Bob Coecke & Aleks Kissinger

Universities of Oxford and Nijmegen

no-broadcasting in process theories

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no-broadcasting in process theories

$$\vdots$$

...the full story in <15 mins

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cf. H. Barnum, J. Barrett, M. Leifer and A. Wilce (2007) *Generalized no-broadcasting theorem*. PRL. arXiv:0707.0620

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no-broadcasting in process theories

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...including all math from scratch

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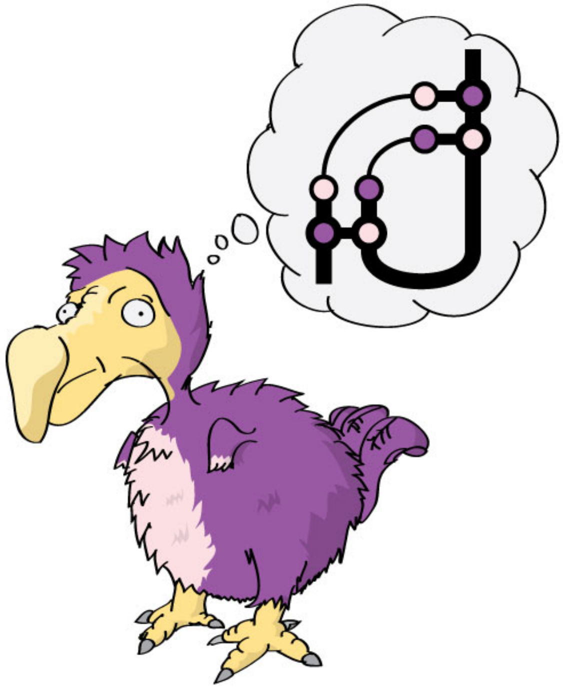
cf. H. Barnum, J. Barrett, M. Leifer and A. Wilce (2007) *Generalized no-broadcasting theorem*. PRL. arXiv:0707.0620

Bob Coecke & Aleks Kissinger

Picturing Quantum Processes.

Cambridge University Press, 2016. (920pp)



Bob Coecke & Aleks Kissinger

Categorical quantum mechanics I: causal quantum processes.

arXiv:1510.05468

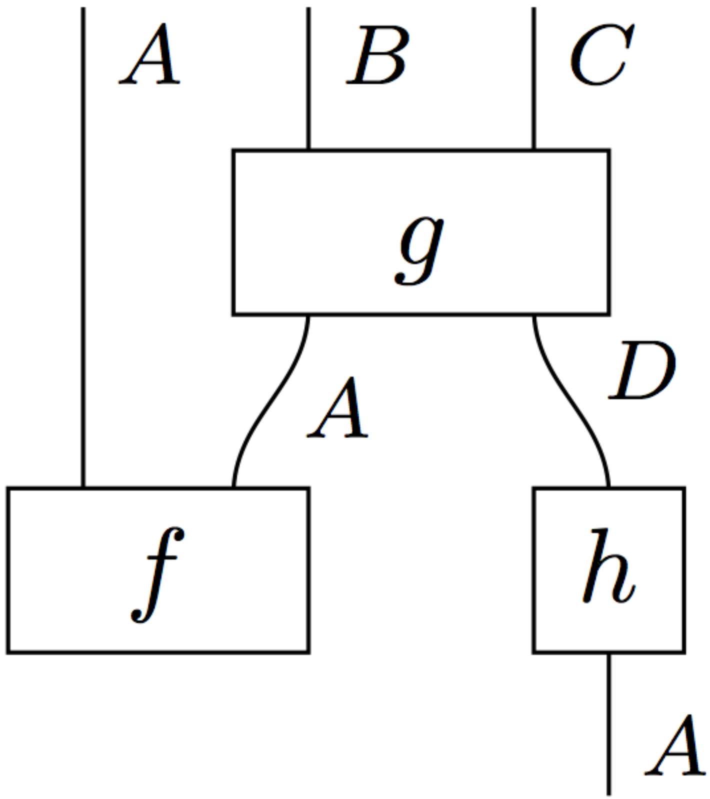
Categorical quantum mechanics II: classical-quantum interaction.

arXiv:1605.08617

Categorical quantum mechanics III: (strong) complementarity.

arXiv:XXX (next couple of weeks)

Diagram := boxes with ins/outs wired together



Process theory := **interpretation of diagrams**

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- assign to each wire a **system**

- assign to each box a **process**

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Process theory := interpretation of diagrams

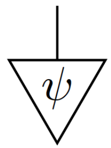
- assign to each wire a **system**

- assign to each box a **process**

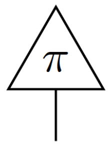
- **interprets 'wiring together'** e.g.:
  - as actual physical wires, or,
  - via decomposing in $\circ$ and $\otimes$.

Special processes:

- State :=



- Effect / Test :=



Special processes:

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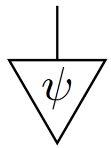
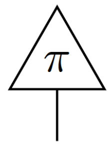
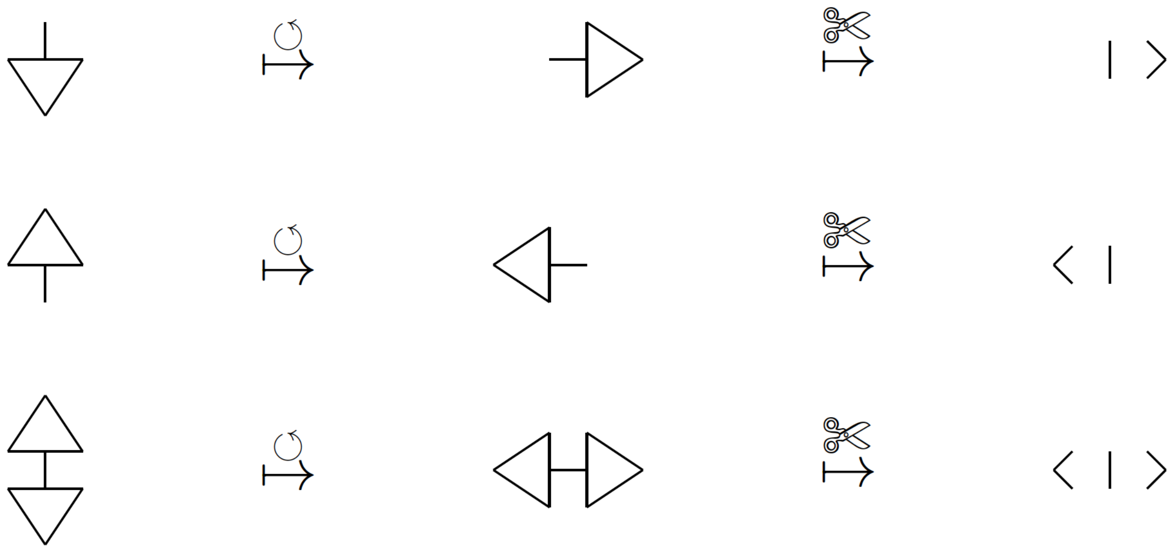


