Informazione Quantistica
e
Fondamenti della Meccanica Quantistica
e della teoria di Campo Quantistica

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Corsi

Teoria Fisica dell'Informazione (F03)

Fondamenti della Meccanica Quantistica (F02)

Fisica Quantistica della Computazione (F03)

Ottica Quantistica (F03)

Complementi di Meccanica Statistica (F02)

Metodi Matematici 3 (M07)

Linee di ricerca

Quantum Information and Computation

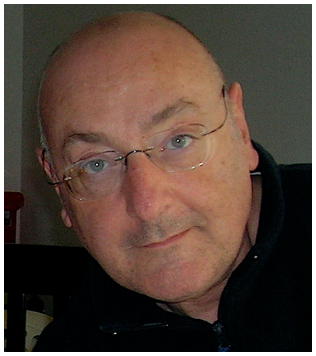
Quantum Metrology

Foundations of Quantum Theory

Foundations of Quantum Field Theory

Nicola Mosco

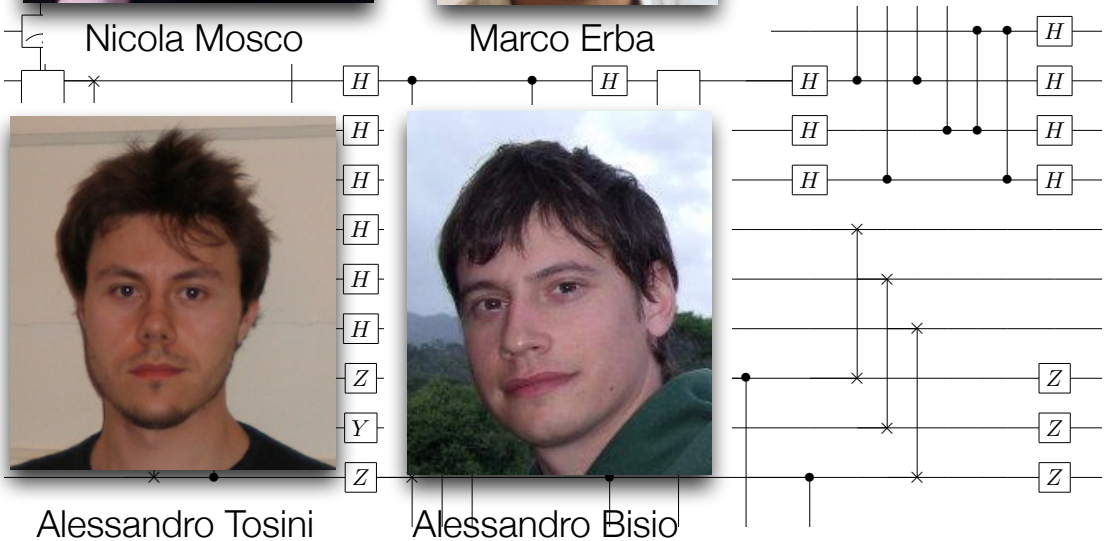
Marco Erba



Giacomo Mauro D'Ariano

Paolo Perinotti

Massimiliano Sacchi



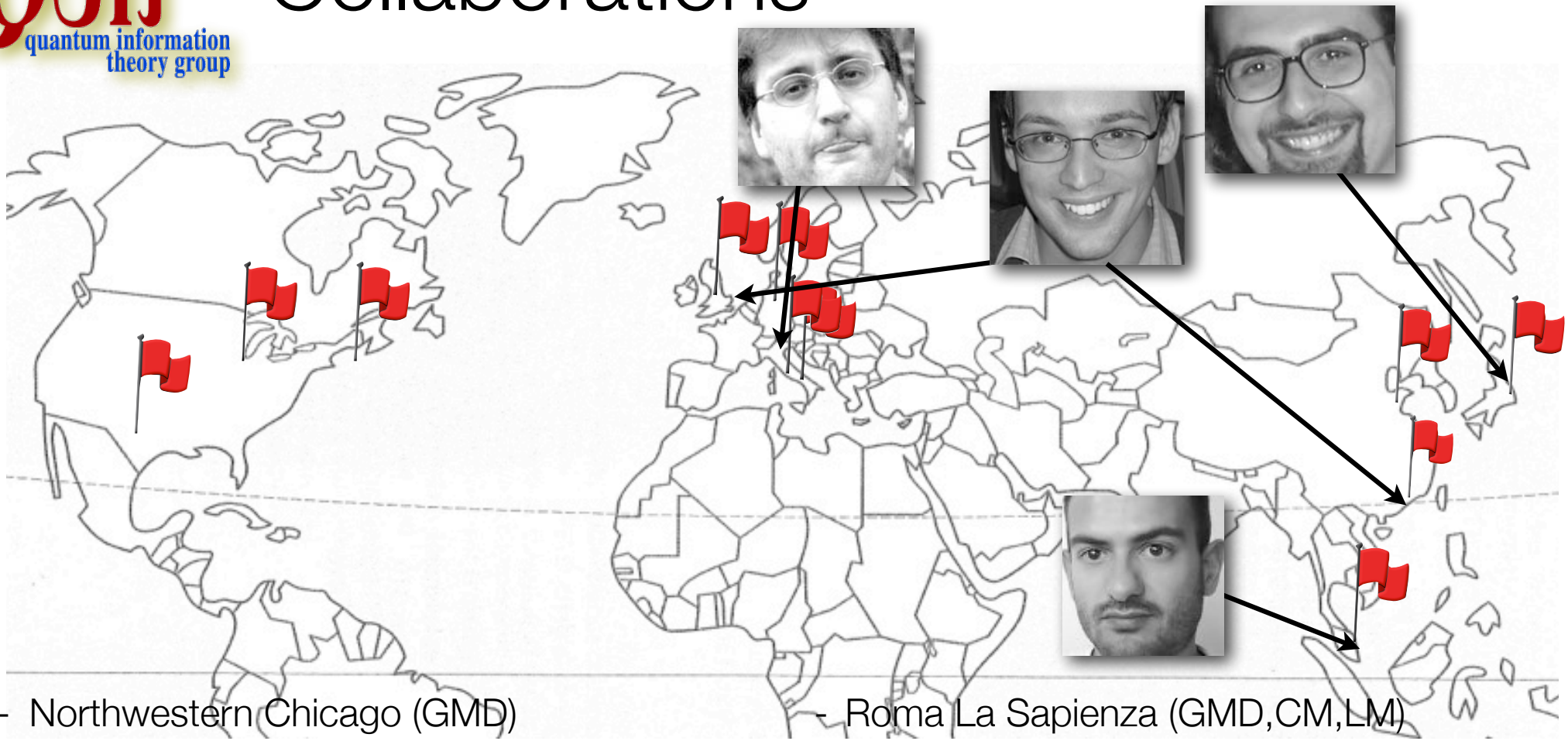
Alessandro Tosini

Alessandro Bisio

Lorenzo Maccone

Chiara Macchiavello

Collaborations



- Northwestern Chicago (GMD)
- U. Chicago, U. Illinois Chicago (GMD)
- Hannover (GMD,PP)
- MIT Boston (LM)
- Tsinghua Beijing (GMD,PP)
- Nagoya (GMD,PP)
- Singapore (CM)
- Roma La Sapienza (GMD,CM,LM)
- Dusseldorf, Edimburgo (CM)
- Normale Pisa (LM)
- Los Alamos (LM)
- Oxford, Cambridge (GMD,PP,CM)
- ETH Zurigo (PP,GMD)
- Bratislava (PP,GMD)

