

Argonne Wakefield Accelerator

-A testbed for future accelerator technologies

Wei Gai

ANL

CLIC workshop 2013

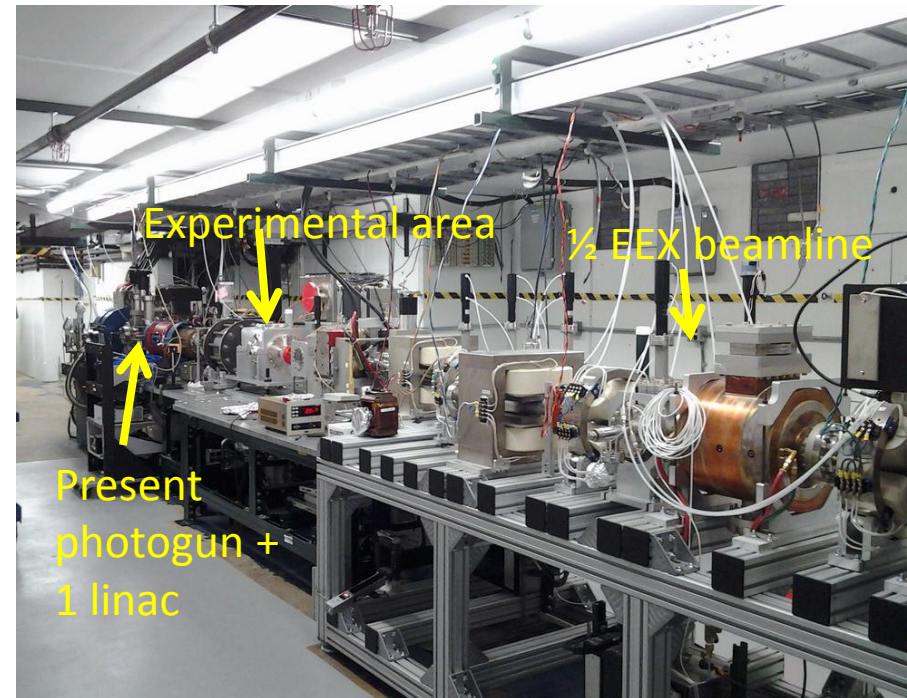
Introduction--- AWA Facility In The Past

Basic parameters:

- 1.3GHz Photogun w/ Mg cathode
- 15 MeV, 1 – 100 nC (reached 150 nC)
- 2 mm bunch length
- norm emittance < 200 mm mrad (at 100 nC)
- High Current: ~ 10 kA
- Bunch train operation: 4 X 25nC or 16 X 5nC

Selected results in the past 5 years:

- 100MV/m short pulse in an X-band DWA (dielectric wakefield accelerator)
- 50MW short pulse in C-band DWPE (dielectric wakefield power extractor); 20 MW in K-band
- 300MV/m short pulse in a K-band diamond based DWA.
- Enhanced transformer ratio ($R=3.4$) achieved in a collinear wakefield acceleration



Introduction--- AWA Facility in 2013: 75 MeV Drive Beam+ 15MeV witness beam

Basic parameters for the drive beam:

- 1.3GHz Photogun w/ CsTe cathode
- 75 MeV, 1 – 100 nC (reached 150 nC)
- 1~2.5 mm bunch length (a bunch compressor is planned)
- Normalized emittance < 200 mm mrad (at 100 nC)
- Bunch train operation: 32 X 30nC or 10 X 100nC
- Beam power: 3GW or 10GW



Experiments forecast in 5 years:

- High power rf generation: 0.1~1GW, ~20ns duration, frequency covers cm to mm wave.
- Two beam acceleration: >200MeV/m energy gain (short rf pulse, ~20ns).
- Collinear wakefield acceleration: >300MeV/m energy gain.
- Bunch shaping to improve efficiency for collinear wakefield acceleration

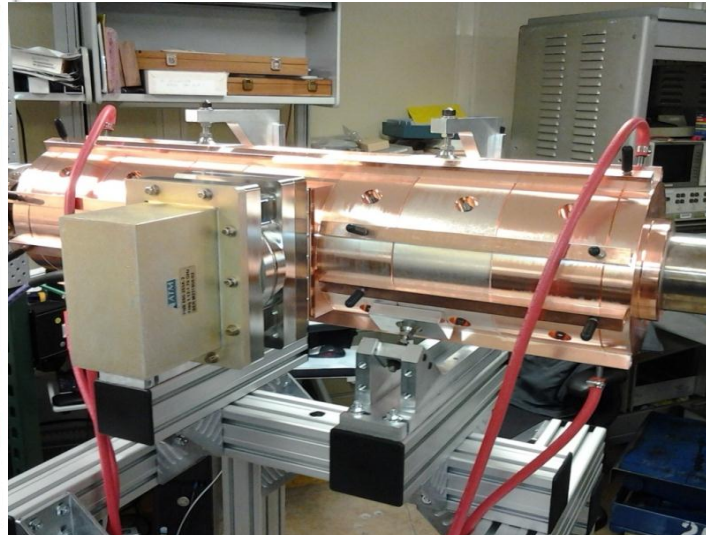


with DoE fund:

