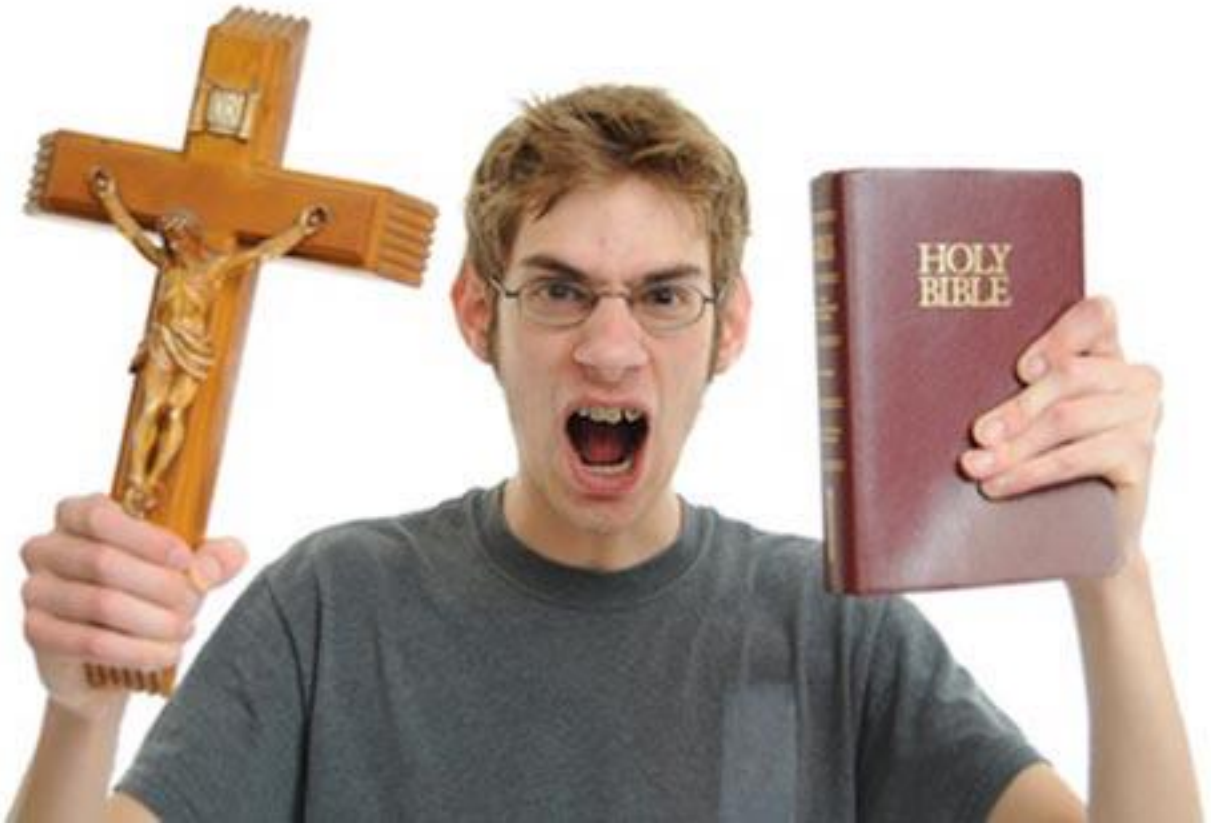
Making the most of your 10 minutes of fame

Dave.Barney@cern.ch

Making engaging presentations ≠ soft skill!

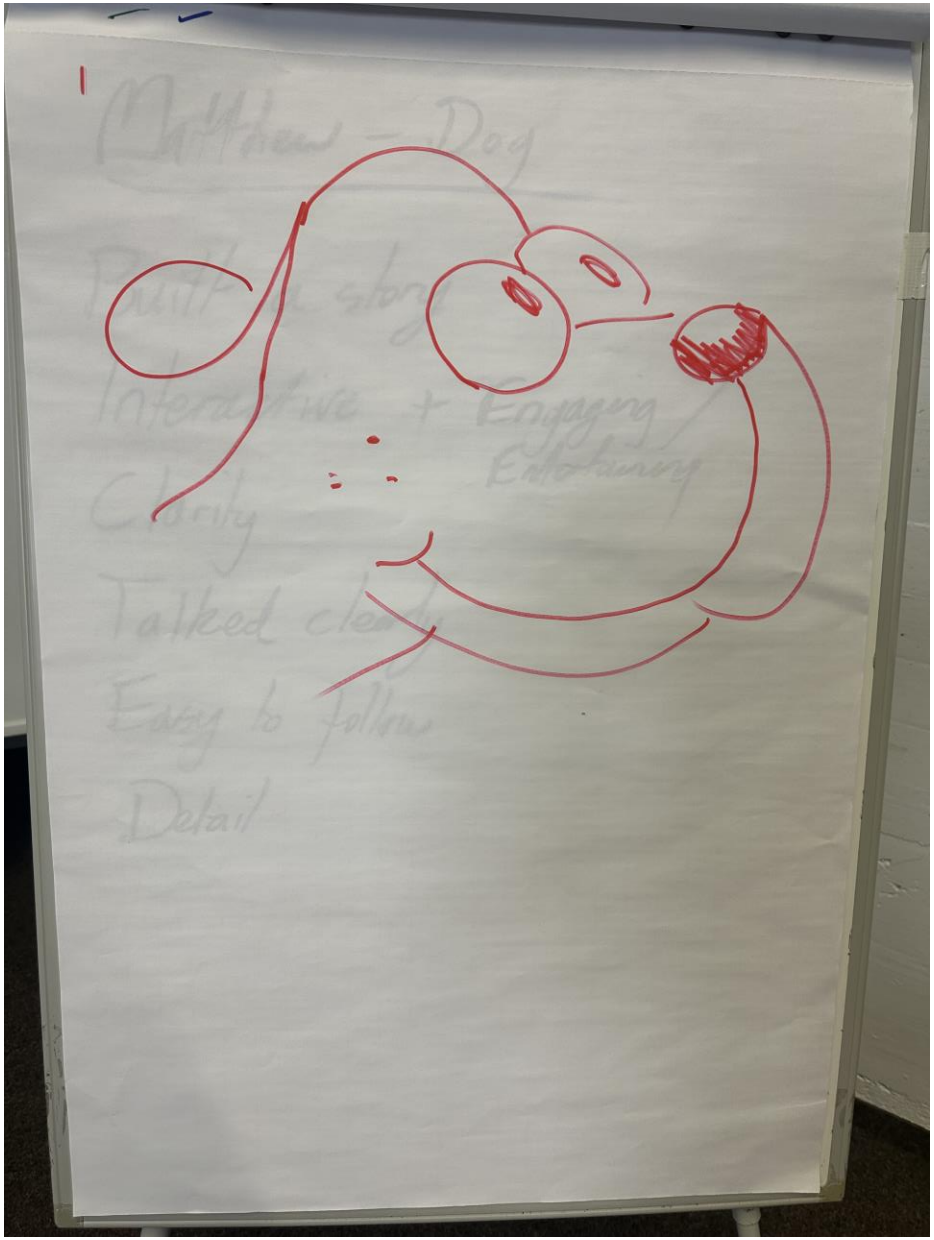
I am not going to evangelize!

