

# Concluding Remarks

*- a few initial remarks, updated to include comments made in the last session*

Not surprisingly, both conventional laser and accelerator based sources are likely to undergo significant development on the scale of 2-5 years (and beyond).

Makes it difficult to know what should be included in the proposal for a new facility ...  
balance between what can be guaranteed and what needs significant R&D ..  
(won't get capital funding only for R&D ...)

# Laser technology

- is clearly advancing (and could do faster with more funding in some areas ..)

Drive lasers - towards 1 kW average, and in particular towards higher rep rates ( $> 100$  Hz) with high power

HHG/gases – is some R&D directed towards improving conversion efficiency, but no guaranteed outcome; moving towards higher power and rep. rates through drive laser development; need work on stability for use in a facility

HHG/surfaces – not as mature, but potential for shorter wavelengths; need work on rep. rate, and target stability

# Linacs

- the prospect is that either NC or SC linacs can drive a short wavelength SASE FEL with good stability
- SC has the advantage of higher rep. rate/flexibility, but at higher cost.
- requirements for a seeded FEL are more severe; detailed comparison between NC and SC lacking (?)
- SC linac possibly has the greater potential for further improvements in stability through feedback loops ..(?)

# Seeding

- HHG experiments advancing (SCSS, MAX-lab, SPARC); wavelength reach is limited by the HHG laser source
- Cascaded HHG: not recommended to use more than 2 (at most 3) stages (signal/noise etc)
- Alternative schemes for shorter wavelength need to be investigated further
- Self-seeding lacks experimental verification and also further detailed study, esp. sensitivity to errors; not as easy a scheme as the simple diagram suggests  
..tuneability non trivial

# Attosecond schemes

- Not just a case of “attosecond pulses” .. need to consider the needs of actual experiments. Photon delivery to the experiment may also be challenging.
- Some slicing schemes – relatively simple addition, in hardware terms, to the basic FEL
- Single-spike: wins on contrast, but intrinsically poor stability; might also be possible to implement using the same gun & linac
- mode-locked FEL/HHG amplifier scheme potentially very interesting for attosecond pulse trains; requires further study; could be a relatively simple addition to a standard FEL scheme

# Novel sources

- Compton backscattering:

not competitive with a short wavelength FEL, but potentially an interesting source of moderately short (~100 fs) X-rays using relatively modest infrastructure

- Laser plasma accelerator based light sources: definitely a 5<sup>th</sup> generation light source and needing significant R&D, including that of the drive laser to increase rep. rate

Measurement of electron beam quality crucial.

Relevance to NLS ?? – if NLS contains high power lasers and high brightness electron beams it could be an ideal place to do the R&D ...

# Goodbye

## from the NLS Workshop on Advanced Photon Sources

3<sup>rd</sup>-4<sup>th</sup> June 2008, Daresbury Laboratory

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Thanks for coming,  
for your presentations  
and input to the  
discussions

**Please email me your  
comments for the Workshop  
Summary**

Thanks to Marie for  
organising everything