Frequency tuning and alignment of the ECDL-7920R.

The mechanical stability of the ECDL-7920R is high enough to keep the laser output in close vicinity of the particular wavelength (say atomic transition) for weeks, so that the LD current and the PZT voltage remain the only means to tune the laser precisely to this desirable wavelength. However, the degraded characteristics of the ECDL (increasing of the threshold current, output power reducing, tuning range reducing, poor side-mode suppression ratio, amplitude noise increasing) might indicate that realignment of the extended cavity is necessary.

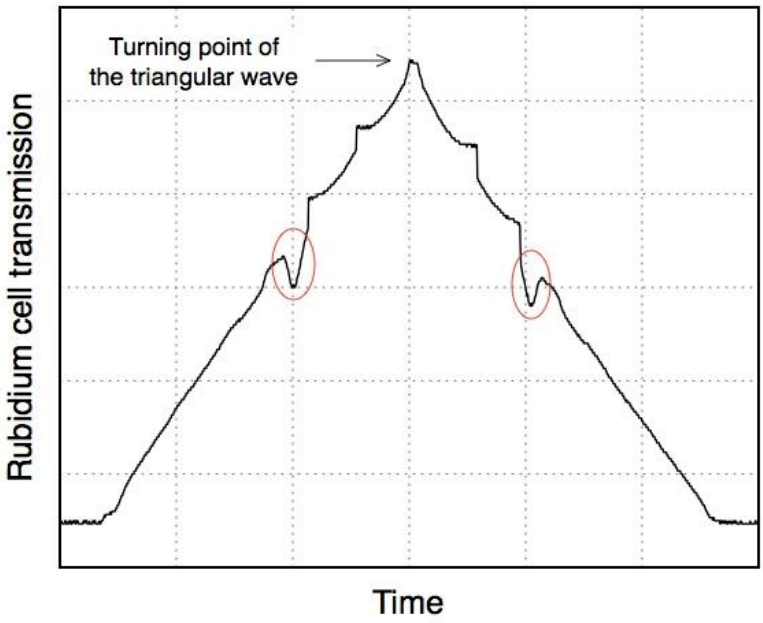

Fig.3. The dependence of the output power on the LD current. The LD current is changed by the symmetrical triangular wave. The red ellipses show the zone of the Rb absorption.

The following experimental data specify the operation of the ECDL-7920R and might serve as references for its alignment. Fig.3 shows the output power of the ECDL-7920R when the internal triangular-wave generator modulates the laser current. The clearly observed steps of the power-on-current dependence are resulted from the extended cavity mode-hops. The Rb absorption is revealed at some certain steps in Fig.3 (the regions surrounded by the red ellipses). The Rb cell is warmed up to make the absorption more evident.

The transmission of the cell containing vapor of a natural abundance of Rb at the constant current and the gradually changing PZT voltage is shown on Fig.4. The absorbtion in the Rb cell at the D1 line is very week (a few percents) at room temperature, so the cell was warmed up. Four consecutive extended-cavity mode hops are visible displaying Doppler-broadened profiles which correspond to F=3 – F'=2,3 transitions in ^{85}Rb and to F=2 – F'=1,2 transitions in ^{87}Rb.

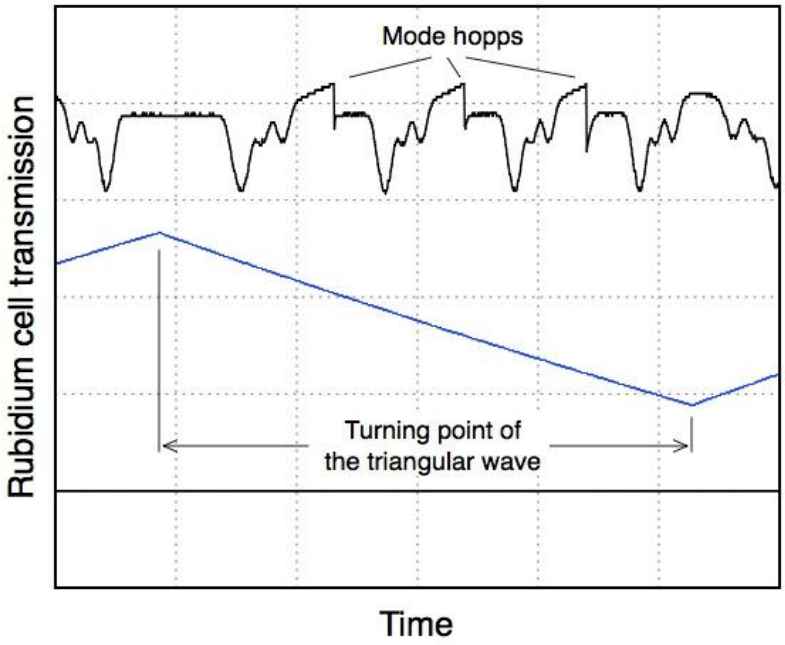

Fig.4. The transmission of the cell containing vapor of a natural abundance of Rb (^{87}Rb+^{85}Rb) on the PZT voltage sweeping. The LD current is constant. The signal driving PZT is shown in blue. The lowest curve reflects zero power level at a photo detector.

