The University of Texas at Austin
Cockrell School of Engineering

**August 2025**

# STARTING TIPS: MAKING FIGURES AND IMAGES

Wang Materials Group Meeting Tutorials

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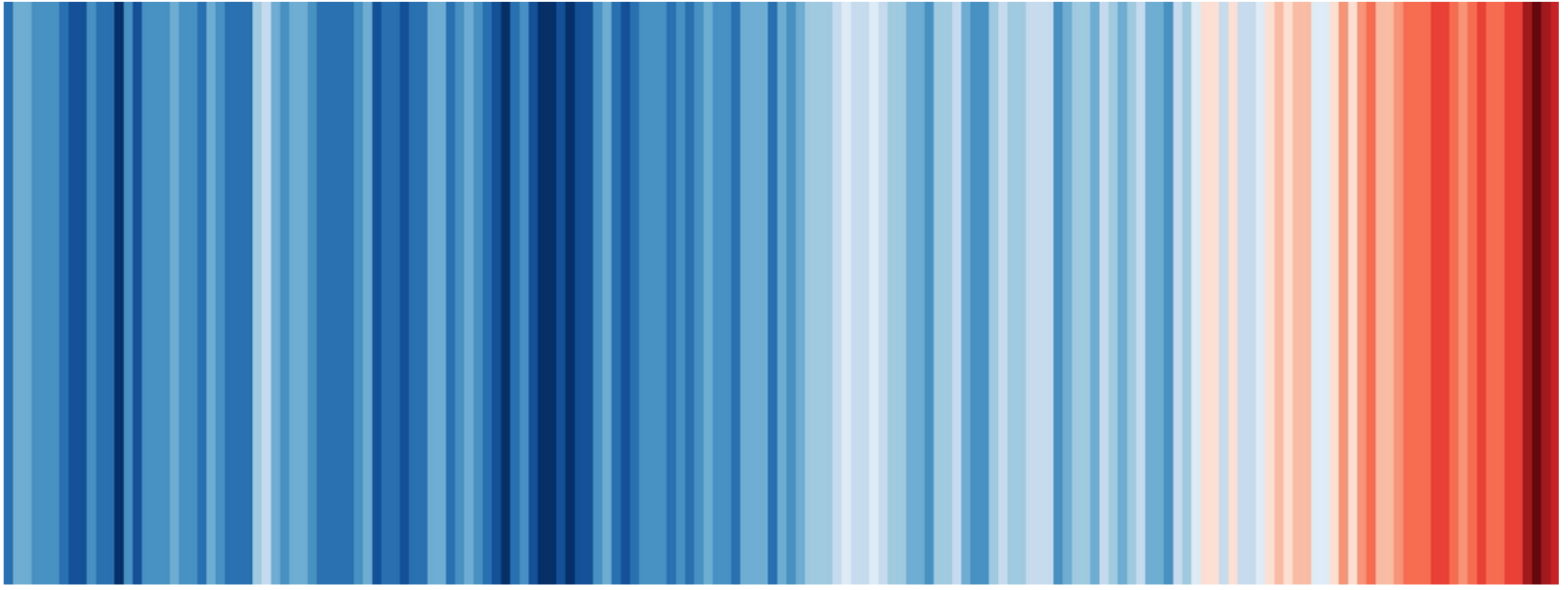
# Why bother making a nice figure?

- A figure is worth a thousand words
- It is often the first impression you make to the reader
- It is sometimes the only thing a reader looks at
- Visual communication is just as powerful a form of communication as written!

# Good design is memorable

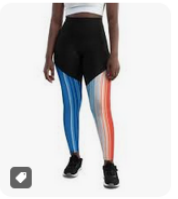
Example: Warming stripes, Ed Hawkins
Annual average global temperature 1850-2010

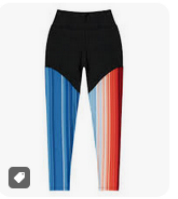


# Good design is memorable


Grist.org
climate change leggings ...

