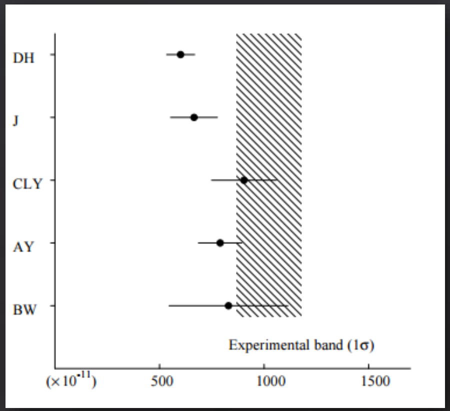
Discussion Section

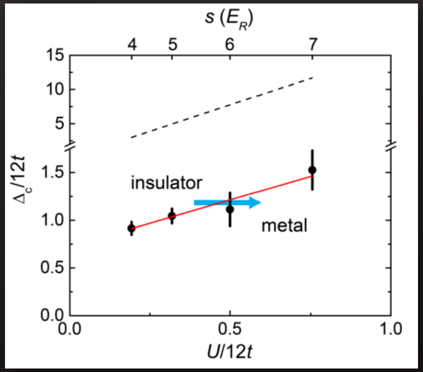
Purpose:

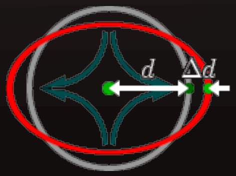
Give meaning and interpretation to your results

Examples:

- Data are inconsistent with previous measurements, potential explanations
- Phase boundary has positive slope, consistent with theory
- Theory predicts observable gravity-wave amplitude; experiment is viable



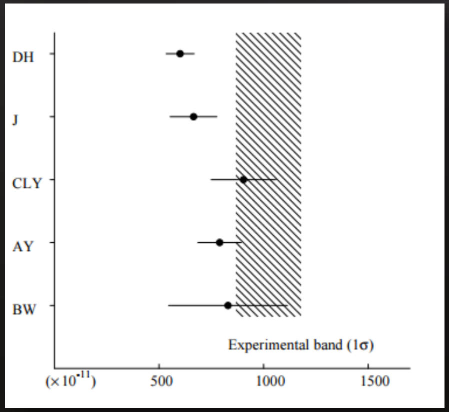


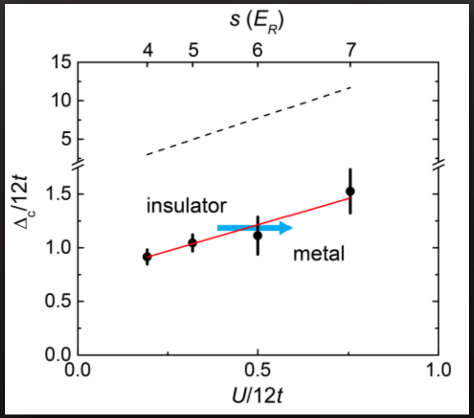


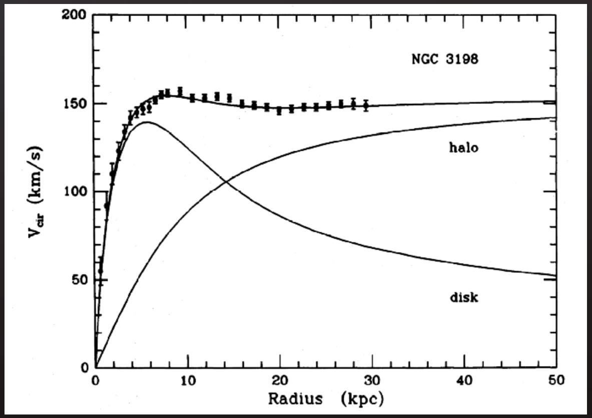
$$g' = \frac{\Delta g}{d} = \frac{\text{change in gravity}}{\text{displacement}}$$

$$h = \frac{2\Delta d}{d} = 2 \times \frac{\text{change in displacement}}{\text{displacement}}$$

Meaning and interpretation should be associated with a key plot or table







Before you start…

- Analyze and understand your results
- Digest the literature and understand how your results fit into the context of prior work

Typically:

Start by summarizing the most important points of your Results section

JOURNAL OF CHEMICAL PHYSICS VOLUME 120, NUMBER 7 15 FEBRUARY 2004

Disagreement between theory and experiment in the simplest chemical reaction: Collision energy dependent rotational distributions for $H+D_2 \rightarrow HD(\nu'=3,j')+D$

V. DISCUSSION

As shown in Fig. 6(a), we have constructed a fully experimental $E-j'$ plot for the reaction $H+D_2 \rightarrow HD(\nu'=3,j')+D$ over the collision energy range 1.49–1.85 eV. We have also presented an $E-j'$ plot resulting from a fully time-dependent quantum mechanical calculation [Fig. 6(b)], which agrees closely with a time-independent quantum mechanical calculation [Fig. 6(c)]. We observe a systematic disagreement between theory and experiment at high collision energies. This result is unexpected in light of the previous good agreement found between measured and calculated rotational distributions for this reaction for many isotopes and vibrational manifolds at lower collision energies.[5,13–18,37–39,46,63–66]

In an attempt to understand these distributions, we begin by applying some traditional analyses. As is expected, the relative population of high lying rotational states increases with the collision energy. To quantify this effect, we calculate the rotational temperature, the average rotational energy, and the fraction of total energy in rotation for each rotational

Answer these questions

What did you learn?

