Krypton Fluoride Laser Driven Inertial Fusion Energy

Presented to

NAS Committee on the Prospects for Inertial Confinement Fusion Energy Systems

San Ramon CA

January 29, 2011

presented by

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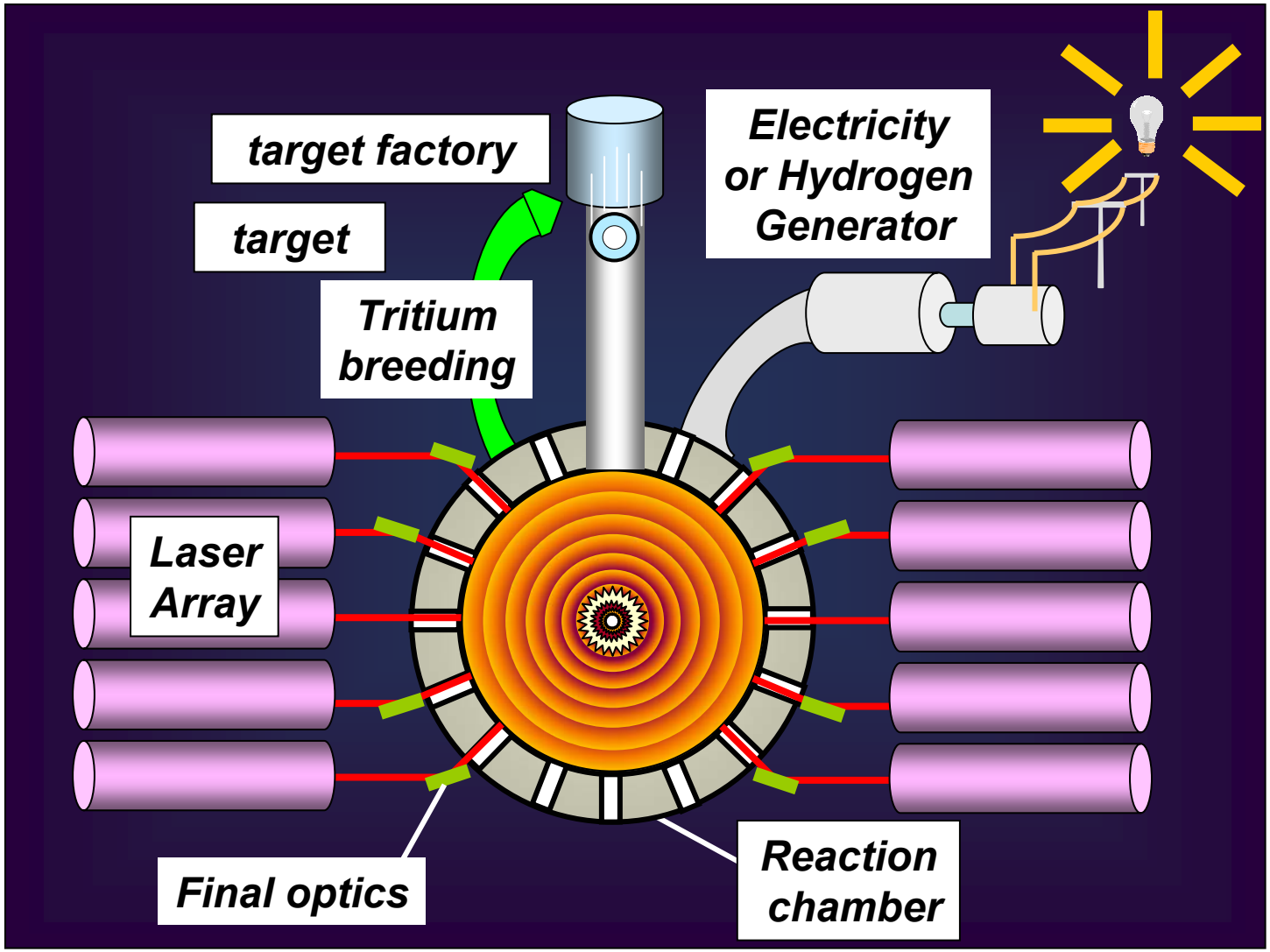
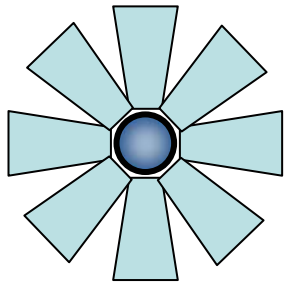
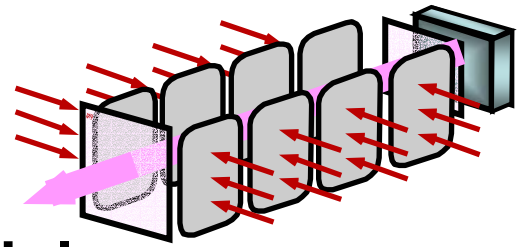
Fusion Energy with Lasers and Direct Drive



