Picosecond synchronously pumped optical parametric oscillators (SOPO) offer a balance between short pulse durations and relatively narrow spectral bandwidth. SOPO allows to reach high conversion efficiency and high mean power. Featuring extremely broad tuning range it is a very attractive coherent source for many applications [1, 2]. Proper method of linewidth formation is very important for development of ps SOPOs with narrow pulse bandwidth. Narrowing of pulse bandwidth and wavelength tuning typically are performed using Lyot filters. But diffraction gratings have several advantages comparing with these [3, 4]. In this work results of investigations of two type resonators exploiting Lyot filters and diffraction grating (DG) for spectral line narrowing is presented.

A synchronously pumped LiB₃O₅ optical parametric oscillator pumped by frequency doubled picosecond Nd:YVO₄ laser was demonstrated. The power of the second harmonic 532nm radiation was 4.9 W, pump laser operated at 88.37 MHz repetition rate with nearly 8ps pulse duration. The SOPO was continuously tunable from 690nm to 990 nm. As much as 1.3 W of radiation at signal wave around 800 nm was obtained. In the first experimental run, the Lyot filters were used for SOPO tuning and spectral shaping of picosecond pulses. Using Lyot filters as much as 0.95 W output power at 800 nm wavelength was demonstrated. It was obtained that resonator with the Lyot filters was very sensitive to cavity length detuning. In process of changing the cavity length the output wavelength jumps from one wavelength to another (Fig 1(a)) [5]. During the second experimental run the narrowing of the pulse bandwidth and the wavelength tuning was performed by replacing of one of the cavity mirrors by diffraction grating with 1600 grooves/mm. In this configuration the wavelength didn’t depend on resonator length detuning. The output power was varied only when resonator length was detuned. We want to point out that pump power SOPO with diffraction grating was lower for some wavelength ranges due to damage of diffraction grating during operation at maximum power.

This was the reason why output power was limited to 0.7W using 90% output coupler. The SOPO tuning curves for Lyot filters and diffraction grating are presented in Fig 1b. For Lyot filters results presented for the pump power of 4.9 W. In the case of SOPO with diffraction grating the pump power was varied in range from 2.5 W to 4.9 W while keeping the output power at the 0.7W level.

In conclusion we demonstrated that the resonator of SOPO with Lyot filters is sensitive to detuning of the cavity length. It also have a clustering effect which occurs at the same time when the cavity length is changed. On other hand there is not the pump power limit. In the case of SOPO with diffraction grating the pump power is limited by grating damage, but it less sensitive to cavity length detuning. SOPO with diffraction grating possess reduced sensitivity to frequency pulling effects and can be used in broad spectral range from 690 to 990 nm.

References