Experimental Setup for Study of Generation of Optical Harmonics

First, consider the experimental setup for study of the generation of the second harmonic (see Fig.1). The radiation source is a pulsed solid-state laser L. The laser radiation has the following parameters:

Wavelength	1064 nm
Polarization	Linear
Pulse duration	10 ns
Repetition rate	2,5 Hz

The laser beam passes through a half-wave plate (HWP) and a polarizer (P). This allows one to vary continuously the laser beam intensity by rotating the plate. Then a small part of the radiation is channeled to the first photodetector (PD 1) by a beam splitter (BS 1). The photodetector is used to monitor the intensity of the first harmonic during the measurements. A set of neutral-density filters is placed before the first photodetector to ensure its correct operation (in the linear mode).

The main part of the laser beam is incident on a nonlinear crystal (NC 2ω) mounted on a rotary stage (RS 1). The crystal is rotated in the horizontal plane. The rotation is necessary for tuning the nonlinear crystal at the phase matching angle. The rotary stage can be rotated both manually and automatically by means of a PC controlled stepper motor. One step corresponds to a crystal rotation by $2{,}5 \cdot 10^{-5}$ rad.

A color filter (CF 1) is placed after the nonlinear crystal; the filter transmits the second harmonic radiation and absorbs the radiation of the first harmonic. Then a beam splitter (BS 2) channels a small part of the second harmonic radiation to the second photodetector (PD 2). A set of neutral-density filters (NDF 2) is placed before PD 2 to ensure the correct operation of the second photodetector.

The main part of the second harmonic radiation is directed to a power meter (PM) of laser radiation. The power meter allows one to measure power of optical radiation in a wide range of wavelengths and powers and is required for calibration of photodetectors.

Generation of the second optical harmonic in this experiment is performed by means of crystals of potassium of dihydrogen phosphate (KDP) of various length: 0,5 cm, 2,0 cm, and 4,0 cm.

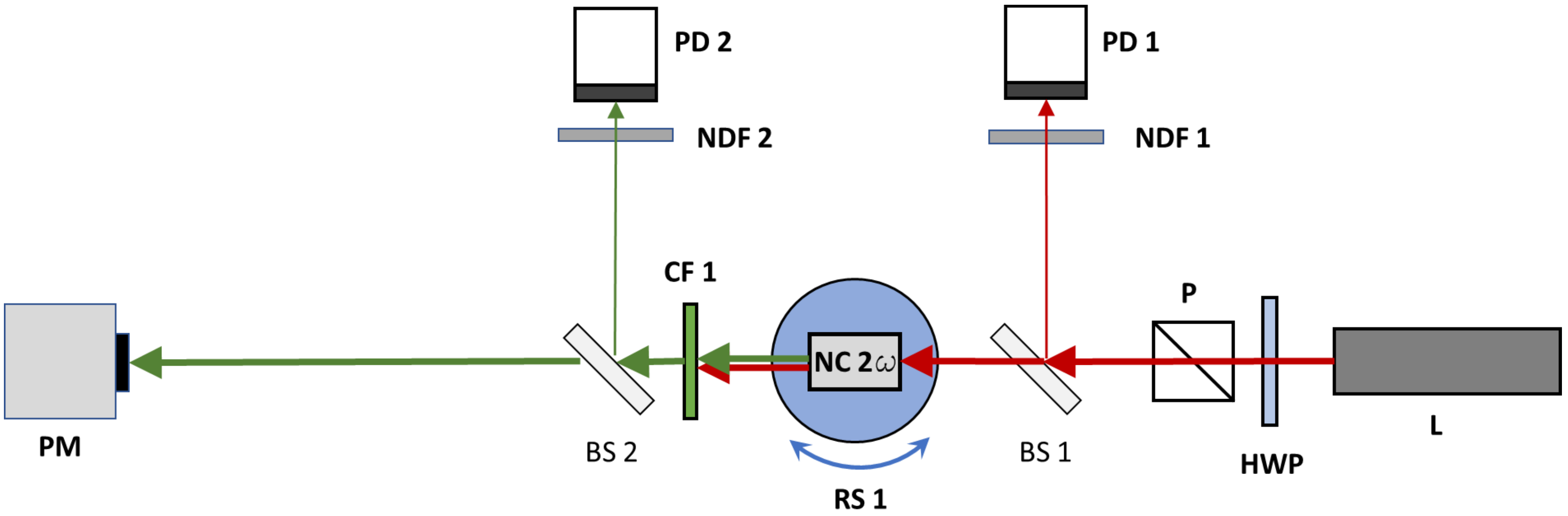

Fig. 1. Experimental setup for study of generation of the second harmonic.

Now consider the setup used for study of the cascade generation of the third harmonic (see Fig.2).

The cascade generation of the third harmonic requires radiation of the first and the second harmonics. To this end, the color filter (CF 1) is relocated to a position before the second photodetector (PD 2). This allows one to keep the level of radiation power entering the second photodetector.

