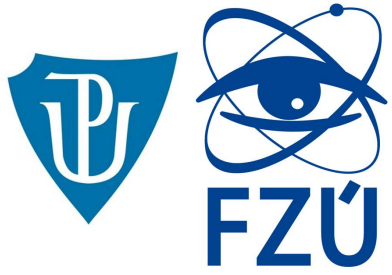
Quantum cryptography for socio-economic problems



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QIPA 2018,
HRI Allahabad
December 05, 2018

Quantum cryptography for socio-economic problems

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Jaypee Institute of Information Technology,
Noida, India

QIPA 2018,
HRI Allahabad

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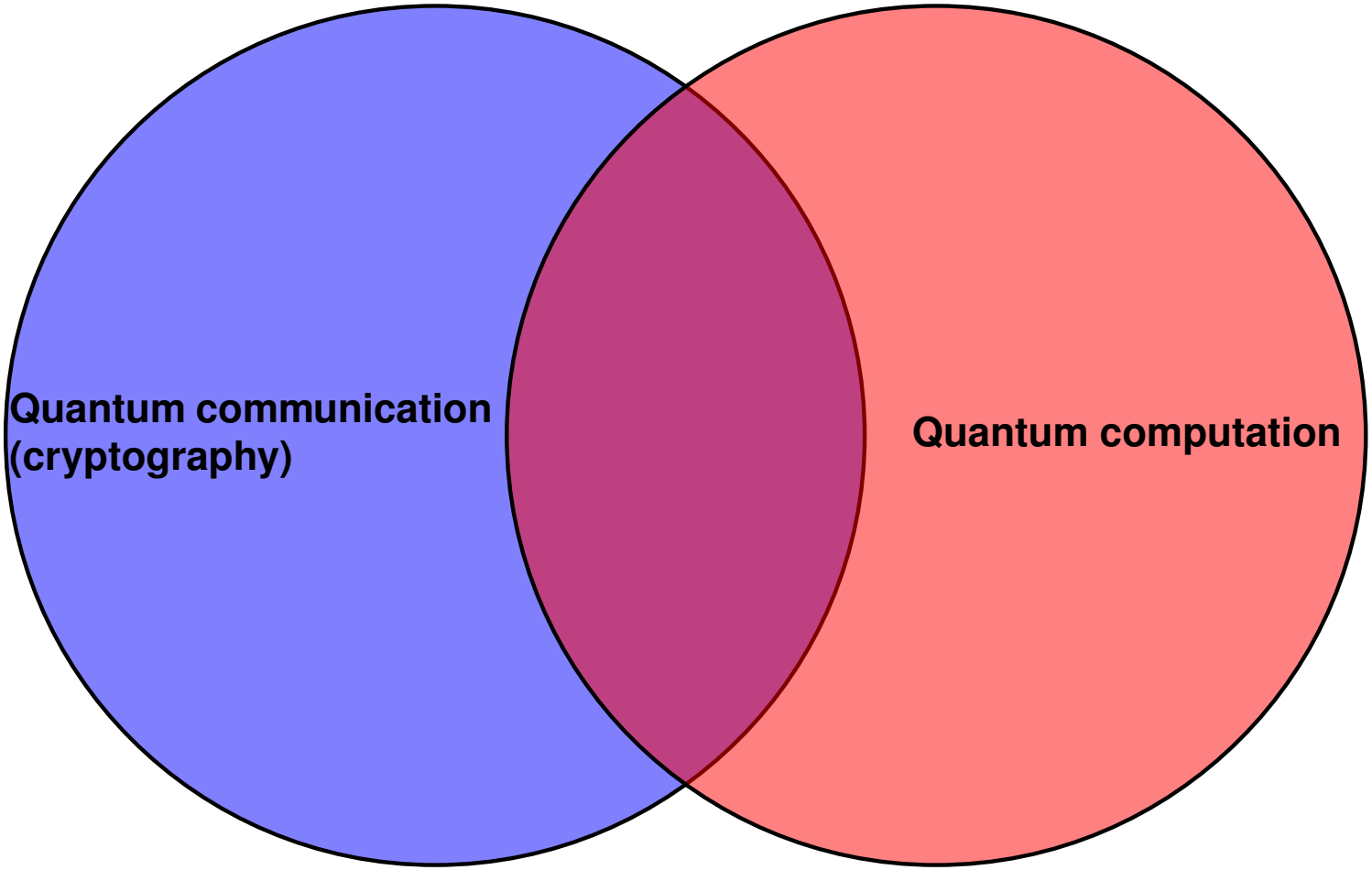
Outline

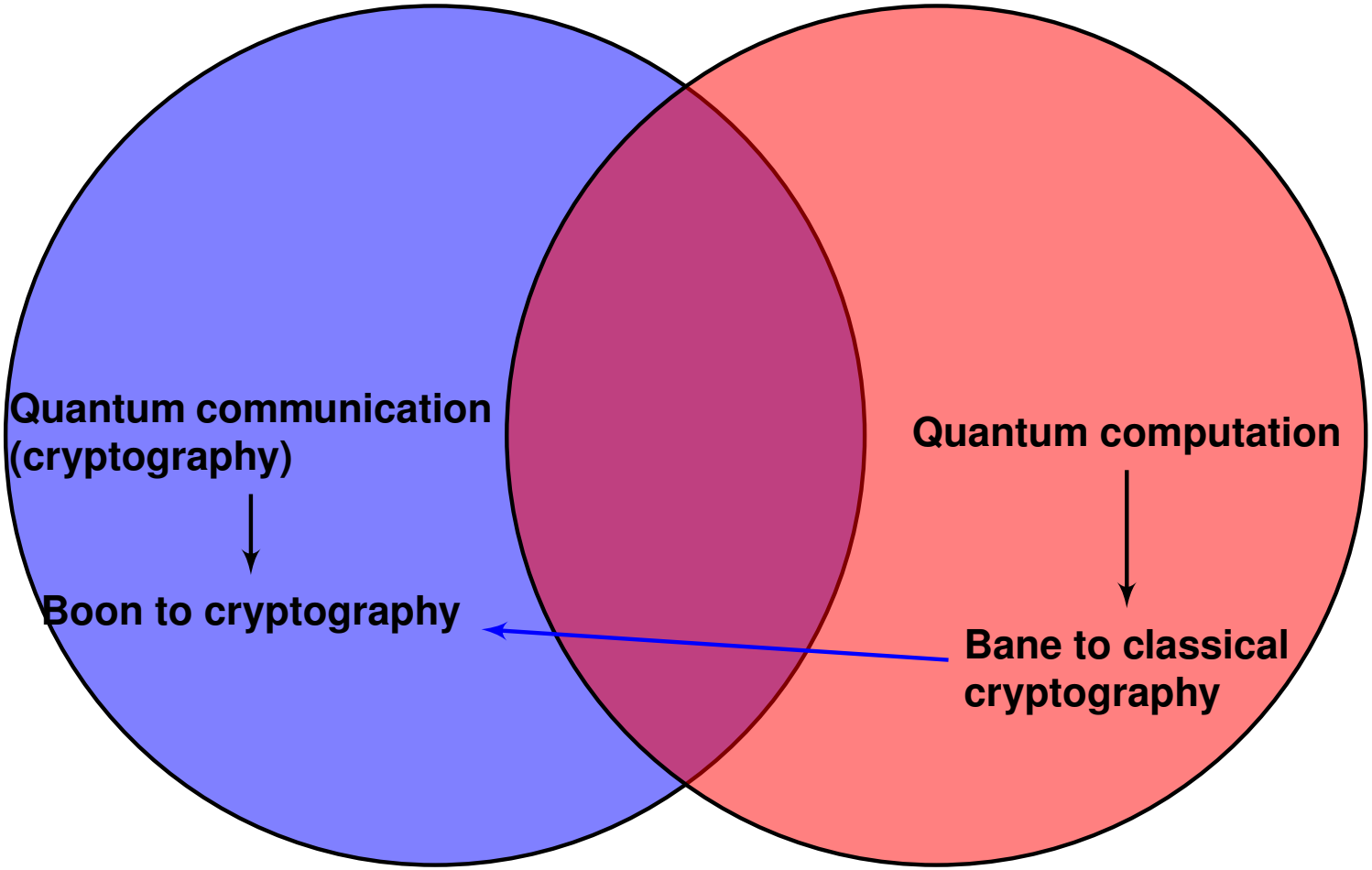
1. Quantum information processing: Quantum communication and computation
2. Secure multiparty computation
3. Quantum solutions for socio-economic problems

