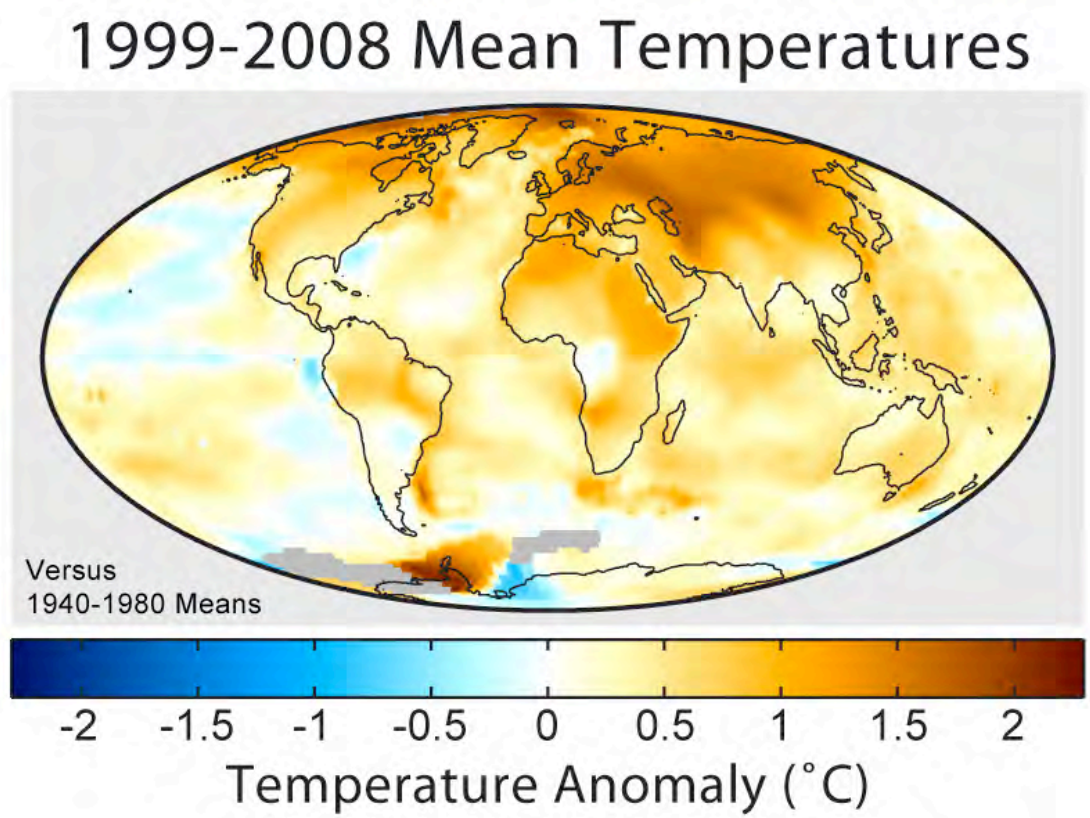
Inertial Fusion Energy in Japan



from Wikipedia

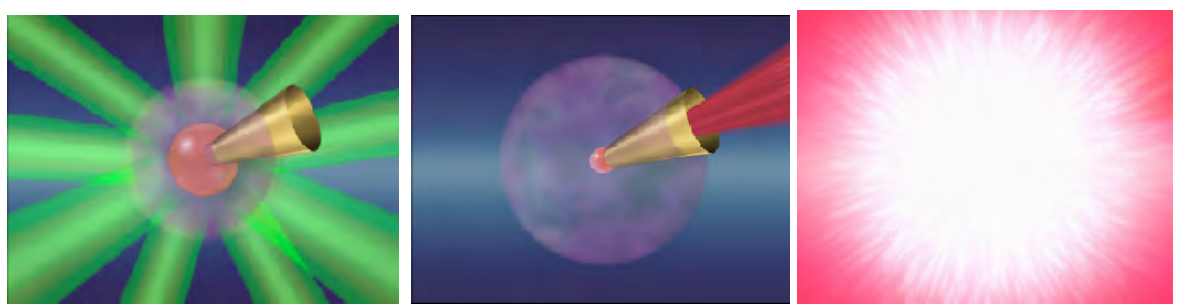
NIF Technical Symposium
Livermore
2009.5.28

H. Azechi
Director
Institute of Laser Engineering
Osaka University

ILE OSAKA

Fast Ignition Realization Experiment (FIREX) Project

Implosion Fast heating Ignition/Burn



- Proof-of-concept: Scalable to 600 times liquid density
  Demo of 1 keV temp. by 0.5kJ/0.5ps.
- FIREX-I: Demo of 5-10 keV temperature by 10kJ/10ps.
- FIREX-II: Demo of ignition and burn by Fast Ignition

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Double Cone Doubles Electron Confinement.