After passing through the first nonlinear crystal (NC 2ω), the radiation of the first and the second harmonics enters the second nonlinear crystal (NC 3ω). In this crystal a wave of the sum of frequencies of the first and the second harmonics is being generated, so the radiation of the third harmonic exits the crystal as a result. This nonlinear crystal is also mounted on a rotary stage (RS 2) which enables tuning to the phase matching angle. For this crystal the tuning to the phase matching angle occurs in the vertical plane.

A color filter (CF 2) is installed next, it transmits the radiation of the third harmonic and absorbs radiation of the first and the second harmonics. Then a beam splitter (BS 3) follows which channels a small part of the third harmonic radiation to the third photodetector (PD 3). A set of neutral-density filters (NDF 3) is placed before the third photodetector to ensure its correct operation.

Generation of the sum of frequencies is performed by a KDP crystal 4 cm long and cut in a certain way.

A PC is used to register the signals of the photodetectors and to control the rotary stage (RS 1).

All three photodetectors have been preliminarily calibrated to measure power of the corresponding wavelength.

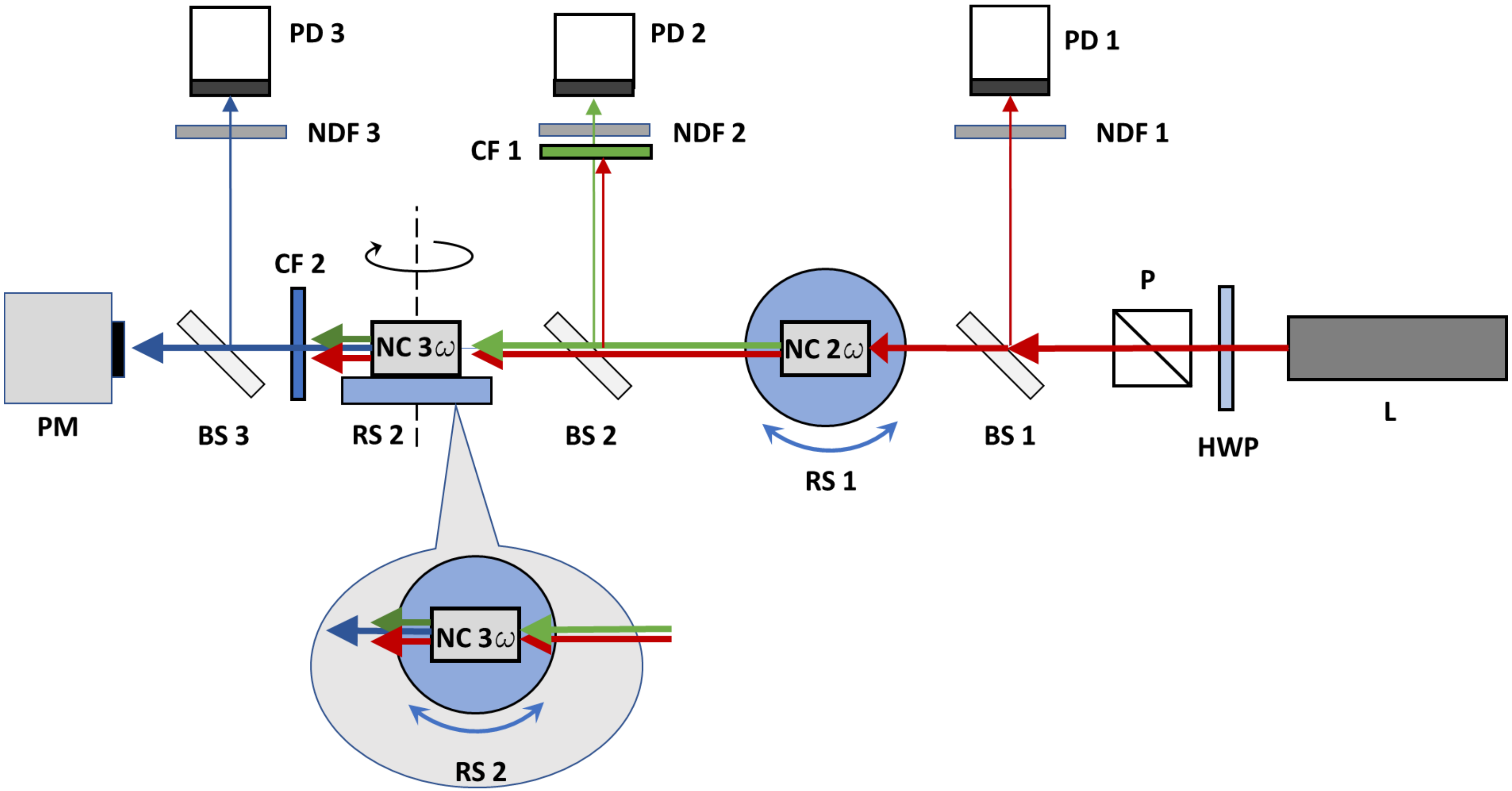

Fig. 2. Experimental setup for study of cascade generation of the third harmonic.