Quantum Resources

Krakow's group

Jagiellonian University

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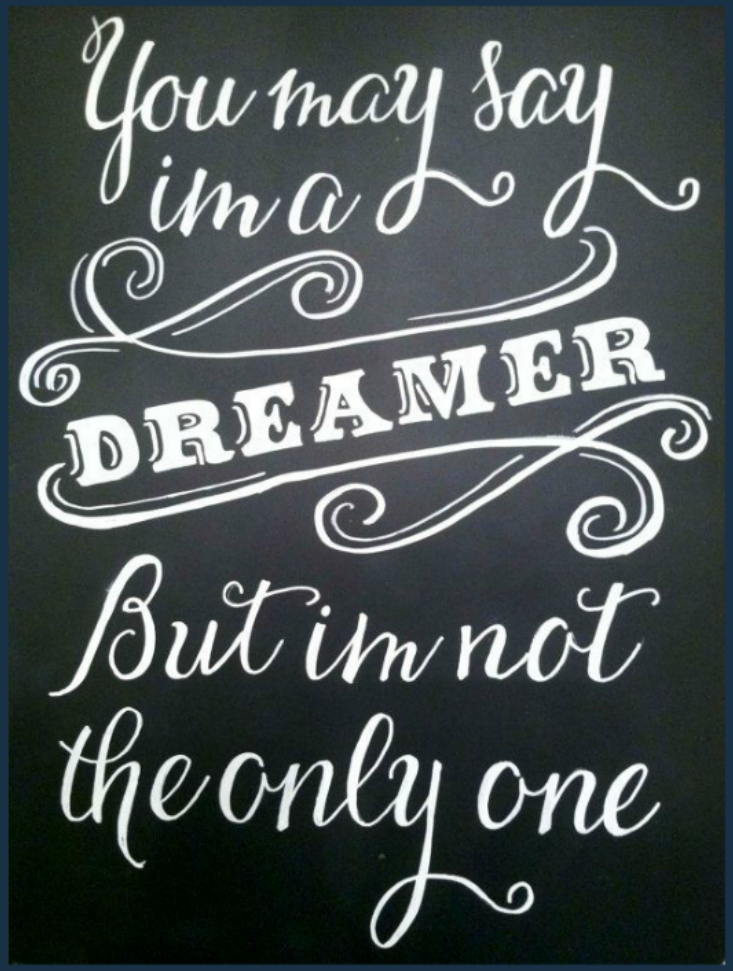
Jagiellonian University


You may say
im a
DREAMER
But im not
the only one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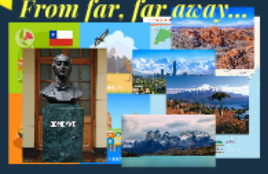
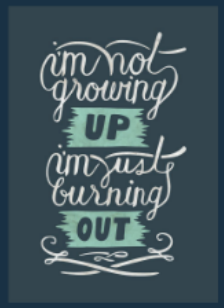
Quantum Resources