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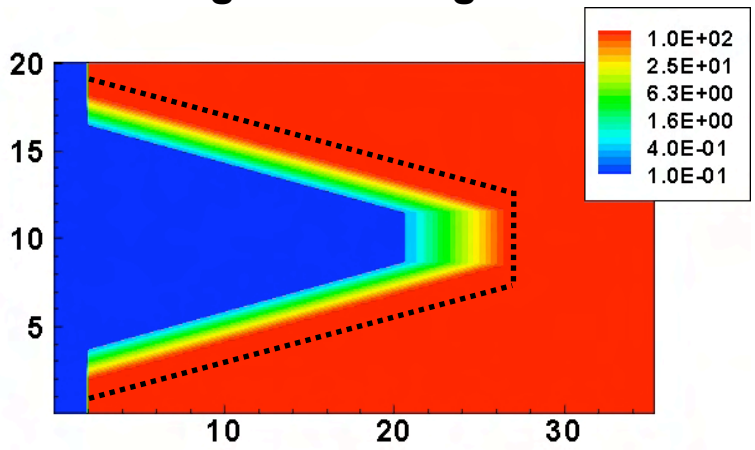
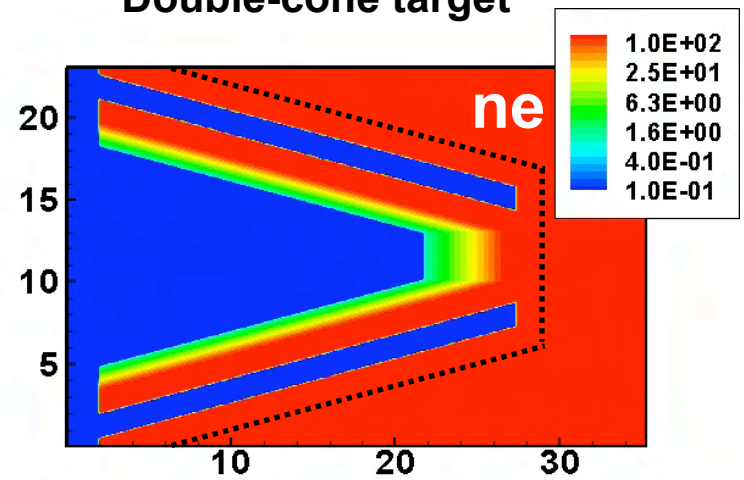
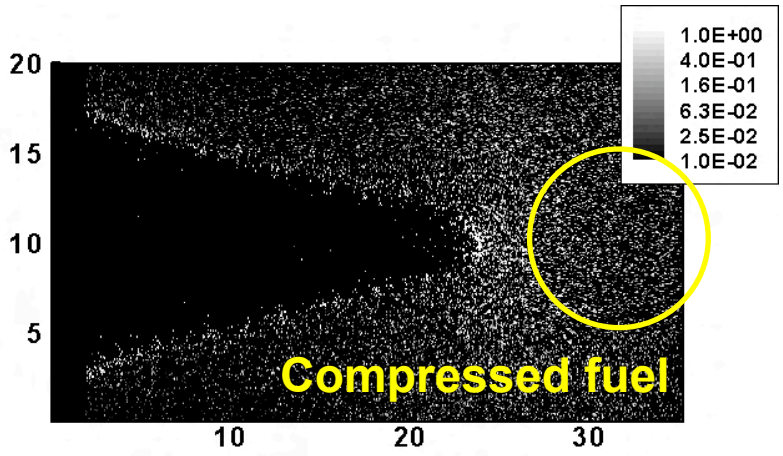
Single-cone target



