Generating and teleporting entanglement for quantum networks

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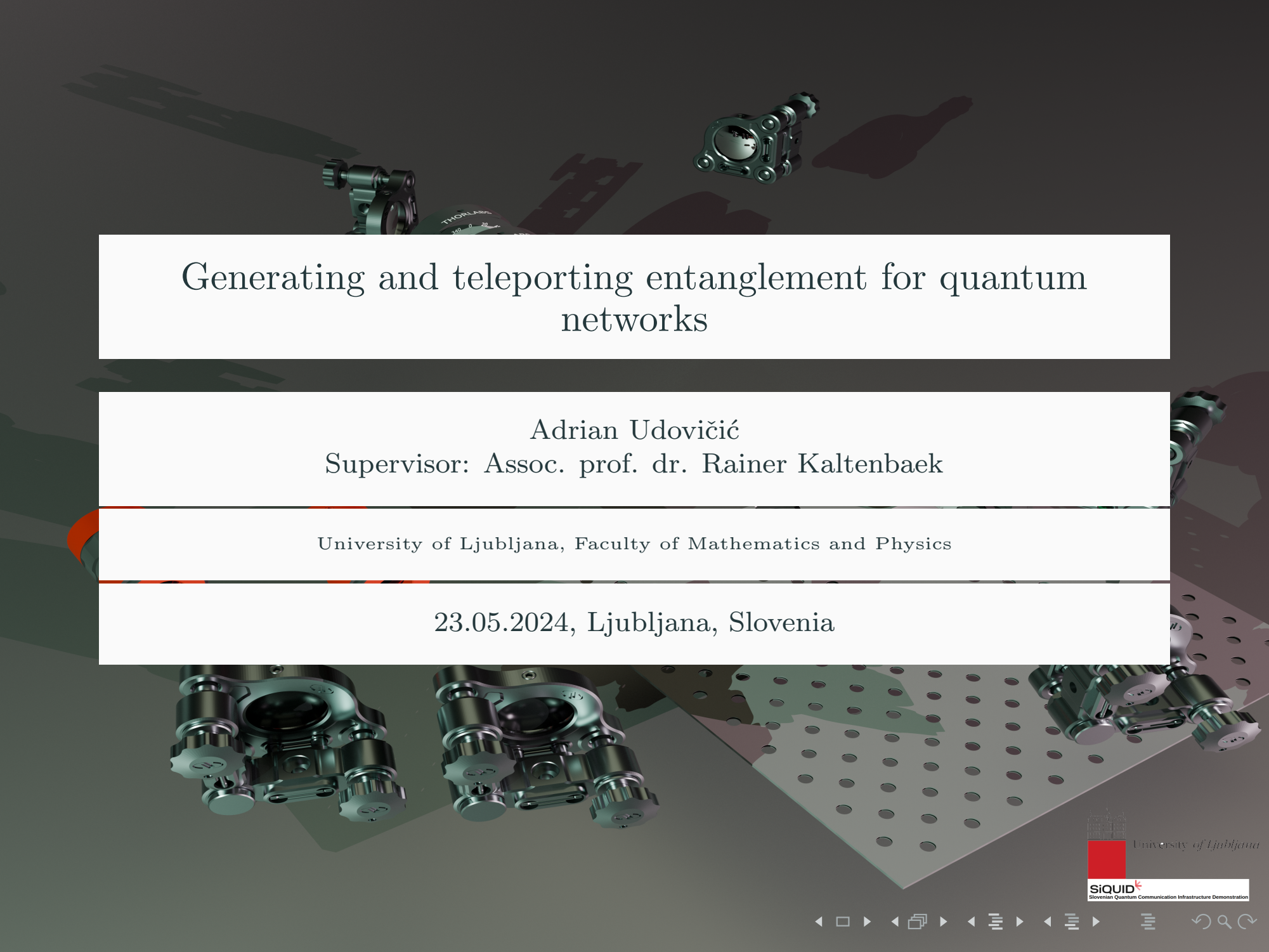

Contents

Introduction

Motivation

- SiQUID
- Very bright source of entanglement can supply many nodes
- Training in quantum technologies in Slovenia
- Quantum Interent for Slovenia
- Testbed for industriallized version
- Beyond Semiconductor
  - Might also be able to connect multiple nodes with the same source

