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# POINTS FOR DISCUSSION

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# Round Table Discussion: Day 1



1. Figure-of-merit of FEL performance for different disciplines: Intensity vs Brilliance (peak & aver.) vs Photon Flux.
2. Where is the cut-off for the figure-of-merit for different applications?
3. What is the added value of having fully coherent FEL pulses? Grade on the scale from 1 to 5.
4. Is there an added value of CEP-stable FEL pulses?
5. What are the examples of groundbreaking experiments that can be done only with fully coherent FEL pulses.
6. What is missing in the survey of the FEL dream parameters?

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# Photon Range, Energy & Focus

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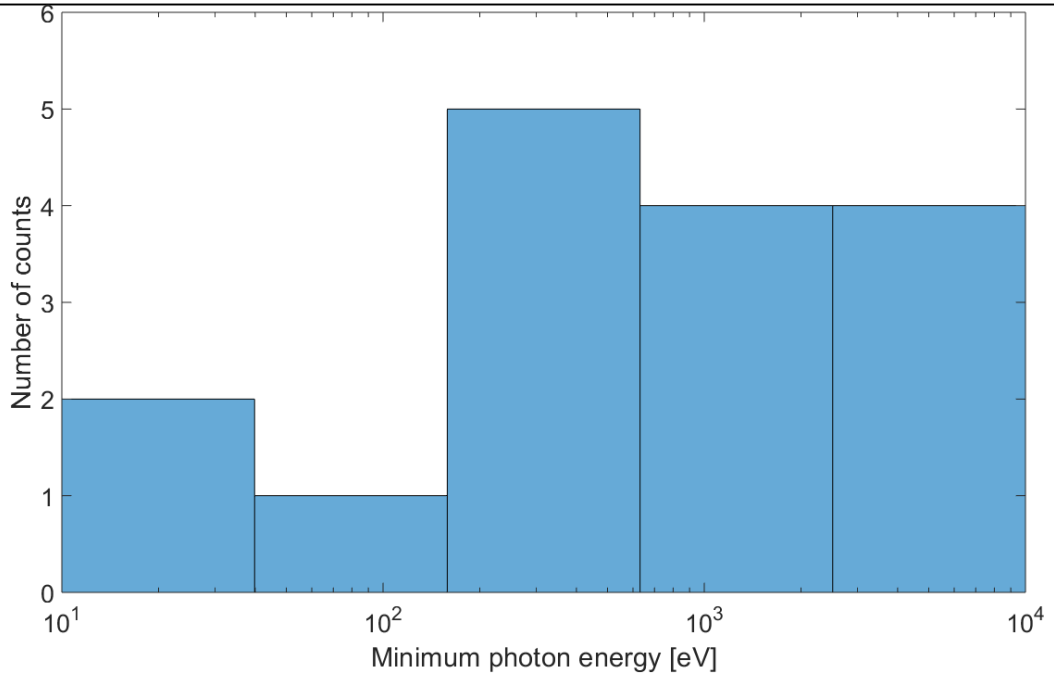
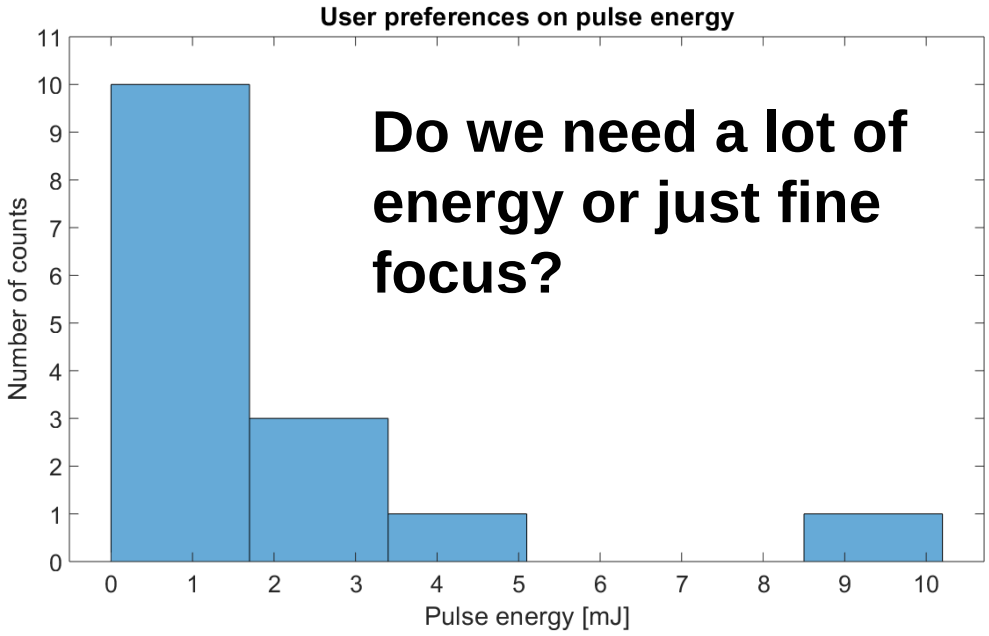
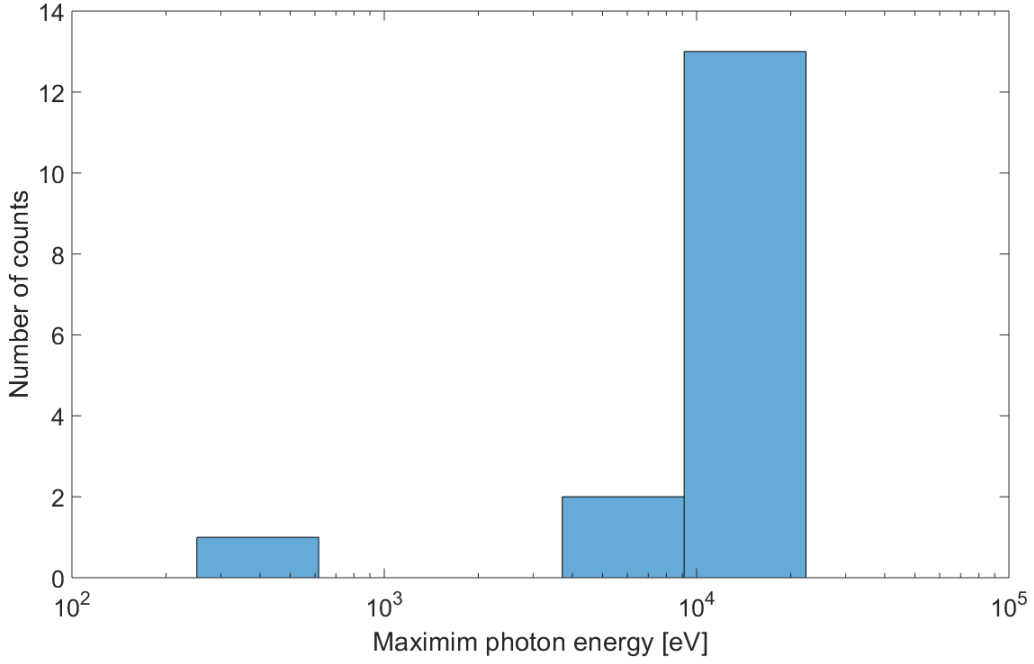
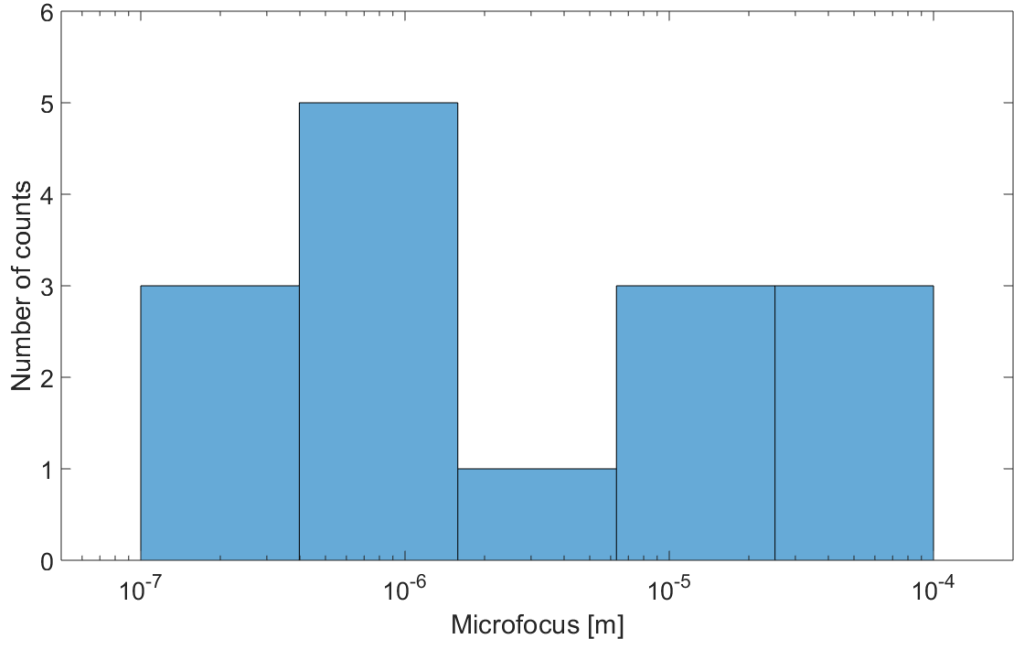



