

Today's essential \LaTeX tools

M. Bruker

“Paradigms for a more efficient
publication workflow” series

February 2022



Jefferson Lab

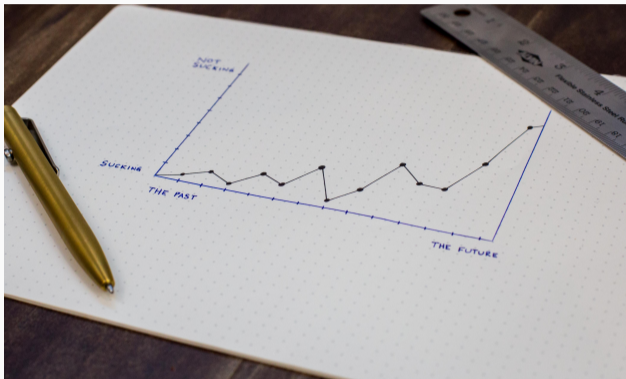


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Why are we here today?

- We have set expectations
- and discussed common errors...
- Part 2: \LaTeX and friends
- Part 3+: Interactive problem-solving session



Picture by Isaac Smith on Unsplash

Recap: WYSIWYG deficiencies & workflow implications

- Fails to separate content and style
- Content hard to reuse without degradation
- No consistent look & feel
- Quick & dirty



Picture by K8 on Unsplash

Superquick intro to \LaTeX

- \TeX = programming language for typesetting, \LaTeX = macro extension for convenience and extensibility
- pronounced /tɛx/ (as in “loch”) or /tɛk/
- Separate content and style
- Giving experts control over your layout will improve it
- Document layout governed by style templates



Picture by Clay Banks on Unsplash

Some \LaTeX examples

```
1 \documentclass[16pt, paper=letter]{scrartcl}
2
3 \title{The importance of cake}
4 \subtitle{Don't make it too sweet}
5 \author{M.~Bruker\thanks{bruker@jlab.org}}
6 \date{February 2022}
7
8 \begin{document}
9
10 \maketitle
11 \begin{abstract}
12 This simple example shows what  $\LaTeX$  source code looks like.
13 \end{abstract}
14
15 \section{Types of cake}\label{sec:cake}
16 There are various types of cake.
17 Subsection~\ref{sec:cake:chocolate} describes one in detail.
18
19 \subsection{Chocolate cake}\label{sec:cake:chocolate}
20 It involves cocoa and powdered sugar.
21
22 \section{Conclusion}
23 As described in Section~\ref{sec:cake}, cake is tasty.
24
25 \end{document}
```

The importance of cake

Don't make it too sweet

M. Bruker*

February 2022

This simple example shows what \LaTeX source code looks like.

1 Types of cake

There are various types of cake. Subsection 1.1 describes one in detail.

1.1 Chocolate cake

It involves cocoa and powdered sugar.

2 Conclusion

As described in Section 1, cake is tasty.

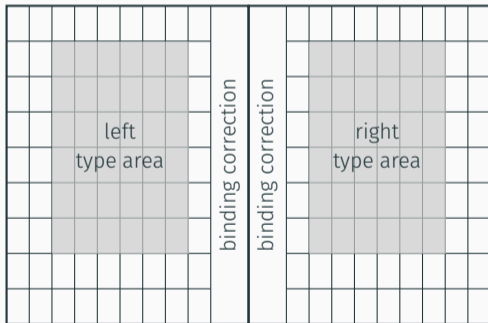
*bruker@jlab.org

General hints

- Define structure using only the appropriate commands
- Paragraphs are paragraphs; use `\` only when appropriate
- Don't mess with dimensions, e.g., margins, skips, and indentations
- Don't mess with any details of typesetting or page layout
- `\includegraphics` is for photos
- Use Lua^AT_EX

The importance of type area / page layout

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.



- type area ratio = page ratio
- combined inner margin = outer margin (left = right for one-sided)
- page layout only possible if binding correction is known
- 16 : 9 screens are unsuitable for full-screen text

- LaTeX only produces output formats with fixed layout
- Uninteractive, not suitable for today's variety of devices
- Waiting for technological advancement now... HINT format?
- We are stuck with PDF for the time being—But stay open

How to do things right: Math typesetting

- Useful article: Claudio Beccari, “Typesetting mathematics for science and technology according to ISO 31/XI”, TUGboat, Volume 18 (1997), No. 1
- `amsmath` is fine, `mathtools` fixes/extends it
- Chemical elements and particles: \exists packages...
Simple cases: `\text{Kr}^{25+}` gives $^{86}\text{Kr}^{25+}$
- Paired delimiters: `\DeclarePairedDelimiter` or `\left / \right`
 - Wrong: `\langle x^2 \rangle` or `|\frac{a^2}{b}|`
 - One right way: `\left\langle x^2 \right\rangle` or `\left|\frac{a^2}{b}\right|`
- Upright operators etc.: `\sin\phi` $a \sin \phi$, not `\text{sin}\phi` $a \sin \phi$ (spacing)
- Differentials complicated, but \exists universal solution (reference above)
- Actual text: `\text{heat}` P_{heat} , not `P_{heat}` P_{heat}

