Outlook …
Outlook …

• Wie ist das wetter?
Outlook ...

• Wie ist das wetter?
  ➔ Mostly sunny with a chance for Discovery!
Outlook ...

• Bernhard Lauss email:

“I don't want to bother you with a summary of the workshop or similar, but an outlook where low-energy fundamental physics will go in the next, say up to 10 years might be something you would also find exciting [ ] boring [ ] impossible [ ] great, and I want to do [ ]”

⇒ much easier than a workshop summary ...
Physics at different Energy Scales

$E = \vec{d} \cdot \vec{E}$

- $10^{14}$ eV
- $10^{13}$ eV
- $10^9$ eV
- $10^8$ eV
- $10^6$ eV
- $10^{-1}$ eV
- $10^{-19}$ eV
- $10^{-23}$ eV

- Higgs Boson
- "Next LHC" Collision Energy
- LHC Collision Energy
- Proton Rest Mass Energy
- Muon Decay Energy
- Neutron Beta Decay Energy
- Neutrino Rest Mass Energy
- Electron Electric Dipole Moment
- Neutron Electric Dipole Moment
First a look at the Past ➔ Present

“We hold these conferences every 3 years which allows time for new results to be available” K. Kirch

What’s the scorecard:
First a look at the Past ➔ Present

“We hold these conferences every 3 years which allows time for new results to be available” K. Kirch

What’s the scorecard:

Based on Titles of Talks:

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<thead>
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<th>Status</th>
<th>Results</th>
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First a look at the Past ➔ Present

“We hold these conferences every 3 years which allows time for new results to be available” K. Kirch

What’s the scorecard:
Based on Abstracts and actual Talks:

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</table>

Hard Experiments often take TIME
Order of Magnitude Smaller Limit on the Electric Dipole Moment of the Electron


The Standard Model of particle physics is known to be incomplete. Extensions to the Standard Model, such as weak-scale supersymmetry, posit the existence of new particles and interactions that are asymmetric under time reversal (T) and nearly always predict a small yet potentially measurable electron electric dipole moment (EDM), $d_e$, in the range of $10^{-27}$ to $10^{-30}$ e·cm. The EDM is an asymmetric charge distribution along the electron spin ($\vec{S}$) that is also asymmetric under T. Using the polar molecule thorium monoxide, we measured $d_e = (-2.1 \pm 3.7_{\text{stat}} \pm 2.5_{\text{syst}}) \times 10^{-29}$ e·cm. This corresponds to an upper limit of $|d_e| < 8.7 \times 10^{-29}$ e·cm with 90% confidence, an order of magnitude improvement in sensitivity relative to the previous best limit. Our result constrains T-violating physics at the TeV energy scale.
Results:

Presentation by Giulia Brunetti
Results:

muonic deuterium
the size of the deuteron

→ 5.9σ discrepancy between $r_d(\mu d)$ and CODATA-2014.

[R. Pohl et al. (CREMA-coll.), Laser spectroscopy of muonic deuterium, Science 353, 669 (2016)]

Presentations by Aldo Antognini & Julian Krauth
We have developed a new method for measuring the neutron lifetime

• We have demonstrated an *in situ* active neutron detector that allows for many systematic tests and enables the measurement of corrections for cleaning effectiveness and phase space evolution

• We have made a measurement of $\tau_n$ for the first time with no extrapolation: $878.8\pm2.6_{\text{stat}} \pm0.6_{\text{sys}}$
Results:

- a new upper limit for the branching ratio of $B(\mu^+ \to e^+ \gamma) < 4.2 \times 10^{-13}$ at 90% C.L. has been established (a factor 30 improvement with respect to the previous MEGA experiment and also the strongest bound on any forbidden decay particle)
Results:

Presentation by
– Anita Govaerts-Van Loon + Stefan Ritt
Almost Results:

- Determine pieces of cryostat that came from single pour and assume independent
- Cut up LH$_2$ cryostat
- Design targets to replicate background with parahydrogen vessel full
- Composite target to mimic neutron capture on original LH$_2$ vessel

NPDGAMMA (AGAIN)

- New false asymmetry makes for an “exciting” data analysis
- After 15 years in the making, NPDGamma will be presenting the final result soon

Presentation by Nadia Fomin
Almost Results:

Presentation by Holger Müller
In Addition ...

• Many beautiful (experimentally) technical talks and posters on exciting developments of hardware and techniques

• Now to the Outlook ...
Good News & Bad News ...

• First the Bad News:
Good News & Bad News ...

2015 ATLAS detector findings

CMS detector findings

2016 ATLAS detector findings

CMS detector findings

In Memory of...

750 GeV

Prepare to follow.
Good News & Bad News ...

• Now the Good News:
Good News & Bad News ...

• Now the Good News:
  – Last time (2013) – Precision, Intensity, Low energy Frontier was a ripple ...
Good News & Bad News ... 

–At Present (2016) – Precision, Intensity, Low energy Frontier is more of a ground swell ...

*ground swell*: a broad deep undulation of the ocean caused by an often distant gale or seismic disturbance
Good News & Bad News ...

- Next time (2019) – Precision, Intensity, Low energy
  Frontier WILL be more of a serious California wave:
Predictions:

• There will be 3 major intriguing BSM results:
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  1. One will be a statistical fluctuation
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  2. One will be a new systematic effect
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• There will be 3 major intriguing BSM results:
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  2. One will be a new systematic effect
  3. One will be a **Discovery**!
Predictions:

• There will be 3 major intriguing BSM results:
  1. One will be a statistical fluctuation
  2. One will be a new systematic effect
  3. One will be a **Discovery** !

Of course any decent theoretical prediction should include an error bar: $\pm 1$
“There’s plenty of room at the bottom!”

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The Bottom