Operating Procedure for the CTF laser

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1 Safety

Lasers are classified by their output, for the CTF laser they are as follows: (April 1994)

Wavelength, nm	Energy, mJ	Peak Power, MW	Power Density, TW/m^2
1047	10	1000	300
523	5	500	150
349 (optional)	1.5	150	45
262	1	100	30

This places the laser in **Class IV, there is a risk of permanent damage to eyes and skin from direct or reflected radiation.**

The laser system is still in a development phase and does not meet normal laser safety practises such as automatically stopping when the covers are opened and only having the required output wavelength outside of the protective covers, therefore **the laser room is a classified area, subject to laser safety rules,** to minimise the risk of accidents the following procedures must be observed.

- **safety goggles which cover all of the output wavelengths should be worn at all times.** Three of the four outputs are invisible, also **a real danger exists from reflections even from surfaces which are mat, black or diffuse to visible light**.

- **Only authorised and suitably protected persons are allowed in the laser room** during operation.

- The **laser room should be kept locked at all times**, unless an Authorised Person is present.

- It is the responsibility of the laser operator to ensure the correct functioning and use of all safety equipment, signs and warnings, and to ensure that no danger of exposure exists for people in the CTF.

- **If in doubt, get out.**

This list is not exhaustive, additional safety procedures are described in the following documents which are available from the divisional secretariats:

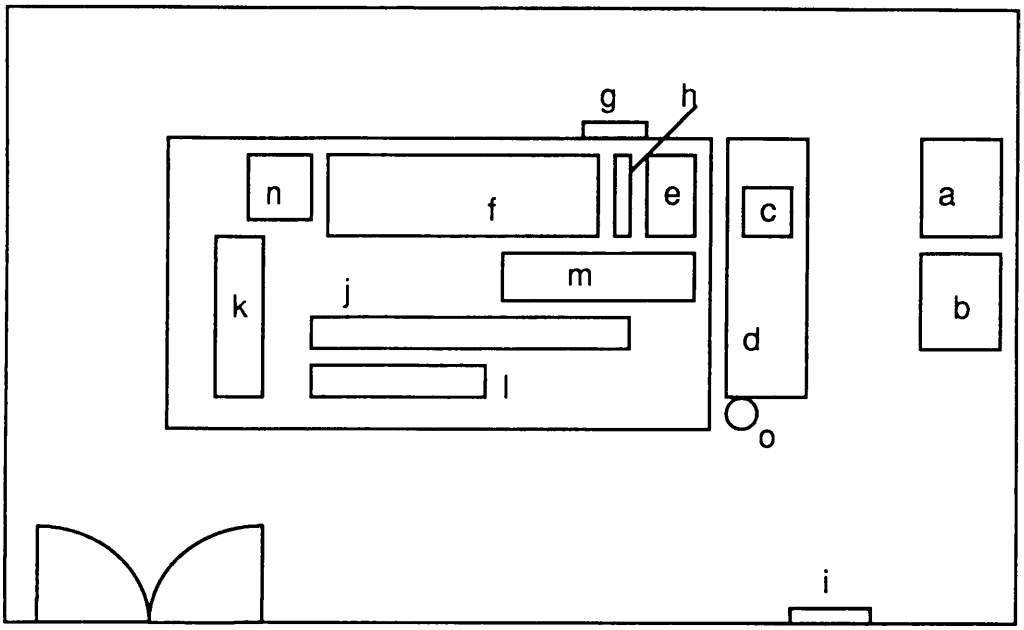
- Safety code CERN A6 and NS 8 "the two person working rule"
- Safety instruction CERN IS22 rev.1994 "rules for the safe use of lasers at CERN"
- Safety Bulletin CERN 1992-02 "Use of lasers"

In addition, all staff who are called upon to operate a laser should have attended a suitable laser safety course.

2 Operation

The CTF laser comprises many modules distributed around the Laser room, the following plan will help to locate the various elements.

The CTF Laser Room



a/ Quanta System Rack	b/ Electronics Rack	c/ Lightwave control box
d/ Controls and Monitoring shelves.	e/ Light wave Electronics laser	f/ Quanta System laser
g/ Pockles cell drivers	h/Pockels cell pulse selector	i/ water and electricity
j/ polarising beam splitter-PTG3	k/ pulse train gen.1	l/ pulse train gen.2
m/ grating pulse stretcher	n/ harmonic separation	o/ laser path to CTF

3 Switching on Procedure

3.1. The master clock for all timing is derived from the LWE laser to ensure synchronisation with the RF in the CTF. **The Lightwave is switched on with a key on the control box front panel (c.),** the start-up sequence is automatic, and takes 3 minutes. The timing is enabled even in standby mode, when there is no laser emission.