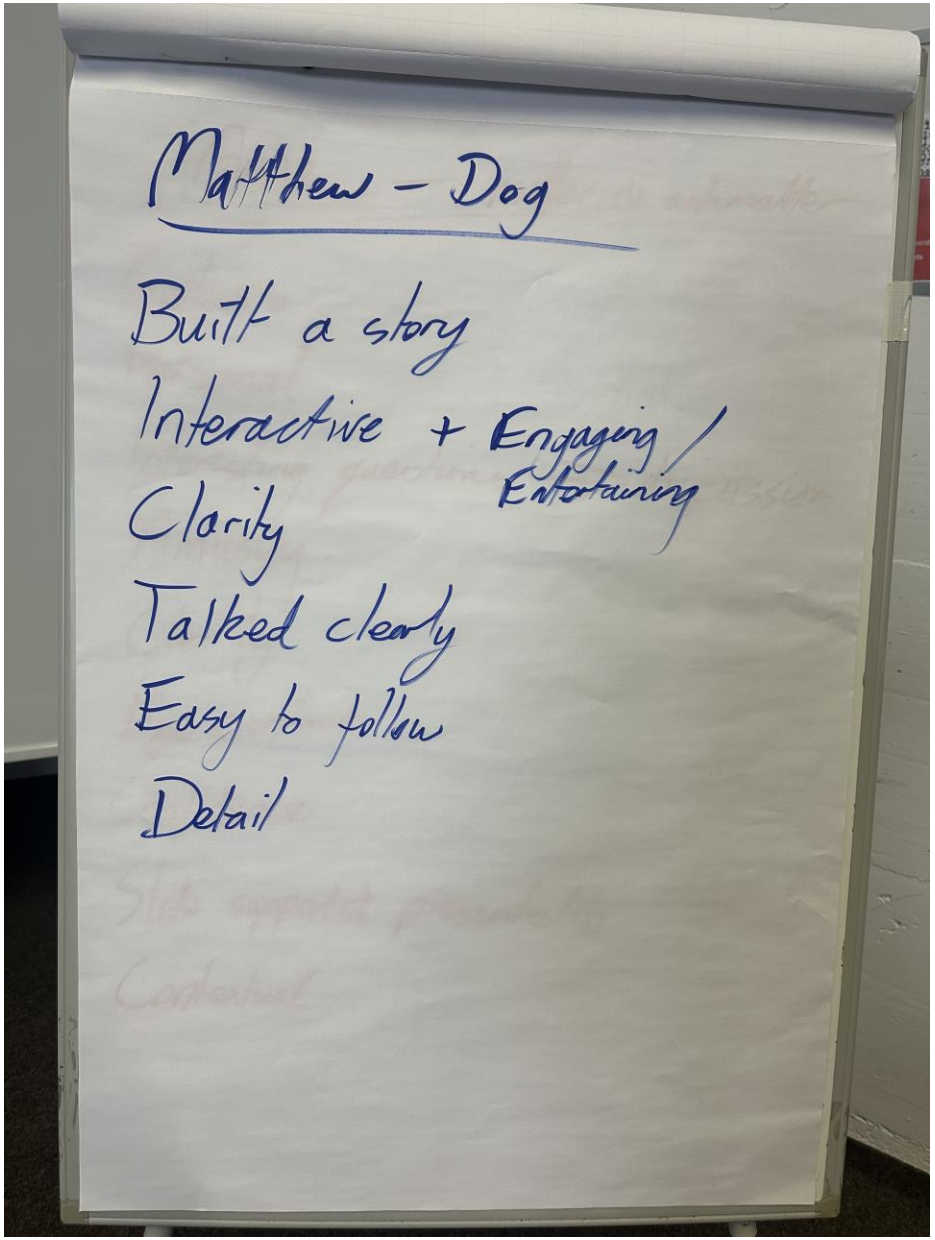


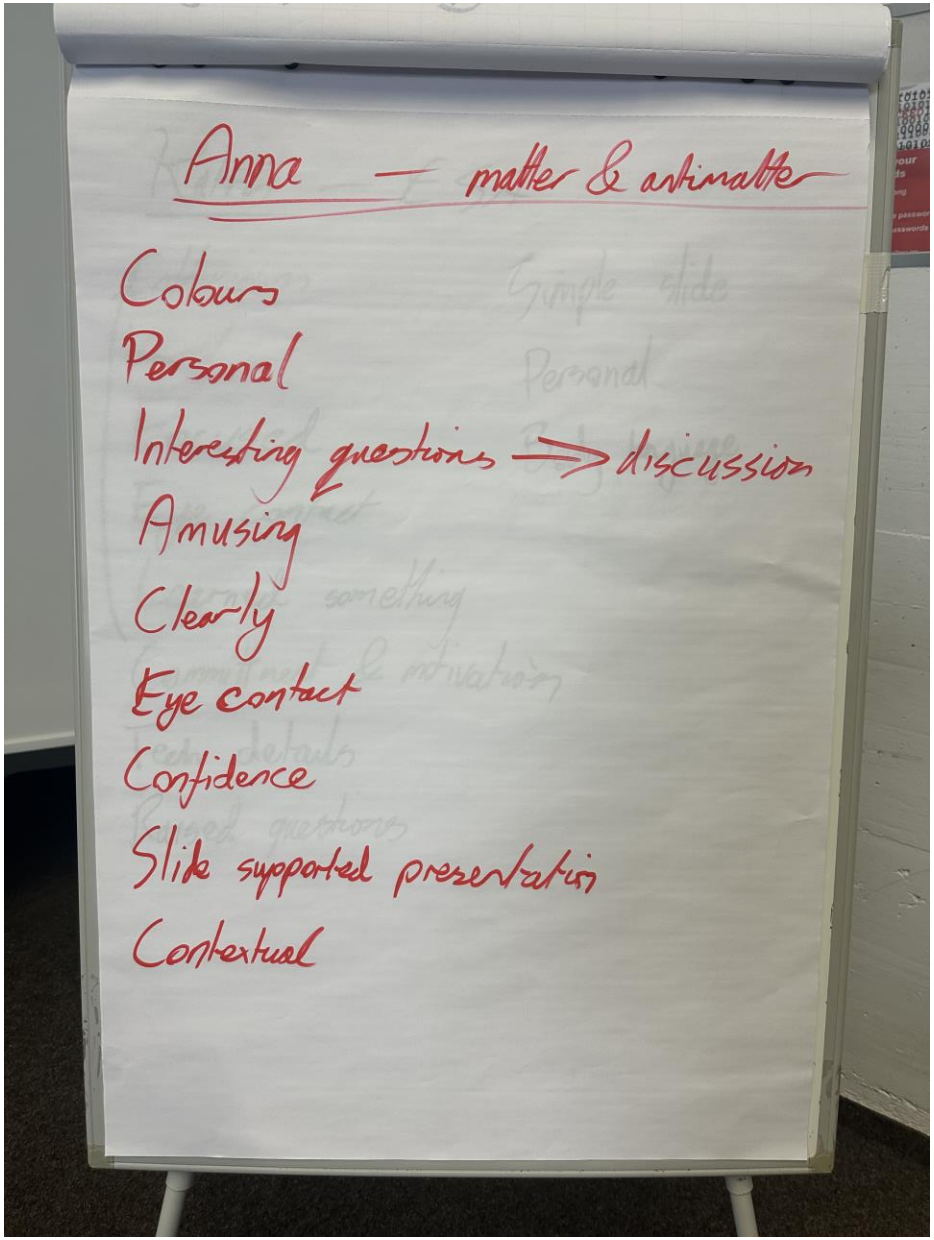
Exercise 1: You have 10 minutes to prepare a 1-minute presentation on your favourite topic (not necessarily particle physics!)

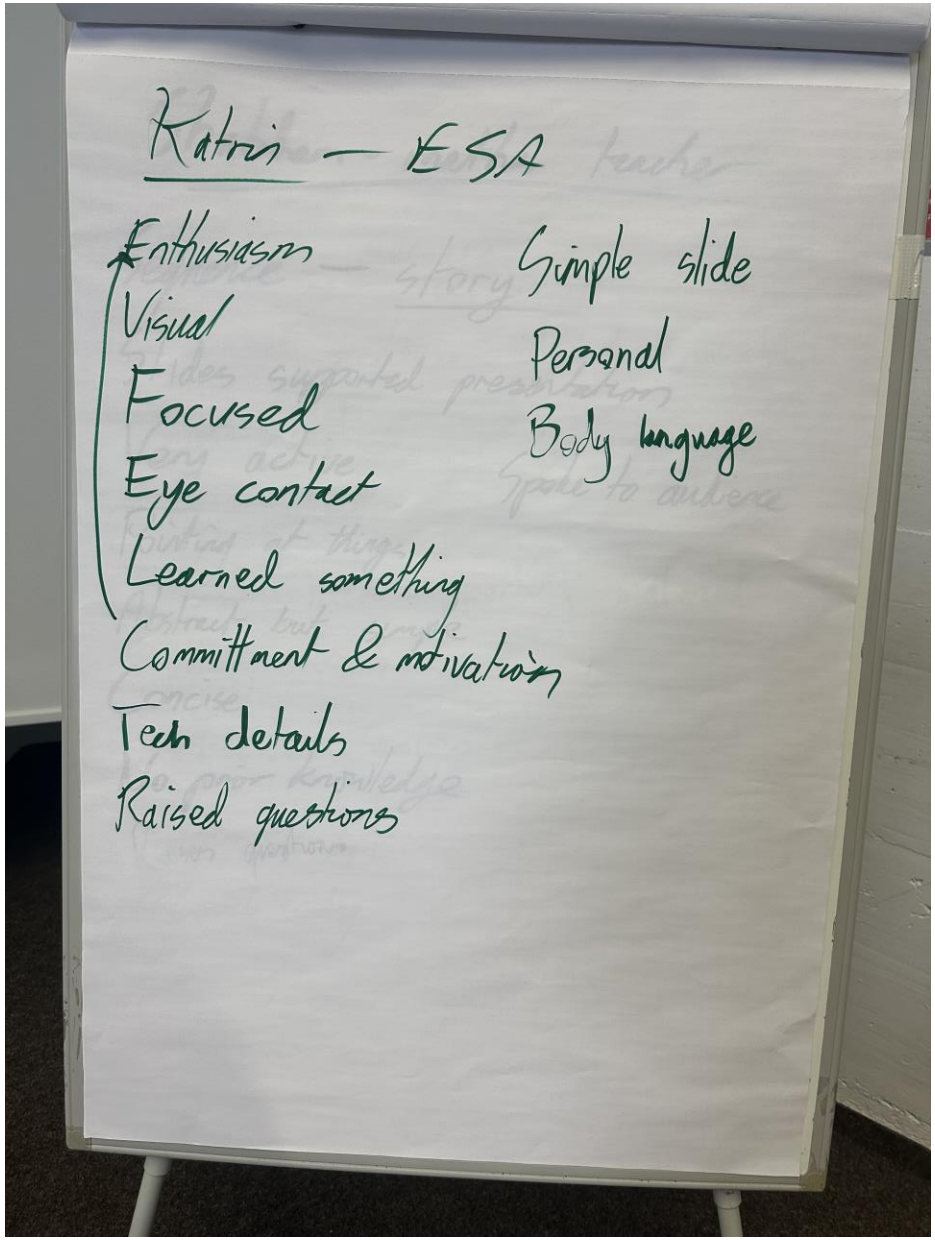
Send any slides to David.Barney@cern.ch using filename: **1_<Yourname>.<extension>**
(or you can use your own laptop)

