

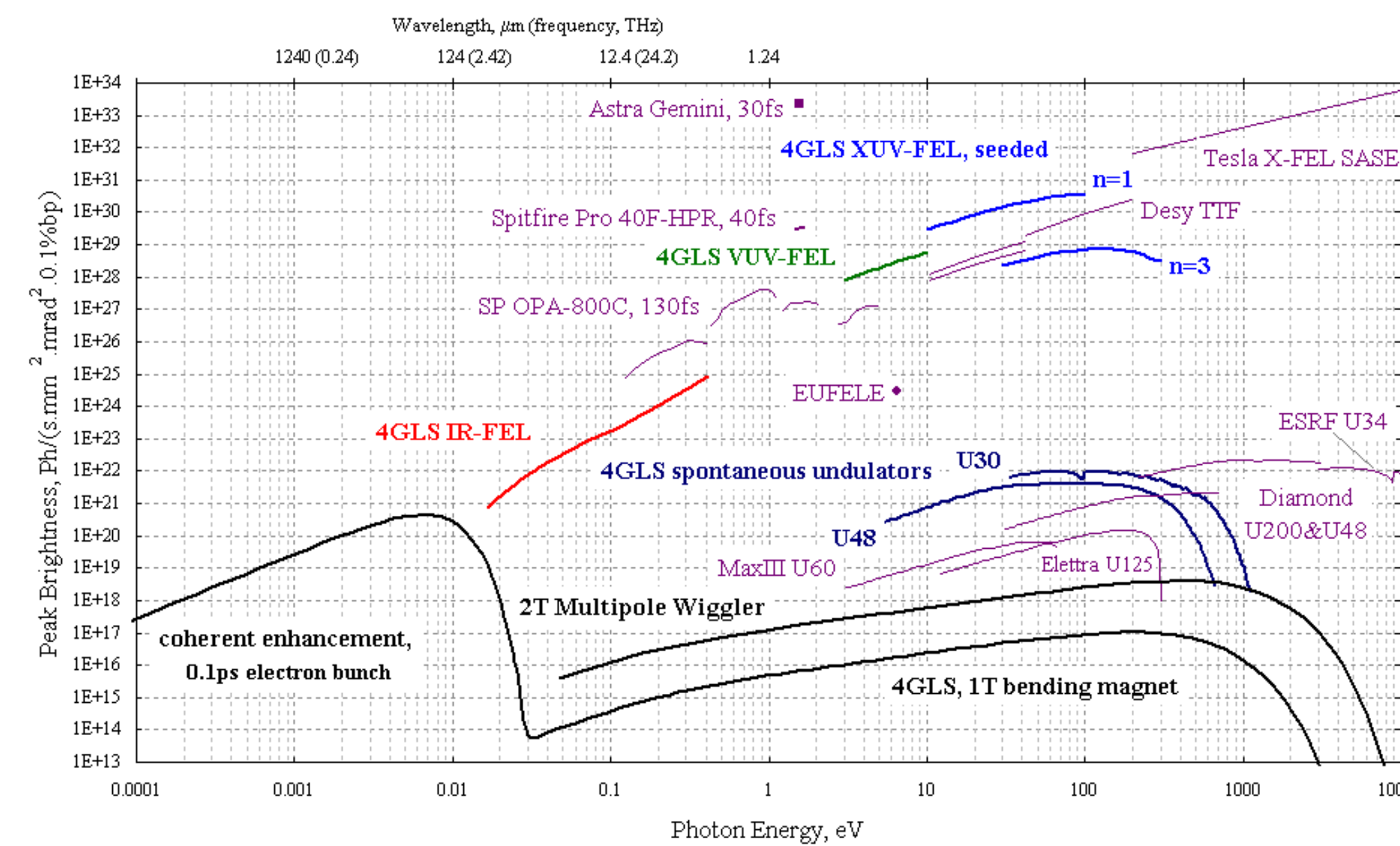


# Calculated Photon Output of 4GLS

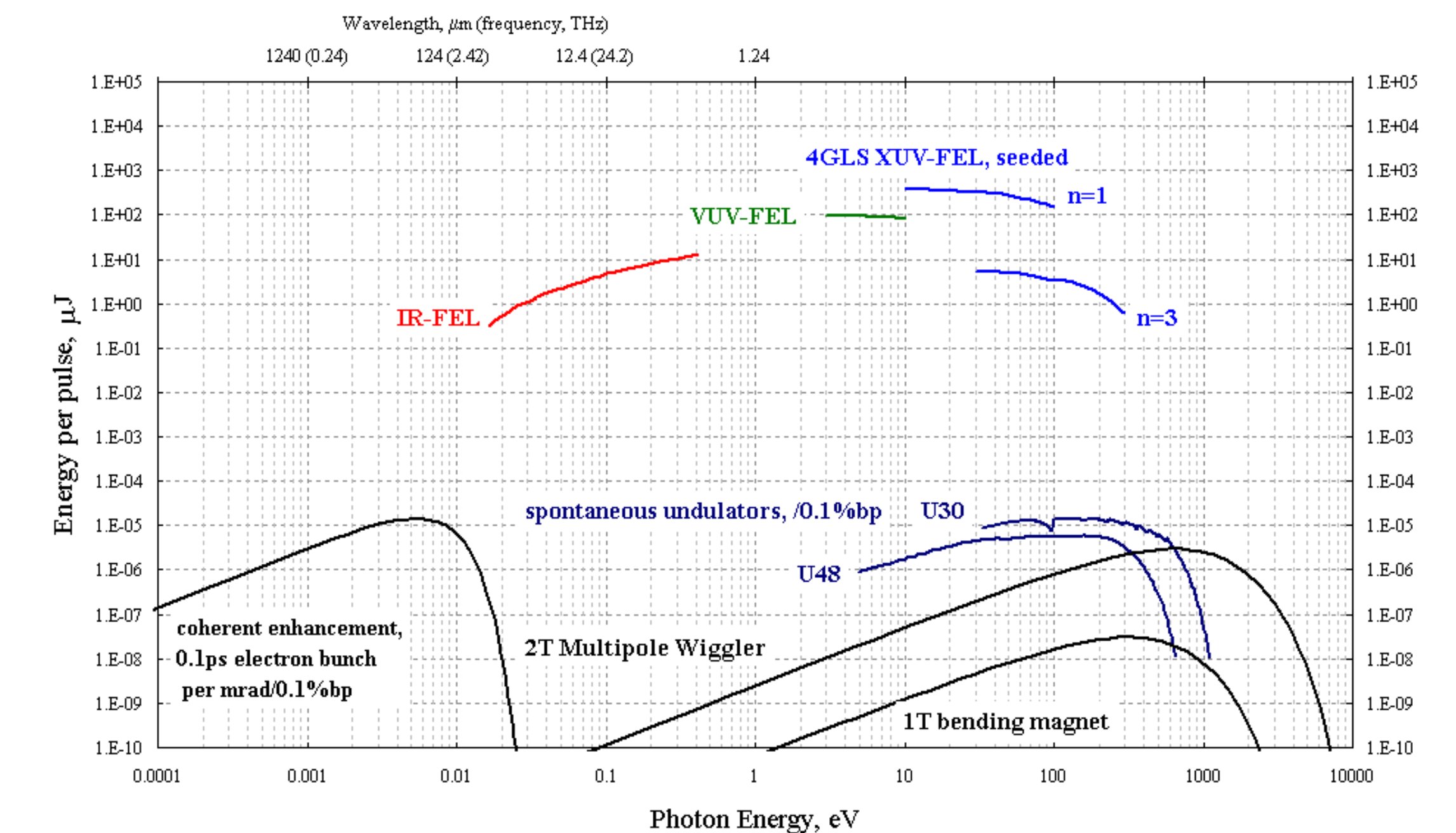
## Introduction

The following tables and graphs for 4GLS photon output have been produced for the 4GLS user meeting in July 2005. They update the data presented in the Science and Business Cases. As the conceptual design is still evolving, the feedback from this meeting on these example outputs will inform the source optimisation process leading up to production of the Conceptual Design Report early in 2006.

