We will present some of my slides and many Phys 403 student slides as examples. We can talk about why they are well constructed examples.

(All remarks about real slides are in these red boxes)

An eye-catching feature on slide 1
This is a technical presentation, so you must develop it as a logical sequence

- **What was the goal?**
  - What physics did you address?
  - What technology?
  - Define your special vocabulary here

- **What did you actually do?**
  - Apparatus / Procedures / Raw Data

- **What are your results?**
  - Polished graphs, proofs, numerical findings
  - Principal difficulties and uncertainties

- **Conclusions**
Presentation components and grading scale.

- Title slide
- Science introduction
- Procedure
- Results. Analysis. Data.
- Conclusions. Suggestions etc.

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical slides</td>
<td>(15)</td>
</tr>
<tr>
<td>Science accuracy</td>
<td>(15)</td>
</tr>
<tr>
<td>Quality of oral delivery and sharing of effort</td>
<td>(15)</td>
</tr>
<tr>
<td>Got essential points across of effort</td>
<td>(15)</td>
</tr>
<tr>
<td>Overall impression</td>
<td>(15)</td>
</tr>
<tr>
<td>Final Totals</td>
<td>(75)</td>
</tr>
</tbody>
</table>
OPTICAL STUDY OF FERROELECTRIC POTASSIUM DIDEUTERIUM PHOSPHATE (DKDP)
Phase transition of Helium 4

Below $T_\lambda = 2.17$ K, helium exists in mixture of superfluid and normal liquid helium.
The muon lifetime leads to the most precise determination of the Fermi constant, and gives the weak interaction strength $\mu$

- The relation is

$$\frac{1}{\tau} \propto G_F^2 (1 + \delta)$$

- MuLan aims to determine $\tau_\mu$ to 1 part per million precision, which requires:
  - $10^{12}$ muon decays
  - A muon beam of several MHz
  - A time-structured (chopped) beam
What happen if they are struck by pulses?

A pulse or a series of pulses is used to change the net magnetization of system. Pulsed NMR!

\[
M(t) = M_0 e^{-t/T_2}
\]
What happens to a nucleus in a magnetic field?

\[ \Delta E = \gamma \cdot \hbar \cdot B_0 = \hbar \omega_0 \]

Larmor frequency!

(Courtesy of Bishop. K)
Phase Transition in BaTiO$_3$
Phase Transition in BaTiO$_3$
Phase Transition in BaTiO$_3$
Phase Transition in BaTiO$_3$
What can an audience grasp in ‘real time’?
- If they already know it, then they know it
- If they don’t know it, they usually have to study it term by term

Take a simpler approach
- Substitute proportionalities for equalities?
  - Can eliminates uninteresting constants
  - Can emphasize relationship of variables

- Substitute words for blocks of standard terms?

Use builds and arrows to walk audience thru (see example)
Excitation and fluorescence signal convoluted together

\[ F(t) \propto \int_0^t E(t') F_\delta(t - t') dt' \]

- Excitation as sinusoid is simplest:
  \[ E(t) = E_0 + 2E_1 \cos(\omega t) \]
- Generalized through Fourier analysis
  - All periodic function can be expanded as sum of sinusoids
Show the equipment IF it helps explain your steps – not because you love it

- Photographs give scale and reality – but you add labels
- Schematics provide concept
- Icons strip away unnecessary details
- All of these techniques can be useful
Everybody loves an optical bench, but unless you map out the elements and the beam paths, it doesn’t mean much.
An example of image which is nice but does not help too much
Magnetic Field Calibration

- The magnetic field from the Earth and other residual magnetic fields is minimized by rotating the stand and adjusting the vertical field coils to minimize the zero field peak width.
- With the main field coils off, the sweep field is applied to determine the center of the zero field resonance (was found to be at 0.251A; using the geometry of the coils, this corresponds to 0.151 gauss).
- RF field is adjusted to provide maximum transition probability.
Schematic diagram adapted from notes
Samples: preparation, configuration etc.

