Disclaimer: There were so many excellent talks during the academy, that I feel more than a bit silly presenting this to you...
Disclaimer: There were so many excellent talks during the academy, that I feel more than a bit silly presenting this to you...

Making the **worst** out of your **presentation**

Maybe Your Name

Your past Funding

Not Your E-Mail

Your Home, maybe?

Florian Bernlochner
florian.bernlochner@uni-bonn.de
Tell people where you are and what the destination is going to be

This means not necessarily providing an outline, but to remind people what the next steps are or why you are looking at something.
For long talks great! For a 15 min talk, likely overkill
Fantastic Bs ... and where to find them

B-Mesons & b-Baryons!

Physikalisches Kolloquium
Travel Guide for Today

I. Introduction

II. Ground rules

III. Advanced Stuff

IV. Finishing Thoughts
An attempt for tonight’s Talk

questionable advice

we share a few laughs on the way

make sure to have a beverage handy
Less is sometimes more.

Don’t overload slides.
How to make a Good First Impression

Making a first good impression can be vital when looking for a new job. Whether we like it or not, people do judge a book by their cover. The first few seconds with someone can be critical to your career.

• Be on time. The person you are just meeting is probably not interested in your excuses, even if it is the first time you are late in your whole life. All they are going to know is that you are not keeping up with a previous agreement. The image you are leaving behind is of someone that is not reliable. Make an extra effort and make sure to arrive on time. Too early is always better than too late.

• Be prepared. Before going to your interview you should have done your research about the company, the position you’re applying for, and so on. Think about what kind of questions you could be asked, and how you would answer them. In one word, practice!

• Take care of your clothes and your overall grooming. It has been said that 55% can be determined by the person’s appearance. So be careful when choosing how to present yourself in an interview. Dress to impress, maintaining in mind the job you are applying to, and when in doubt, choose the most conservative choice.

• Take into consideration non-verbal communication. You might bee feeling nervous, but studies have shown that people who present themselves in a more friendly, confident manner usually have better results. Something as simple as a smile can make a difference.
How to make a Good First Impression

Making a first good impression can be vital when looking for a new job. Whether we like it or not, people do judge a book by their cover. The first few seconds with someone can be critical to your career.

• Be on time. The person you are just meeting is probably not interested in your excuses, even if it is the first time you are late in your whole life. All they are going to know is that you are not keeping up with a previous agreement. The image you are leaving behind is of someone that is not reliable. Make an extra effort and make sure to arrive on time. Too early is always better than too late.

• Be prepared. Before going to your interview you should have done your research about the company, the position you’re applying for, and so on. Think about what kind of questions you could be asked, and how you would answer them.

• Take care of your appearance. A person’s appearance is often the first thing that is noticed. Make sure to maintain in mind that the first impression can be determined by the way you present yourself during the interview. Dress to impress, but conservative choice. Studies have shown that people who look good and present well have better results.

• Take into consideration that people judge the book by the cover. Something as simple as a well-groomed appearance or a good first impression can make a huge difference.
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

Overconstrain Unitarity condition
→ Potent test of Standard Model

Unitarity $CC^\dagger = 1$

$V_{ud}V_{ub}^* + V_{cd}V_{cb}^* + V_{td}V_{tb}^* = 0$

$\mathcal{O}(\lambda^3)$

Cabibbo angle $\sin \theta_C \simeq 0.22$

CKM Matrix
SM: Unitary 3x3 Matrix

Nobel prize 2008
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

Overconstrain Unitarity condition
$\rightarrow$ Potent test of Standard Model

$|V_{ub}| / |V_{cb}|$
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

Overconstrain Unitarity condition → Potent test of Standard Model

B-Meson Mixing

$|V_{ub}| / |V_{cb}|$
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

CPV Kaon Mixing

Overconstrain Unitarity condition → Potent test of Standard Model

B-Meson Mixing

$|V_{ub}| / |V_{cb}|$
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

Present day

B-Meson Mixing

CPV Kaon Mixing

Some tensions exist, uncertainties inflated
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

**CPV Kaon Mixing**

$|V_{ub}| / |V_{cb}|$

Dominated by $W$-Boson exchange a-priori free from new physics

CKM $\gamma$ can also be measured using tree-level decays

**B-Meson Mixing**

$B^0 \rightarrow K^*\pi$ & $B^0 \rightarrow K^*\pi$

The future? with Belle II & LHCb

**Introduction:**

Unitarity Triangle (2/2)

Constraints:

- Tree-level a priori 'free' from New physics
- Loop mediated sensitive to New physics!

