



HGHG Experiment

Results

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for the HGHG Experiment team



BROOKHAVEN
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Brookhaven National Laboratory

Operated by Brookhaven Science Associates for the U.S. Department of Energy

The HGHG Experiment Team

The HGHG is BNL experiment (ATF & NSLS)
in collaboration with ANL/APS

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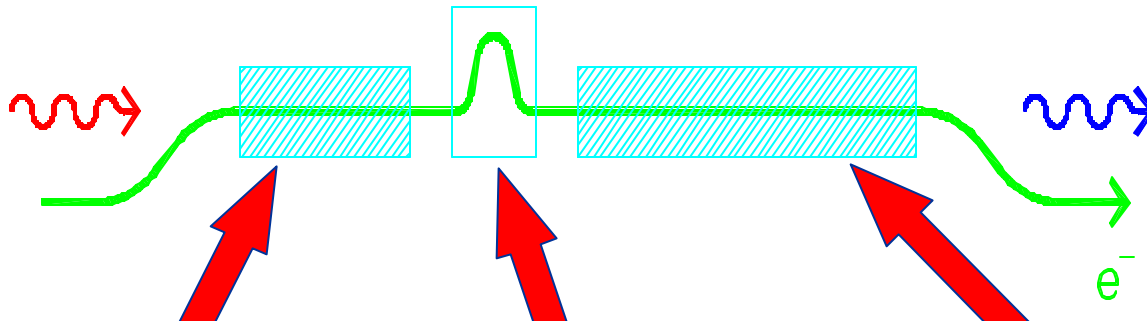
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Vasserman

