



# OZ Optics

shop.ozoptics.com  
www.ozoptics.com



**Elliot Scientific Ltd**  
Unit 11 Sandridge Park,  
Porters Wood, St Albans,  
AL3 6PH, United Kingdom  
Tel: +44 (0)1582 766300  
Fax: +44 (0)1582 766340  
www.elliotscientific.com  
sales@elliotscientific.com

## BRIGHT POLARIZATION-ENTANGLED PHOTON SOURCE NARROWBAND TELECOM

### Features

- Highest counts/coincidence rate available in the market
- High Heralding efficiency and excellent fidelity
- Turn-key, highly stable, room temperature operation
- Rugged, alignment free, proprietary design
- Built-in noise-suppression filters
- Built-in stable pump laser with variable attenuator
- Customizable

### Applications

- Quantum key distribution
- Quantum computing and information processing
- Quantum LIDAR
- Subsystem integrable for quantum communication
- High-dimensional quantum information processing
- Polarization and frequency superdense teleportation



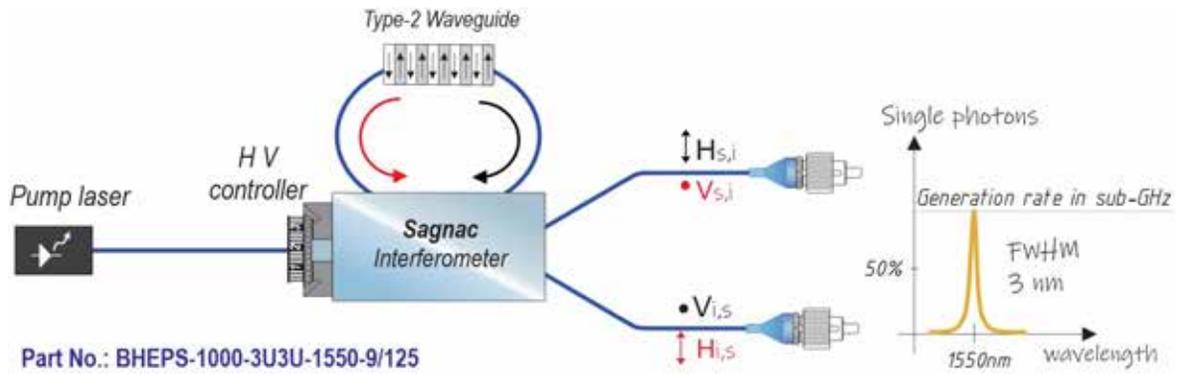
Bright entangled photon source with a built-in pump laser

### Product Description

OZ Optics' bright entangled photon sources capitalize on the high optical confinement within a periodically poled nonlinear waveguide (PPNW) to achieve excellent efficiency and abundant photon pairs. Photons are generated via spontaneous parametric down-conversion (SPDC) within a periodically poled lithium niobate (PPLN) type-2 waveguide, placed within a fiber-based Sagnac loop. The PPNW is thermally stabilized to maintain the ideal phase matching condition. Upon creating the photon pairs, the pump photons and associated fluorescence noise are completely filtered out from the remaining pairs via a built-in set of optical filters.

The highly stable performance is achieved through the self-compensation effect of an all-in-fiber Sagnac interferometer. This is combined with a single frequency external cavity laser operating at 775 nm with an ultra-narrow linewidth. As a result bright, high-performance and low-noise entangled photon sources operating at room temperature are realized. The polarization-entangled photon pairs are generated within a narrow spectral bandwidth of a few nanometers in the C Band, centered at 1550 nm.