Silver Paint

Electrode

Sample

Leads
Setup of Source and Detectors
Results

Raw tunneling data

Energy gap derived from tunneling conductivity

Data + fitting results α-range

Data + fitting results fluorescence

\[ \tau_{\text{slow}} = 3.9 \pm 0.14 \text{ ms} \]

\[ \tau_{\text{fast}} \approx 4 \text{ ns} \]

\[ \alpha_{\text{slow}} = 99\% \]

\[ \alpha_{\text{fast}} = 1\% \]
Results

Difference in Up-Down (unnormalized)

Fit equation

\[ Ne \tau \left(1 + \alpha \cos(\omega t + \delta)\right) \]
Results

Difference in Up-Down \(\text{normalized}\)

Fit equation: 
\[
N e^{-\frac{t}{\tau}} \left(1 + \alpha \cos(\omega t + \delta)\right)
\]

Courtesy Samuel Homiller and Pakpoom Buabthong Fall 2013
Results – witnessing a mystery?
Presenting data is your most important and challenging task.

- Counting data for silver with some wiggles here.
- All silver data, simple fit: 857064 entries, mean 7224, RMS 6014, \( \chi^2 / \text{ndf} = 2811 / 2531 \), parameters: 1.285e+09, 21982.02672, 2.194e+05, 13.08.

- Residuals from simple fit to all silver data have some wiggles remaining.

- Silver FFT of residuals (updated from earlier): frequencies from 0 to 0.03 GHz with various amplitudes.
A fit to the Curie-Weiss law shows a shift in $T_C$

$$\varepsilon' = \frac{C}{T - T_C}$$

$C = 5.4 \times 10^3 \text{K}$

$T_C = 95 \text{K}$
AFM of Optical Data Storage Media

<table>
<thead>
<tr>
<th></th>
<th>CD</th>
<th>DVD</th>
<th>Blu-Ray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark length</td>
<td>0.99 - 2.96</td>
<td>0.48 - 1.45</td>
<td>0.14 - 0.41</td>
</tr>
<tr>
<td>Track pitch</td>
<td>1.63</td>
<td>1.00</td>
<td>0.40</td>
</tr>
<tr>
<td>Track width</td>
<td>0.50</td>
<td>0.24</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Units in μm

Physics 403. Spring 2014
Fitting the data

\[ V = C \sqrt{\left( \frac{T - T_{\text{offset}}}{T_{\lambda}} \right) \left( 1 - \left( \frac{T - T_{\text{offset}}}{T_{\lambda}} \right)^{5.6} \right)} \]

Offset, intrinsic to the experiment

\[ C \approx 26 \]
\[ T_{\lambda} \approx 2.17 \]

Fit to the exponents as well

Perform the 5 parameter fit-

The values that are obtained are not very close to the expected values

Also, the fit is not the best
Try a simpler fit

Try to fit the data with this function

The data refuses to fit to this function

\[ V = \left( 1 - \frac{T - T_{\text{offset}}}{T_\lambda} \right)^\gamma \]

\[ \chi^2 / \text{ndf} ~ 361.7 / 14 \]
\[ C ~ 14.56 \pm 0.04278 \]
\[ \gamma ~ 0.1668 \pm 0.003116 \]
\[ T_{\text{off}} ~ -0.2356 \pm 0.005738 \]
\[ T_\lambda ~ 2.17 \pm 0 \]
Finish your talk with the data analysis and conclusions and a slide showing the main points you want us to remember

- Make sure you discuss the principal uncertainties.
  - For most of these experiments, it will be how accurately does your instrument measure something
  - A few experiments will also have statistical uncertainties … more data leading to a better finding

- Include a representative (simplified) graphic
  - This slide will be up during question period so this graphic will get burned into people’s memory

- Because this is a lab, offer some advice for others who follow