&

Communication

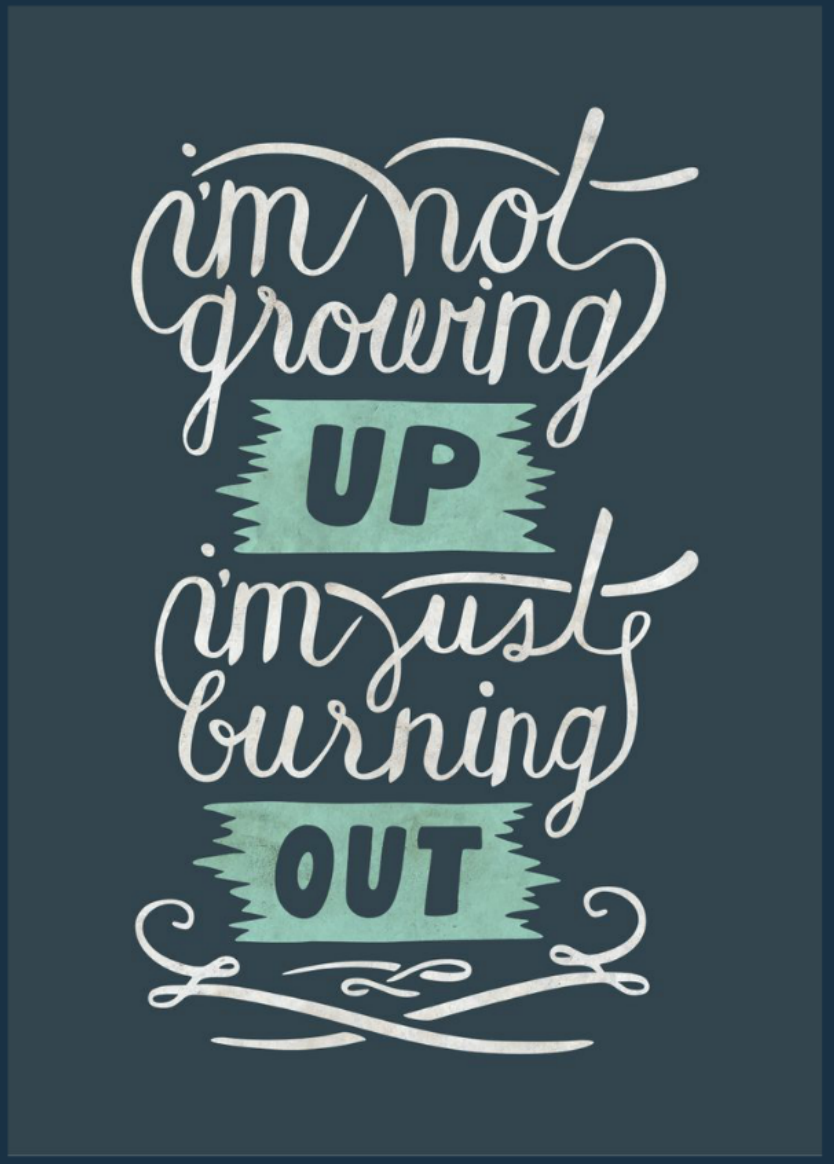
Roberto Salazar





Salazar

From far, far away...



From far, far away...

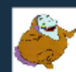
Resource Theories

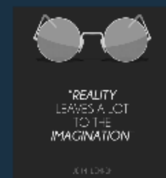
Bonus

Optimal allocation of quantum resources

Roberto Salazar, Tanmoy Biswas, Jakub Czartowski, Karol Życzkowski, and Paweł Horodecki

arXiv:2006.16134



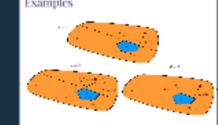


Resource theories

A resource theory is defined as a triple $[\mathcal{F}, \mathcal{O}, \mathcal{M}]$ where $\mathcal{F}$ are the *free objects* under consideration which forms a subset within the set of objects $\mathcal{S}$. The *free operations* $\mathcal{O}$ is a set of functions $o : \mathcal{S} \to \mathcal{S}$ which preserve the set of free objects. A measure $\mathcal{M}$ is given by a function $\mathcal{M} : \mathcal{S} \to [0, \infty+]$ which is monotone under the set of free operations $\mathcal{O}$ and $\mathcal{M}(f) = 0$ for all $f \in \mathcal{F}$.

$$\mathcal{M}(o(s)) \leq \mathcal{M}(s)\ \forall o \in \mathcal{O}, s \in \mathcal{S}$$

Examples



Open problems:

Find lower bound for encodable messages

Find tighter upper bound

Characterize interesting partial orders between Schur-product Super channels

Channel resource theories

Resource Theories

Resource theories

- General Objective: *Understand the limitations of a physical context and explore our possibilities to overcome such limits.*
- Specific Objective: *Study the value of particular objects and operations to carry out practical tasks.*

