Justification
TECHNICAL REASONS

Subject	Reasons for the single-source contract award regarding a laser system for ARCNL

1 Reason for the procurement requirement

ARCNL requires a femtosecond Ti:sapphire laser system delivering pulses with energy >7 mJ, pulse duration of approximately <35 fs, and a repetition rate of 1 kHz. The laser will be used to pump a TOPAS HE optical parametric amplifier, which accepts up to 8 mJ / 35 fs input pulses, and will form the first stage of a planned multi-stage ultrafast experimental platform.

The system must also support future in-lab expansion to a second amplifier beamline of the same performance class, generating an additional >7 mJ, 1 kHz, 35 fs beam, without replacing or modifying the seed laser. This upgrade path is required because the laboratory will ultimately operate multiple synchronized ultrafast beamlines for source generation, pump-probe experiments, and metrology applications.

The primary scientific use of the laser is high-harmonic generation for ultrafast nanoscale metrology. In these experiments, the generated high harmonics will be used to probe nanoscale structures with target feature sizes below 100 nm. The measurements are expected to run over extended acquisition times, ranging from many hours to several days. Therefore, the system must deliver highly reproducible illumination conditions over long periods.

For this reason, the suitability of the laser cannot be assessed only by pulse energy and pulse duration. Long-term stability of the beam is a mandatory requirement. Small fluctuations in pulse energy, beam pointing, beam mode, pulse duration, or thermal lensing can shift the laser focus, alter nonlinear conversion efficiency, move the high-harmonic source position, and compromise measurement reproducibility. These effects are especially critical for high-harmonic generation, where the signal depends nonlinearly on the driving laser field.

The laser system must therefore meet the following mandatory performance requirements at the specified operational energy, pulse duration, and repetition rate:

- Beam pointing stability better than 4 µrad rms;
- Pulse energy stability better than 0.4% rms over 24 hours;
- TEM_{00} beam quality with $M^2 < 1.20$ in both axes;
- Active stabilization of the pulse compressor to avoid pulse-duration drift or compressor "breathing";
- Dedicated Thermo-Electric stabilization of the Ti:Sapphire crystal to minimize thermal-lens variations;
- Stable operation over realistic laboratory temperature variations of ±5 °C;
- Nanosecond pre-pulse contrast better than 2000:1.

- To accommodate a future change in output requirements required for subsequent experimental projects ARCNL wants to keep options open to modify the amplifier. In-laboratory conversion to a different pulse duration or repetition frequency should be possible.

The nanosecond pre-pulse contrast is a critical requirement because the experiments involve nanostructured samples. A pre-pulse with insufficient contrast can heat, modify, or damage the sample before the arrival of the main femtosecond pulse. Such pre-damage would compromise both the scientific measurement and the integrity of the metrology target.

In addition to HHG-based metrology, the amplified Ti:sapphire output will also be used directly for optical excitation and probing of carrier dynamics in liquids, solids, and interfaces. These experiments impose the same requirements on pulse stability, beam quality, and long-term reproducibility.

2 Scope of the assignment

- Assembly of the laser system on Contractor's premises in accordance with Programme of Requirements and Tender;
- Delivery and installation of the laser system at ARCNL
- Site assessment tests (SAT) and verification of the technical specifications mentioned in the contract, after installation at ARCNL
- Aftercare phase after delivery at ARCNL;
- Basis training for laser maintenance and advanced training for users for laser alignment and operation. Up to two follow-up user-training or troubleshooting visits within 12 months after installation.
  - Address new questions from the laser user - after having gained some experience with the system.
  - Basic user training for new/different laser users

- 3-year warranty on the seed laser and 1 year warranty on the rest of the system.
- Other possible items for delivering the laser in working order.

3 Estimated contract value

The contract value for the purchase is: €254.662 excluding VAT.

4 Market

A market research has been carried out for femtosecond Ti:sapphire laser systems capable of delivering >7 mJ pulse energy, approximately 35 fs pulse duration, and 1 kHz repetition rate, while also meeting the long-term stability, beam quality, pre-pulse contrast, and upgrade requirements described in Section 2.

