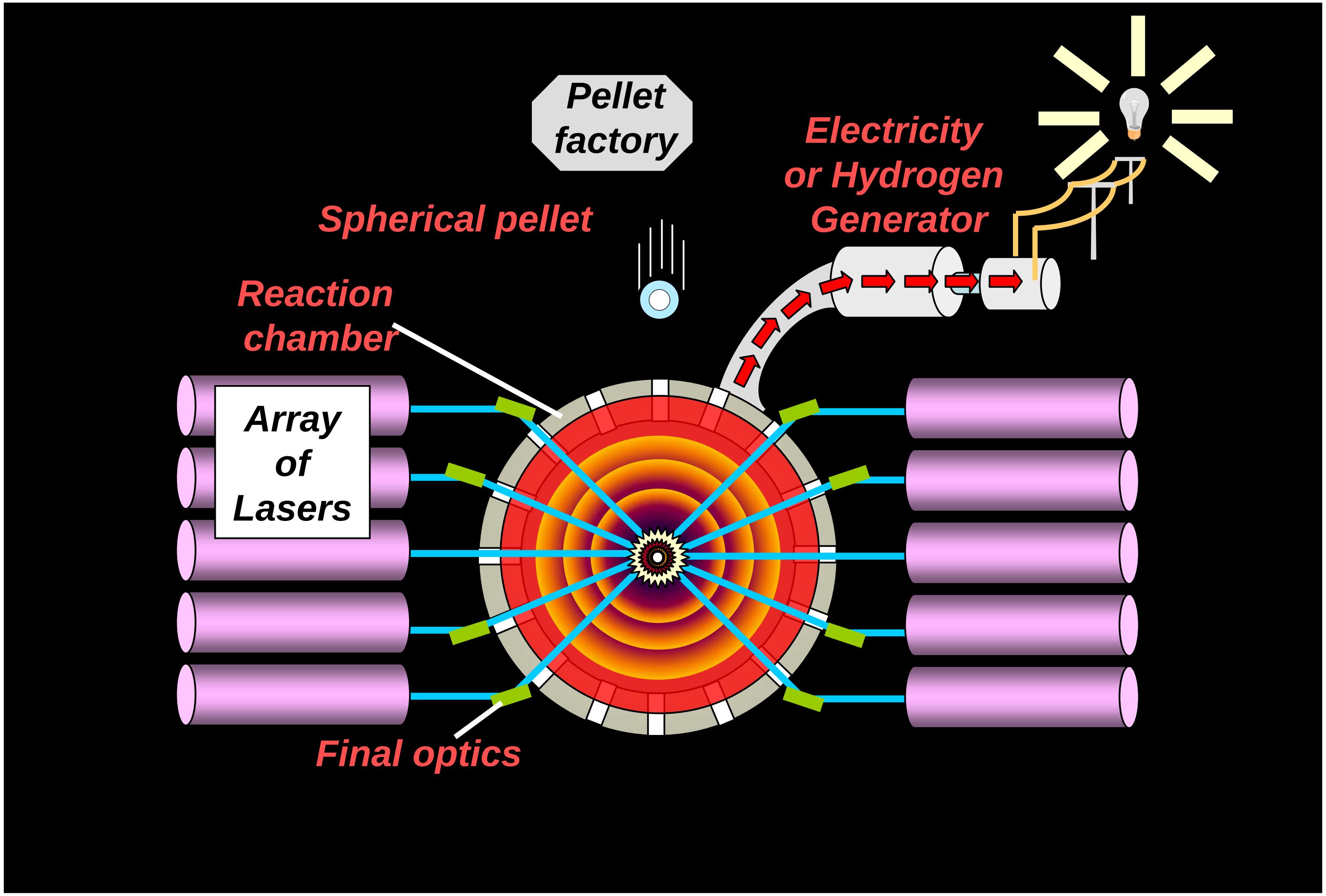
- ~150 MW (thermal) fusion power
- ~500 kJ  laser energy @ 5 Hz
- ~50 to 100× target gain
- based on advanced laser direct drive

The Fusion Test Facility (FTF) is a high-repetition moderate-sized ignition facility that would bridge the gap between single shot facilities (such as NIF and LMJ) and a fully functioning laser fusion power plant.