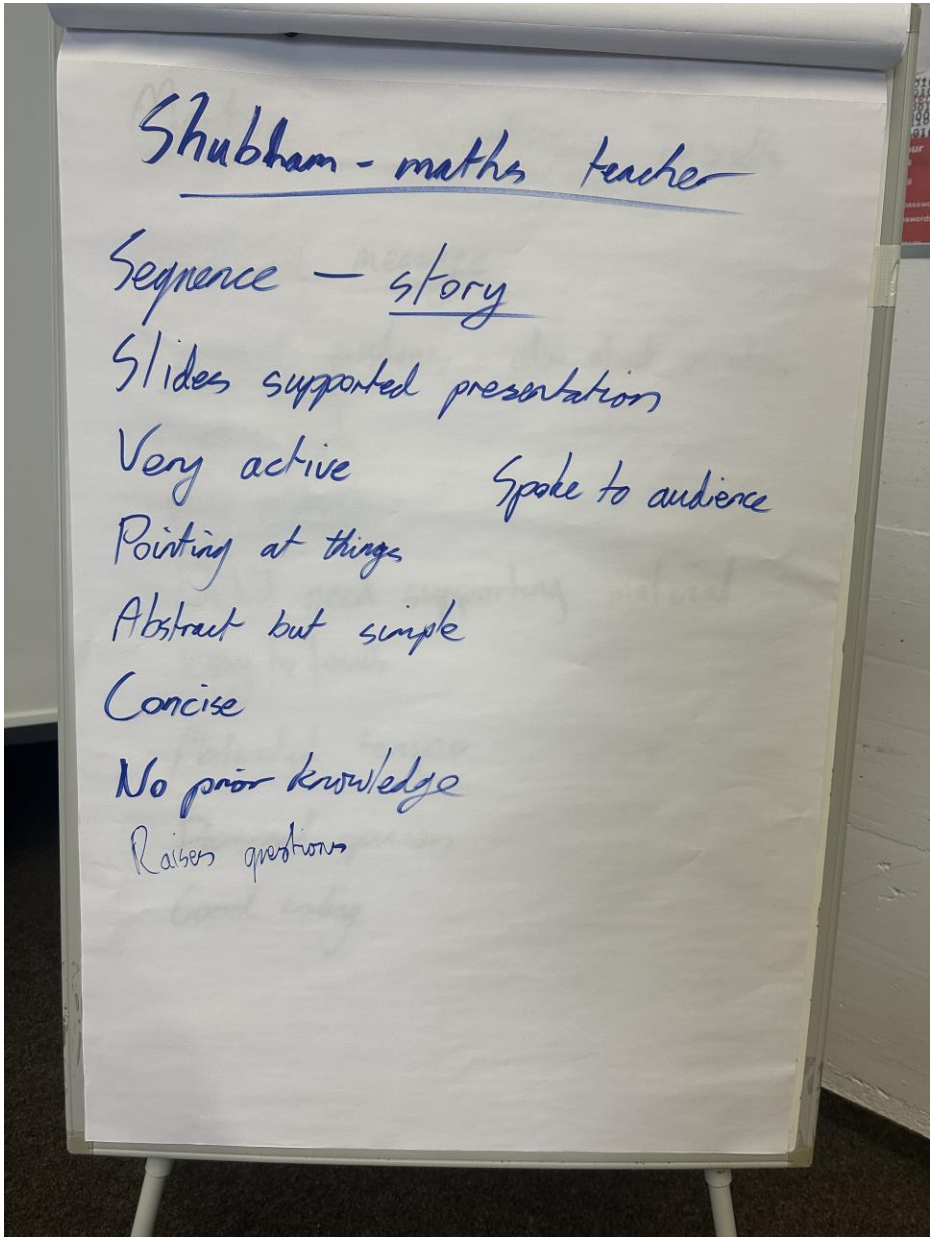
I will choose some at random for presentation!

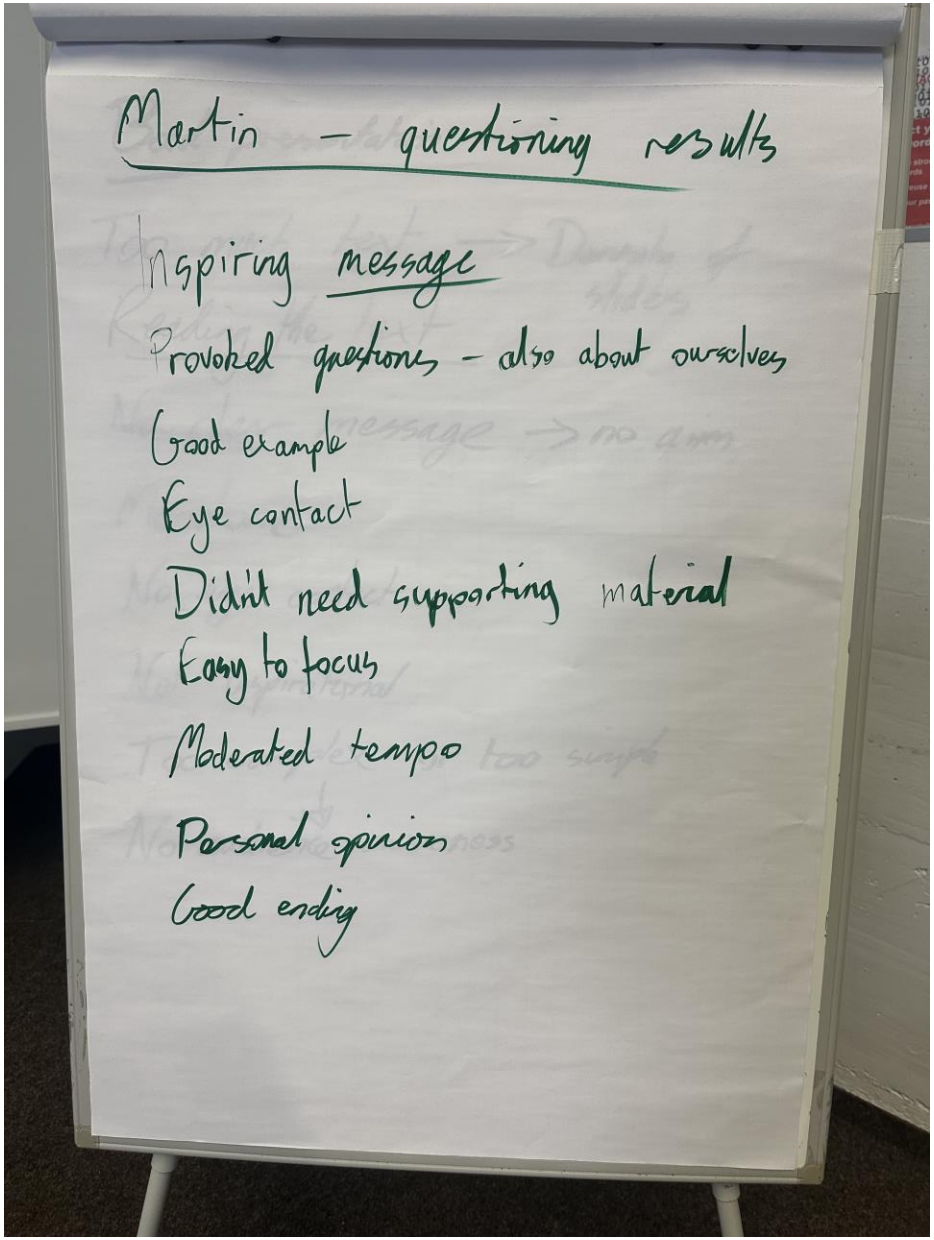



Matthew – Dog
Built a story
Interactive + Engaging
Entertaining
Clarity
Talked clearly
Easy to follow
Detail


Anna — matter & antimatter
Colours
Personal
Interesting questions ⇒ discussion
Amusing
Clearly
Eye contact
Confidence
Slide supported presentation
Contextual


Katrin — ESA
Enthusiasm
Visual
Focused
Eye contact
Learned something
Simple slide
Personal
Body language
Commitment & motivation
Tech details
Raised questions


Shubham - maths teacher
Segnence — story
Slides supported presentation
Very active
Spoke to audience
Pointing at things
Abstract but simple
Concise
No prior knowledge
Raises questions


Martin — questioning results
Inspiring message
Provoked questions - also about ourselves
Good example
Eye contact
Didn't need supporting material
Easy to focus
Moderated tempo
Personal opinion
Good ending

Link to video from John Cleese

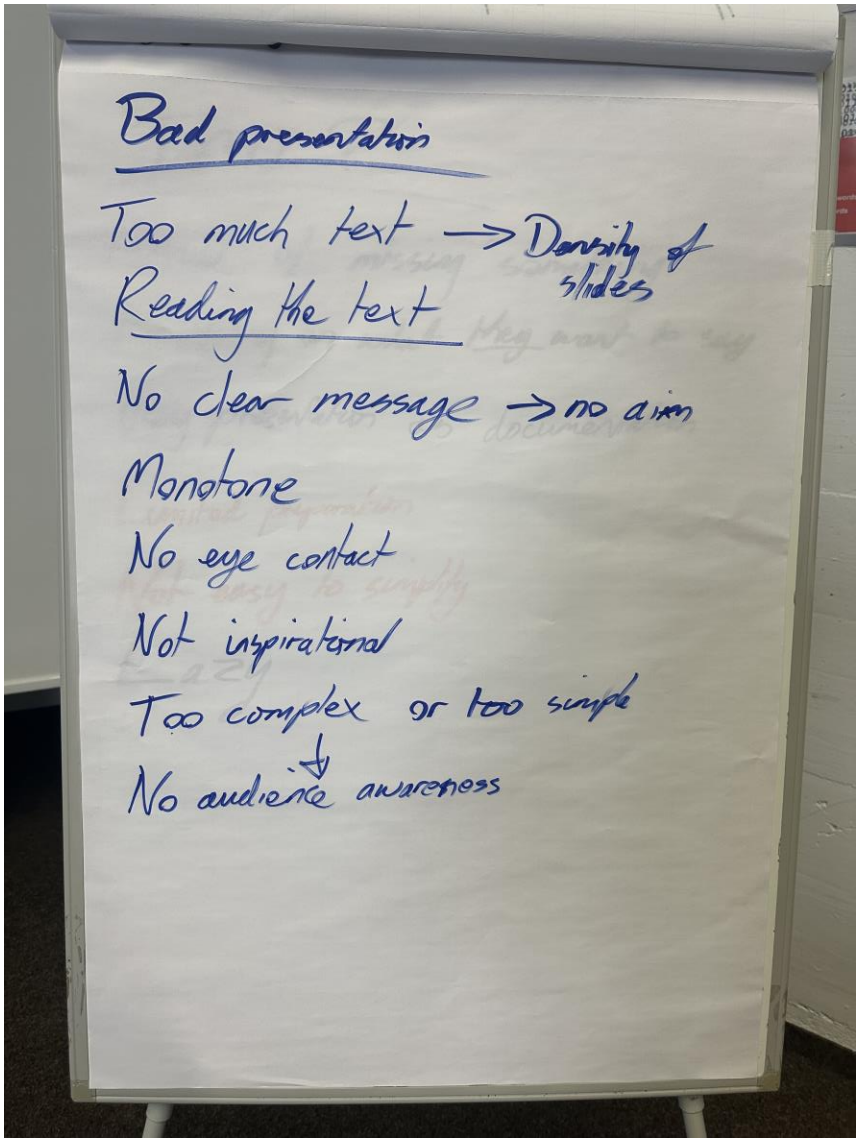
https://www.youtube.com/watch?v=Pb5oIIPO62g
from ~20 mins

