Sample Feynman Diagrams in TikZ
Vol. I: Simple Diagrams, pieces of diagrams

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Abstract

This is collection of useful sample Feynman diagrams and pieces typeset in TikZ.

1 Set Up

1.1 PGF/Ti*k*Z

"Portable Graphics Format" and "Ti*k*Z ist *kein* Zeichenprogramm" ("Ti*k*Z is *not* a drawing program") are languages and macros for LaTeX developed by Till Tantau[1]. It is used, for example, by the Beamer class for producing presentations. This is already included in the full distribution of MacTeX[2] which is based on TeXLive. For the remainder of this document I won't be italicizing the k.

1.2 Wiggly lines and arrows

Most of the the wiggly lines and arrowed lines are already coded into TikZ. For simplicity, I've called the relevant libraries and made useful definitions in `tikzfeynman.sty`. Just dump this into your manuscript folder and call it with the `usepackage` command. Use this document as a template if need be.

1.3 Note on External TikZ Diagrams

Complicated diagrams or multiple diagrams can cause typesetting to take a long time. One way to simplify this is to have TikZ output a PDF of a finished diagram so that it will automatically include that PDF instead of re-processing the TikZ commands. Note that it can get a little annoying if you want to modify the diagram later on.

Usage: create the subdirectory tikz, or whatever "prefix" you use in the `tikzexternalize` option, see the sample lines—commented out by default—in this tex file. Make sure the `-shell-escape` is used when you compile[3]. Tikz pictures will be exported as PDFs in the tikz directory.

Note that this is NOT perfect! Some diagrams come out wonky, especially if you use arrows (e.g. for Feynman diagrams) or if you put the TikZ pictures in odd places (like in equation environments). What it does buy you is a HUGE improvement in compile time. I suggest using this for intermediate typesets in a large document. For the final compile just turn it off again so you get clean graphics. Alternately, you can compile a snippit in an editor like LaTeXiT and export that as a PDF.

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[1] http://sourceforge.net/projects/pgf/

[2] https://tug.org/mactex/

[3] For Texpad this is a checkbox in the typesetting preferences.

The arXiv can process TikZ commands so you don't need to use externalize for this. However, not all journals will do this. For example, APS journals require image attachments. In this case one has to use externalize to output the PDFs, then *manually* go though and insert `includegraphics` commands in your manuscript. Sorry, I don't make the rules.

1.4   Fancy Fonts?

Maybe you want to make diagrams with your crazy fonts. XeLaTeX lets you access local system fonts for use in LaTeX. It's great for Beamer, but I don't recommend it in a regular paper. It doesn't play well with some useful macros like 'blackboard math,' http://tinyurl.com/a28hrle.

1.5   Other resources and options

In addition to the comprehensive PGF/TikZ manual, You can find lots of great TikZ tutorials using your favorite internet search site. I especially like http://www.texample.net/tikz/. Here are some TikZ alternatives:

1. JAXODRAW. A simple Java-based interface for drawing Feynman diagrams based on `axodraw.sty` (which is what was used to typeset Peskin & Schroeder), http://jaxodraw.sourceforge.net.

2. FEYNMAN DIAGRAM MAKER. An even simpler web interface by Aidan Randle-Conde[4], http://www.aidansean.com/feynman/. Recommended if you want something for a quick e-mail, but perhaps not publication quality.

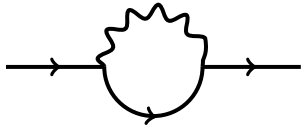3. FEYNMN. An older method based on Metafont. I found it a bit clunky to use and not as flexible as TikZ, http://www.ctan.org/pkg/feynmf.
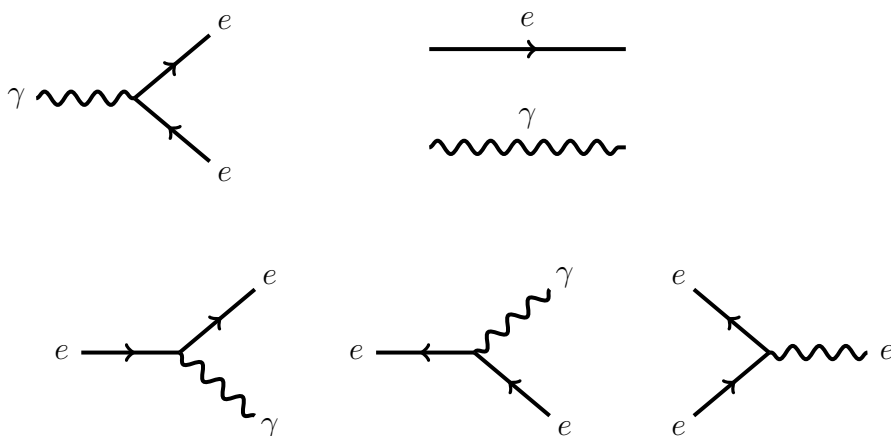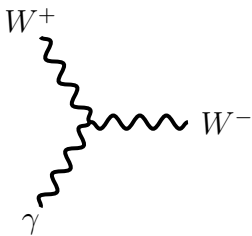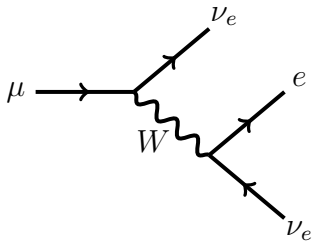
2   QED vertices
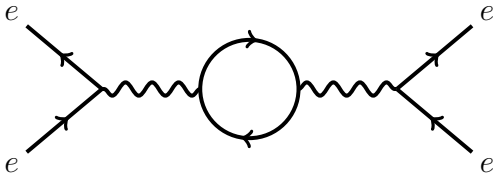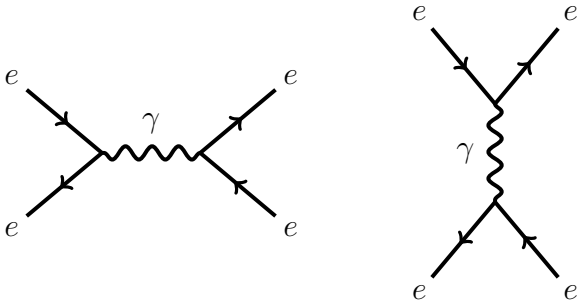
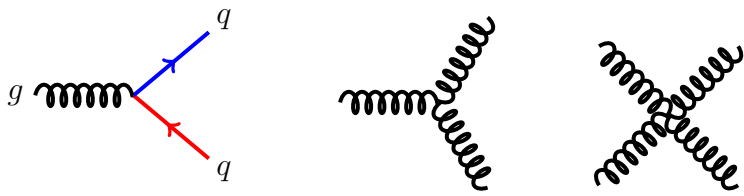Wiggly lines don't always close well. Sometimes you can adjust them by hand.

I don't have a good solution for this. One option specifically for semi-circles is here: http://bit.ly/1vFCNzi. I think it can be adapted for arbitrary angles. For further discussion, see: http://bit.ly/12wA4kQ.

3   W Diagrams

4   QCD

Acknowledgements