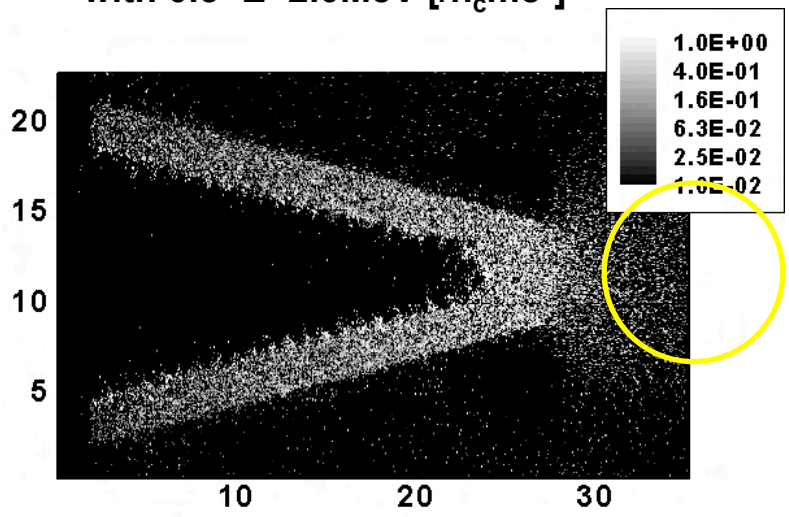
Double-cone target



Energy distribution of electrons with $0.5<E<2.0$MeV [/$n_c mc^2$],



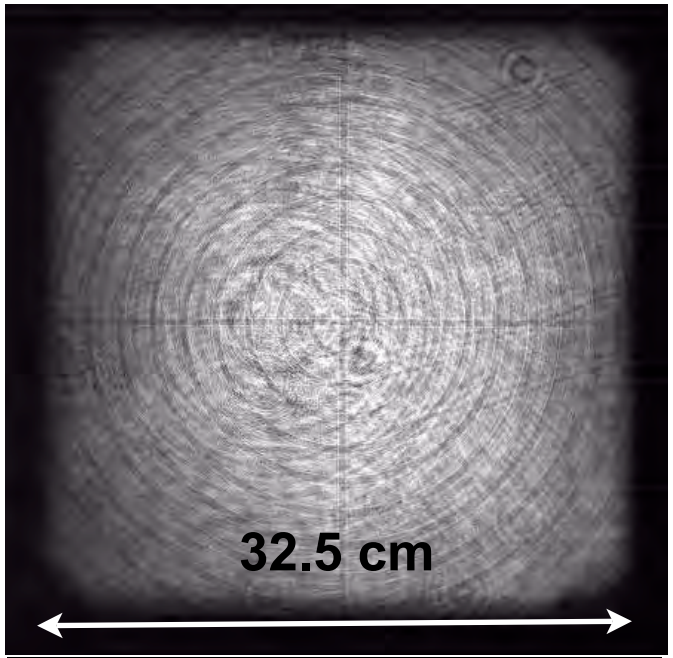
Energy distribution of electrons with $0.5<E<2.0$MeV [/$n_c mc^2$]