How to do things right: Units

- Stop thinking—Use SIUNITX for everything
- Works regardless of math environment
- `\si` for units, `\SI` for quantities with units, `\num` for numbers without units, `\SIrange` or `\numrange` for ranges (customizable)

```
\mathcal{L} = \SI{1.5e34}{\per\square\centi\meter\per\second}
```

$$\mathcal{L} = 1.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$$

```
\frac{\diff{\xi}}{\diff{t}} = \SI{1.2e-7}{\nano\meter\milli\radian}  
\leftrightarrow \per\giga\electronvolt\tothe{5}\per\minute}
```

$$\frac{d\xi}{dt} = 1.2 \times 10^{-7} \text{ nm mrad GeV}^{-5} \text{ min}^{-1}$$



How to do things right: Bibliography

```
@article{DECLERCQ2019100058,  
  title = {The effect of having Christmas dinner with in-laws on gut microbiota composition},  
  journal = {Human Microbiome Journal},  
  volume = {13},  
  pages = {100058},  
  year = {2019},  
  issn = {2452-2317},  
  doi = {https://doi.org/10.1016/j.humic.2019.100058},  
  author = {Nicolien C. {de Clercq} and Myrthe N. Frissen and Evgeni Levin and Mark Davids and Jorn  
↪ Hartman and Andrei Prodan and Hilde Herrema and Albert K. Groen and Johannes A. Romijn and Max  
↪ Nieuwdorp},  
}
```

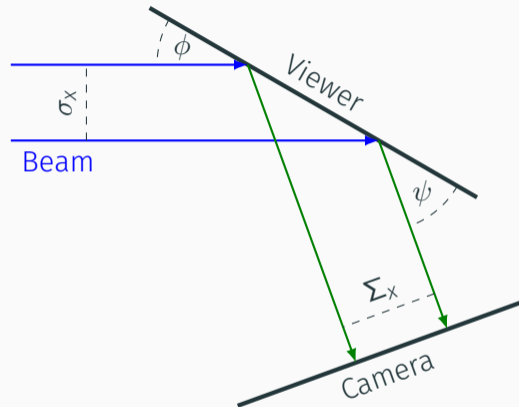
A recent study~\cite{DECLERCQ2019100058} has shown that\ldots{}

A recent study [1] has shown that...

- [1] N. C. de Clercq et al. “The effect of having Christmas dinner with in-laws on gut microbiota composition”. In: *Human Microbiome Journal* 13 (2019), p. 100058. ISSN: 2452-2317. DOI: <https://doi.org/10.1016/j.humic.2019.100058>.

How to do things right: TikZ/PGF

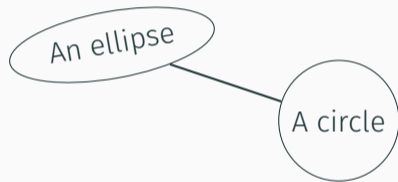
- Drawing based on paths and nodes
- Various coordinate systems and transformations
- **Seamlessly** integrates into \LaTeX
- Simple syntax; extensive feature set
- Libraries for graphs/trees, circuits, mind maps, data...
- non-WYSIWYG pros & cons



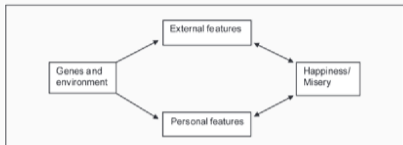
From a recent tech note draft of mine. Time spent adapting code to slide show format: 0 s

Simple example (from the TikZ manual)

```
1 \begin{tikzpicture}
2 \path
3   (0, 0) node(a) [ellipse,rotate=10,draw] {An ellipse}
4   (3, -1) node(b) [circle,draw] {A circle};
5 \draw[thick]
6   (node cs:name=a) -- (node cs:name=b);
7 \end{tikzpicture}
```