Use of the deeper UV light from a KrF laser would help achieve adequate energy gain for an FTF at sub-megajoule  laser energies

Presented by   S.P. Obenschain, *Plasma Physics Division, U.S. Naval Research Laboratory*

# The laser fusion energy concept

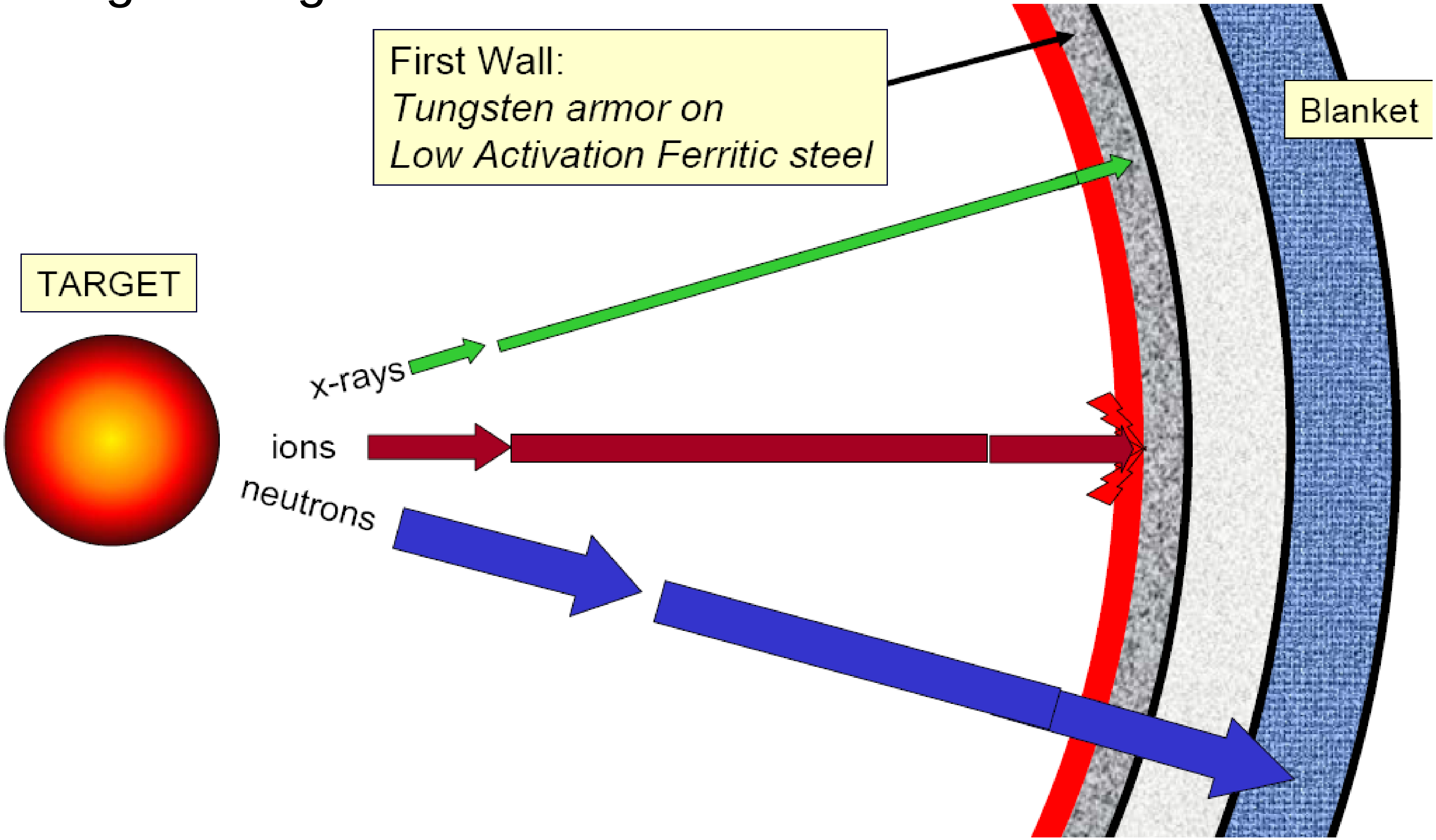



Major components are separable and modular

# Issues for laser IFE

- Robust high gain target designs
- Physics base for above
- Inexpensive high-precision targets