John Cleese on Creativity In Management

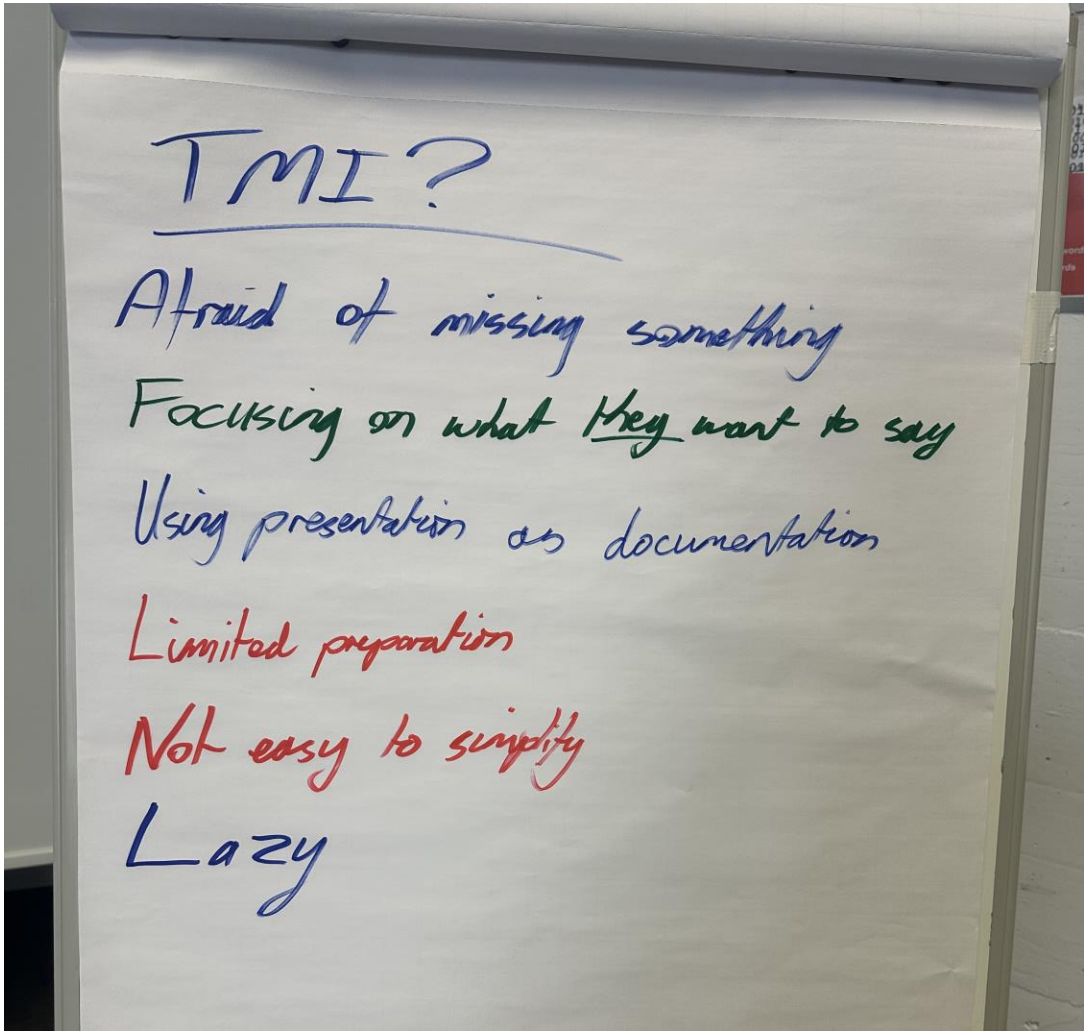
"the most creative people are the ones who are not afraid to feel uncomfortable when they do not immediately try to answer a question. Taking time to think about the problem and possible solutions is critical. And will always lead to more creative paths forward"

(I paraphrased a LOT here!)

What are the most common problems with presentations?



Why do people put too much information into a presentation?



Your audience is **intelligent**
But not knowledgeable

***You* are the only expert in the room!**

GUIDELINE #1:

THE PRESENTATION IS FOR THE AUDIENCE
MAKE SURE YOU KNOW YOUR AUDIENCE!

What is the purpose of a presentation?

What is the purpose of a presentation?

For the audience to understand one or more **messages**

And possibly **act upon** those messages

message ≠ information

Supercars of Munich (1/3)

This is “information”

Koenigsegg Agera RS in Munich

This is also “information”

The only Koenigsegg Agera RS in Munich is the official EIROforum taxi!

This is a “message” that you can act upon!

What is a message?

It is not the “what”

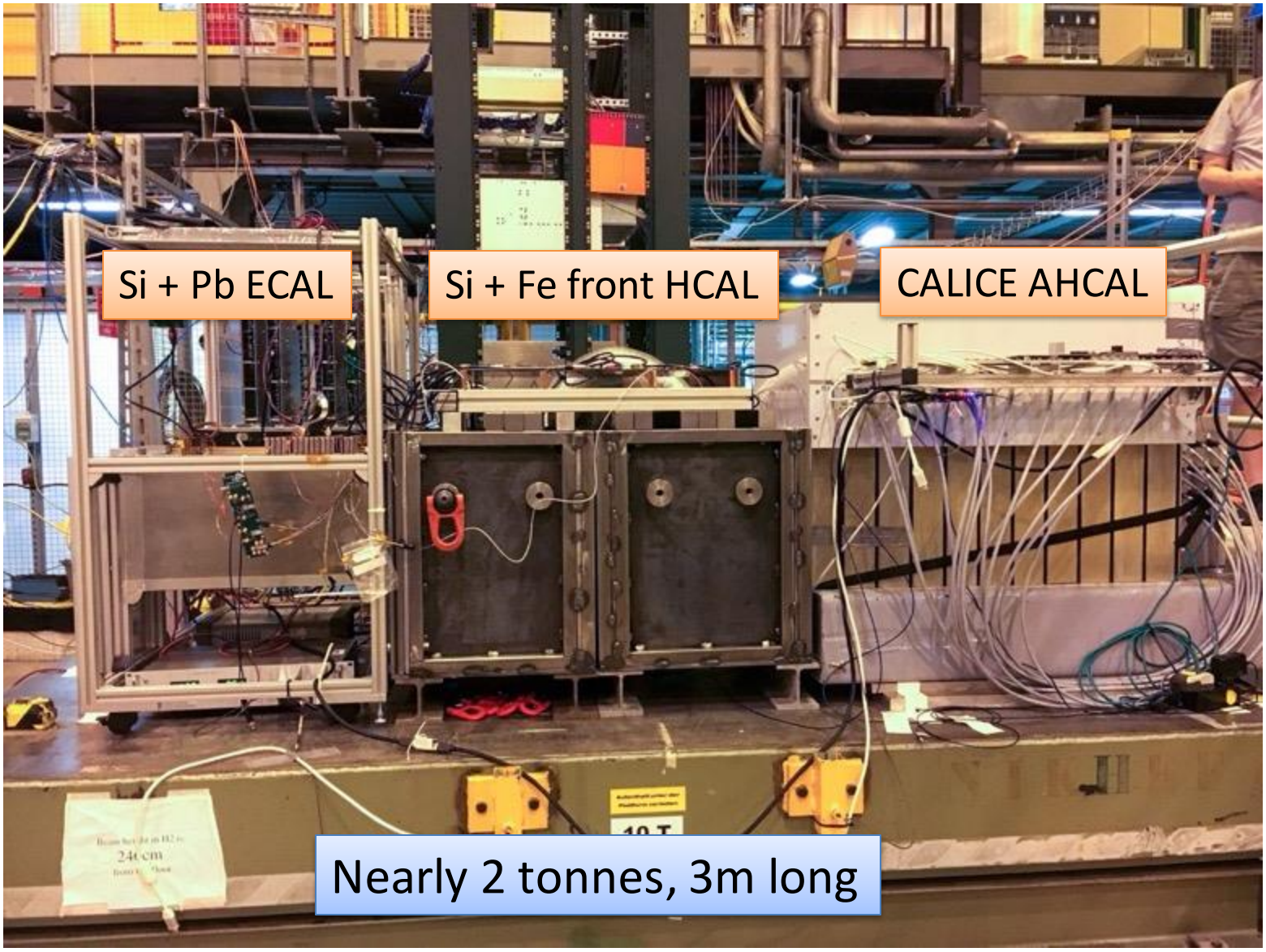
It is the “***so what?***”