Outline

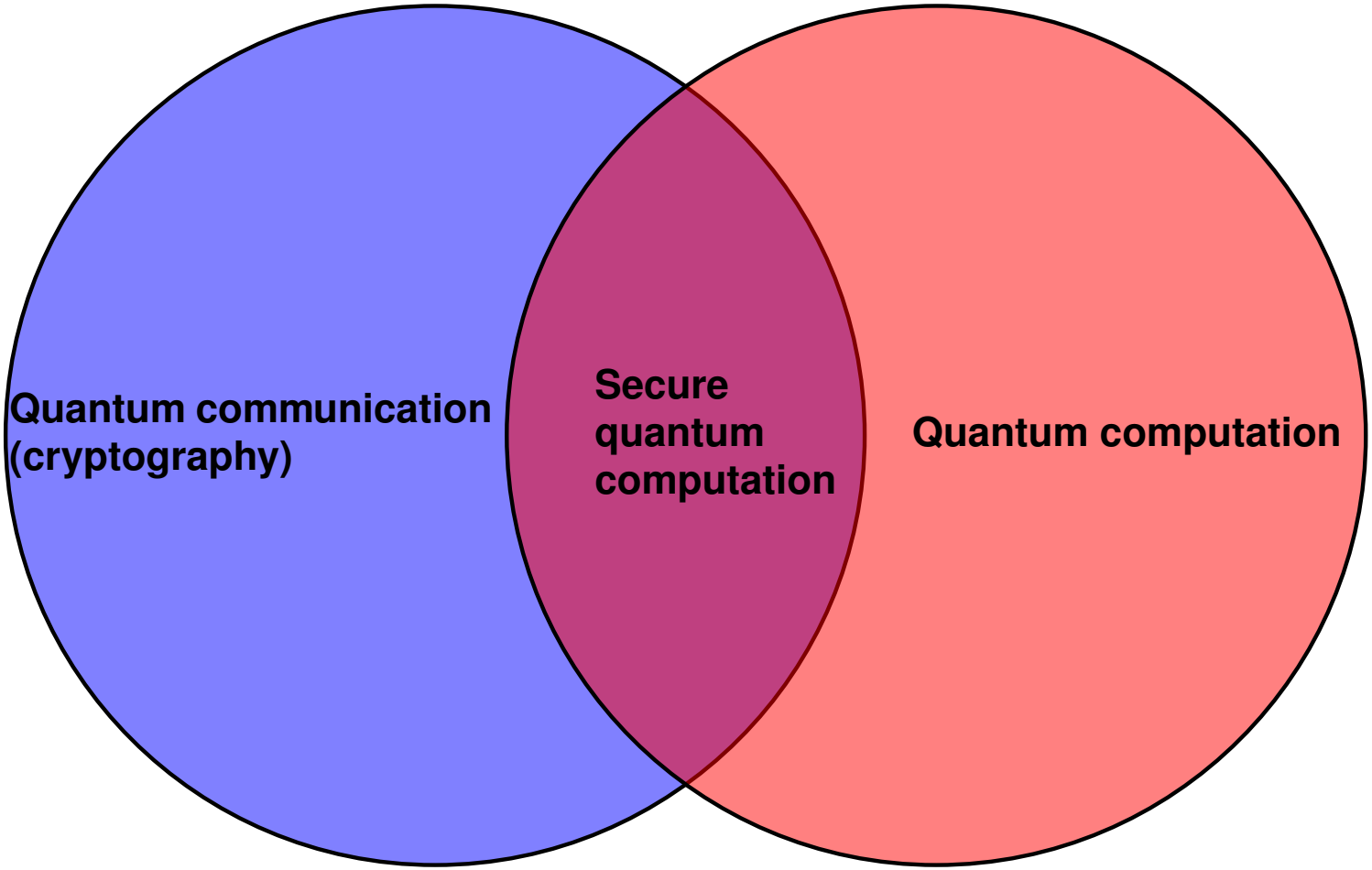
Quantum information processing: Boon or bane?



Quantum information processing: Boon or bane?

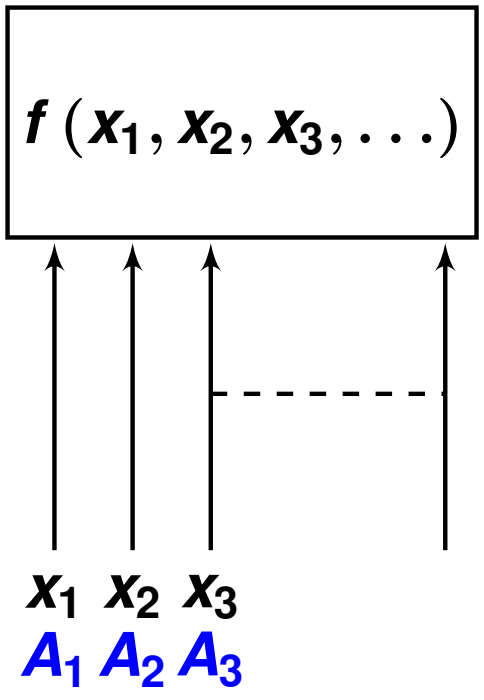


Quantum information processing: Boon or bane?

