



First Observation of Coherent THz Undulator Radiation Driven by NSRRC High Brightness Photo-injector

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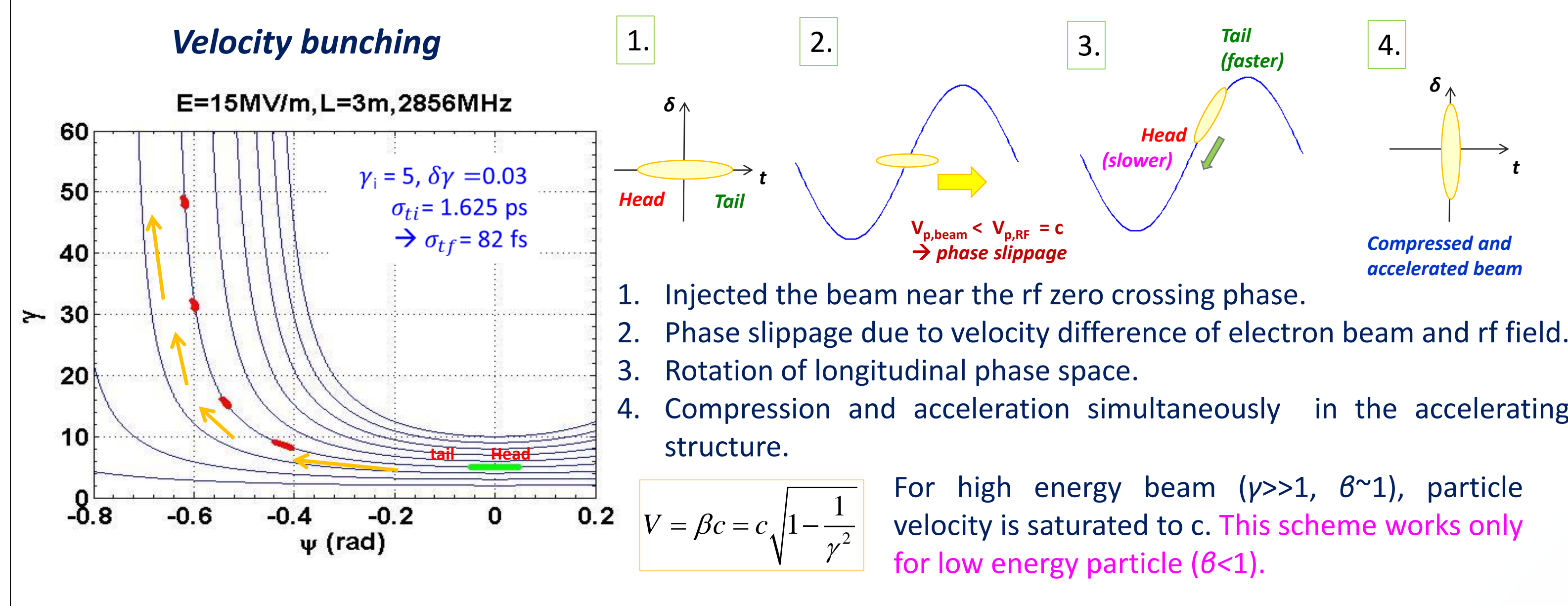
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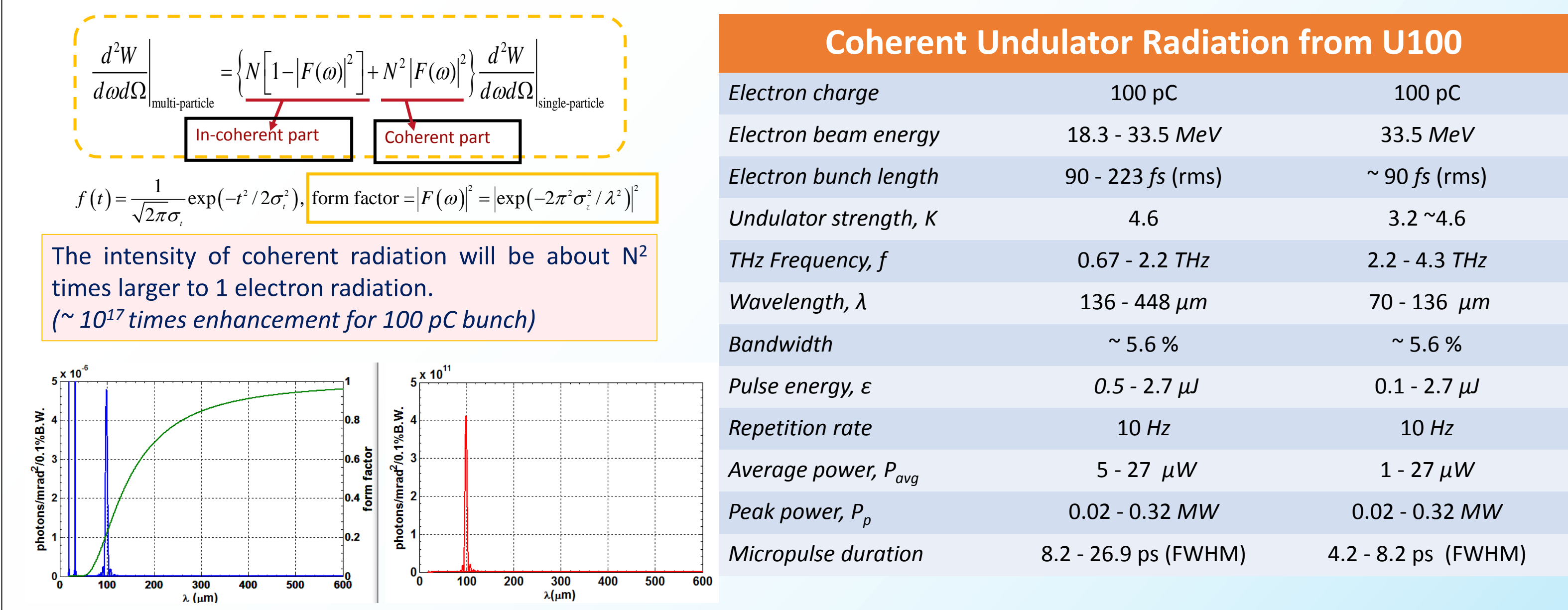
Abstract