$B^0 \rightarrow K^*\pi$ + New Physics

Unitarity over-constrains CKM Matrix

Highly non-trivial test of the SM with 3 quark generations!
Why is it important to measure $|V_{ub}|$ and $|V_{cb}|$?

- $|V_{ub}| / |V_{cb}|$ inkl.
- $|V_{ub}| / |V_{cb}|$ exkl.

Ok, not such a great anchor, if we cannot agree on the value of the ratio...

Drive your point home
Know your audience

Introduce the basics if needed
The setup of a $e^+ e^-$ beauty factory

- Collide electrons and positrons at a **centre of mass energy** of about $2 \times B$ meson mass

$$\sqrt{s} = 10.58 \text{ GeV}$$

$$e^+ \rightarrow \Upsilon(4S) \rightarrow \langle bb \rangle$$

$$\Upsilon(5S) \rightarrow B_s^*(\*) \bar{B}_s^*(\*)$$

$$m_{\Upsilon(5S)} = 10.89 \text{ GeV}$$
Setup of a $pp$ B-Factory

Experimental setup 35
and $pp$ $c\bar{c}$ interactions. In particular, the production cross-section, $(pp \rightarrow b\bar{b}X)$, for $p_s = 7$ TeV $pp$ collisions has been measured to be $(284 \pm 29 \pm 40) \mu b$ [49]. This cross-section is five orders of magnitude larger than the corresponding production cross-section for $ee + \pi$ $(4s)$ at the $B$-factories BaBar [50] and Belle [51].

Beauty or charm hadrons are produced from the hadronisation of any beauty or charm quarks produced in the proton-proton collisions. This gives $LHCb$ the opportunity to study a range of beauty hadrons including $\Psi^0 b$ baryons, which were not produced at the $B$-factories.

In order to provide a clean environment for flavour physics measurements the $LHCb$ detector is designed for a luminosity of around $3 \times 10^{32}$ cm$^2$ s$^{-1}$ corresponding to an average of less than two $pp$ interactions per bunch crossing. Beam optics are used to reduce the $LHC$'s nominal luminosity ($\sim 7 \times 10^{33}$ cm$^2$ s$^{-1}$ in 2012) to the required level.

The production mechanism for $b\bar{b}$ and $c\bar{c}$ pairs from $pp$ interactions is predominantly gluon-gluon fusion as shown in Fig 3.1. Interacting gluons will each have a fraction of the proton's momentum as determined by the proton's structure functions. Any misbalance between the fractions carried by the gluons results in their interaction being boosted with respect to the proton-proton centre of mass.

\[
\sigma(pp \rightarrow b\bar{b}X) = (284 \pm 29 \pm 40) \mu b
\]
The setup of a $e^+e^-$ beauty factory

- Collide electrons and positrons at a **centre of mass energy** of about $2 \times$ B meson mass

$$\sqrt{s} = 10.58 \text{ GeV}$$

$e^+ \rightarrow \Upsilon(4S) \rightarrow b\bar{b}$

- Pulls quark-anti-quark pair from vacuum
- Fragmentation into two B mesons
The setup of a $e^+e^-$ beauty factory

- Collide electrons and positrons at a **centre of mass energy** of about $2 \times $ B meson mass

$$\sqrt{s} = 10.58 \text{ GeV}$$

$$e^+ \rightarrow \Upsilon(4S) \rightarrow b\bar{b}$$

- Pulls quark-anti-quark pair from vacuum

- Fragmentation into two B mesons

- Colour field

- Heavy b-quark

- Light anti-quark

- Colour field

- Heavy anti-b quark

- Light quark
Tell a story

Make it personal
EPS 2013 in Stockholm
Thermische Leistung

Reaktionsrate:

\[ W_f = J \times N \times \sigma_{\text{fission}} \]