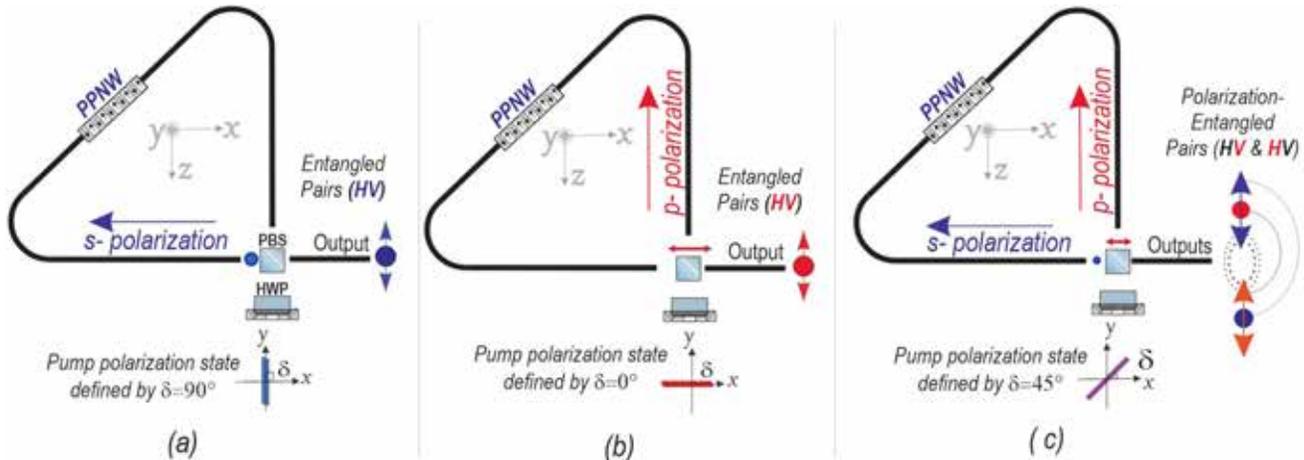
The standard bright source, shown in Figure 1 generates photon pairs that are entangled in polarization and frequency at the same time. The photon pairs are directed into two output ports via a polarizing beam splitter (PBS) forming the Sagnac loop without introducing any additional loss, as shown in Figure 2. In addition, a built-in variable optical attenuator is added to control the pump power and hence the accidental photons and the counts noise floor. A rotatable half-wave plate (HWP) is integrated to control the number of the photon pairs generated in each of the two interferometric paths (see Figure 2). Consequently, the polarization reference bases can be set while the entanglement is switched between the polarization and energy domains. This feature is expected to support the quantum optics community around the world.



**Figure 1.** Schematic of a standard narrowband bright polarization-entangled photon source implementing a type-2 waveguide with two output ports. High heralding efficiency is achieved as the photon pairs are separated upon exiting the Sagnac loop without using a wavelength splitter.

### Operation Principle

The pump photons are linearly polarized. Their polarization state is controlled via a rotatable HWP. As shown in Figure 2, the polarization state of the pump photons in  $xy$ -plane is defined by the angle,  $\delta$ , while the beam enters the polarizing beam splitter (PBS) in the negative  $z$  direction. The beam is then split to  $p$ -polarization component along  $x$ -axis and  $s$ -polarization component along  $y$ -axis and the ratio is controlled via  $\delta$ . Both polarization components are coupled to the slow axes of the PM fiber that forms the Sagnac loop. By controlling  $\delta$  through the HWP, the user can correlate the lab frame with the polarization bases of the photon pairs at  $0^\circ$  and  $90^\circ$  as shown in Figure 2(a) and (b), respectively. The optimum polarization entanglement is achieved at  $45^\circ$ , shown in Figure 2(c).



**Figure 2.** Illustration of the of photon pairs state as a function of the polarization state of a linearly polarized pump laser passing the PBS when deploying a type-2 SPDC PPNW in the Sagnac loop.