**Do we need a lot of energy or just fine focus?**



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# Temporal Characteristics

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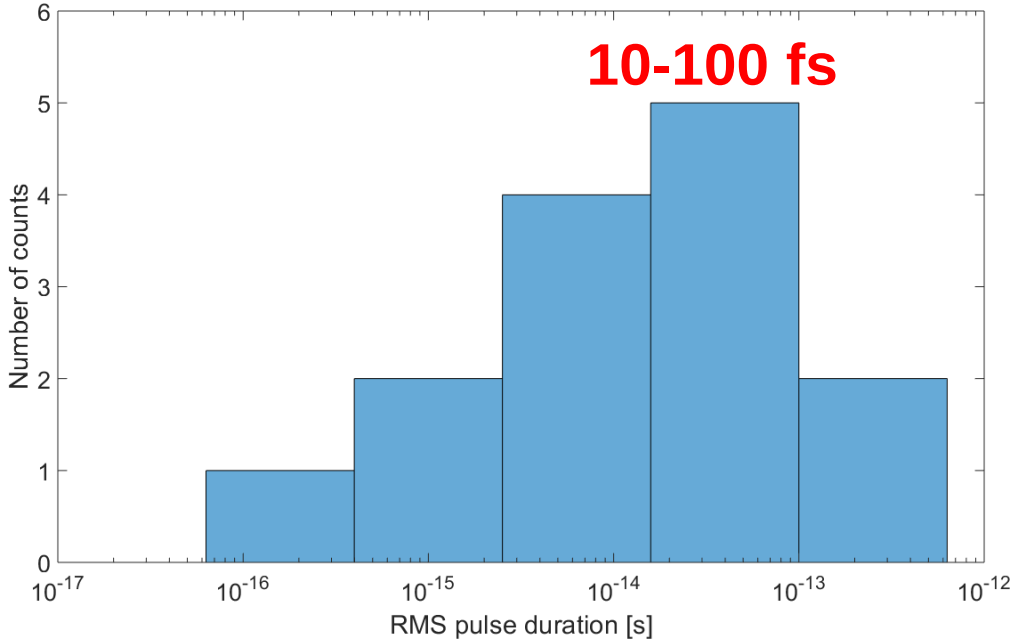
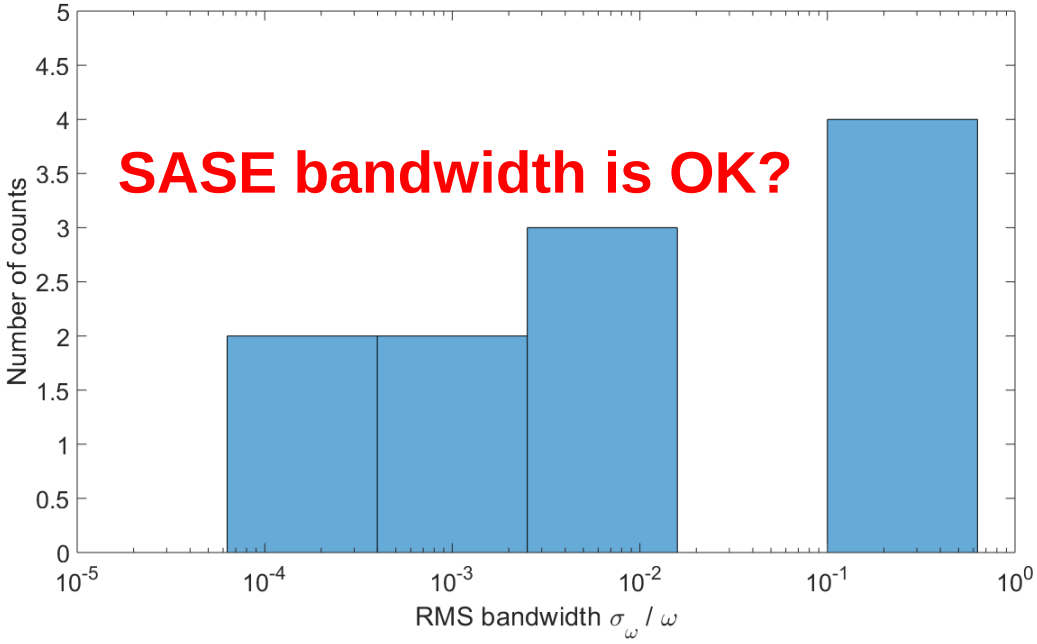
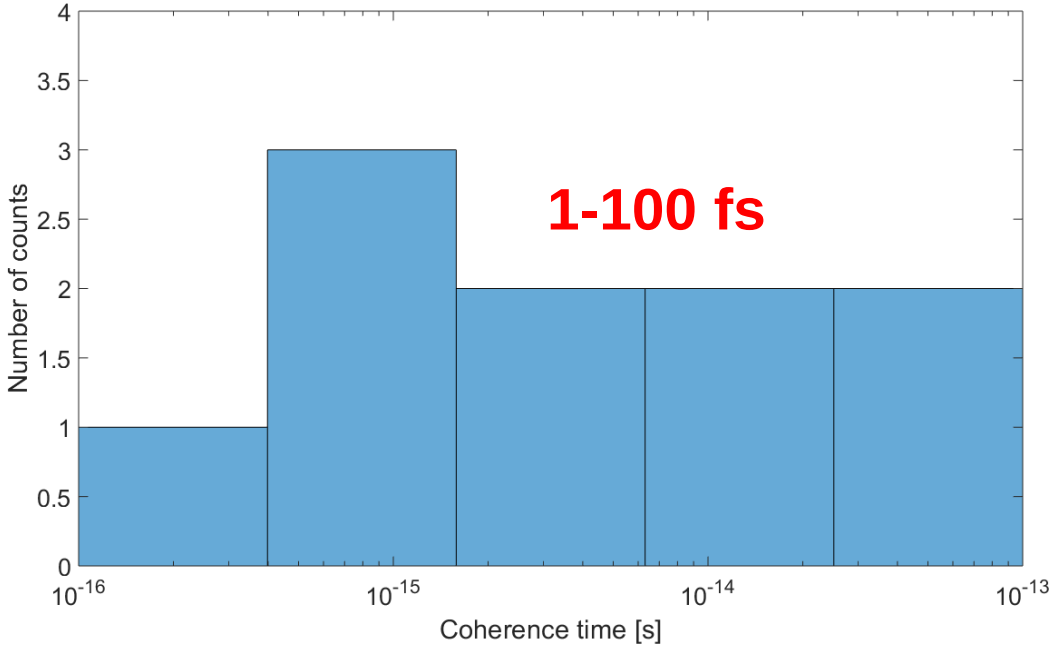
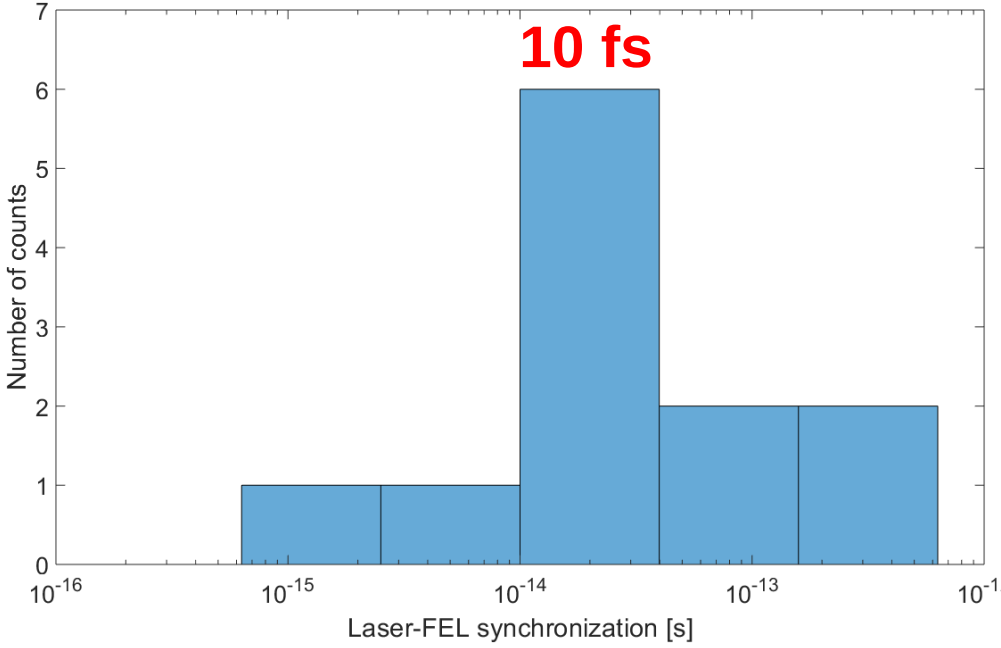