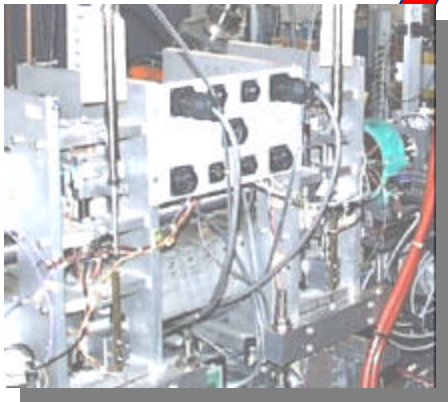
Spokesperson: Li Hua Yu

The HGHG Experiment

Seed Laser
 $l = 10.6 \text{ mm}$
 $P_{pk} = 0.7 \text{ MW}$

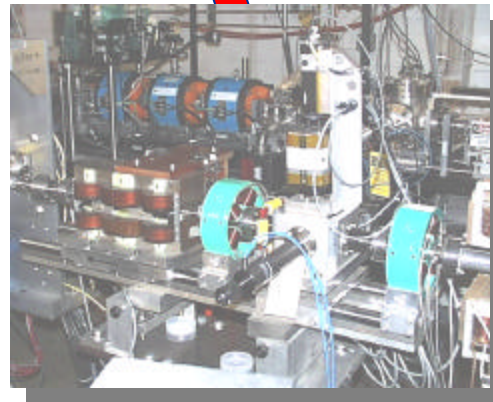


HGHG FEL
 $l = 5.3 \text{ mm}$
 $P_{pk} = 35 \text{ MW}$



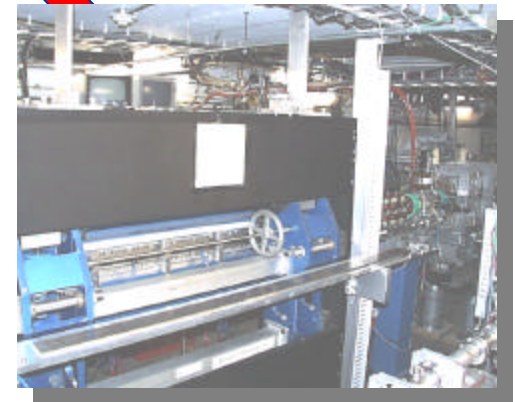
Modulator Section

$B_w = 0.16 \text{ T}$ $l_w = 8 \text{ cm}$ $L = 0.76 \text{ m}$



Dispersion Section

$L = 0.3 \text{ m}$



Radiator Section

$B_w = 0.47 \text{ T}$ $l_w = 3.3 \text{ cm}$ $L = 2 \text{ m}$

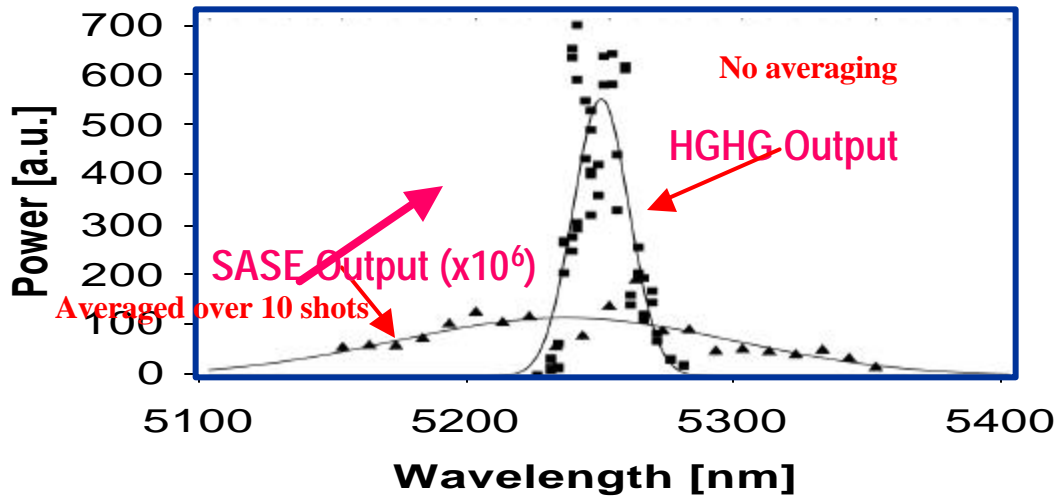
Electron Beam Input Parameters: $E = 40 \text{ MeV}$

$e_n = 4 \text{ p mm-mrad}$ $dg/g = 0.043\%$ $I = 110 \text{ A}$ $t_e = 4 \text{ ps}$

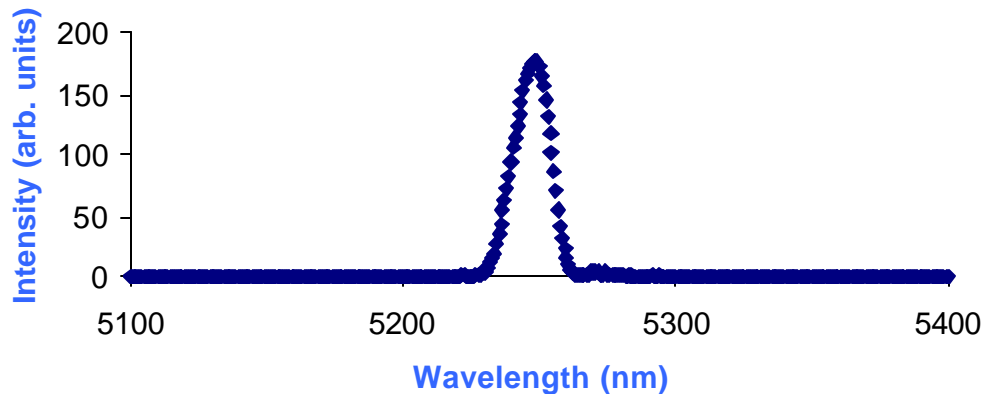
Advantages of HHG

- Longitudinally fully coherent
- Narrower bandwidth
- Larger ratio of output/spontaneous radiation
- Central wavelength is stable
- Pulse length is controllable
- Output fluctuations can be reduced