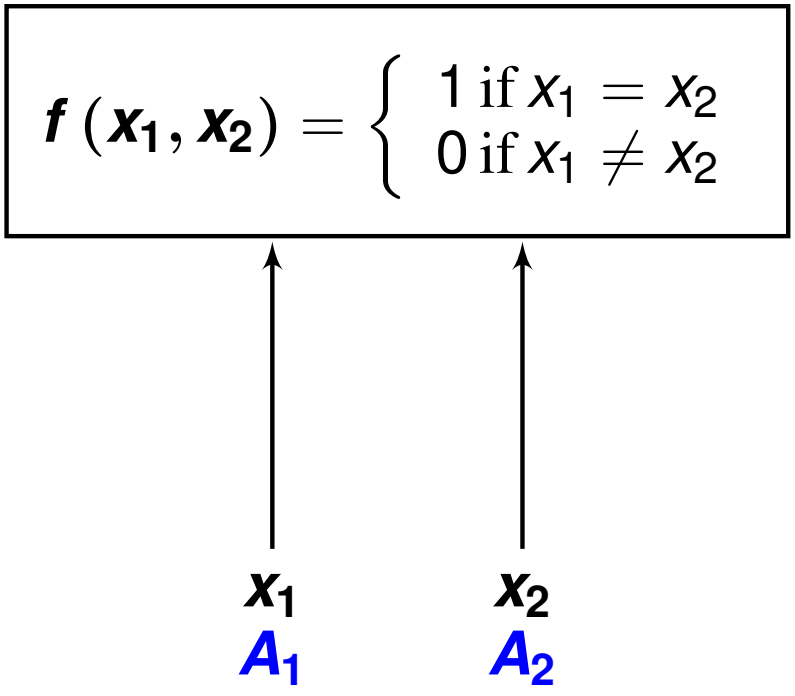


Outline

Idea of secure computation



Example: Quantum private comparison/ Socialist millionaire problem

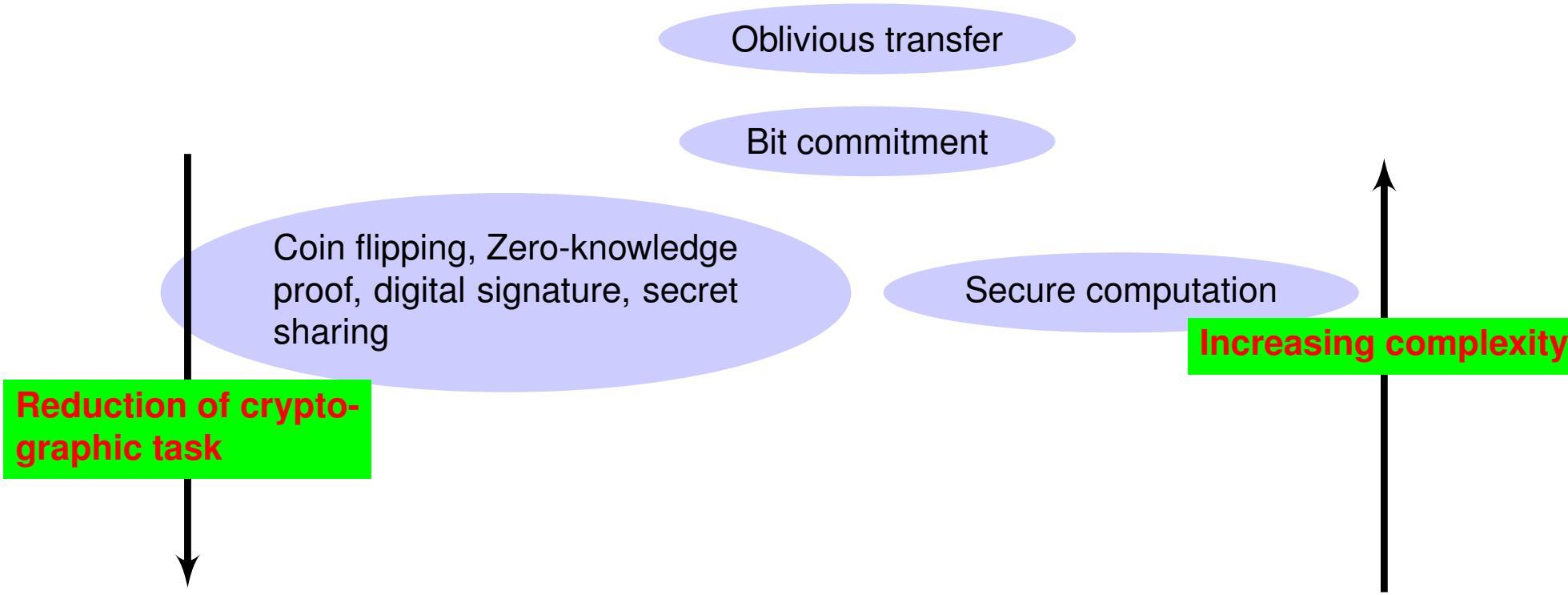


Secure computation in real life scenarios

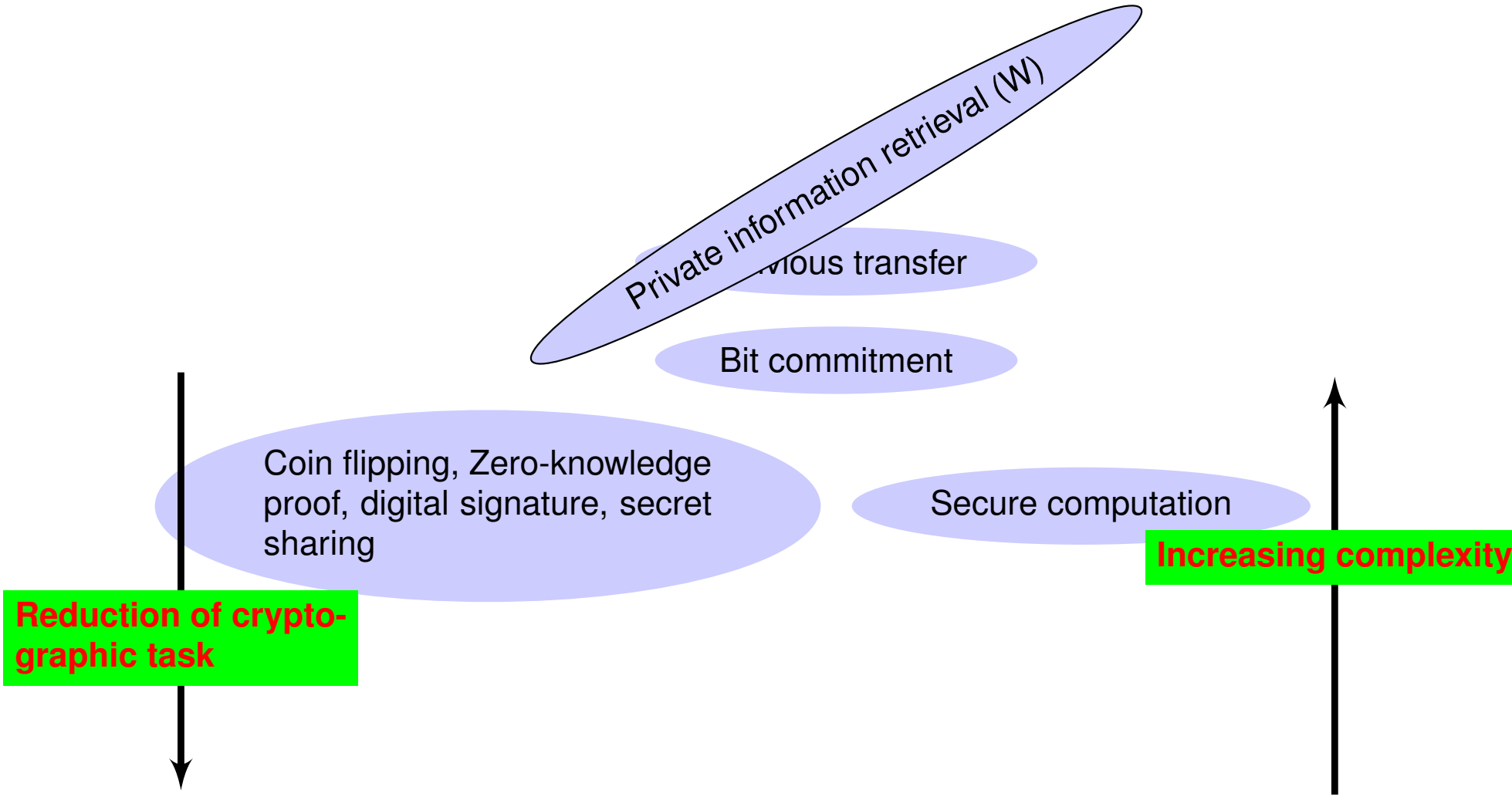
Private information retrieval

Also, in secure supply chain collaboration, as a countermeasure against (mainly hardware) side-channel attacks, and to avoid satellite collisions.