- Neutronenfluss
- Wirkungsquerschnitt

\[ N = \frac{100 \times 10^7 \times 0.0072 \times N_A}{A} = 1.82 \times 10^{27} \]

\[ J = 10^{11} \text{ cm}^{-2} \text{ s}^{-1} \]

\[ \sigma_{\text{th}} = 580 \text{ barn} \]

P = W_f E

Thermische Leistung eines einziges Gramms 235 U entspricht ca. 2,8 Tonnen Steinkohle oder 10 Tonnen Braunkohle

Energiedichte: \( \sigma(1 : 10^7) \)

Bindungsergie von z.B. Wasserstoff ca. 13.6 eV

\( \rightarrow \) Größenordnung Energiegewinn von chem. Reaktionen versus 200 MeV bei Fusion
Thermische Leistung

Reaktionsrate:

\[ W_f = J \times N \times \sigma_{\text{fission}} \]

\[ J = 10^{12} \text{ cm}^{-2} \text{ s}^{-1} \]

\[ \sigma_{\text{fission}} = 580 \text{ barn} \]

\[ N = 100 \times 10^5 \times 0.0072 \times N_t = 1.82 \times 10^{21} \]

\[ P = W_f E \]

\[ P \approx 340 \text{ MW} \]

Thermische Leistung eines einzigen Gramms \(^{235}\text{U}\) entspricht ca. 2,8 Tonnen Steinkohle oder 10 Tonnen Braunkohle

Bindungsenergie von z.B. Wasserstoff ca. 13.6 eV

\[ \rightarrow \text{Größenordnung Energiedichte von chem. Reaktionen versus } 200 \text{ MeV bei Fusion} \]

Energiedichte: \(\mathcal{O}(1 : 10^7)\)

Fusion

Bindungsenergie pro Nukleon steigt stark an für leichte Elemente → kann durch die Fusion von leichten Elementen kin. Energie gewinnen.

Problem in der Praxis:

Coulomboszillen:

\[ V_C = \frac{1}{4 \pi \varepsilon_0} \frac{Z Z' e^2}{R + R'} \]

Effektiver Radius

\( ^1\text{H} \)  \( ^2\text{H} \)

\[ ^1\text{H} \]

Mit \( R = 1.2 \text{ A}^{1/3} \):

\[ V_C \approx \frac{\left( \frac{e^2}{4 \pi \varepsilon_0} \right)}{1.2 \left[ A^{1/3} + (A')^{1/3} \right] \text{ fm}} \times \frac{h c Z Z'}{A^{1/3} + (A')^{1/3}} = 1.198 \frac{Z Z'}{A^{1/3} + (A')^{1/3}} \text{ MeV.} \]
It’s ok to be nervous

Don’t be nervous, be excited!

The physiological reaction to being nervous is the same as excitement

Most people are
It’s intimidating to talk in front of many people, embrace it

Most people are

It’s ok to be nervous

Don’t be nervous, be excited!

The physiological reaction to being nervous is the same as excitement
It’s ok to be nervous

Don’t be nervous, be excited!

The physiological reaction to being nervous is the same as excitement
Florian Bernlochner, Präsident des VSETH, illustrierte seine Empfehlungen gleich mit einem kurzen "Drama in drei Akten" - sichtlich zum Vergügen des Publikums. Es zeigte die teils widerstrebenden Ansichten und Ziele, die sich mit Forschung und Bildung verknüpfen, modellhaft an der (scheiternden) Entwicklung einer Dampfmaschine. Das Gleichnis mündete in ein Bündel von Schlussfolgerungen: Studierende sollten ihr Studium sorgfältig auswählen und betreiben; Forschende sollten sich die erforderliche Zeit zur Vermittlung ihres Wissens nehmen; die Ökonomie müsse der Forschung die für Entwicklungen notwendige Zeit einräumen, und die Politik müsse Bildung und Forschung stets eine Stütze sein, "auch wenn nicht immer alle Werte messbar sind", so Bernlochner.

Most people are

It’s ok to be nervous

Don’t be nervous, be excited!