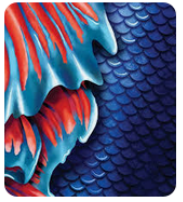

Vox
Climate change data…


Etsy · In stock
Warming Stripes, Cli…

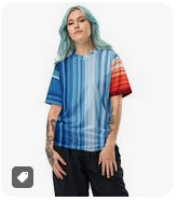

Breanna Cooke · In st…
High Waist Compres…


Breanna Cooke · In st…
High Waist Compres…

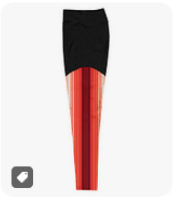

Breanna Cooke · In st…
High Waist Compres…

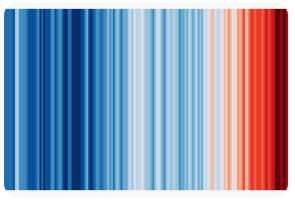

Etsy
Warming Stripes, Cli…


Breanna Cooke · In st…
Warming Stripes | Re…

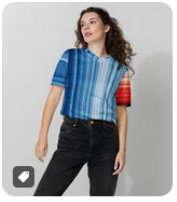

Breanna Cooke · In st…
Warming Stripes | Re…

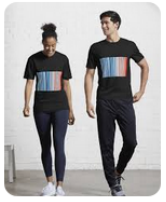

Breanna Cooke · In st…
Warming Stripes | Re…


Breanna Cooke · In st…
High Waist Compres…


POMP store
Ed Hawkins Warming Stripes


POMP store
Ed Hawkins Warmi…


Breanna Cooke · In st…
Warming Stripes | R…


Redbubble
Australia climate a…

# Figures are a form of visual design

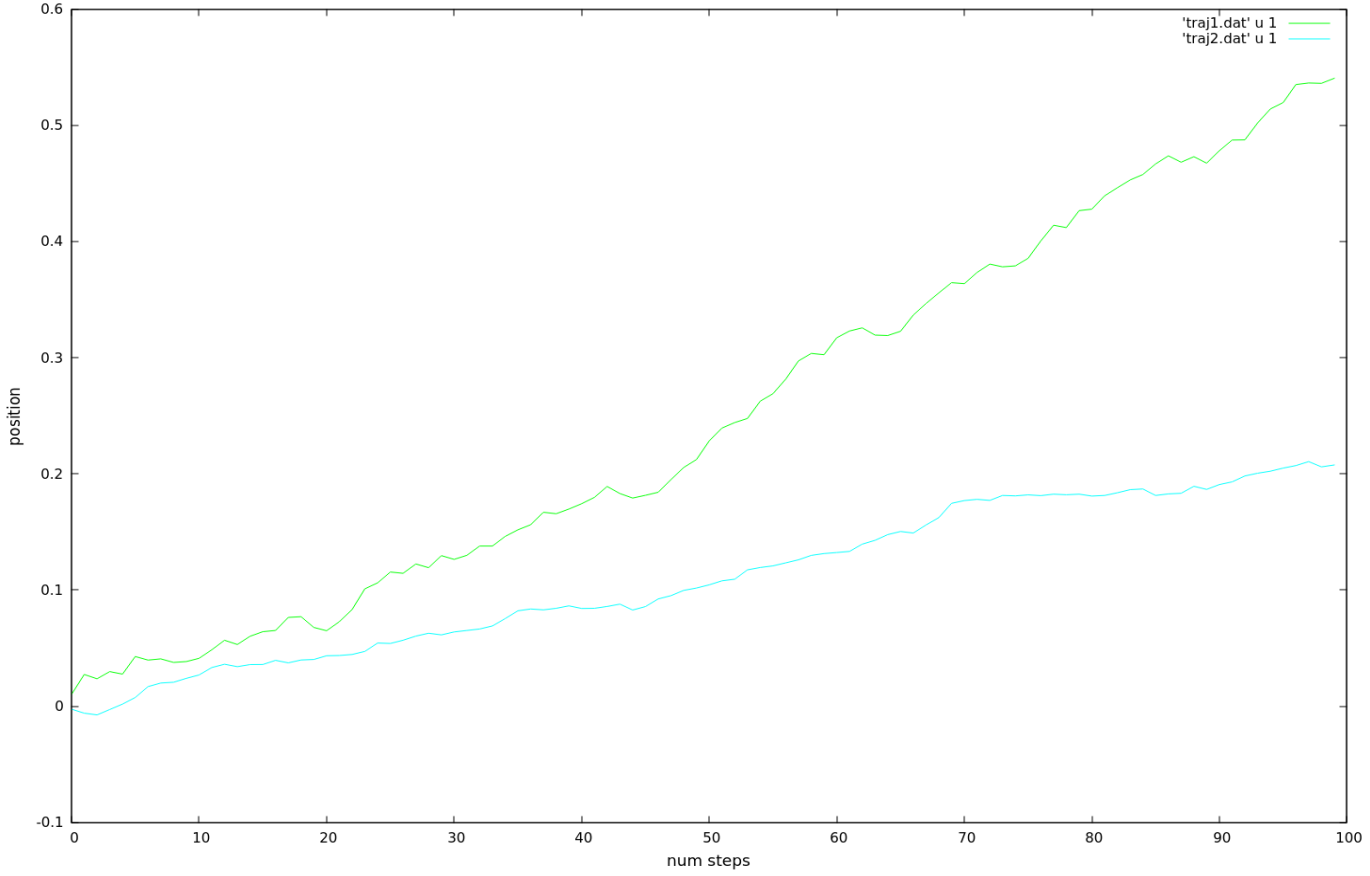
- Design with intent
- Do not just directly copy a figure in a paper into a presentation
- The visual design will not always translate
  - adjust the relative scale of axes labels, tick marks, etc.
  - break down a complex figure

# Always take the time to typeset

- LaTeX is your friend (klatex for generating image equations)
- The hyphen (-), the minus (−),
  the en dash (–, denote range), the em dash (—, separate parts of sentence)
- Times ( $\times$, not ‘x’)
- Subscript, Superscript (cm-1 v $cm^{-1}$)
- Element names are not italicized ($CuO_2$, not $\mathit{CuO_2}$)
- Variables are italicized (or in math mode)
- Approximately (≈, not ~)
- Space between value and units (2.0 eV, not 2.0eV);
  if there is a newline, keep the value and units together
- Much greater than ( $\gg$, not >>)
- Bra-ket notation ( $\langle\rangle$, not <> )

Generated with gnuplot, a command-line graphic utility

# A bad figure

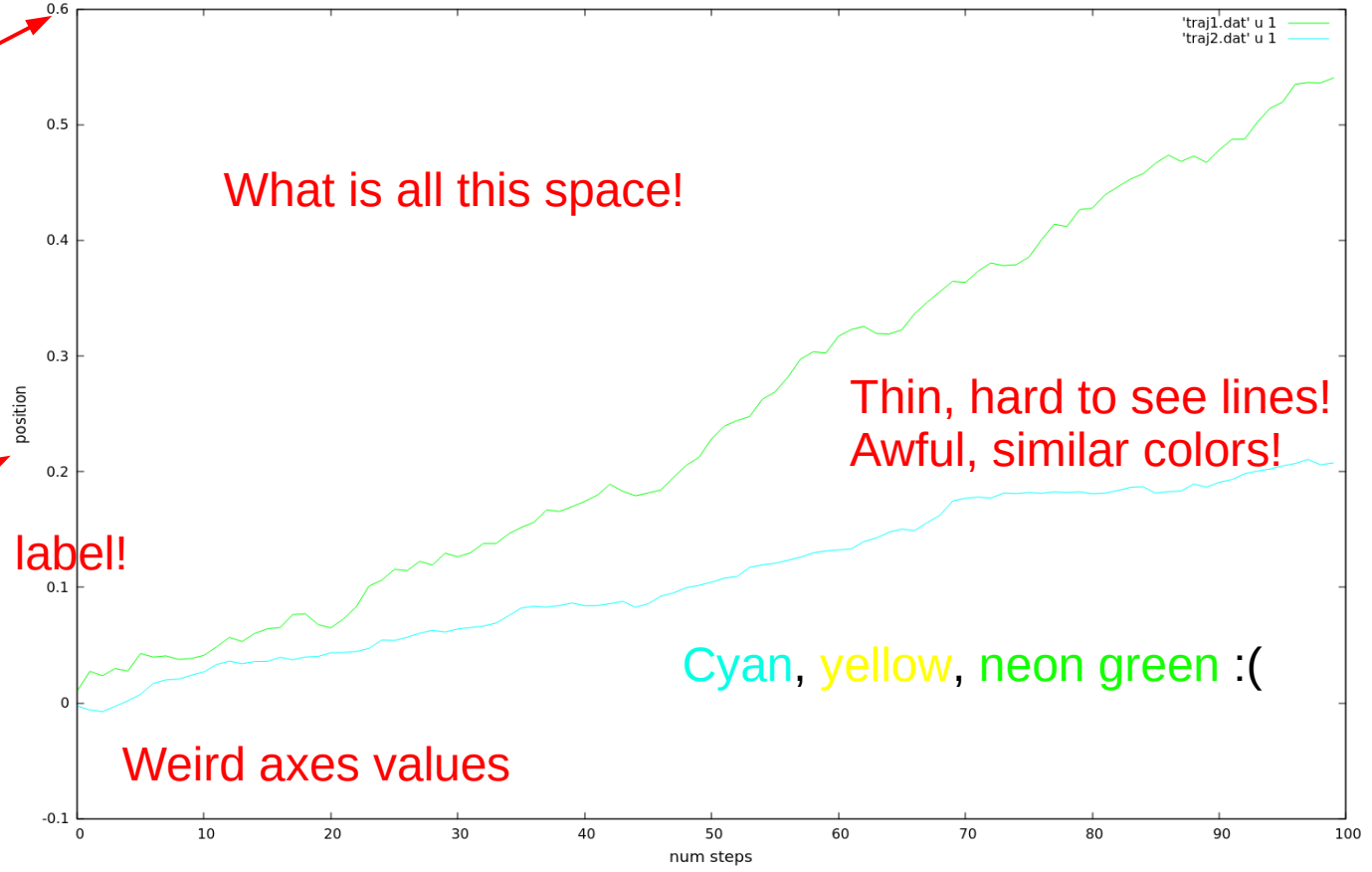


Ok for quick visualization
Not ok for paper figure

# A bad figure

Meaningless key!