HGHG Single Shot Spectrum

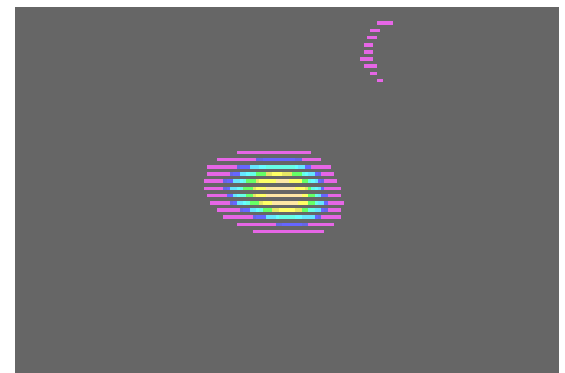


Single Shot Spectrum Of HGHG

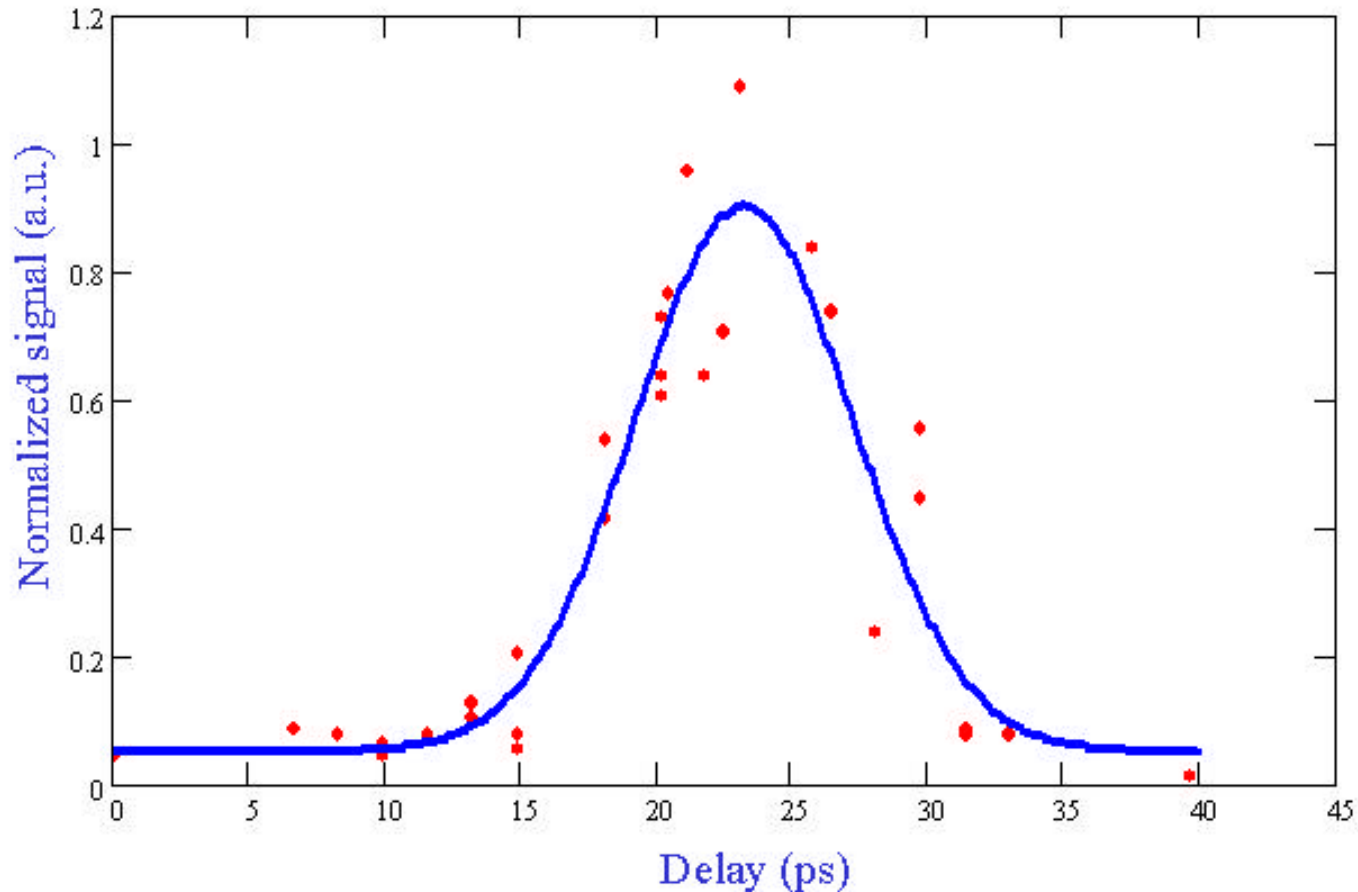


- HGHG multi shot spectrum (last years measurement)