The physiological reaction to being nervous is the same as excitement

In Form eines erzählten Dramas um die Entwicklung einer Dampfmaschine brachte der Präsident des Studierendenverbands, Florian Bernlochner, Anliegen zum Ausdruck, die offenkundig allgemein geteilt wurden: eine grosszügige öffentliche Hand, eine Wirtschaft, die nicht zu rasch Ergebnisse erwartet, Forscher, die sich für die Ausbildung Zeit nehmen, und Studierende, die sich für ihr sorgfältig ausgewähltes Fach engagieren.
If you give a long talk, don’t forget that attention span is limited.
Belle (II) is maybe (?) the only experiment that explains how it works via its logo:

And to be honest: I did not realize this after about a year joining the collaboration.
Plenty of Puns

1) Belle collides electrons and their anti-particle positrons
2) B breaks the symmetry between el - le
   (i.e. between matter and antimatter)
3) Belle II investigates beauty quarks, which are of course “belle”
Boosted Decision Trees (BDTs)

BDTs offer a robust way to approximate likelihood ratios
Before detailing all parts of the algorithm, let’s do a classroom experiment.

**Goal:** separate two groups of students from each other using two variables.

Fisher’s approach line is an illustration.

\[ t(x) = \sum_{i=1}^{n} a_i x_i \]
• Before detailing all parts of the algorithm, let’s do a classroom experiment.
Goal: separate two groups of students from each other using two variables $x_1$ and $x_2$. Before detailing all parts of the algorithm, let’s do a classroom experiment.
First split

- Highest difference in impurity measure: $x_1^{\text{cut}} = 4$

- Now let’s repeat this procedure with our two new nodes $L_2/3$
Next splits

- Split according to highest difference in impurity measure

\[
\begin{align*}
\mathcal{L}_1 & : x_1 \leq 4 \quad x_1 > 4 \\
\mathcal{L}_2 & : x_1 \leq 2 \quad x_1 > 2 \\
\mathcal{L}_3 & : x_2 \leq 7 \quad x_2 > 7 \\
\mathcal{L}_4 & \\
\mathcal{L}_5 & \\
\mathcal{L}_6 & \\
\mathcal{L}_7 & 
\end{align*}
\]

- What is the purity of each leaf?

\[
p = \frac{s}{s + b}
\]

\[p_{4,5,6,7} = \{2/3, 0, 1, 0.6\}\]
Next splits

- Split according to highest difference in impurity measure

\[
\begin{align*}
\mathcal{L}_1 & \quad x_1 \leq 4 \quad \mathcal{L}_2 \quad x_1 > 4 \\
\mathcal{L}_2 & \quad x_1 \leq 2 \quad \mathcal{L}_3 \quad x_1 > 2 \quad x_2 \leq 7 \quad \mathcal{L}_5 \quad x_2 > 7 \\
\mathcal{L}_4 & \quad \mathcal{L}_5 \quad \mathcal{L}_6 \quad \mathcal{L}_7
\end{align*}
\]

- What is the purity of each leaf?

\[
p = \frac{s}{s + b}
\]

\[p_{4,5,6,7} = \{2/3, 0, 1, 0.6\}\]
Tell people what they see

Rule: if you include a figure, talk about it
Remind people how it's done

\[ |V_{ub}| = \sqrt{\frac{\Delta B(B \rightarrow X_u \ell^+ \nu_\ell)}{\tau_B \cdot \Delta \Gamma(B \rightarrow X_u \ell^+ \nu_\ell)}} \]

Fit kinematic distributions and measure partial BF

4 predictions of the partial rate

- BLNP
- DGE
- GGOU
- ADFR
- Our average
- HFLAV \( B \rightarrow \pi \ell \nu \)
- CKMFitter

Exclusive Average for \( B \rightarrow \pi \ell \bar{\nu}_\ell \):
\[ |V_{ub}| = (3.67 \pm 0.09 \pm 0.12) \times 10^{-3} \]

CKM Unitarity:
\[ |V_{ub}| = (3.62^{+0.11}_{-0.08}) \times 10^{-3} \]