- 4 klystrons
- 6 linac tanks
- RF distribution and Control systems upgrade
- Laser upgrade



Klystrons Stations



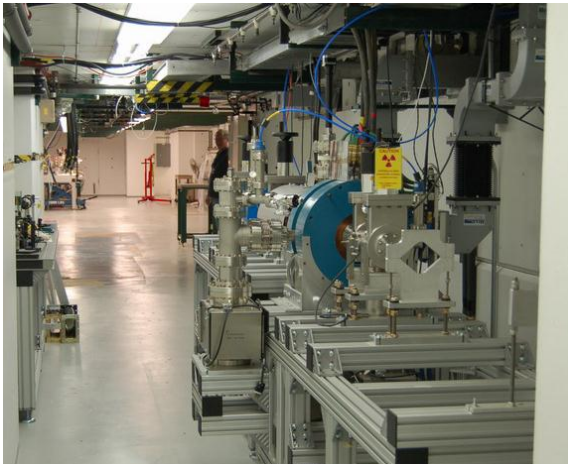
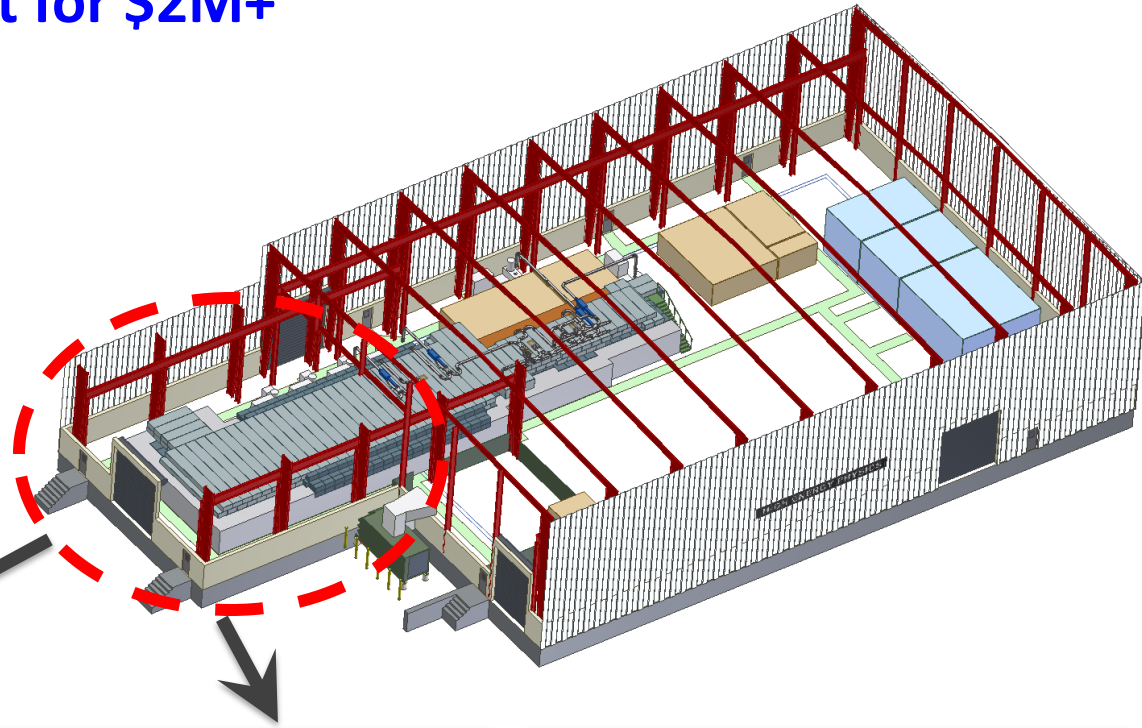
6 Linacs are ready for use



New KrF UV amplifier

Thanks to ANL management for \$2M+ construction fund:

- new annex building
- new SF6 recovery system
- new cooling water station
- new 1MW power transformer



