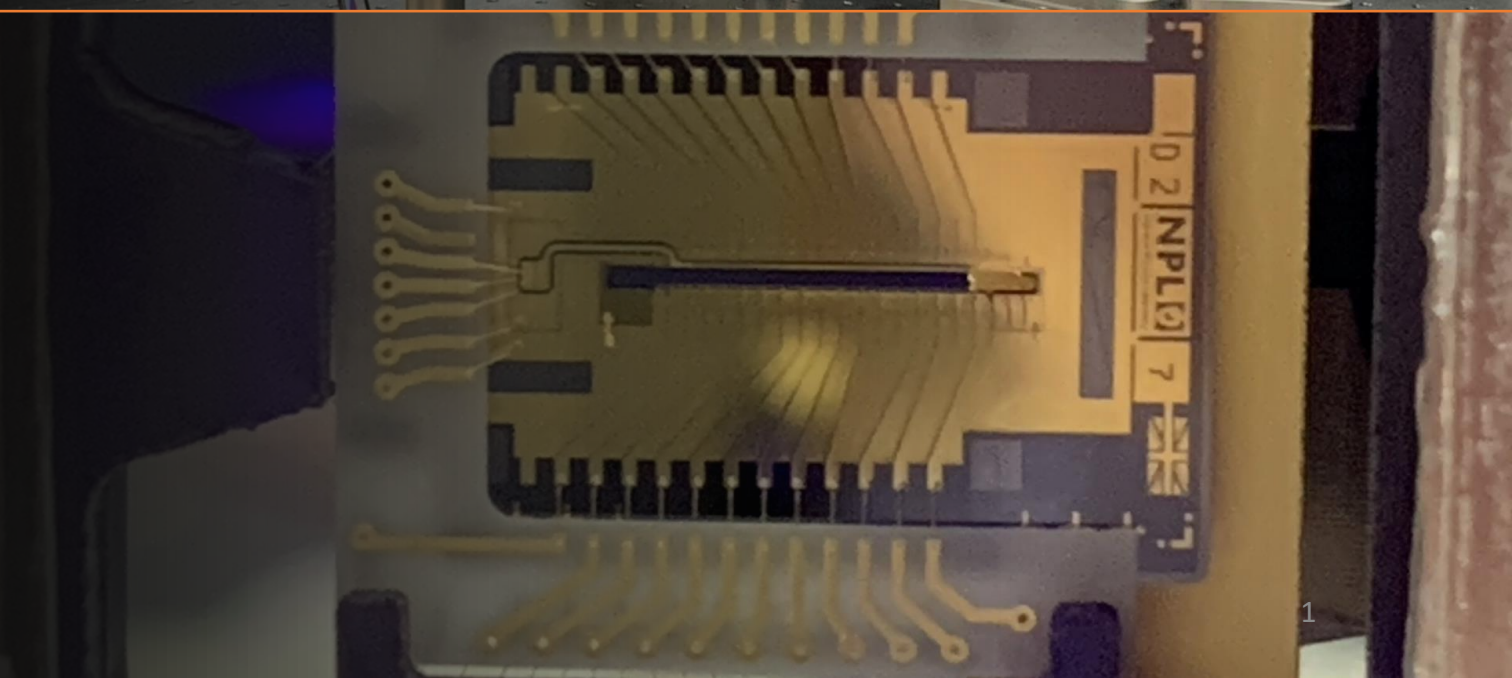
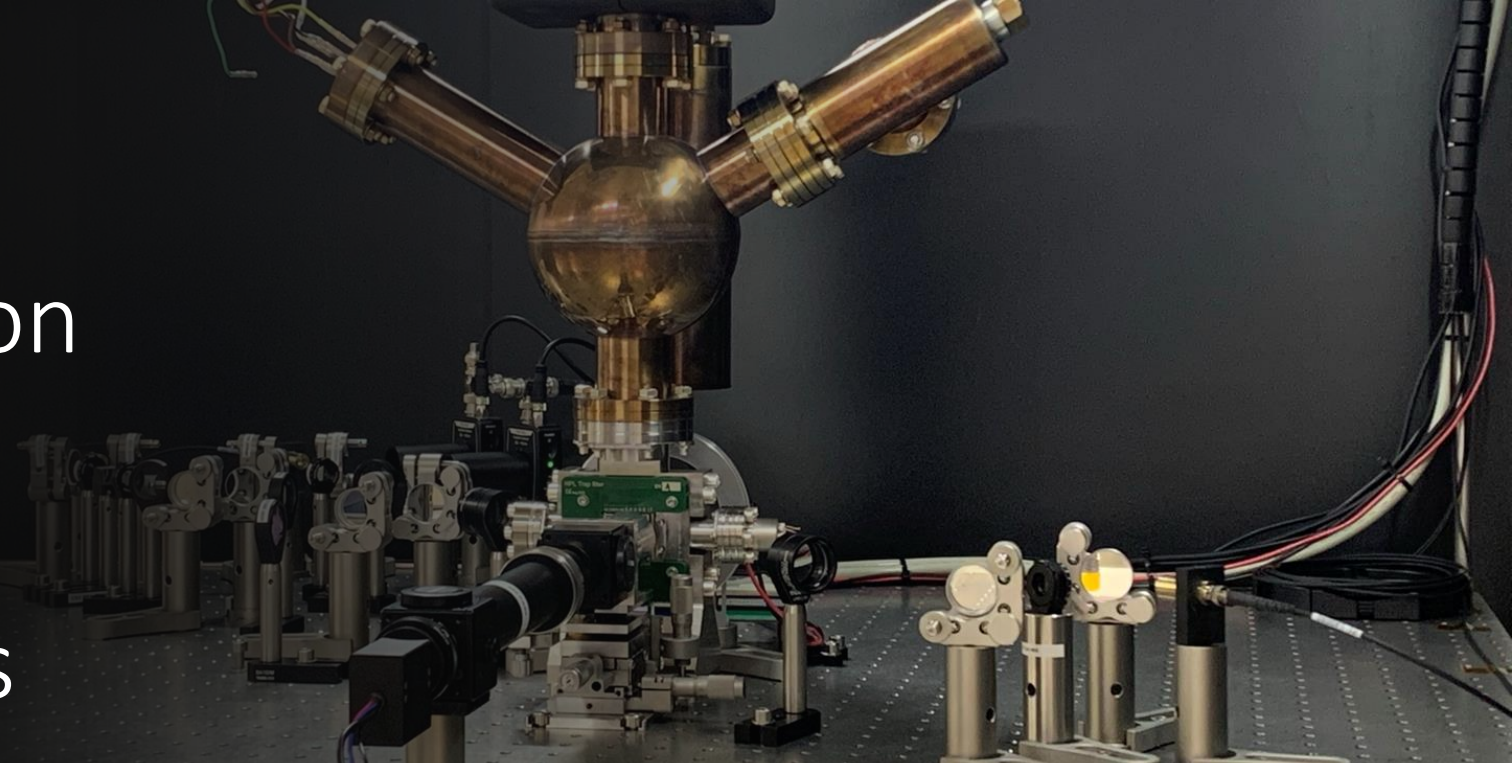
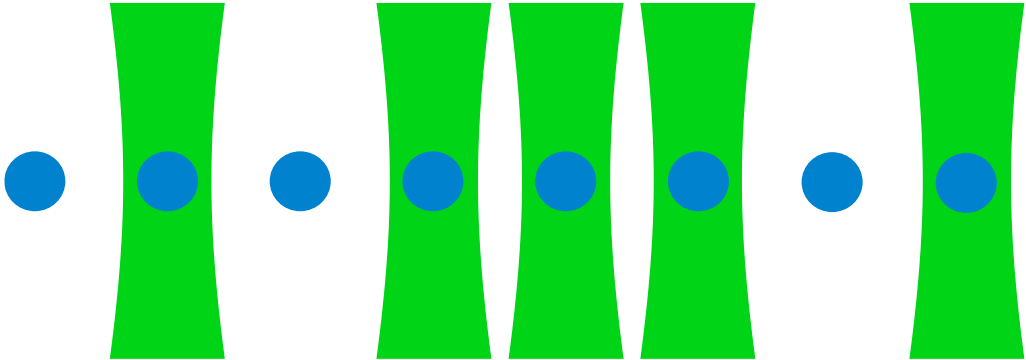