Generation of coherent undulator radiation in the THz region using the NSRRC S-band photo-injector linac system is achieved. Using velocity bunching, an electron bunch in the linac can be accelerated and compressed simultaneously. Narrow-band tunable fully coherent THz radiation can be produced from a U100 planar undulator when it is driven by a 100 pC electron bunch with effective bunch length of ~ 90 fs. In this work, the experimental setup and the measurement of the power and the frequency spectrum of the coherent THz undulator radiation are reported.

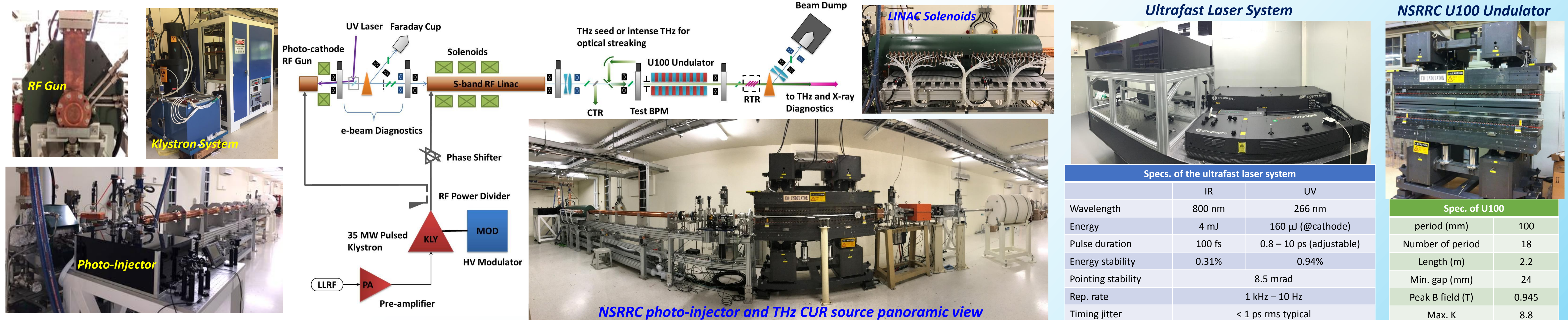
Generation of Relativistic Sub-100 fs Bunches