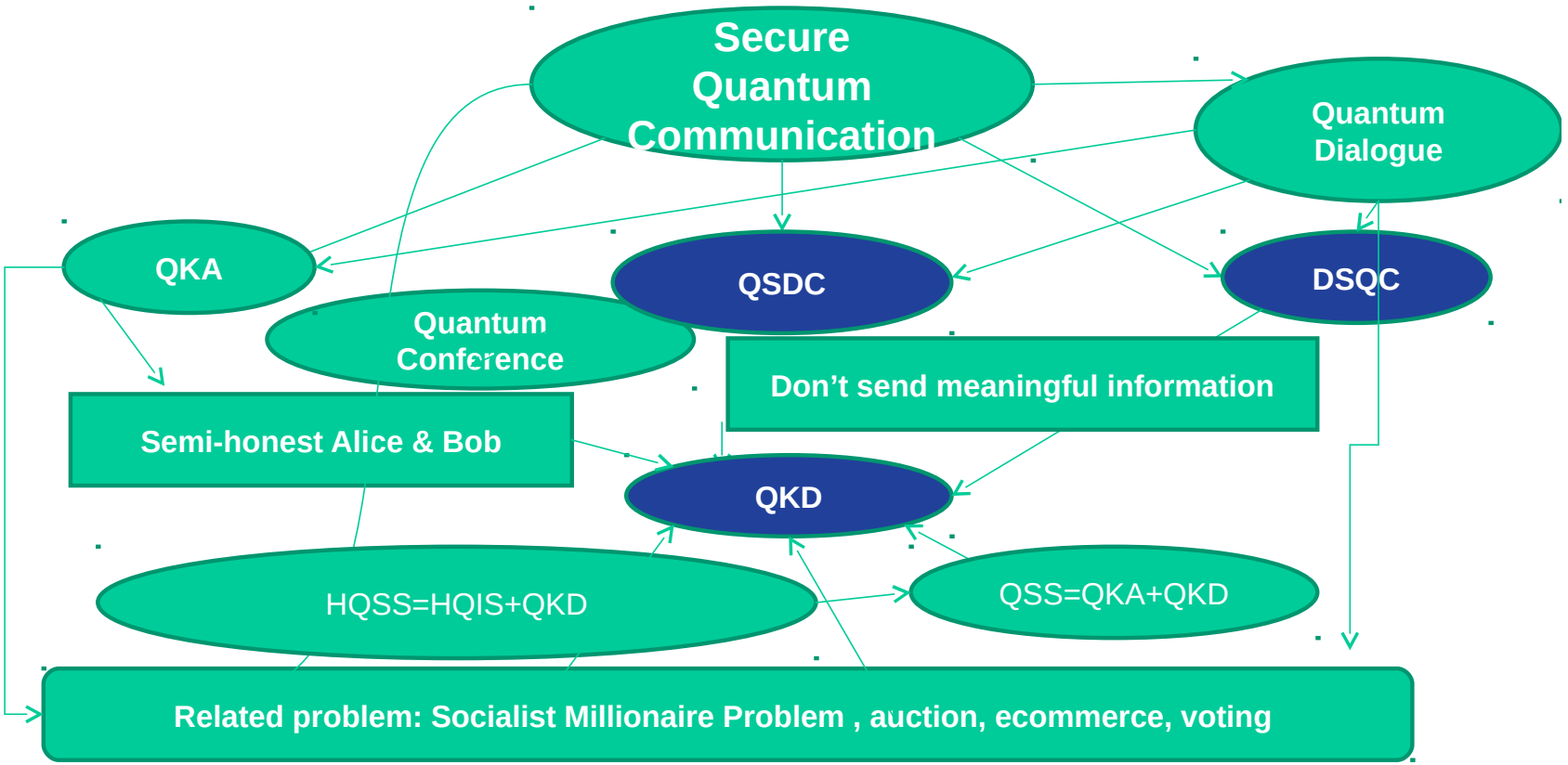
Secure computation and hierarchy of cryptographic primitives