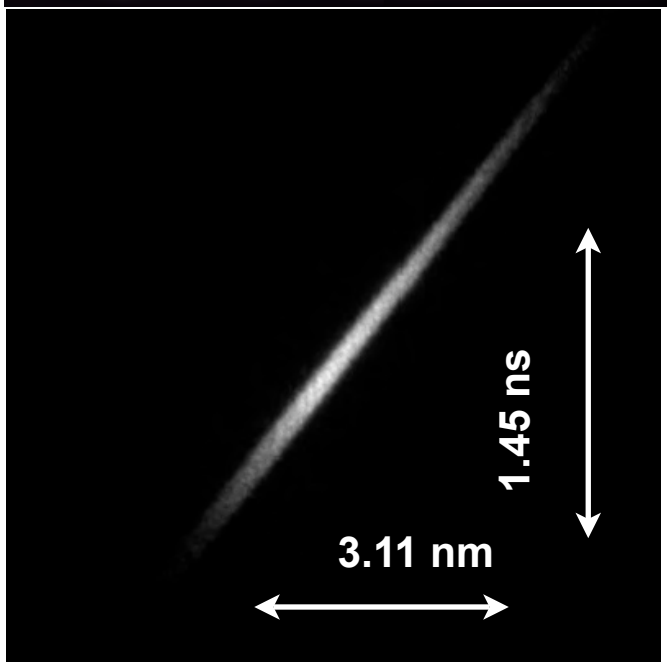


Nakamura, PoP07

World's Largest Short Pulse Laser

Energy demo
11.8 kJ @Broadband





Tiled Grating

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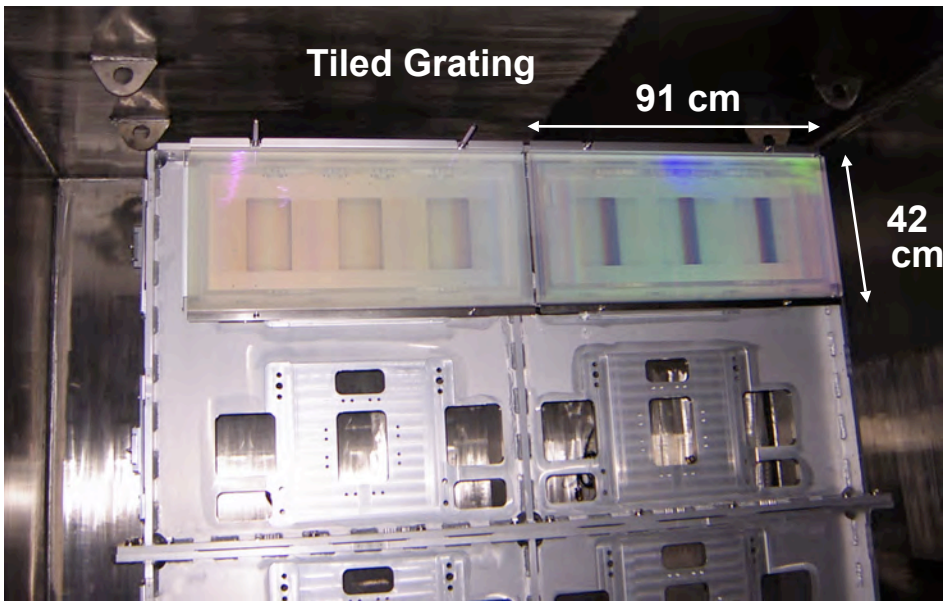
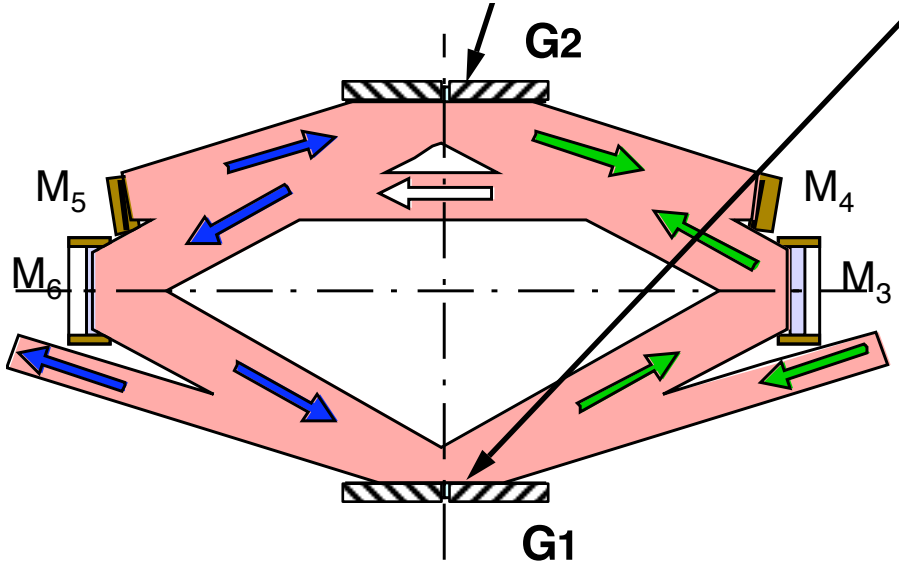
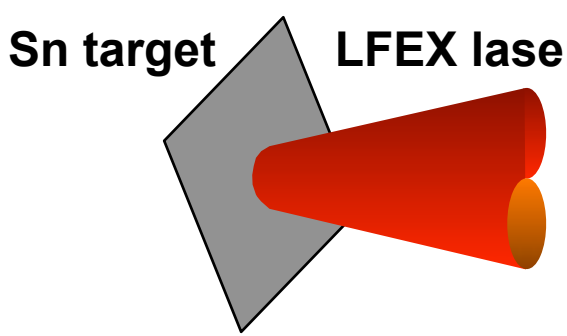
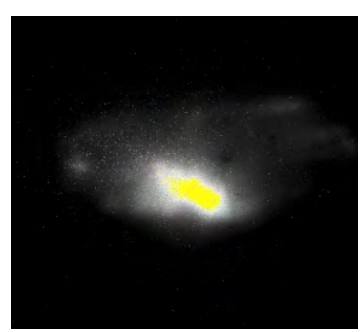