Quantum information processing with metastable states in trapped barium ions

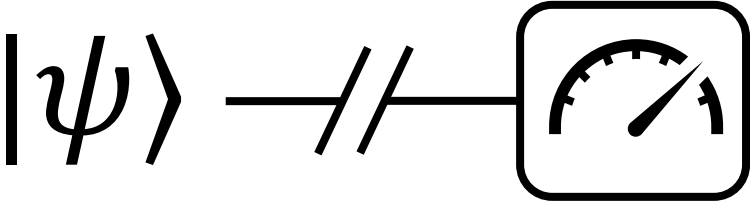
Andres Vazquez-Brennan
10.07.2024



Individual addressing



SPAM

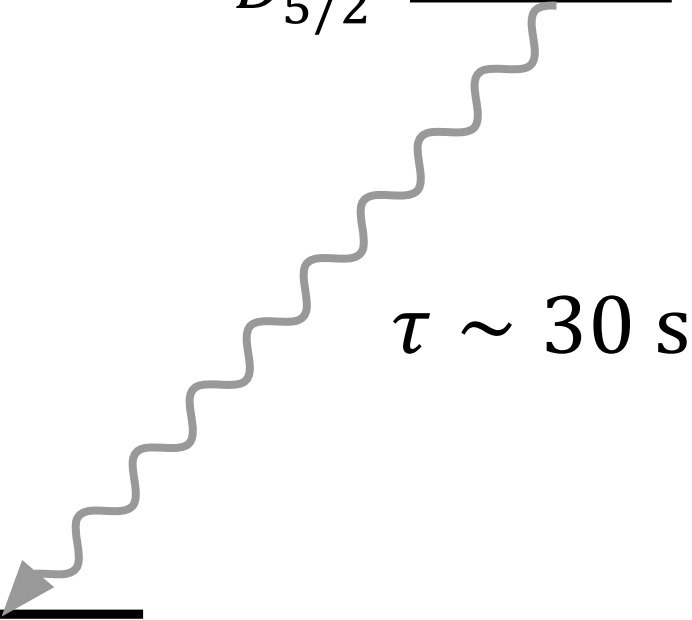


Ground

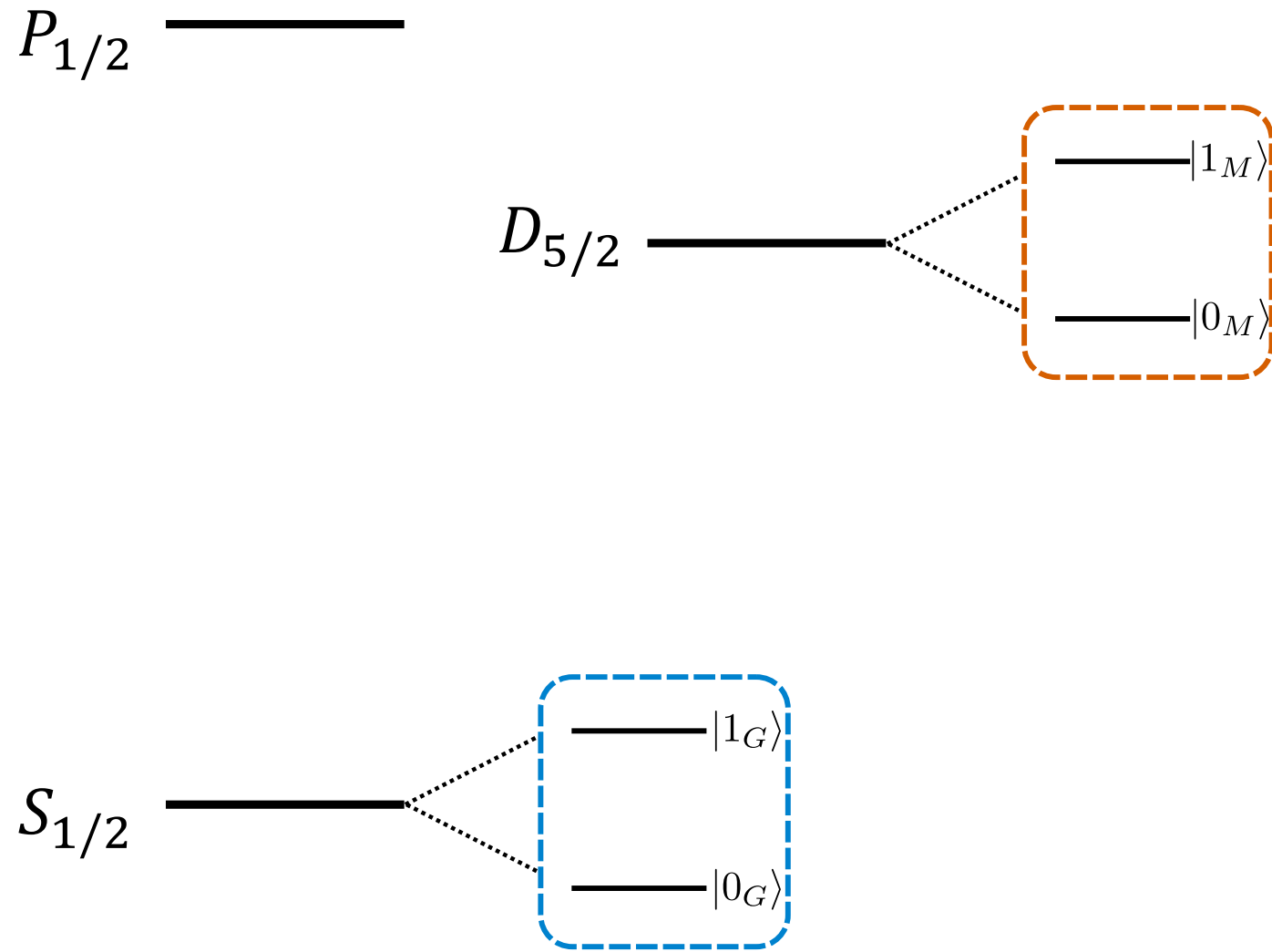
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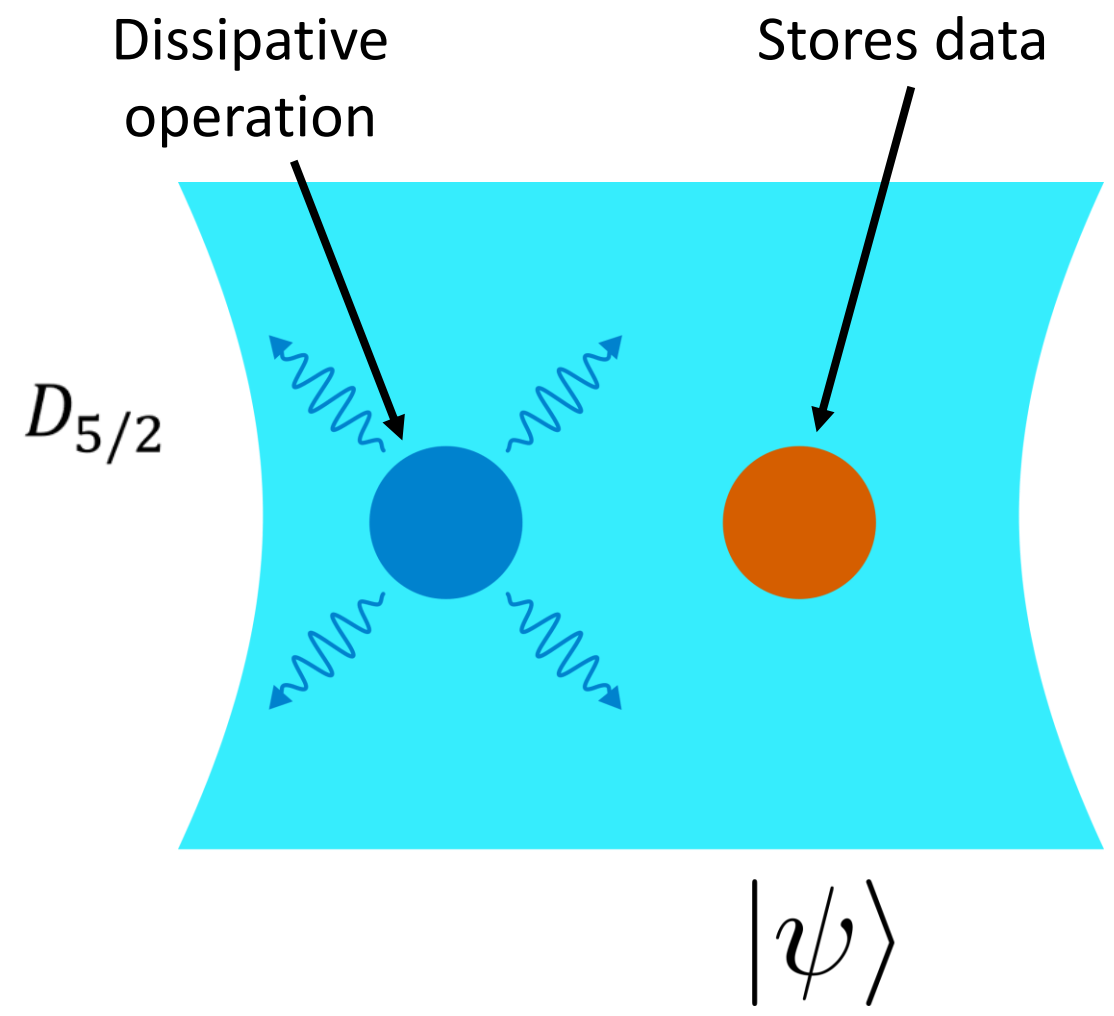
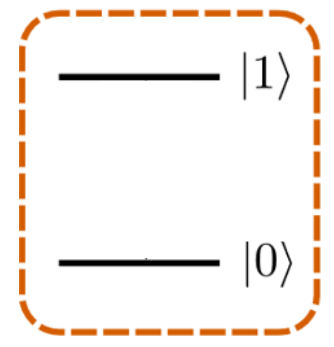
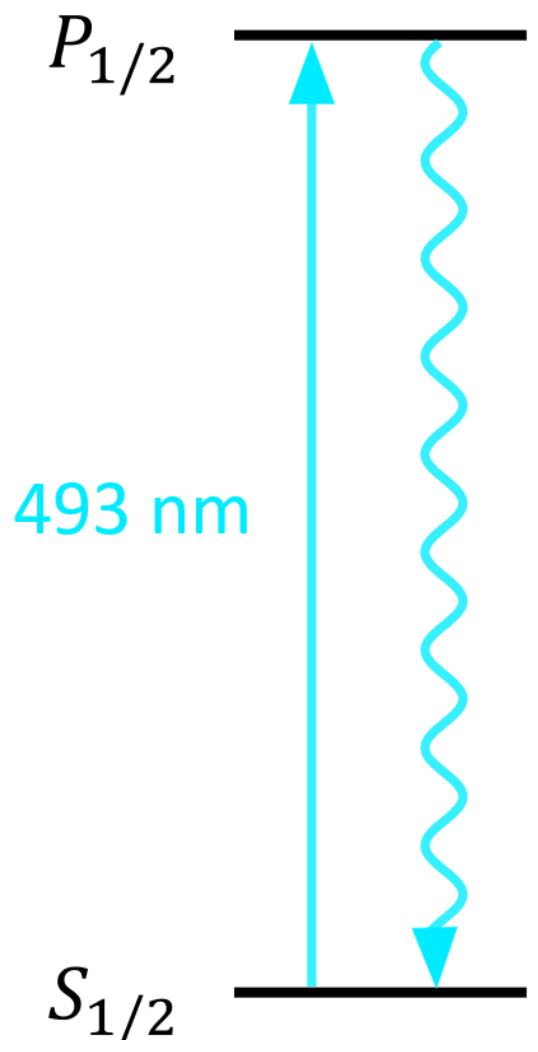
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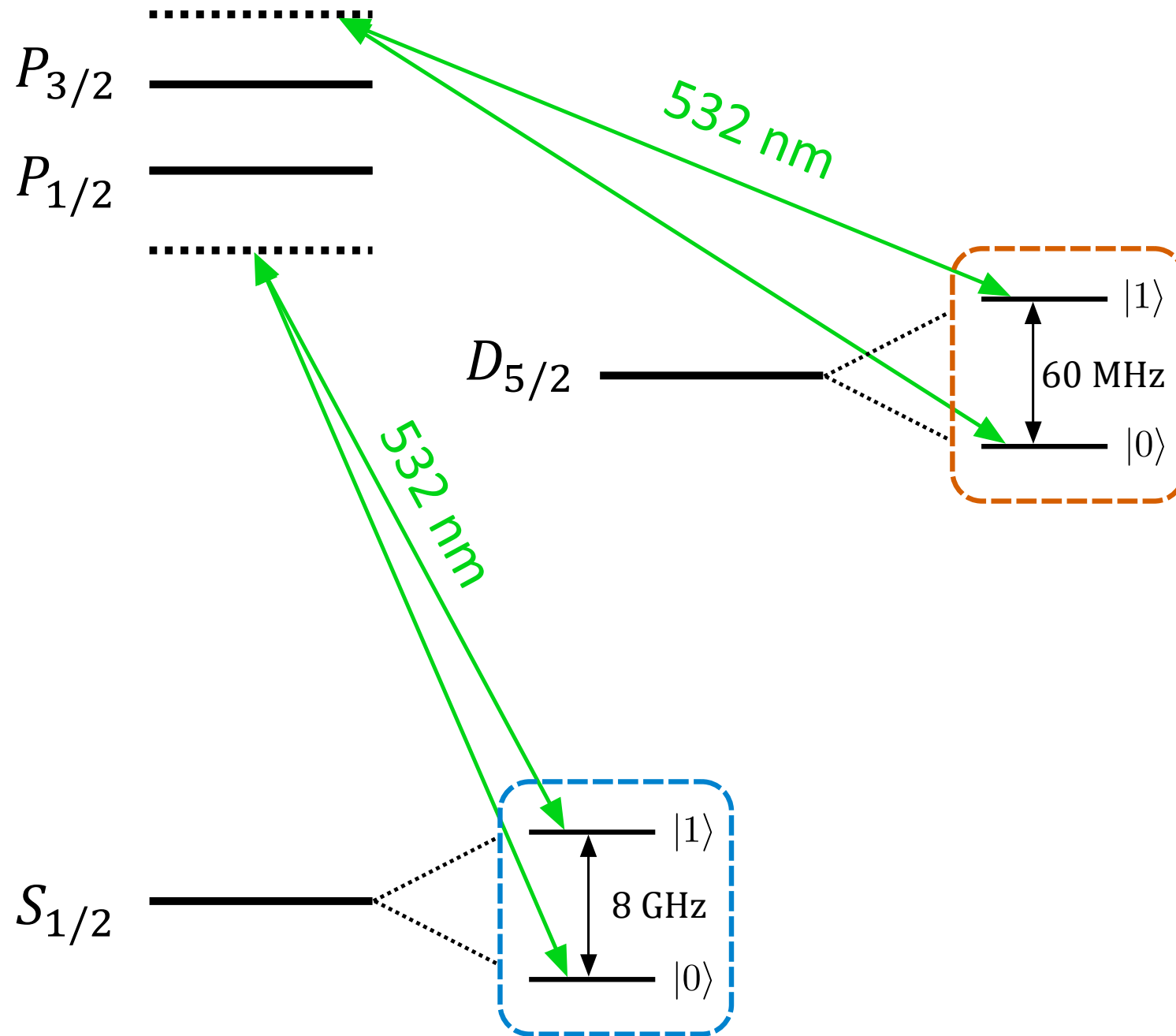
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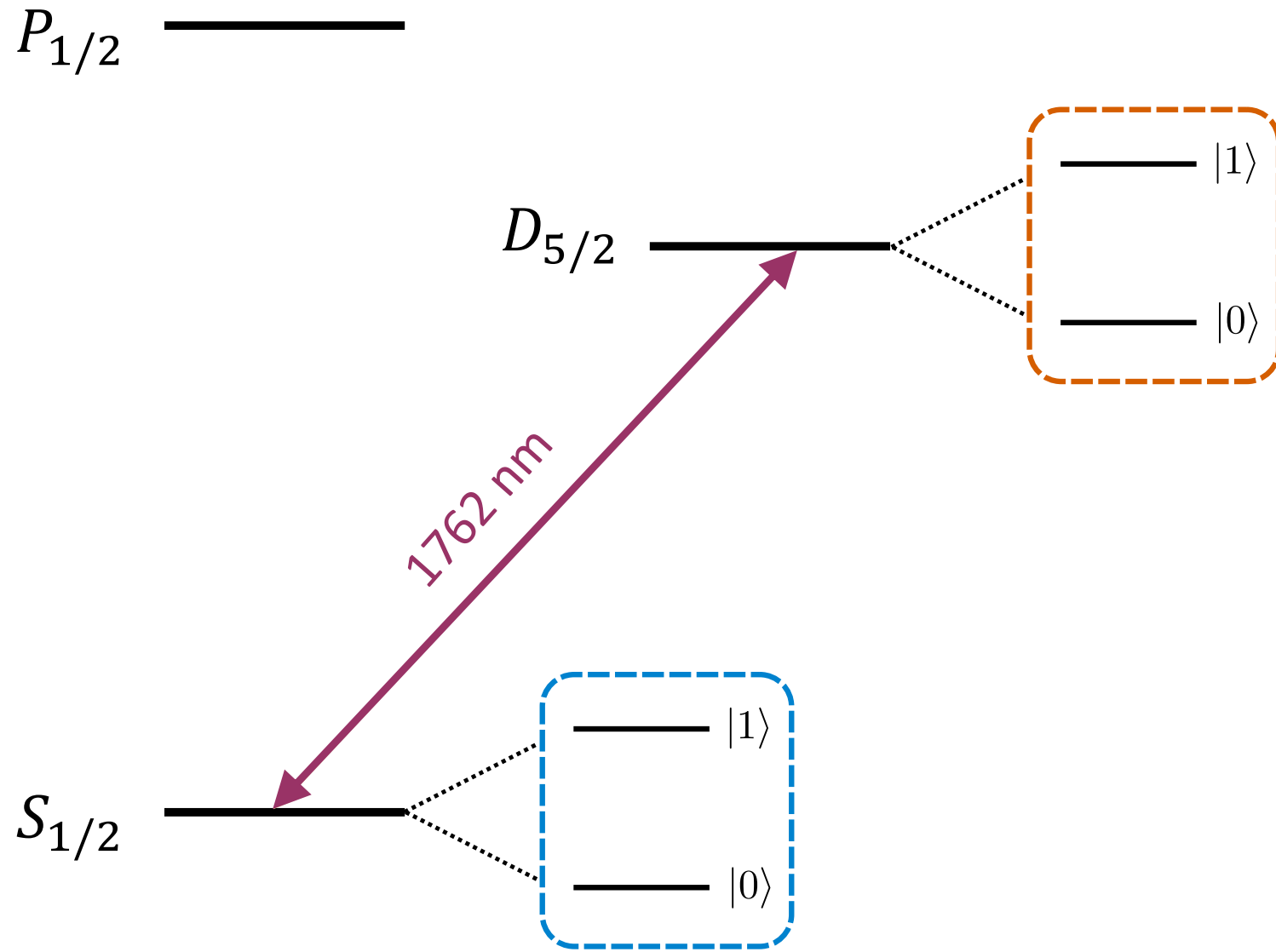


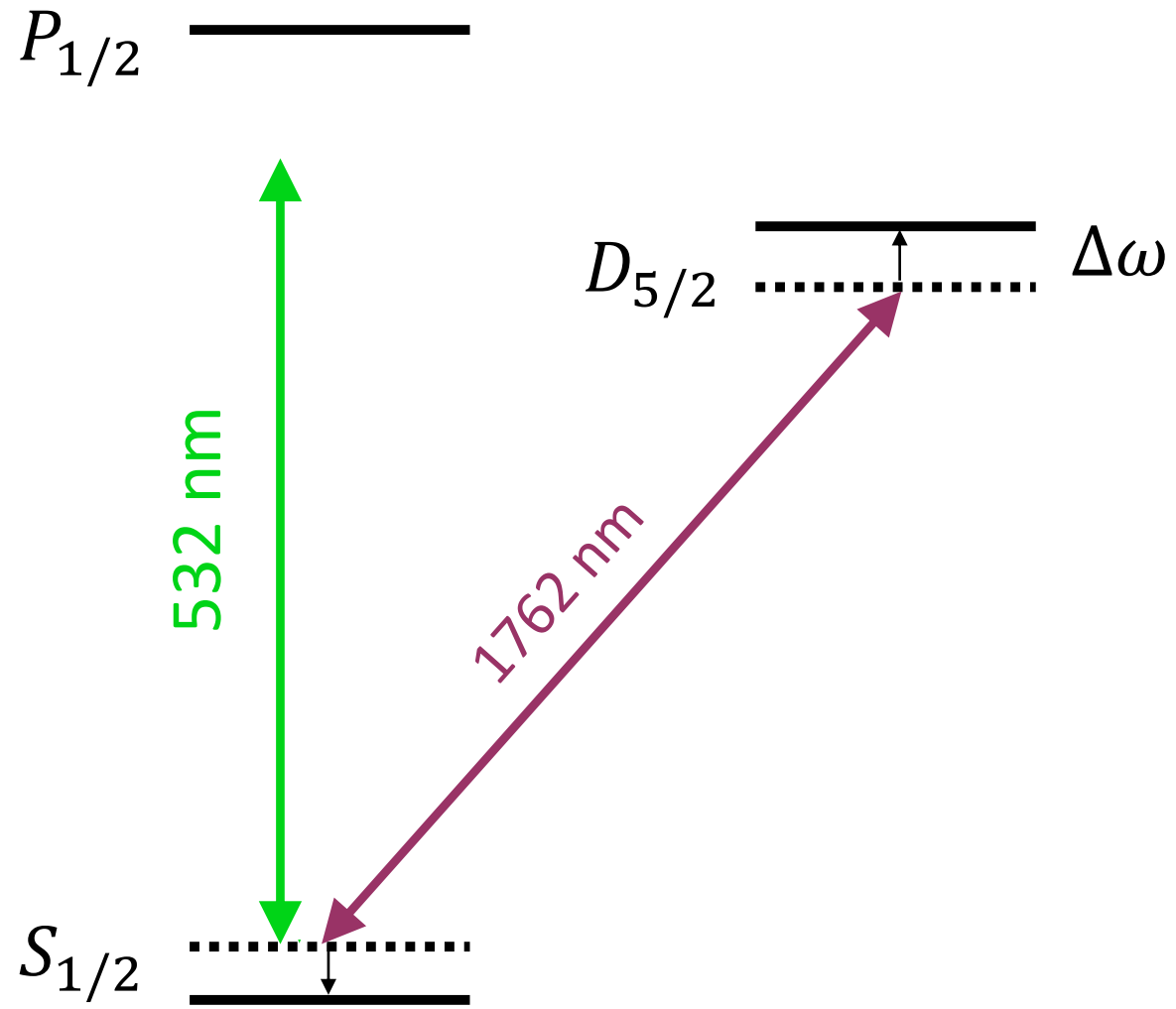
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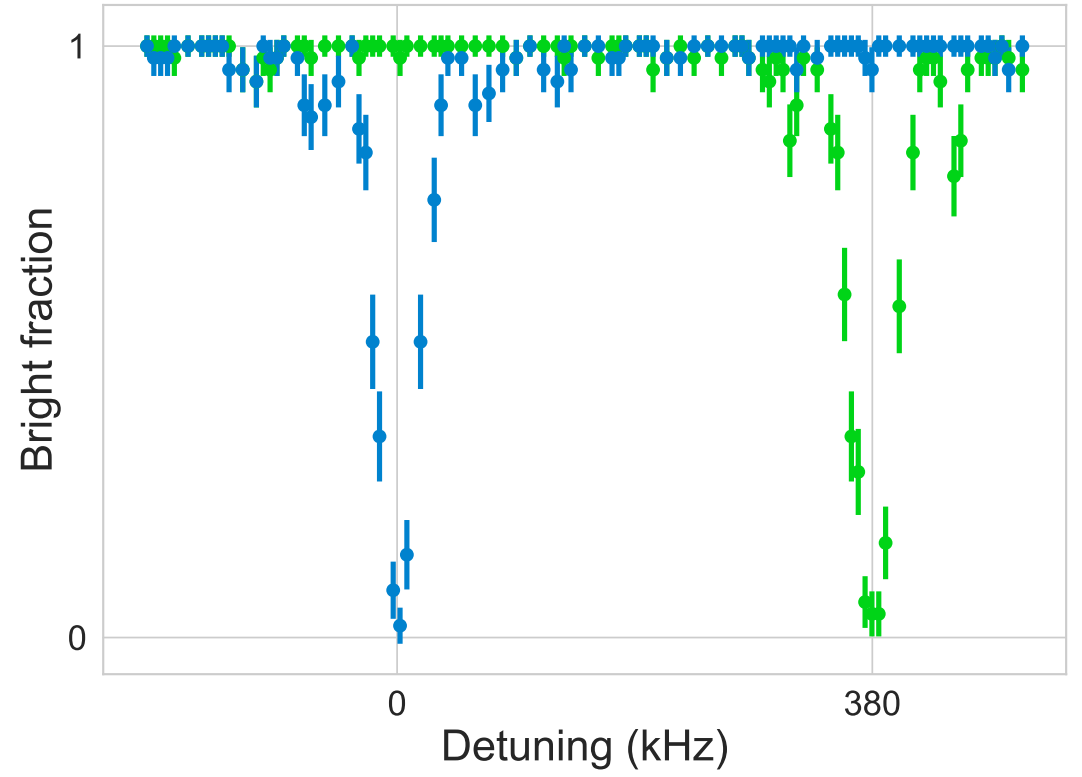
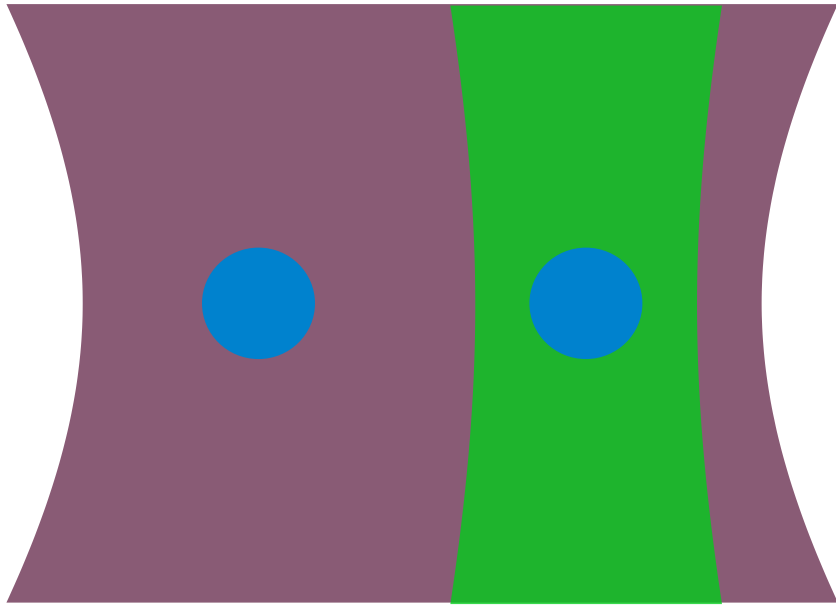