Tiny font!




What is all this space!

Thin, hard to see lines!
Awful, similar colors!

Informal axes label!
No units!

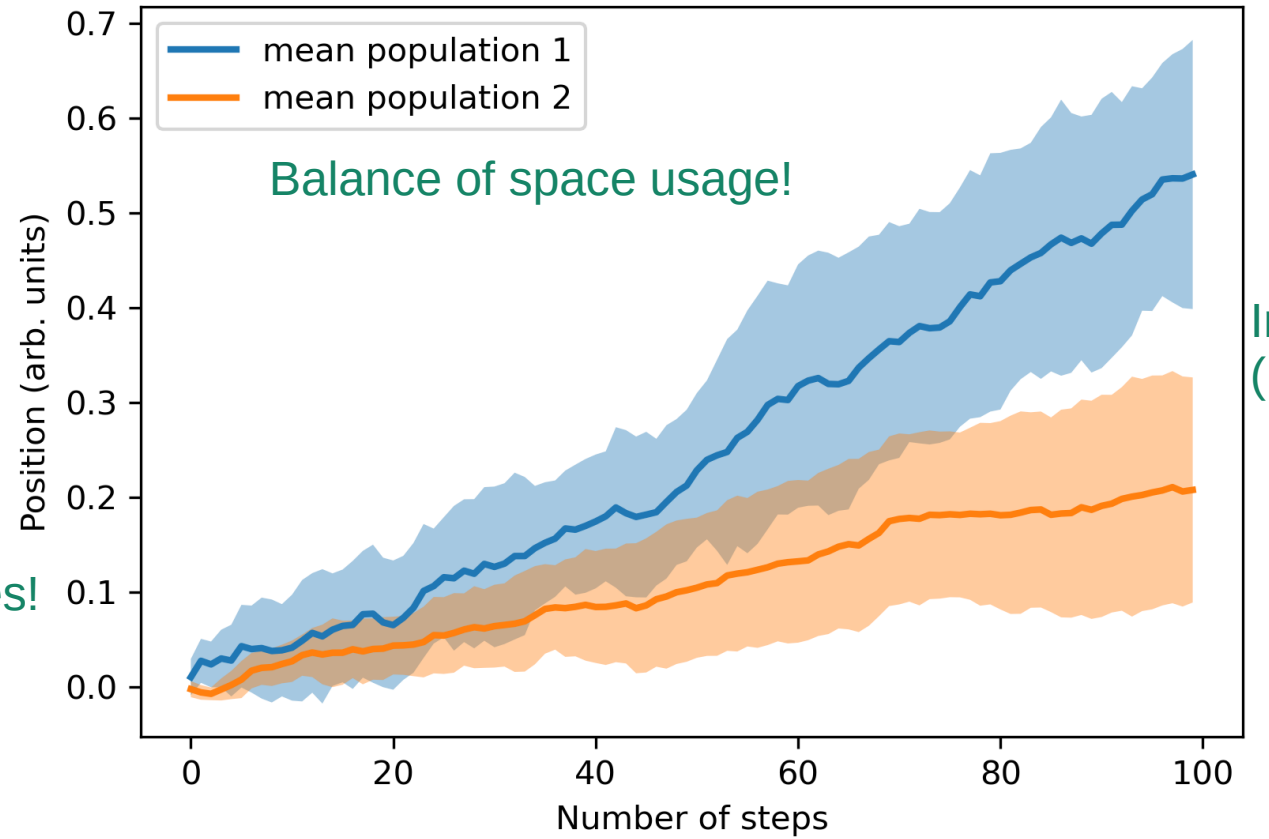
Cyan, yellow, neon green :(

Weird axes values

# A better figure

Clear lines
with contrasting,
complementary colors!

Legible font!




Descriptive axes!

Inclusion of statistics!
(If relevant)

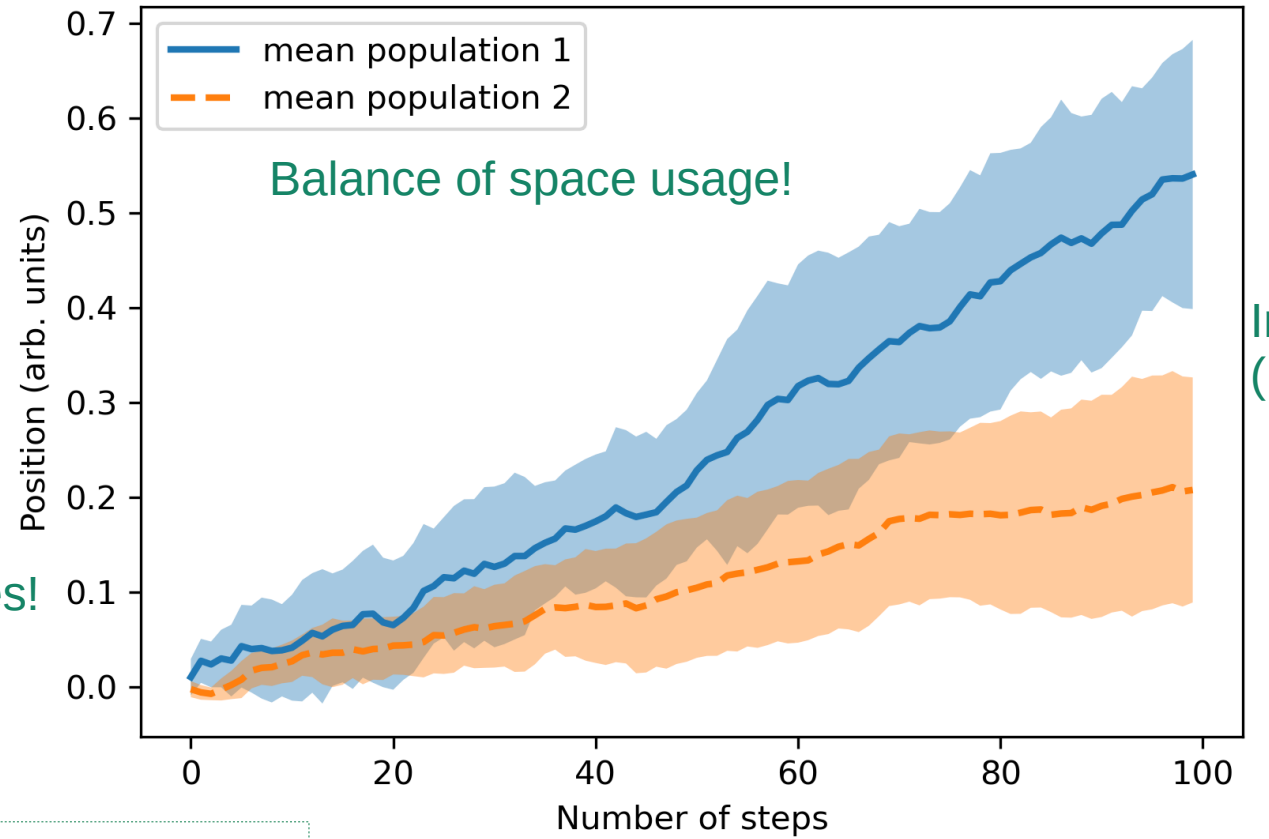
Crisp resolution!