Tell people what they see

Arithmetic average:
\[ |V_{ub}| = (4.10 \pm 0.09 \pm 0.22 \pm 0.15) \times 10^{-3} \]

Auxiliary plot, if you don't talk about it, shade it out

Stability as a function of BDT cut:

Point out what it means

33% more Bkg
37% less Bkg
Give credit

Acknowledge other people’s work, it’s important for them and for you.
How are we doing?

\[ |V_{ub}| \]

\[ |V_{cb}| \]

Image credit: Markus Prim
Don’t assume everybody is an expert

Break complicated things down

Depends of course on the composition of the audience: expert conference or broad topical conference

People like to hear what they already know (to some extent)
Into the Kitchen: Let’s bake some moments

Step #1: Subtract Background

Want to subtract background in **model-independent** way → use $M_X$ instead of e.g. $q^2$

---

Event-wise **Master-formula**

$$\langle q^{2^n} \rangle = \frac{\sum_i w_i(M_X) q_{\text{calib},i}^{2^n}}{\sum_i w_i(M_X)} \times C_{\text{calib}} \times C_{\text{true}}$$

---

**Background Subtraction Weights** $w_i(M_X)$

- Construct smoothed cubic spline $w_i(M_X)$ to continuously describe bin-wise signal probability
- Use `csaps` implementation ([https://github.com/espdev/csaps](https://github.com/espdev/csaps)) with default smoothing
- Determine statistical uncertainty of spline fit with bootstrapped data samples
- Set of different probabilities based on lower $q^2$ cut
- Limit prediction between 0 and 1

---

**Smooth signal prob. Function** $w_i(M_X)$

$$w_i(M_X) = \frac{N_i^{\text{data}} - N_i^{\text{bkg,MC}}}{N_i^{\text{data}}}$$
Into the Kitchen: Let's bake some moments

**Step #1: Subtract Background**

Want to subtract background in **model-independent** way → use $M_X$ instead of e.g. $q^2$

**Step #2: Calibrate moment**

Use MC to calibrate **reconstructed** moment

---

**Event-wise Master-formula**

\[
\langle q^2 \rangle = \frac{\sum_i w_i(M_X) q_{\text{calib},i}^{2n}}{\sum_i w_i(M_X)} \times C_{\text{calib}} \times C_{\text{true}}
\]

---

Beautiful **linear** dependence between reconstructed and true moments as a function of $q^2$

\[
q_{\text{calib},i} = (q^2_{\text{reco},i} - c)/m
\]

from MC
### Into the Kitchen: Let’s bake some moments

**Step #1: Subtract Background**
Want to subtract background in **model-independent** way → use $M_X$ instead of e.g. $q^2$

**Step #2: Calibrate moment**
Use **MC** to calibrate **reconstructed** moment

**Step #3: If you fail, try again**
**Correct** for residual calibration bias

---

**Event-wise Master-formula**

\[
\langle q^{2^n} \rangle = \frac{\sum_i w_i(M_X)q_{\text{calib},i}^{2^n}}{\sum_i w_i(M_X)} \times C_{\text{calib}} \times C_{\text{true}}
\]

---

**Correct for residual calibration bias**

- very small
- $>1\%$

---

**Calibration Performance**

- **Belle II** (simulation)
- $\langle q^2 \rangle$ vs $q_{\text{cut}}^2$ [GeV$^2$/c$^4$]
Into the Kitchen: Let’s bake some moments

Step #1: Subtract Background

Want to subtract background in **model-independent** way → use $M_X$ instead of e.g. $q^2$

Step #2: Calibrate moment

Use **MC** to calibrate **reconstructed** moment

**Event-wise Master-formula**

$$\langle q^2\rangle = \frac{\sum_i w_i(M_X)q_{calib,i}^{2n}}{\sum_i w_i(M_X)} \times C_{calib} \times C_{true}$$

Step #3: If you fail, try again

Correct for residual calibration bias

**Step #4: Correct selection bias**

Overall event reconstruction itself also **biases** measured moment

**Correct for residual calibration bias**

**bit larger 1-5%**
Beautiful slides from this week

I really enjoyed these
**Decision trees**

*How to construct them?*

Basic principle: Work from **root** down, using some **cost** to decide which **feature** to use at each node

\[
\text{Gini} = 1 - \sum_{i=1}^{c} \rho_i^2 = \text{chance of incorrectness}
\]