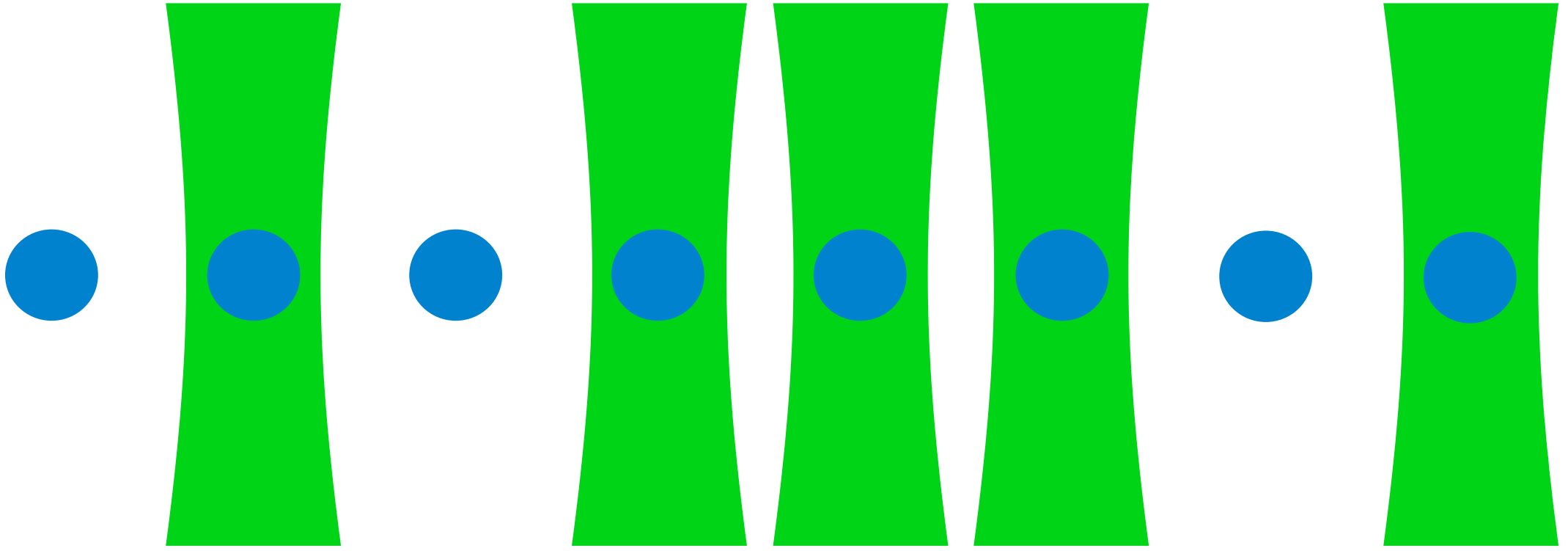




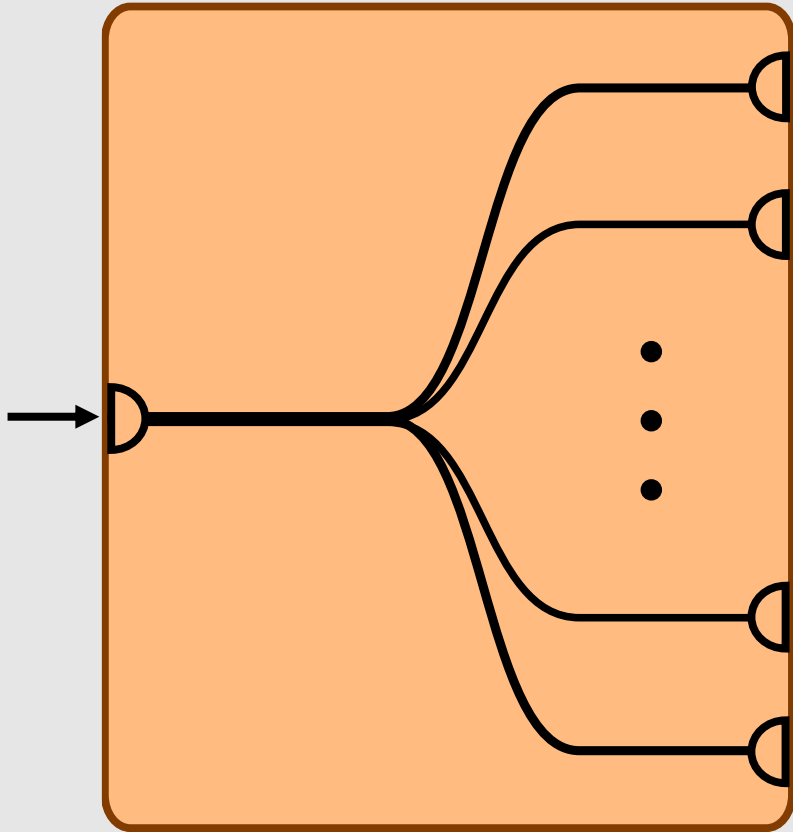






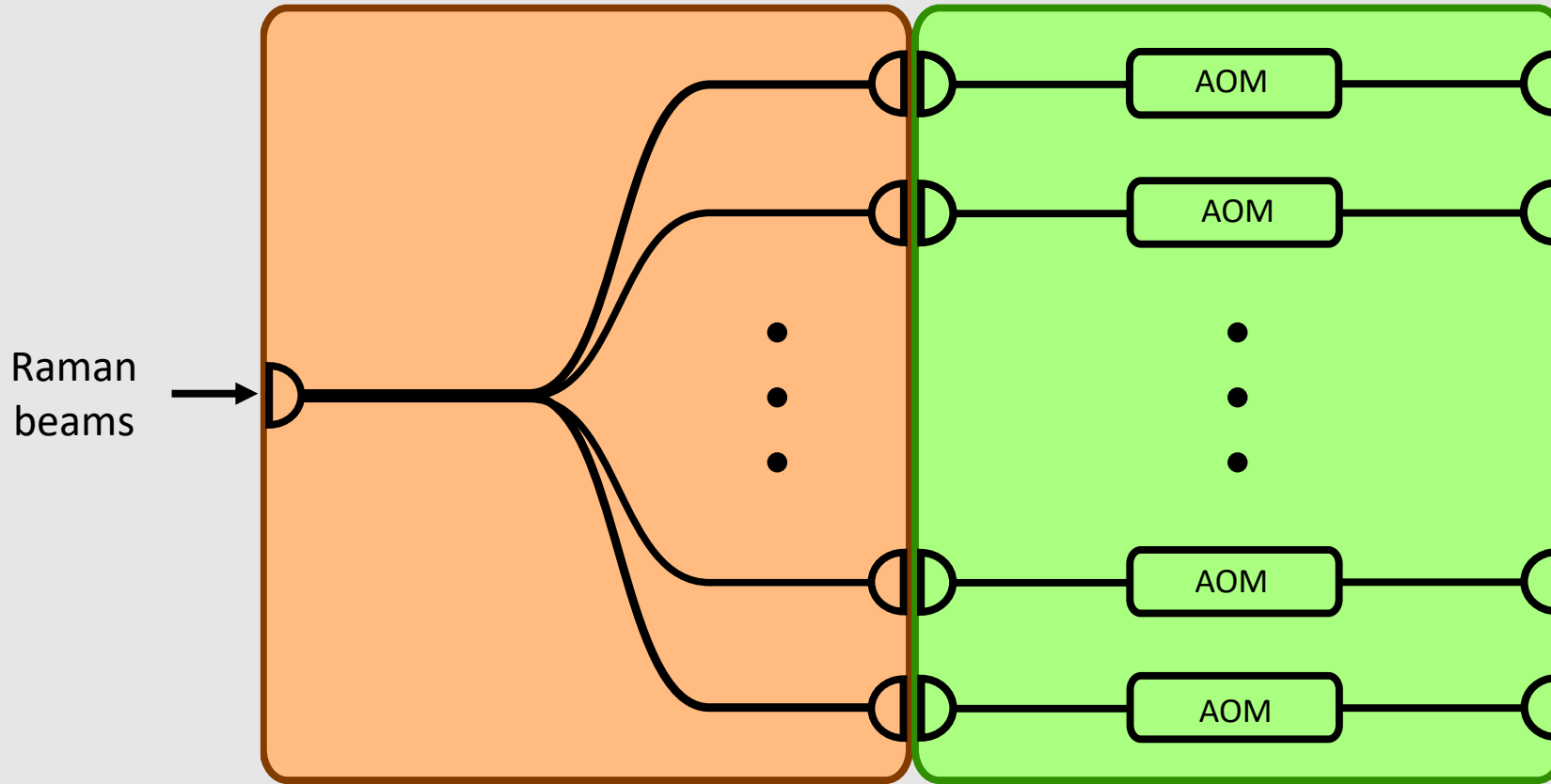


Raman
beams



Fibre splitters

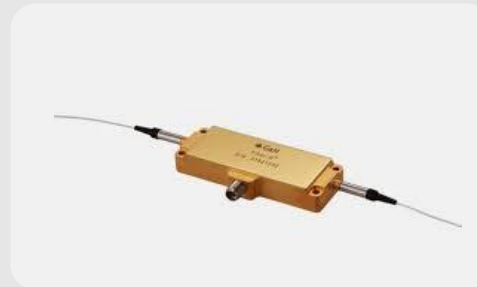


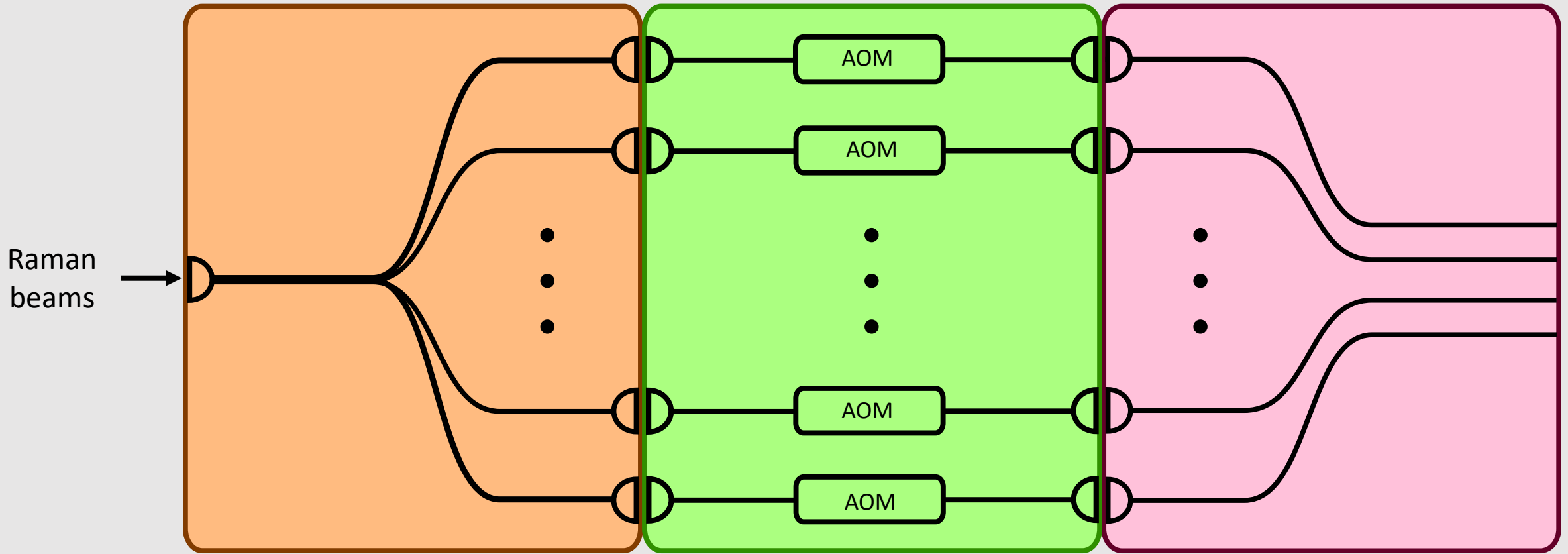


Fibre splitters



Fibre AOMs

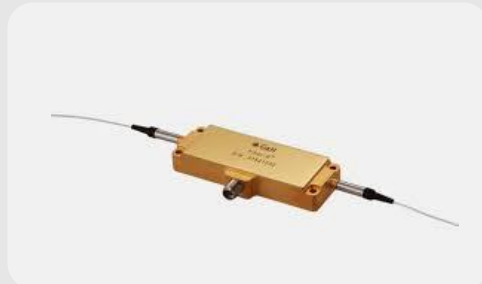




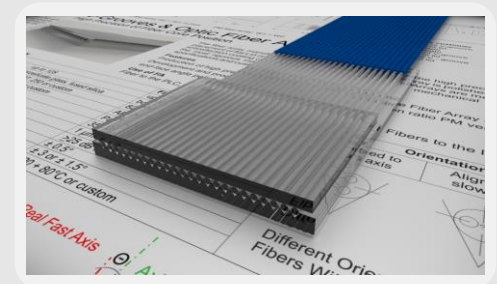
Fibre splitters

