Introduction

In the age of measurement-device-independent quantum key distribution (MDI QKD) and twin-field QKD (TF QKD), the source units of these QKD schemes may become a new " Achilles heel" of the whole system because an adversary, Eve, can inject lasers to conduct various attacks on the sources, i.e., the laser damage attack, Trojan-horse attack, and the laser seeding attack [1-6]. To protect laser injection attacks, we investigate the effectiveness of several possible countermeasures, which includes isolators, circulators and integrated components in the chip.

Experiment

Passive fiber components

After illumination

Circulators

InP QKD transmitter chip


Results

<table>
<thead>
<tr>
<th>Isolators</th>
<th>Circulators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polarization sensitivity</td>
<td>Temperature (°C)</td>
</tr>
<tr>
<td>sensitive</td>
<td>2</td>
</tr>
<tr>
<td>insensitive</td>
<td>3</td>
</tr>
<tr>
<td>Power monitor</td>
<td>Insertion loss (dB)</td>
</tr>
<tr>
<td>Minimum isolation,</td>
<td>Power</td>
</tr>
<tr>
<td>from port 3 to 1</td>
<td>from port 3 to 1</td>
</tr>
<tr>
<td>forever</td>
<td>1</td>
</tr>
<tr>
<td>permanent</td>
<td>insensitive</td>
</tr>
</tbody>
</table>

Conclusion

The experimental results show that the tested components may be a good passive countermeasure against all the known attacks that rely on light injection into the QKD source (laser-damage, Trojan-horse, and laser-seeding). However, we caution that these good candidates should be further tested in a pulsed regime and at different wavelengths, to ensure their reliability as the protection. The possibility for Eve to affect the internal components in the photonic chip in these other regimes should also be checked.

References