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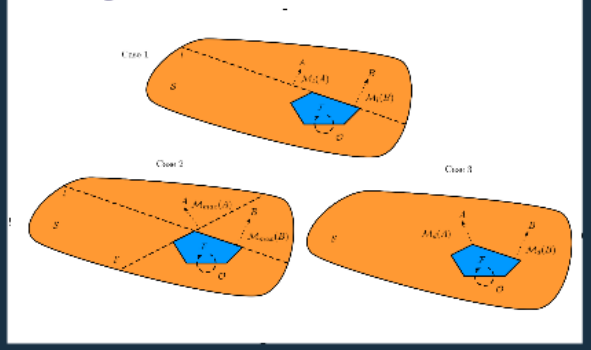
Examples



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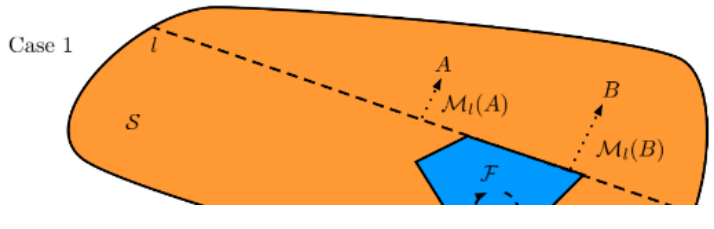
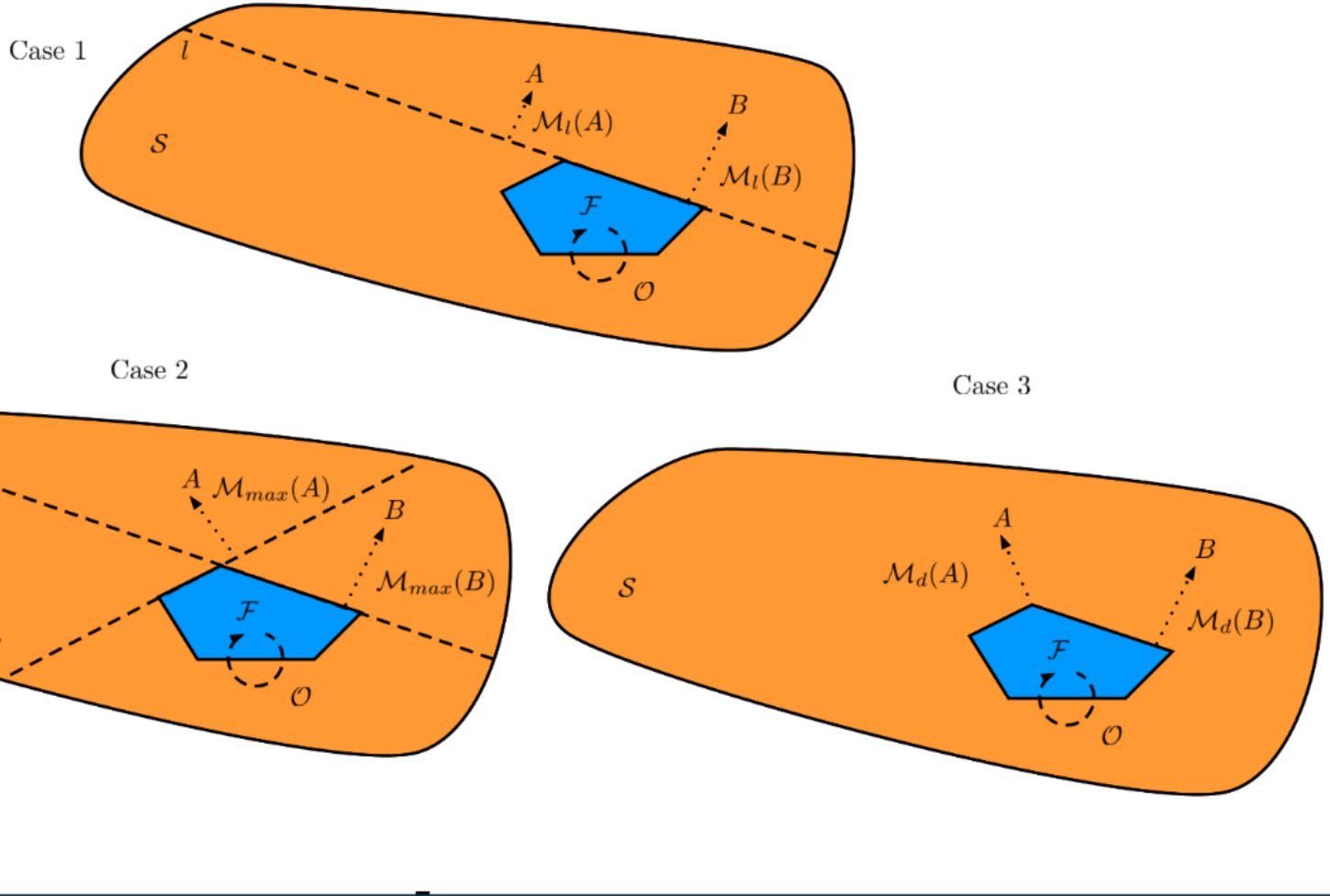
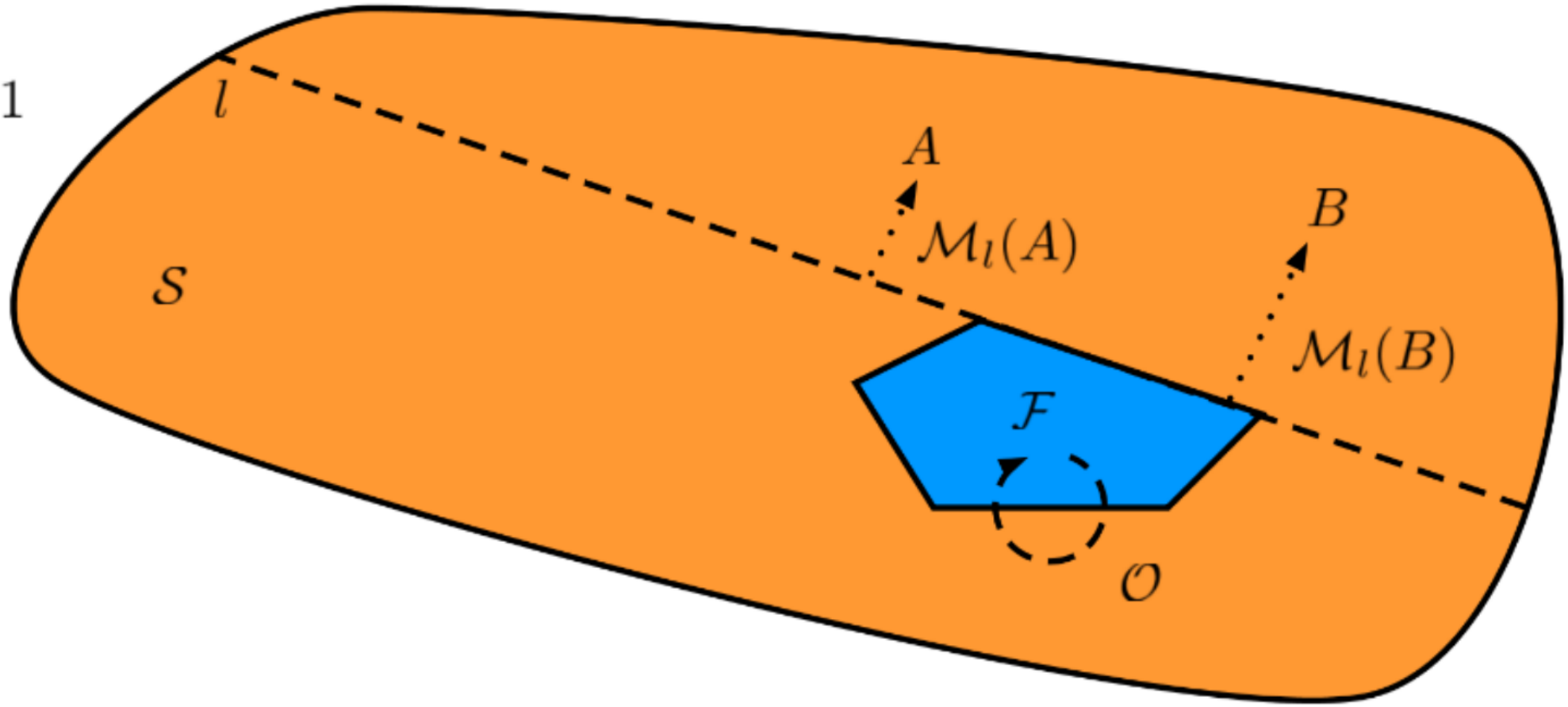