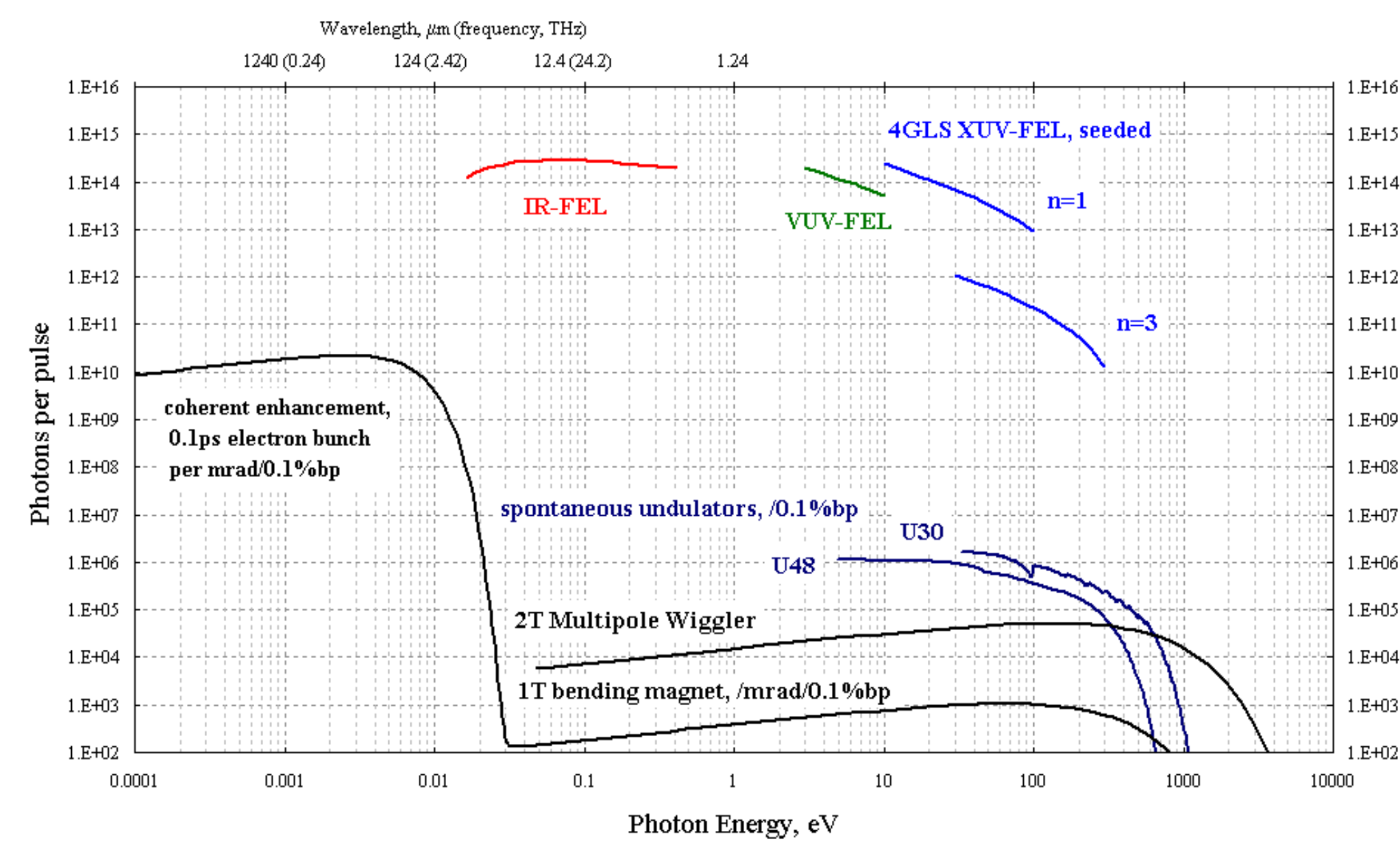
## Peak Brightness



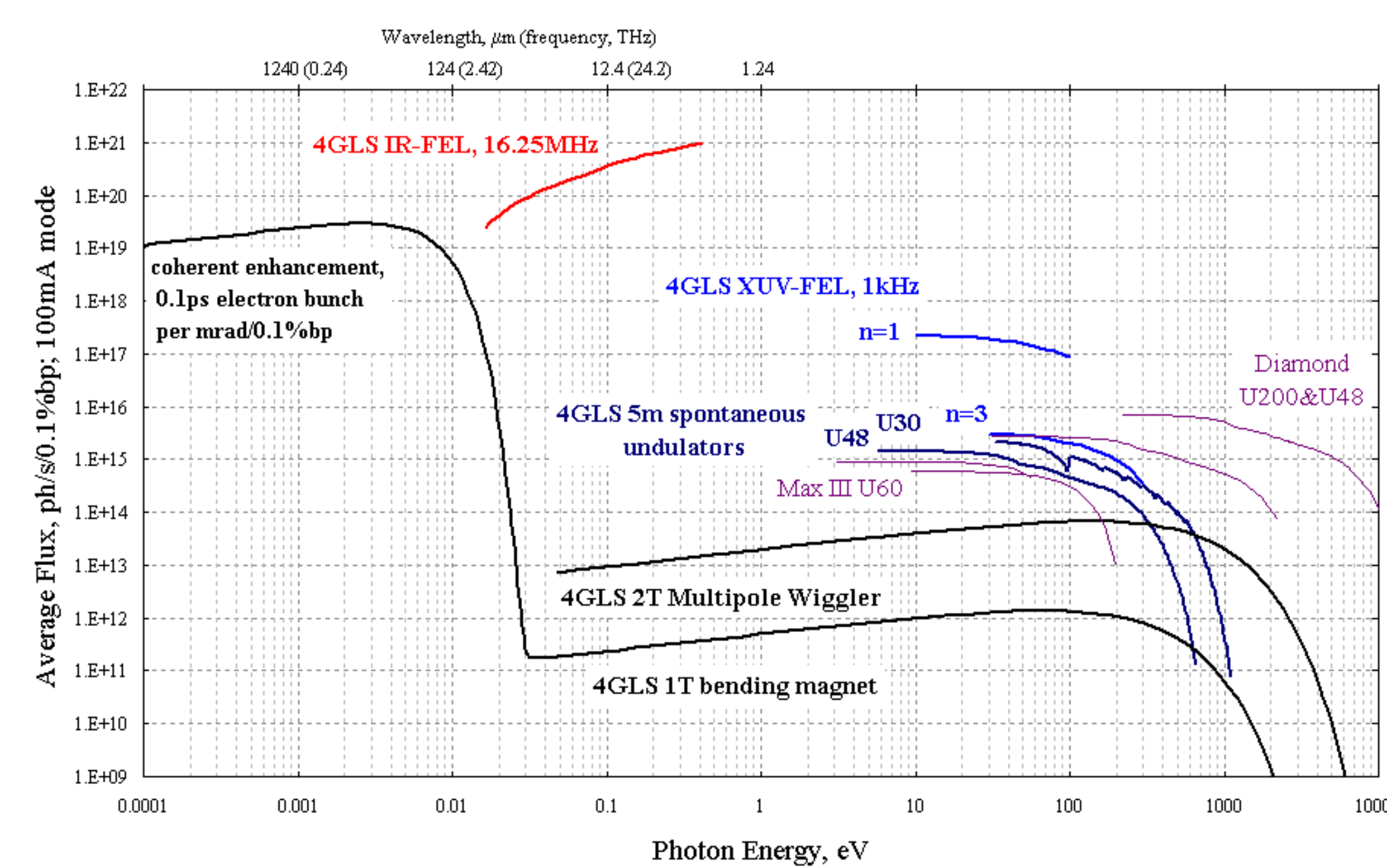
## Energy per Pulse



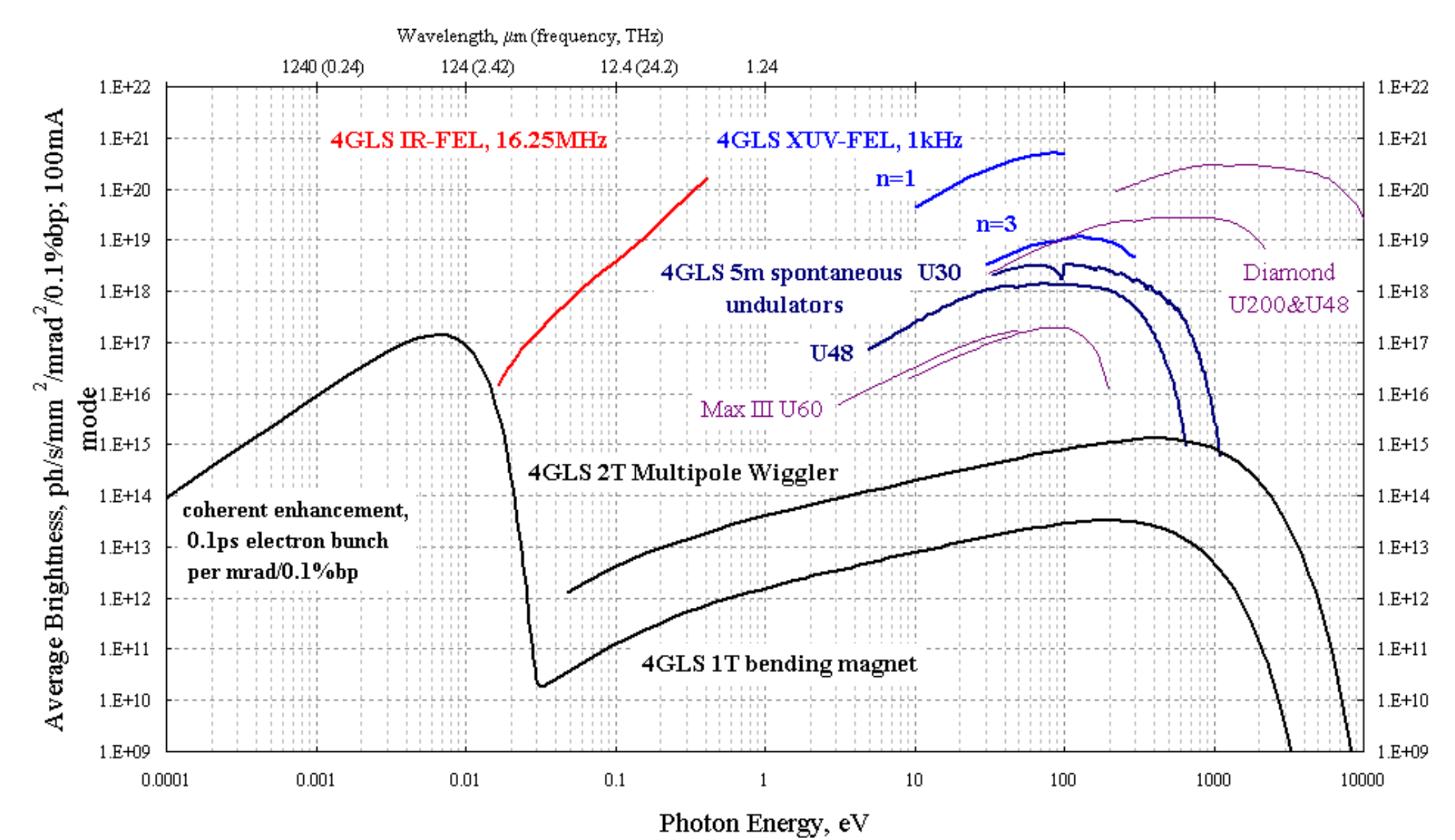
## Photons per Pulse



## Average Flux, 100 mA Mode



## Average Brightness, 100 mA Mode

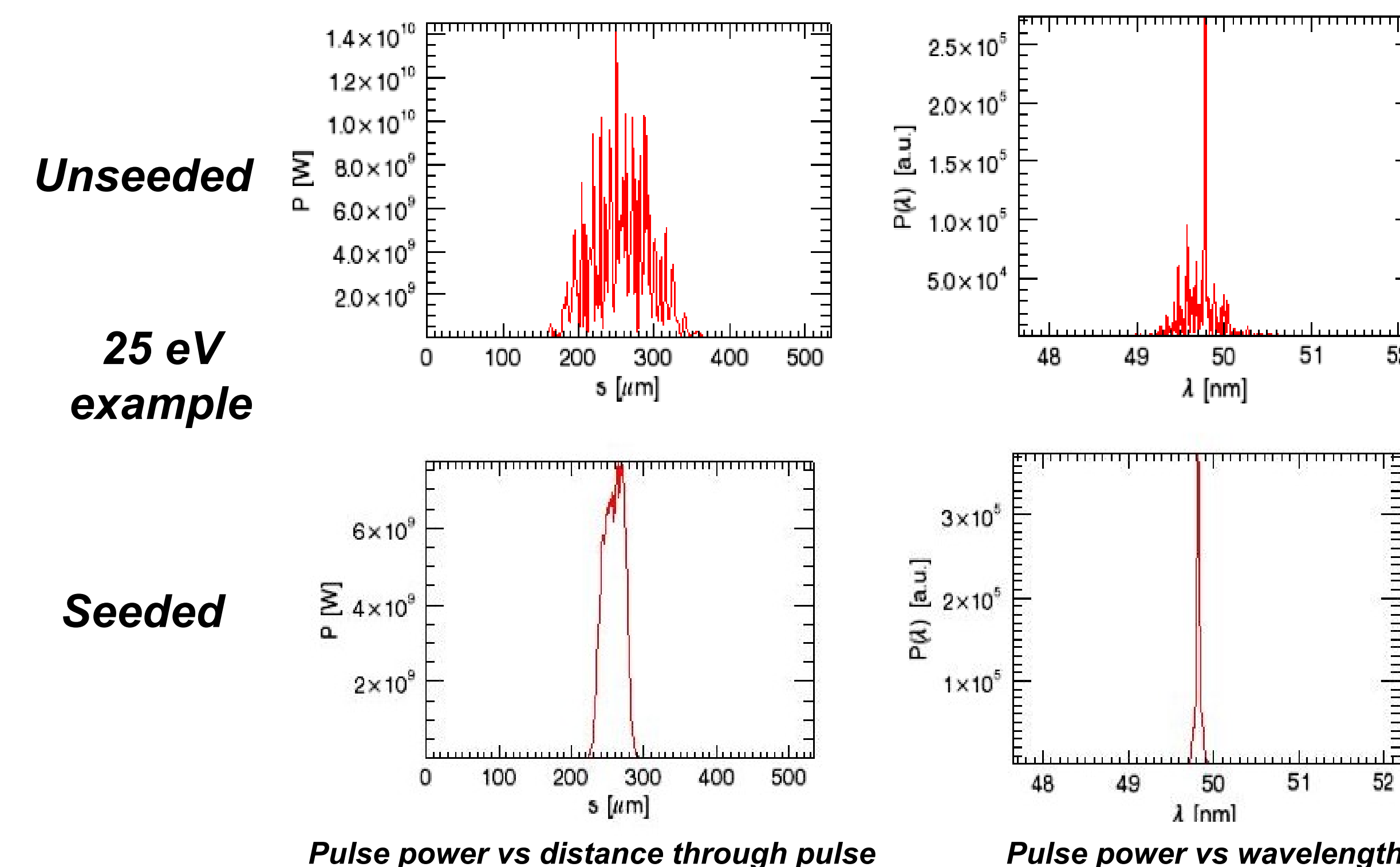


## Accelerator Parameters Assumed

| Operating mode                                                               | high average current branch |               |                    | XUV FEL branch         | IR FEL Branch |
|------------------------------------------------------------------------------|-----------------------------|---------------|--------------------|------------------------|---------------|
|                                                                              | high average current mode   | Timing mode 1 | Timing mode 2      | Same timing most modes | Timing mode 1 |
| RF frequency (MHz)                                                           | 1300                        | 1300          | 1300               | 1300                   | 1300          |