Bunker Interior



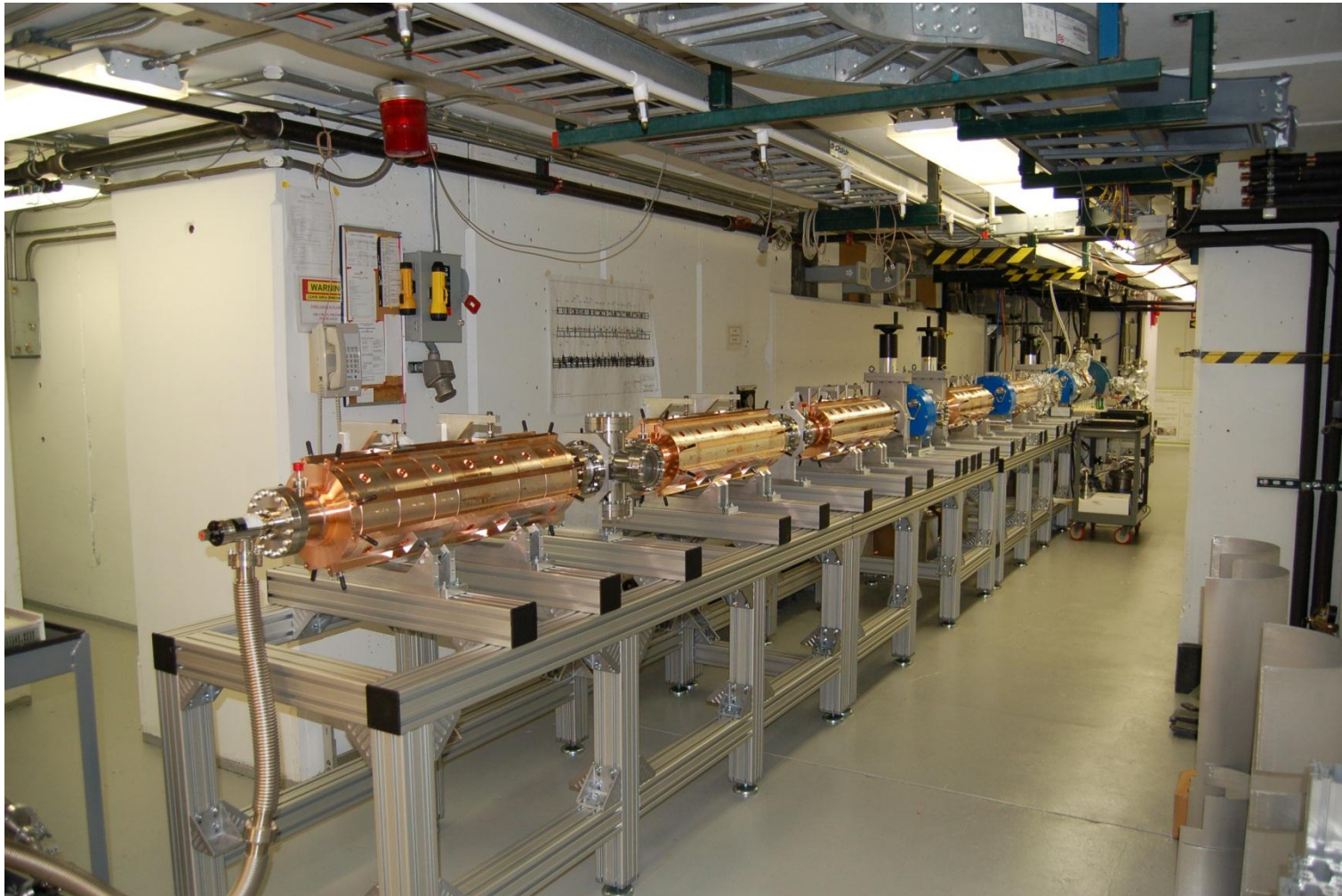
New annex building



Roof of the new bunker



AWA Facility update (as last week):



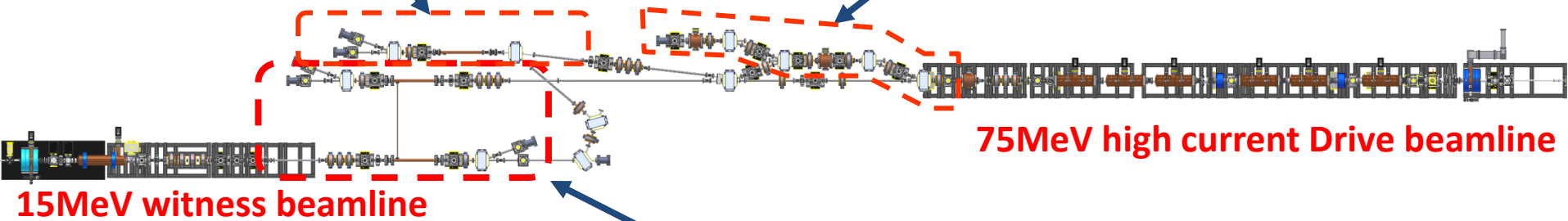
Beamline Configuration (completion in the next year)

