The Short-Pulse Facility at DELTA*

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Introduction

Coherent Harmonic Generation (CHG) is a laser based method that enables the generation of ultrashort VUV pulses in a storage ring [1].

![Diagram of CHG setup](attachment:image.png)

Electron Bunch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron energy</td>
<td>1.5 eV</td>
</tr>
<tr>
<td>Bunch current</td>
<td>10 mA / 8 ns</td>
</tr>
<tr>
<td>Charge</td>
<td>100 ps (FWHM)</td>
</tr>
<tr>
<td>Bunch length</td>
<td>2.6 MHz</td>
</tr>
</tbody>
</table>

Modulator / Radiator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period length</td>
<td>250 mm</td>
</tr>
<tr>
<td>Number of periods</td>
<td>17</td>
</tr>
<tr>
<td>k value</td>
<td>0 - 11</td>
</tr>
<tr>
<td>Chicanic $R_{ch}$</td>
<td>0 - 130 μm</td>
</tr>
</tbody>
</table>

A CHG facility is in operation since 2011 at the storage ring DELTA operated by the TU Dortmund University in Germany [2-6].

Ti:Sapphire laser and a telescope to focus the laser at the modulator.

A fraction of the laser (~10%) is sent by an evacuated beamline to the experimental station at BL 5 and BL 5a for pump-probe experiment.

Modification of the Magnetic Chicane

By rewiring the poles of the chicane, thus changing the longitudinal profile of the magnetic field, a much larger transverse excursion is created which leads to higher values of $R_{ch}$ and dramatic increase in the CHG intensity [7].

CHG intensity vs. chicane strength a) for a laser pulse energy of $E_l = 2.6 \mu J$ and b) for $E_l = 3.3 \mu J$. Fitting yields the energy modulation.

![CHG intensity vs. chicane strength](attachment:image.png)

Energy Modulation vs. Laser Pulse Energy

Effective energy modulation amplitude versus laser pulse energy. The solid line is obtained by particle tracking simulation [10].

![Energy Modulation vs. Laser Pulse Energy](attachment:image.png)

Detection of CHG Pulses Using Photoelectron Spectroscopy at VUV beamline

CHG (at $t = 0$) and spontaneous emission (at $t = ± 384 ns$) signal from photoelectrons detected by the DLD [11,12] at $λ = 199 \text{ nm}$ (left) and $λ = 133 \text{ nm}$ (right).

The ratio between photoelectron counts from a gold target due to CHG and due to spontaneous radiation was about 600 and 150 at 199 nm and 133 nm, respectively.

![Detection of CHG Pulses Using Photoelectron Spectroscopy](attachment:image.png)

Improvements and Results

By modifying the chicane and achieving higher $r_{ch}$ values, a dramatic increase in the CHG signal was observed. The CHG pulses up to the fifth harmonic were detected using a photoelectron spectrometer. Seeding with 265 nm is the next step to generate lower wavelengths for pump-probe experiments at BL 5. For even lower wavelengths the EEEHQ[13] scheme is planned to be implemented at DELTA.

![Improvements and Results](attachment:image.png)

Transverse Coherence Measurement

First double-slit experiments to study the transverse coherence were performed. The interference pattern is measured by a fast gating intensified CCD camera [14]. slit width = 0.1 mm, slit separation = 0.5 mm, distance from the slits to the screen = 1 m.

A preliminary analysis yields a central visibility of the fringes of 0.76 (coherence degree of the radiation).

![Transverse Coherence Measurement](attachment:image.png)

Summary and Outlook

By modifying the chicane and achieving higher $r_{ch}$ values, a dramatic increase in the CHG signal was observed. The CHG pulses up to the fifth harmonic were detected using a photoelectron spectrometer. Seeding with 265 nm is the next step to generate lower wavelengths for pump-probe experiments at BL 5. For even lower wavelengths the EEEHQ[13] scheme is planned to be implemented at DELTA.

![Summary and Outlook](attachment:image.png)

Acknowledgments

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REFERENCES

[9] P. Ungelenk et al., this conference (MOPEA014).
[12] The APD was set up by K. Holldack, HZB Berlin.
[17] The camera was provided by B. Schmidt and W. Wunderlich, DESY, Hamburg.

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