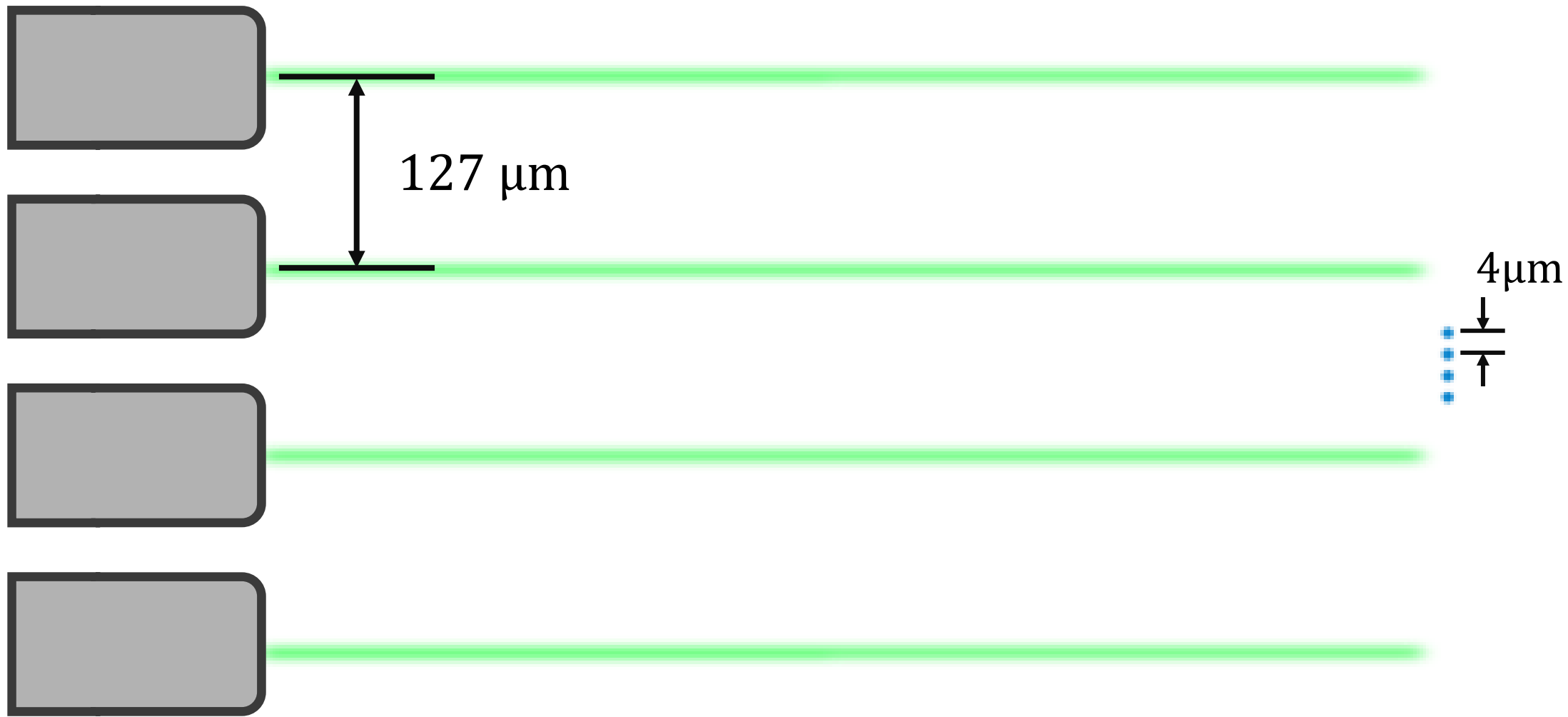


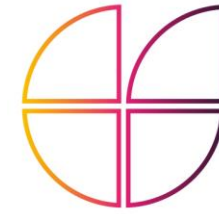
Fibre AOMs



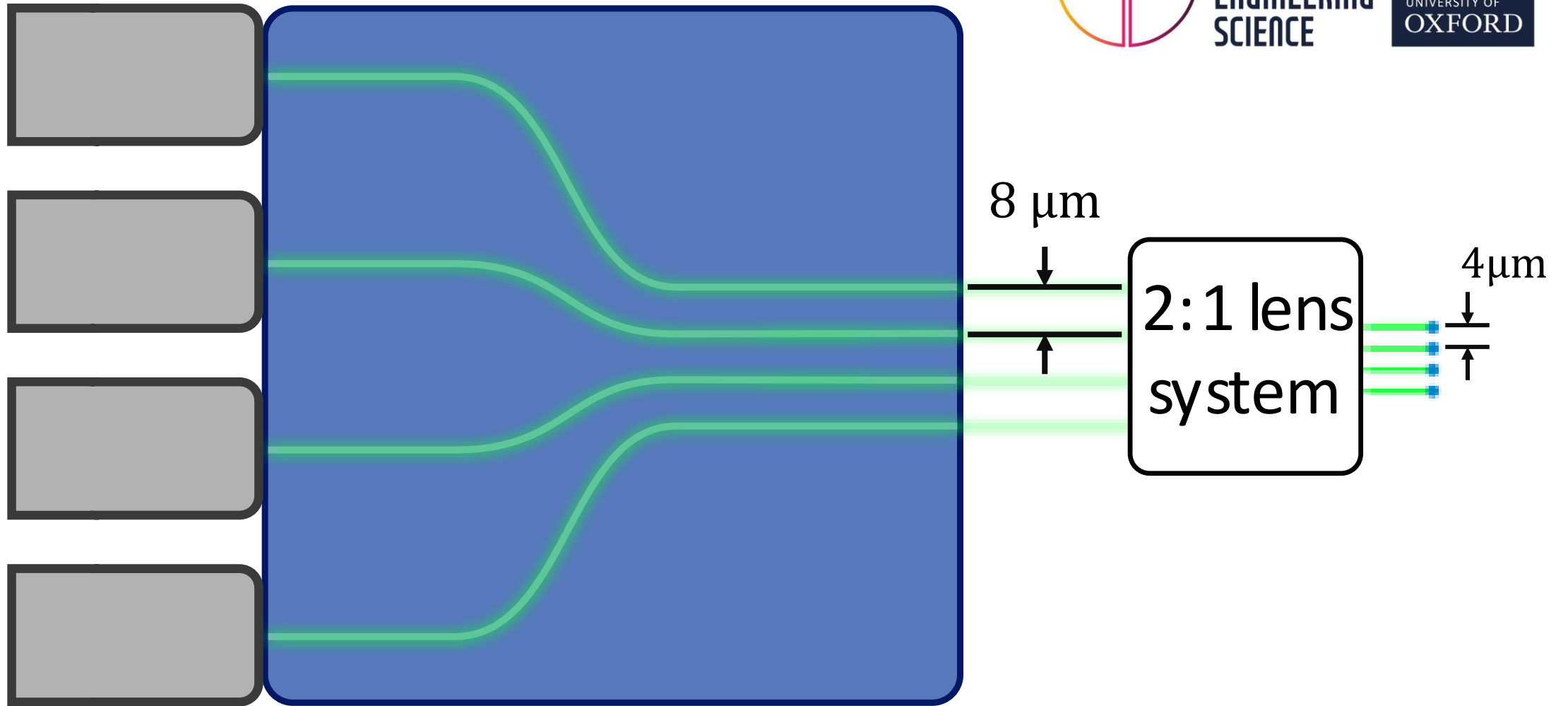
V-groove array

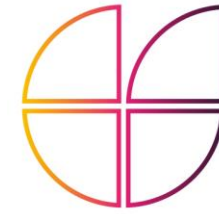




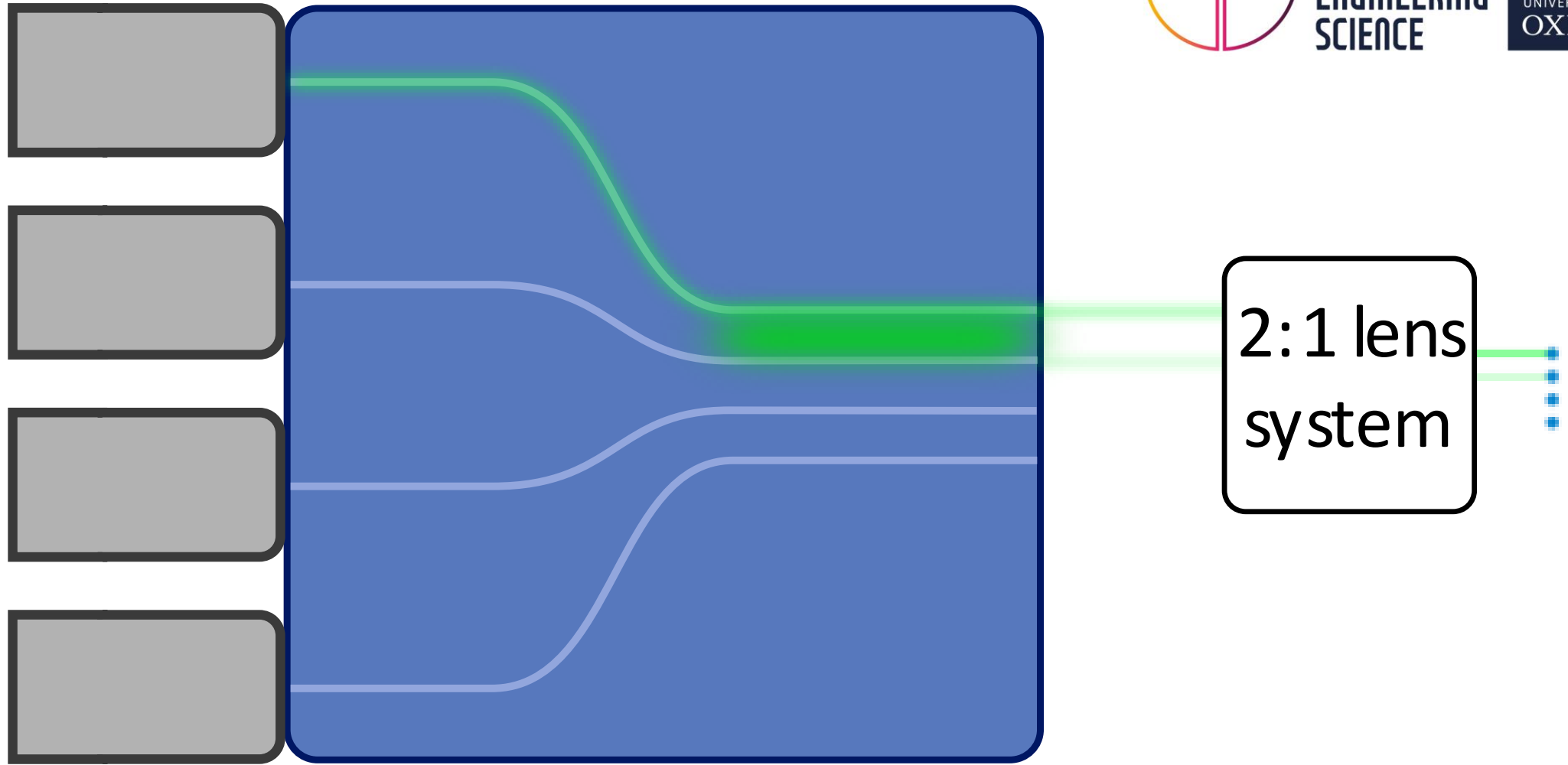


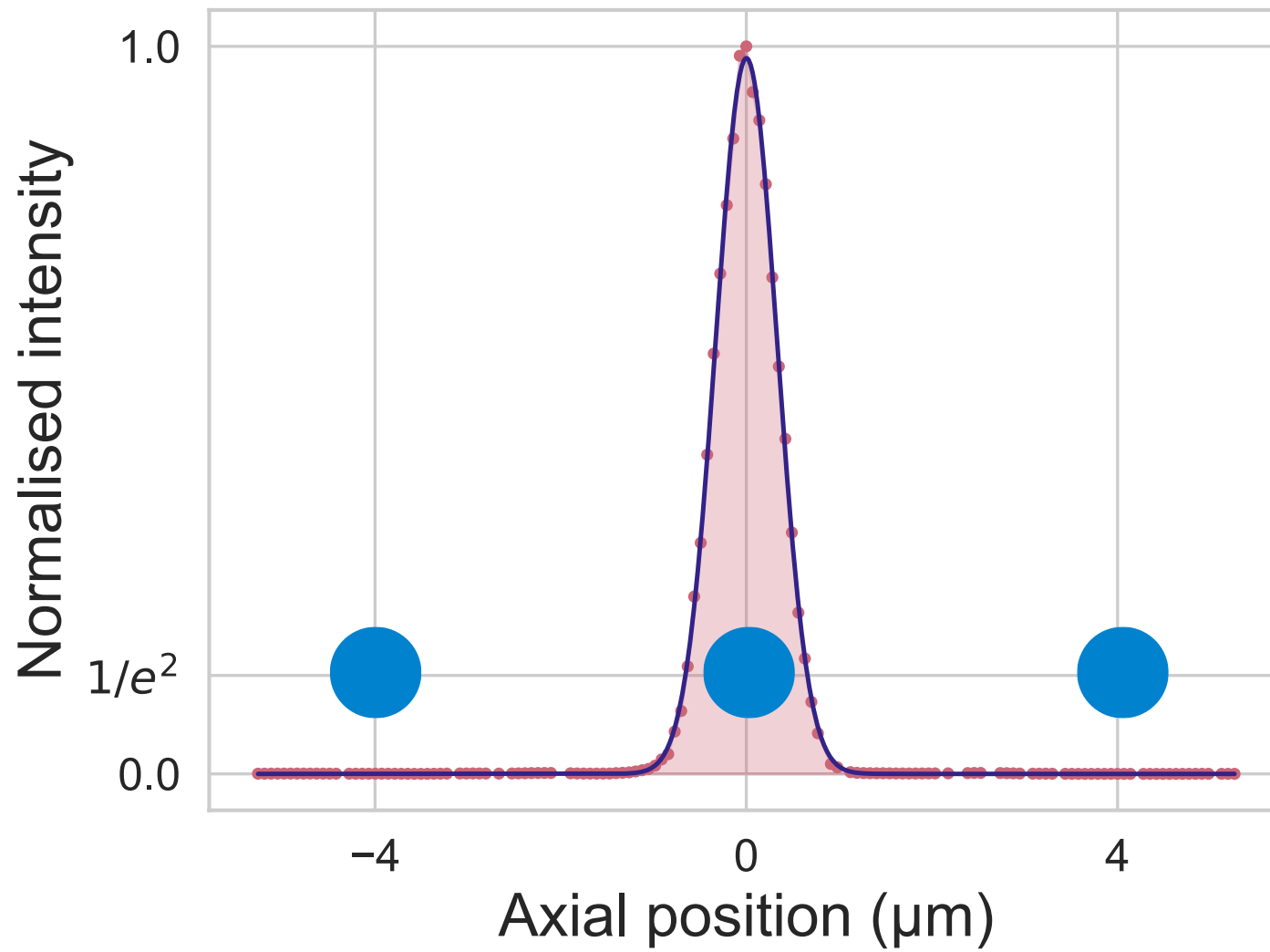
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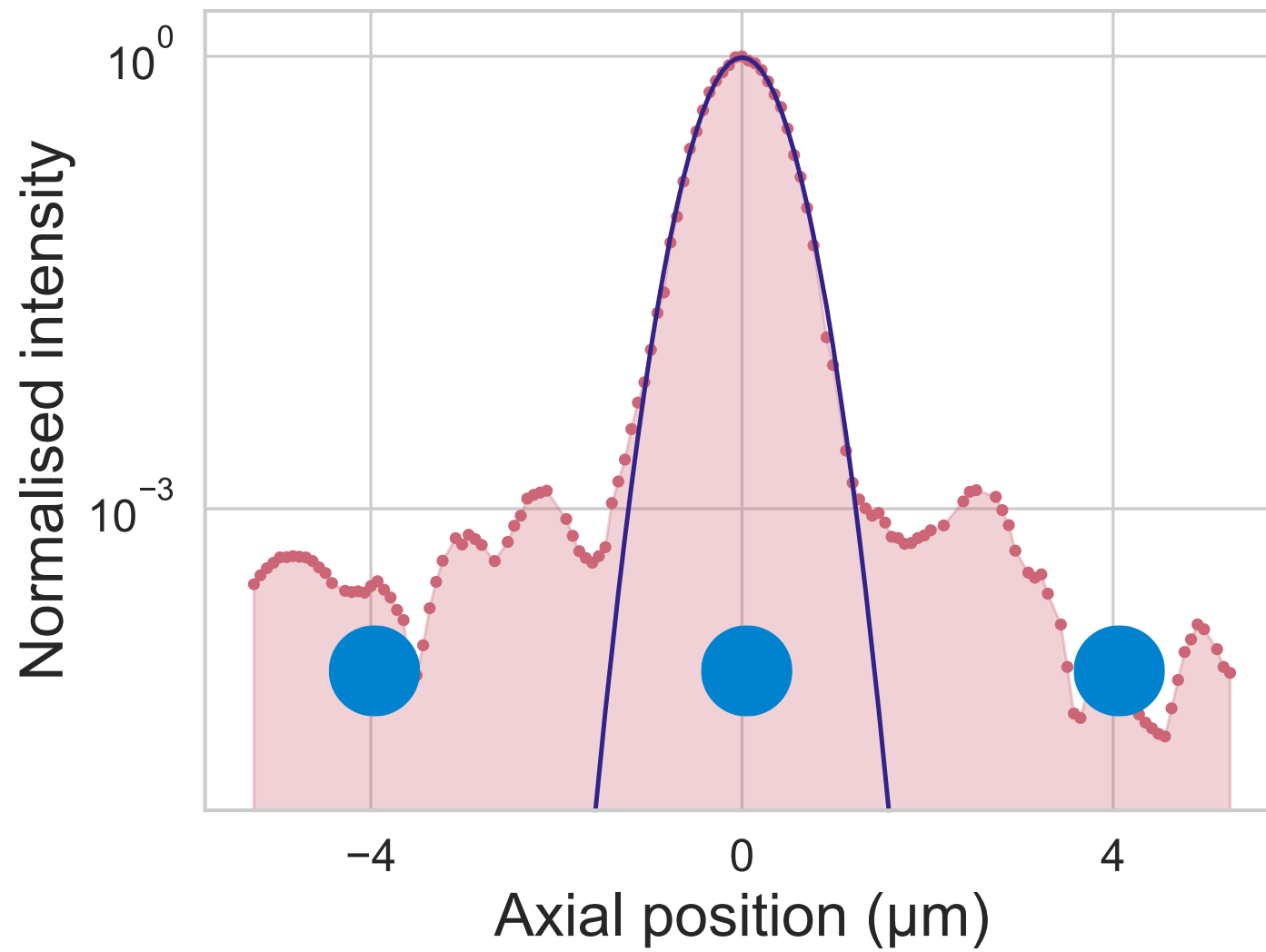