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Theory

1. SPDC
2. Entanglement swapping

- Spontaneous Parametric Downconversion

- Spontaneous Parametric Downconversion

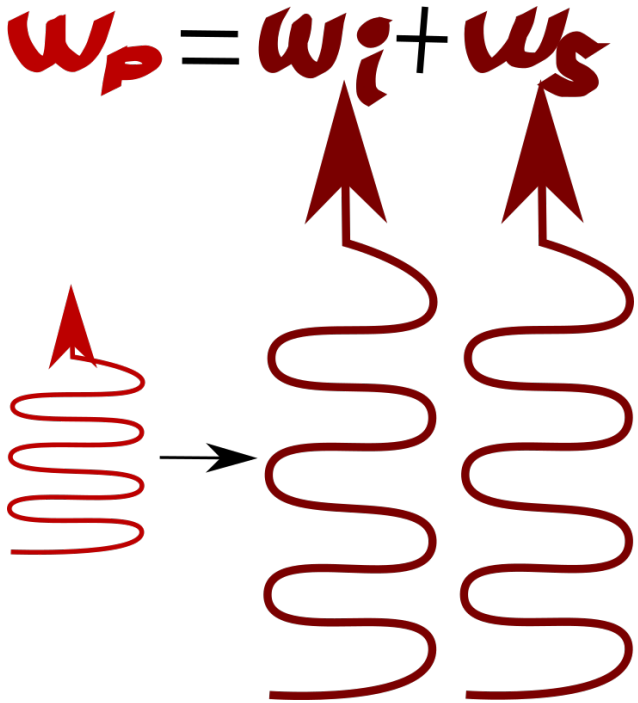

Figure: Illustration of SPDC

- Spontaneous Parametric Downconversion

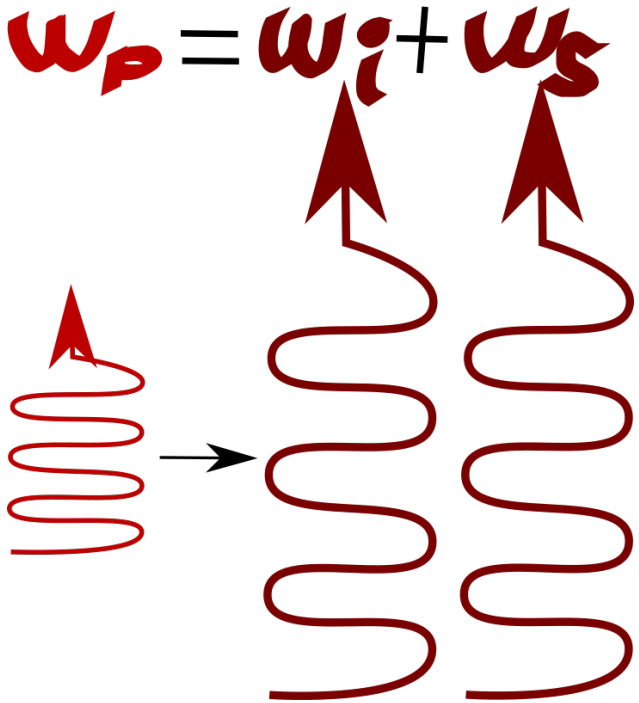

Figure: Illustration of SPDC

- Asymmetric (non-degenerate)
- State of the art
- Different designs

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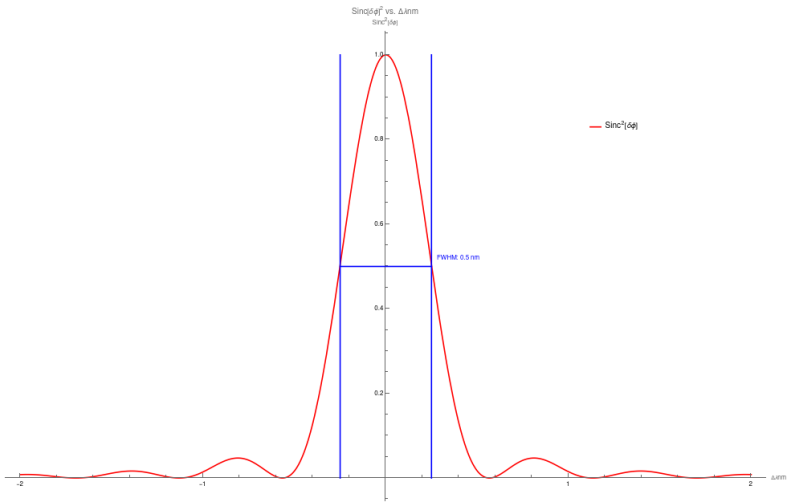
- Phase Matching, Quasi Phase Matching

$$f(\mathrm{T},\mathrm{T0}){=}(T-\mathrm{T0})(T+\mathrm{T0}+546.3) \tag{1}$$

$$\mathrm{nS}(\mathrm{a},\mathrm{b},\mathrm{T},\lambda){=}\sqrt{a_1+\mathrm{f}\cdot b_1\frac{a_2+\mathrm{f}\cdot b_2}{\lambda^2-(a_3+\mathrm{f}\cdot b_3)^2}+\frac{a_4+\mathrm{f}\cdot b_4}{\lambda^2-a_5^2}-a_6\lambda^2]} \tag{2}$$