Diamond compressor

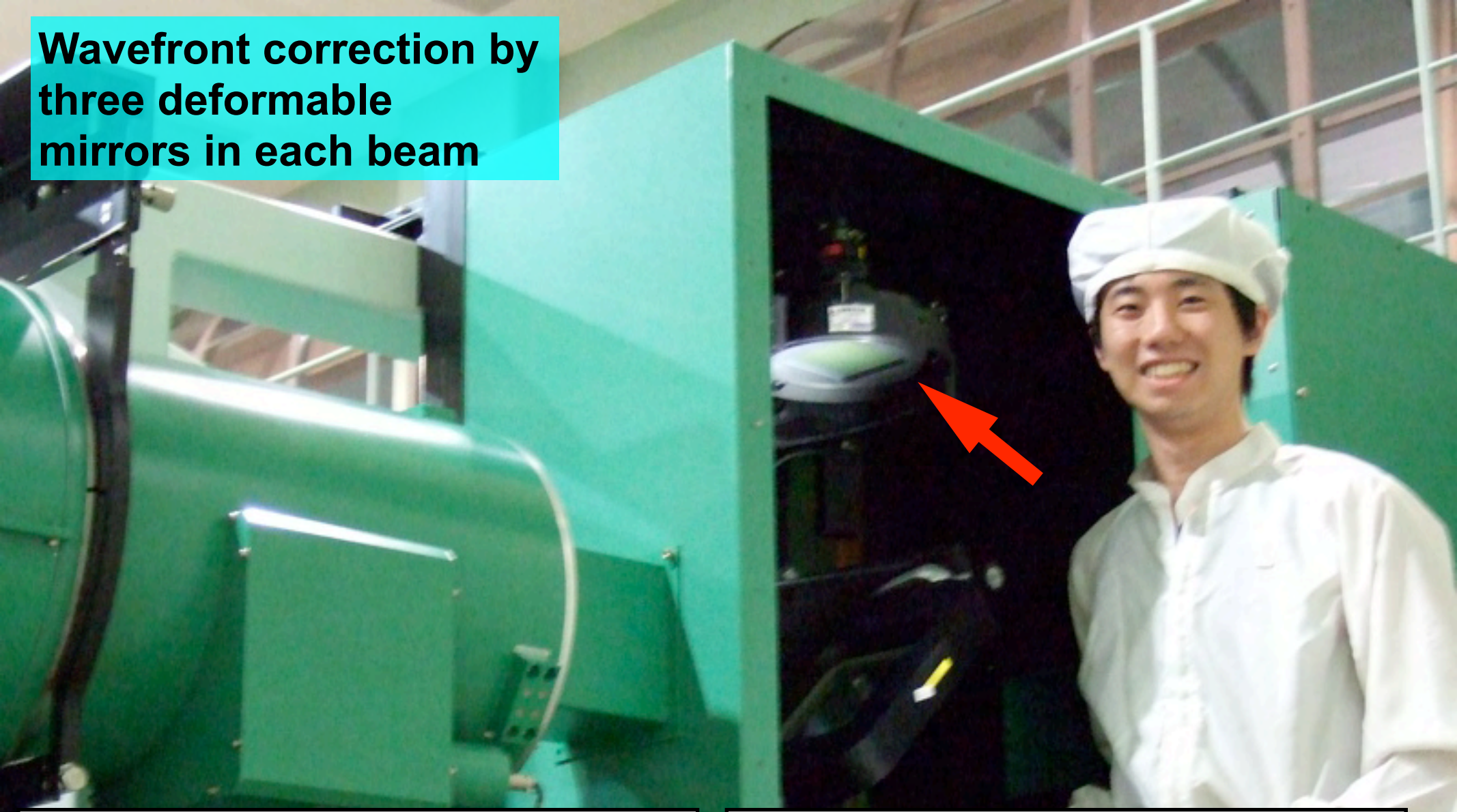


First plasma for EUV





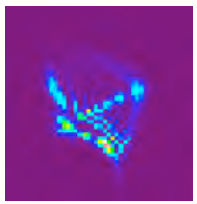
Wavefront correction by three deformable mirrors in each beam



before correction

Phase aberration

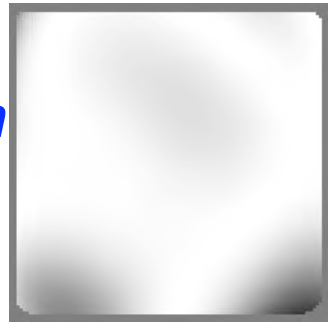
FFP



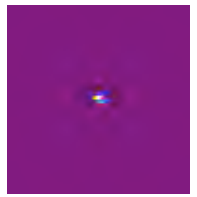
0.54μm rms

after correction

Phase aberration



FFP



0.08μm rms

Optical Phase Lock by Tip-tilt/piston mirrors

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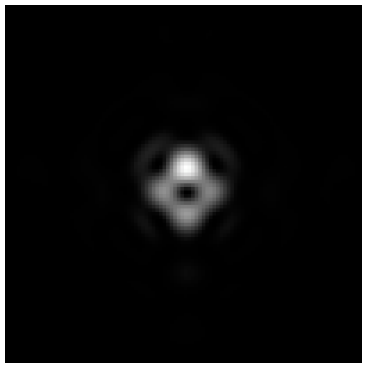
Near Filed Pattern