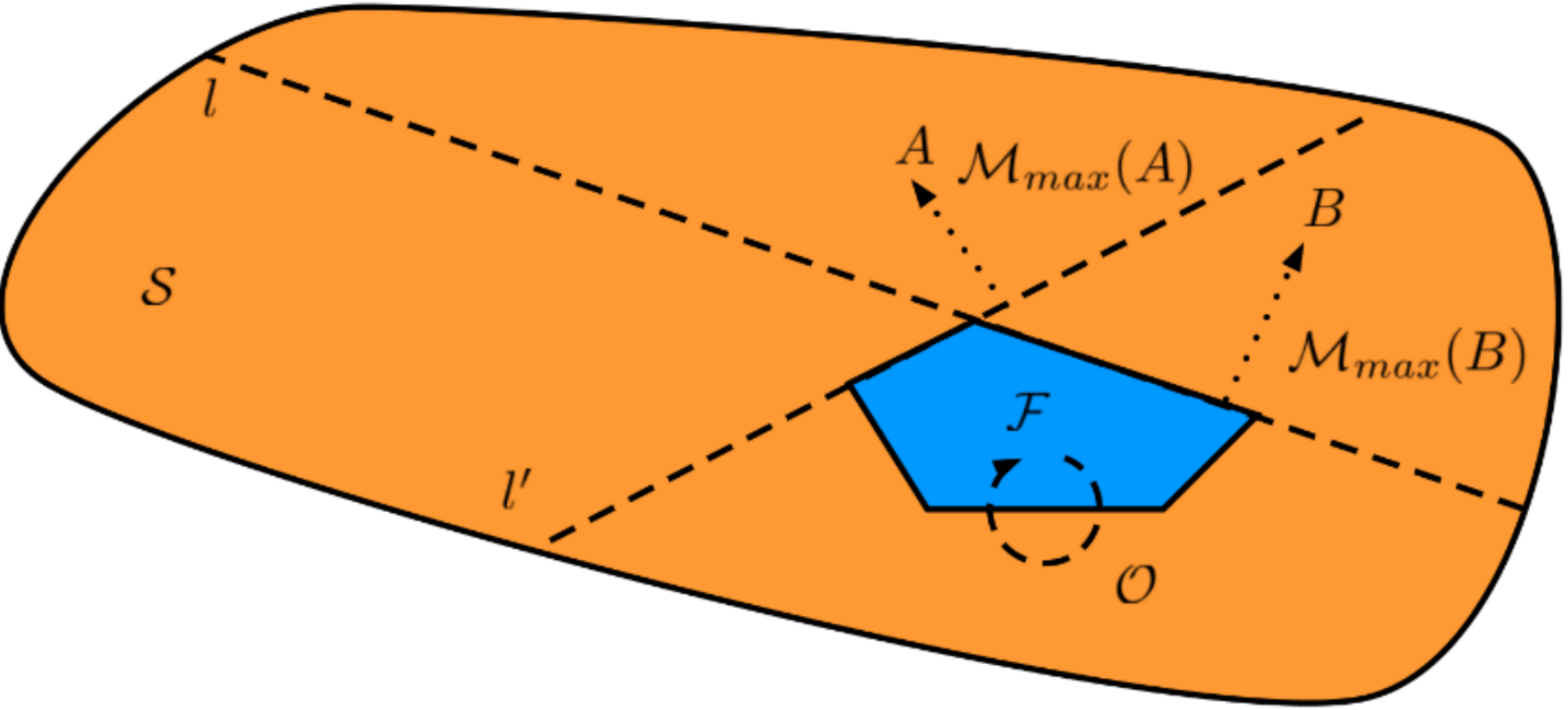
Examples


Case 1
l
$\mathcal{S}$
A
$\mathcal{M}_l(A)$
B
$\mathcal{M}_l(B)$
$\mathcal{F}$
$\mathcal{O}$
Case 2
l
$\mathcal{S}$
A
$\mathcal{M}_{max}(A)$
B
$\mathcal{M}_{max}(B)$
$\mathcal{F}$
l'
$\mathcal{O}$
Case 3
$\mathcal{S}$
A
$\mathcal{M}_d(A)$
B
$\mathcal{M}_d(B)$
$\mathcal{F}$
$\mathcal{O}$