Including the “so what?” explicitly on your slides is a basic redundancy

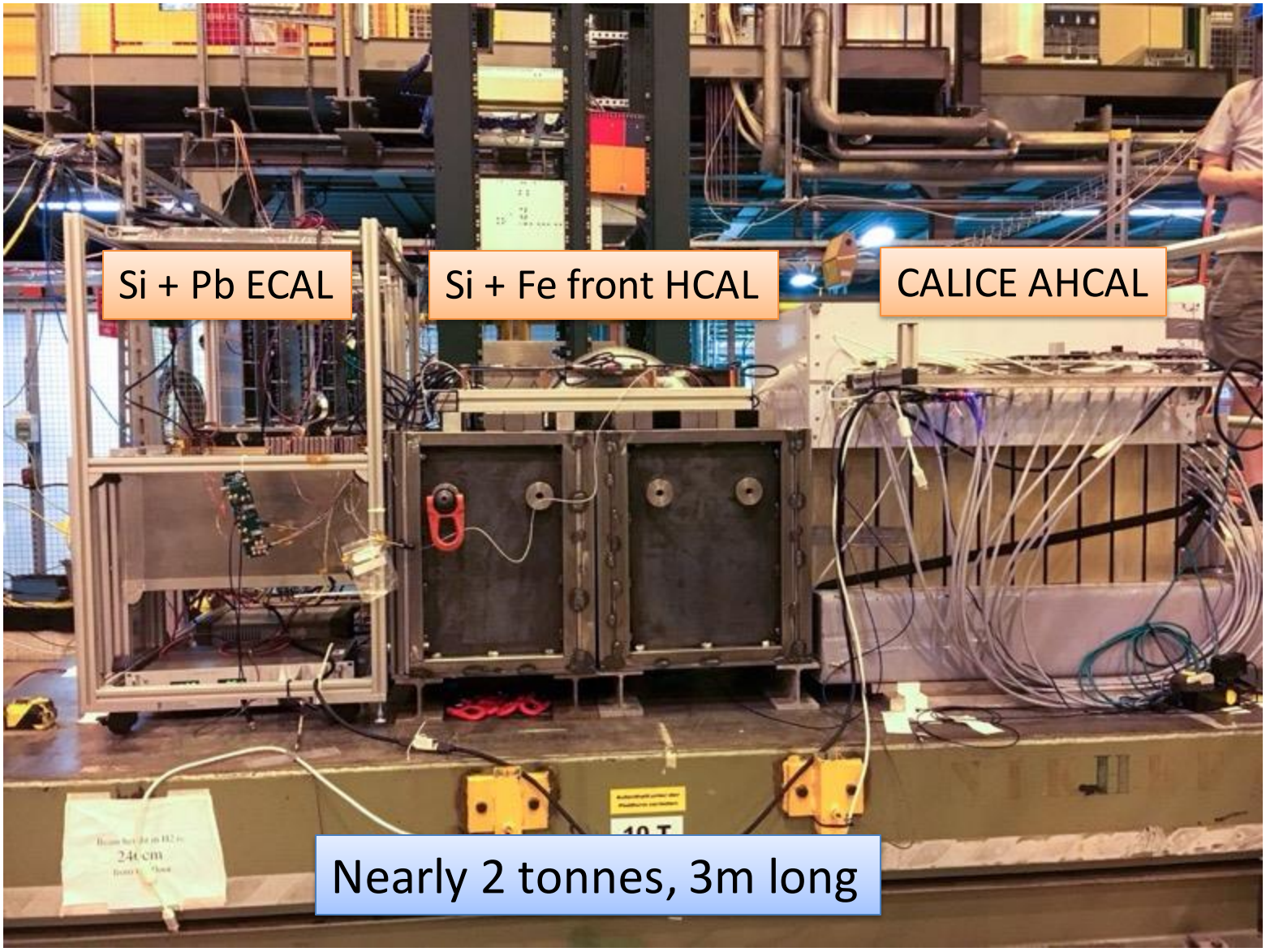
Even if the “so what?” is the only text on your slide, an offline reader will be able to understand the important points of the presentation

The “title” part of your slide is perfect for putting the “so what?”

HGCAL Beamtest 2017



Full prototype HGCAL is at the limit of what can be placed on the CERN SPS H2 moving table



Omitting the “so what?” or not being clear can have serious consequences…

For a pretty extreme view, take a look at:
https://www.inf.ed.ac.uk/teaching/courses/pi/2016_2017/phil/tufte-powerpoint.pdf

And a nice response:
http://web.mit.edu/5.95/readings/doumont-responds-to-tufte.pdf

Review of Test Data Indicates Conservatism for Tiles Penetration

- The existing SOFI on tile test data used to create Crater was reviewed along with STS-107 Southwest Research data
  - Crater overpredicted penetration of tile coating significantly
    - Initial penetration to described by normal velocity
      - Varies with volume/mass of projectile(e.g. 200ft/sec for 3cu. In)
    - Significant energy is required for the softer SOFI particle to penetrate the relatively hard tile coating
      - Test results do show that it is possible at sufficient mass and velocity
    - Conversely, once tile is penetrated SOFI can cause significant damage
      - Minor variations in total energy (above penetration level) can cause significant tile damage
  - Flight condition is significantly outside of test database
    - Volume of ramp is 1920cu in vs 3 cu in for test

Exercise 2: Decoding NASA

Look at your handouts. Work in pairs! You have 5 minutes to determine the three most important conclusions from this slide

Some context & glossary:

This concerns a **US Space Shuttle**

- **Tiles** = the special foam tiles covering the Space Shuttle
- **Crater** = simulation program
- **SOFI** = spray-on foam insulation, used on the separate fuel tanks of the space shuttle
- **ramp** = piece of debris
- **cu in** = cubic inch

1) The “Crater” simulation is not a realistic representation of what happened

2) A penetration of the tile cannot be ruled out

3) If this happened, the consequences could be catastrophic

Don’t let Powerpoint control the apparent importance of something depending on where it is in the list!

POSSIBLY A GOOD TIME FOR A BREAK!

Bullet lists have their uses, but don’t overdo it!

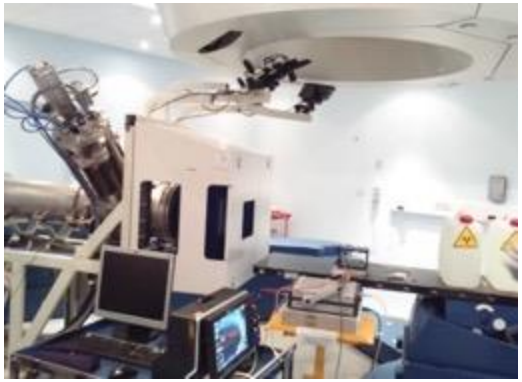
Good examples:

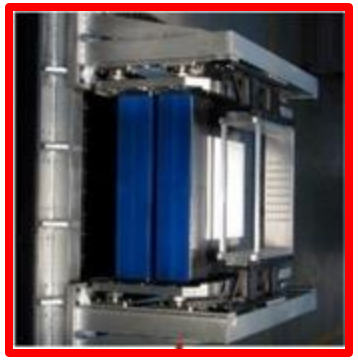
Pros vs cons

Checklists

Beam monitoring in charged-particle therapy

Parallel-plate ionization chambers





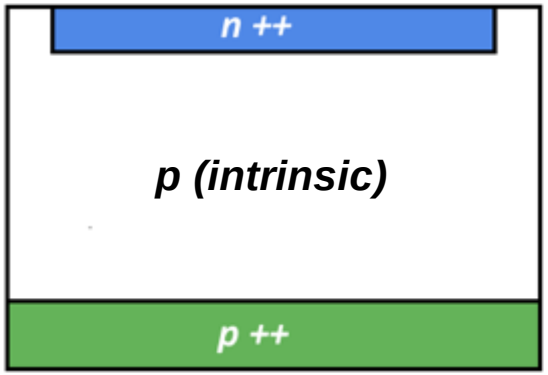
PROS:

- Robust, stable, radiation resistance

CONS;

- Slow response time
- Limited sensitivity
- Measurement of number of particles from the produced charge depends on energy
- Daily QA and calibration measurements.

Silicon detectors



PROS:

- Good sensitivity (single particle detection)
- Small signal duration (direct count of number of particles)
- Fine segmentation -> beam profile
- Time resolution (measurement of beam energy with time-of-flight techniques)

CONS:

- Pile-up effects at high frequencies
- Radiation resistance.

Practical Aspects in irradiation-test organization

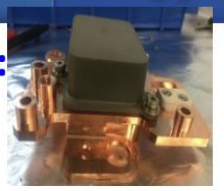
- Ensure that **facility is compliant with your requirements** (energy, flux, etc.)
- Ensure that your **system is compliant with facility requirements** (dimension, operation, safety, etc.)
- Respect instructions of the facility about **positioning and alignment of your samples**. Get this checked by facility staff before going, if possible
  - spare devices can be useful if re-test needed
- Dosimetry usually (but not always) done by facility staff. When this is available, it is likely to be accurate typically ±10%
  - **dosimetry may be complex**
  - possibly **bring your own reference dosimeter**. This is even more important when the experimental team is not present during irradiation
- Inform the facility about the need of maintaining equipment **for post-irradiation measurements** (annealing tests, etc.)
- **Personnel Dosimetry**: always required when working with ionizing radiation

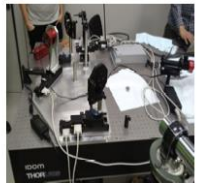
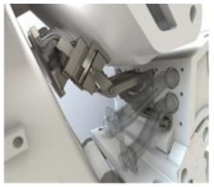
Federico Ravotti," Dosimetry Techniques and Radiation Test Facilities for Total Ionizing Dose Testing", Short course RADECS2017

F4E Diagnostic Programme – ITER projects

FUSION FOR ENERGY

A wide range of Diagnostics systems are under final design and/or manufacture:




- Magnetics sensors (55.A*x*) and scientific software – **Delivered**
- Radial neutron camera (55.B1) – Preparing for **manufacture**
- Core-plasma Thomson scattering (55.C1) – Completing **design**
- Collective Thomson scattering (front end) (55.C7) – Prep. **manufacture**
- Bolometers (55.D1) – Completing **design**
- Core-plasma CXRS (55.E1) – Completing **design**
- Equatorial Vis./IR wide-angle viewing system (55.G1) – Prep. for **manufacture** (EQ12) / **design**
- Diagnostic pressure gauges (55.G3) – Closing FDR, preparing for **manufacture**
- Cable looms, electrical feedthroughs, divertor RH connector (55.NE) – **Delivered** /**manufacture**/**design**
- Port integration – Preparing for **manufacture**

Anecdotes can be even more memorable than messages

1975

A Phenomenological Profile of the Higgs Boson

- First attempt at systematic survey

A PHENOMENOLOGICAL PROFILE OF THE HIGGS BOSON

John ELLIS, Mary K. GAILLARD * and D.V. NANOPOULOS **
CERN, Geneva

Received 7 November 1975

A discussion is given of the production, decay and observability of the scalar Higgs boson H expected in gauge theories of the weak and electromagnetic interactions such as the Weinberg-Salam model. After reviewing previous experimental limits on the mass of

We should perhaps finish with an apology and a caution. We apologize to experimentalists for having no idea what is the mass of the Higgs boson, unlike the case with charm [3,4] and for not being sure of its couplings to other particles, except that they are probably all very small. For these reasons we do not want to encourage big experimental searches for the Higgs boson, but we do feel that people performing experiments vulnerable to the Higgs boson should know how it may turn up.