Displacement of 10 random walkers

# A better figure

Clear lines
with contrasting,
complementary colors!

Legible font!




Balance of space usage!

Inclusion of statistics!
(If relevant)

Descriptive axes!

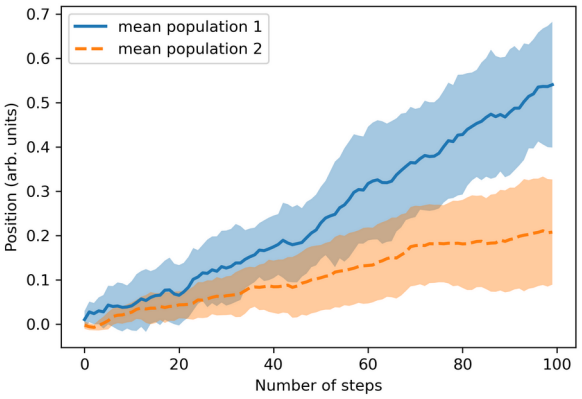
Crisp resolution!

**Redundancy in grey scale!**

Displacement of 10 random walkers

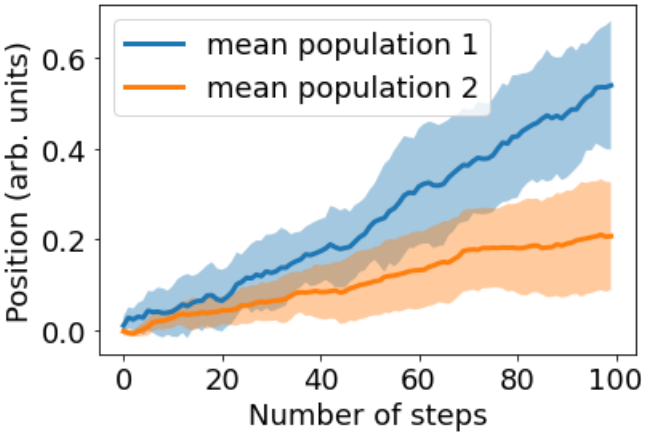
# Make it scalable

Original scaled down figure




versus

Re-adjusted scaled figure

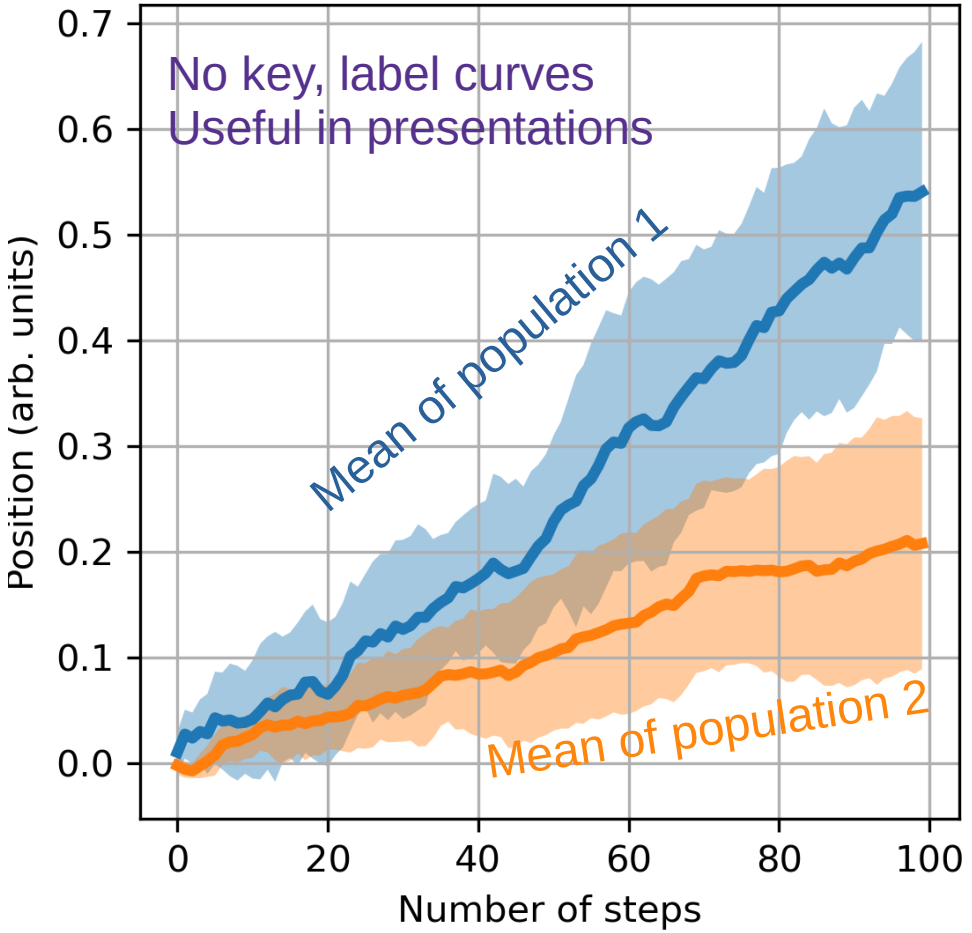



The font size is scaled to match the scaling of the figure

You can save space without compromising on the readability of the figure!

# Some things of personal choice

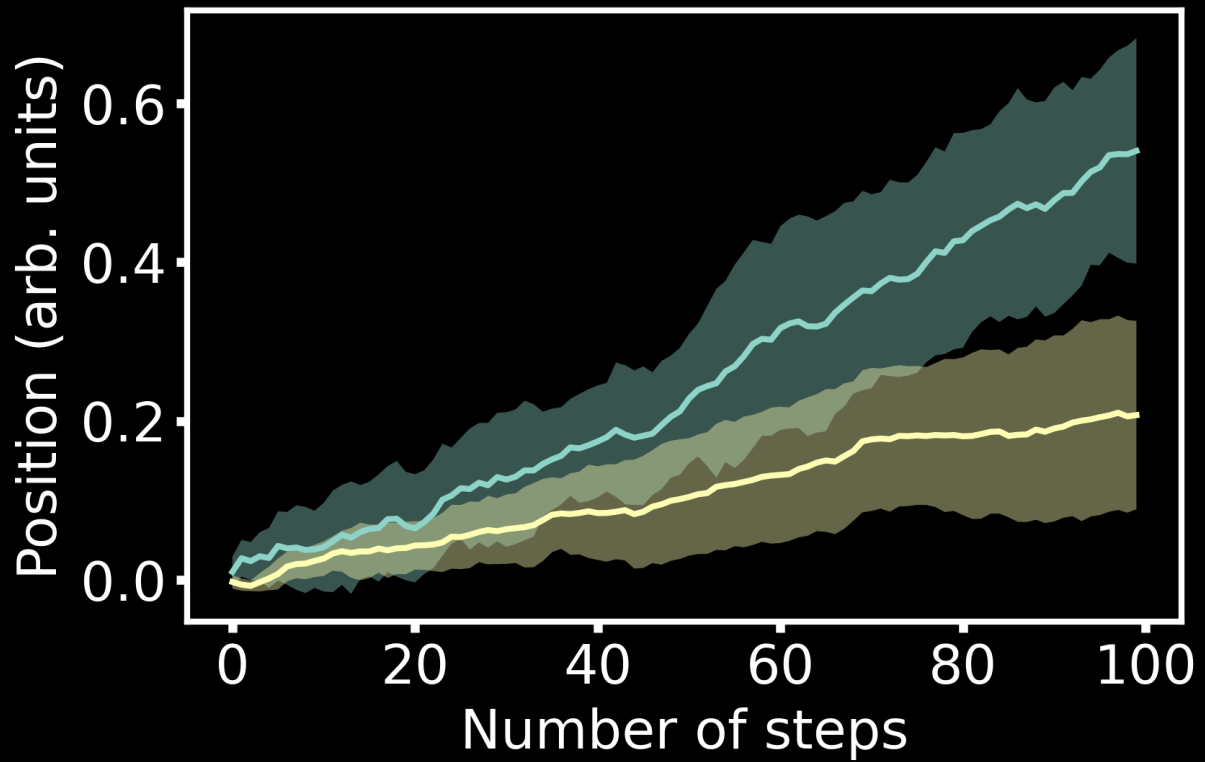
Square ratio!