Secure computation and hierarchy of cryptographic primitives

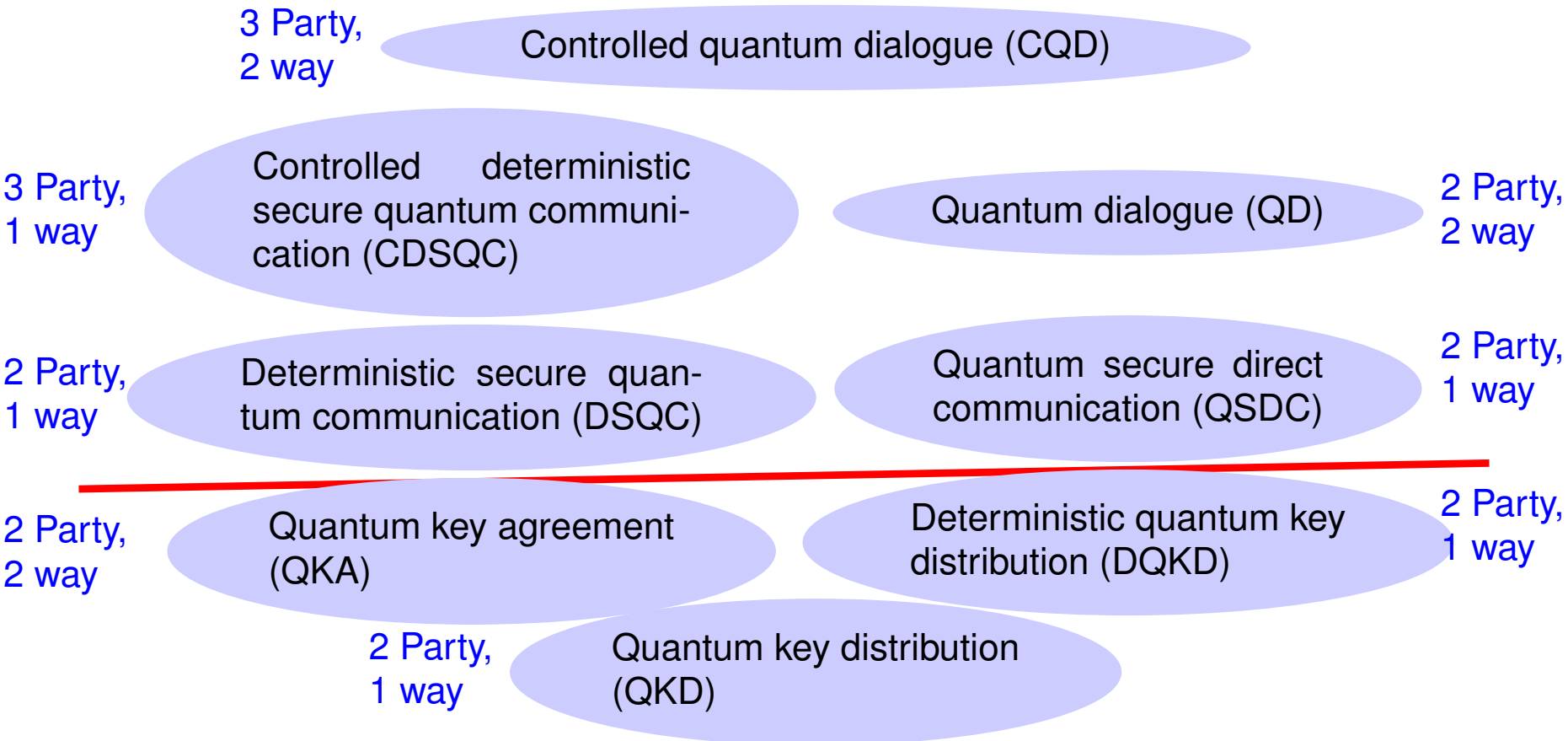


Quantum cryptography



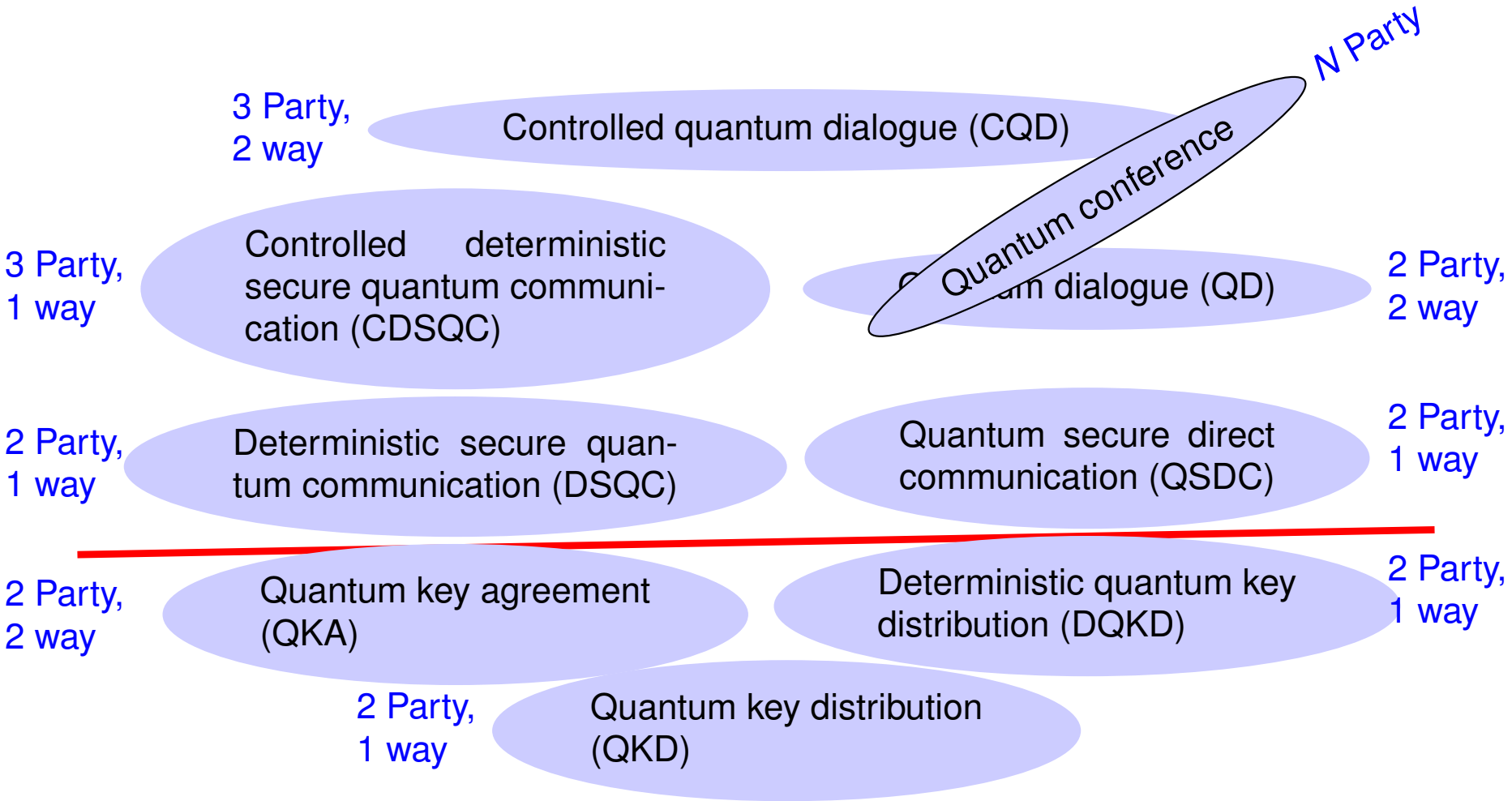
Other relevant problems: HQSS, HDQSS, CQD, C-DSQC, Crypto-Switch, etc.

Hierarchy of quantum cryptography tasks



***K. Thapliyal**, A. Pathak, and S. Banerjee, Quantum cryptography over non-Markovian channels, Quantum Inf. Process. 16, 115 (2017).*

Hierarchy of quantum cryptography tasks



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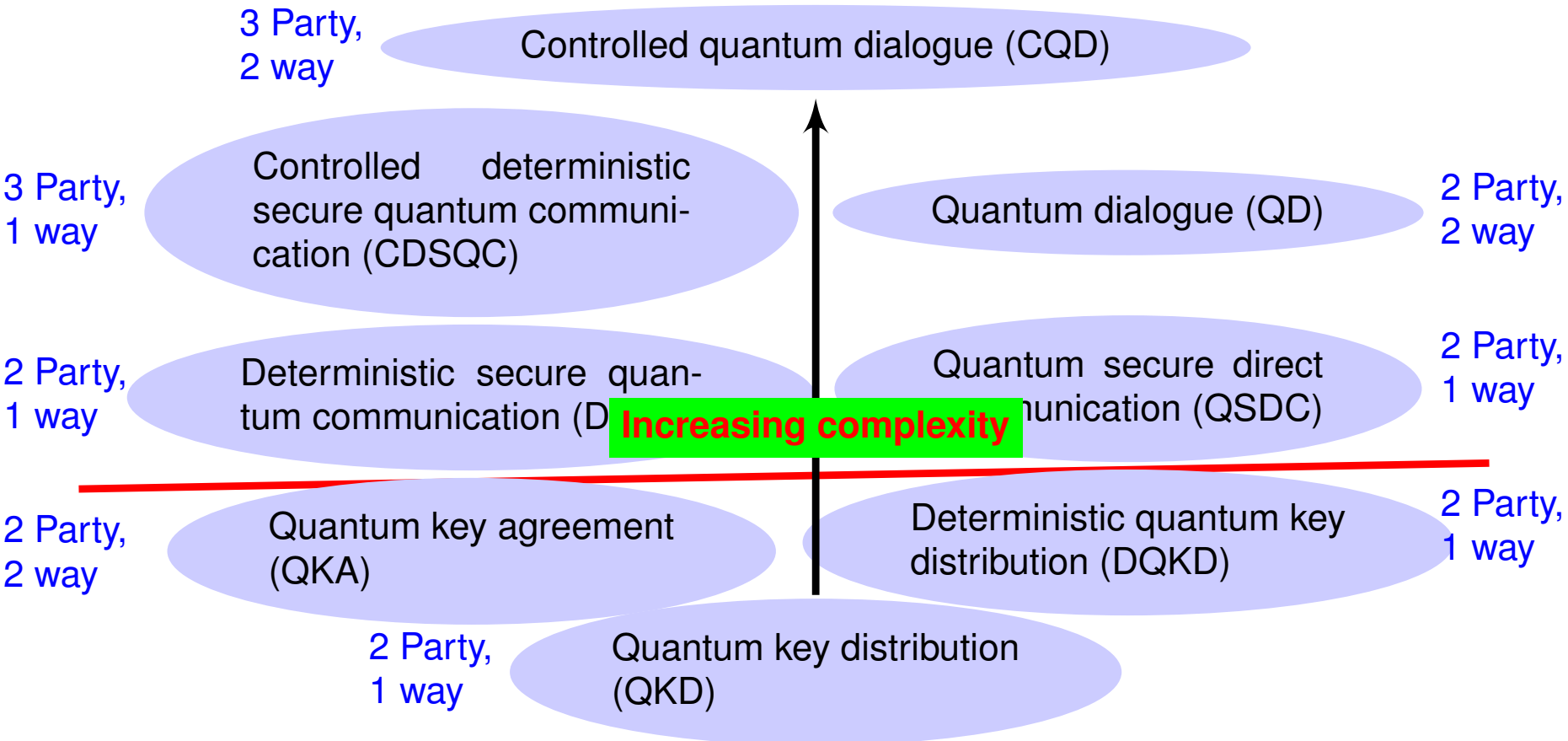