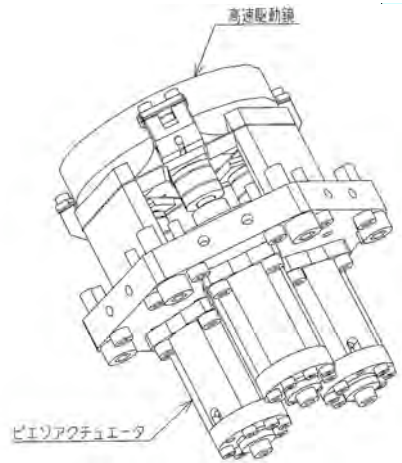
Piston error

$\Delta\varphi_{rms}$= 0.3λ

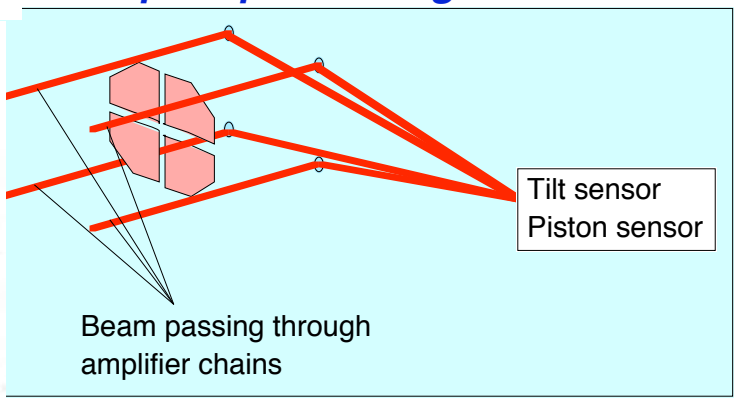
Far Field Pattern



Tip-tilt/piston mirror

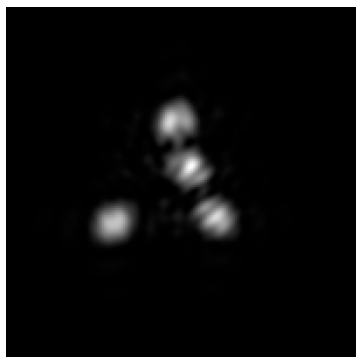


Tip-tilt/piston diagnostics

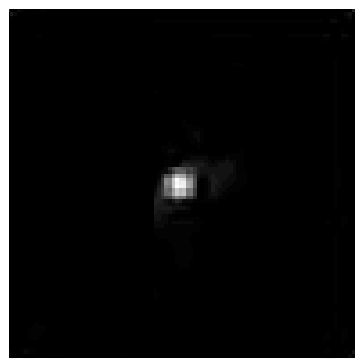


Tip-tilt error

θ_{rms}= 5 μrad



With Tip-tilt/piston mirror



Near Term Schedule and Future Plan

FIREX-I Timetable

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FY	Laser Construction	Milestones
2009	One-beam operation	Repeat *Nature* exp't
2010	Full beam operation	
2011	Wavefront Control	CD heating (5keV)
		Goal of FIREX-I
2012	GEKKO-XII Renewal (plan)	
2015		DT heating (Q=0.1)
		Excess achievement

Sub-ignition is a precursor of FIREX-II.

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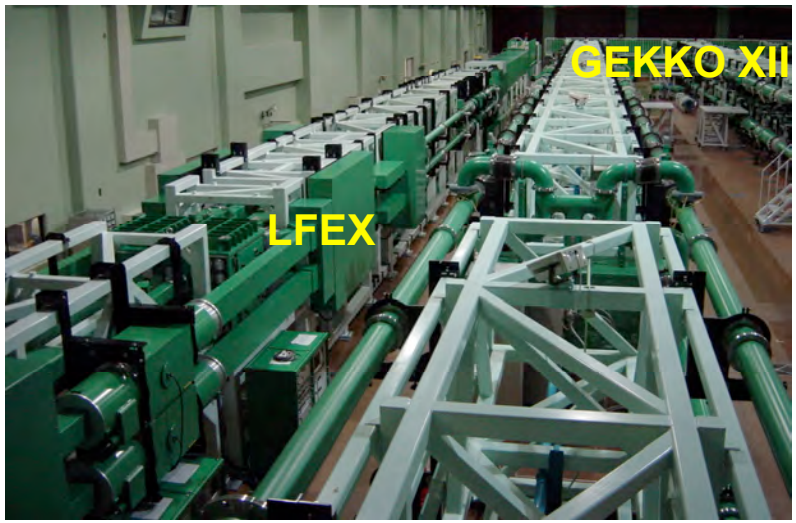
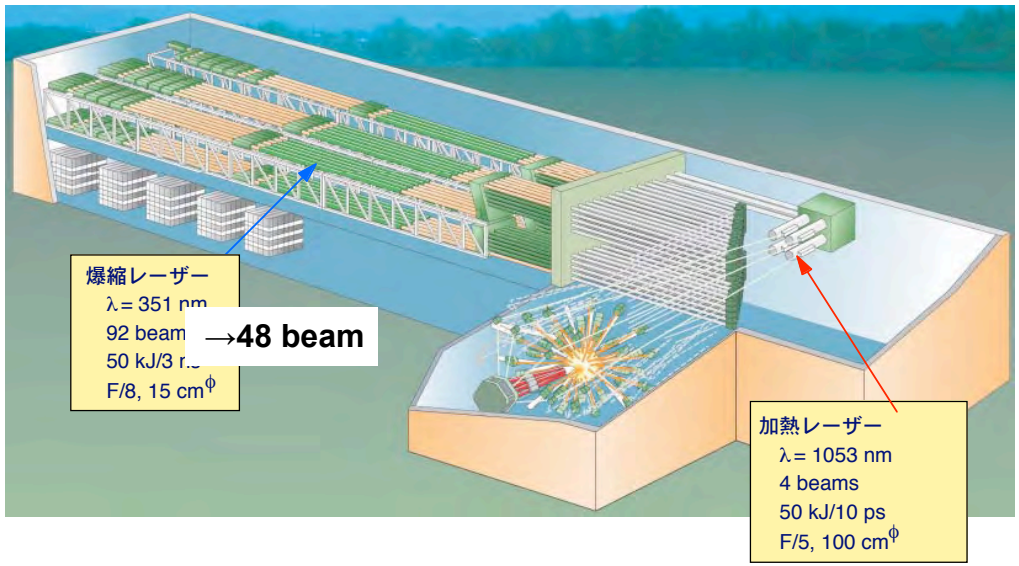
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018

Proof of Principle T > 5keV → Sub Ignition Q > 0.1 → Ignition Q > 5

FIREX-I 75 M$ GEKKO Renewal (plan) 150 M$ FIREX-II 300–400 M$





Atomic Energy Commission of Japan reported (Oct. 2005):
"Based on its (FIREX-I) achievement, decide whether it should be advanced to the second-phase program aiming at the realization of ignition and burning"

Fast ignition proof-of-principle and ignition by NIF&LMJ will provide concrete basis of inertial fusion physics.