**Elliot Scientific Ltd**  
 Unit 11 Sandridge Park,  
 Porters Wood, St Albans,  
 AL3 6PH, United Kingdom  
 Tel: +44 (0)1582 766300  
 Fax: +44 (0)1582 766340  
 www.elliotscientific.com  
 sales@elliotscientific.com

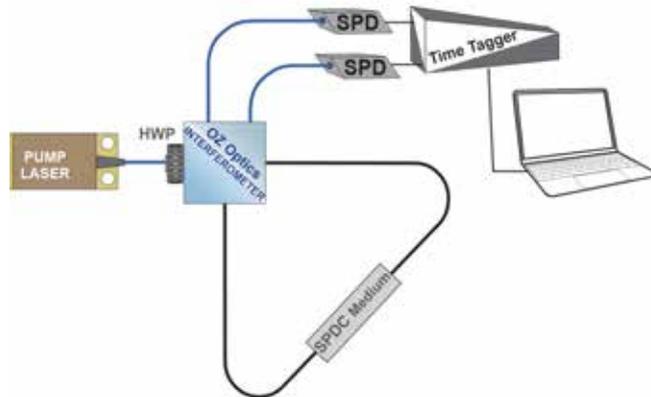
## Performance Specifications<sup>1</sup>

Part number: BHEPS-1000-3U3U-1550-9/125				
Parameter	Max.	Typical	Min.	Unit
Signal/Idler degeneracy wavelength <sup>2</sup>	–	1550 ±0.7 <sup>2</sup>	–	nm
Photon Pairs bandwidth FWHM <sup>3</sup>	–	3	–	nm
Noise suppression	–	>75	–	dB
Pair-generation rate <sup>4</sup>	–	>2x10 <sup>6</sup>	1x10 <sup>6</sup>	Pairs/second
Fidelity <sup>5</sup>	–	>98%	–	
Bell type visibility	–	>98%	94%	
Variable output power of Pump laser	12	variable	0	mW
Physical Dimensions	Width x depth x height (cm)	39 x 34.4 x 8.6		
	Weight (kg)	~4		
	Front panel color	Navy Blue		

**Note:**

- Under continuous-wave (CW) operation.
- Can be customized for high volume orders.
- This bandwidth refers to 3-dB spectral brightness.
- Measured at low power level in mW regime.
- Limited by detector dark counts.

## Optical Specifications

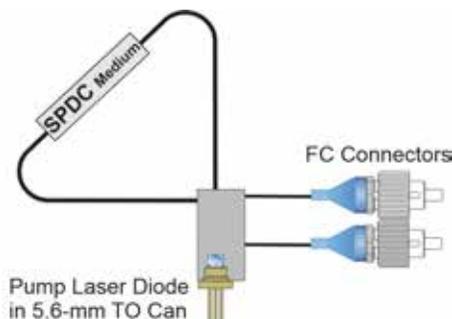


**Figure 3.** Test setup demonstration of the type-2 bright polarization-entangled photon source with about 3 nm spectral bandwidth

## Customized sources

Robust, alignment-free and miniature sources can be customized upon request to meet the industrial standards for system integration purposes. For example, a miniature version can be constructed within a compact block based on a proprietary interferometric scheme as shown in Figure 4.

**Please contact OZ optics to get a customized part number.**



**Figure 4.** Schematic diagram showing a miniature bright polarization-entangled photon source. All of the parts including the wavelength splitter, electro-optical birefringent crystal and pump laser diode are integrated into a compact housing.

## Operating and Storage Conditions

Parameter	Min.	Max.
Preferred operating temperature 15°C 25°C	15°C	25°C
Operating relative humidity (% RH)	5	60
Storage temperature	0°C	40°C
Storage relative humidity (% RH)	0	90

## Part Numbers

As illustrated in Figure 1 the standard source includes a pump laser, wavelength splitter, accessible HWP, accessible attenuator and controllable optical switch.

## Narrowband Telecom Bright Polarization-Entangled Photon Sources

***BHEPS-1000-XY-W-F***

**XY**: 3A = FC/APC  
3S = FC/SPC  
3U = FC/UPC

**F** = 9/125 single mode

**W** = Specify in nanometers  
1550: 1550 nm

Example: BHEPS-1000-3U3U-1550-9/125



**Elliot Scientific Ltd**  
Unit 11 Sandridge Park,  
Porters Wood, St Albans,  
AL3 6PH, United Kingdom  
Tel: +44 (0)1582 766300  
Fax: +44 (0)1582 766340  
www.elliotscientific.com  
sales@elliotscientific.com