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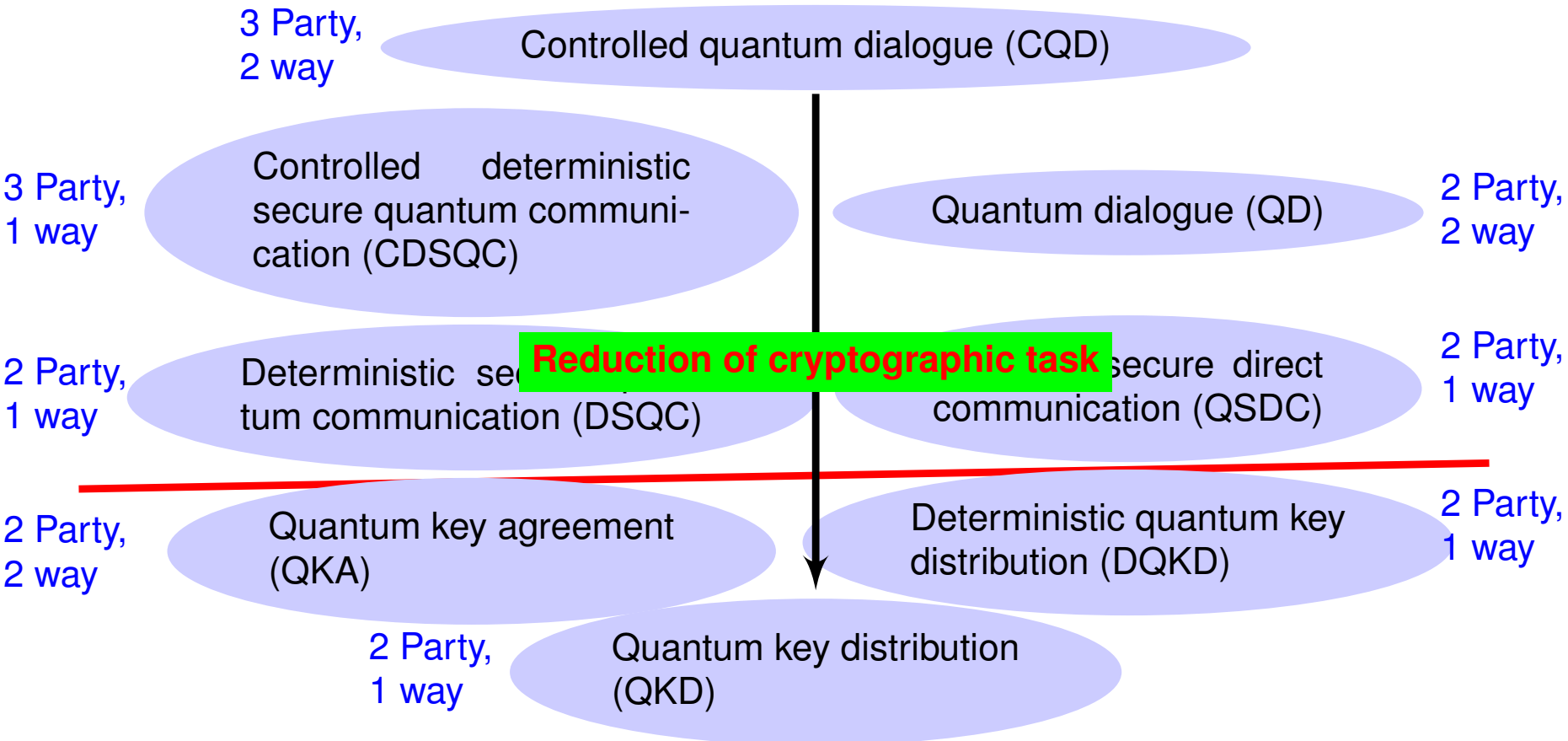

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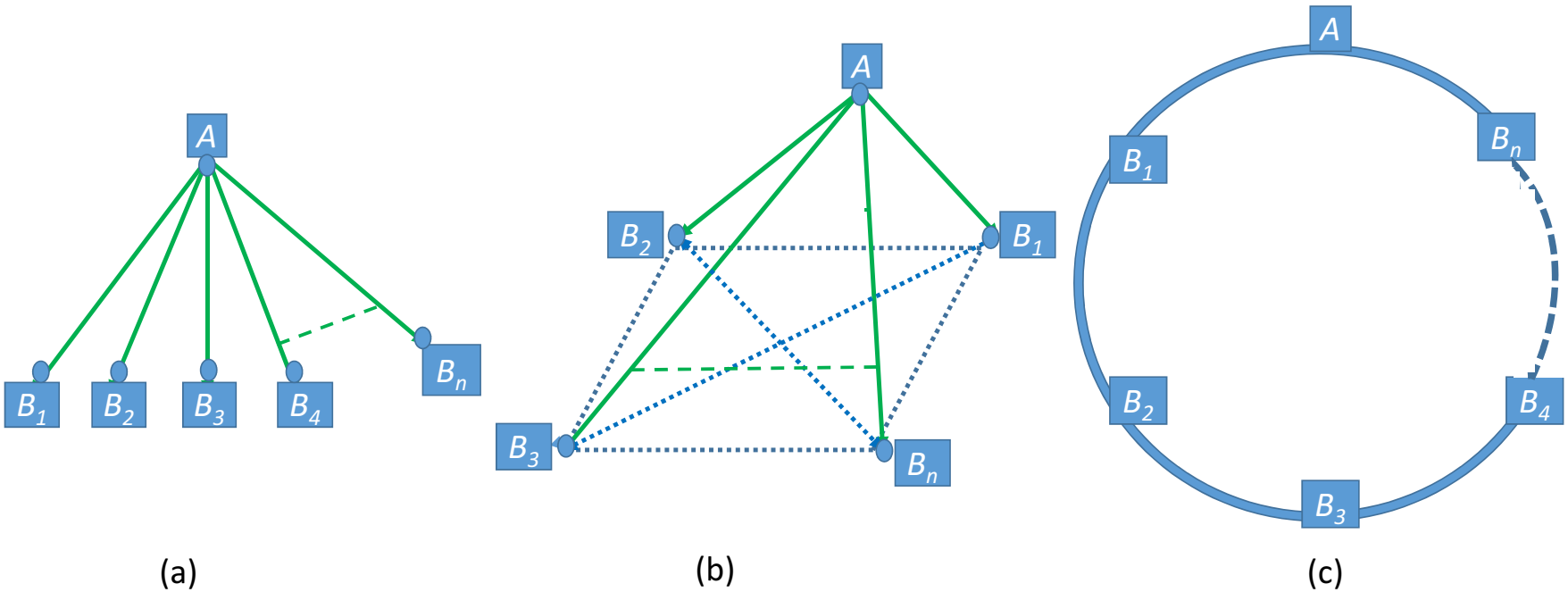
Outline

Sealed bid quantum auction

Task: $f(x_1, x_2, x_3, \ldots, x_n) = \max(x_1, x_2, x_3, \ldots, x_n)$



A: Auctioneer; **B:** Bidder

*R. D. Sharma, **K. Thapliyal**, and A. Pathak, Quantum sealed-bid auction using a modified scheme for multiparty circular quantum key agreement, Quantum Inf. Process. 16, 169 (2017).*