Why we believe direct drive with lasers can lead to an attractive power plant

1. Simplest target physics:

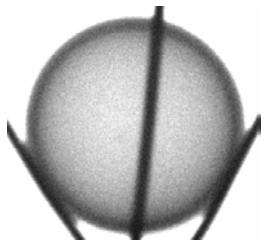




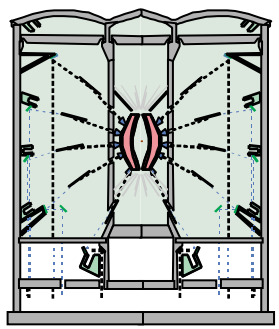
2. Laser (most costly component) is modular

3. Separate components lower cost of development

4. Simple spherical targets:
   facilitates mass produced “fuel"



5. Power plant studies economically attractive



6. We have made a lot of progress!!

What is a Krypton Fluoride (KrF) Laser?

- **Gas Laser--Excimer (Excited Dimer)**
- **Fundamental wavelength is 248 nm**
  - **Energy + (Kr + F_2) $\Rightarrow$ (KrF)* + F $\Rightarrow$ Kr + F2 + hν (λ = 248 nm)**
- **Small discharge pumped KrF lasers are used routinely in industry for chip lithography**

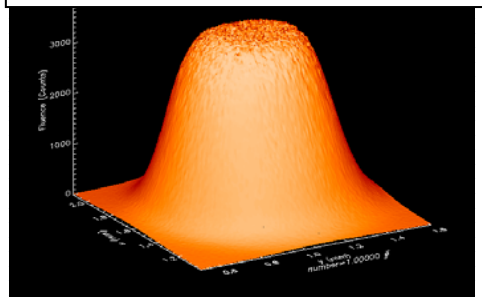
Cymer ELS 7010

- **Large KrF lasers for IFE are pumped with electron beams**
  - **Share several technologies with commercial systems**
  - **Requires R&D for e-beam science & technology and larger size**

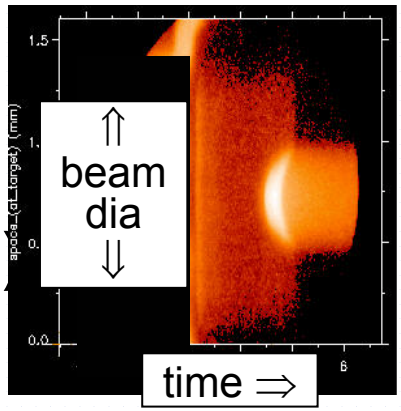
KrF lasers have inherent advantages for fusion energy

PHYSICS: High Gain

Nike single beam focus



- **Most uniform laser beam**
  - Helps achieve smooth implosions
- **Shortest UV (248 vs 351 nm)**
  - Allows higher drive pressures
  - Better coupling to target
  - Higher threshold for Instabilities
- **"Zoom"** (decrease spot as pellet implodes)



POWER PLANT: Attractive Technology

- **Gas Medium...easy to cool, durable**
- **Mostly robust industrial technology**

Outline

Introduction	J. Sethian
KrF target physics Advantages for IFE High gain target designs Simulations Experiments	S. Obenschain
KrF Laser Achievements Durable, efficient, rep rate technologies	J. Sethian
The HAPL program to develop components for IFE "Business Model" (Integrated, multi-institutional) Highlights of technical achievements	J. Sethian
Vision of R&D path to Inertial Fusion Energy	S. Obenschain

NRL agrees with The ICF community common viewpoint

- Demonstration of laboratory ignition will establish that the physics underpinning IFE exploitation is fundamentally sound.
- IFE is a field in which the US is a clear world leader – academically, technologically and industrially.
- We have an opportunity to capitalize on this leadership position over the next few years, and leverage prior substantial defense program investment.
- Recent action by the DOE to propose a new IFE development program and secure a stable home for IFE is timely and very welcome.
- Moving forward, the IFE program needs to focus on the requirements of an operating power plant, with design choices managed at a systems-level.
- The inherent modularity and separability of IFE provides significant benefits when considering power plant development, operations , and evolution.
- Taking advantage of significant prior research, future development activities in this program need to include IFE scale science and technology development and demonstration.
- IFE is a national scale program requiring a coordinated effort by academic, Laboratory, and industrial partners.
- A phased program with competition and unambiguous selection criteria is needed