GUIDELINE #2:

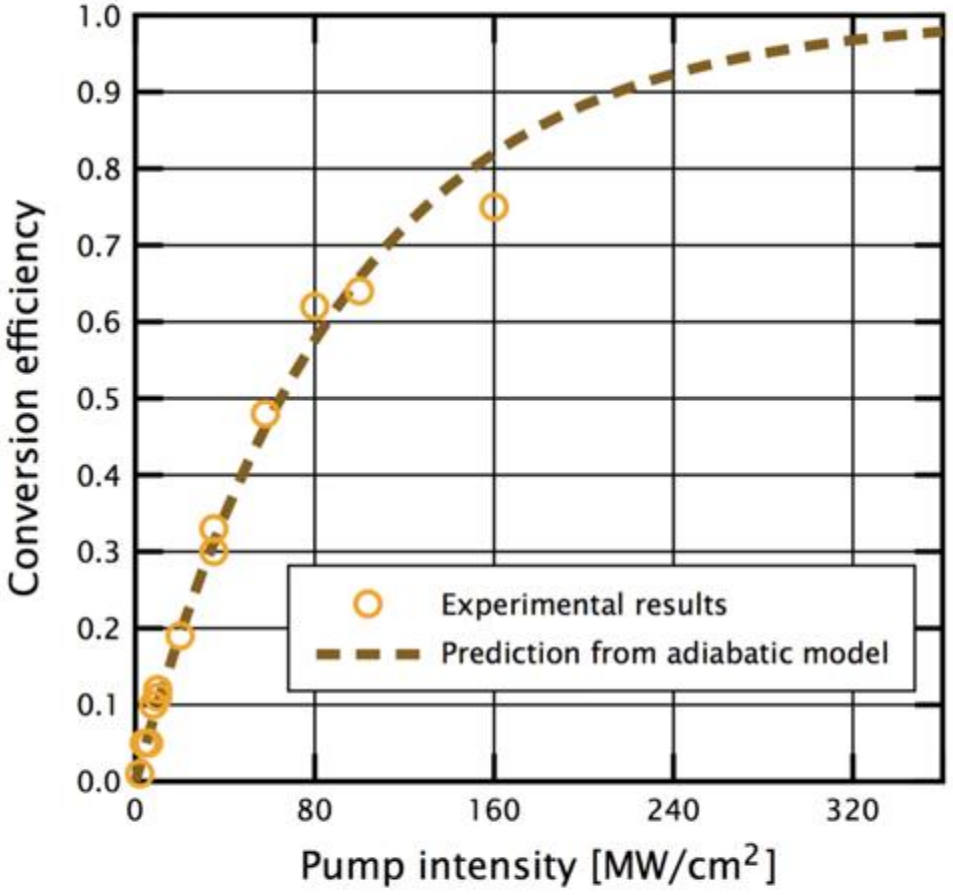
FOCUS ON YOUR MAIN MESSAGES (AND ANECDOTES WHEN APPROPRIATE) AND DON'T LET POWERPOINT CONTROL HOW YOUR MESSAGES APPEAR

Plots

The following is taken from the excellent “Traditions, templates, and group leaders” by Jean-Luc Doumont

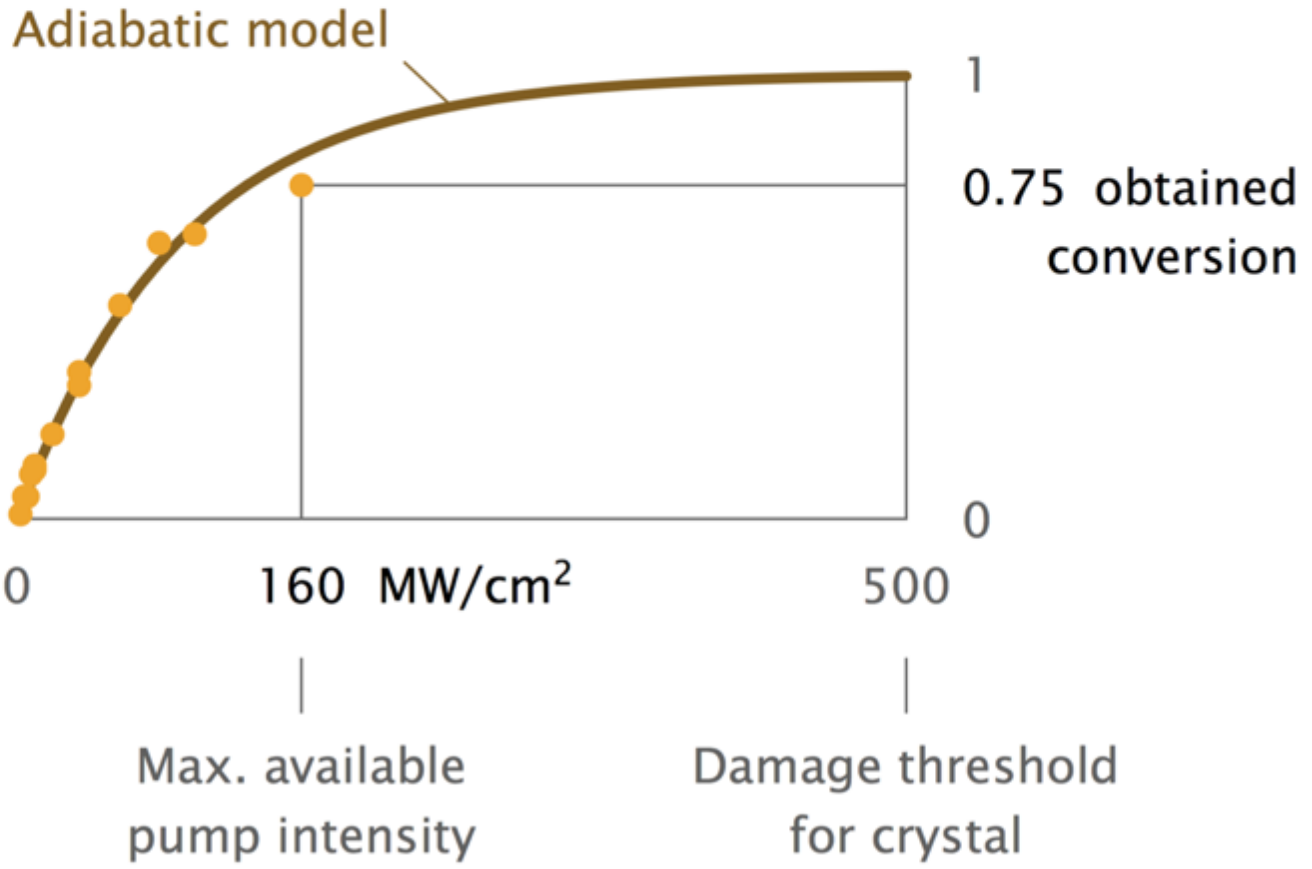
http://www.treesmapsandtheorems.com/barriers

Efficiency of adiabatic frequency conversion



- Maximum pump intensity available experimentally: 160 MW/cm^2
- λ_1 = 1530 nm; λ_2 = 1064 nm (Q-switched Nd:YLF)
- The maximum demonstrated conversion efficiency was 75 percent
- Periodically poled crystal can get damaged from 500 MW/cm^2 of pump intensity

The conversion approaches 100% for high enough pump intensity



Global Reconstruction - Full Simulation
Reconstruction and Detector Performance: Photons