Grid lines as guide to eye
(WW is meh)

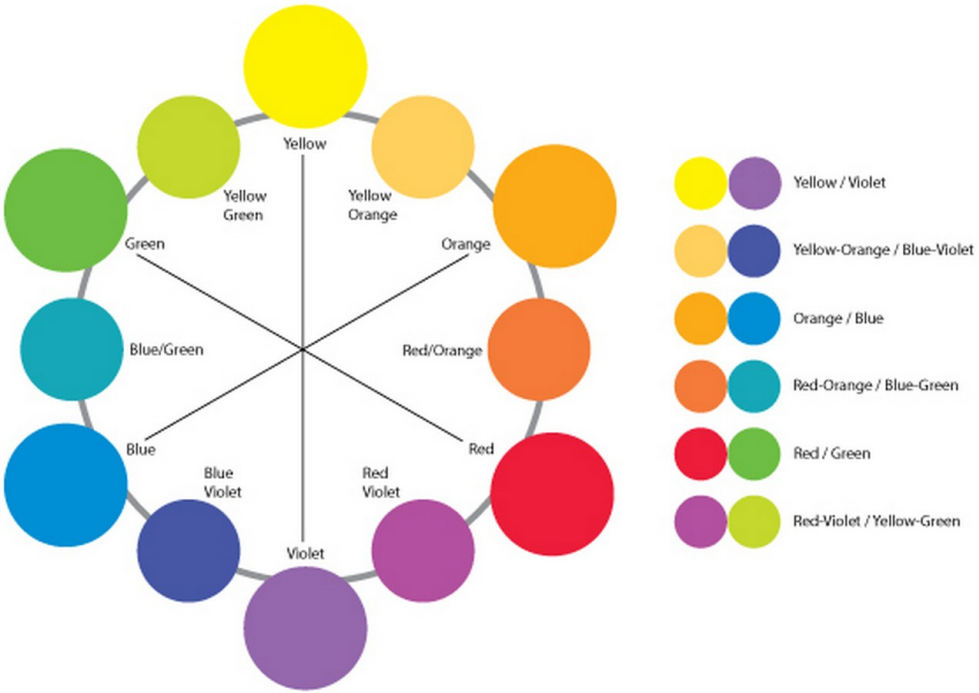
# Dark Background?

It can work,
but you need to be
careful of visibility

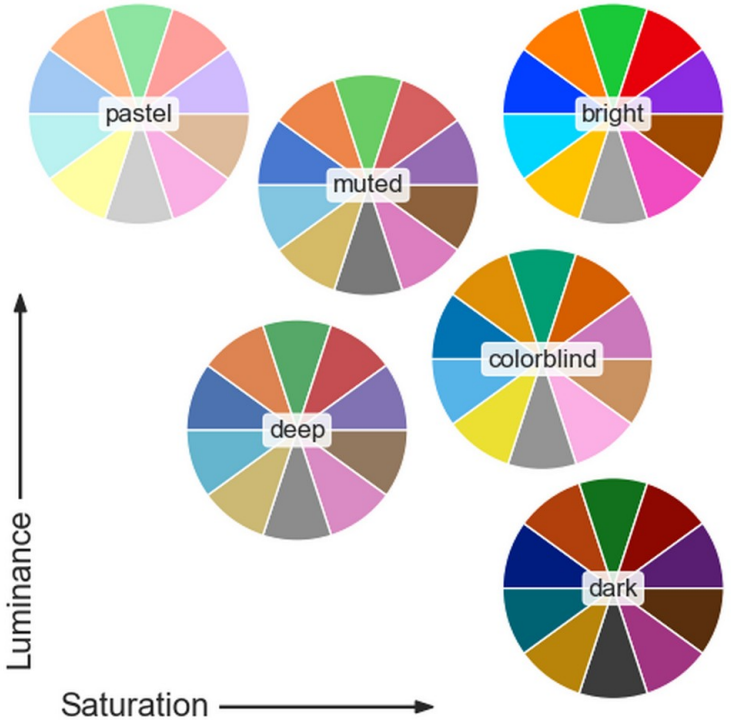


# Color is important

Complementary colors




seaborn color palettes

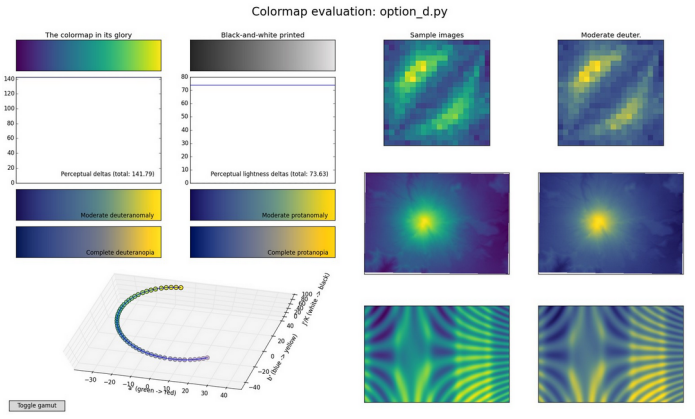


# Color Maps

## Avoid default jet (rainbow) setting... not great


https://youtu.be/xAoljeRJ3lU

Viridis, Parula are better!