- Precise target injection & engagement
- Durable, efficient 5-10 Hz laser driver
- Chambers and final optics that can withstand the "threat spectrum" from pellets (x-rays, ions and neutrons)
- Neutron absorbing blanket and tritium breeding
- Systems design, safety, environmental issues.
- Economics of development and fielding.

The first wall of an IFE reactor must survive the “threat” spectrum from a the target – which is sensitive details of the target design.



# The High Average Power Laser (HAPL) team is developing the science and technology for a laser fusion power plant.

18th HAPL meeting
April 8 & 9, 2008
Santa Fe, NM

**Government Labs**

1. NRL
2. LLNL
3. SNL
4. LANL
5. ORNL
6. PPPL
7. SRNL

**Universities**

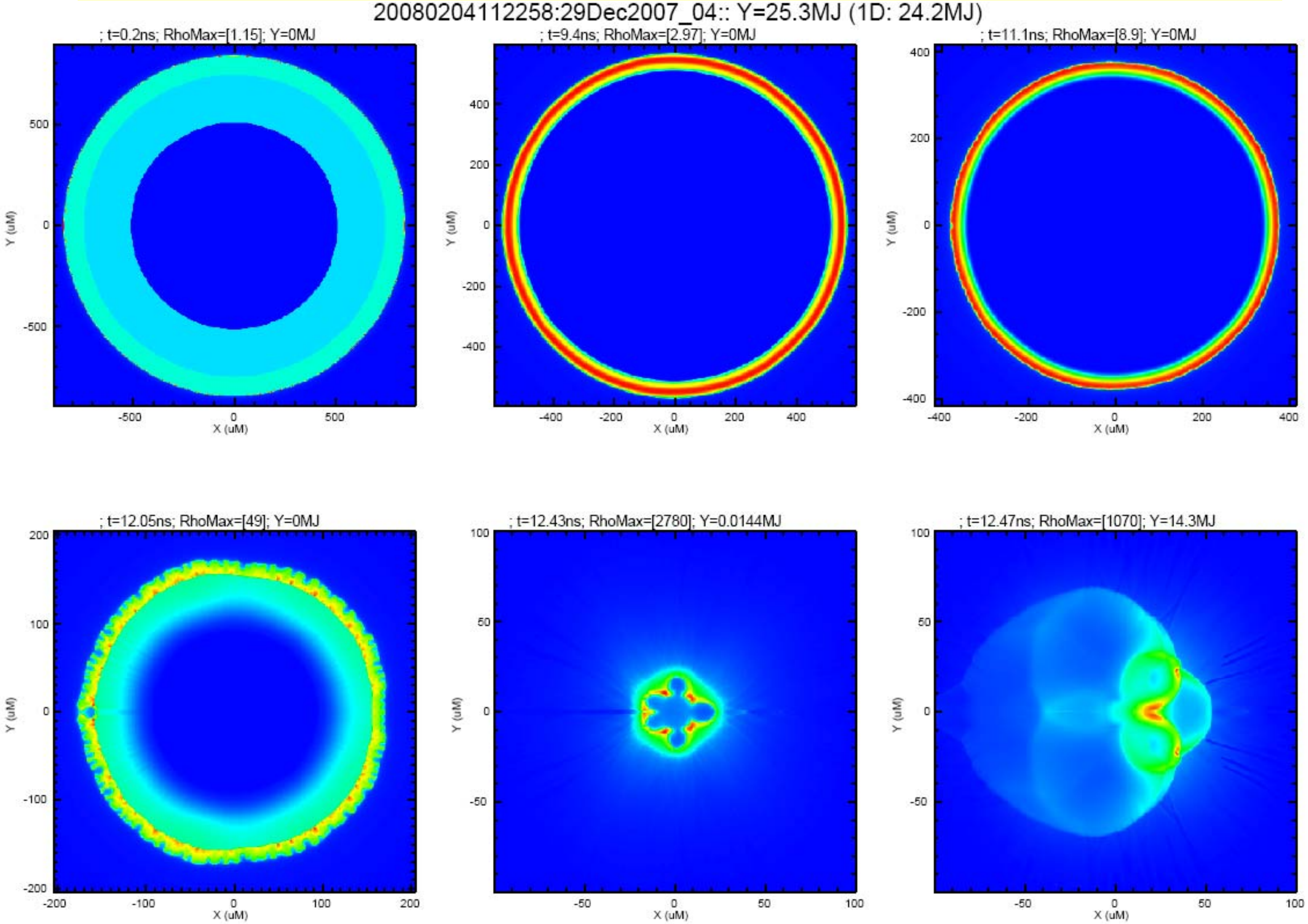
1. UCSD
2. Wisconsin
3. Georgia Tech
4. UCLA
5. U Rochester, LLE
6. UC Berkeley
7. UNC
8. Penn State Electro-optics