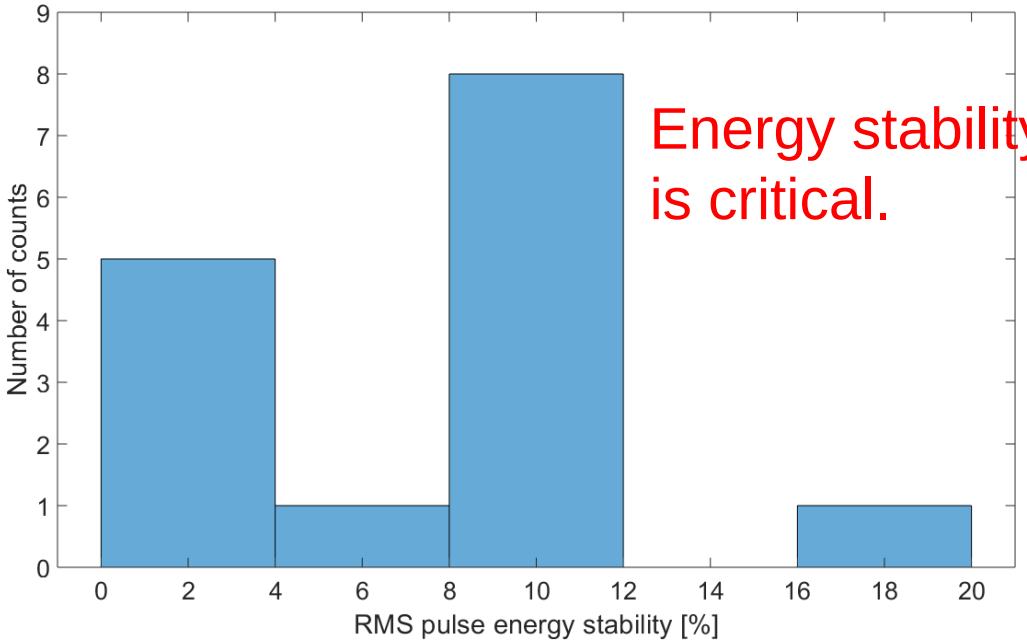



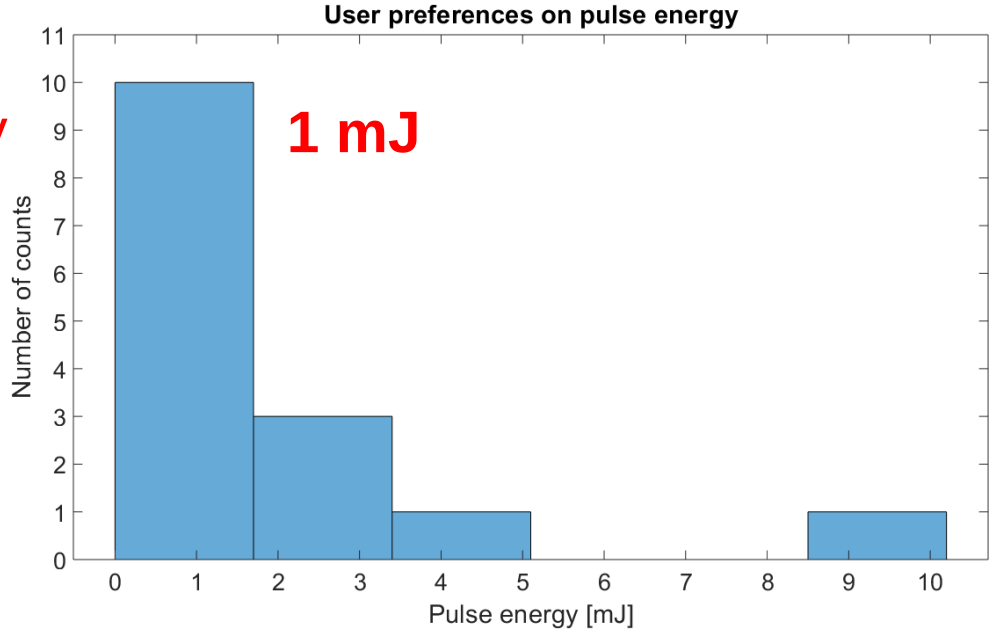



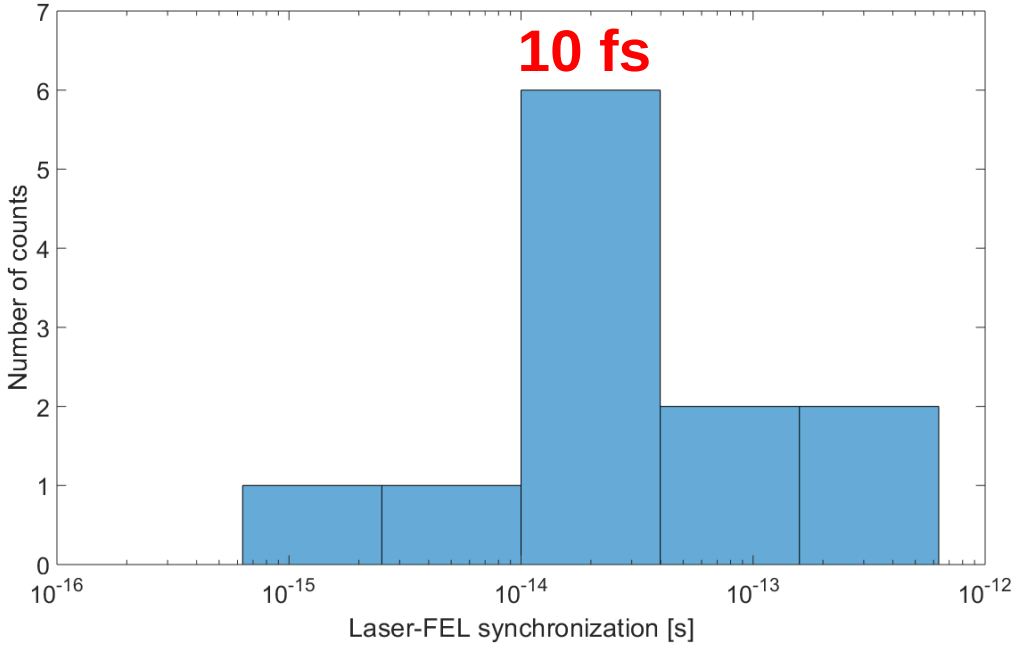



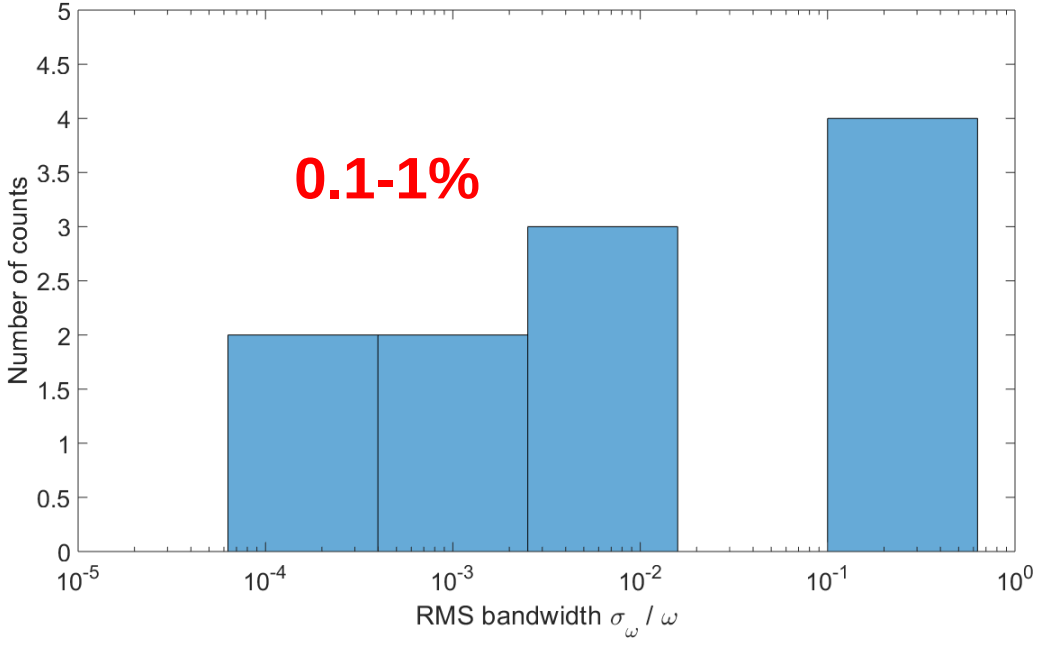
# Stability




Number of counts
RMS pulse energy stability [%]
Energy stability
is critical.


User preferences on pulse energy
Number of counts
Pulse energy [mJ]
1 mJ


10 fs
Number of counts
Laser-FEL synchronization [s]


0.1-1%
Number of counts
RMS bandwidth $\sigma_\omega$ / $\omega$

# Marketing of future FEL



Target group: **Universities**

1. Excellent but not necessary groundbreaking research
2. Education of students
3. Very high-risk experiments that are not granted beam time at mega scale FELs.
4. Must be affordable by Universities: 25-30 MEuro (*including civil construction*).

Target group: **Infrastructure beyond the-state-of-the-art**

1. Groundbreaking research
2. Mega scale FEL facility.
3. Pulse energy: 1-10 mJ
4. Pulse duration: 0.2-0.5 fs
5. Focus: 0.1-0.5 um
6. Photon energy up to 25 keV.
7. User experiments in 10 years from now.

**General note on funding**: the funding success rate is 10-15% for EU grants and probably the same for national grants. The success rate for beam time applications doesn't need to be much higher. Hence, the argument that we don't have enough FEL beam time is week.