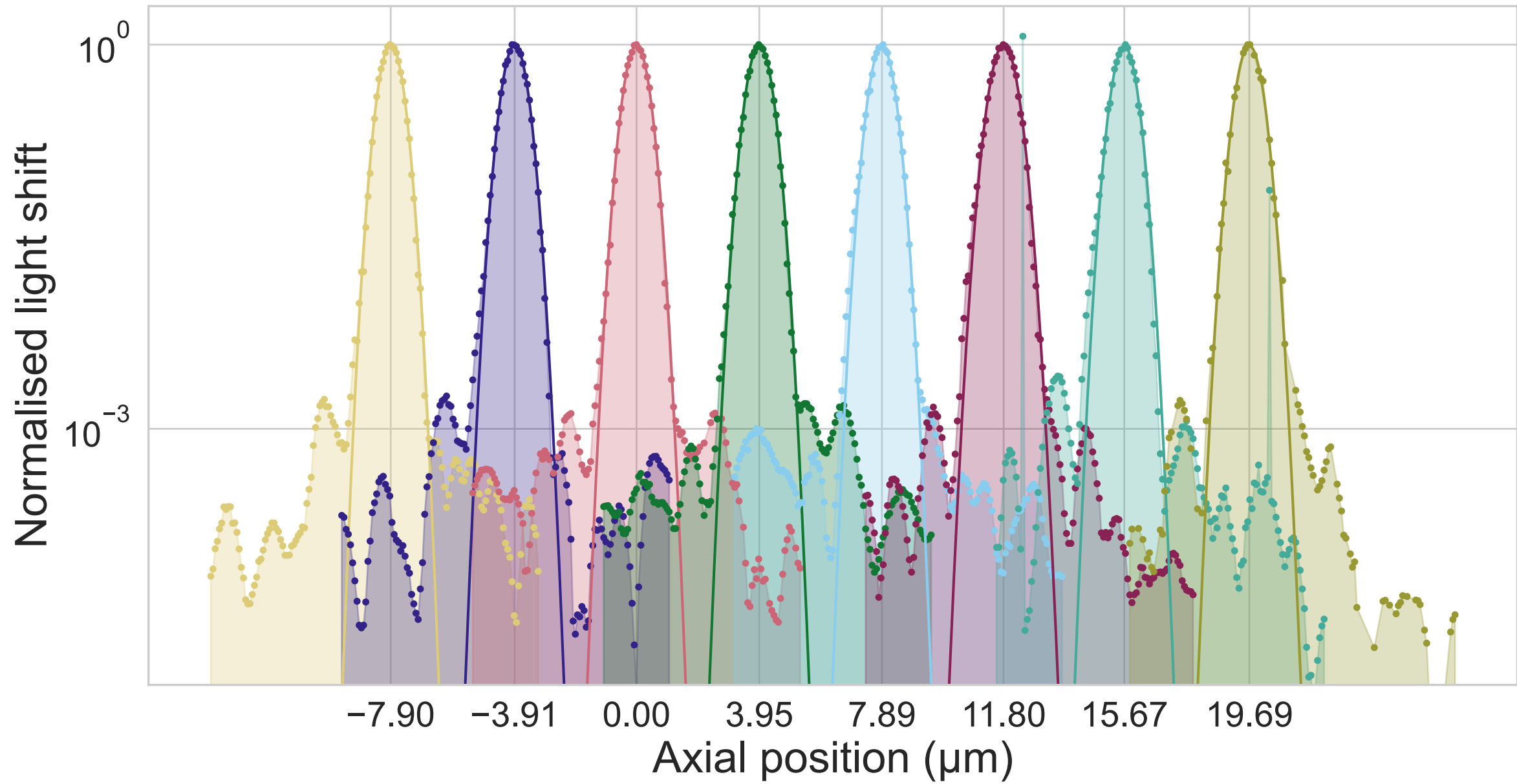


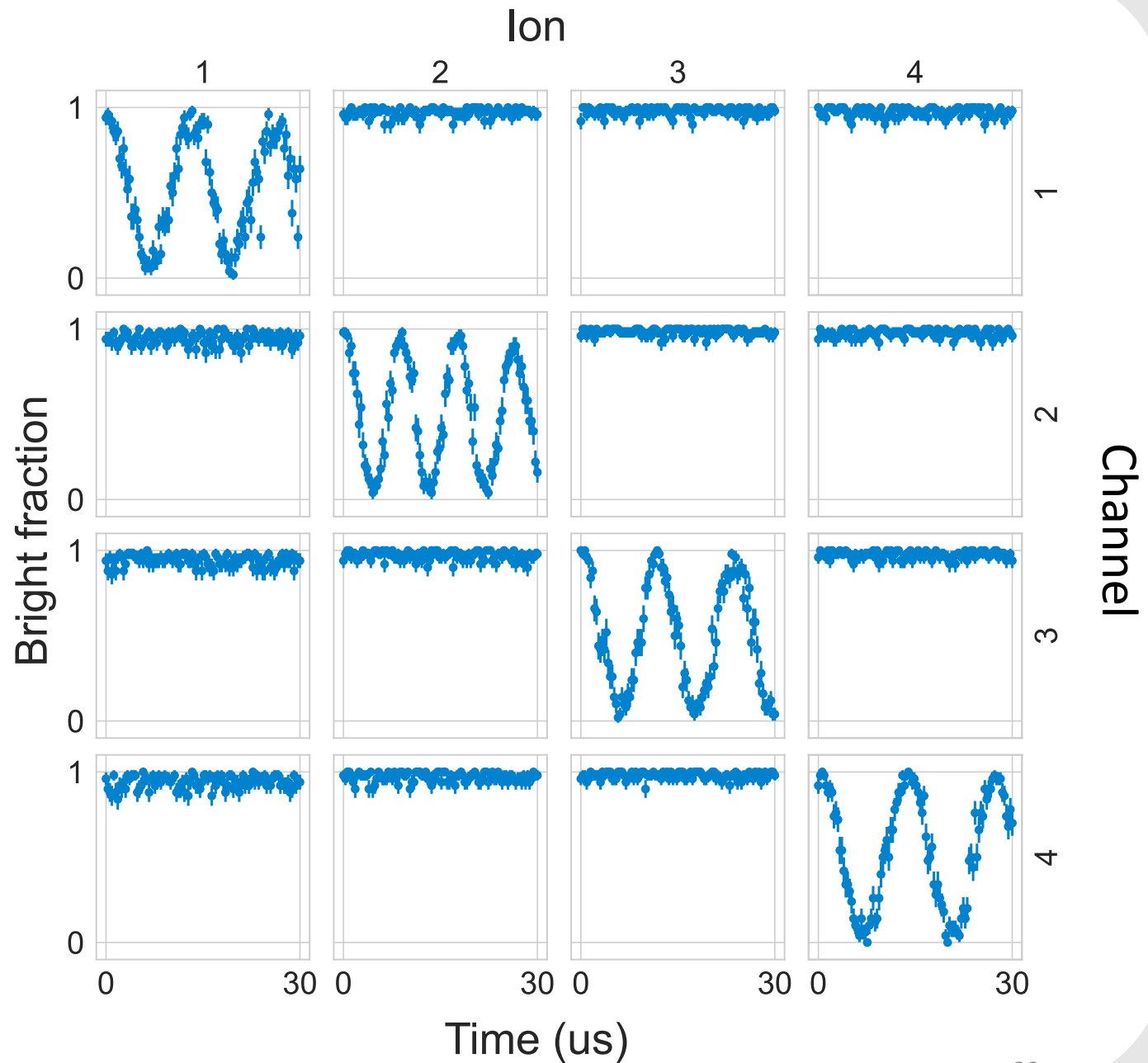
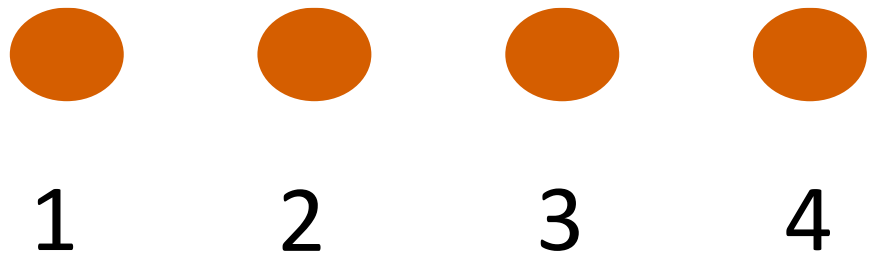
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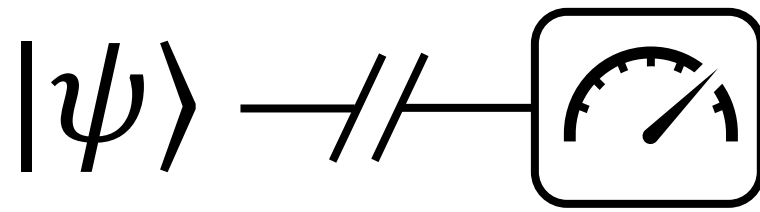








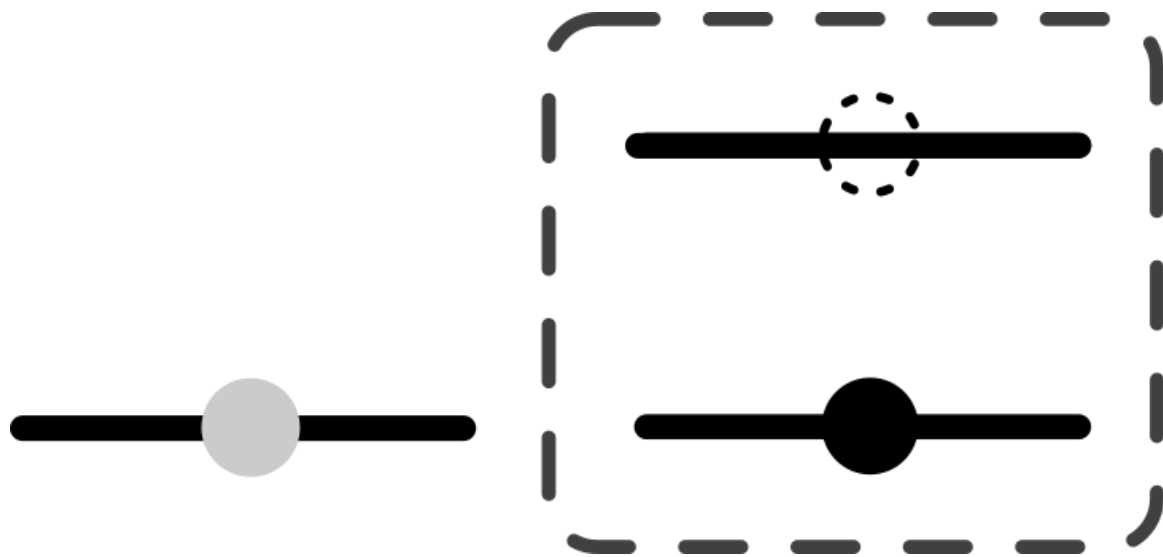
State
Prep



Measurement

And





$|\psi\rangle$

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¹AWS Center for Quantum Computing, Pasadena, California 91125, USA

²California Institute of Technology, Pasadena, California 91125, USA


³Institute of Applied Physics, The Hebrew University of Jerusalem, Jerusalem 91904, Givat Ram, Israel

⁴Racah Institute of Physics, The Hebrew University of Jerusalem, Jerusalem 91904, Givat Ram, Israel

 (Received 15 August 2022; revised 2 July 2023; accepted 30 August 2023; published 1 November 2023)

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Quantum Error Correction with Metastable States of Trapped Ions Using Erasure Conversion

[Mingyu Kang](#) , ^{1,2,*} [Wesley C. Campbell](#), ^{3,4,5} and [Kenneth R. Brown](#) ^{1,2,6,7,†}

¹Duke Quantum Center, Duke University, Durham, North Carolina 27701, USA

²Department of Physics, Duke University, Durham, North Carolina 27708, USA


³Department of Physics and Astronomy, University of California, Los Angeles, California 90095, USA

⁴Challenge Institute for Quantum Computation, University of California, Los Angeles, California 90095, USA

⁵Center for Quantum Science and Engineering, University of California, Los Angeles, California 90095, USA

⁶Department of Electrical and Computer Engineering, Duke University, Durham, North Carolina 27708, USA

⁷Department of Chemistry, Duke University, Durham, North Carolina 27708, USA

 (Received 15 November 2022; revised 12 March 2023; accepted 15 May 2023; published 30 June 2023)

