Welcome to the first Bridge Lab

Symposium on Laser Wakefield acceleration: Route to reality

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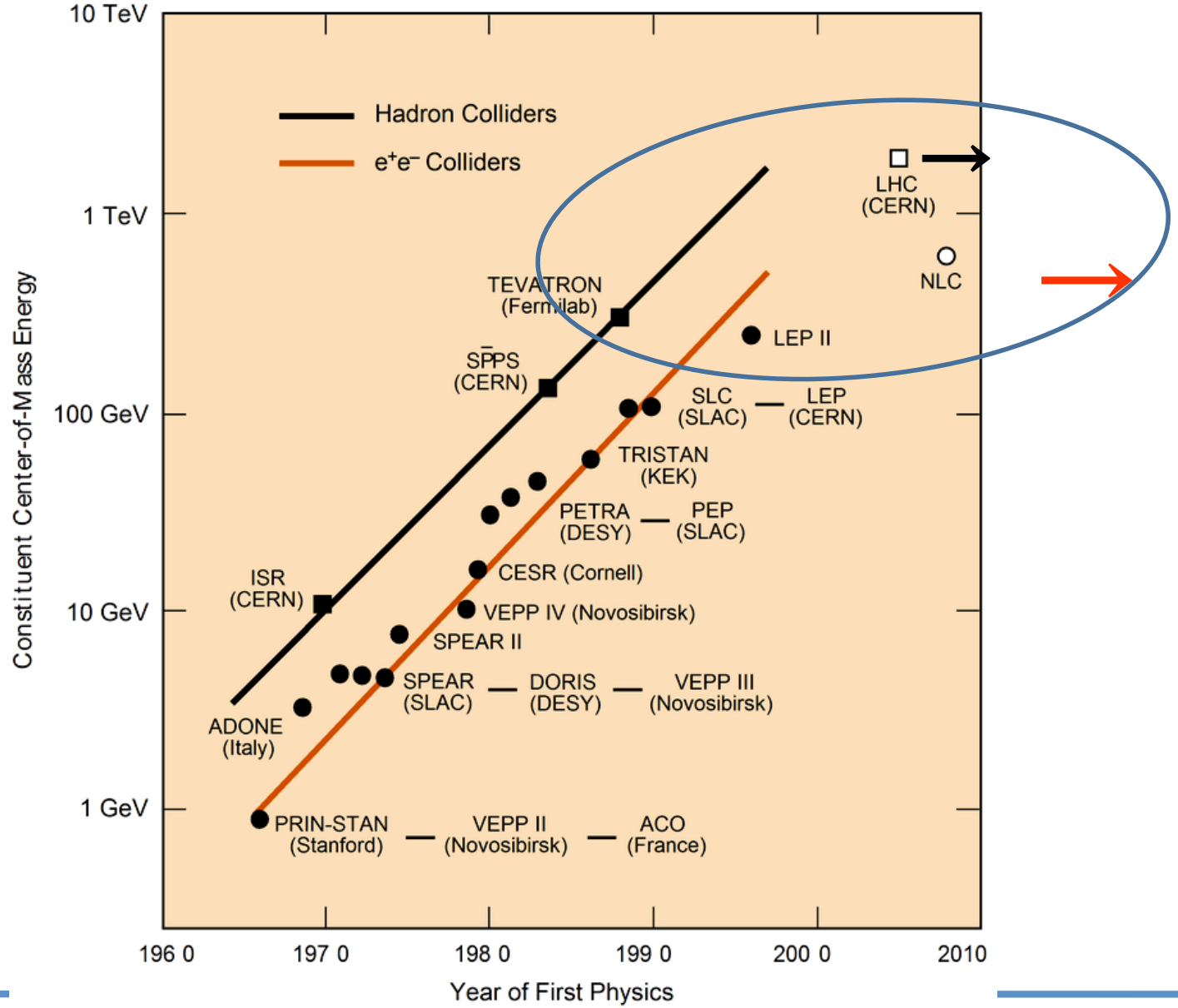
T. Tajima

Bridging two Communities:

Ultra high Intensity laser –High Energy Particle Physics

ICUIL and ICFA

Livingston Chart and Recent Saturation



(Suzuki, 2009)

(http://tesla.desy.de/~rasmus/media/Accelerator%20physics/slides/Livingston%20Plot%202.html)