- HGHG Pyroviewer image after the spectrometer

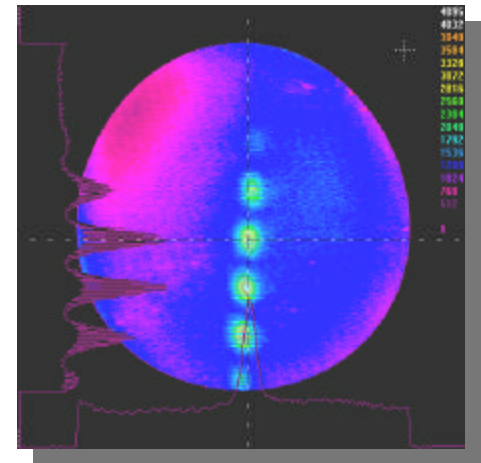
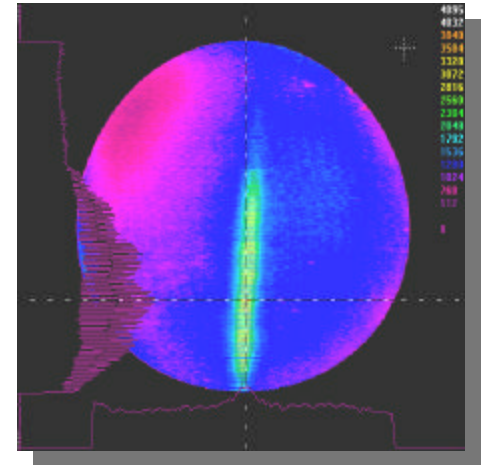
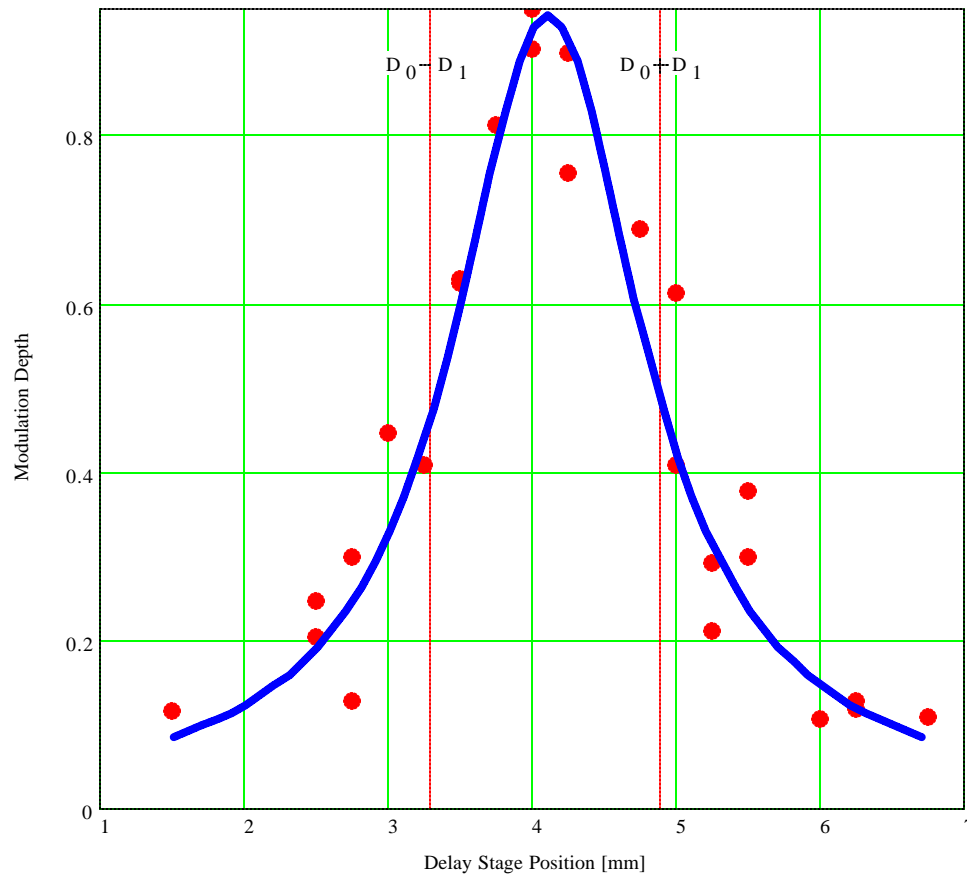


