SLAC NATIONAL ACCELERATOR LABORATORY

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# Guidelines for One-Page White Paper Submissions to the HEXFEL Workshop on Novel X-ray Science opportunities

SLAC National Accelerator Laboratory, CA. August 28 – 29, 2026.

We ask for your input to help us to shape the workshop and identify the most compelling science cases for a high-energy x-ray free electron laser (HEXFEL). Please focus on a specific case of highest interest for you and outline the unique opportunity and addressed research need leveraging the novel capabilities enabled by a HEXFEL.

We are looking for major leaps in x-ray science beyond the capabilities of existing XFELs and 4$^{th}$ generation high-energy synchrotrons, such as ESRF, APS-U, Spring-8-II, or PETRA IV. For your guidance, we provide a rough set of parameters for such an FEL when driven by a 30GeV electron beam with existing undulators at SLAC, see below.

We encourage concise submissions, and bullet points are very welcome.
Please consider addressing the following aspects, but don't feel limited by these questions:

- What is the most exciting scientific gap or challenge, which could be tackled with a HEXFEL and photon energies up to 50 keV?
- Why does the ultra-short and coherent x-ray pulse matter for the understanding in your science case?
- Would the tunable polarization of the X-ray beam impact in your case?
- What advantage of the high-energy x-rays matters for the suggested science case (high-energy PDF analysis, large reciprocal space, high penetration power…)?
- How is the experimental limitation today affecting progress in your scientific field (e.g., instrumentation limitations, access to required energy ranges, limited flux per shot, coherent fraction of the beam)?
- What further actions might be needed to guarantee success (e.g. data analysis, detectors, optics, sample environments)?
- What very first flagship experiment with high chance of success would you propose for a HEXFEL facility, which would be outstanding to demonstrate the impact?
- What future upgrades do you envision to enable even more advanced experiments on longer-term (e.g. low emittance, higher photon energy, high repetition rate, using soft- and high-energy x-rays FELs simultaneously)?

*Prepared by the HEXFEL Workshop Organizers: Claudio Emma (cemma@slac.stanford.edu), David Reis, Uta Ruett, Chi-Chang Kao, Jerry Hastings*

| Parameter | Up to 30 GeV hard X-ray FEL |
|---|---|
| **Photon Energy [keV]** | 1 - 50 |
| **Pulse Length [fs]** | sub 1 - 100 |
| **Pulse Energy [uJ]** | 1e2 - 1e4 |
| **Repetition Rate [Hz]** | Up to 360 |
| **Bandwidth [eV]** | 1e-3 (relative) |
| **Spot size at focus [um]** | Variable |
| **Polarization** | Variable |

| Photon Energy [keV] | Pulse energy [uJ] | Photons per shot | Photons/sec at max rep rate (360) | Bandwidth [eV] |
|---|---|---|---|---|
| 5 | 1000 | 1.E+12 | 4.E+14 | 5 |
| 10 | 1000 | 6.E+11 | 2.E+14 | 10 |
| 15 | 1000 | 4.E+11 | 1.E+14 | 15 |
| 20 | 1000 | 3.E+11 | 1.E+14 | 20 |
| 25 | 1000 | 2.E+11 | 9.E+13 | 25 |
| 30 | 1000 | 2.E+11 | 7.E+13 | 30 |
| 35 | 1000 | 2.E+11 | 6.E+13 | 35 |
| 40 | 1000 | 2.E+11 | 6.E+13 | 40 |
| 45 | 1000 | 1.E+11 | 5.E+13 | 45 |
| 50 | 1000 | 1.E+11 | 4.E+13 | 50 |