- Focusing parameters, Heralding,...
- Brightness
- Bandwidth

Figure: Wavelength bandwidth of a) Type-2 crystal with a polling period of 9,12 um Type-0 crystals with polling periods of b) 19,25 um

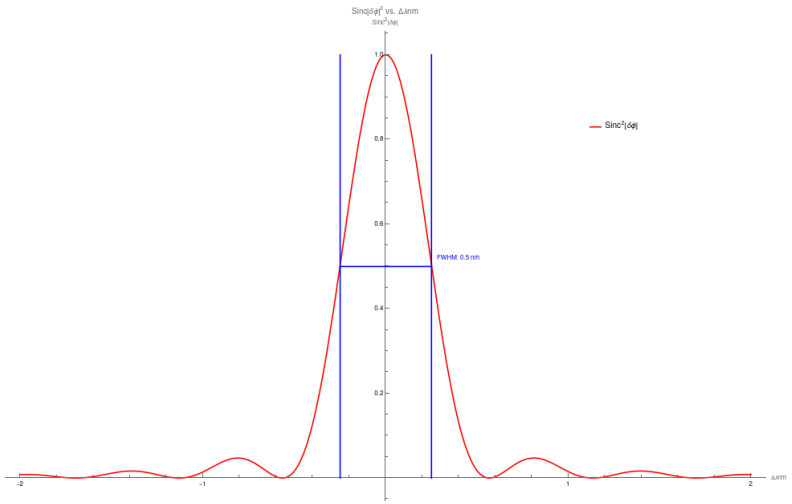


(a)

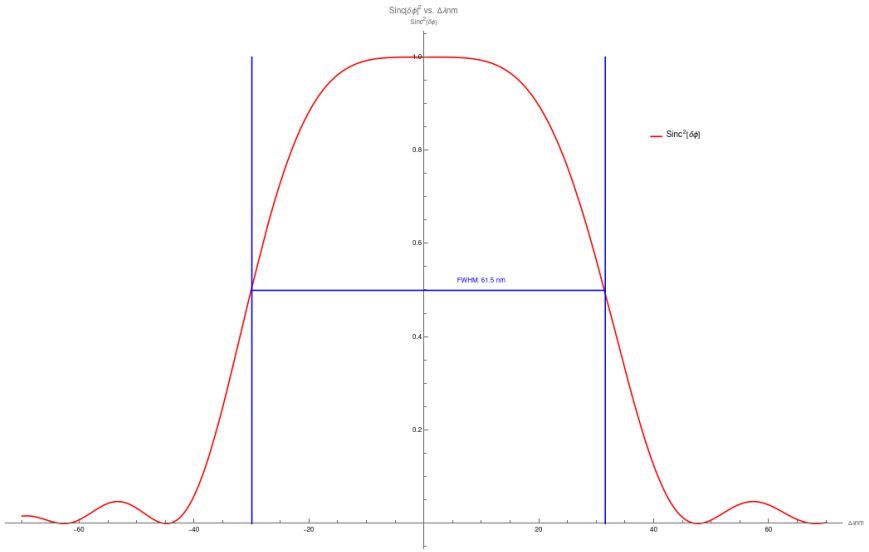
Type-II vs Type-0

Bandwidth

Figure: Wavelength bandwidth of a) Type-2 crystal with a polling period of 9,12 um Type-0 crystals with polling periods of b) 19,25 um



(a)



(b)

Table: Brightness comparison

$Hz/mW/nm$

FMF		**IJS**
Type-II	**Type-0**	**Type-II**
$7{,}8\times10^6$	$2{,}6\times10^7$	$0{,}5\times10^6$

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Dead-time dependency

Fiorentino Expected efficiency

Entanglement swapping

- FMF/IJS
- Quantum Repeaters
  1. Quantum Memory - wrong wl for now, have to figure out

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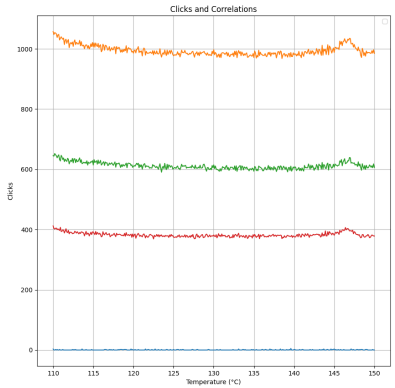
Present state