World Happiness Report revisited

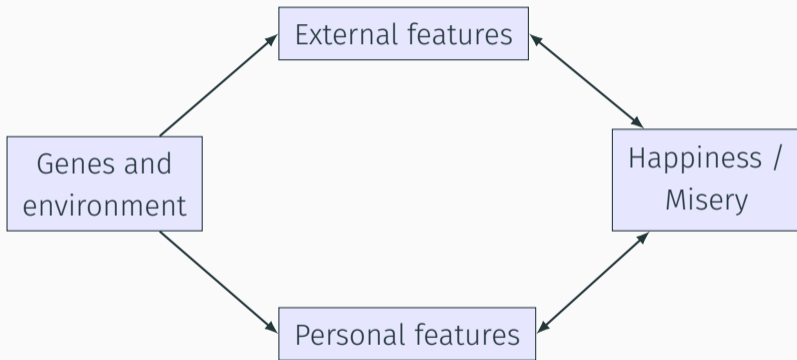


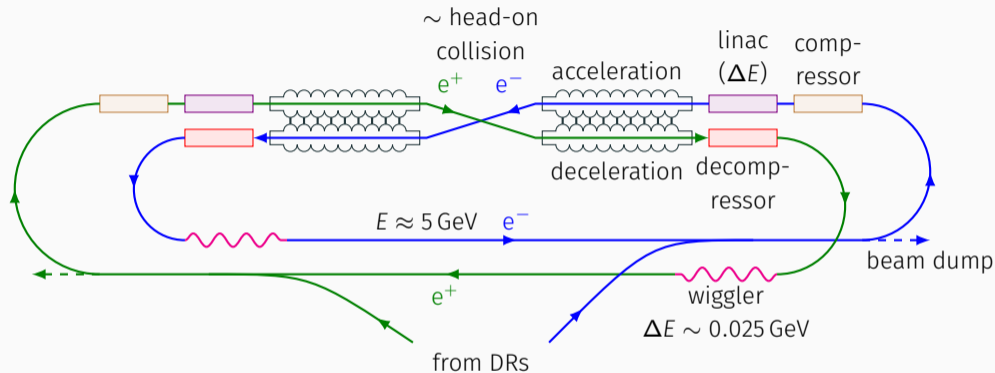
Columbia Climate School—The Earth Institute:
World Happiness Report

- We saw this masterpiece last week
- You usually want a hand-drawn sketch of what you're going to program—This will do

```
1 \begin{tikzpicture}
2 [
3     mynode/.style={draw, rectangle, fill=blue!10,
4     <-> align=center, inner sep=1ex},
5     myedge/.style={draw, thick,
6     >=latex,
7     ]
8     \node[mynode]
9     (genes) {Genes and\\environment};
10    \node[mynode, above right=of genes]
11    (external) {External features};
12    \node[mynode, below right=of genes]
13    (personal) {Personal features};
14    \node[mynode, above right=of personal]
15    (happiness) {Happiness /\\Misery};
16
17    \path[myedge, ->] (genes) -- (external.west);
18    \path[myedge, ->] (genes) -- (personal.west);
19    \path[myedge, <->] (happiness) -- (external.east);
20    \path[myedge, <->] (happiness) -- (personal.east);
21 \end{tikzpicture}
```

Now the world can be happy



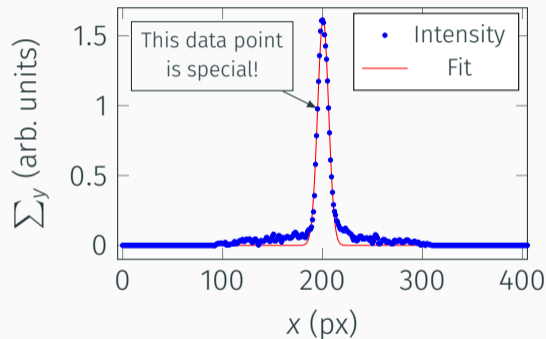


Based on: V. I. Telnov, "A high-luminosity superconducting twin e^+e^- linear collider with energy recovery", 2021.

<https://arxiv.org/abs/2105.11015>

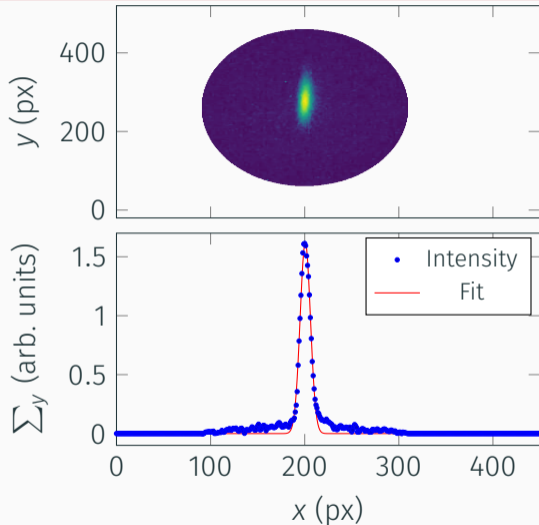
Bread and butter: Data

```
\begin{tikzpicture}
\begin{axis} [
  width=\linewidth, height=.7\linewidth,
  xlabel={x (px)},
  ylabel={\sum_y (arb.~units)},
  xmin=-2, xmax=402,
  ymin=-0.1, ymax=1.7,
]
\addplot+[only marks, mark size=.8pt]
  table[x index=0,
    y expr={\thisrowno{1}*1e-4}
  ] {data/plot_x.dat};
\addlegendentry{Intensity}
\addplot+[mark=none]
  table[x index=0,
    y expr={\thisrowno{1}*1e-4}
  ] {data/plot_x_fit.dat};
\addlegendentry{Fit}
\path (rel axis cs:0, 1)
  node[draw, anchor=north west, font=\scriptsize,
    align=center, xshift=5pt, yshift=-5pt]
    (annotation) {This data point\\is special!};
\draw[-latex] (annotation) -- (axis cs:195, 0.98);
\end{axis}
\end{tikzpicture}
```