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Letter | [Published: 01 August 2022](#)

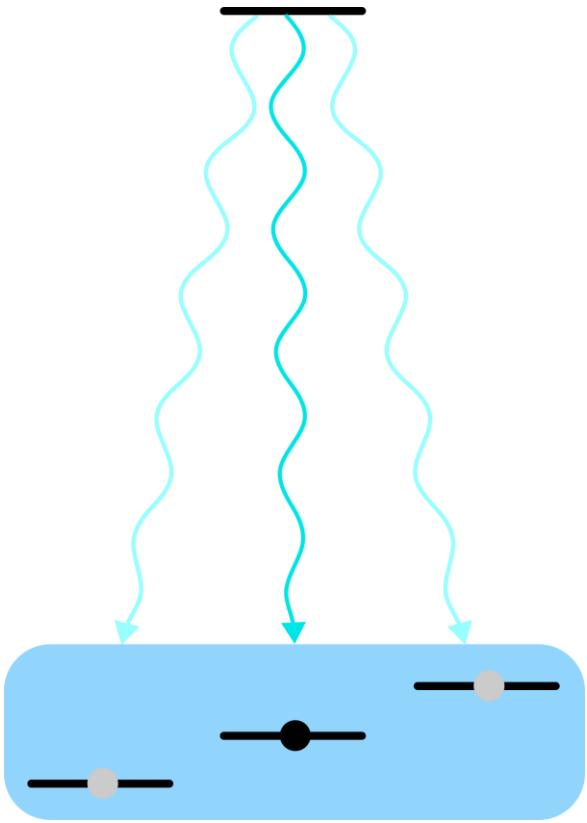
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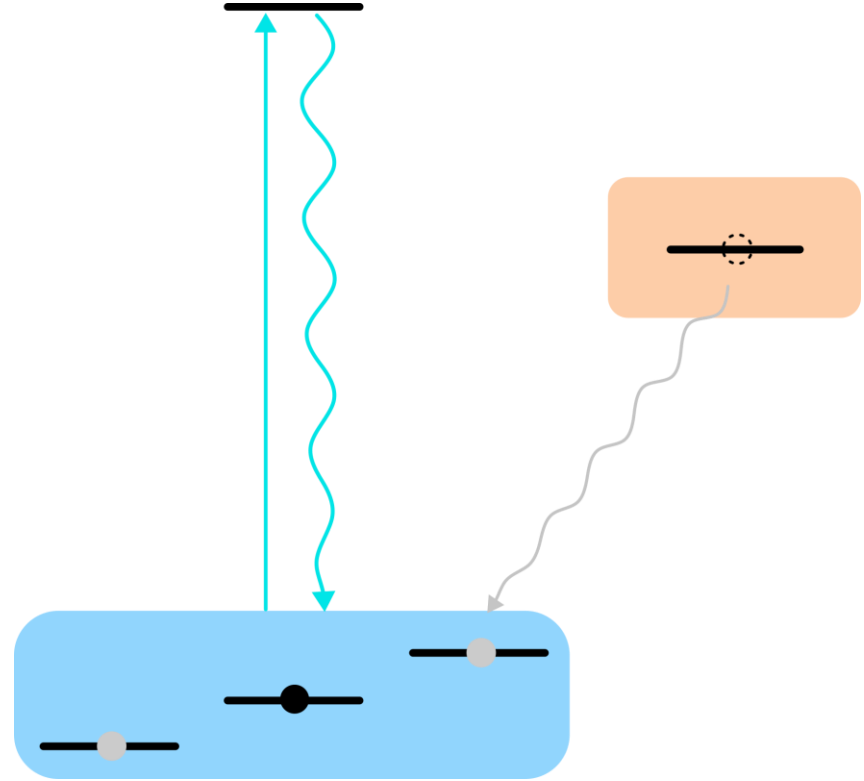
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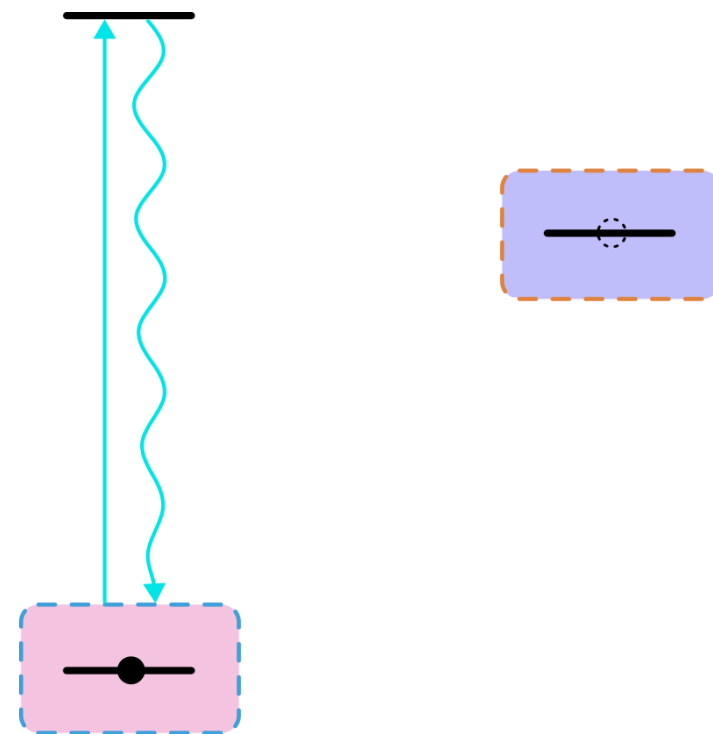
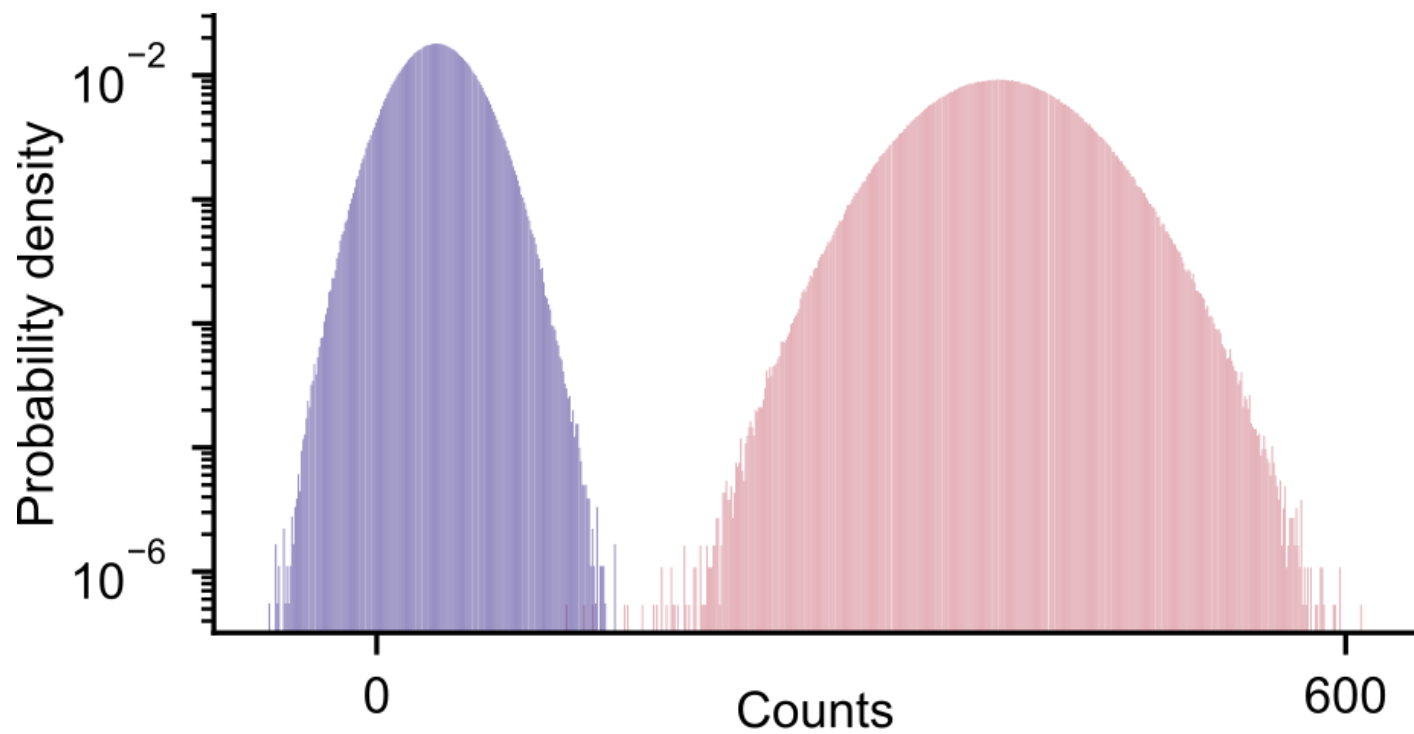
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State Prep