3.2. For the Quanta System (QS) laser and auxiliaries, **water and electrical power** should be switched on at **(i.)**.

3.3. **Electrical Auxiliaries are powered from the QS rack (a.)** this includes monitoring scopes warning signs and power supplies. The Power is switched with a **contact breaker marked "LINE"** at the top of the rack.

3.4. The internal QS power supplies are switched on with the **button "POWER"** on the front panel of the 4th chassis from the top.

3.5. The three flash-lamp simmering supplies are switched on with the buttons marked **"simmering" on chassis 3,4 and 5.** There is an internal warm-up delay before the amplifiers can be used.

3.6. The single pass amplifiers are switched on and off with the large green and red buttons on the top chassis in the QS rack (a.).

At least 20 minutes are required for the QS laser to stabilise, this time can be used to verify timing and operation of the LWE laser, timing and auxiliaries.

4 Check of Lightwave operation.

4.1. The display monitor on the shelving (d.) displays and controls the LWE settings, the display program is started automatically by the LWE control module, the display is recovered from its automatic screensaver (which operates after 5 minutes) by typing "S" <return> on the key board. Typical settings are shown.

Diode Current Set	1.20A
Diode Temp Set	6.7C
Diode Enable/Disable	Ena
Mode Locker Temp Set	55.7C
Cavity Length Set	+003017
Int. Ext. Set	Ext.
Piezo Drive Level	45.2V
Phase Shift Level	4.76V
Phase Detector Level	+0.24V
RF Reflected Level	1.70V
Laser power level	145 mW *see note below
Laser AC power Level	1.12V
Diode Power monitor	3.30V
Case Temp	28 C
Internal Sensed	Diode is on
Interlock on	Standby off
Diode over voltage/current	No
Screen update is	On

* Laser power level, this value is temperature dependant, possibly due to ageing of the laser diode pump source, at a case temperature of 28°C the output is 145 mW, when cooler the output may approach the nominal 160 mW.

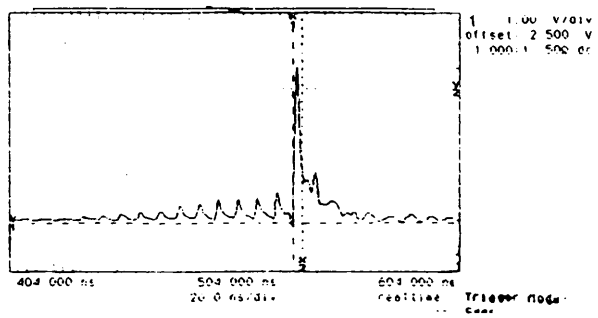
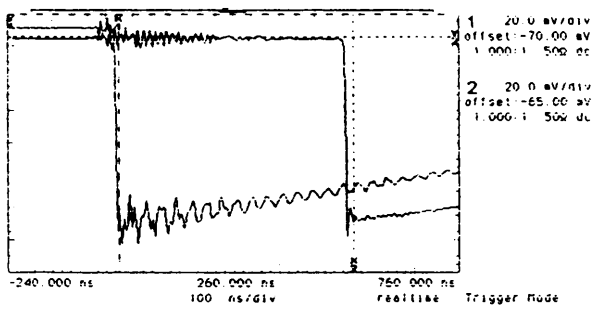
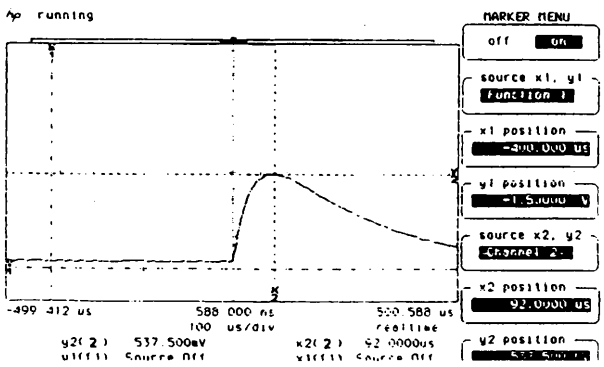
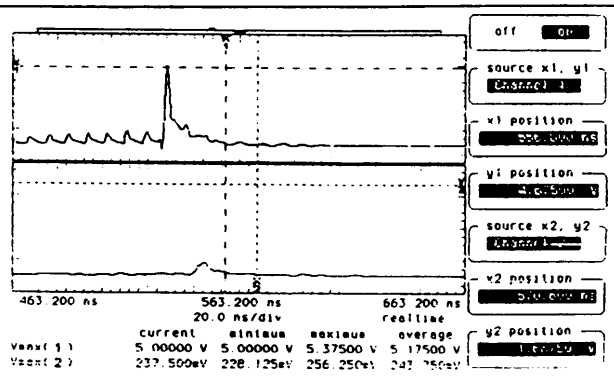
4.2. An analogue signal is monitored on a Phillips PM3233 scope, which is also on the shelving (d.) A low amplitude signal which is sensitive to noise and vibrations in the laser room shows that the LWE is in lock and operating correctly, a large amplitude signal shows that the LWE has fallen out of phase lock and a small, insensitive signal indicates that the LWE is far from its operating point.