- Effect / Test :=

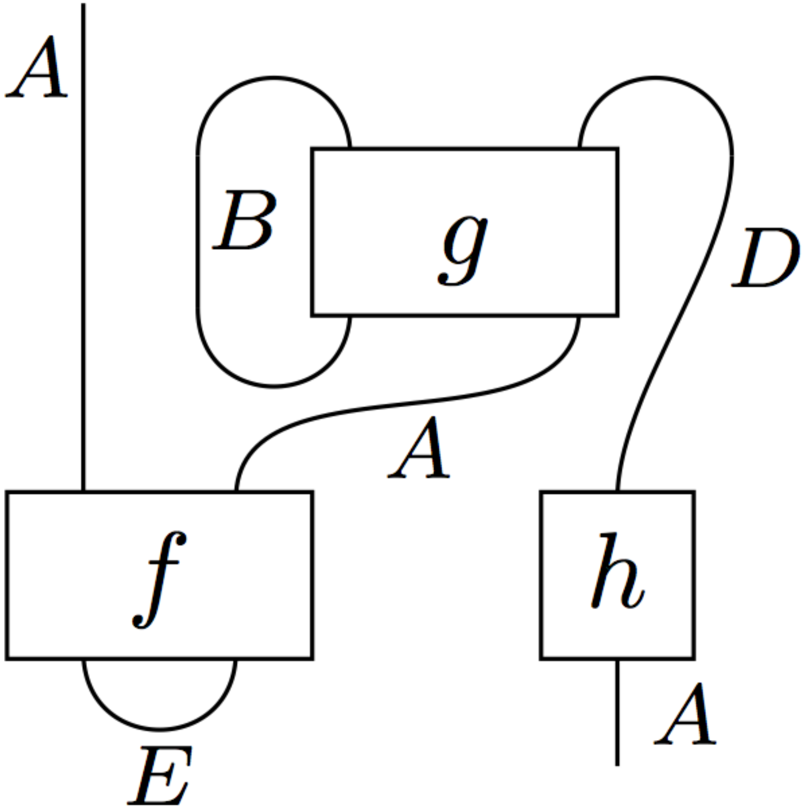


- Number :=

Special processes:

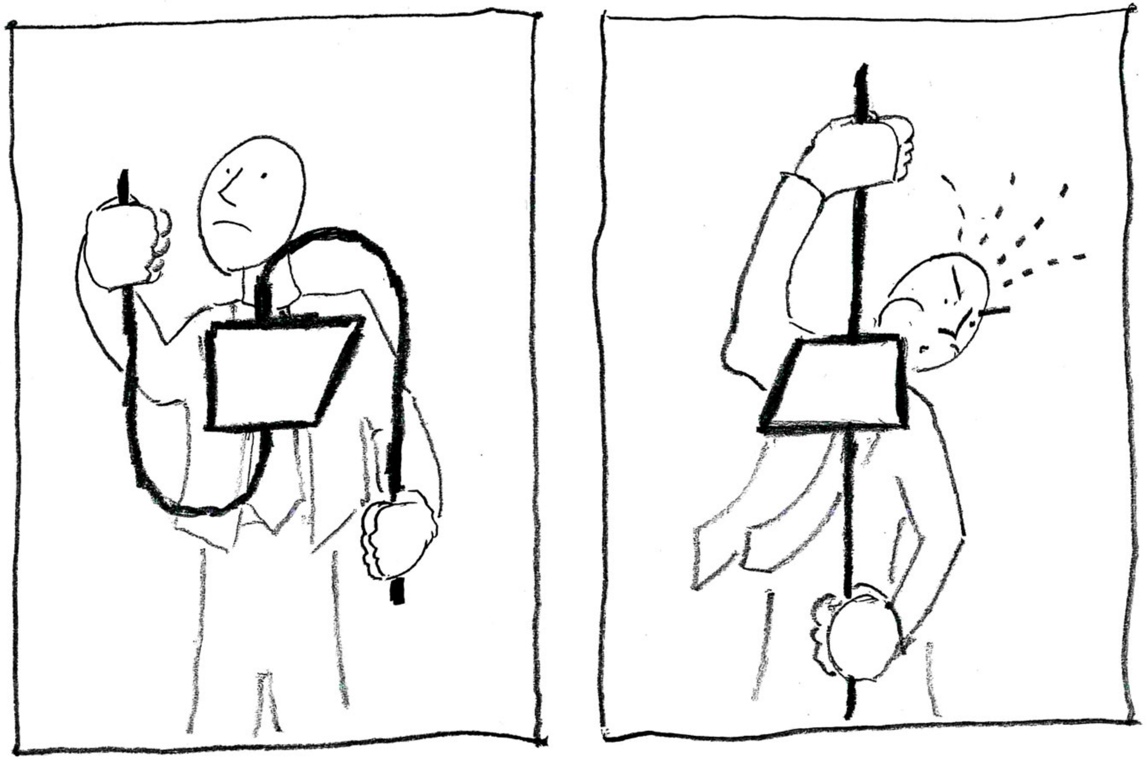


String diagram := **ins and outs on equal footing**

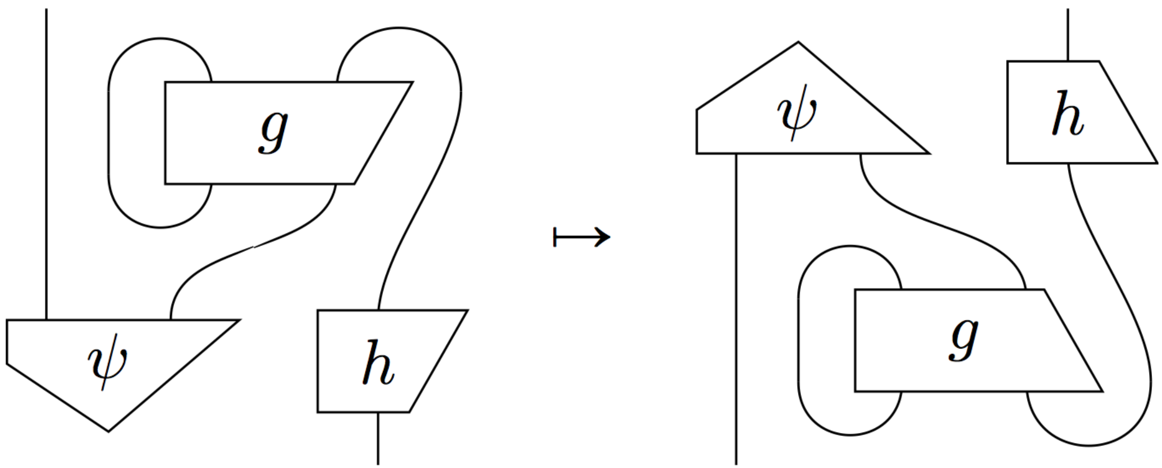


– teleportation –

– transpose –

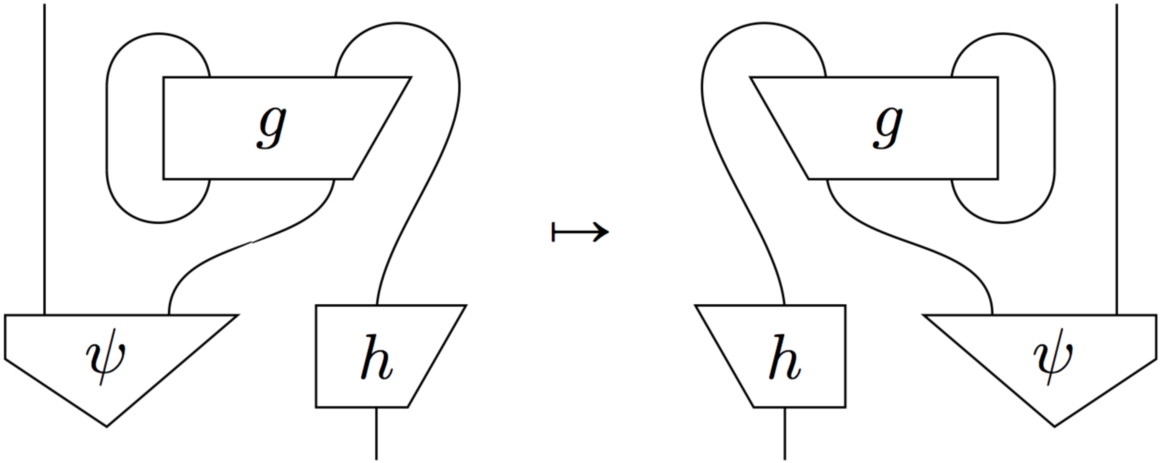


Adjoint := H-reflection



...conjugate

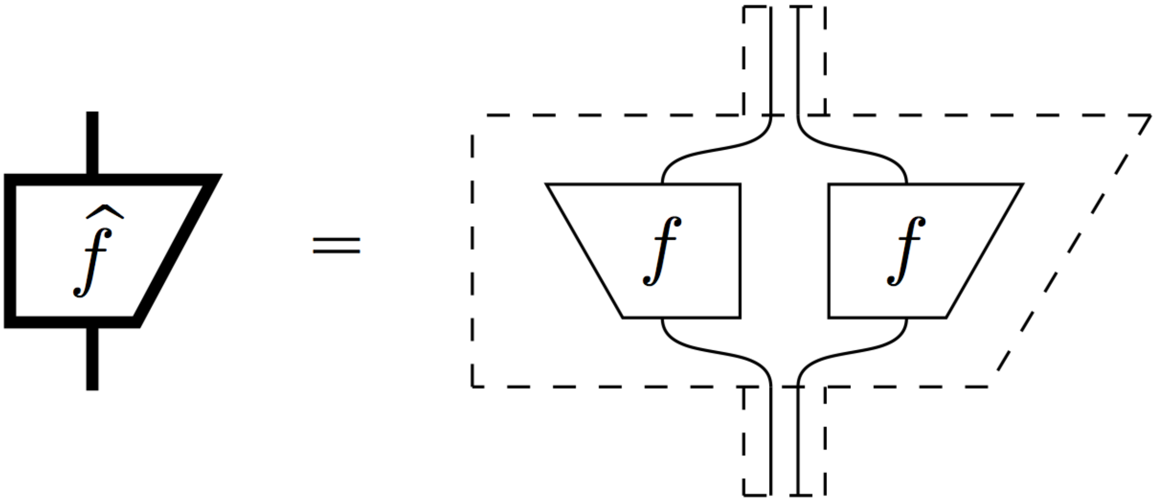
...conjugate := V-reflection



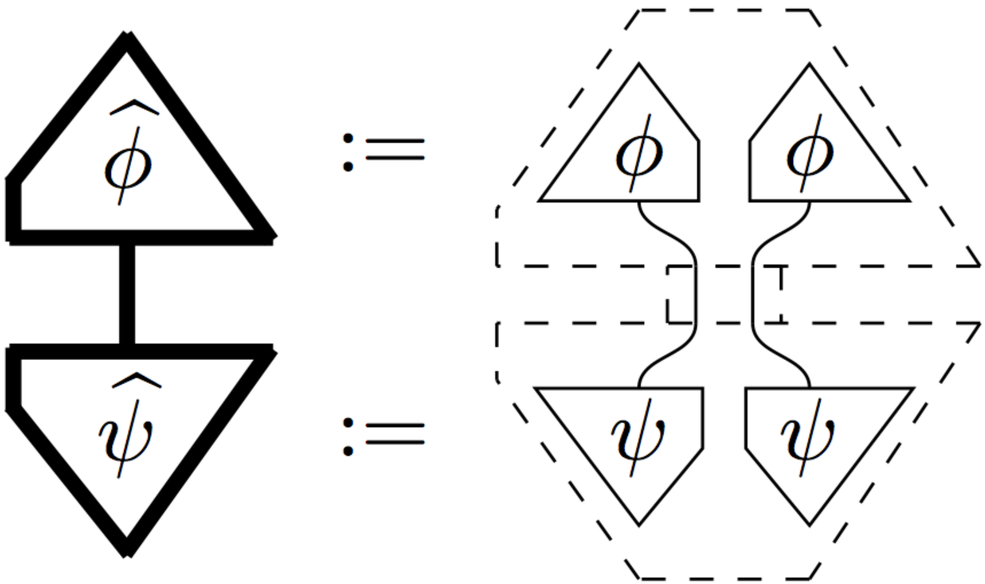
Main idea:

$$\frac{\text{classical system}}{\textbf{quantum system}} = \frac{\text{single wire}}{\textbf{double wire}}$$