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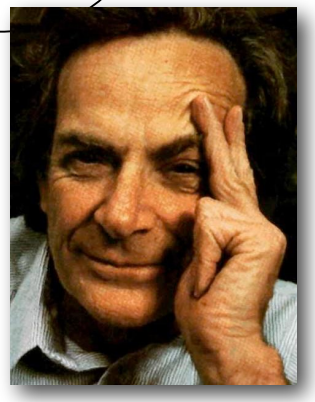
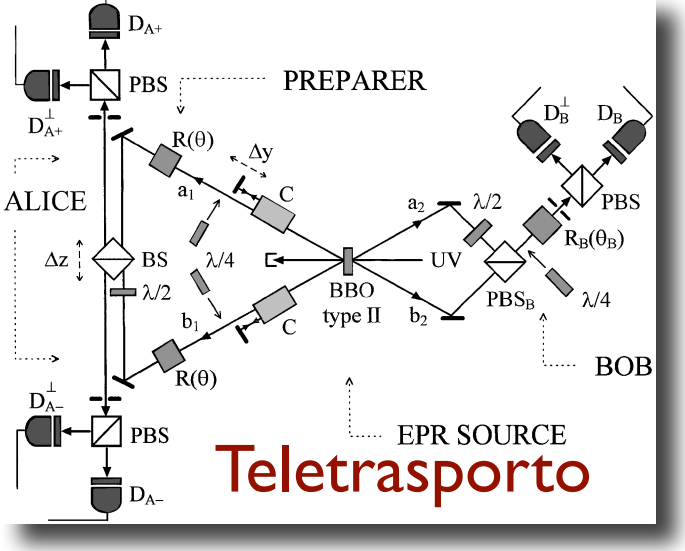
PHYSICS IS INFORMATION