2. Collinear wakefield beamline:

- Drive bunch enters at 6 deg
- Witness bunch enters at 42 deg

3. EEX beamline:

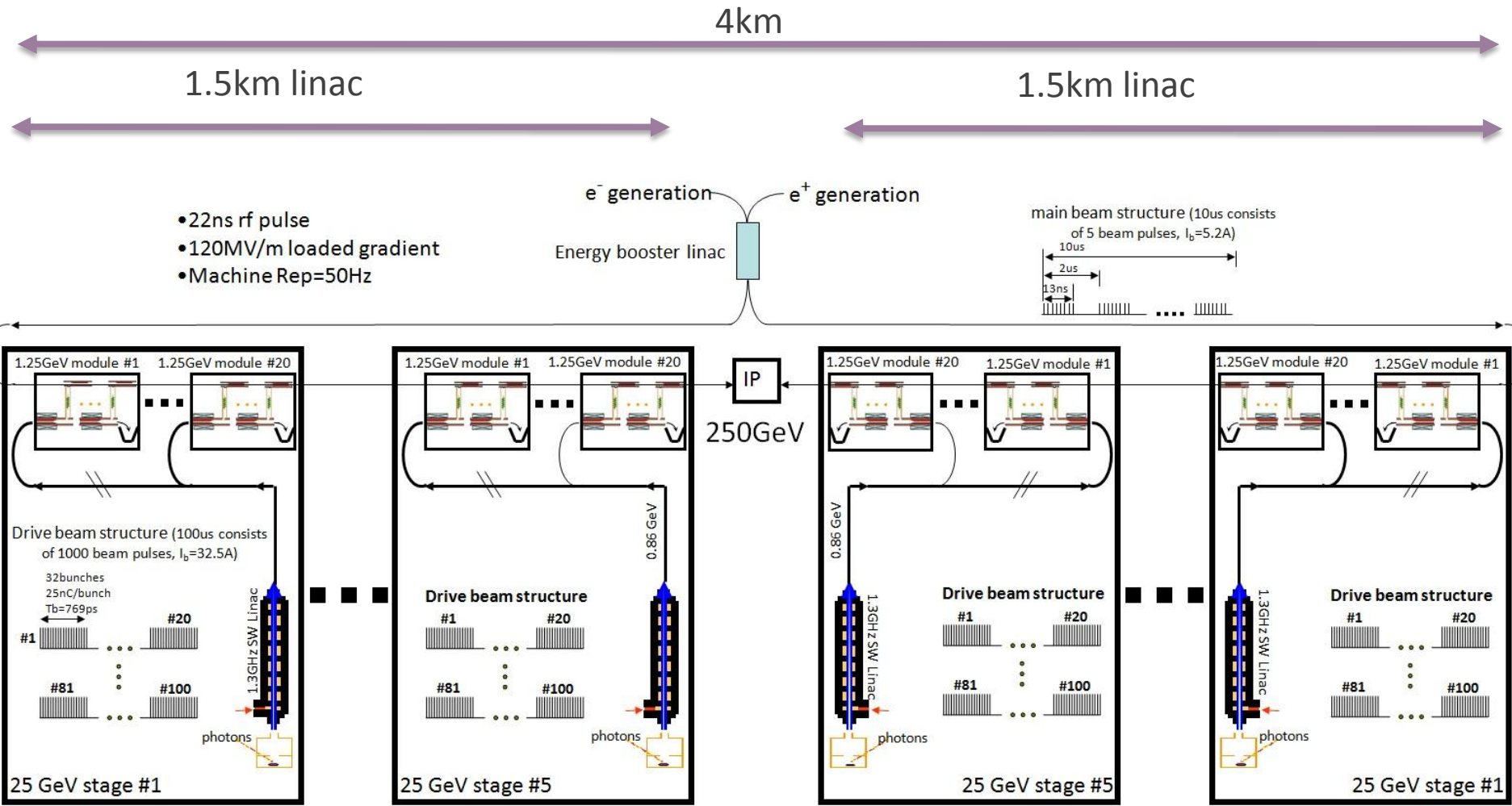
- Ramped bunch production
- Continue EEX experiment
- LPS measurements



1. Parallel (Two-beam) beamline :

- High charge bunch train transmission
- High RF power generation
- High gradient acceleration of witness

ANL K-Band 250GeV Higgs Factory



DWA Driven FEL (100MeV/m, 100kHz Rep.)

DWA, 850GHz, ID=400μm, OD=465μm,
 $\epsilon_r=3.75$, L=10cm, TR=16.5, $E_0=114\text{MV/m}$,
 Energy Gain=100MeV/m, $P_{\text{diss-ave}}=50\text{W/cm}^2$

$$\frac{P_{\text{main-beam}}}{P_{\text{drive-beam}}} = 37.5\%$$