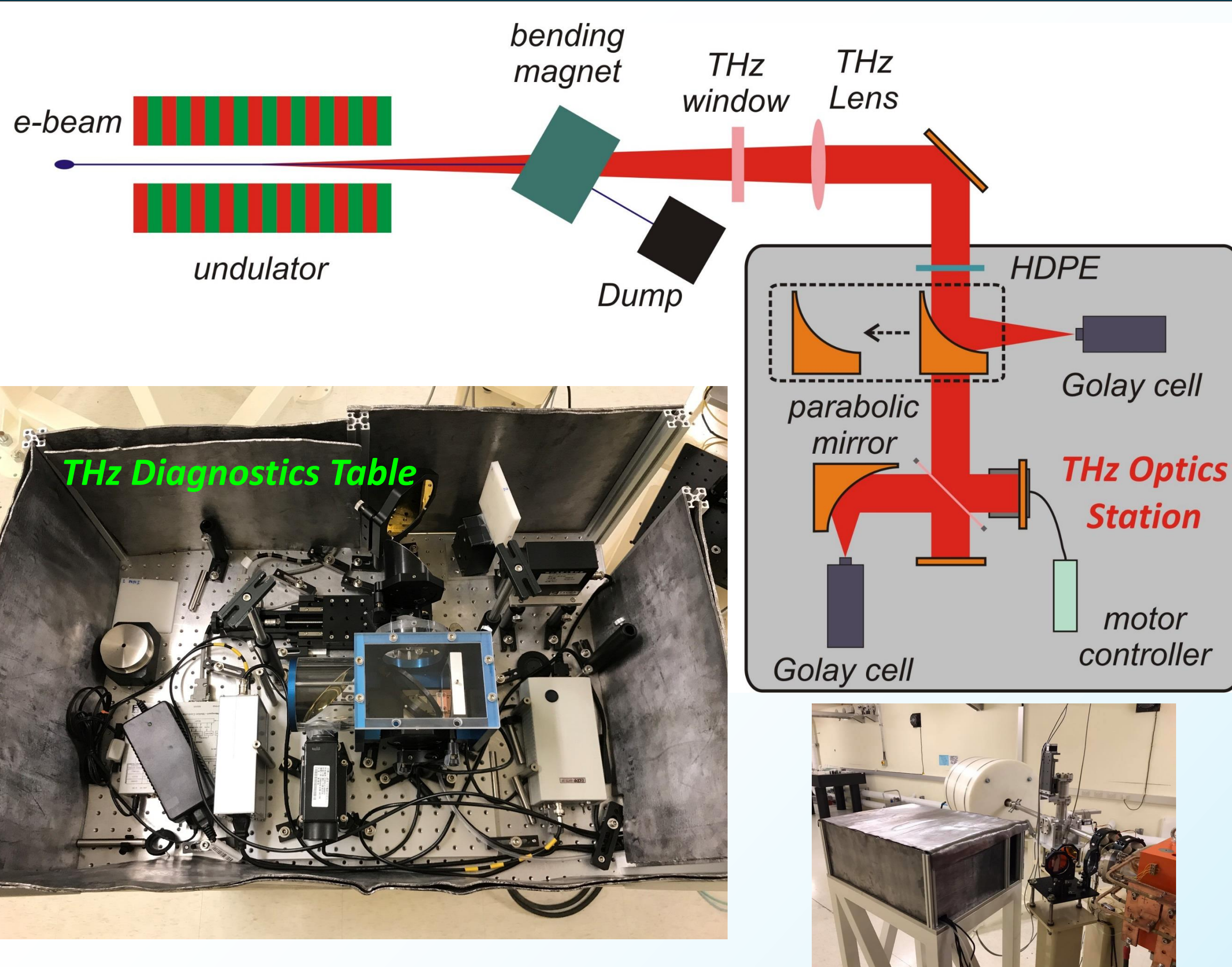
THz Coherent Undulator Radiation



Layout of the NSRRC High Brightness Photo-Injector and THz Coherent Undulator Radiation Source