Autocorrelator Measurement

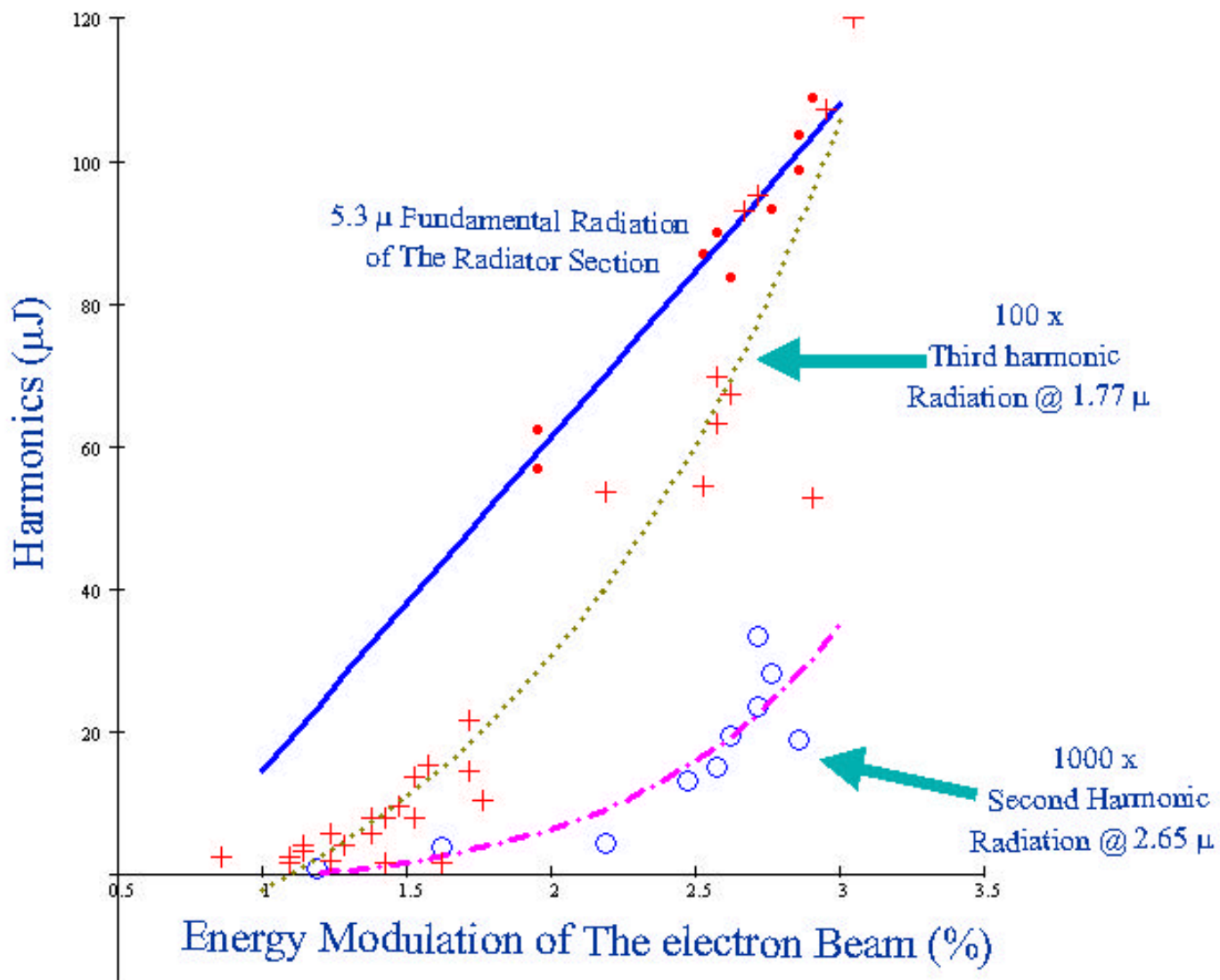


Measured Electron beam FWHM pulse length is 6 ps
The optical Pulse length of HGHG= $\text{FWHM}/1.5=5.6$ ps
Measured HGHG Energy= $100\mu\text{J}$
Power ~ 18 MW

Pulse Coherence Length Measurement using Michelson Interferometer



Optical coherence length of HGHG=1.6 mm



For a modulation of 2.5%

Harmonic/Fundamental

	simulation	Experiment
2 nd harmonic	6×10^{-4} Biedron et al.	2×10^{-4}
3 rd harmonic	1×10^{-2} Biedron et al.	0.8×10^{-2}

Conclusions

- The single-shot spectrum of HGHG has been measured and it is consistent with the multi-shot spectrum measurement
- The pulse length of the HGHG has been measured using two different methods
 - ❖ Autocorrelator measures the intensity pulse length of the beam.
 - ❖ Michelson Interferometer measures the coherence length of the beam.

Since they are in a very good agreement, pulse is fully coherent.
- Preliminary harmonic content of the HGHG has been measured and observed very good agreement with the theoretical simulations