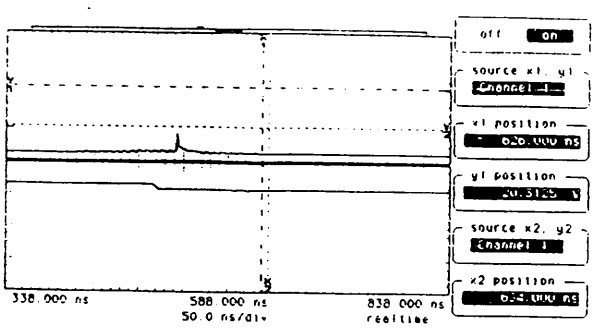
4.3. The length of the cavity which phase locks the LWE is adjusted with the large knob on the control box front panel.(c.) The nominal value is 470 ps +/- 30 ps.

4.4. There is a manual mechanical shutter on the output of the LWE laser (e.), verify that it is open.

5 Quanta Laser monitoring

5.1 Monitor signals of laser operation are displayed on a HP 54510B scope on the shelving (d.) several preset configurations are stored, these are used in conjunction with the monitoring cables patch panel- which is mounted on the side of the shelving- as the source of signals. Some configurations are rarely used, new ones may be added.

Recall setup #	Description	
1	Regenerative amplifier Signal D1 to Scope Ch. 1 single pulse mode	
2	Pockels cells operation Signal pc1 to ch1 Signal pc2 to ch2	
3	Molectron J4 joulemeter Signal joulemeter to ch2 calibration 1.2 mV/mJ	
4	Regenerative amplifier D1 to CH1: as in recall #1 D2 to CH2: detector is placed at the output of laser 4th harmonic generator	

5	Setting up timing D1 to CH1 pc2 to CH2	
6	Fast photodiode signal photodiode to CH2	100ps risetime diode, illuminated by the 523nm green light. used as trigger
7	Gentec Joulemeter	large area joulemeter
8	Geophone	used during vibration and noise investigations
9	CCD (CH1)	used to see the profile of the beam in the laser

6 Timing Control

A falco terminal dedicated to timing control is situated on the shelving (d.) the logon procedure is as follows

6.1. Power on the terminal.

6.2. Tap <return>

6.3. Type "run ctf-tim" . Typical values for timing pre-sets are shown in the "1-pulse" mode,

KX.LASERC	32755	KX.FLSHLMP1	23960	KX.FLSHLMP2	30500
KX.FLSHLMP3	29500	KX.POCKCEL1C	32754	KX.POCKCEL2C	32761
KX.POCKCEL3C	32754	KX.POCKCEL4C	32754	KX.STREAK1C	10
KX.STREAK2C	32763	KX.SPARE1C	32765	KX.SPARE2C	12
KX.SPARE3C	13	KX.SPARE4C	14	KX.LASERF	148
KX.POCKCEL1F	133	KX.POCKCEL2F	32	KX.POCKCEL3F	29
KX.POCKCEL4F	58	KX.STREAK1F	0	KX.STREAK2F	150
KX.SPARE1F	10	KX.SPARE2F	23	KX.SPARE3F	24
KX.SPARE4F	25				

6.4. The laser may be operated in a mode where **two pulses** are selected from the 250 MHz train and are amplified at the same time in the regenerative amplifier, this requires different timing for the Pockels' cells, as follows:

KX.POCKCEL1C	32755	KX.POCKCEL1F	30	Regen amp. injection
KX.POCKCEL2C	32761	KX.POCKCEL2F	30	Regen amp. extraction
KX.POCKCEL3C	32754	KX.POCKCEL3F	29	Single pulse selection
KX.POCKCEL4C	32754	KX.POCKCEL4F	58	Double pulse selection

6.5. To change between one and two pulse modes, in addition to changing the timing, the power supply for Pockels cell #3 (single pulse) is selected /deselected by a switch in rack (b.), and the two power supplies for Pockels cell #4(double pulse operation) must be switched on/off in the same rack.

7 Switching off

7.1 If shutting down overnight, **switch Lightwave to standby** (button on front panel). For longer shutdowns, switch off with the key on front panel of (c.).

7.2. **Switch off QS** laser at contact breakers, top chassis in rack (a.).

7.3. Turn off water cooling at tap (i.).