T. Tajima and J. M. Dawson

Phys. Rev. Lett. 43, 267–270 (1979)
Laser Electron Accelerator

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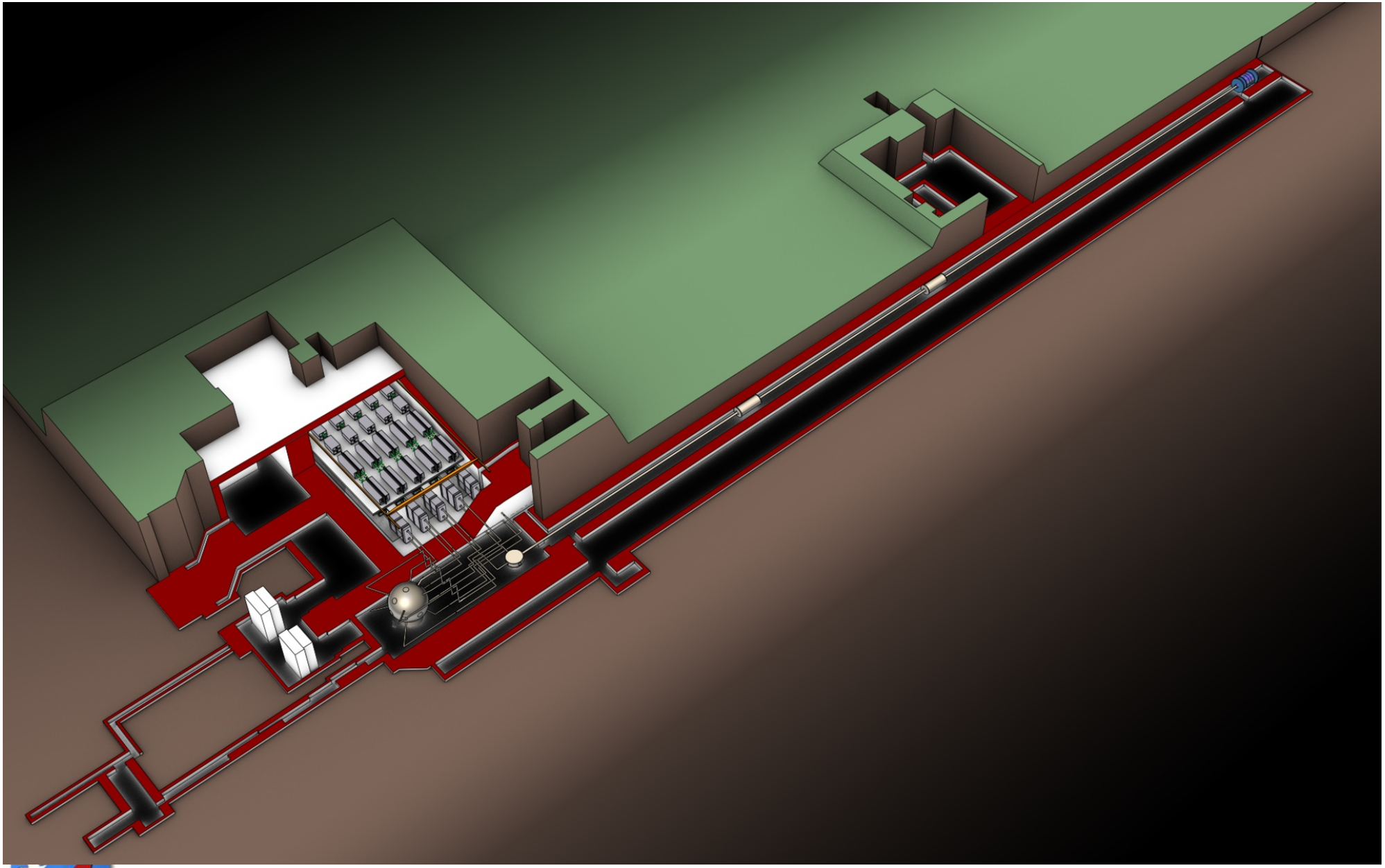
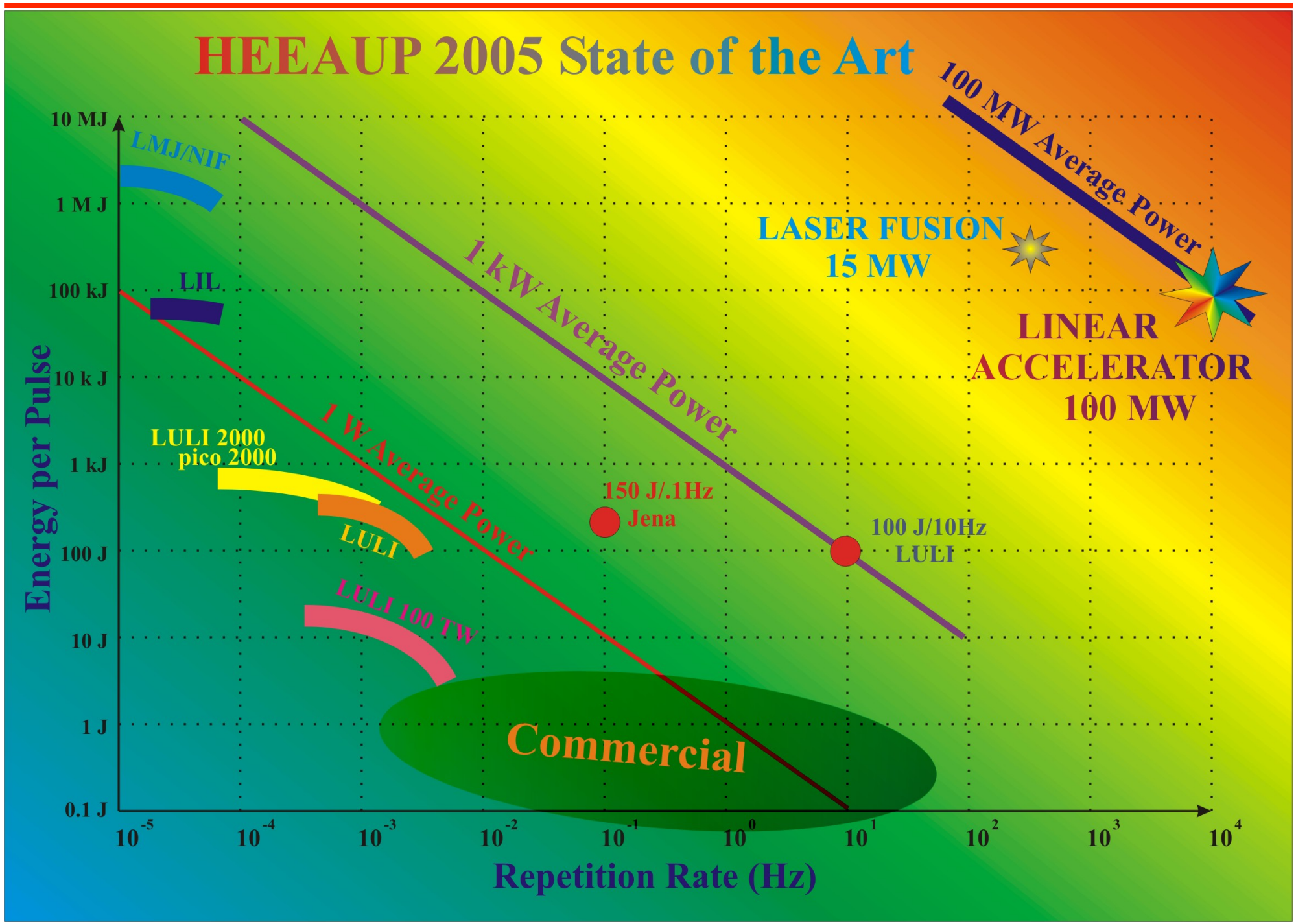
An intense electromagnetic pulse can create a weak of plasma oscillations Through the action of the nonlinear ponderomotive force. Electrons trapped in the wake can be accelerated to high energy. Existing glass lasers of power density 10^{18}W/cm^2 shone on plasmas of densities 10^{18} cm^{-3} can yield gigaelectronvolts of electron energy per centimeter of acceleration distance. This acceleration mechanism is demonstrated through computer simulation. Applications to accelerators and pulsers are examined.