Building a linear test setup

Figure: Temperature scans of Type-0 crystals with different polling periods, a) misaligned, b) 19,25 μm, c) 19,45 μm, d) 19,65 μm



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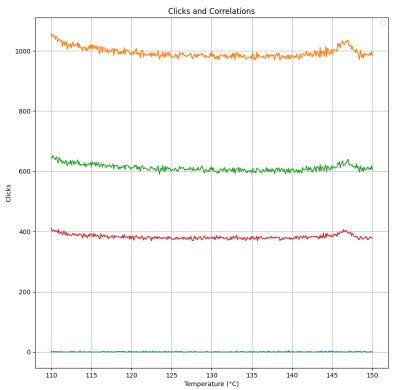

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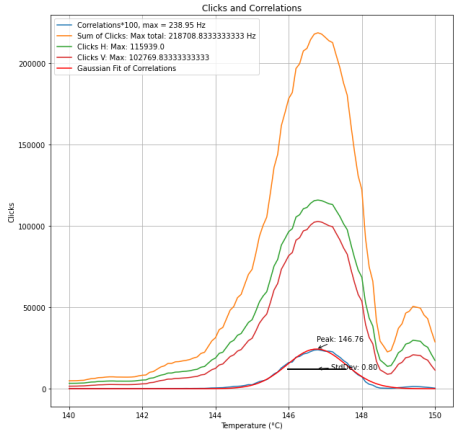
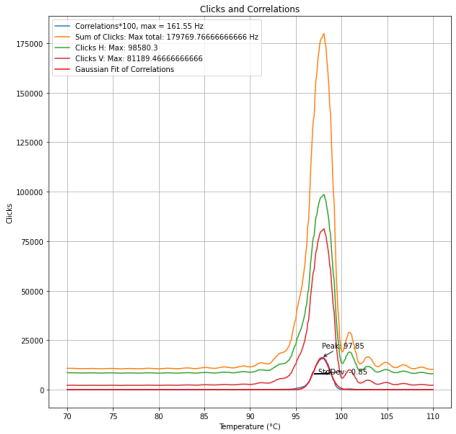
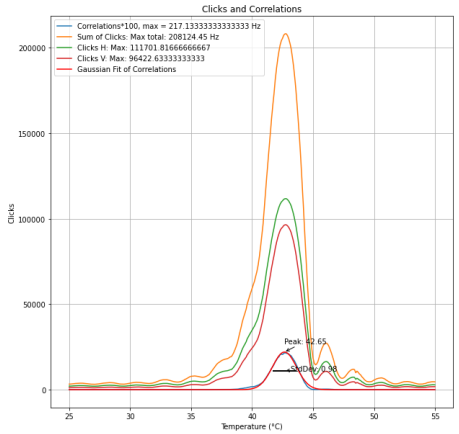


(b)



(c)



(d)