Teletrasporto

Quantum Computer

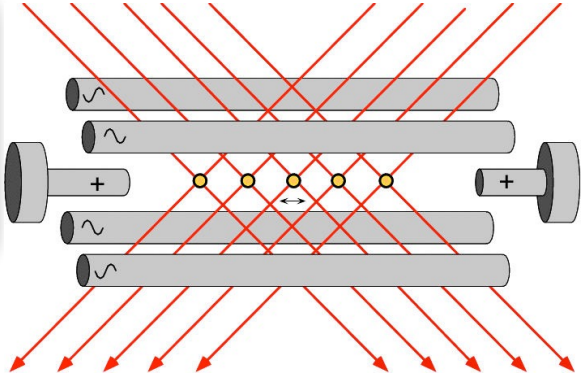
NEW TECHNOLOGY

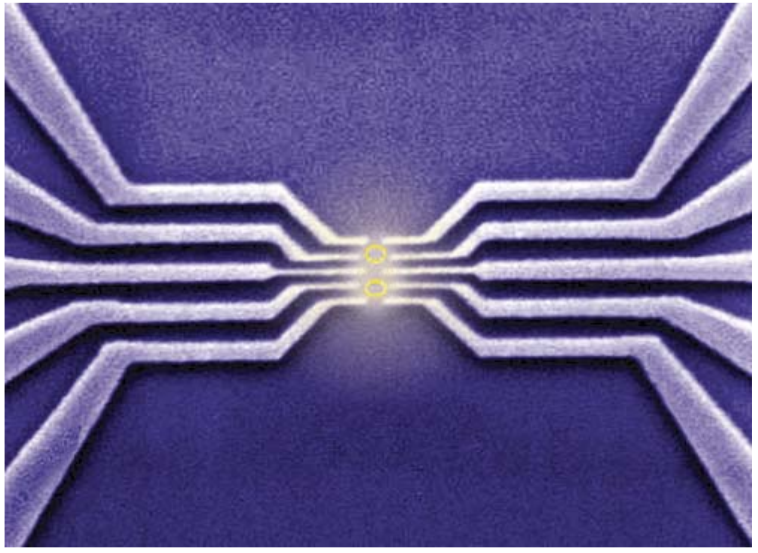
QUANTUM INFORMATION

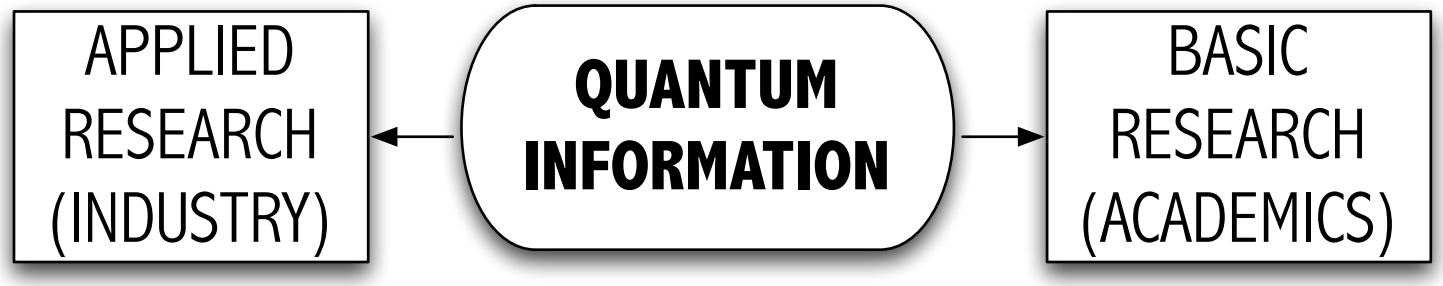
FOUNDATIONS OF QUANTUM MECHANICS

COMPUTER SCIENCE

INFORMATION SCIENCE







Cultura generale di Fisica Contemporanea

- Meccanica Quantistica sistemi aperti e misurazione, POVMs, ..., Tomografia Quantistica, cloning
- Non località e entanglement
- Master Equation
- Metodi ottimizzazione e teoria della stima, approcci Bayesiani
- Teoremi di Shannon, entropie, mutua informazione
- Data-processing theorems, channel capacity
- Algoritmi e complessità computazionale
- Crittografia Quantistica
- Ottica non lineare quantistica, misurazioni quantistiche ottiche
- Fondamenti della teoria quantistica e della teoria di campo
- Automi cellulari quantistici

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Lorenzo Maccone

Quantum Metrology

Nuova relazione di indeterminazione
[Lorenzo Maccone and Arun K. Pati, PRL **113** 260401 (2014)]

Strategie metrologiche che usano l'entanglement contro il noise
[R. Demkowicz-Dobrzański and L. Maccone, PRL **113** 250801 (2014)]

Quantum Information

Relazione tra entanglement e complementarietà
[L. Maccone, D. Bruß, and C. Macchiavello, PRL **114** 130401 (2015)]

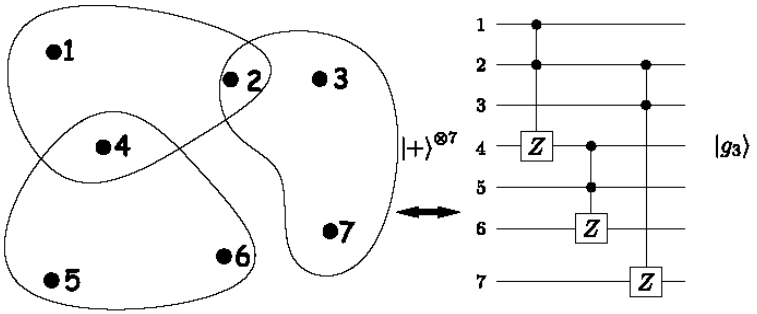
Foundations of QM

Quantizzazione del tempo
[V. Giovannetti, S. Lloyd, L. Maccone arXiv:1504.04215]

Chiara Macchiavello

Study of entanglement in quantum computation via hypergraph states

Rossi, Huber, Bruss and Macchiavello, NJP 15 (2013)



Study of entanglement via complementary properties

Maccone, Bruss & Macchiavello, Phys. Rev. Lett. 114, 130401 (2015)

Noisy quantum channels: developing methods to detect them and optimizing information transmission

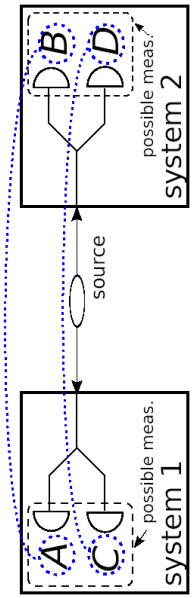
C. Macchiavello and M. Rossi, Phys. Rev. A 88 (2013); Orieoux, Sansoni, Persechino, Mataloni, Rossi & Macchiavello, Phys. Rev. Lett. 111 (2013); D'Arrigo, Benenti, Falci & Macchiavello, Phys. Rev. A 88 (2013)

Quantum information with non Markovian noise

Addis, Haikka, McEndoo, Macchiavello & Maniscalco, Phys. Rev. A 87 (2013);

Liu, Hu, Huang, Li, Guo, Karlsson, Laine, Maniscalco, Macchiavello & Piilo, Europhys. Lett. 114, 10005 (2016)