LWA experimental breakthroughs

- H. Hamster et al., PRL 71, 2725(1993): Observation of excitation of laser wakefield, observation of THz radiation from wakefield.
- C. Durfee and H. Milchberg, PRL 71, 2409 (1993): Plasma channel formation.
- K. Nakajima et al., 1994/95, Phys. Scripta T52, 61 (1994), PRL 74, 4428 (1995): First observation of ultrahigh gradient electron acceleration from Self-modulated LWFA.
- A. Modena et al., Nature 377, 606 (1995): Observation of SMLWFA electrons around 40MeV.
- J. Marques et al. PRL 76, 3566 (1996); C. Siders, et al., PRL 76, 3570 (1996): Direct observation of laser wakefields.
- Dewa et al., NIM PRA 410, 357 (1999): Observation of 100MeV electrons from LWFA.
- S. Mangle, et al. Nature 431, 535 (2004); C. Geddes et al., Nature 431, 538 (200J.Faure et al. Nature 431, 541 (2004): First (quasi-)monoenergetic 100MeV level electron acceleration by LWFA.
- C. Geddes et al., PoP 12,056709 (2005): guiding of relativistic laser in preformed channel.
- W. Leemans et al., Nature Phys.2, 696 (2006): First 1GeV level electron acceleration by LWFA
- J. Faure et al., Nature 444, 737 (2006): Optical injection of electrons to LWFA.
- N. Matlis, et al., Nature Phys. 2, 749 (2006): First direct visualization of LWFA,
- N. Hafz, et al. Nature Photon. 2, 571 (2009): Stable self-guided LWFA at 1GeV level.

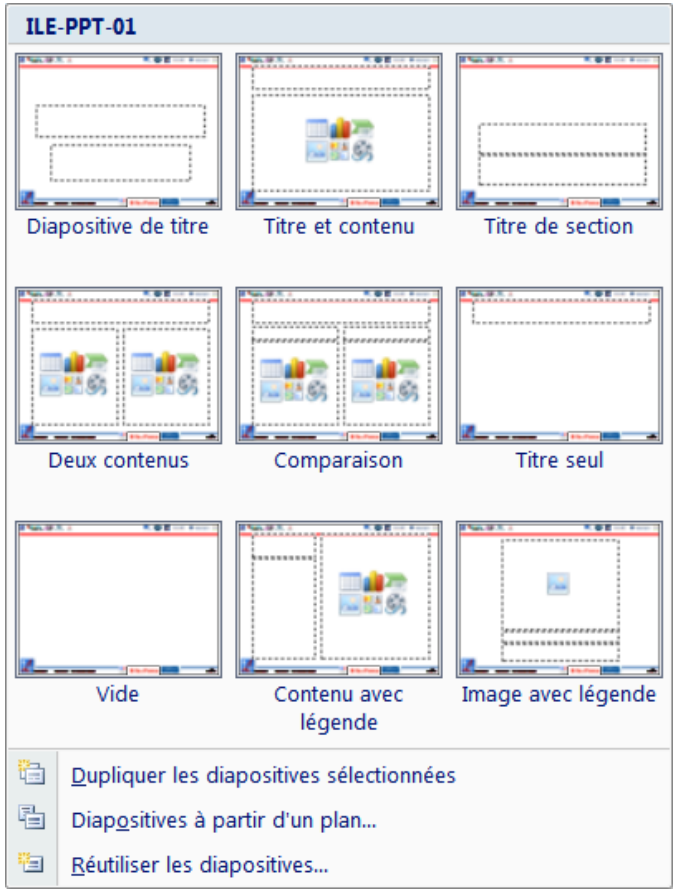


- Energy >TeV ($7B for a TeV Collider)
- Good emittance
- Overall efficiency(wall to beam) ~10%
- Repetition Rate ~ 15kHz
- Pulse duration ~100fs
- Beam Average power 15MW


HEEAUP 2005 State of the Art
100 MW Average Power
1 kW Average Power
1 W Average Power
LMJ/NIF
LIL
LULI 2000
pico 2000
LULI
LULI 100 TW
LASER FUSION
15 MW
LINEAR
ACCELERATOR
100 MW
150 J/.1Hz
Jena
100 J/10Hz
LULI
Commercial
10 MJ
1 M J
100 kJ
10 k J
1 kJ
100 J
10 J
1 J
0.1 J
Energy per Pulse
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
Repetition Rate (Hz)

Types de diapositives

- Il y a 9 types de diapositives
  - Insertion nouvelles diapositives et sélection du type de diapositive
  - Ou disposition



Pour modifier les champs

- WPxx et Prénom NOM
  - Affichage, masque des diapositives
- Date et numéro de diapositive
  - Sont automatiques