## MUST requirements for future FELs

1. Peak brightness of the existing FELs
2. Pulse duration: 10-100 fs
3. Higher stability
4. Polarization control
5. Synchronization: 10 fs
6. Repetition rate: > 100 Hz

**How much do you agree with these parameters?**

**Note**: having only these requirements fulfilled does not seem to be enough for raising the funding for the future FEL facility.

Then, we must make the future FEL either cheap or unique.

# Special Features



## Group 1 (Vitaliy)

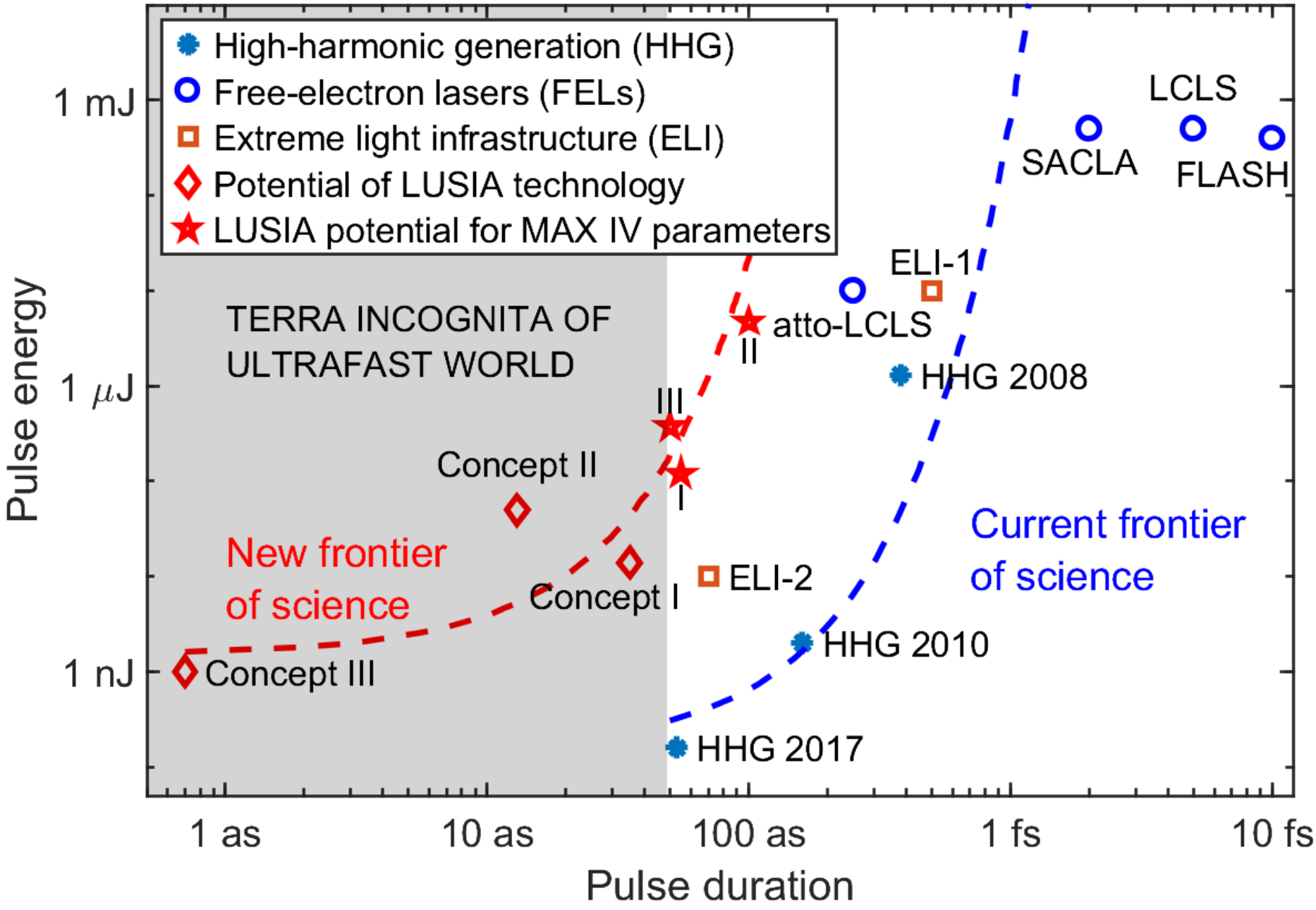
1. Pulses of SASE spikes vs coherent SASE pulses vs CEP-stable pulses
2. Orbital Angular Momentum
3. Several colours within a pulse
4. Multiple pulses with different colours
5. Pulse trains

**Grade importance on the scale from 1 to 5.**

## Group 2

1. Terawatt FELs and ultrahigh pulse energy.
2. Ultratight focusing
3. Polarization variation within a pulse
4. Wavelength modulation within a pulse
5. Long pulses (> ps)
6. Attosecond pulses and sub-attosecond pulses