**Industry**

1. General Atomics
2. L3/PSD
3. Schafer Corp
4. SAIC
5. Commonwealth Tech
6. Coherent
7. Onyx
8. DEI
9. Voss Scientific
10. Northrup
11. Ultramet, Inc
12. Plasma Processes, Inc
13. PLEX Corporation
14. APP
15. Research Scientific Inst
16. Optiswitch Technology
17. ESLI

# Simulations give 100× gain at 300 kJ and gains near 200× at 1 MJ with KrF driven shock-ignited targets

**gains of >100 are entree' to a laser fusion power plant**

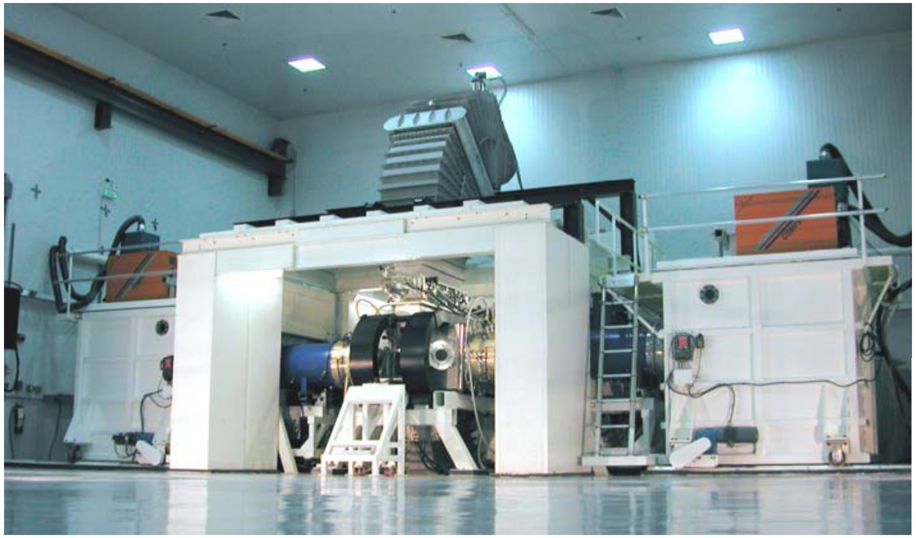



**simulations with NIF-spec ($\sigma_{rms}$=0.5μm) outer surface perturbations only**

# NRL Krypton-Fluoride Laser Facilities



Electra: goal 700 J @ 5 Hz, >$10^6$ shots



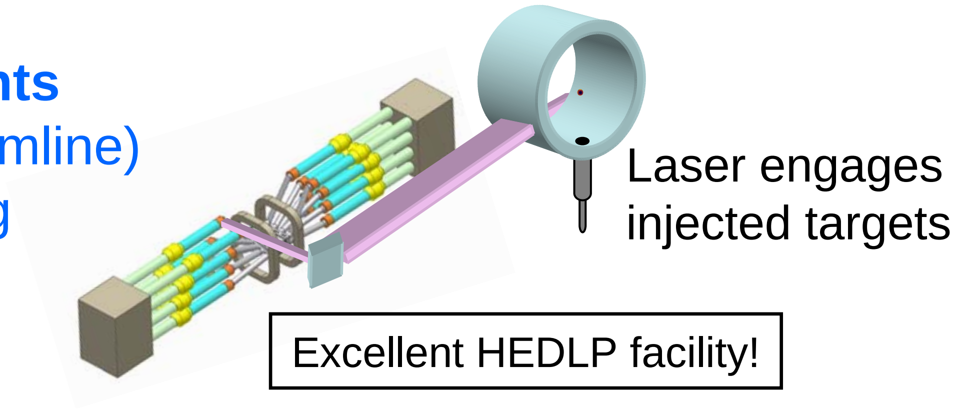
Nike: 56 beam 5 kJ laser-target facility
(1 to 2 shots per hour)

# A three-stage plan for laser IFE:

## Key elements are developed and implemented in progressively more capable IFE oriented facilities

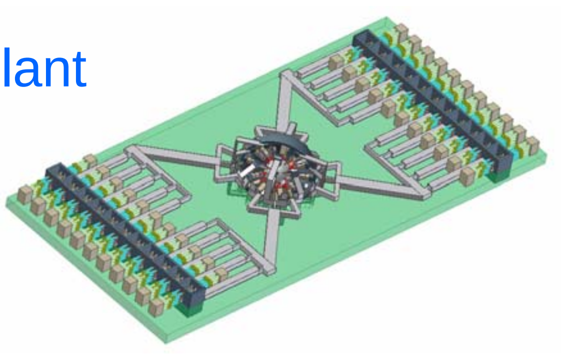
**Stage I : Develop full size components**

- Laser module (25 kJ 5 Hz KrF beamline)
- Target fabrication/injection/tracking
- Chamber design
- Refine basic pellet physics




**Stage II Fusion Test Facility (FTF)**

- Demonstrate physics / technologies for a power plant
- Develop/ validate fusion materials and structures
- Operating: ~2020
- Significant participation by private industry