Chruscinski, Macchiavello and Maniscalco, Phys. Rev. Lett. 118, 080404 (2017)



Methods for entanglement detection

Macchiavello & Morigi, Phys. Rev. A 87 (2013); Borrelli, Rossi, Macchiavello & Maniscalco, Phys. Rev. A 90 (2014)

Quantum correlations without entanglement

Orieux, Ciampini, Mataloni, Bruss, Rossi & Macchiavello, Phys. Rev. Lett. 115, 160503 (2015)

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Massimiliano Sacchi

(con C. Macchiavello)

Stima della capacità quantistica di canali con set limitati di misure

procedura sperimentale facilmente accessibile e versatile

stato di ingresso fissato, poche misure locali, senza necessità di tomografia completa

fornisce limiti inferiori alla capacità quantistica per canali ignoti, di cui anche teoricamente non si conosce la capacità

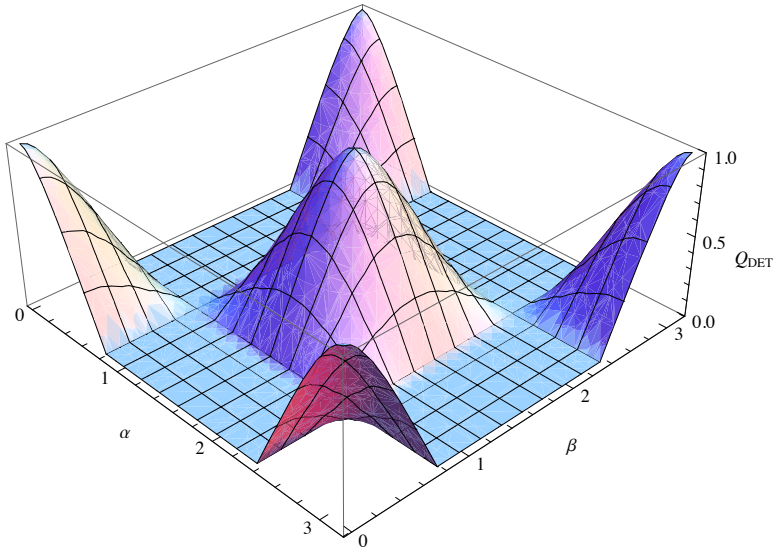
applicabile anche a canali correlati e con memoria

$$\mathcal{E}(\rho) = \sum_{i=1}^{2} A_i \rho A_i^\dagger \ ,$$

$$A_1 = \begin{pmatrix} \cos\alpha & 0 \\ 0 & \cos\beta \end{pmatrix}, \quad A_2 = \begin{pmatrix} 0 & \sin\beta \\ \sin\alpha & 0 \end{pmatrix}$$

$\alpha = \beta$ ‘dephasing’

$\beta = 0$ ‘damping’