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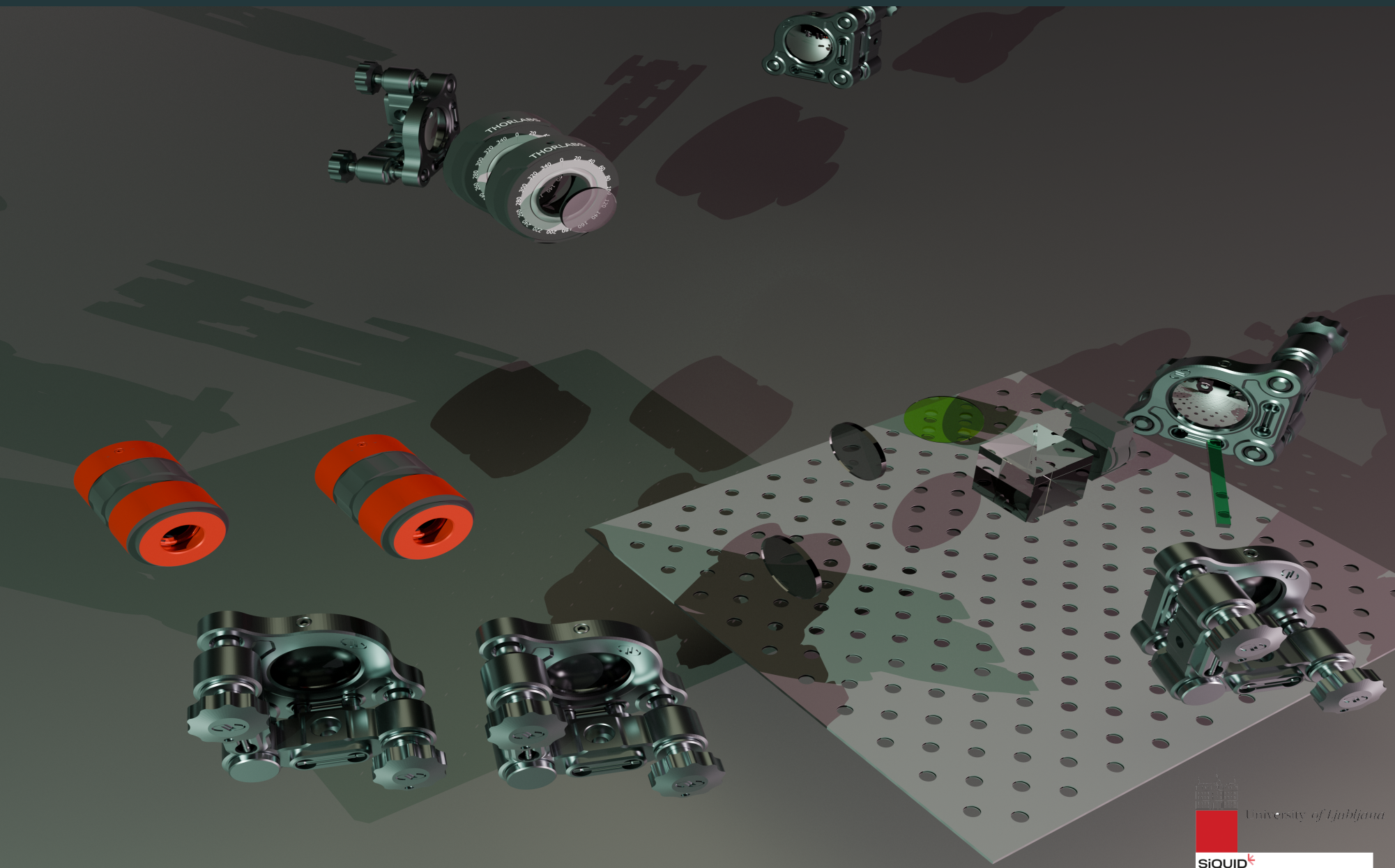
Present state

Building a Sagnac Interferometer



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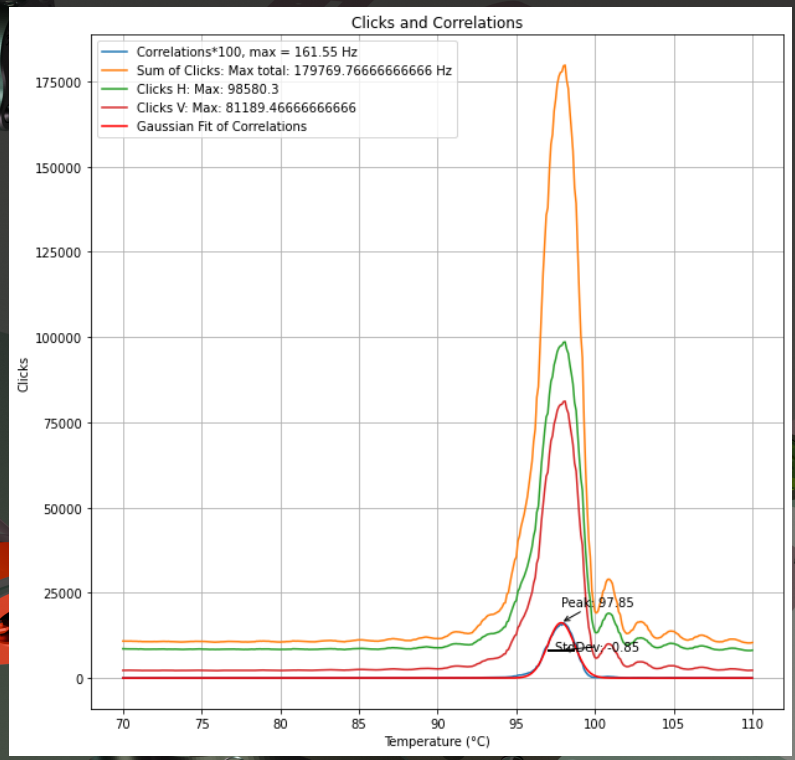
Present state

Building a Sagnac Interferometer



(a)

Figure: 3D design of the Sagnac interferometer

Outlook

- SiQUID
- Entanglement swapping between FMF and IJS
- Building quantum internet

Conclusion

Testing, calculating various properties of the system, limitations,

Thank you

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