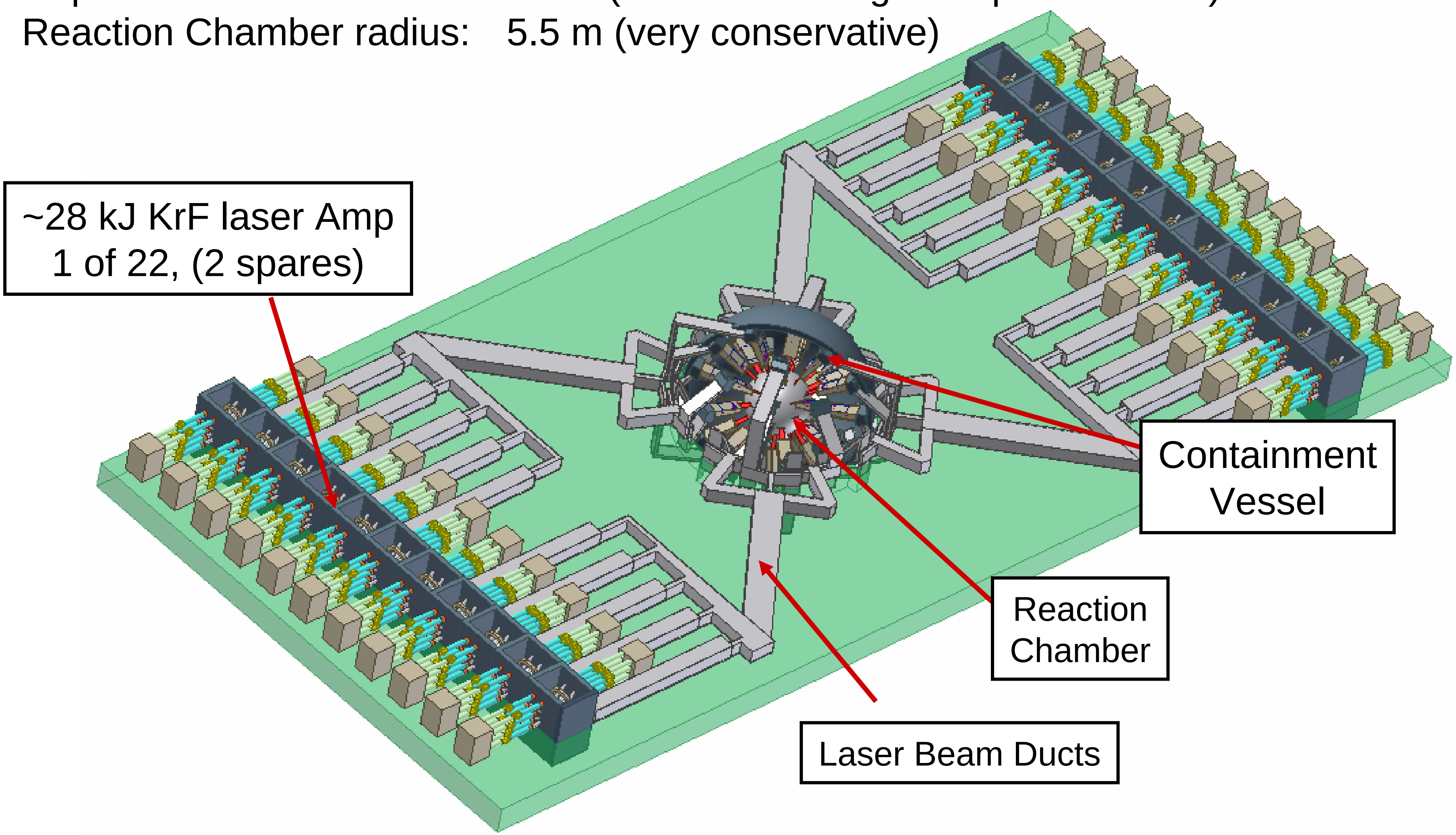


**Stage III Prototype Power plant(s)**

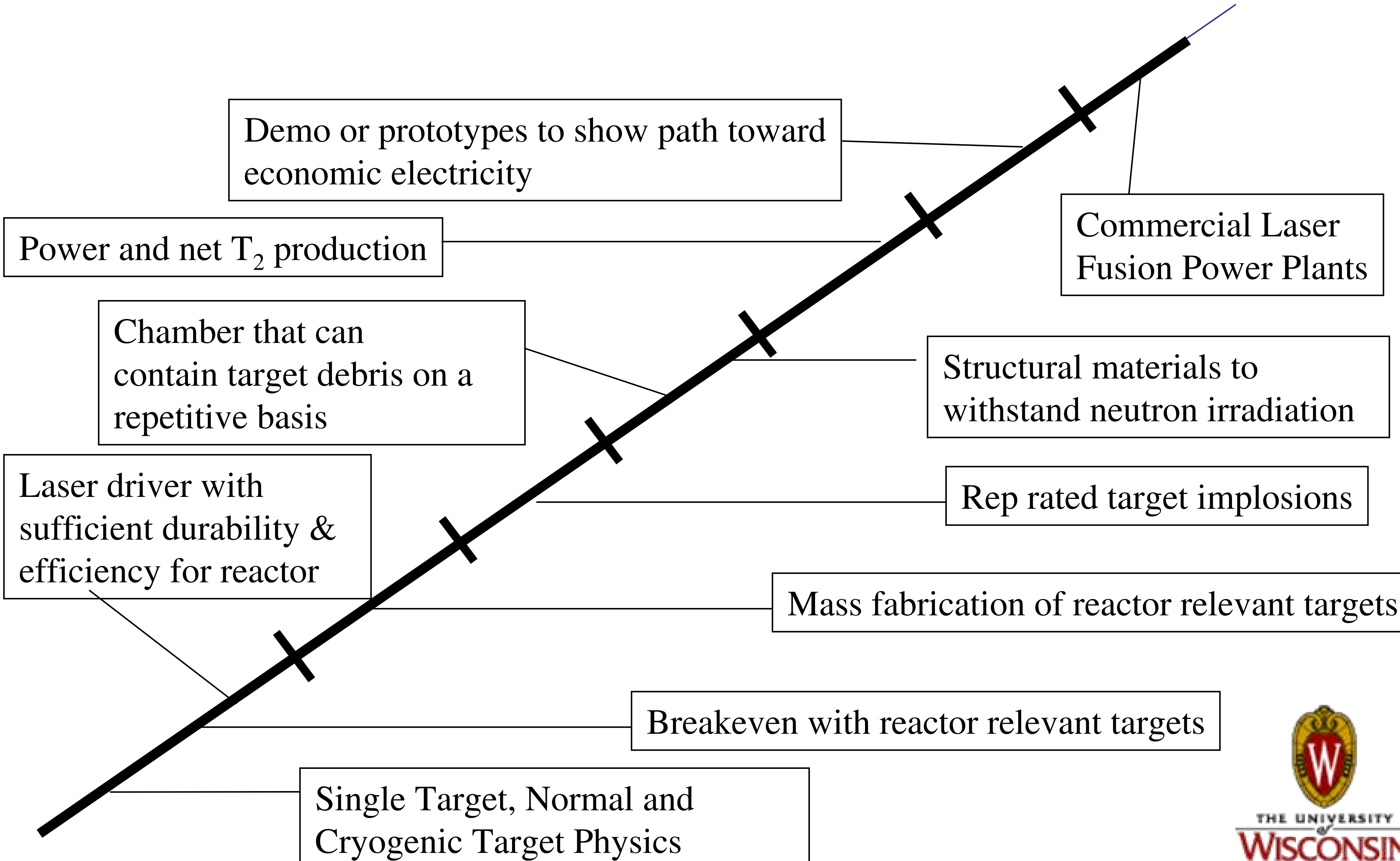
- Electricity to the grid
- Transitioned to private industry

# The Fusion Test Facility (STAGE II)

Laser energy on target: 500 kJ
Fusion power: 150 MW
Rep Rate: 5 Hz (but allow for higher rep-rate bursts)
Reaction Chamber radius: 5.5 m (very conservative)