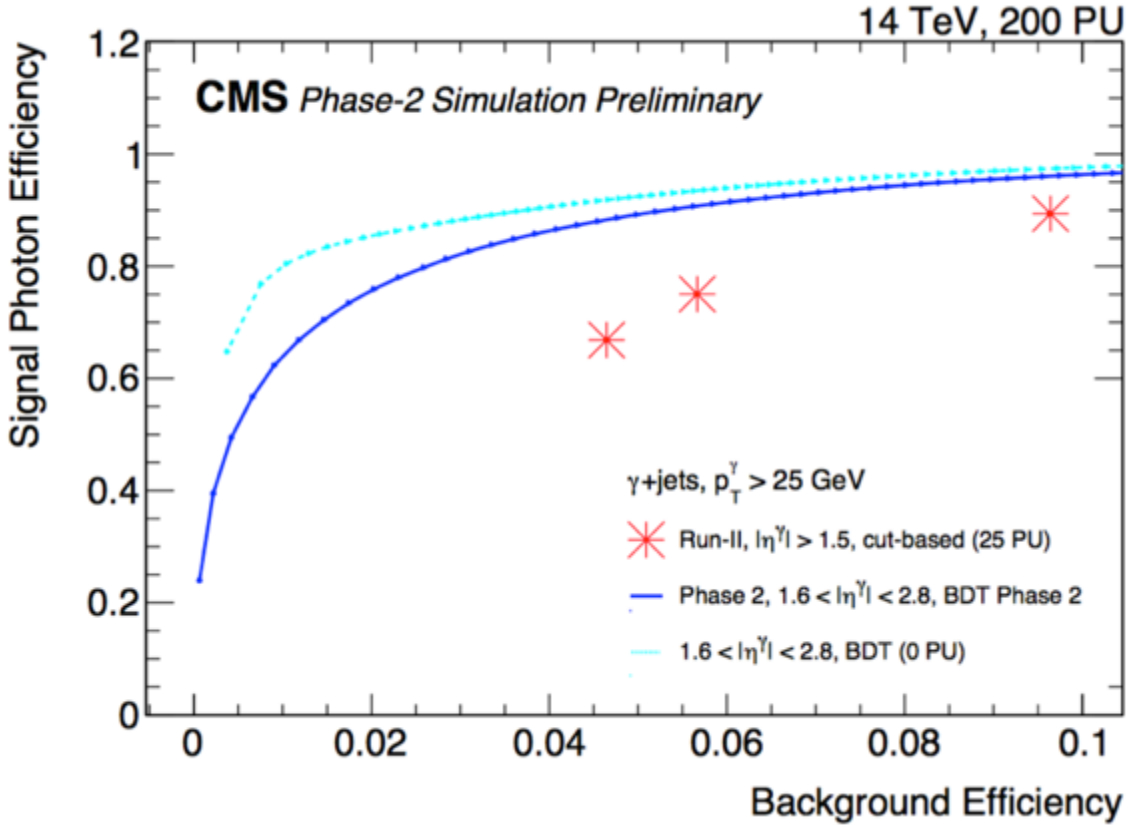
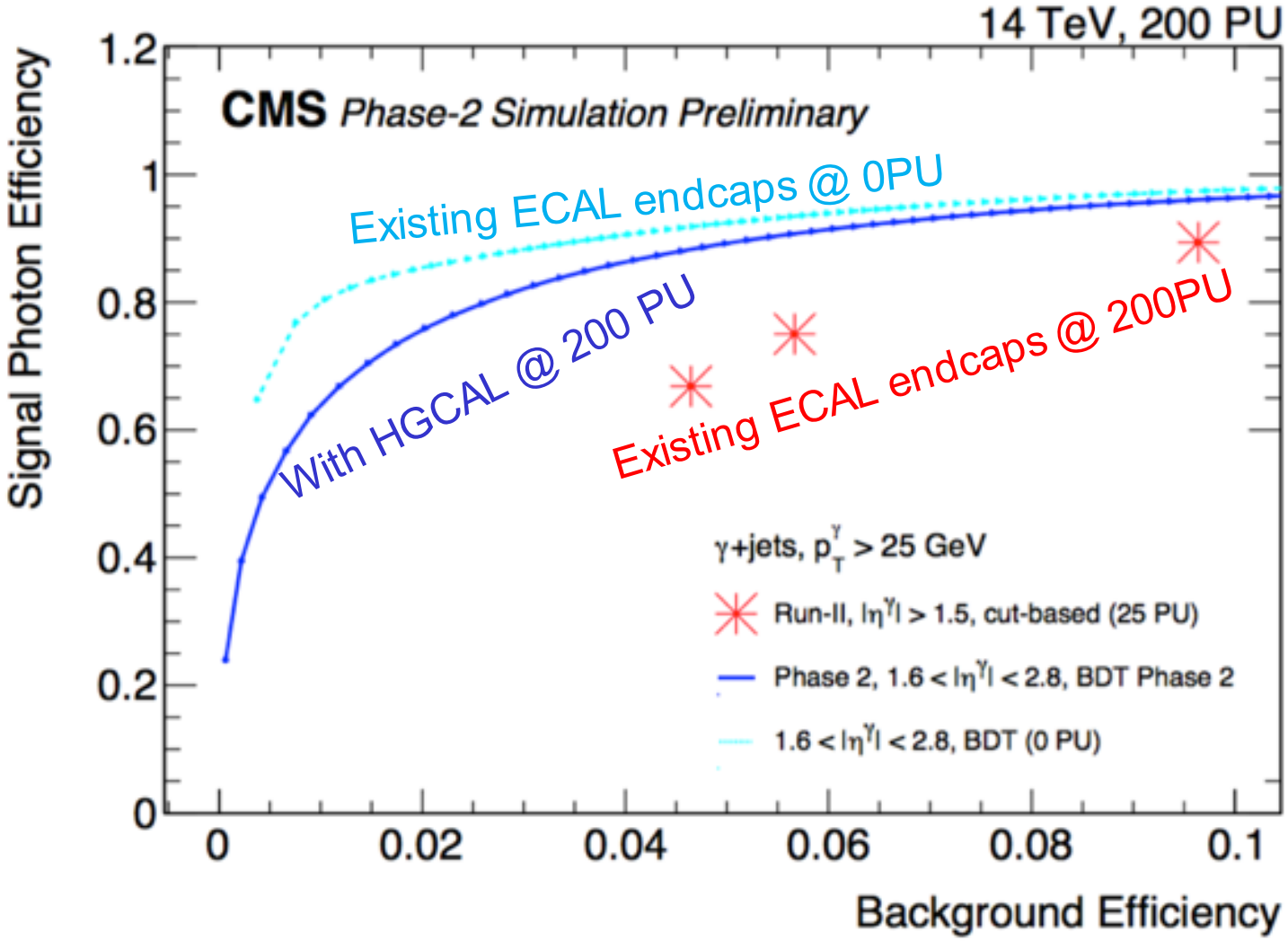
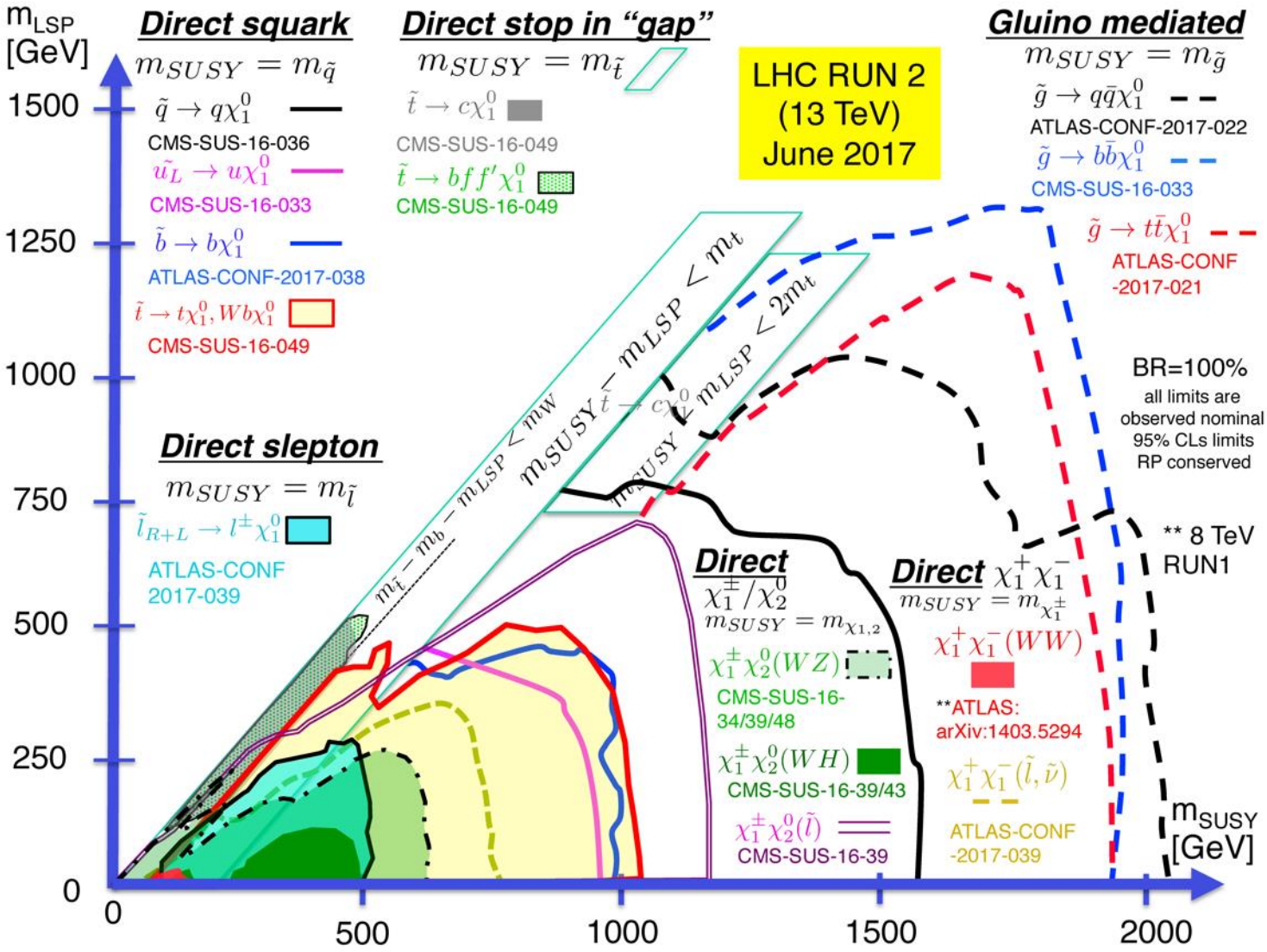
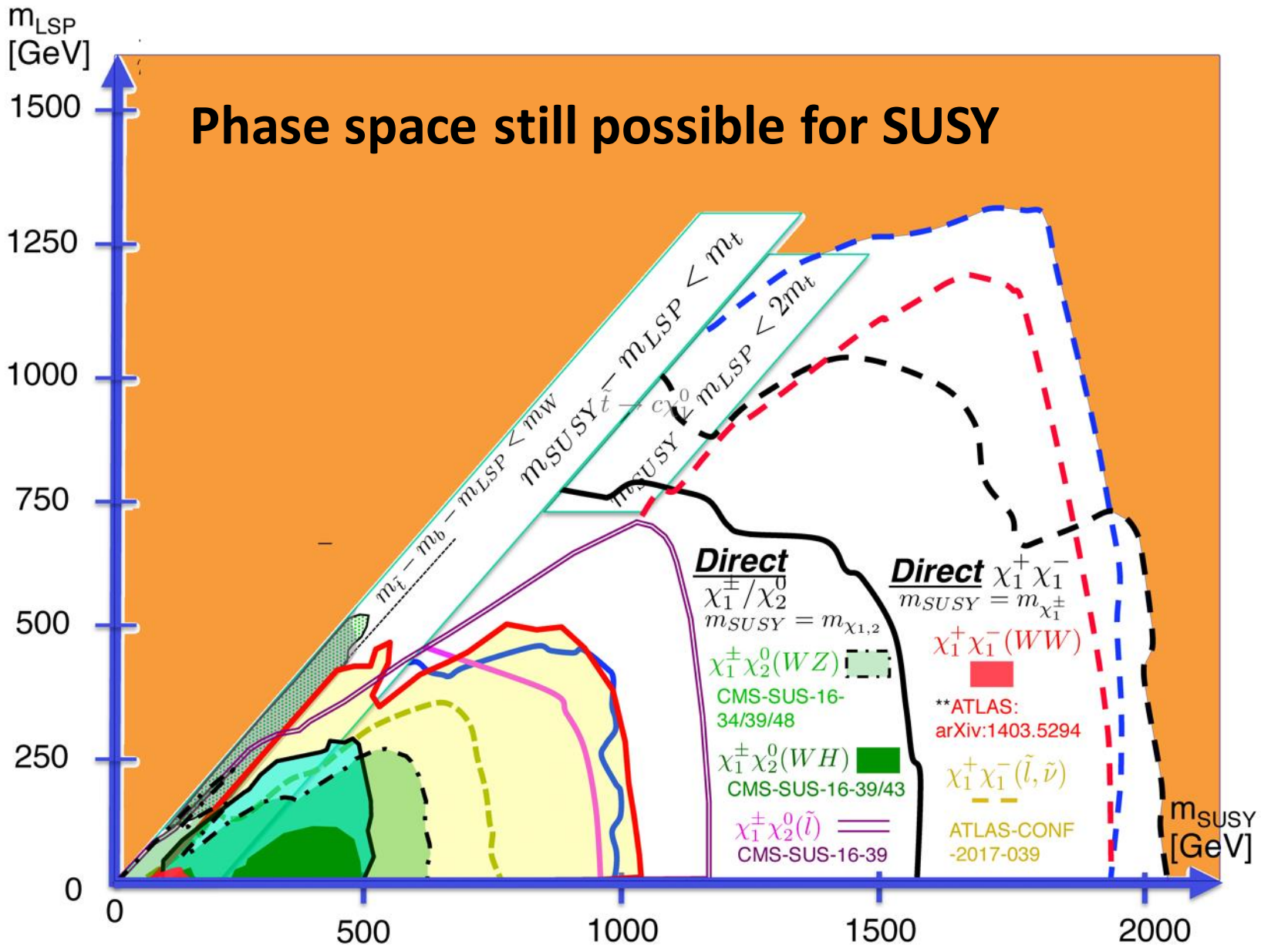