# Attosecond SIngle-Cycle Undulator Light: LUSIA



# Extreme FEL: X-ray pump-probe



## X-ray pump

1. Pink coherent pulses tunable from VUV to soft X-ray
2. Pulse duration 50 fs
3. Minimum pulse energy 1-10 mJ, desirable 10-100 mJ

## X-ray probe

1. 5-10 keV for spectroscopic studies
2. 10-50 keV for diffraction studies
3. Monochromatic pulses with energies around 1 mJ
4. Synchronization better than 50 fs
5. Delay between the pulses from -1 ps to 10 ps
6. Pulses should be incident at slightly different angles
7. The same focal spot regardless of wavelength

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# Thank you!

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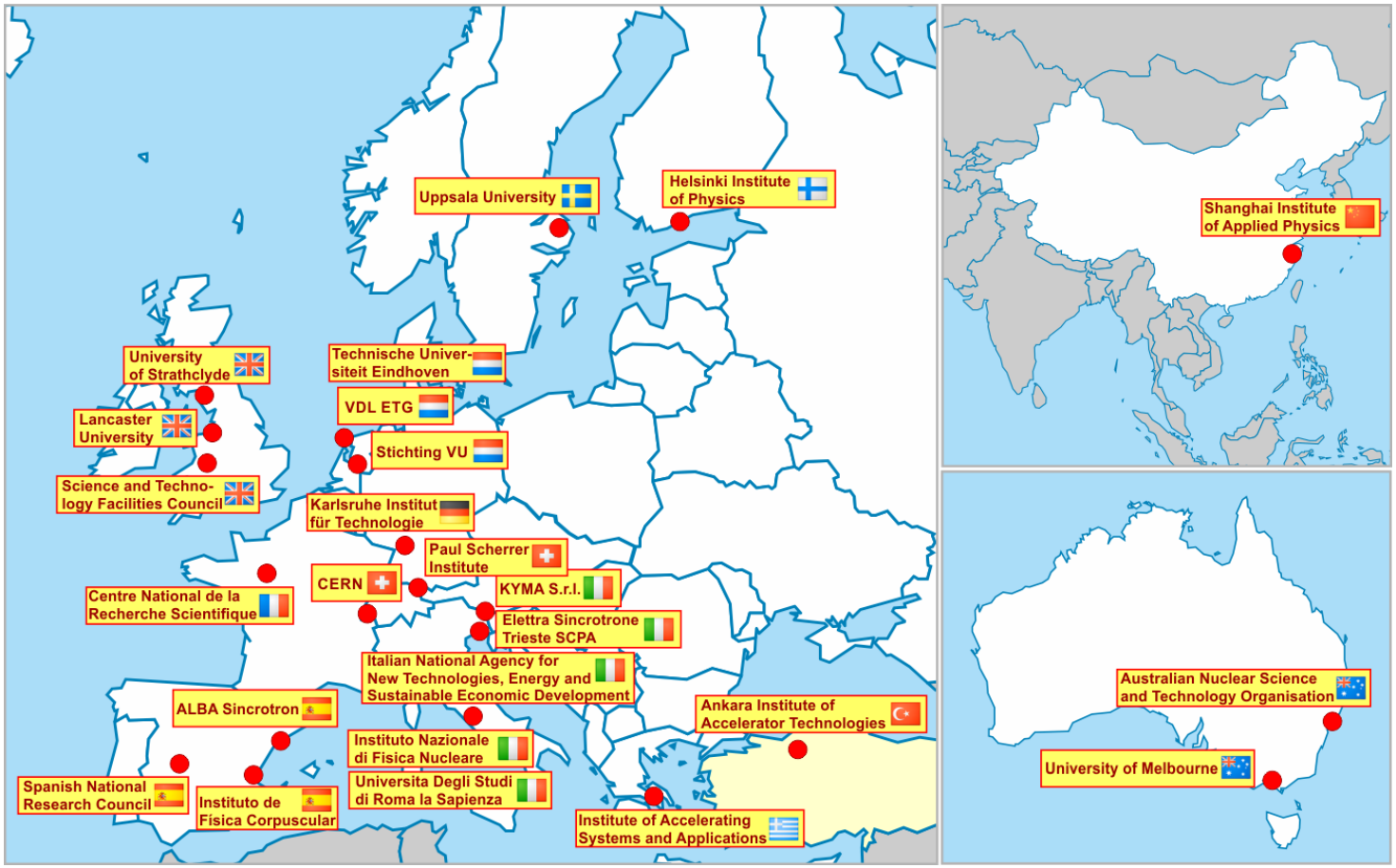


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