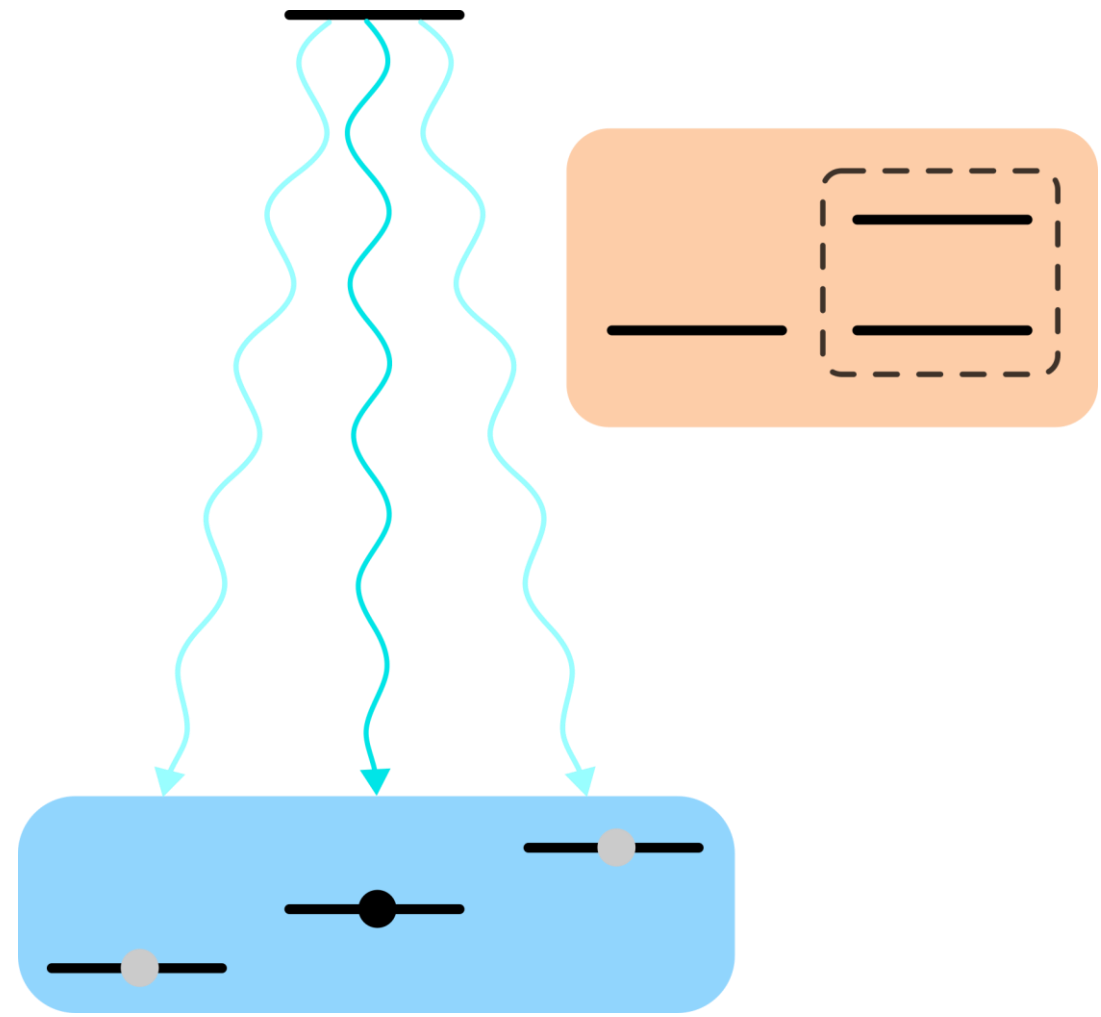
Measurement



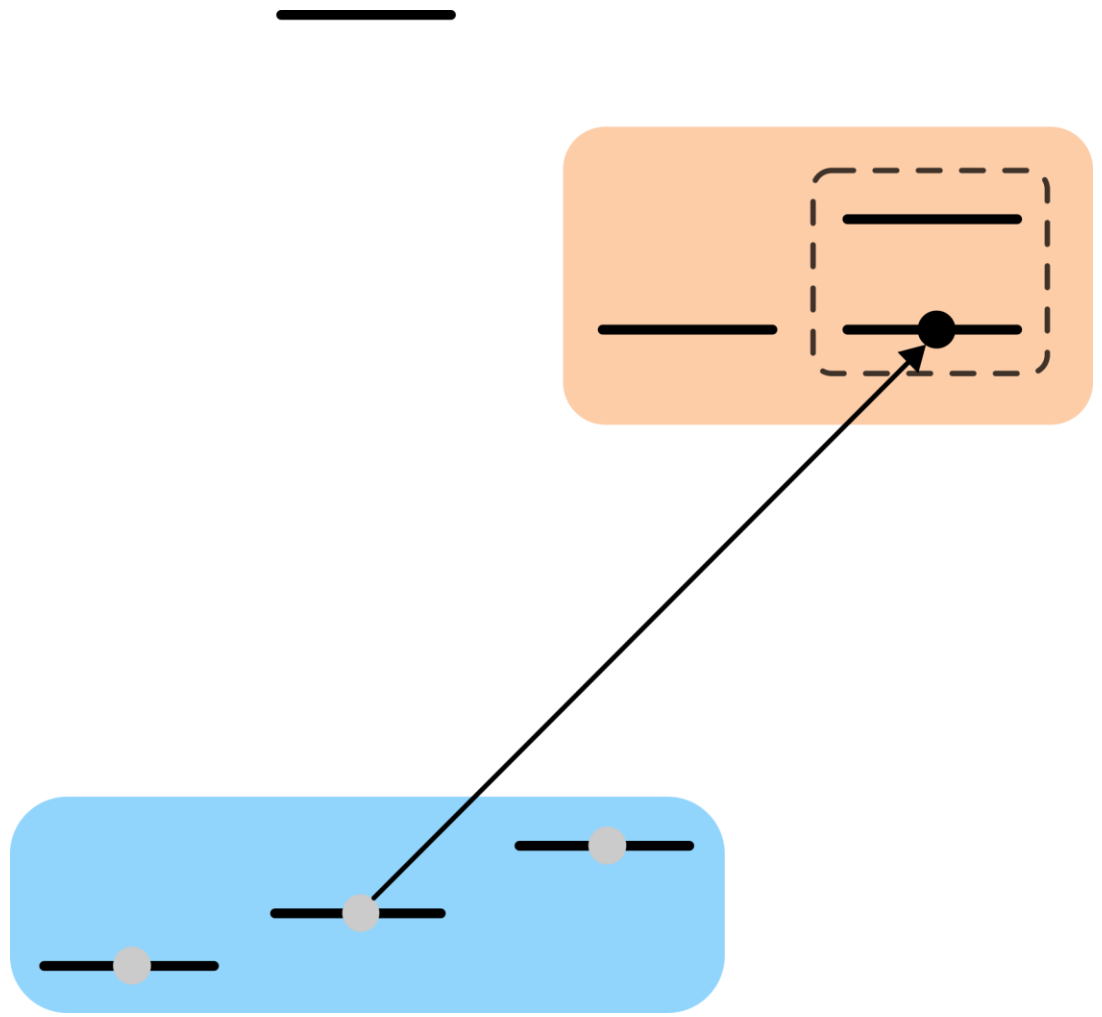


$$\varepsilon \sim 10^{-6}$$

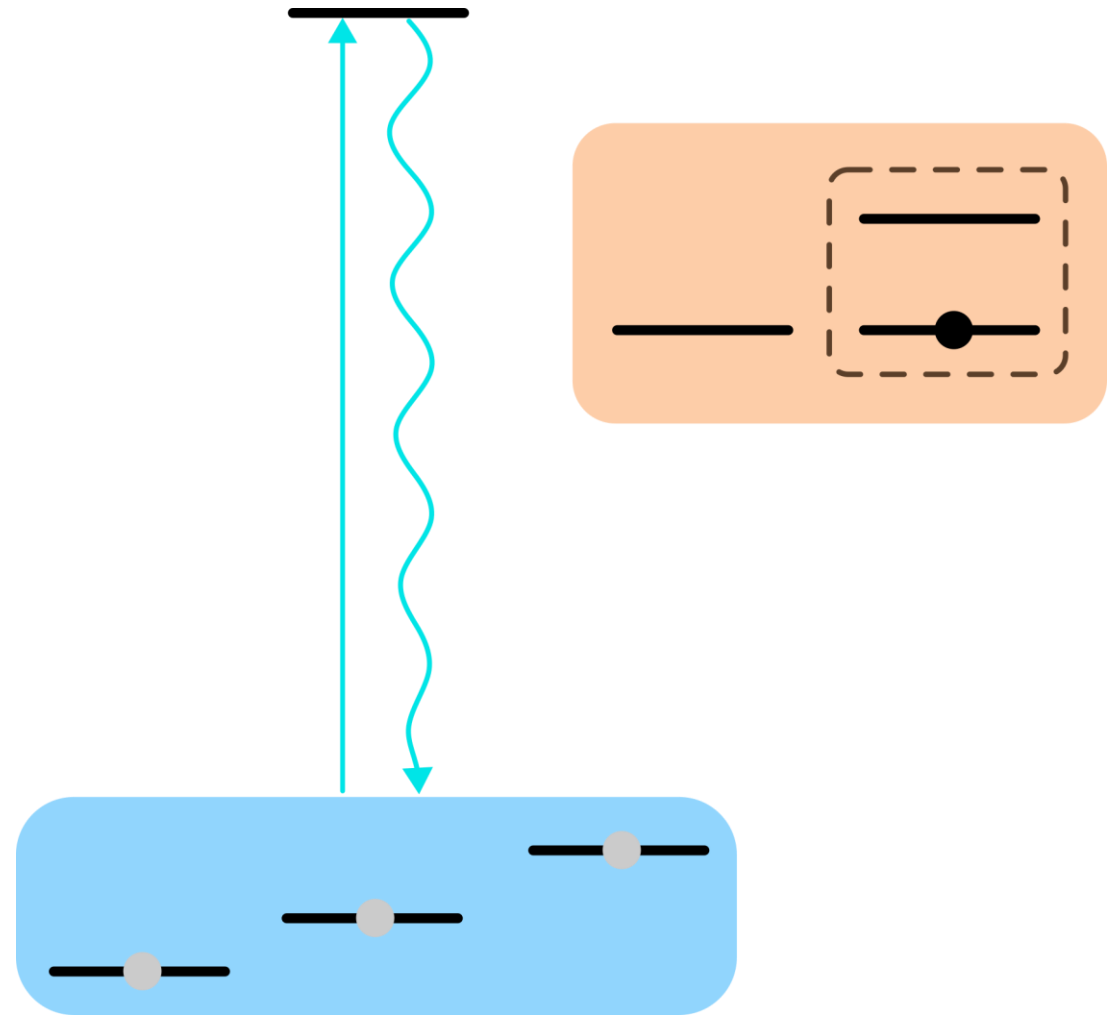
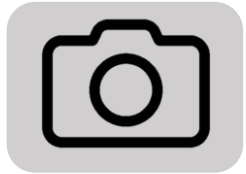
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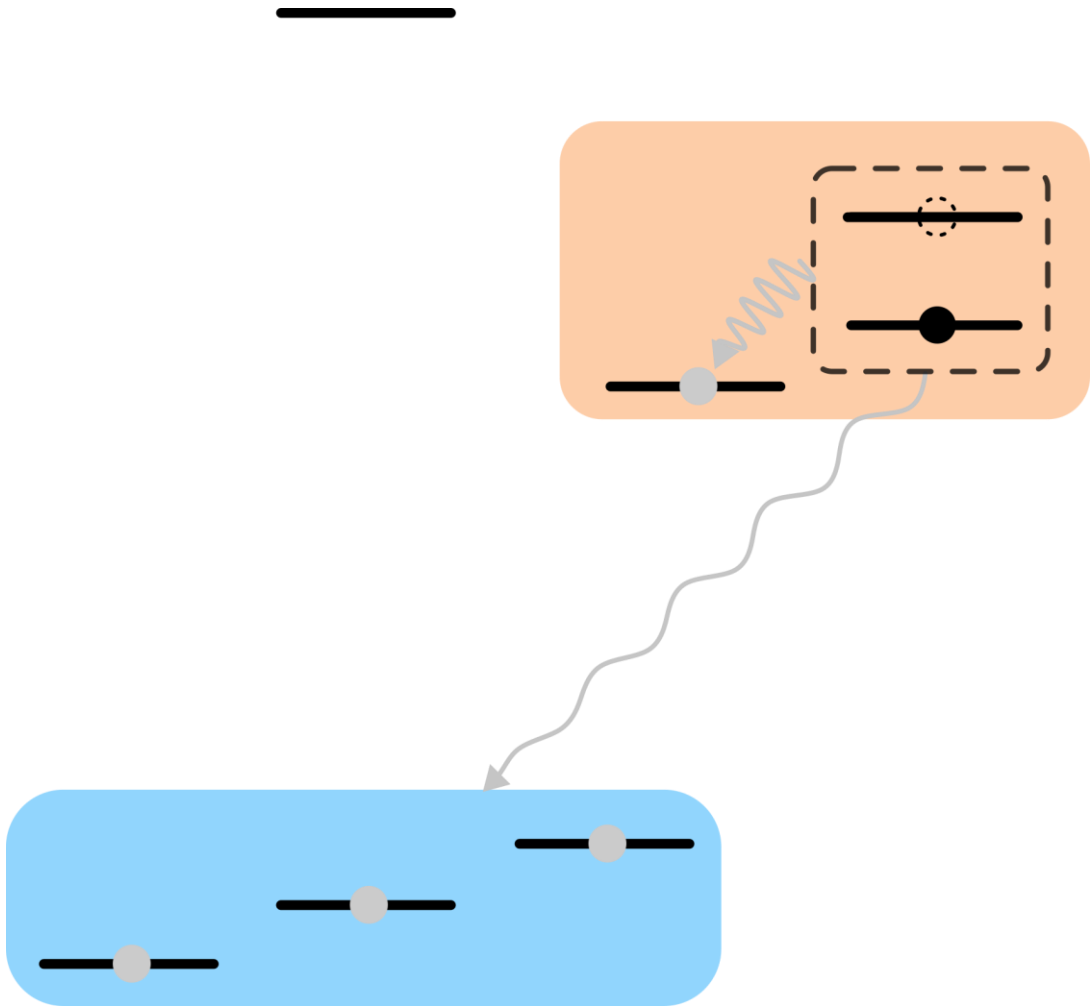
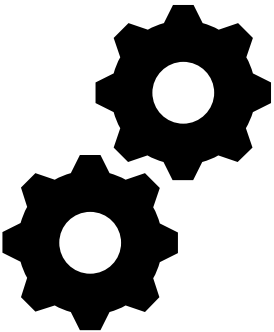
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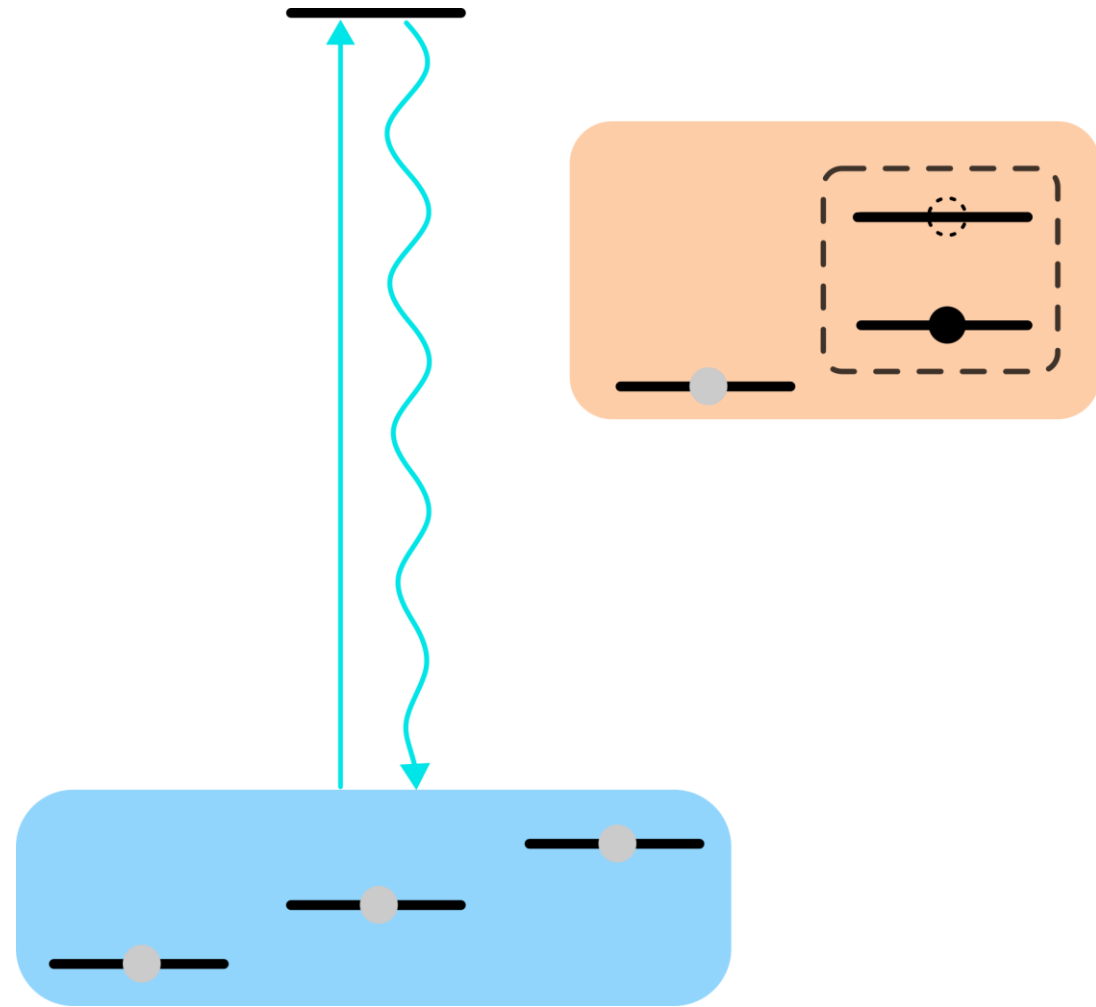
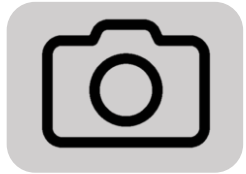
State-prep (Metastable)



Algorithm



Measurement (Metastable)



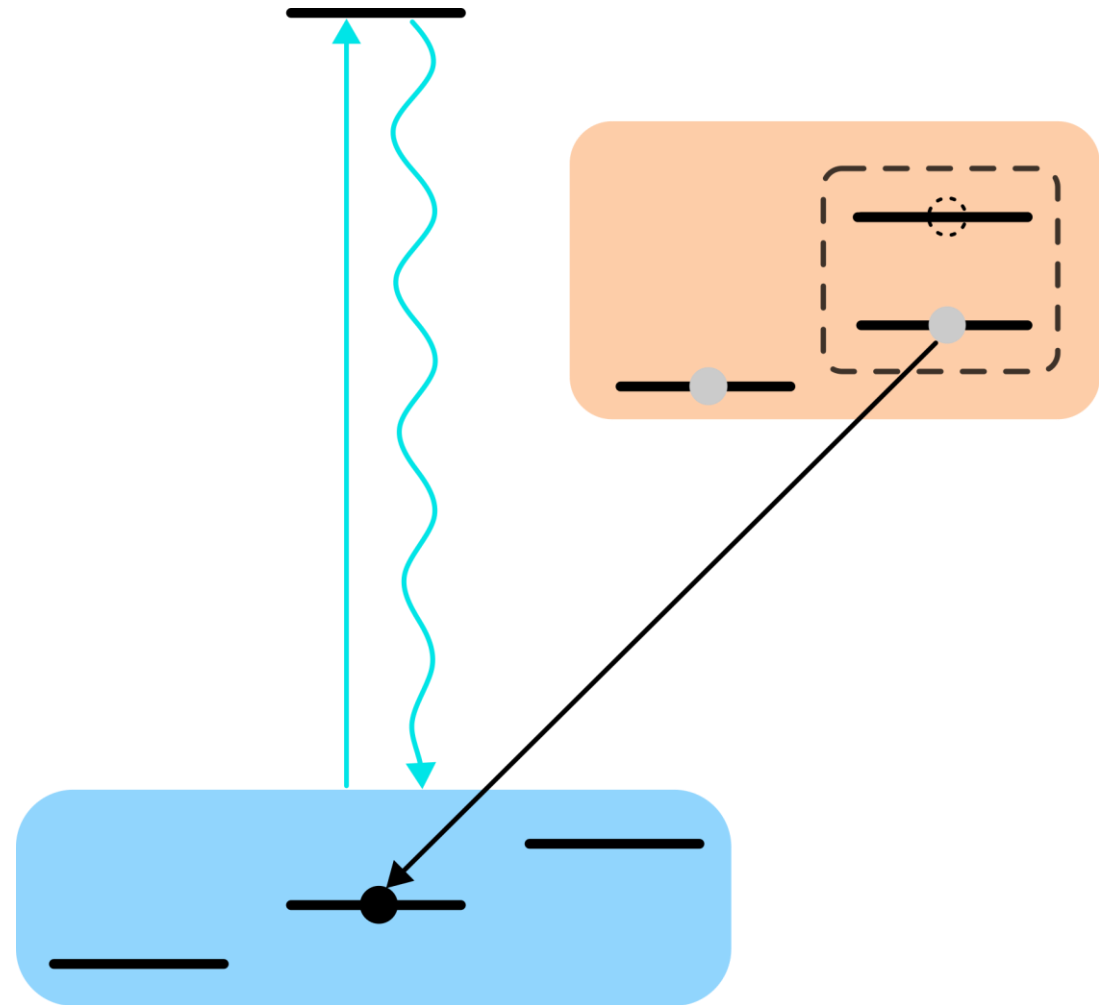
Measurement (Metastable)