What is the significance of your work?

What are possible problems with your techniques and interpretation?

Be quantitative!

Use proper uncertainty analysis to support your argument!

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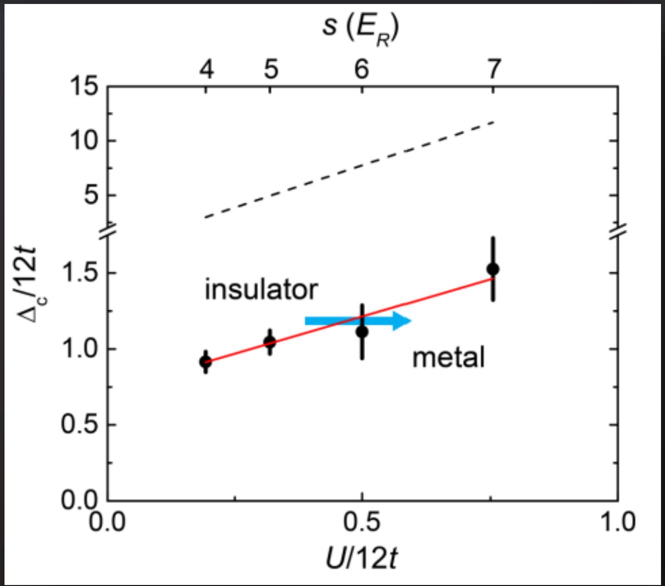
TABLE II. Experimental and theoretical rotational temperatures, average energy in rotation, and fraction of energy in rotation as a function of collision energy.

	Rotational temperature (K)		Average energy in rotation (cm^{-1})		Fraction of total energy in rotation (%)	
E_{coll} (eV)	Experiment	Theory	Experiment	Theory	Experiment	Theory
1.49	288	238	160	160	1.2	1.2
1.54	540	486	299	276	2.1	2.0
1.59	766	671	459	376	3.2	2.6
1.64	1039	905	610	507	4.1	3.4
1.70	1458	1162	839	657	5.5	4.3
1.75	1695	1419	974	810	6.2	5.2
1.80	2231	1690	1257	969	7.8	6.0
1.85	2645	1953	1458	1124	8.9	6.8

PRL **114,** 083002 (2015) PHYSICAL REVIEW LETTERS week ending 27 FEBRUARY 2015

Disorder-Induced Localization in a Strongly Correlated Atomic Hubbard Gas

S. S. Kondov,[1,*] W. R. McGehee,[1] W. Xu,[1] and B. DeMarco[1]
Department of Physics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA
(Received 17 July 2014; published 26 February 2015)



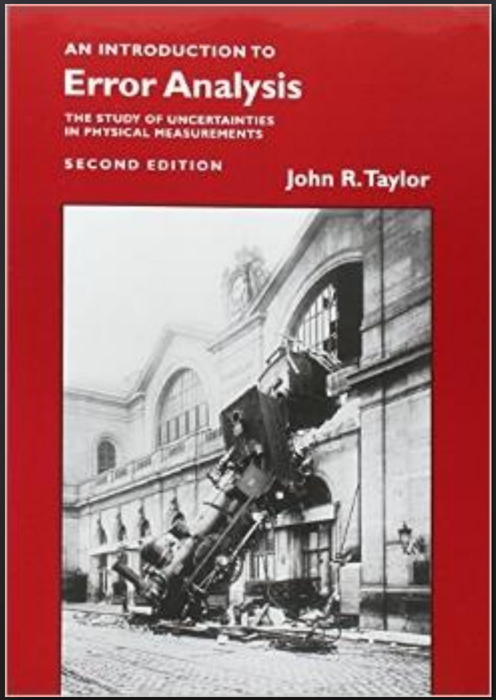
“energy scales [32]. The slope of a linear fit to the data is positive at greater than the six-standard-deviation (in the fit uncertainty) level. A Monte Carlo uncertainty analysis with different underlying assumptions indicates that the slope of the data shown in Fig. 3 is positive at greater than a 99.8% confidence level [20].”