| Electron energy (MeV)                                                        | 600                         | 600           | 600                | 750 - 950              | 15-50         |
| charge per bunch (pC)                                                        | 77                          | 77            | 77                 | 1000                   | 80            |
| repetition rate (MHz)                                                        | 1300                        | 6.5           | 0.001              | 0.001                  | 16.25         |
| average current (mA)                                                         | 100                         | 0.5           | $8 \times 10^{-5}$ | 0.001                  | 1.3           |
| normalised emittance (mm rad); e.g. 2mm mrad equates to 1.7 nm rad at 600MeV | 2                           | 2             | 2                  | 2                      | 10            |

Note that 4GLS will be a very flexible accelerator that can operate in a wide variety of modes. The values above are examples of a few of these modes.

## Impact of Seeding on XUV FEL Output



## Example Spent Beam Undulators

| Photon Energy, eV                                               | 7.5                  | 20                   | 100                  |
|-----------------------------------------------------------------|----------------------|----------------------|----------------------|
| Wavelength, nm                                                  | 163                  | 62                   | 12                   |
| undulator                                                       | 5m U48               | 5m U48               | 5mU48                |
| harmonic                                                        | 1                    | 1                    | 1                    |
| rms pulse length, fs                                            | 100                  | 100                  | 100                  |
| photon/pulse/0.1%                                               | $1.4 \times 10^7$    | $1.4 \times 10^7$    | $9 \times 10^7$      |
| energy/pulse in 0.1%, $\mu\text{J}$                             | $1.8 \times 10^{-5}$ | $4.5 \times 10^{-5}$ | $1.4 \times 10^{-4}$ |
| peak flux, ph/s/0.1%                                            | $5.6 \times 10^{19}$ | $5.6 \times 10^{19}$ | $3.6 \times 10^{19}$ |
| average flux, ph/s/0.1%                                         | $1.4 \times 10^{10}$ | $1.4 \times 10^{10}$ | $9 \times 10^9$      |
| peak brightness ph/s/0.1%/mm <sup>2</sup> /mrad <sup>2</sup>    | $6.4 \times 10^{21}$ | $2.7 \times 10^{22}$ | $1.0 \times 10^{23}$ |
| average brightness ph/s/0.1%/mm <sup>2</sup> /mrad <sup>2</sup> | $1.6 \times 10^{12}$ | $6.8 \times 10^{12}$ | $2.5 \times 10^{13}$ |

Since these undulators use the electron bunch that has just passed through the XUV FEL the photon pulses produced will have intrinsic synchronisation with the XUV FEL pulses