

Draft Gamma Factory laser specification sheet and acceptance tests

1. **Context:**
   Couple of words to introduce the project and final use of the laser.
   The laser will be used at the following several locations:
   - At surface buildings at CERN, in slight over-pressured (<100Pa) clean rooms
   - In underground clean room located in Ti18 tunnel, close to SPS tunnel, at CERN where pressure is expected to be XXX Pa higher than that at ground at CERN
   - At surface buildings at Orsay (91), France, in slight over-pressured (30 Pa) clean rooms

2. **Laser Specification:**
   The laser must be a passively mode-locked soliton ultrafast laser with following specifications:
   - Repetition frequency: 40.0757 MHz with manufacturing tolerance of 0.1 kHz
   - Center wavelength: 1031.5 nm with manufacturing tolerance of 0.5 nm
   - Spectrum: close to transform limited with solitonic shape, no ripples and no pedestals, no ASE background
   - Average power: >50mW
   - Amplitude noise < 0.1% rms over 2 h
   - Pulse duration: <200fs FWHM
   - Pulses must exhibit no pedestals, no satellite pulses and no ASE background
   - Polarization extinction ratio must be larger than 23dB with a fixed direction that needs to be specified by the provider
   - Beam output: PM fibre OR free space with M2<1.1 (TBD)
   - Timing jitter: <3fs over [10Hz,1MHz] integration range
   - RIN performance must be shot-noise limited [100 kHz - 10 MHz]
   - Fine repetition rate tuning via built-in PZT: at least a range of 50Hz at 40MHz over [0V,10V], resonance frequency >30 kHz, BNC input (TBC)
   - Coarse repetition rate tuning via built-in PZT: at least a range of 5kHz (TBC) at 40MHz over [0V,10V], filtered BNC input with cut-off frequency below 10Hz
   - Pump current adjustment by software allowing to tune CEP over [0,2pi]
   - Pump current modulation input allowing CEP stabilization
   - Phase noise power spectral density within the specification given in Fig. 1:
3. **On-site Acceptance tests:**

Upon delivery of the laser, the following acceptance tests will be performed at CERN:

- RF measurement with *Keysight Technologies N9020A MXA* of repetition frequency versus PZT voltage for both fine and coarse tunings and for pump current adjustment over its whole range of tunability
- Beam profile measurement
- Pulse duration with auto-correlator
- Optical spectrum measurement
- Phase noise Power Spectral density measurement with Keysight Technologies N9020A MXA

*Figure 1: Maximum allowed Phase noise spectral density versus relative frequency to the optical carrier (at about 290THz)*