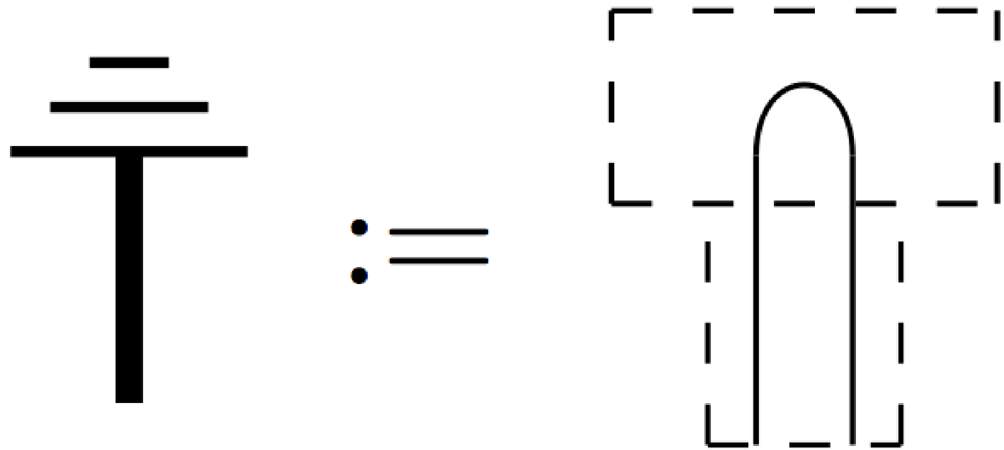
Pure quantum process :=



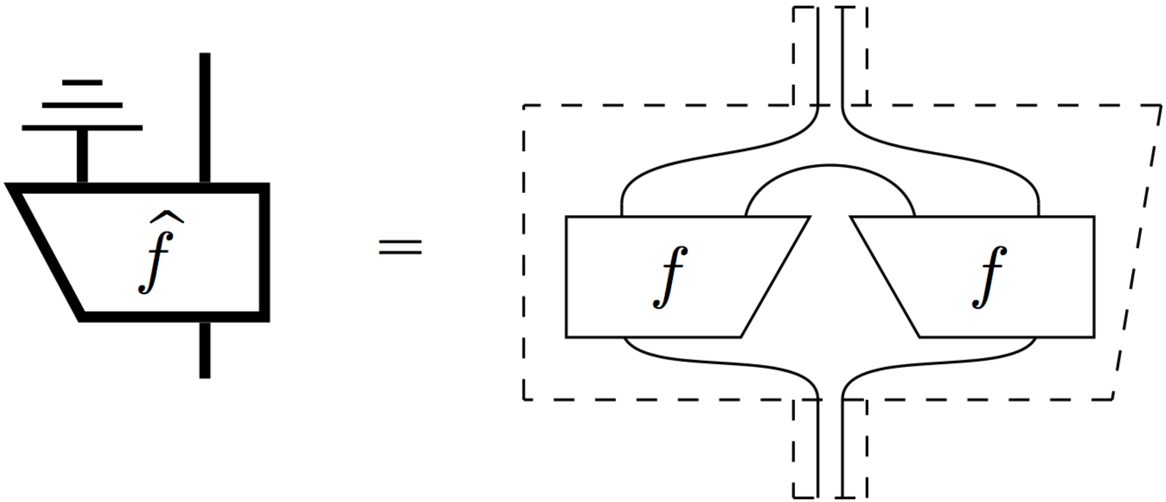
Born-rule :=



Discarding :=



General quantum process :=



THM. **No universal broadcasting**

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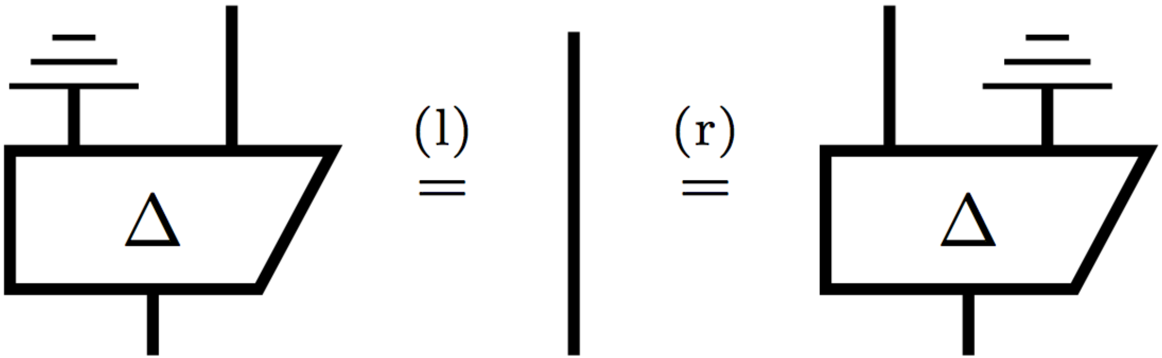