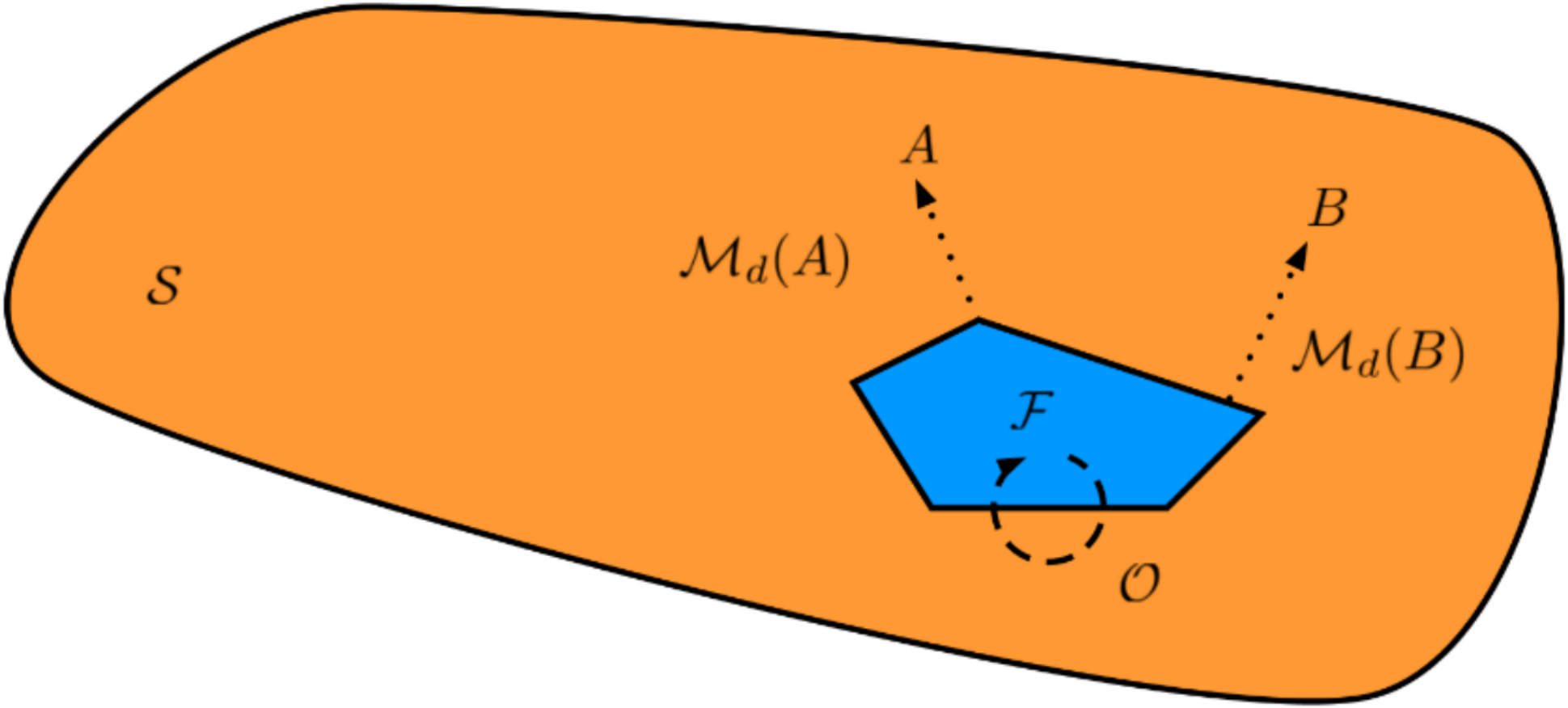


Case 2

Case 2


l
A
$\mathcal{M}_{max}(A)$
B
$\mathcal{S}$
$\mathcal{M}_{max}(B)$
$\mathcal{F}$
l'
$\mathcal{O}$

Case 3



Channel resource theories

1. Our actual research is in the field of Channel resource theories.

IOP Publishing
J. Phys. A: Math. Theor. 52 (2019) 475303 (42pp)
Journal of Physics A: Mathematical and Theoretical
https://doi.org/10.1088/1751-8121/ab30f7

Distinguishing classically indistinguishable states and channels