https://bids.github.io/colormap/

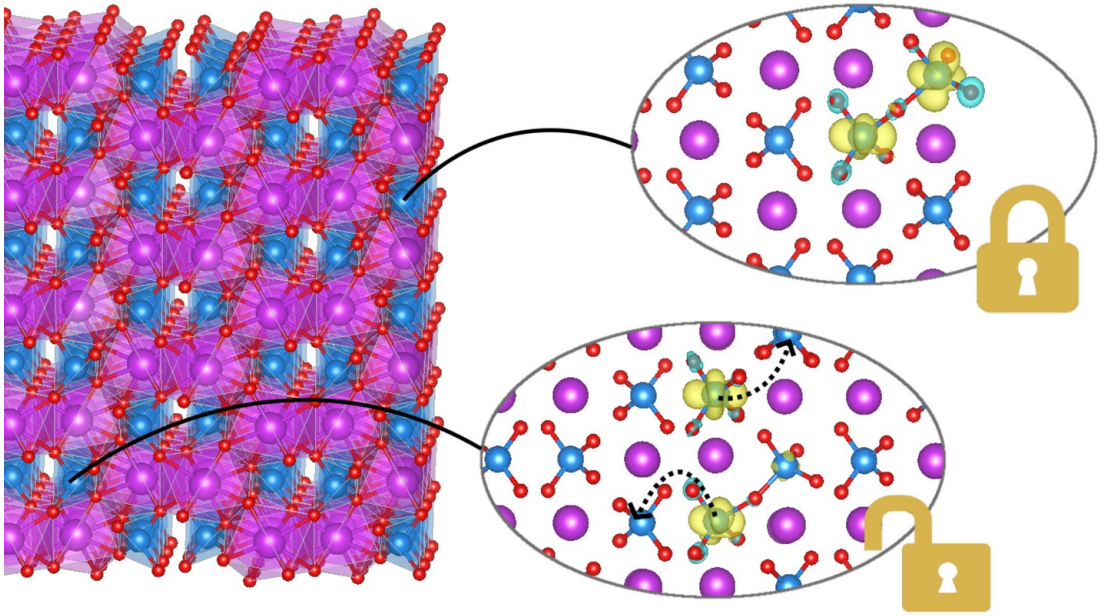
Perceptually uniform,
Translates well to greyscale,
Better for the colorblind,...

# Example Tools (open source!)

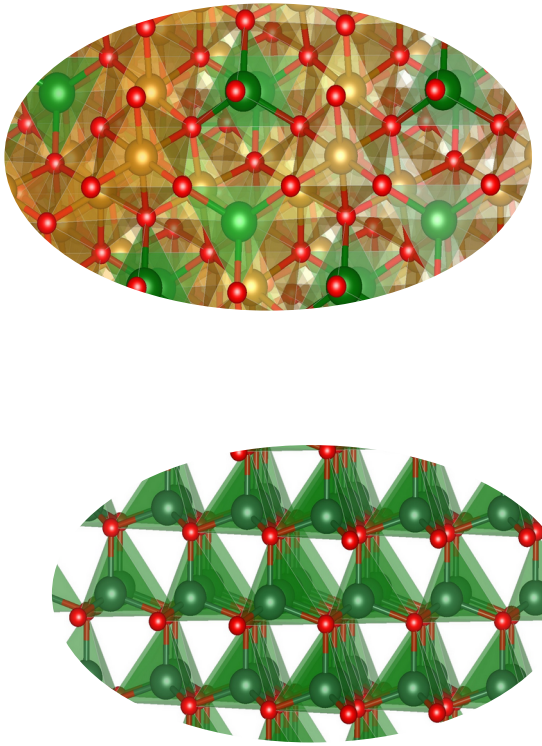
- GIMP (bitmap images)
- Inkscape (vector image)
- Xmgrace, gnuplot (plotting from terminal or script)
- Python, matplotlib, seaborn
- VESTA, Xcrysden, ASE (visualize structure); Ovito (animations)
- Blender (3D rendering and animation)
- TikZ, Asymptote (vector graphics for textbook-like schematics, scriptable)
- ...many, many more

R. Schmied. Using Mathematica for Quantum Mechanics: A Student's Manual.
https://arxiv.org/pdf/1403.7050.pdf

# Crystal structures



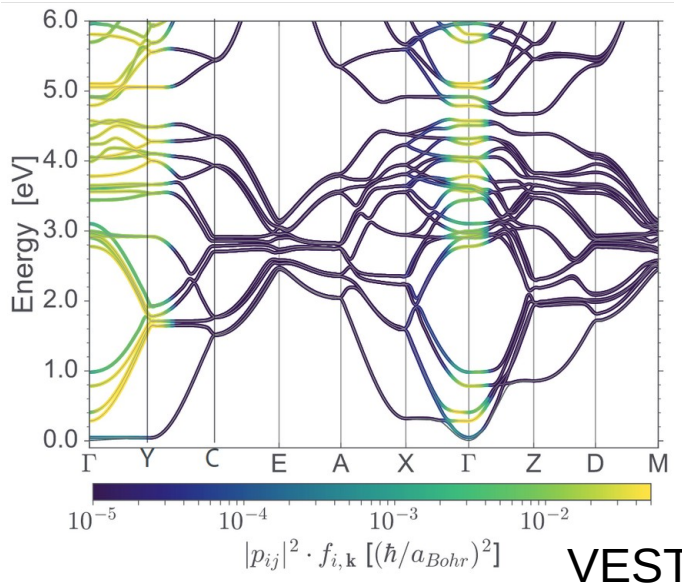
VESTA + GIMP



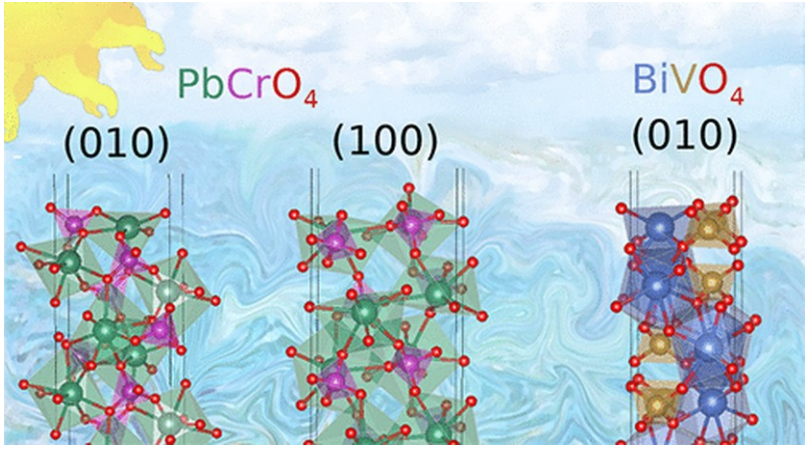
w/ VESTA (plus some tuning)