Sealed bid quantum auction

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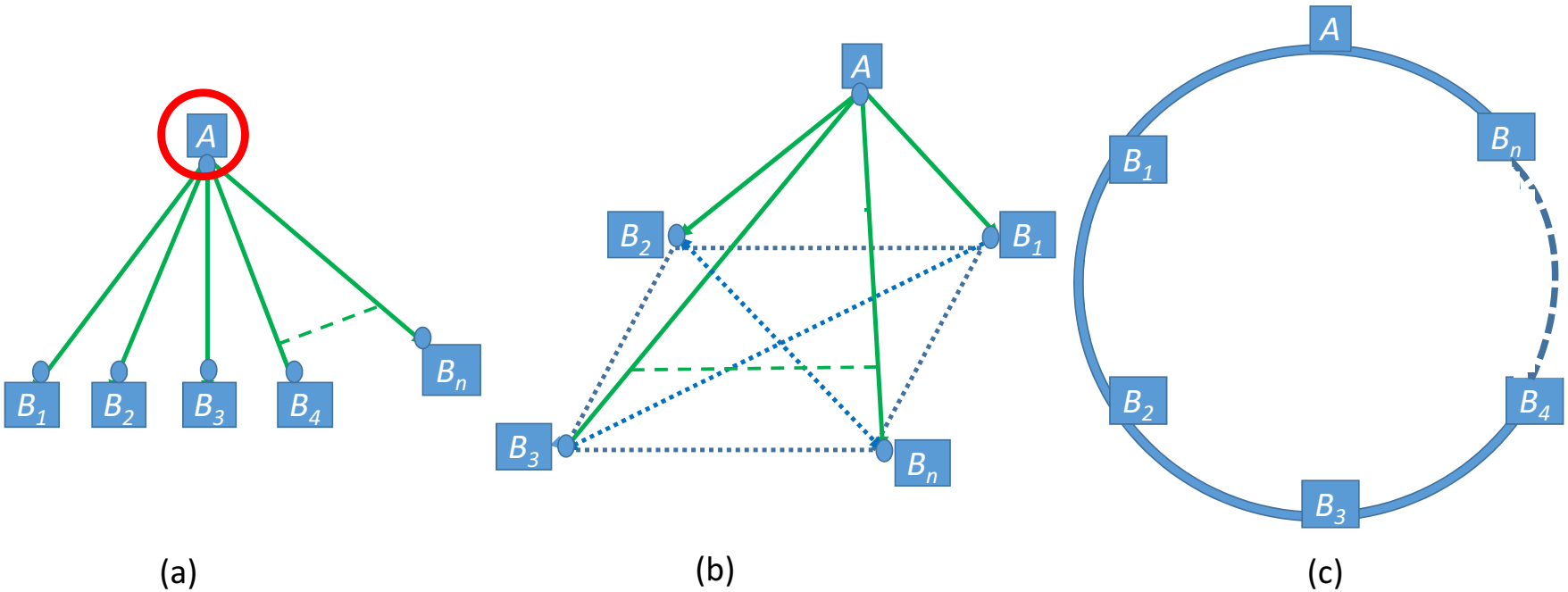

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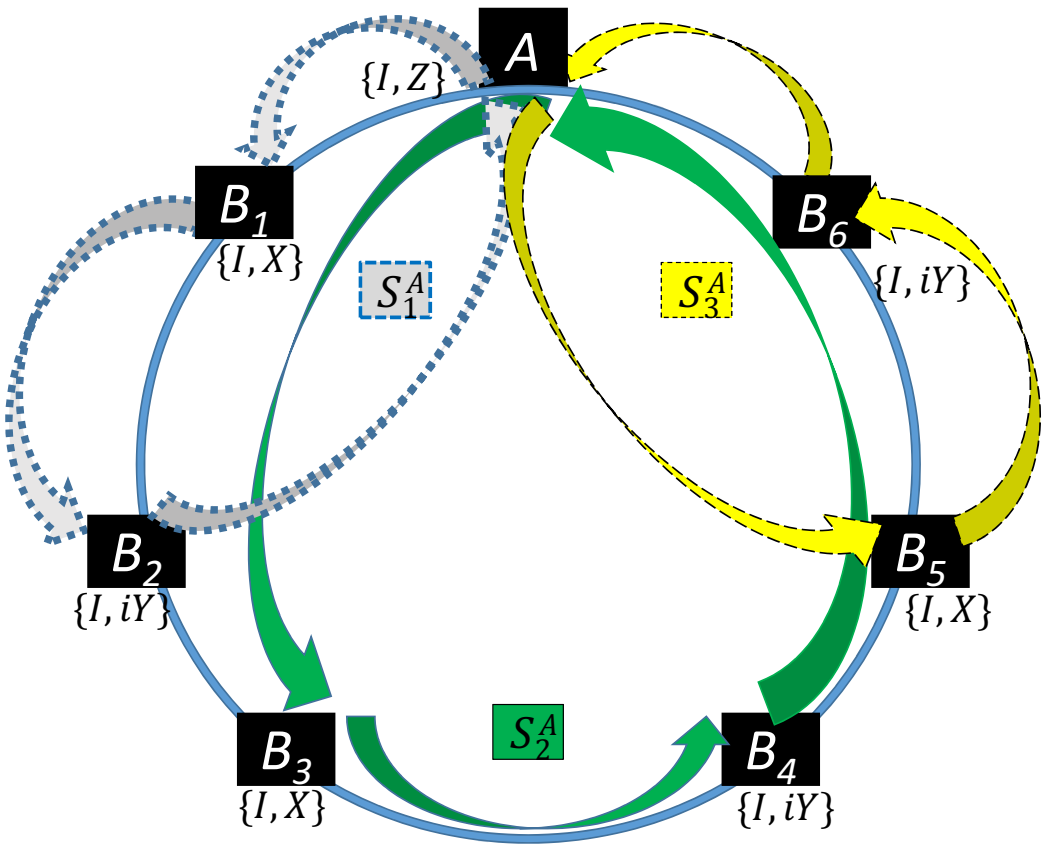
Sealed bid quantum auction



Salient features of our scheme:

1. A complete-graph structure is transformed to a circular structure and subsequently that to sub-circles.
2. With an increase in the number of sub-circles, the size of the entangled state required reduces whereas the security against collusion attack increases.
3. This trade-off lessen the requirement of multipartite entanglement, hard to prepare and maintain, leads to better security, and scalability.
4. The present scheme can be performed without an auctioneer.

*R. D. Sharma, **K. Thapliyal**, and A. Pathak, Quantum Inf. Process. 16, 169 (2017).*

Quantum private comparision

Task: $f(x_1, x_2) = \begin{cases} 1 \text{ if } x_1 = x_2 \\ 0 \text{ if } x_1 \neq x_2 \end{cases}$

TP

Millionaire 1

Millionaire 2

***K. Thapliyal**, R. D. Sharma, and A. Pathak, Int. J. Quantum Inf. 16, 1850047 (2018).*

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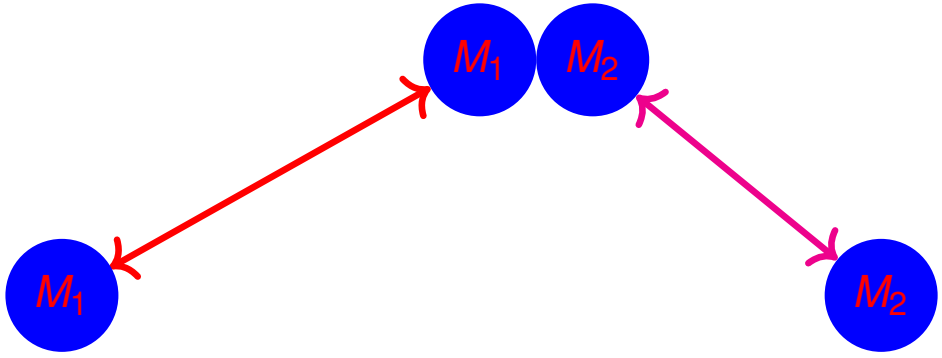

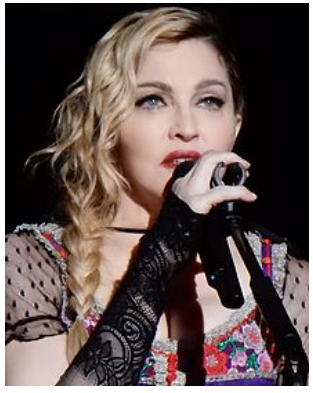

Millionaire 1

Millionaire 2

***K. Thapliyal**, R. D. Sharma, and A. Pathak, Int. J. Quantum Inf. 16, 1850047 (2018).*

Quantum voting

Task: $f(x_1, x_2, x_3, \ldots, x_n) = \sum_i x_i \; \forall x_i : \left\{ \begin{array}{c} x_i = 0 \text{ for “no”} \\ x_i = 1 \text{ for “yes”} \end{array} \right\}$