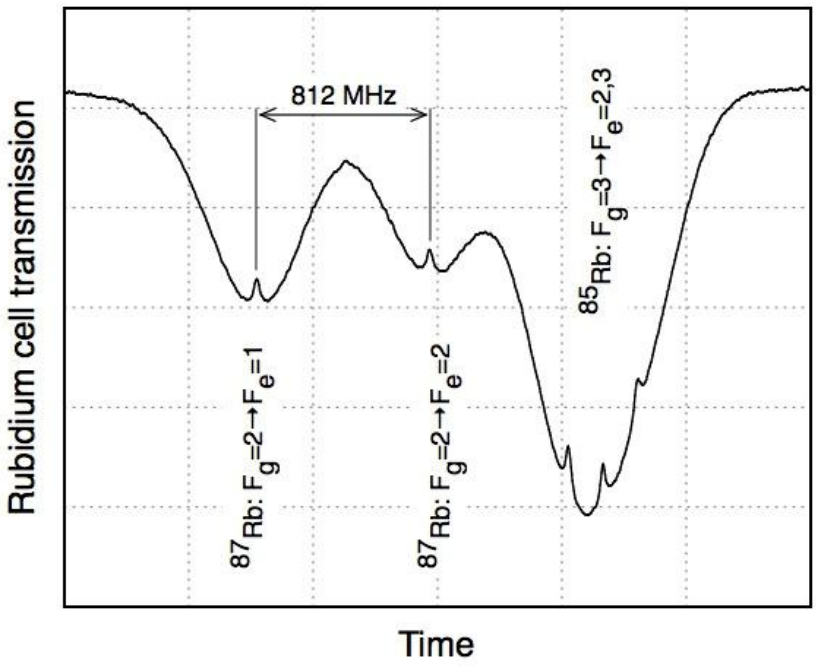

Fig.5. The transmission of the cell containing vapor of a natural abundance of Rb (^{87}Rb+^{85}Rb) at F=2 – F'=1, 2 (^{87}Rb) and F=3 – F`=2,3 (^{85}Rb) transitions. Two laser beams form the standing wave in the cell making the Doppler-free resonances visible.

The laser beam reflected from the exit window of the Rb cell together with the direct beam forms the standing wave in the cell. As a result the nonlinear resonances are

superimposed on the Doppler absorption resonances. They are observed at the small-scale tuning of the laser (Fig.5), proving the high coherence of the ECDL.

Full-scale tuning of the ECDL-7920R is achieved by the synchronous sweeping of the piezo voltage and the LD current (Fig.6). The PZT scan is set close to the maximum, while the current scan and the DC levels of the LD current and the PZT voltage are found experimentally to avoid mode-hops inside the full tuning range.

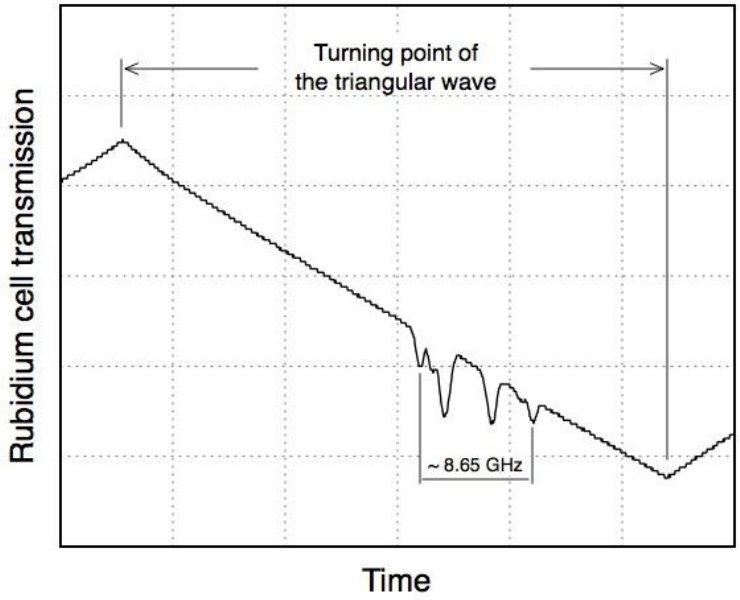

Fig.6. The transmission of the cell containing vapor of a natural abundance of Rb at the synchronous scan of the piezo and the LD current.

Follow the way below, please, if the laser realignment is necessary.

1) Insert the Γ-shaped lever into the slot of the horizontal axle of the grating.

2) Find the direction in which the lever decreases the LD threshold. Gently press the lever up and down for this.

