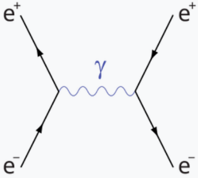
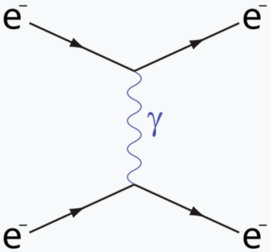
What is...quantum topology - part 18?

Or: Monoidal categories 6 from Chapter 3

Feynman diagrams

Pair production and annihilation	In the Stückelberg–Feynman interpretation, pair annihilation is the same process as pair production	
Møller scattering	electron-electron scattering	

- Above Feynman diagrams (originate ≈1949)
- Feynman diagram = pictorial representation of the mathematical expressions
- Note the appearance of trivalent vertices

Penrose diagrams

Applications of Negative Dimensional Tensors

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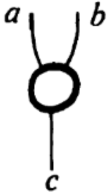
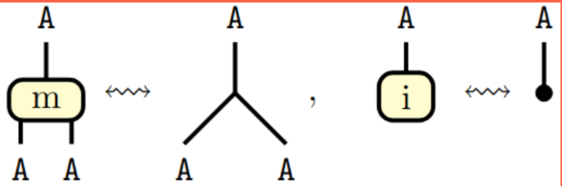


$= \theta_c^{ab}$,

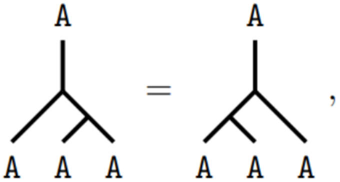
$= \chi^a_{bcd}$.

- Above Penrose diagrams (originate ≈1971)
- Penrose diagram = pictorial representation of the mathematical expressions
- Note the appearance of trivalent vertices

Trivalent vertices and multiplication



are the structure maps and



- Above Multiplication diagrams (originate ?)
- Multiplication diagram = pictorial representation of the mathematical expressions
- Note the appearance of trivalent vertices

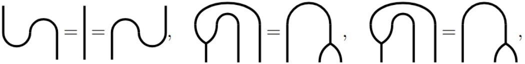
For completeness: A formal definition

Webs

Example 3G.2. The ***(generic) web category*** **Web** (also known as the generic ***trivalent*** category or ***spider*** category or generic ***birdtracks*** category or ...) is defined as follows. We let

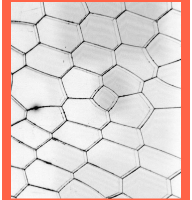
$$\mathrm{S}: \bullet, \quad \mathrm{T}: \cap\colon \bullet \otimes \bullet \to \mathbb{1}, \quad \cup\colon \mathbb{1} \to \bullet \otimes \bullet, \quad \pitchfork\colon \bullet \otimes \bullet \otimes \bullet \to \mathbb{1}, \quad \curlyvee\colon \mathbb{1} \to \bullet \otimes \bullet \otimes \bullet,$$

and the generating morphisms are called ***bilinear*** and ***trilinear (co)form***, respectively. Using Equation 3G-1 and similar expressions to define

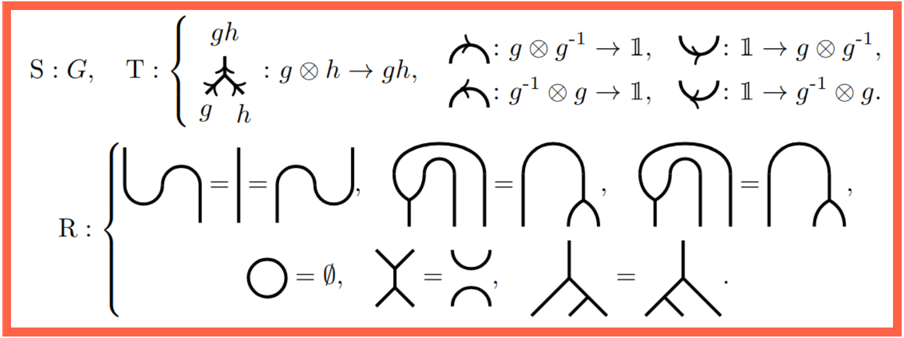
R : 

called ***isotopies*** (or ***non-degeneracy conditions***). ◇

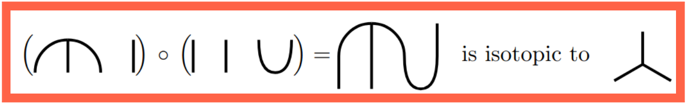
Example



Group graded vector spaces diagrammatically



- Theorem The category of G-graded vector spaces $\mathbf{Vec}_{\mathbb{C}}(G)$ has the above diagrammatic presentation
- This is a quotient of the category of webs
- Proof? E.g. find very consequences of the relations



Thank you for your attention!

I hope that was of some help.