# Example Figures

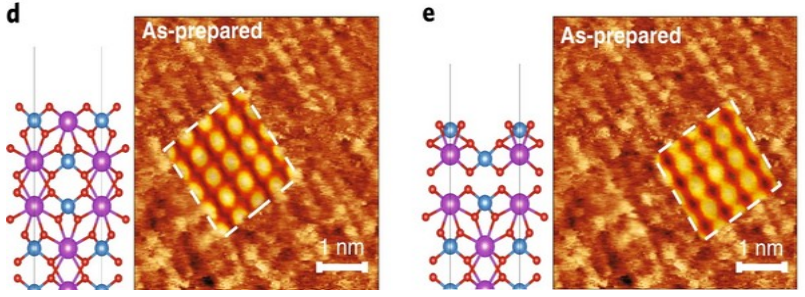
Python
matplotlib



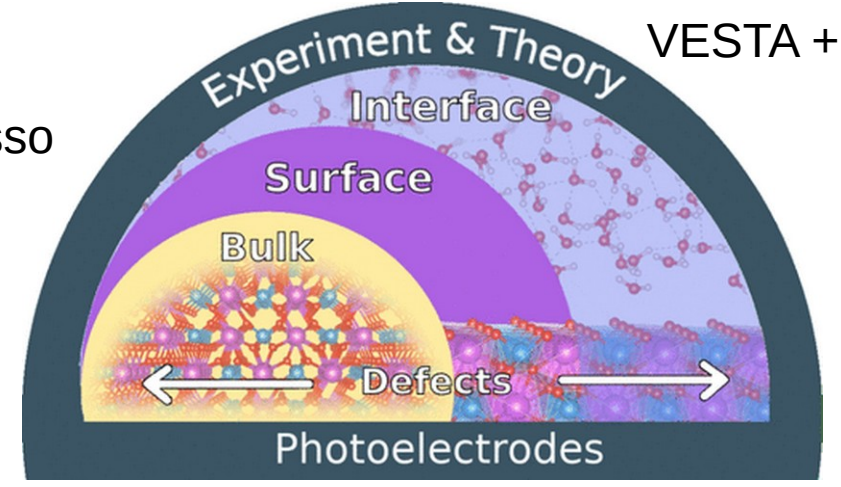

VESTA +
Pixabay
+ GIMP




VESTA + GIMP
+ Quantum Espresso

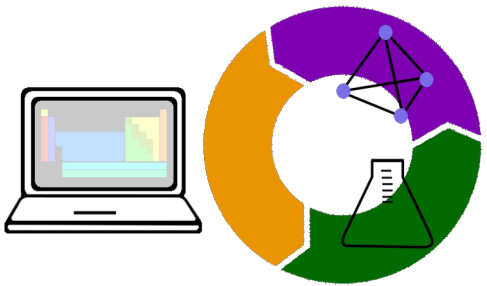



VESTA + GIMP



# Example Figures

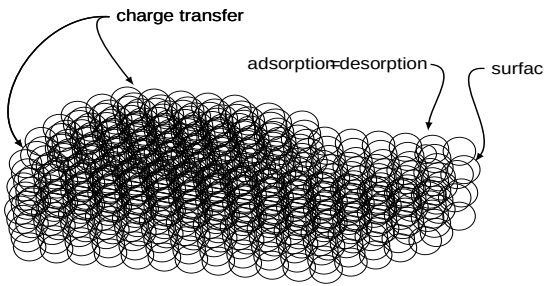
GIMP



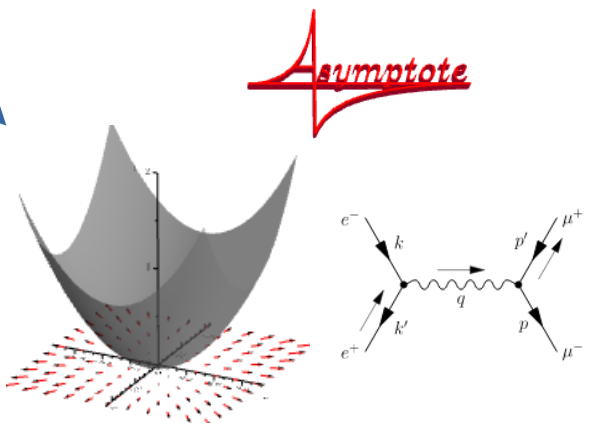
Vector graphics

Example scripts and presentation:
https://github.com/wangmatgroup/tutorials


Tikz (TeX)



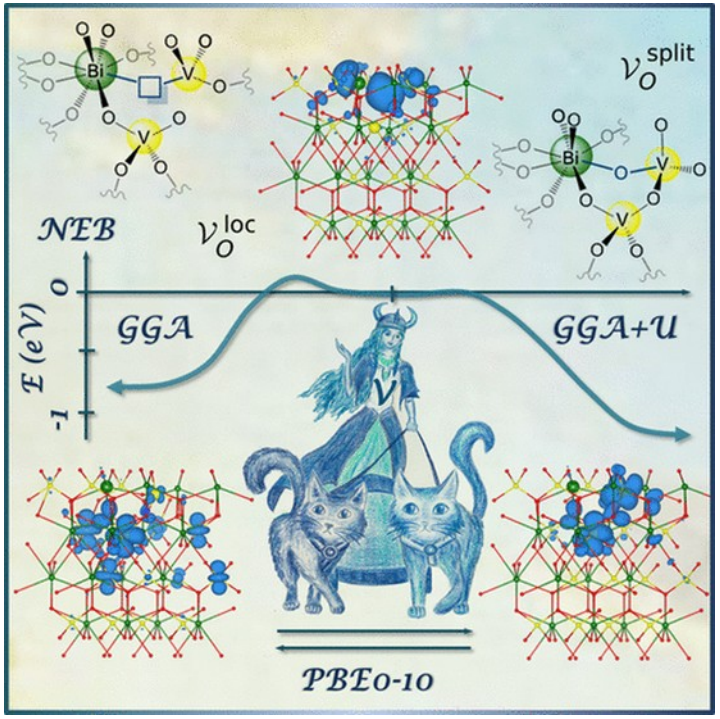

```
\documentclass{article}
\usepackage[rgb]{xcolor}
\usepackage{tikz,pgfor}
\usetikzlibrary{shadows,fadings}
\begin{document}


%\begin{figure}
\centering
\begin{tikzpicture}
%\draw[help lines] (0,0) grid (10,10); %used just for
visualising the positions of objects during construction
%
% \begin{scope}[yshift=-180,yslant=0.5,xslant=-1]
%     %the rectangular surface onto which the clusters are
located
%     \filldraw[black!10,very thick] (0.5,1) rectangle (
10,7);
%     %circle circumventing the smallest cluster
%     \node[circle,circular
glow,fill=maroon!20,draw=maroon,thick]
%     at (4.1,4.9) {\phantom{perimetro}};
% \end{scope}

%atom clusters are rotated for a better visualisation
\begin{scope}[rotate around = {-5:(0,0,0)}]
    %%% text describing the objects in the picture
    % \draw[-latex,thick] (6,3) node[right,text width=3cm]
    %     {$\mathsf{potent\; perimeter\; sites}$} to [
    out=180,in=0] (5.5,1);
    % \draw[-latex,thick](3,-1)node[right]
    %     {$\mathsf{Non-metallic\; molecule}$} to[
    out=180,in=0] (2.6,-3);
    % \draw[-latex,thick](-3,-1)node[above]
    %     {$\mathsf{extra \; electron}$} to[out=-90,in=180]
    (-1.4,-2);

    %now we start with the clusters (maybe this code could
    be improved by a tikz expert)
    %the layers are built starting from the very lowest one

    % user-defined parameters
    \pgfmathsetmacro{\ballsize}{0.3}
    \definecolor{maroon}{rgb}{0.6,0.0,0.0}
    \definecolor{violet}{rgb}{0.3,0.25,1.0}
    \definecolor{darkyellow}{rgb}{0.95,0.75,0.15}

    %largest cluster
    %extra bottom rows for material 1
    \foreach \x  in {
1.5,2.2,2.5,3.3,3.5,4.4,4.5,5.0,5.5,6.0,6.5,7.0,7.5}%
```