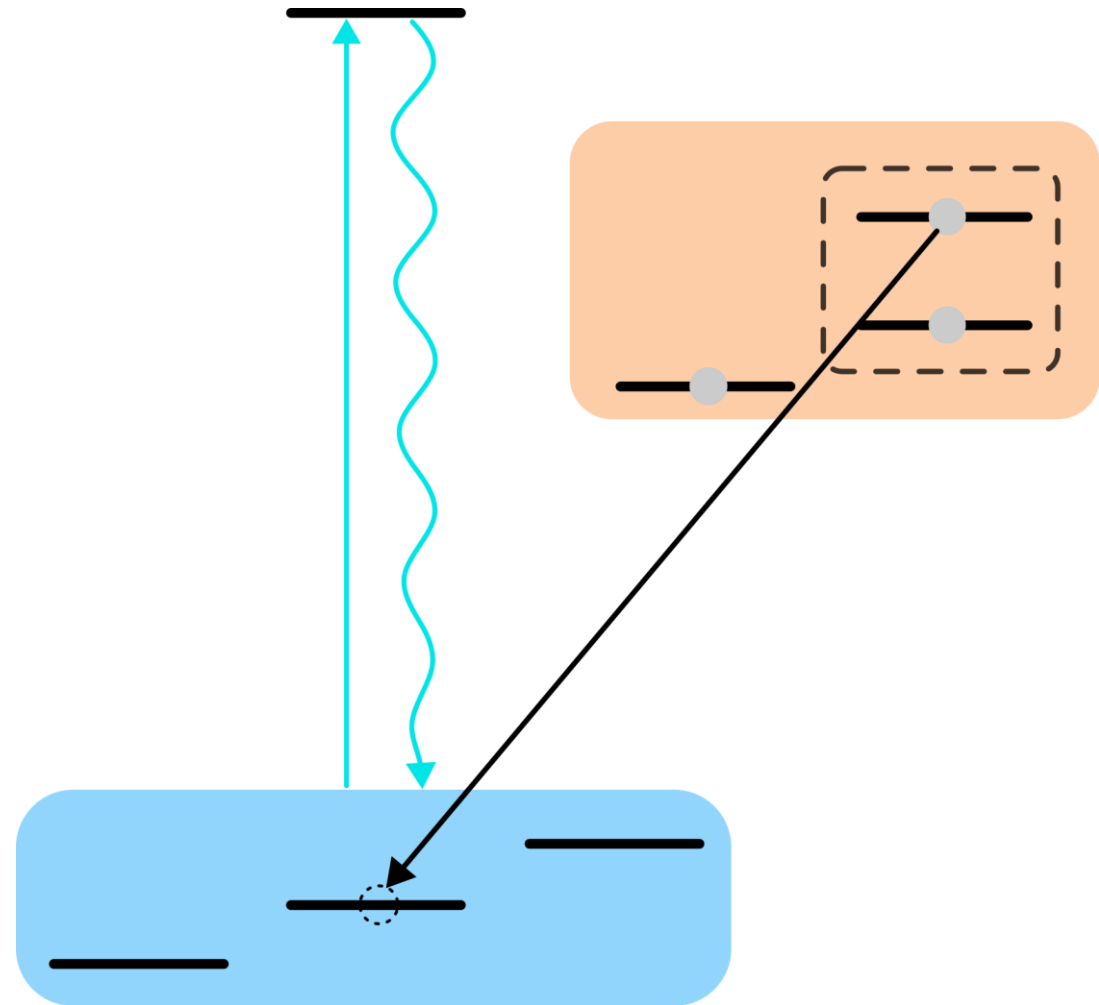
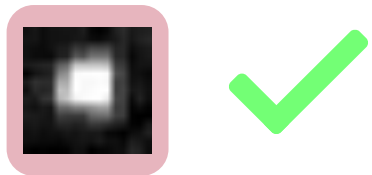
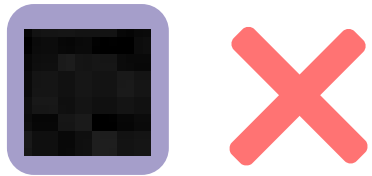
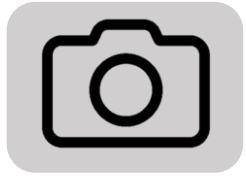
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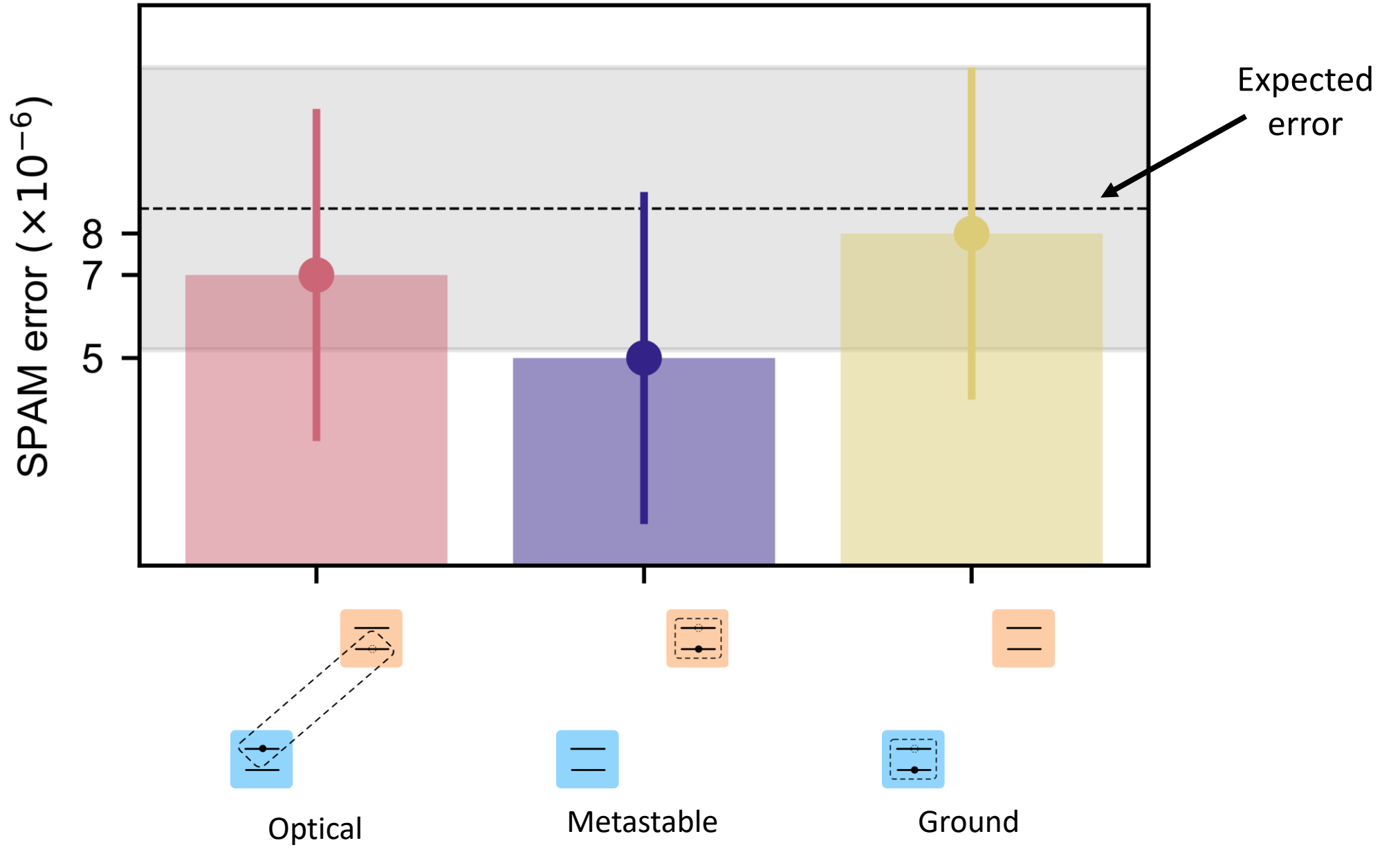


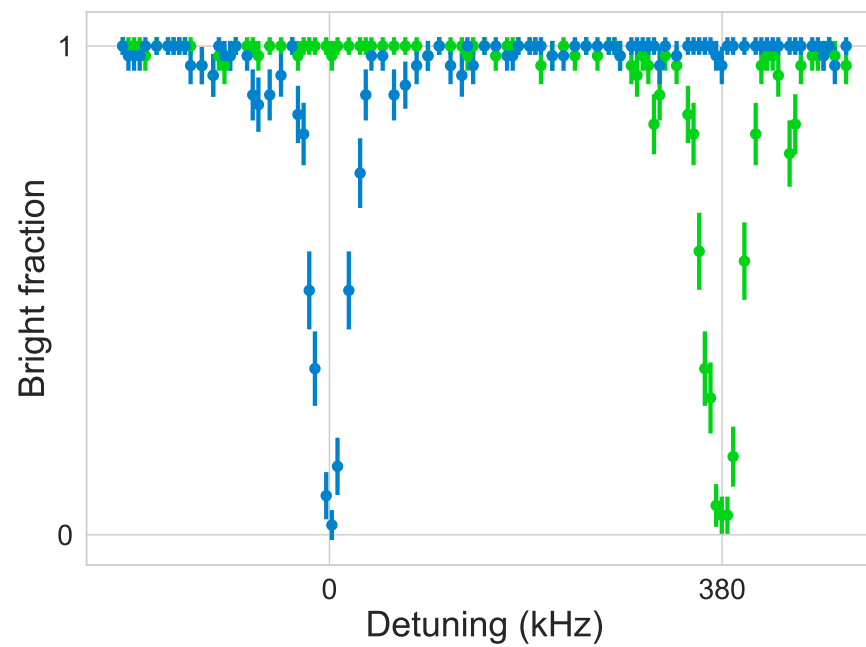
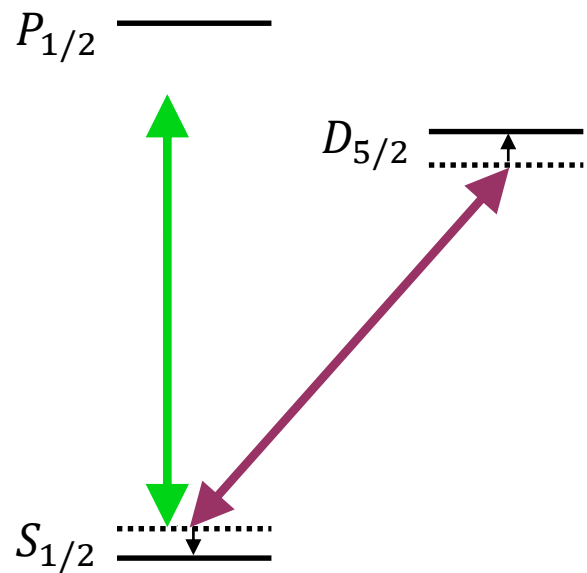
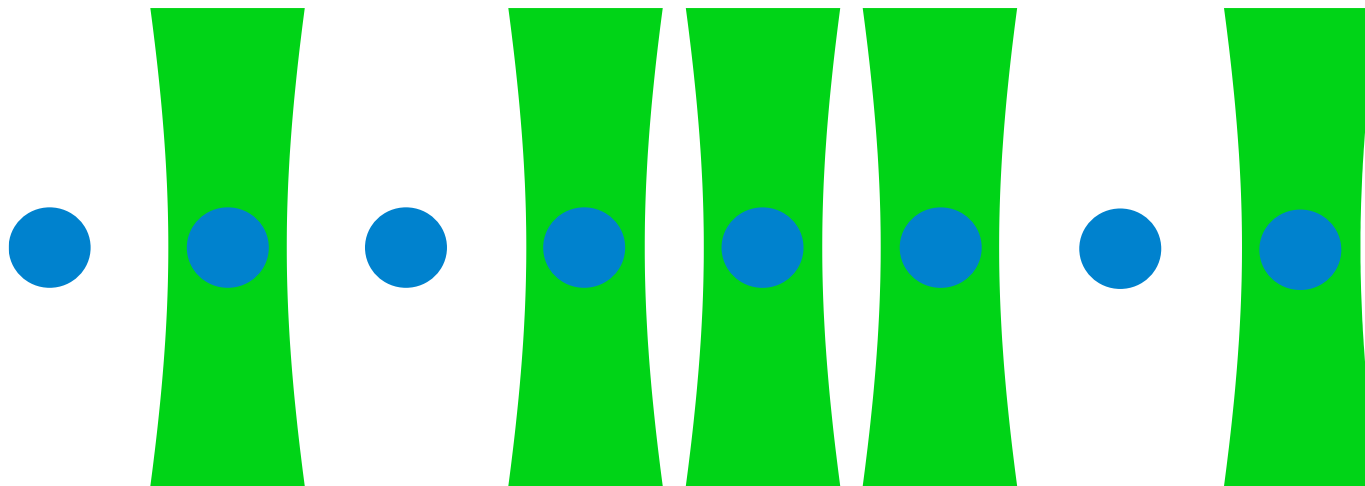
$|1\rangle$



Measurement (Metastable)

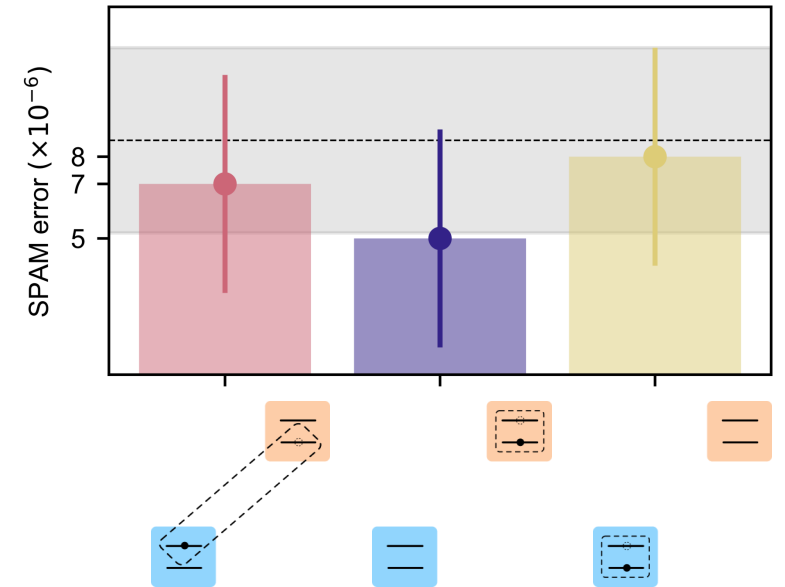
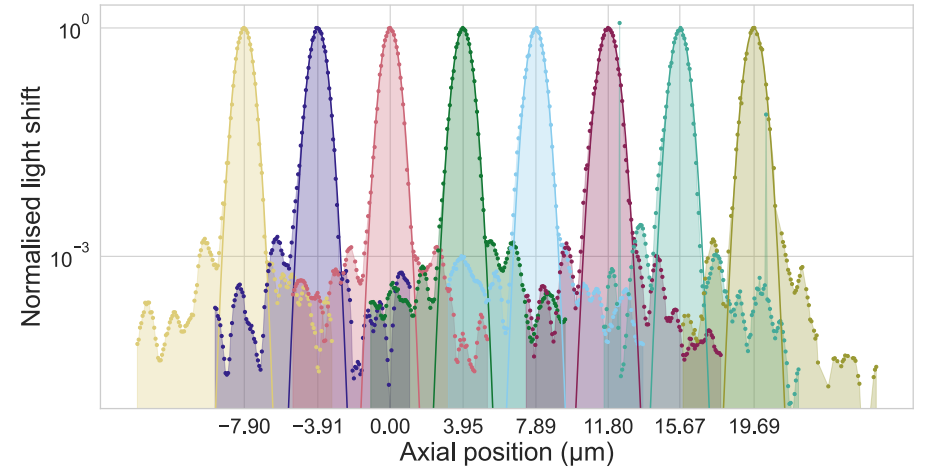






Summary

- Individual addressing of Raman lasers with low crosstalk
- Use this to perform individually addressed dissipative operations, including world-record SPAM
- Next steps:
 - Entangling gates
 - More than one qubit per ion?



The Oxford ion trapping group

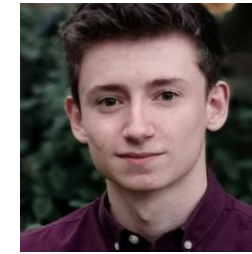
The ABaQuS project



Andres
Vazquez-Brennan
Graduate Student



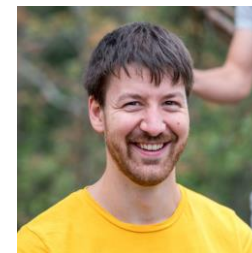
Ana Sotirova
Graduate Student



Jamie Leppard
Graduate Student



Sophie Decoppet
Graduate Student



Fabian Pokorny
Postdoc



David Nadlinger
Postdoc



Chris Ballance
PI

Innovate UK



Maciej Malinowski
Oxford Ionics