Voter

K. Thapliyal, *R. D. Sharma, A. Pathak, Int. J. Quantum Inf. 15, 1750007 (2017).*

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Tallyman

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Controller

Tallyman

Voter

***K. Thapliyal**, R. D. Sharma, A. Pathak, Int. J. Quantum Inf. 15, 1750007 (2017).*

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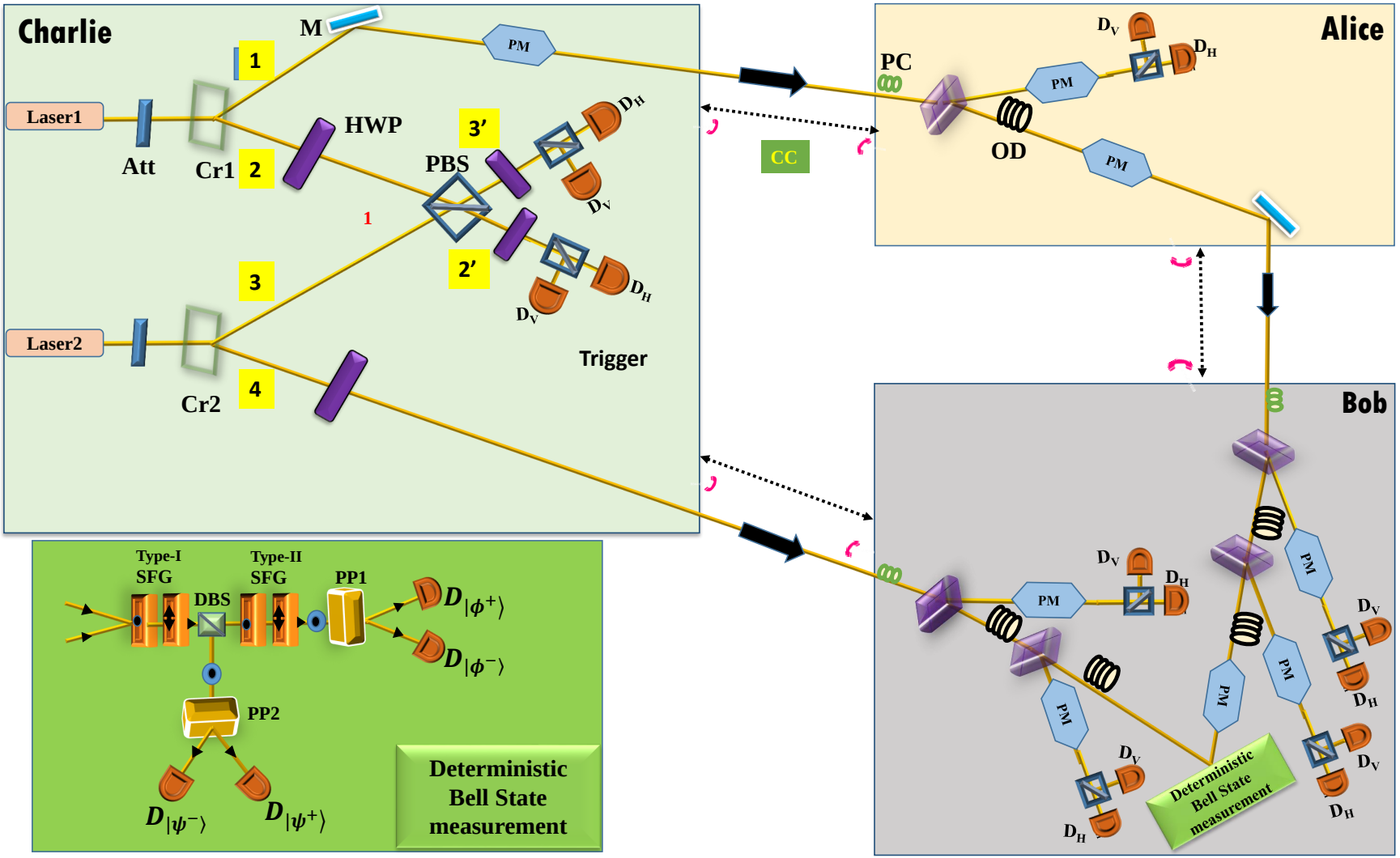
***K. Thapliyal**, R. D. Sharma, A. Pathak, Int. J. Quantum Inf. 15, 1750007 (2017).*

Optical design for controlled quantum dialogue



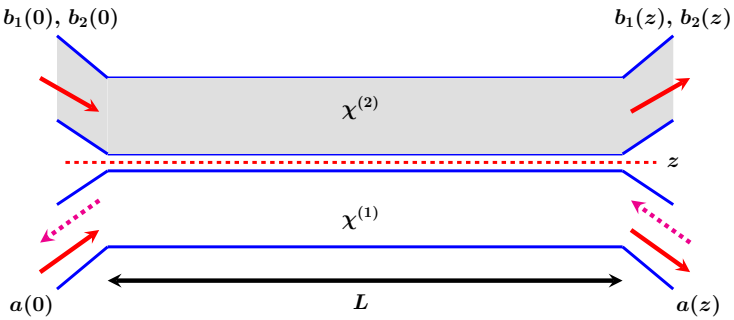
Activities in the field of quantum optics

Optical cavity PRA 97, 063840 (2018) & arXiv: 1708.03967 & Light-semiconductor arXiv:1811.09849

Quantum Zeno effect PRA 93, 022107 (2016) & Parity-Time symmetry arXiv:1811.05604

BEC systems Phys. A 466, 140 (2017) & arXiv: 1708.03967

Spin states Ann. Phys. 362, 261 (2015) & Tomograms Ann. Phys. 366, 148 (2016)



Nonlinear optical couplers PRA 90, 013808 (2014) & PLA 378, 3431 (2014)

Optomechanical system arXiv: 1708.03967 & Coherence arXiv:1811.05599

Engineered quantum states PLA 381, 3178 (2017) & arXiv:1808.01458

Raman and hyper-Raman processes arXiv:1710.04456

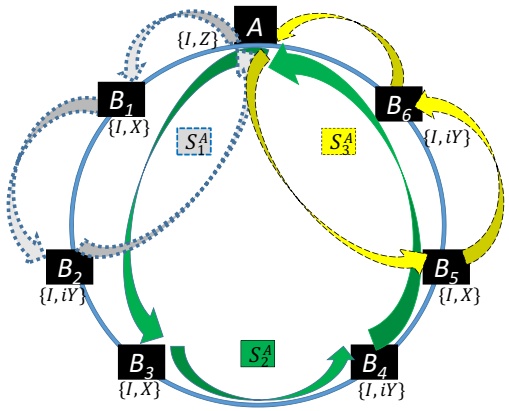
Activities in the field of quantum communication

Teleportation QINP 16, 76 (2017) & QINP 16, 292 (2017) & Controlled teleportation QINP 14, 2599 (2015) & QINP 14, 4601 (2015)

Hierarchical quantum communication QINP 16, 205 (2017)

Direct secure quantum communication QINP 16, 115 (2017) & QINP 17, 229 (2018)

Quantum voting IJQI 15, 1750007 (2017) & Decoy qubits QINP 15, 1703 (2016) & QINP 15, 4681 (2016)



Quantum key distribution arxiv:1609.07473v1 (2016) & Quantum conference QINP 17, 161 (2018)

Controlled direct secure quantum communication QINP 16, 115 (2017) & Semi-quantum QINP 16, 295 (2017) & IJQI 16, 1850047 (2018)

Quantum sealed bid auction QINP 16, 169 (2017) & Asymmetric quantum dialogue QINP 16, 49 (2017)

Quantum e-commerce QINP 16, 295 (2017) & arXiv:1807.08199 & Quantum private comparison IJQI 16, 1850047 (2018)

THANK YOU