# What Needs to be Done on the Path to a Commercial Laser Fusion Reactor?

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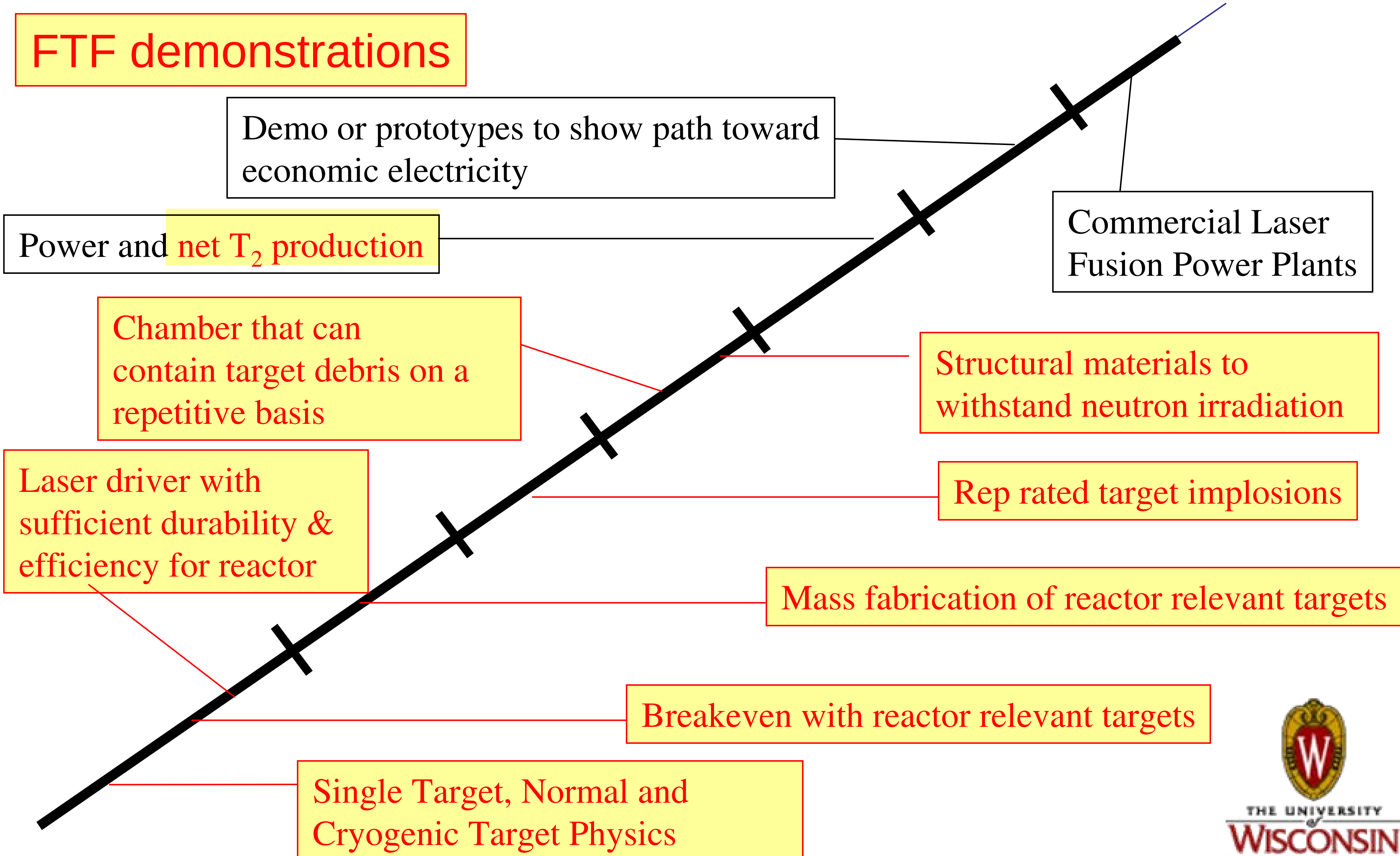


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# We should exploit IFE ,HEDLP (and MFE) Synergisms

IFE

HEDLP

- Pellet physics and design
- Computational models
- Reliable high energy drivers
- Target injection & engagement

- 5-10 Hz Hz operation
- Unique IFE chamber threats
- Very low cost targets
- IFE system design

- Neutron absorbing blankets
- Breeding tritium
- Low Activation materials
- Fusion power production

MFE