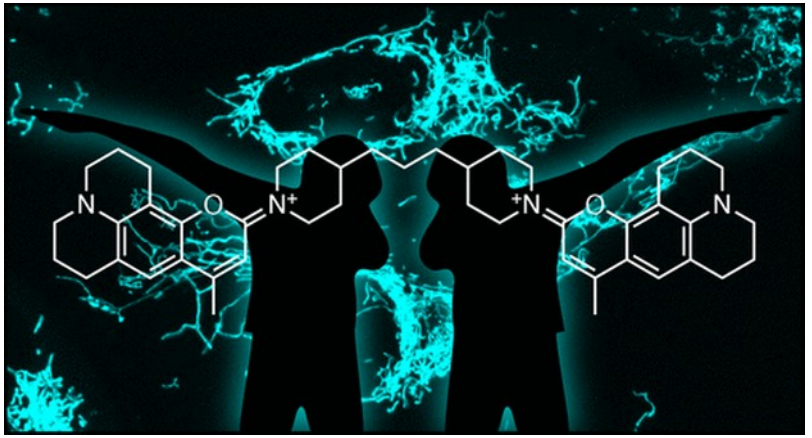

https://asymptote.sourceforge.io/gallery/

https://tocrofl.tumblr.com/

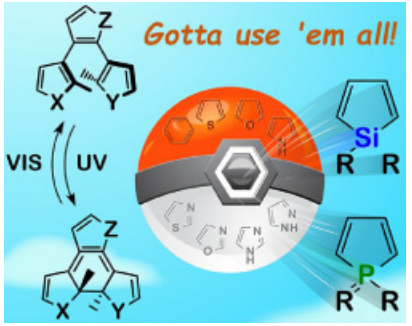
# TOC graphics




https://pubs.acs.org/doi/10.1021/acs.jpclett.9b02552



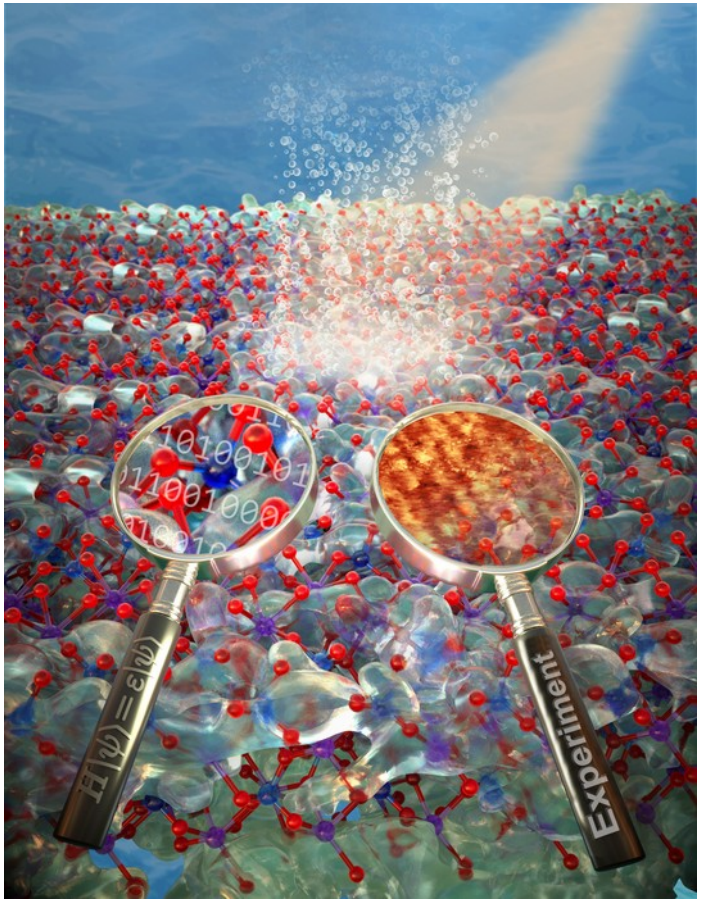
https://href.li/?https://pubs.acs.org/doi/10.1021/acsbiomedchemau.1c00068

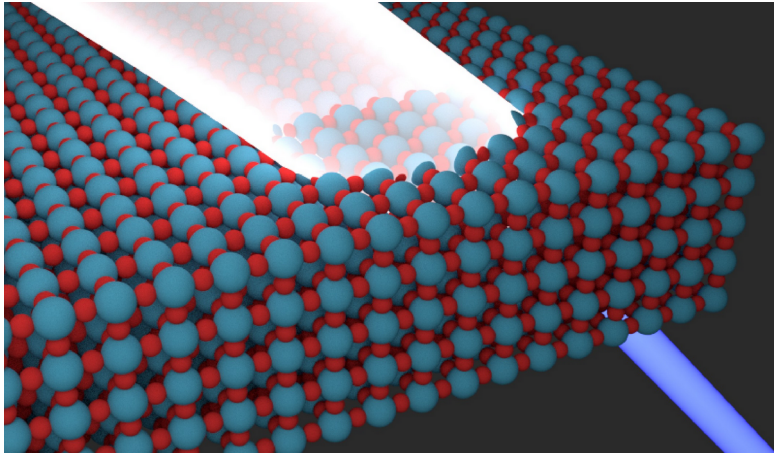



https://href.li/?https://www.sciencedirect.com/science/article/pii/S0022328X21004721?dgcid=rss_sd_all

# Fancier figures

3rd party+ GIMP



VESTA structure file + Blender

# Random tips

- Save in the native file format of the editing program
- Use layers to your advantage
- Save intermediate files- there will be many times you need to slightly modify a figure
- Save a final high-resolution version that can be converted to other file formats
- Ask for feedback on your plots

# Other resources on visual design

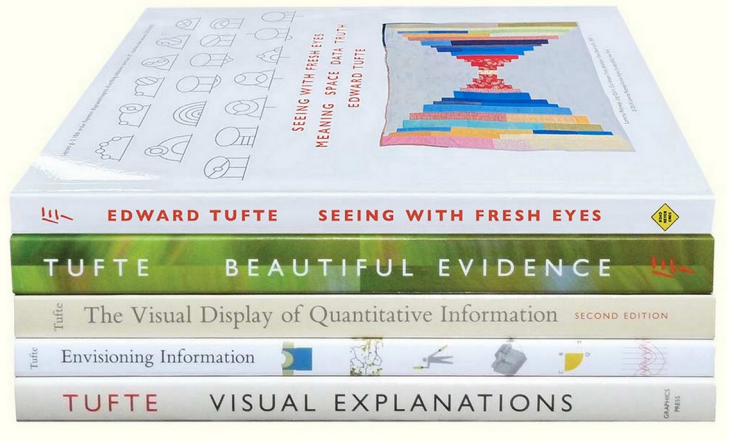
- Jean-Luc Doumont, Felice Frankel
- MRS Science as art
- Ram Seshadri's Preparing Figures

OPEN ACCESS | Science Applications Forum

**Fundamentals of graphic design—essential tools for effective visual science communication**

**Authors**: Karen J. Murchie and Dylan Diomede | AUTHORS INFO & AFFILIATIONS

**Publication**:FACETS · 11 June 2020 · https://doi.org/10.1139/facets-2018-0049



This presentation & related scripts are @

https://github.com/wangmatgroup/tutorials/tree/main/Figure-making