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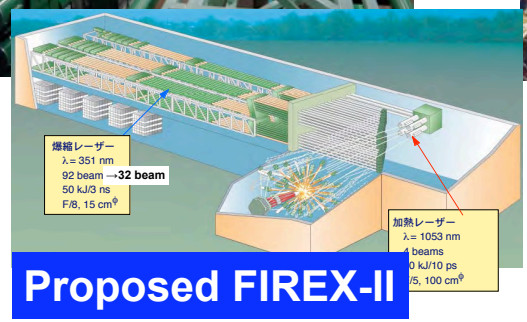
Fast Ignition: Ignition temperature demo. in around 2010, followed by ignition demo. in late 2010's

Japan-FIREX-I



Proposed FIREX-II

US-EP

Proposed ARC

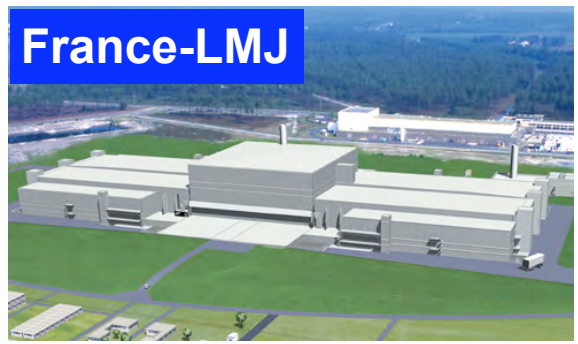
Europe-PETAL

HiPER-under design

Central ignition: Ignition in early 2010's

US-NIF

France-LMJ



It's time to consider a paradigm shift of inertial fusion.

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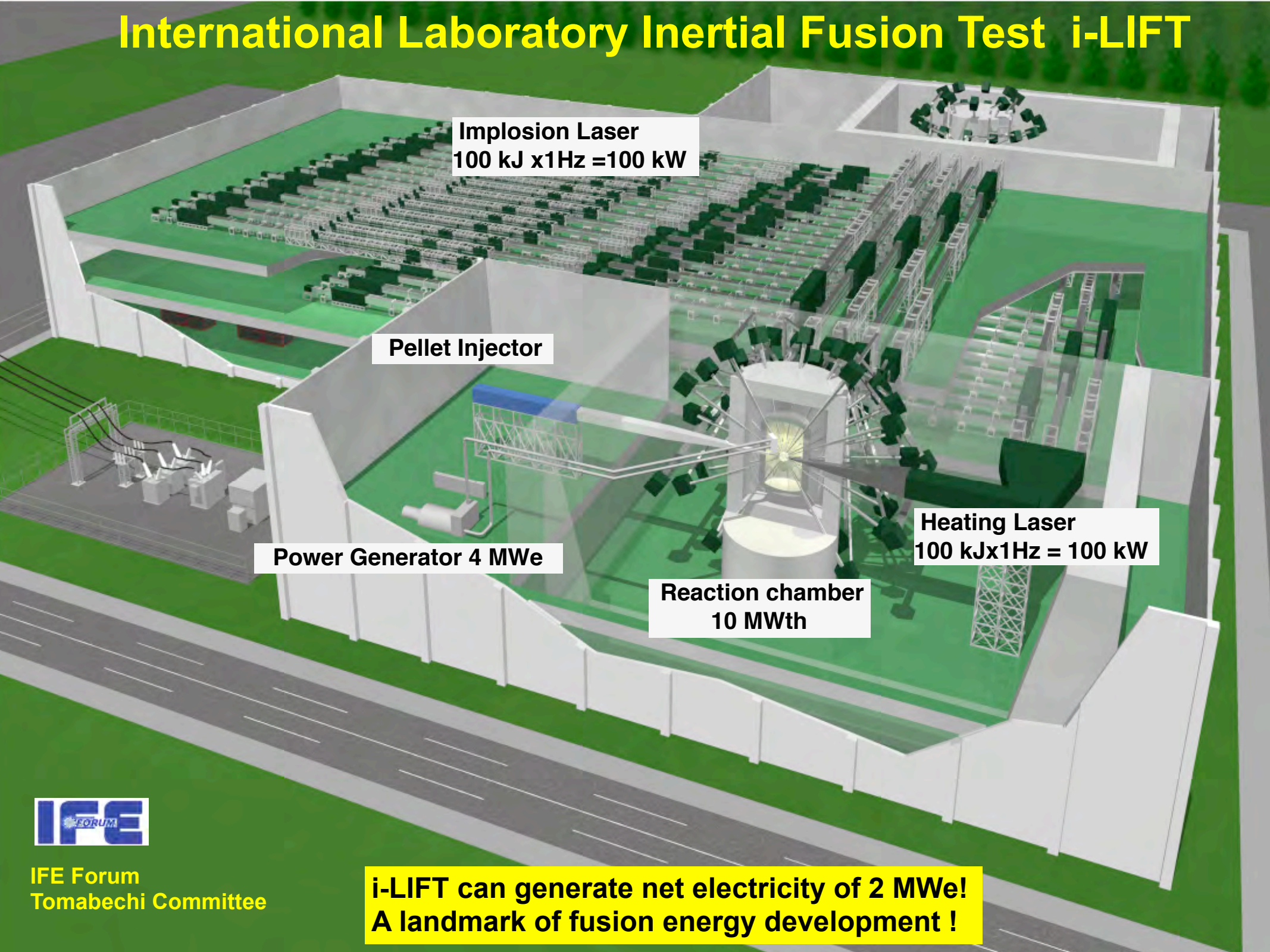
- By the time of NIF/LMJ ignition, it will have passed more than 20 years since the end of the Cold War.
- Global warming is becoming the serious problem.
- MFE community has started the ITER program to participate in solving the crisis.