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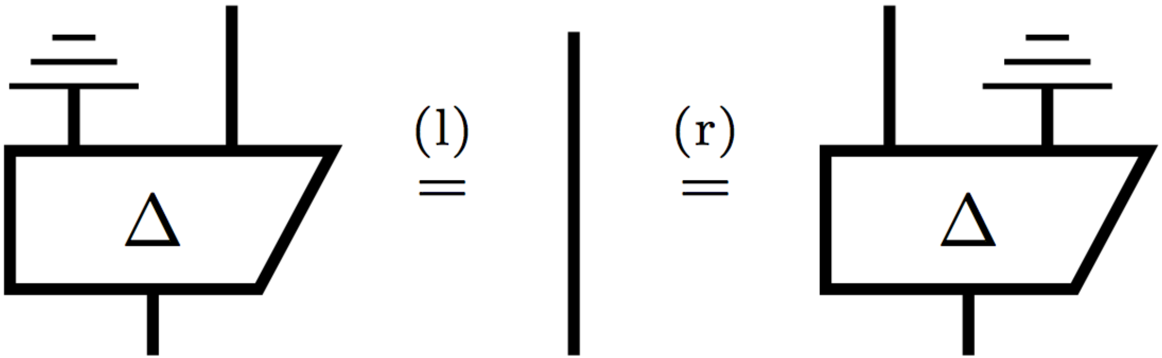
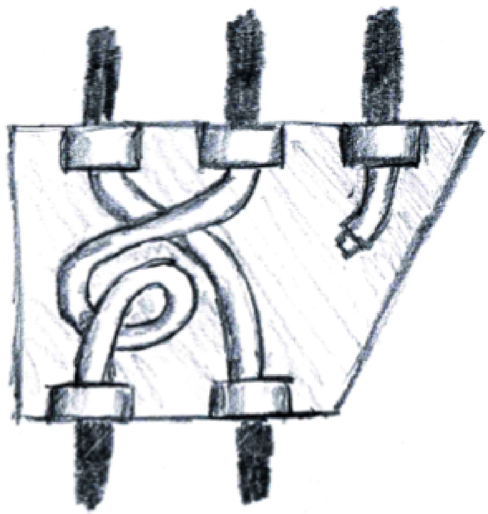
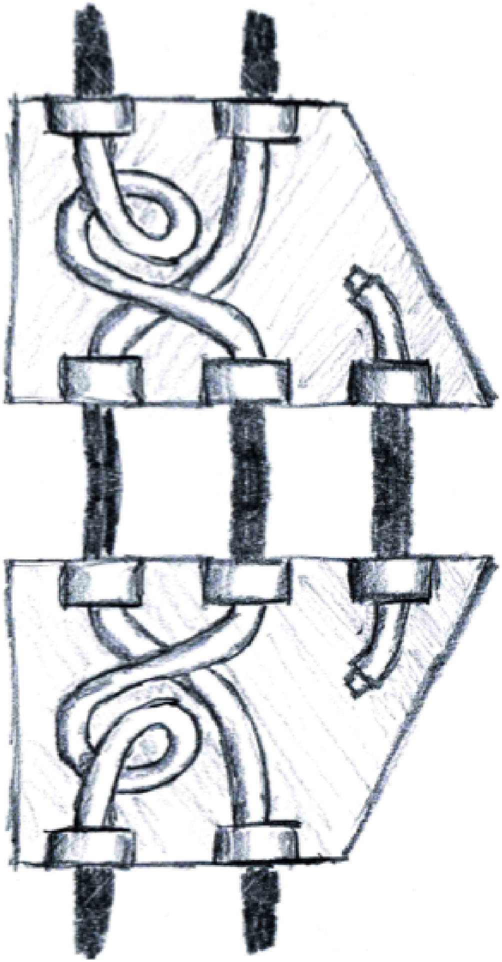
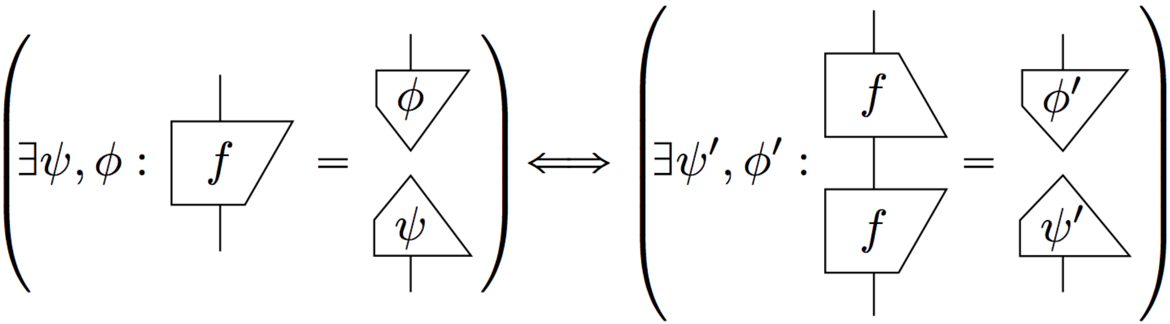
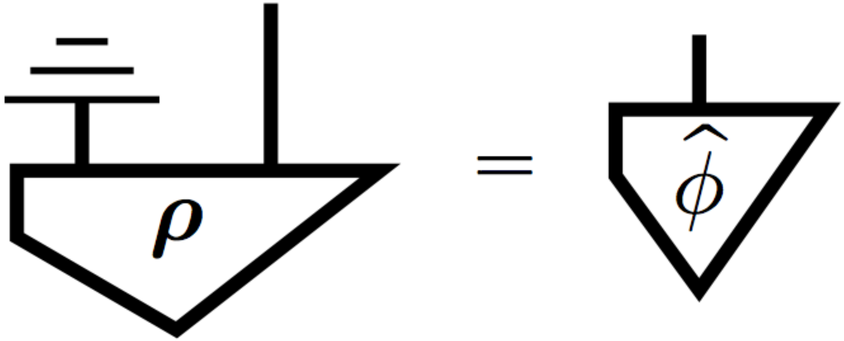




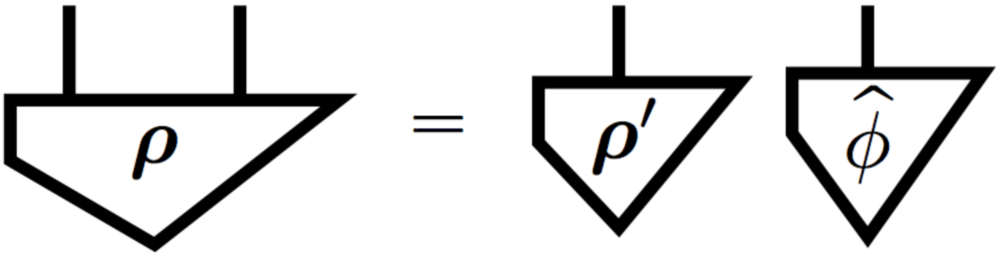




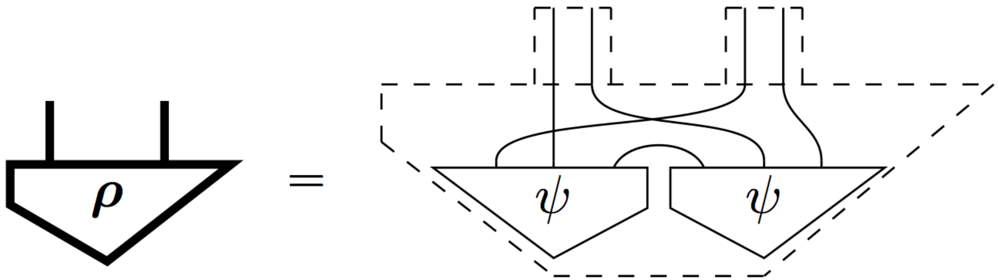
Prop. Pure reduced state:



implies separation:



Pf. Since:



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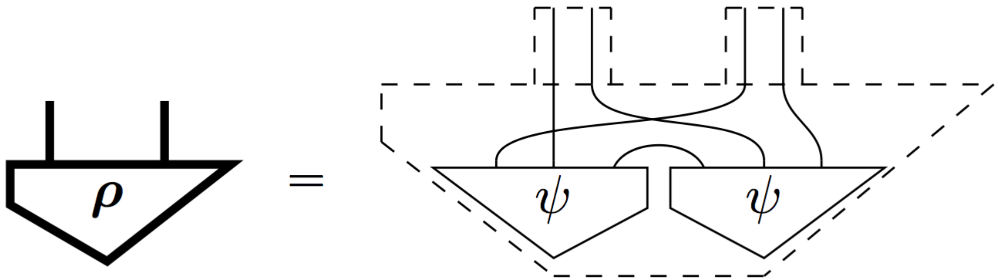
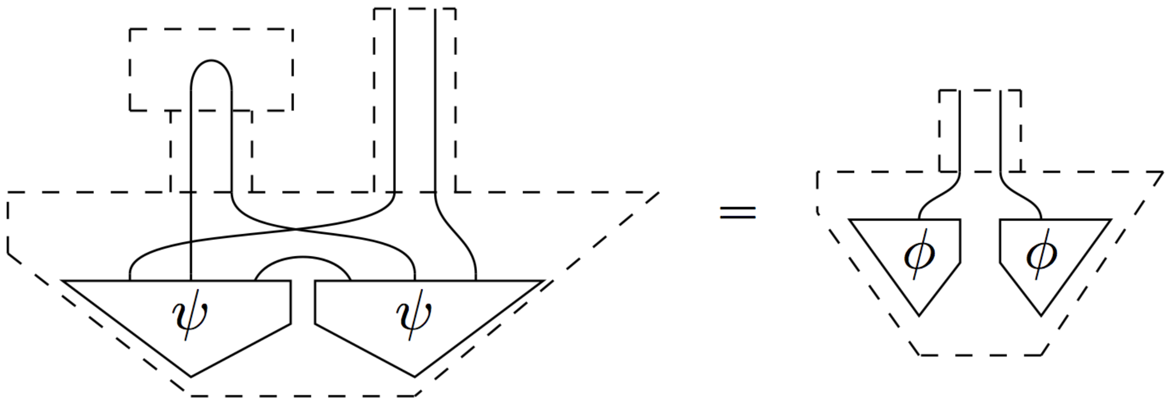
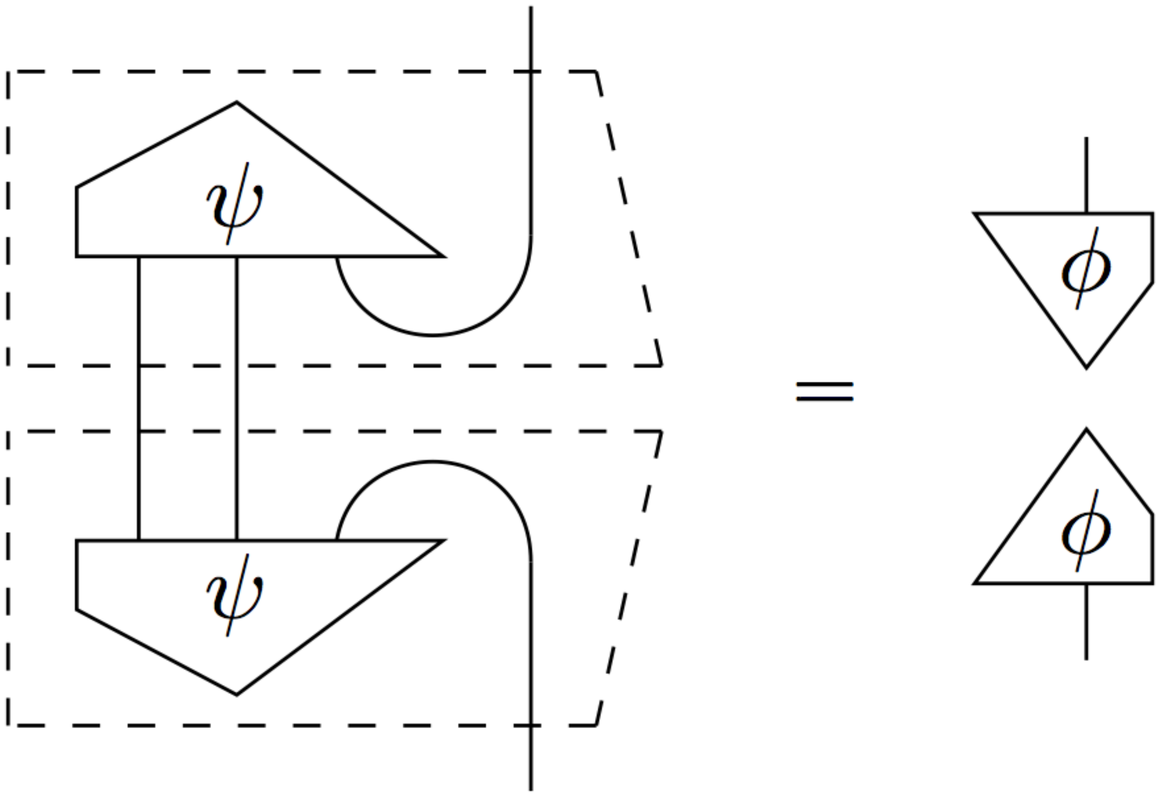