To decide ideal feature/cut for node, evaluate Gini for each: \(x_1 \in [1.5, 2.5]\) and \(x_2 \in [1.5, 2.5]\)

\[
\mathbb{P}(x > 1.5) = \frac{6}{8}, \quad \mathbb{P}(x < 1.5) = \frac{2}{8}
\]

\[
\mathbb{P}(r \mid x_1 > 1.5) = \frac{2}{6}, \quad \mathbb{P}(b \mid x_1 > 1.5) = \frac{4}{6}
\]
How do these operators contribute? Schematically.

[Sketch from Blake, Gershon, Hiller 1501.03309]
Analysis strategy

Experimentally even better: measure double ratios

\[ R_K = \frac{\mathcal{B}(B^+ \to K^+ \mu^+ \mu^-)}{\mathcal{B}(B^+ \to J/\psi(\to \mu^+ \mu^-) K^+)} \] / \[ \frac{\mathcal{B}(B^+ \to K^+ e^+ e^-)}{\mathcal{B}(B^+ \to J/\psi(\to e^+ e^-) K^+)} \].

Lepton-flavour universal!

Christoph Langenbruch, Beauty 2019
ALPs decay so fast, that beam dumps see no events in the far detectors.

Lifetime $\sim \frac{1}{(g\alpha^2m_a^3)}$

Coupling is so small, that we see no events (limited by statistics)
It was a surprise...

PROPOSAL FOR $K^0_{2^-}$ DECAY AND INTERACTION EXPERIMENT

J. U. Cronin, V. L. Fitch, R. Turlay

(April 10, 1963)

I. INTRODUCTION

The present proposal was largely stimulated by the recent anomalous results of Adair et al., on the coherent regeneration of $K^0_1$ mesons. It is the purpose of this experiment to check these results with a precision far transcending that attained in the previous experiment. Other results to be obtained will be a new and much better limit for the partial rate of $K^0_2 + \pi^+ + \pi^-$, a new limit for the presence (or absence) of neutral current as observed through $K^0_2 + \pi^+ + \pi^-$. In addition, if time permits, the coherent regeneration of $K^0_1$'s in dense materials can be observed with good accuracy.

II. EXPERIMENTAL APPARATUS

Fortuitously the equipment of this experiment already exists in operating condition. We propose to use the present 30° beam at the A.G.S. along with the di-pion detector and hydrogen target currently being used by Cronin, et al. at the Cosmotron. We further propose that this experiment be done during the forthcoming $\nu$-$\bar{\nu}$ scattering experiment on a parasitic basis.

The di-pion apparatus appears ideal for the experiment. The energy resolution is better than 4 Mev in the $\pi^+$ or the $\pi^-$ value measurement. The origin of the decay can be located to better than 0.1 inches. The 4 Mev resolution is to be compared with the 20 Mev in the Adair bubble chamber. Indeed it is through the greatly improved resolution (coupled with better statistics) that one can expect to get improved limits on the partial decay rates mentioned above.

III. COUNTING RATES

We have made careful Monte Carlo calculations of the counting rates expected. For example, using the 30° beam with the detector 60-ft. from the A.G.S. target we could expect 0.6 decay events per $10^{11}$ circulating protons if the $K_2$ went entirely to two pions. This means that one can set a limit of about one in a thousand for the partial rate of $K_2 + 2\pi$ in one hour of operation. The actual limit is set, of course, by the number of three-body $K_2$ decays that look like two-body decays. We have not as yet made detailed calculations of this. However, it is certain that the excellent resolution of the apparatus will greatly assist in arriving at a much better limit.

If the experiment of Adair, et al. is correct the rate of coherently regenerated $K_1$'s in hydrogen will be approximately 80/hour. This is to be compared with a total of 20 events in the original experiment. The apparatus has enough angular acceptance to detect incoherently produced $K_1$'s with uniform efficiency to beyond 15°. We emphasize the advantage of being able to remove the regenerating material (e.g., hydrogen) from the neutral beam.