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Foundations of QT and QFT

Giacomo Mauro D'Ariano, Paolo Perinotti

Principles for Quantum Theory

P1. Causality

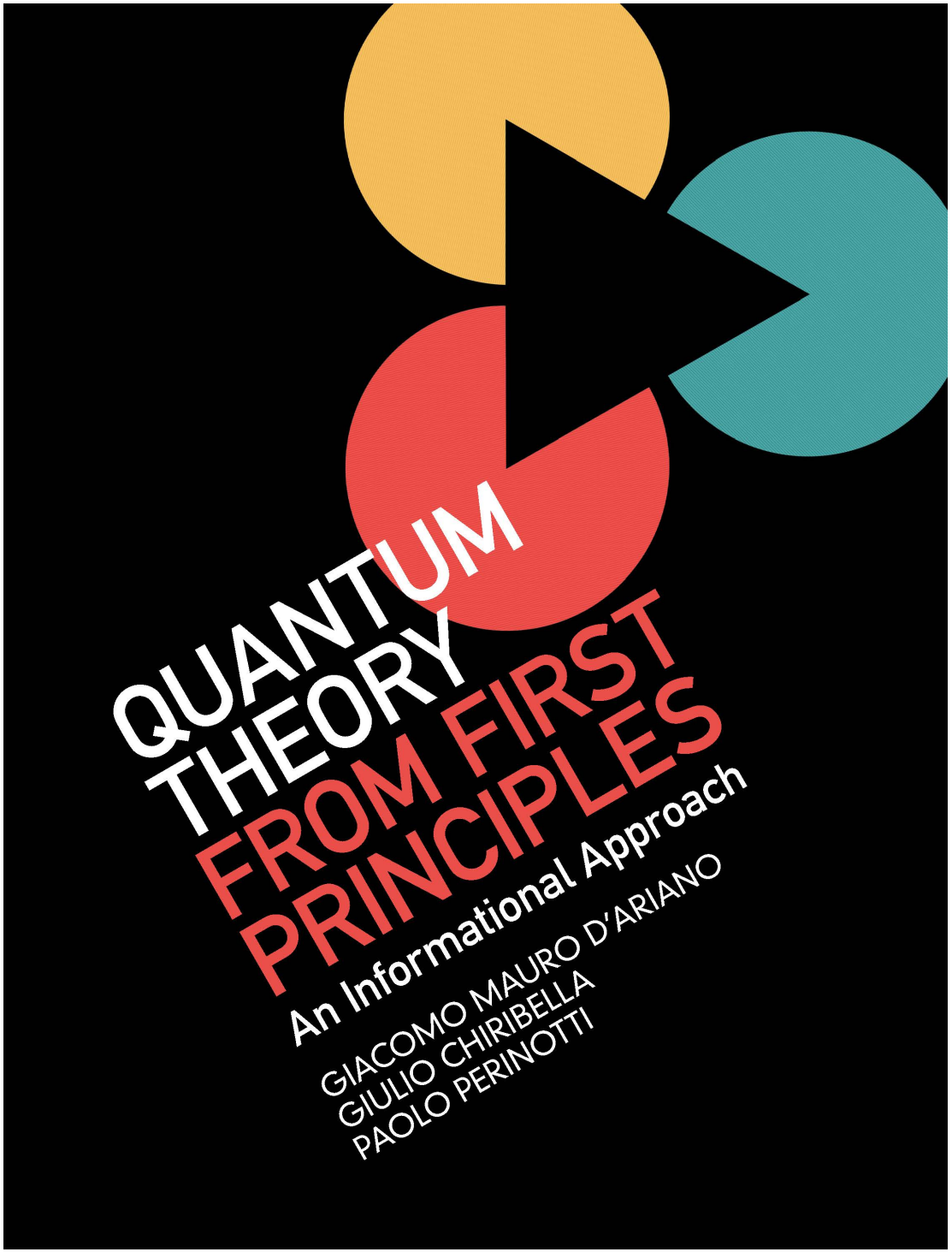
P2. Local discriminability

P3. Purification

P4. Atomicity of composition

P5. Perfect distinguishability

P6. Lossless Compressibility



JOHN TEMPLETON FOUNDATION

SUPPORTING SCIENCE~INVESTING IN THE BIG QUESTIONS

Principles for Physics

Free *QFT derived in terms of countably many interacting quantum systems*

Min algorithmic complexity principle

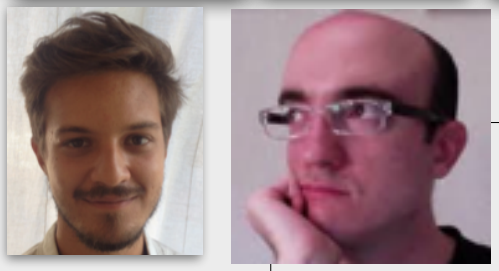
- unitarity
- locality
- homogeneity
- isotropy

without assuming: SR, mechanics, kinematics, space-time

quantum *ab-initio* theory

Framework suitable for
1. axiomatisation
2. a quantum theory of gravity (natural scenario for holographic principle)

- *(k≪1)* free QFT (Weyl, Dirac, and Maxwell)
- *Ultra-relativistic regime (k~1):* [Planck scale]: nonlinear Lorentz



Follow **Project on Researchgate:** *The algorithmic paradigm: deriving the whole physics from information-theoretical principles.*

REVIEW

G. M. D'Ariano, *Physics without Physics*, Int. J. Theor. Phys. **128** 56 (2017) [in memoriam of D. Finkelstein]