

## New and emerging sources, Lund 11-13 June, 2007

### Key messages provided by some speakers as input for discussions.

	Key messages (sources)	Strength of sources	Weakness (challenges)
<b>Gerard Mourou</b> Ultra intense lasers	Ultra intense laser >10PW	<ul style="list-style-type: none"> <li>- Explore new regime of accelerations and generation of radiation in the ultra relativistic regime</li> <li>- Produce harmonics in the 10 KeV range</li> <li>- Possibility to go in the zeptosecond regime</li> <li>- Acceleration &gt; 100 [<i>non readable</i>]eV possible</li> </ul>	Average power on the very low side now. It could however be overcome with new laser technology.
<b>Steve Milton</b> Accelerators for Novel Radiation	<ol style="list-style-type: none"> <li>1. Marry laser technologies with electron beam technologies to produce compact stable, high-quality x-ray sources</li> <li>2. It is all about control</li> </ol>	<ol style="list-style-type: none"> <li>1. Compact. Many smaller laboratories could have direct access to them</li> <li>2. Lower cost/user?</li> </ol>	<ol style="list-style-type: none"> <li>1. Many things are still R&amp;D</li> <li>2. Much engineering remains to make such devices viable and reliable</li> </ol> <p>“You are ready to build when there is more D than R” – D.E. Moncton</p>
<b>Fabien Quéré</b> High-Order Harmonics	<p>HHG in</p> <ul style="list-style-type: none"> <li>- <b>Gases:</b> mature source, suitable for injection in amplifier. Very advanced subject with rich physics involved.</li> <li>- <b>Plasma mirrors:</b> Fes studies so far, but laser technology now available (main issue: contrast improvement). Main mechanisms now identified, very promising source, first results encouraging.</li> </ul>	<p><b>Gases:</b> Excellent optical properties (beam quality, coherence, duration) ONLY demonstrated source of attosecond pulses.</p> <p><b>Plasma mirrors:</b> Good optical properties expected. As good as in gases (?), but with higher photon and pulse energies, and shorter pulse duration.</p> <p>Full potential (E and I) of ultrashort and ultraintense lasers can now be exploited.</p>	<p><b>Gases:</b> Physics of the process limits the maximum photon end pulse energies (<math>h\nu &lt; 200</math> to <math>1000</math> eV, <math>E &lt; 10</math> uJ)</p> <p><b>Plasma mirrors:</b> Largely remains to be explored experimentally. Repetition rate. Strong plasma emission (particles and photons) might become an issue as intensity increases.</p>

<b>Elaine Seddon</b> Multiple Purpose Accelerator Sources	1. Huge science demand for soft X-ray & longer $\lambda$ FEL sources for dynamical spectroscopy and imaging. 2. Explicit seeded amplifier FEL and oscillator FELs in own right and in combination with short pulse & widely tuneable light (eg. spont. SR and/or table-top-laser) 3. User facility	1. Transform limited output 2. fs pulses 3. Average power 4. Variable polarisation (especially circular) 5. Lasing medium electrons : clean 6. Repetition rate flexibility 7. Diffraction limited output.	1. Expensive 2. Synchronisation challenges 3. as pulses requires R&D
<b>Bedrich Rus</b> X-ray Lasers	New user source Several “small breakthroughs” mad in the past years (HHG amplification, GRIP, amplifier shaping)	Largest E per pulse (10 mJ) Brightness >> 3rd generation of synchrotron comparable to current XUV FELs True table top sources possible Inherent synchronisation XUV-optical pulses	“ Table top “ scaling to wavelength < 10 nm yet to be proven Good control of the pump laser parameters is critical Target issues on high rep rates.
<b>Dino Jaroszynski</b> Laser-Based Acceleration and FEL	New source on the map Compact Ultra short pulse inexpensive	1 GeV in 3cm ! Fs, Q=100pC High quality $E_N=1 \pi$ mm mRad $\delta\gamma/\gamma \cong < 1\%$ THg -> X-rays	$\delta\gamma/\gamma$ – still be improved Charge Q – to be increased Pulse to pulse fluctuations Rep rate- 10Hz needs to be increased
<b>Marie-Emanuelle Couprie</b> HHG seeding	Can be applied to soft X-ray FEL facilities for shorter $\lambda$ , combine with amplification in SXRL Transfer of the seed properties to the FEL FEL community benefits from further improvements of HHG/or HH on solid targets	Spectral narrowing with respect to SASE Quicker saturation -> compact Easy synchronisation with laser for pump probe experiments allows high rep. rate	For users rapid tuneability involves change of seed laser, undulator gap, possible chirp on the e-beam Limit in short $\lambda$ seed , issues of noise have still to be further investigated.

<p><b>Nils Mårtensson</b> The MAX IV Project</p>	<p>Rings are fantastic workhorses</p> <p>Short pulse facility</p> <p>FEL</p>	<p>Stable, high rep rate, diffraction limited, 29 parallel exp, (coherent)</p> <p>~100 fs, peak flux, short wavelength, large user interest</p> <p>~100 fs, peak brilliance, coherent, in phase with gun development</p>	<p>Long pulses, “large”</p> <p>Medium rep rate, incoherent, (stability)</p> <p>Medium rep rate, (stability), high demands on e- source</p>
<p><b>Marc Vrakking</b> Ultra Fast XUV Sources and Applications</p>	<p>Attosecond science starting to answer questions</p>	<ul style="list-style-type: none"> <li>- Pulse duration-electron dynamics</li> <li>- Generation + characterisation understand &amp; “nature”</li> <li>- Several exp. pump-probe strategies based on XUV-IR (streaking/ionization)</li> <li>- New ideas eg. IP6</li> </ul>	<ul style="list-style-type: none"> <li>- No XUV-XUV exps</li> <li>- Photons <math>\leq 10^{12}</math> in trains</li> <li><math>\leq 10^7</math> in isolated pulse</li> <li>- Need integrated strategy -&gt; not just source, complete exp.</li> </ul>