ITER-like flagship program is necessary to lift up inertial fusion community's spirits.

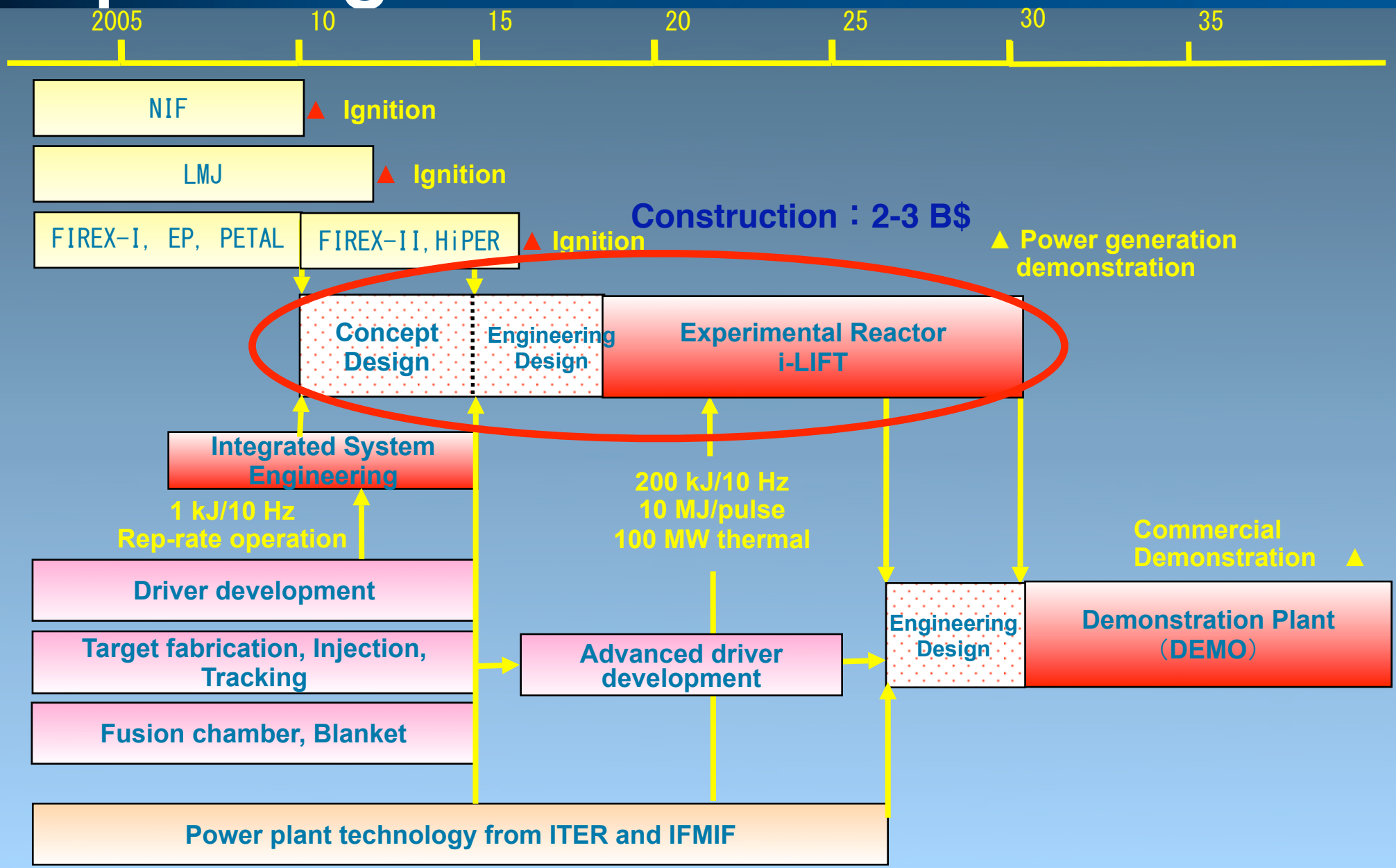
International Laboratory Inertial Fusion Test i-LIFT



IFE Forum
Tomabechi Committee

i-LIFT can generate net electricity of 2 MWe!
A landmark of fusion energy development !

A plan for international demonstration of power generation



We would like to invite the international community to co-ordinate around a common project

IFE Forum

Summary

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- Advanced target design is completed for FIREX-I.
- Integrated Fast Ignition experiment will start in June 2009.
- Central ignition by NIF/LMJ, and Fast ignition PoP by FIREX-I/EP/PETAL will provide concrete basis of FIREX-II, NIF-ARC and HiPER-Europe.
- These programs would converge onto an experimental reactor, i-LIFT, that will lift up people's spirits.

Congratulations on the NIF dedication!