IV. POWER REQUIREMENTS

The power requirements for the experiment are extraordinarily modest. We must power one 15-in. x 36-in. magnet for sweeping the beam of charged particles. The two magnets in the di-pion spectrometer are operated in series and use a total of 20 kw.

⇒ Cronin & Fitch, Nobel Prize, 1980
⇒ 3 generations, Kobayashi & Maskawa, Nobel Prize, 2008
Know your speed

For me: about 1 minute per slide

Don't go over, but also don't go under
Anticipated Questions

If you mention a concept, someone might ask for details.

Like if you point out large beam backgrounds during the Belle II luminosity ramp-up, someone will ask what’s the deal with such.
Beam Backgrounds

- Touschek Scattering
- Synchrotron Radiation
- Radiative Bhabha
- Beam-gas
- Injection Background
- Two photon process

Peter Lewis
Be different

can work, but test with others
Why am I excited about Belle II?
How would you like your Higgs?

- Higgs discovery was based on most common production mechanism: gluon fusion (~90% of Higgs events)
- VBF and VH offer clear signatures which allow more difficult Higgs decays to be probed, and were observed shortly later.
- Looking at medium-rare and rare processes can give more information on couplings and properties and probe BSM.
- There are also ultra-rare “Higgs tartare” production mechanisms which we could only observe if there are significant deviations from the Standard Model.
- I will not cover these.
Higgs fiducial and differential cross section measurements at ATLAS
I am once again asking you to interpret an RK central value of 0.85

Patrick Owen

FLAVOUR ISN’T WORKING.

MORIOND ELECTROWEAK

THEORIES ARE BETTER OFF WITH LFV

Conor Fitzpatrick
Breaks

- Long talks can have breaks
- Typical Talk:
  - Start → Questions
  - Questions → Questions
  - Questions → Questions
- Mix it up, how about questions in the middle?
- Or before you go into another topic?
Dress for the act (?)

Most important: Be comfortable and yourself.

If you are receiving a prize or present slides for a job interview, consider dressing up.

It signals that you are taking things seriously.

I have mixed feelings about this one.
John R. Ellis

Comment by an attendee at 1979 Lepton-Photon Symposium at FNAL after a session with talks by MKG, JE and Frank Wilczek: “Very interesting session — talks by a woman, a hippy and a schoolboy”
It's worth it

Inject your own ideas
Thought #1: Is there new physics hiding in $|V_{ub}|$?

New physics observable via right-handed currents? $|V_{ub}| = |V_{ub}^L| f(\epsilon_R' = \epsilon_R \Re \frac{V_{ub}^R}{V_{ub}^L})$

![Graph showing $|V_{ub}^L| \times 10^3$ vs $\epsilon_R'$ with different decay modes and annotations for HFA and new Belle data.](image)

| Fit Scenario          | $|V_{ub}^L|$ | $\epsilon_R'$ | Tension wrt SM | $\chi^2$/ndf | P-Value |
|-----------------------|-------------|---------------|----------------|--------------|---------|
| $B \to \pi, X_u, \tau$ (dashed) | 4.07 ± 0.16 | -0.17 ± 0.06  | 2.8$\sigma$  | 2.8/1       | 0.09    |
It is ok not to know things

Really!

When asked a question you don’t know the answer to, say you don’t know it.

People often babble or answer a different question. Often since they are nervous. It’s ok to say “I don’t know, let me think about it and discuss in the coffee break.”
Florian Bernlochner

Fantastic Bs

and where to find them

Have a strong summary

What have we learnt?
Measurement summary

- This measurement represents the first search for $B^+ \rightarrow K^+ \nu \bar{\nu}$ performed with an inclusive tag.

- No signal observed yet, but an observed upper limit on the branching ratio of $4.1 \times 10^{-5}$ is set at the 90% CL.

- With 63 fb$^{-1}$ of $\Upsilon(4S)$ data recorded by the Belle II experiment, the inclusive tagging is competitive with the previous searches despite the much lower integrated luminosity.
Ok, but what does it mean with respect to the status quo?