3) The clockwise rotation of the lock screw (Fig.1, pos.4) is applied if the motion of the lever down (i.e. the laser beam reflected from the grating goes up) reduces the threshold. The counter clockwise rotation is needed at the up-level position. Use a wrench number 4 to rotate the lock screw. Typically few degree rotation of the screw is enough to restore the operation of ECDL-7920R.

4) When the minimum of the threshold current is achieved, set if necessary the operation wavelength by tuning the horizontal screw (Fig.1, pos.5) which is accessible even in fully assembled optical unit.

Common recommendations of the ECDL-7920R maintenance.

1. Do not try to change the laser beam collimation. In the case of laser diode degradation the module has to be replaced as a whole by a manufacturer.

2. Do not violate the procedures of the laser activation and disabling.

3. Do not reduce the LD temperature below the dew point. The LD temperature can be estimated using the TCR (temperature coefficient of resistance) of the thermistor: TCR = -4 %/°C.

4. Use an optical isolator to avoid unwanted reflections back into the laser.

5. Follow **the golden rule:** an ECDL as a part of an experimental setup must be switched on the last and switched off the first.

Specifications.

1. Wavelength	**794.7 nm**
@ 51, 84, 117, 149, 179 mA	
2. Output power	
@ 51 mA	4 mW
@ 84 mA	**20 mW**
@ 117 mA	36 mW
@ 149 mA	51 mW
@ 179 mA	66 mW
3. Continuos tuning range	
by PZT only	5 GHz
by PZT+LD current	40 GHz
4. Coarse tuning range	± 2 nm
5. Polarization	linear vertical
6. Beam shape	elliptical 5×1.5 mm^2
7. Threshold current	42 mA
8. Operating current (D1Rb)	**84 mA**
9. Thermistor	**13.0 kOhm**
10. Optical head dimensions	56×50×33 mm^3
11. Optical head weight	150 g
12. Electronic unit dimensions	260×210×70 mm^3
13. Electronic unit weight	2.7 kg

Tentative specifications of the common LD-objective module for ECDL-7930

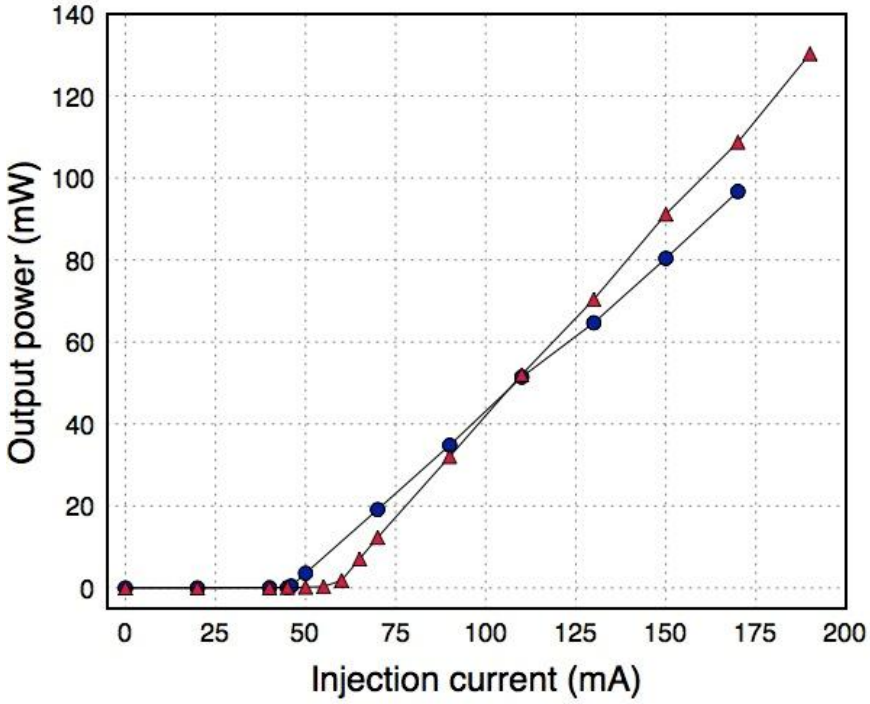

Fig.1. Power vs. current dependences of the solitary LD module (red triangles) and of the ECDL-7930 utilizing this module at D1Rb line (blue circles).

1. Parameters of ECDL used to specify the module

diffraction grating	1800 mm^{-1}
extended cavity length	50 mm
temperature	22.5°C

2. Wavelength — 794.7 nm

3. Output power of the ECDL

@ 90 mA	32 mW
@ 150 mA	91 mW

4. Polarization — linear

5. Beam shape — elliptical 5×1.5 mm^2

6. Threshold current of the ECDL

@ 806 nm	37.5 mA
@ 794.7 nm (D1Rb)	46 mA

7. Operating current (@ D1Rb) — 90 mA

8. Optical module dimensions — Ø11×12 mm