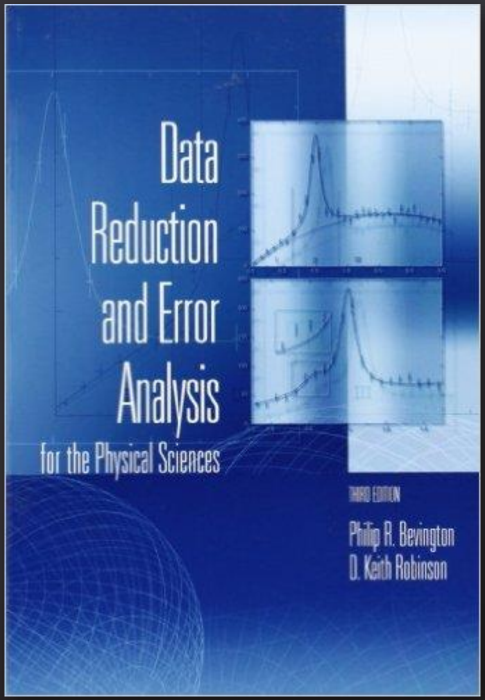
INTERACTION-INDUCED DELOCALIZATION UNCERTAINTY ANALYSIS

We used a Monte Carlo simulation to determine the probability that, if $\Delta_c/12t$ was independent of lattice potential depth (as is the case for single particles), that a linear fit to the data shown in Fig. 3 returns a positive slope equal to or larger than the experimental value. We assume that $\Delta_c/12t$ is fixed to the weighted average of the measured values. We generated a statistically large number of realizations of the data, drawing at each point from a Gaussian distribution with a RMS width set by the error bar of the point. Each set of four points representing one possible measurement reality is then fit to a line. Approximately one in 750 samples have a positive slope greater than or equal to the experimental value, corresponding to a 3.2σ deviation, or greater than a 99.8% confidence level.

```
Uo12t = [0.19285, 0.31889, 0.50044, 0.75469];
DeltaC = [0.915, 1.045, 1.113, 1.526];
avgDeltaC=1.23;
DeltaCerr = [0.066, 0.077, 0.174, 0.203];
nsamples = 150000;
data = zeros(nsamples,2);
for i = 1:nsamples,
    tempVals = avgDeltaC + DeltaCerr.*randn(1,4);
     p = polyfit(Uo12t,tempVals,1);
    data(i,:) = p;
end
```

Uncertainty Analysis





Key ideas / techniques

Least squares fitting with error bars, reduced chi-square, standard deviation, standard error of the mean, jackknife, bootstrap, confidence interval

Discussion

Other key questions to answer:

- What are the sources of uncertainty?
- How do your results compare with previous work?
- Anything surprising?
- Any contradictions?
- What are your assumptions?
- What approximations did you employ?
- What are alternative conclusions?

Be skeptical of your work!

Conclusions Section

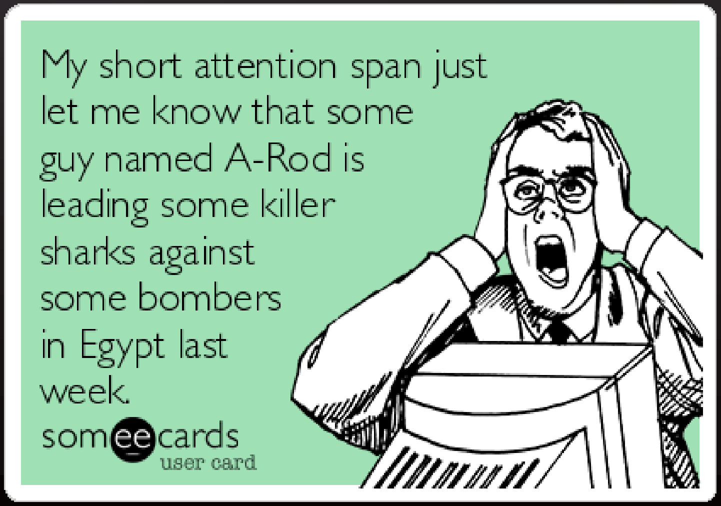
Purpose:

Brief recap for the reader

Note: not allowed by all journals

Say what you want the reader to remember

3-5 main points



Summarize:

- Method
- Results
- Interpretation

Often end with:

Future work…what’s next?

Example

PHYSICAL REVIEW A **92**, 043604 (2015)

Degenerate Bose-Fermi mixtures of rubidium and ytterbium

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Joint Quantum Institute, University of Maryland and NIST, College Park, Maryland 20742, USA

(Received 26 June 2015; published 5 October 2015)

V. CONCLUSIONS AND OUTLOOK

We have created a degenerate Bose-Fermi mixture of ^{87}Rb and ^{171}Yb in a species-dependent potential. Our ability to independently tune trap potentials allows us to sympathetically cool Yb with minimal loss, allowing us to create large degenerate Fermi gases. We further demonstrate that the degenerate mixtures are stable and long lived, with the loss rate limited by slow photon scattering from the 423-nm crossed-dipole trap.

A species-selective optical lattice created by the 423-nm laser will allow us to realize several lattice cooling schemes [6,7]. Furthermore, our method of creating degenerate mixtures is extremely flexible and can be extended to other alkali metals such as sodium or cesium, providing a route for a variety of other degenerate alkali-metal–alkaline-earth mixtures.

In all communication:

Remember that audience has short attention span!