Bread and butter: Plot groups

```
\begin{tikzpicture}
\begin{groupplot} [
  group style={group size=1 by 2, vertical sep=1ex},
  scale only axis,
  width=.8\linewidth, height=.4\linewidth,
  xmin=0, xmax=450,
]
\nextgroupplot[xticklabel=\empty, ylabel={\$y\$ (px)}]
\addplot graphics[xmin=0, xmax=450, ymin=25,
  ↪ ymax=475] {data/plot_image.png};
\nextgroupplot[xlabel={\$x\$ (px)}, ylabel={\$\sum_y\$
  ↪ (arb.~units)}, ymin=-0.1, ymax=1.7]
\addplot+[only marks, mark size=.8pt]
  table[x index=0, y expr={\thisrowno{1}*1e-4}]
  {data/plot_x.dat};
\addlegendentry{Intensity}
\addplot+[mark=none]
  table[x index=0, y expr={\thisrowno{1}*1e-4}]
  {data/plot_x_fit.dat};
\addlegendentry{Fit}
\end{groupplot}
\end{tikzpicture}
```



Color schemes

- red/green-blind compatibility and, by extension, colorblind compatibility
- different for qualitative, diverging, sequential data
- Note, compromise for video projectors: they don't handle yellow well
- Excellent explanations/numbers by Paul Tol: <https://personal.sron.nl/~pault/>
- Correct choice of color scheme depends on number of items



Qualitative, bright (Paul Tol)

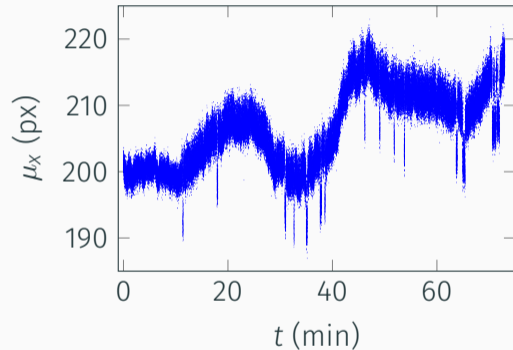
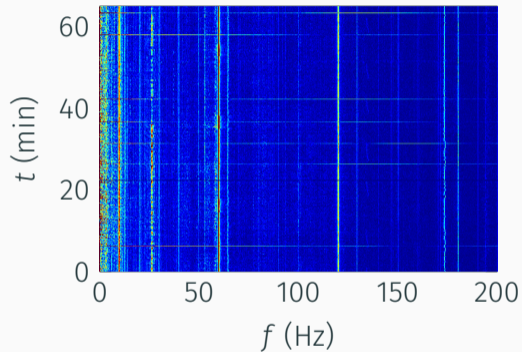


Sequential, rainbow (Paul Tol)



Sequential, YlOrBr (Paul Tol)

Digression on data sampling for visualization



The Jefferson Lab beamer template

- BEAMER: popular \LaTeX document class to make slide shows
- Template made in 2019 based on METROPOLIS; resembles official JLab templates
- Code not very flexible/customizable, but reasonable starting point
- Will hopefully be available on the website soon
- I'll send the source of this document to anyone who wants it

```
1 \documentclass[aspectratio=169]{beamer}
2 \setbeameroption{show notes on second screen=right}
3 \setbeamertemplate{note page}{\insertnote}
4 \setbeamerfont{note page}{size=\footnotesize}
5 \usepackage{pgfplots}
6 \usetheme{jlab}
```

...

```
55 \begin{document}
56 \begin{frame}[plain]
57   \maketitle
58 \end{frame}
59
60 \begin{frame}{Why are we here today?}
61 \begin{columns}
62 \column{.4\linewidth}
63 \begin{itemize}
64 \item We have set expectations
```

From tutorial to real-world examples

- Items to touch on next time (two weeks from now?) include:
 - OVERLEAF and other means of collaborating
 - Version control
 - Interfacing with data analysis code (e.g., PYTHON)
- More important: Send me your problems to **bruker@jlab.org**
 - Visualization problems of past, present, or future
 - Can be abstract figures or data (or combination thereof)
 - Please stay within a reasonable scope
- Interactive problem-solving session!