The market assessment showed that several suppliers can provide high-energy femtosecond Ti:sapphire laser systems in the relevant pulse-energy and repetition-rate class. However, the procurement requirement is not only defined by nominal pulse energy. The required system must simultaneously satisfy the following combined set of specifications under operational laboratory conditions:

- 7 mJ pulse energy at 1 kHz and approximately 35 fs;
- Compatibility with a TOPAS HE OPA accepting up to 8 mJ / 35 fs input pulses;
- Upgrade path using the same seed laser to support an additional >7 mJ, 1 kHz, 35 fs amplifier beamline;
- Beam pointing stability better than 4 µrad rms;
- Pulse energy stability better than 0.4% rms over 24 hours;
- TEM_{00} beam quality with $M^2 < 1.20$ in both axes;
- Active compressor stabilization;
- Dedicated stabilization of the Ti:sapphire thermal lens;
- Guaranteed stable performance over ±5 °C laboratory temperature variation;
- Nanosecond pre-pulse contrast better than 2000:1;
- Laser design that minimizes spectral distortion of the compressed pulse.

Based on the market research, this complete combination of requirements is only met by the Newport Spectra-Physics Solstice APX system released in 2026. In addition to the mandatory stability and contrast parameters, this system includes design features directly relevant to the intended experiments, including four enclosed amplifier sub-systems to reduce thermal disruption during operation and maintenance, a single Pockels-cell amplifier design to minimize high-order dispersion, an end-pumped Ti:sapphire amplifier crystal to reduce beam ellipticity and astigmatism, and no exit window after pulse compression to avoid additional spectral distortion.
Other systems considered in the same general laser class may meet individual requirements, such as pulse energy or repetition rate, but do not meet the full combined requirement set needed for long-duration HHG-based nanoscale metrology and future synchronized beamline expansion.

5 Procurement procedure and

The contract is awarded by private treaty with reference to Article 2.32(1)(b) of the
the Public Procurement Act 2012. This article stipulates that the contract may be awarded by private treaty if the contract can only be performed by one specific contractor,

a) because competition is lacking for technical reasons, or
b) because exclusive rights, including intellectual property rights, must be protected and there is no reasonable alternative or substitute.

In this case, it concerns a) Competition is lacking for technical reasons:
The technical need is defined by the combination of requirements described in Section 2. The laser system must provide >7 mJ, 1 kHz, approximately 35 fs pulses for pumping a TOPAS HE OPA, while also delivering the long-term beam stability, beam quality, active compressor stabilization, thermal-lens stabilization, laboratory-temperature robustness, nanosecond pre-pulse contrast, and future dual-amplifier upgrade path required for ARCNL's HHG-based nanoscale metrology platform.
The market research described in Section 5 shows that this complete combination of mandatory requirements is only provided by the Newport Spectra-Physics Solstice APX system. Although other suppliers may offer femtosecond Ti:sapphire amplifiers with comparable nominal pulse energy or repetition rate, they do not provide a technically equivalent solution satisfying the full set of requirements. In particular, the combined requirements on beam pointing stability, 24-hour energy stability, beam quality, active compressor stabilization, Ti:sapphire thermal-lens stabilization, operation over ±5 °C laboratory temperature variation, nanosecond pre-pulse contrast better than 2000:1, and upgrade using the same seed laser are not available as an equivalent market alternative. A relaxation of these requirements would not be scientifically or technically acceptable. Reduced pointing or energy stability would compromise long-duration high-harmonic generation measurements by changing the focus, harmonic yield, and source position during acquisition. Insufficient beam quality or compressor stability would reduce reproducibility of the nonlinear conversion process. Insufficient nanosecond pre-pulse contrast would introduce a risk of modifying or damaging nanostructured samples before the main pulse arrives. Finally, a system without the specified seed-laser upgrade path would not meet the planned laboratory architecture and would require later replacement or duplication of core infrastructure.
There are no other market parties known that can provide what is requested (see paragraph 5) and there is also no reasonable alternative or substitute. The contract will therefore be awarded by private treaty to Newport Spectra-Physics.

Publication of awarded contract
In accordance with Article 2.37(e) of the Aw 2012, the contract awarded will be announced on TenderNed.