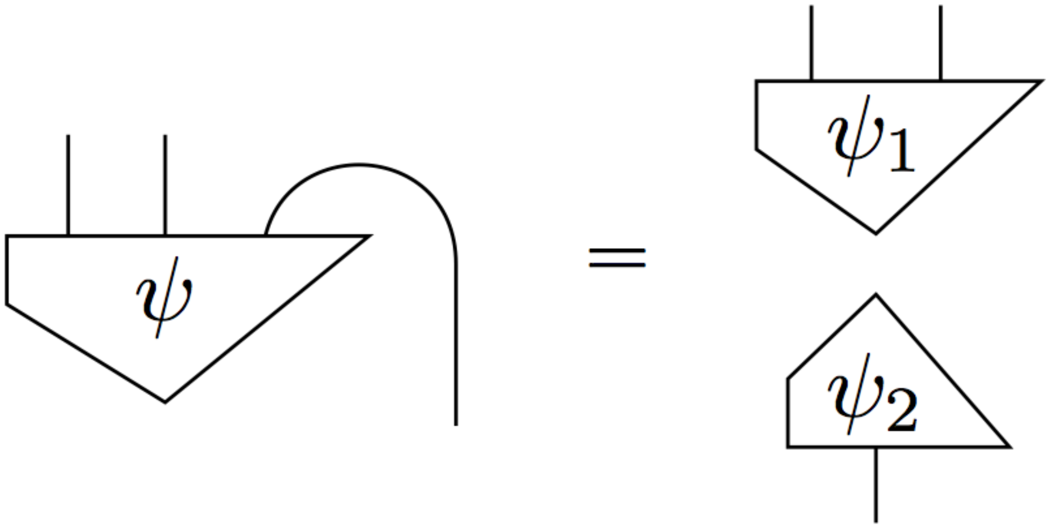
we have:



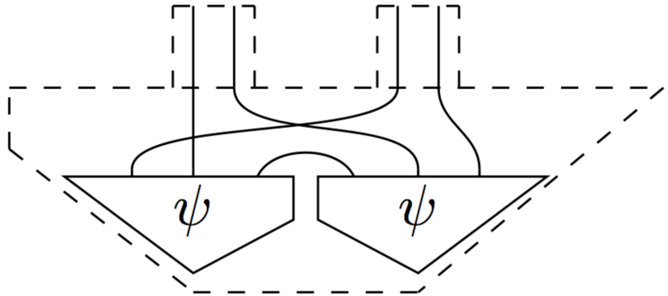
i.e.:



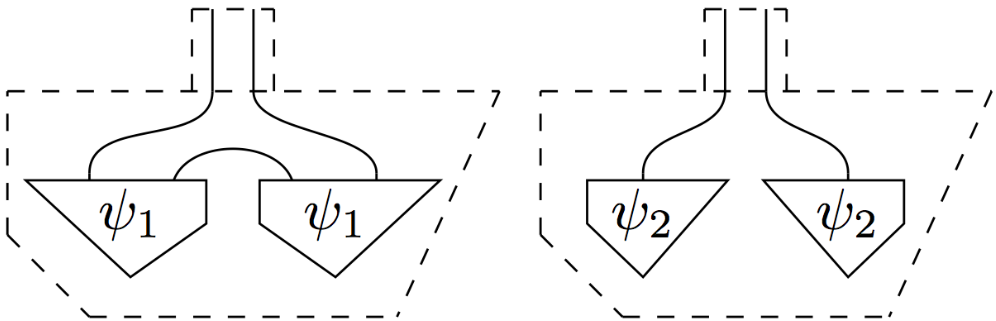
so:



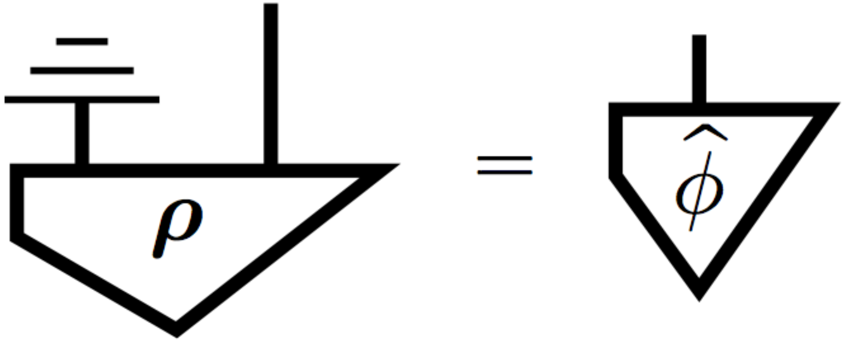
and hence:



separates:



Prop. Pure reduced state:



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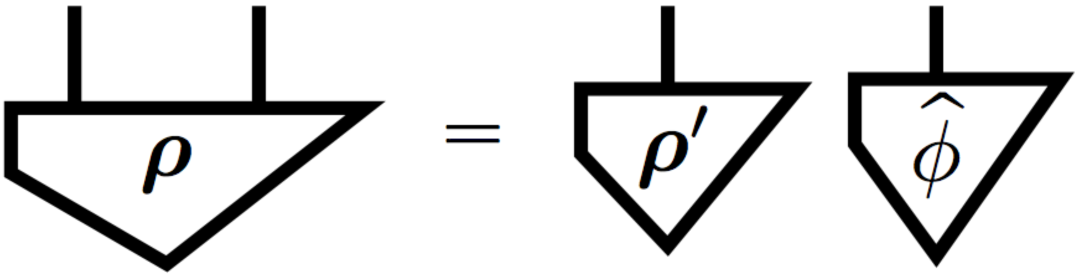
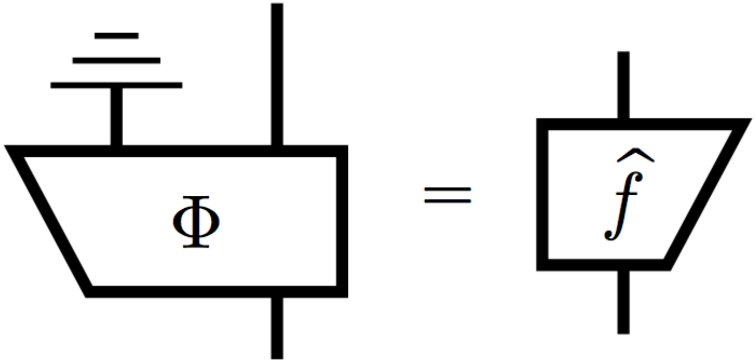


Prop. Pure reduced process:



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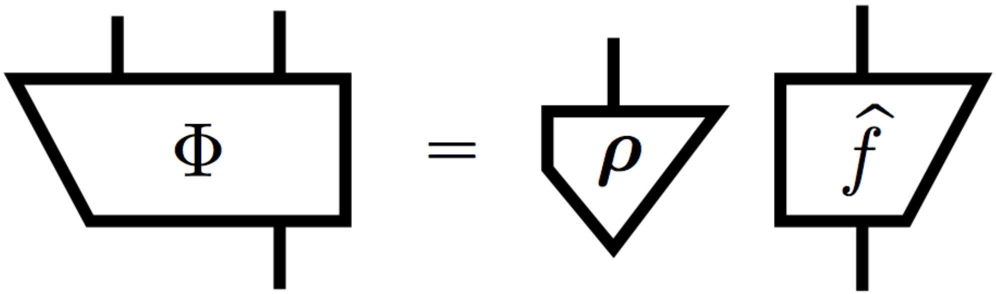
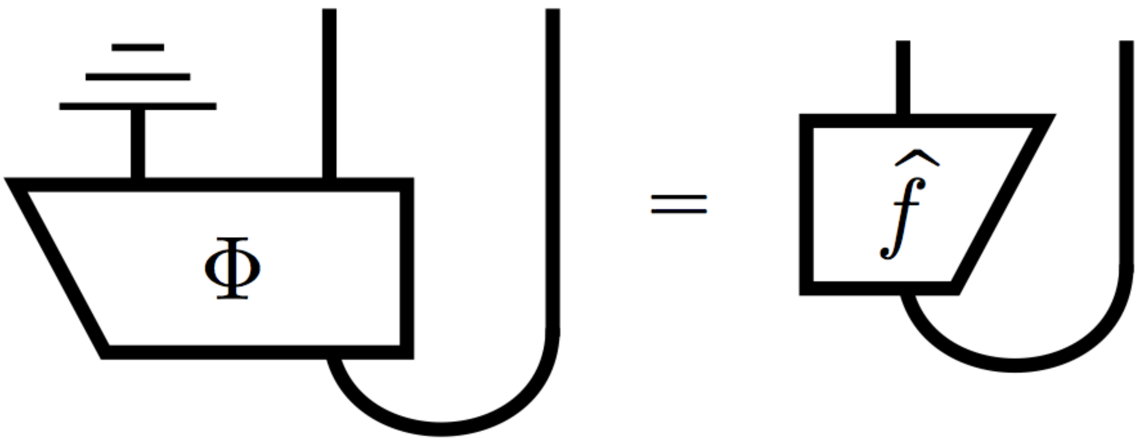


Pf. Reduces to previous:



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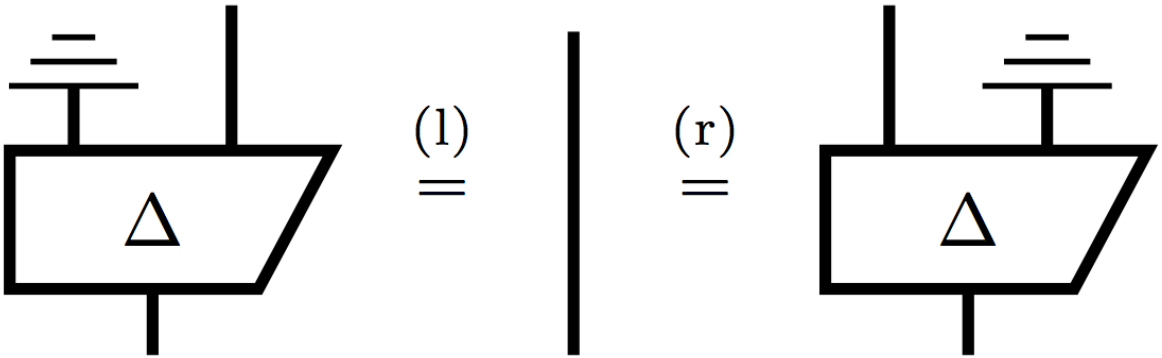
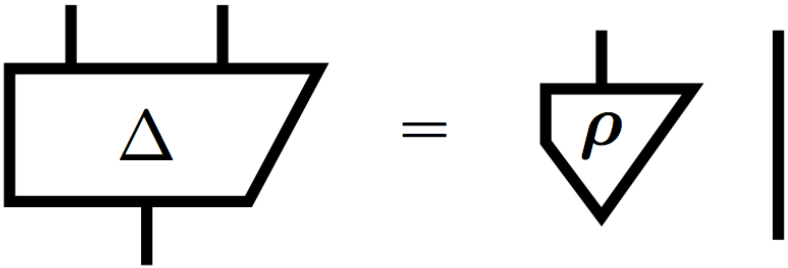


Pf. By (l) and Prop:



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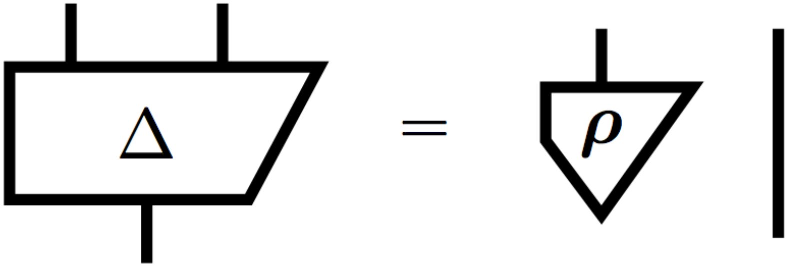

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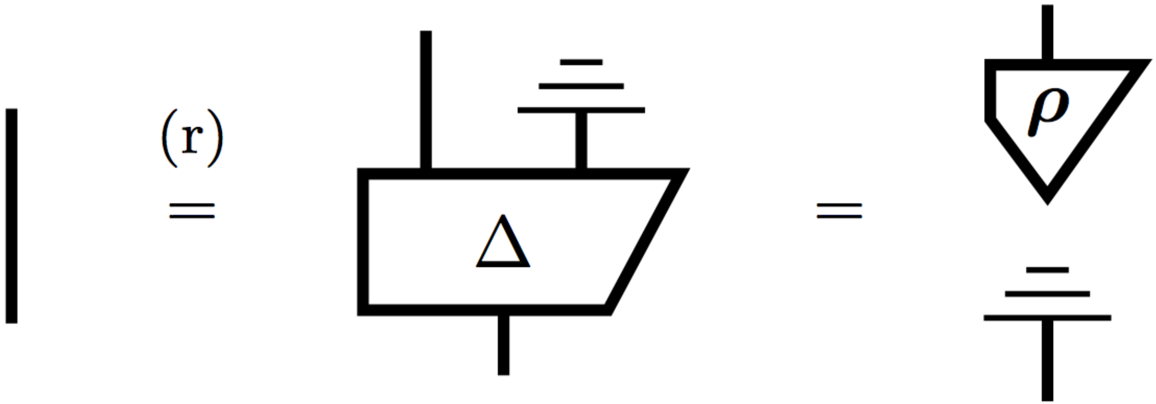

RIP

(3/3/2009 – 6/6/2016)