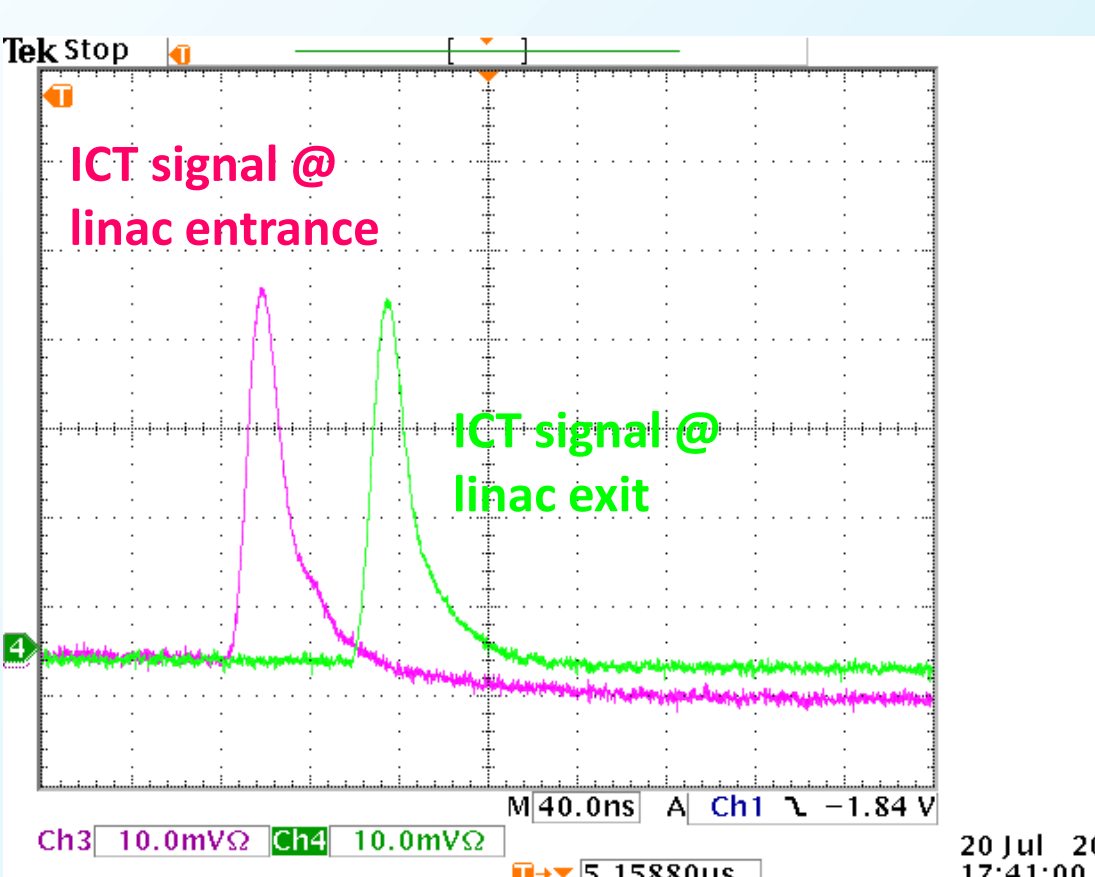


Setup of THz CUR Measurement

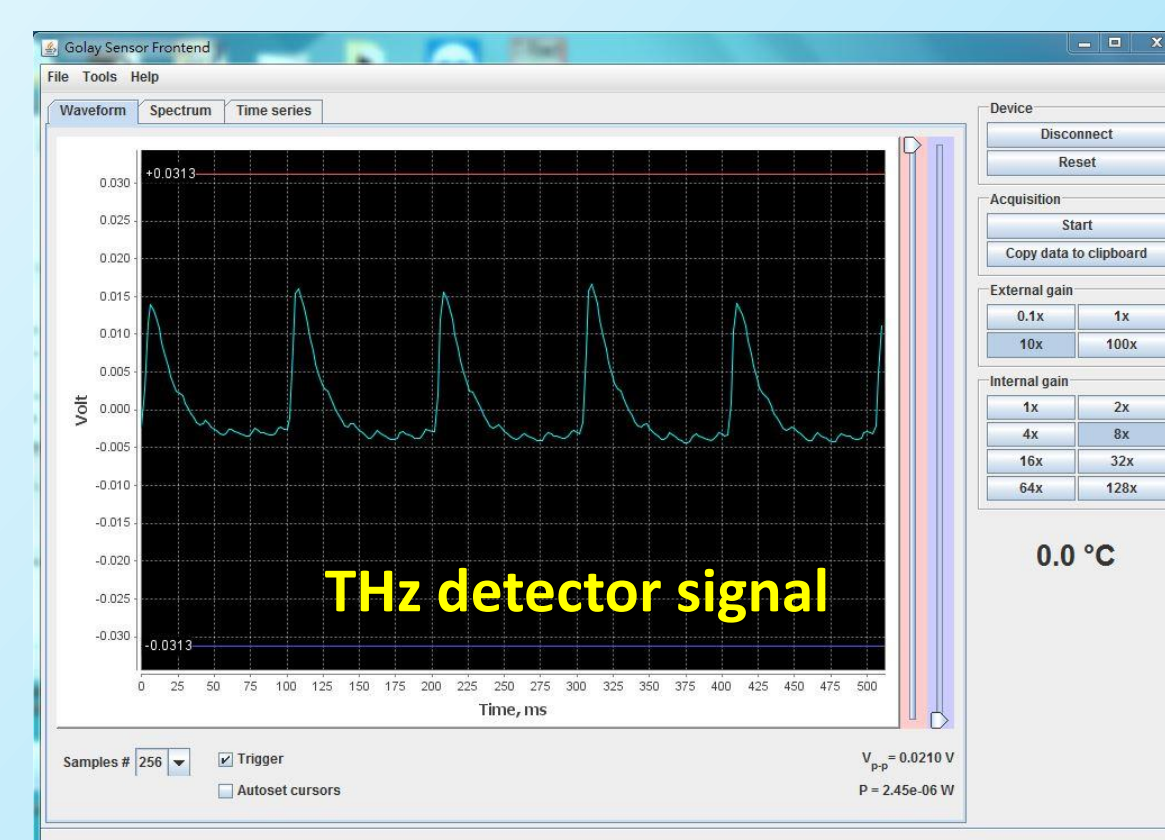


Current Results of THz CUR Experiment

Beam Acceleration in the RF Linac



First THz light from U100



| Parameters | Values |
|---|----------------------------------|
| Beam energy [MeV] | 43.7 |
| Bunch charge [pC] | 90 \pm 10 |
| Bunch rep.-rate [Hz] | 10 |
| Undulator period [mm] | 100 |
| Number of undulator periods | 18 |
| Undulator gap [mm] | 40 |
| Undulator constant, K | 4.6 |
| Inner height of undulator vacuum chamber [mm] | 28 |
| THz pulse energy [nJ] | 38.7 |
| THz Frequency [THz] | @ undulator chamber exit 3.79 |

Summary

- A laser-driven photo-injector system has been developed by the NSRRC High Brightness Injector Group for R&D of future light sources such as free electron lasers, inverse Compton sources etc.
- A THz CUR source (or THz superradiant FEL) has been installed to demonstrate the capability of this injector. First THz light has been observed with the Golay cell detector installed at downstream of the U100 undulator. Considered the power loss of the THz optics, the radiation pulse energy at the exit of the undulator chamber is 38.7 nJ (interception of THz energy by the undulator vacuum chamber has not been taken into account yet).
- Optimization of bunch form factor by velocity bunching for higher THz pulse energy and measurement of spectral distribution are in progress.
- Improvement of the photo-injector for lower emittance and higher repetition-rate is under consideration.