Figures

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Figures are part of the narrative

...and made him king of all wild things.
And now, cried Max, let the wild rumpus start!

• Each figure should have a single point (or closely related points)
• Caption (in a paper) should explain every part of figure
Different types of figures

Explanatory Figure

Supercooled spin liquid state in the frustrated pyrochlore Dy$_2$Ti$_2$O$_7$

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**Explanatory Figure**

- Gives overview, summary, or big picture
- Often schematic
- Not data or results
- Important to (over-) simplify without introducing errors
- Important to be visually attractive

A great resource:

Learn a software platform: Illustrator, CorelDraw, Powerpoint...

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**Example: Explanatory Figure**

Coupling Identical 1D Many-Body Localized Systems

Pranjal Bordia,¹,² Henrik P. Lüschen,¹,² Sean S. Hodgman,¹,² Michael Schreiber,¹,² Immanuel Bloch,¹,² and Ulrich Schneider¹,²,³

arXiv:1509.00478v1
Example: Explanatory Figure

FIG. 1. (a) An illustration of a 30 nm Bi$_2$Se$_3$ flake exfoliated on YIG and contacted by Ti/Au electrodes. The coordinate system depicts that the current flows in the $x$-direction and an external magnetic field is applied in the $xy$ plane at an angle $\Phi$. The magnetization of the TI canters towards the in-plane direction of the external field as described by the polar angle $\phi$. (b) Atomic force microscope image of a TI flake. False shaded yellow rectangles represent the patterned Ti/Au electrodes. (c) Illustration of the theoretical mechanism behind AMR in a proximity magnetized TI. Perpendicular magnetization induced in the TI by the YIG will open a gap ($\Delta$) between the surface states. Applying an in-plane field ($H$) rotates the magnetization ($M_{Z1}$) which closes the gap.

Results (data) Figure

Supercooled spin liquid state in the frustrated pyrochlore Dy$_2$Ti$_2$O$_7$

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Results (data) Figure

- Presents data, numerical results, theory curve
- Usually a graph
- Can encode a lot of information
  Be careful! Too much is deadly
- Important to label axes clearly and correctly
- Make sure points, lines, and error bars are visible and distinct
  Make sure distinctions can be seen even if printed in B/W

Another example: results figure

Coupling Identical 1D Many-Body Localized Systems

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Another example: results figure

FIG. 2. (a) SQUID magnetometry of the bare YIG film shown over the temperature range where we observed ferromagnetic effects in the magnetoresistance. Note that the coercive field of the YIG is less than 2 Oe over the relevant temperature range. (b) Resistance versus temperature for a resistive Bi$_2$Se$_3$ flake (red) compared with a conductive flake (blue), that are exfoliated on the same YIG substrate.

Essential elements of a plot

Scale (logarithmic, linear, ...)

Tick marks
- major
- minor

Make them thick enough to see (at least 1 pt)

Axes, or frame
Essential elements of a plot

- Axis labels
- Tick labels
- Big enough to read!
Essential elements of a plot

- Points (markers)
- Error bars
- Thick enough to see!
- Curves
Essential elements of a plot

White space

General Advice

- Legible fonts
  - Print the figure at 100% (reproduction scale)
- Avoid similar colors, yellow, orange; red/green
- Avoid arbitrary units
- Explain every part of the figure in the caption
  - symbols, insets, what each part is about
- Include scale bars & color bars
- Use high resolution, high contrast images
- Use vector graphics when possible
Figure 1. SRO Plots of $T_i/T_e$ (Vertical Axes) Against $i/n$ (Horizontal Axes) for the Gibbs Sampler (a) and an Alternating Gibbs/Independence Sampler (b) for the Pump Failure Data Based on Runs of Length 5,000. Lines through the origin with unit slope are shown dashed; axis ranges are from 0 to 1 for all axes.

FIG. 2. (Color online) Possible layout for the 16-qubit chip.
**Problems**

- Make axis labels large enough to be seen easily when figure is printed on ¼ page

- Plot markers should be large enough to be seen at ¼ scale

- Plot markers should be visually distinct in color, but also distinguishable when printed in black and white (hint: use different shapes)

- Legend should clearly indicate which curves are which

- Caption should explain all aspects of the figure

**Common issues from last year:**

- Make axis labels large enough to be seen easily when figure is printed on ¼ page

- Plot markers should be large enough to be seen at ¼ scale

- Plot markers should be visually distinct in color, but also distinguishable when printed in black and white (hint: use different shapes)

- Legend should clearly indicate which curves are which

- Caption should explain all aspects of the figure
• Count the problems:

![Image of a graph showing polarization reduction factor as a function of mass and energy.](image)

**FIG. 4:** Polarization reduction factor \( \cos \omega \) for three different sets of new particle masses, as a function of parent top partner mass \( t \). The phase space integral over \( \cos \theta \) has been performed. The red (central) curve is for a top partner with mass 500 GeV and boson partner 250 GeV. The green (upper) curve is for a top partner with mass 900 GeV and boson partner 300 GeV. The blue (lower) curve is for a top partner with mass 900 GeV and boson partner 200 GeV.

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Resources
Software for making professional-quality plots

Origin (Webstore)

Matplotlib (Python)

MATLAB, Mathematica...caution

Excel

Resources
Software for making professional-quality figures

Line / vector art
Illustrator, CorelDraw, Inkscape (free)
Mathematica

3D Illustration
SketchUp (free), VPython (free), Blender (free)
Autodesk products (free for students)
More resources (Celia)


“Graphing Resources” (http://www.ncsu.edu/labwrite/res/res-homepage.htm), particularly their “Revising your Visuals” section.