Kamil Korzekwa[1,5], Stanisław Czachórski[2], Zbigniew Puchała[2,3] and Karol Życzkowski[2,4]

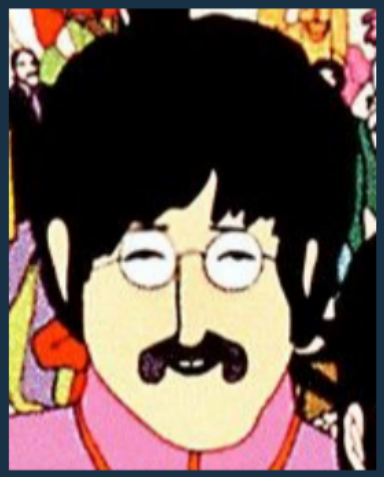
2. In particular, we investigate resource theories with a resource-destroying map.

Encoding classical information into quantum resources

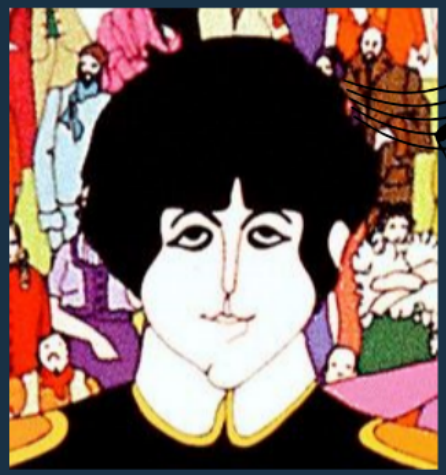
Kamil Korzekwa, Zbigniew Puchała, Marco Tomamichel, Karol Życzkowski

3. For this class of theories we aim to provide an operational interpretation of resources in terms of their capacity to encode classical and quantum information.

J



R

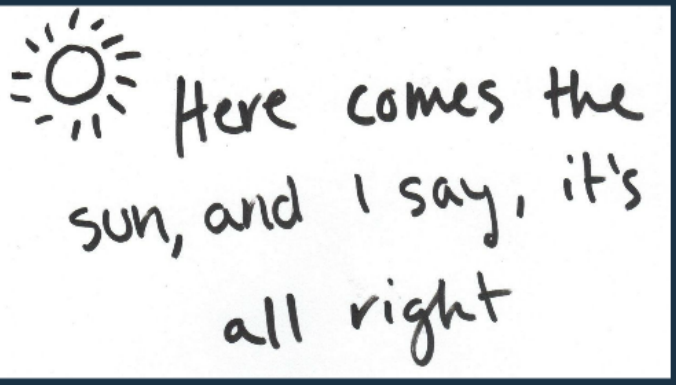


P

G

Super Channels!

Results:



- **Relevant Super Channels:**

Schur-product Super Channels

- **Several realizations and representations of Schur-product Super Channels**
  - **Non-increasing Classical and Quantum information capacity**
- **Non-increasing coherence generating power**
  - **Upper bound for encodable classical messages in the channel**

Open problems:

Find lower bound for encodable messages

Find tighter upper bound

Characterize interesting partial orders between Schur-product Super channels

Bonus

Optimal allocation of quantum resources

Roberto Salazar[1,2], Tanmoy Biswas[1,3], Jakub Czartowski[2], Karol Życzkowski[2,4,5], and Paweł Horodecki[1,4,6]

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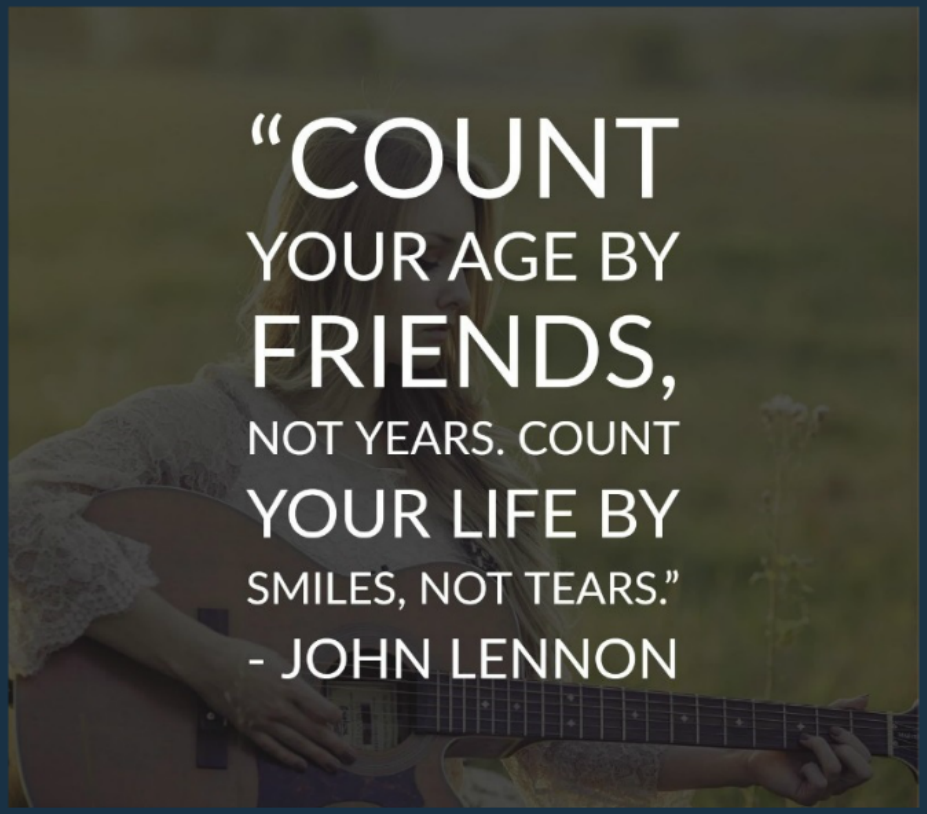
Thanks!


"COUNT
YOUR AGE BY
FRIENDS,
NOT YEARS. COUNT
YOUR LIFE BY
SMILES, NOT TEARS."
- JOHN LENNON