Figure 11.6: Photon efficiency versus photon-misidentification probability in simulated γ+ jets events for the BDT training. Signal photons are matched within $\Delta R(\eta, \varphi) < 0.1$ to isolated photons generated within the kinematic phase space $p_T^\gamma > 25$ GeV and $1.6 < |\eta_\gamma| < 2.8$. Misidentified photons are defined as reconstructed photons found in the same kinematic phase space but not matched to an isolated generated photon. The performance of a Run 2 cut-based ID is also presented, evaluated on a similar sample of γ + jets produced using the Run 2 conditions (average pileup of 25 pp collisions at $\sqrt{s}$ = 13 TeV).

Replacing the existing ECAL endcap with the HGCAL will bring almost the same photon efficiency in 200PU as with the existing ECAL at 0PU



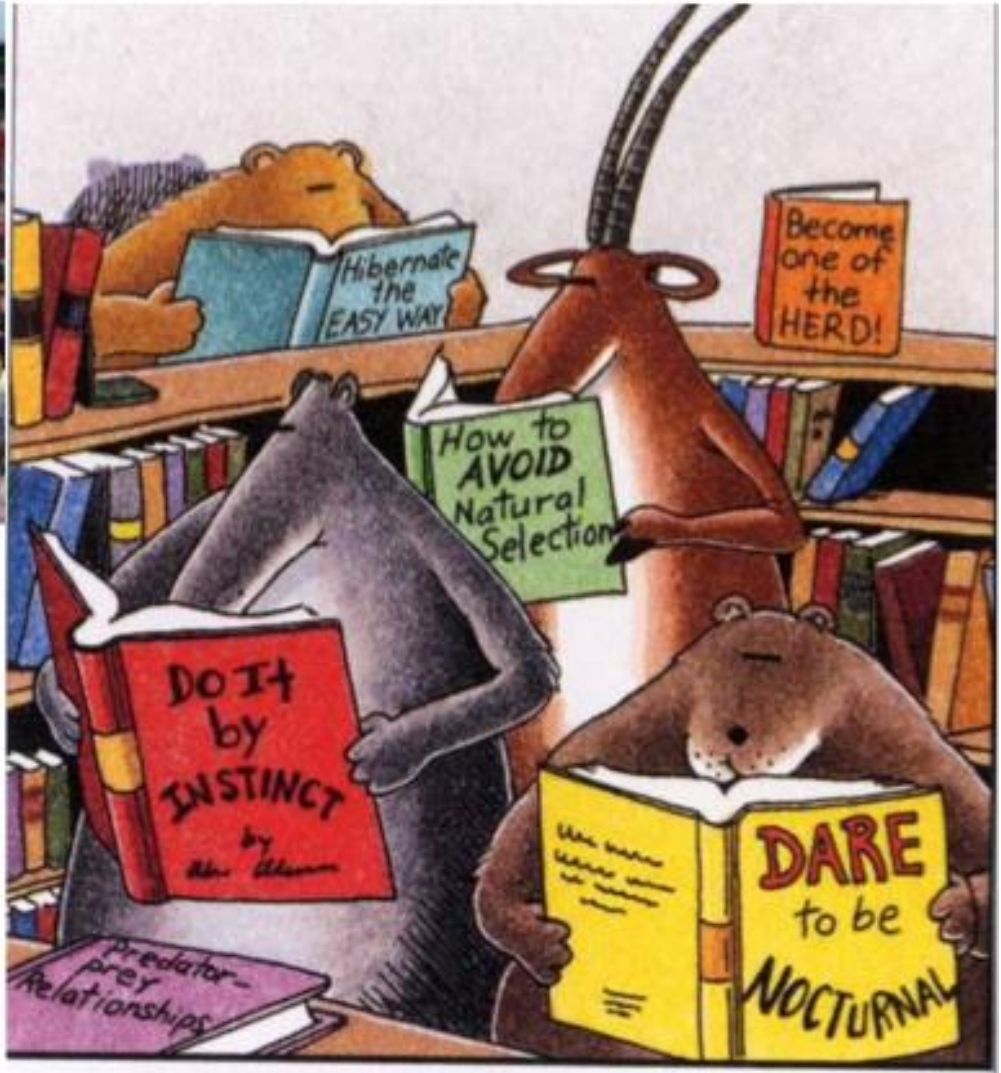

m_LSP [GeV]
Direct squark
$m_{SUSY} = m_{\tilde{q}}$
$\tilde{q} \to q\chi_1^0$
CMS-SUS-16-036
$\tilde{u_L} \to u\chi_1^0$
CMS-SUS-16-033
$\tilde{b} \to b\chi_1^0$
ATLAS-CONF-2017-038
$\tilde{t} \to t\chi_1^0, Wb\chi_1^0$
CMS-SUS-16-049
Direct stop in "gap"
$m_{SUSY} = m_{\tilde{t}}$
$\tilde{t} \to c\chi_1^0$
CMS-SUS-16-049
$\tilde{t} \to bff'\chi_1^0$
CMS-SUS-16-049
LHC RUN 2
(13 TeV)
June 2017
Gluino mediated
$m_{SUSY} = m_{\tilde{g}}$
$\tilde{g} \to q\bar{q}\chi_1^0$
ATLAS-CONF-2017-022
$\tilde{g} \to b\bar{b}\chi_1^0$
CMS-SUS-16-033
$\tilde{g} \to t\bar{t}\chi_1^0$
ATLAS-CONF
-2017-021
BR=100%
all limits are
observed nominal
95% CLs limits
RP conserved
** 8 TeV
RUN1
$m_{\tilde{t}} - m_b - m_{LSP} < m_W$
$m_{SUSY} - m_{LSP} < m_t$
$m_{SUSY} \tilde{t} \to c\chi_1^0$
$m_{SUSY} < m_{LSP} < 2m_t$
Direct slepton
$m_{SUSY} = m_{\tilde{l}}$
$\tilde{l}_{R+L} \to l^{\pm}\chi_1^0$
ATLAS-CONF
2017-039
Direct
$\chi_1^{\pm}/\chi_2^0$
$m_{SUSY} = m_{\chi_{1,2}}$
$\chi_1^{\pm}\chi_2^0(WZ)$
CMS-SUS-16-
34/39/48
$\chi_1^{\pm}\chi_2^0(WH)$
CMS-SUS-16-39/43
$\chi_1^{\pm}\chi_2^0(\tilde{l})$
CMS-SUS-16-39
Direct $\chi_1^+\chi_1^-$
$m_{SUSY} = m_{\chi_1^{\pm}}$
$\chi_1^+\chi_1^-(WW)$
**ATLAS:
arXiv:1403.5294
$\chi_1^+\chi_1^-(\tilde{l}, \tilde{\nu})$
ATLAS-CONF
-2017-039
m_SUSY [GeV]
0
250
500
750
1000
1250
1500
0
500
1000
1500
2000


m_LSP [GeV]
1500
1250
1000
750
500
250
0
0
500
1000
1500
2000
m_SUSY [GeV]
Phase space still possible for SUSY
m_t̃ − m_b − m_LSP < m_W
m_SUSY − m_LSP < m_t
m_SUSY − m_LSP < 2m_t
Direct
χ1±/χ20
m_SUSY = m_χ1,2
χ1±χ20(WZ)
CMS-SUS-16-34/39/48
χ1±χ20(WH)
CMS-SUS-16-39/43
χ1±χ20(l̃)
CMS-SUS-16-39
Direct χ1+χ1−
m_SUSY = m_χ1±
χ1+χ1−(WW)
**ATLAS: arXiv:1403.5294
χ1+χ1−(l̃, ν̃)
ATLAS-CONF -2017-039

IMAGES AND CARTOONS:
CAN BE GREAT. BUT BE CAREFUL NOT TO LOSE YOUR MAIN MESSAGE(S)!

If I have a novel idea, how do I navigate?

- Numerous discussions, several levels many stages,
- Long process: "how can it be known to the outside world, that the idea was mine" particularly to pertinent committees
- Options and metrics to get individual recognition.
- Motivations to seek more new ideas and/or help career promotion?



In the animal self-help section

Challenge #6

What we do at CERN:

Smash things together, see what happens!

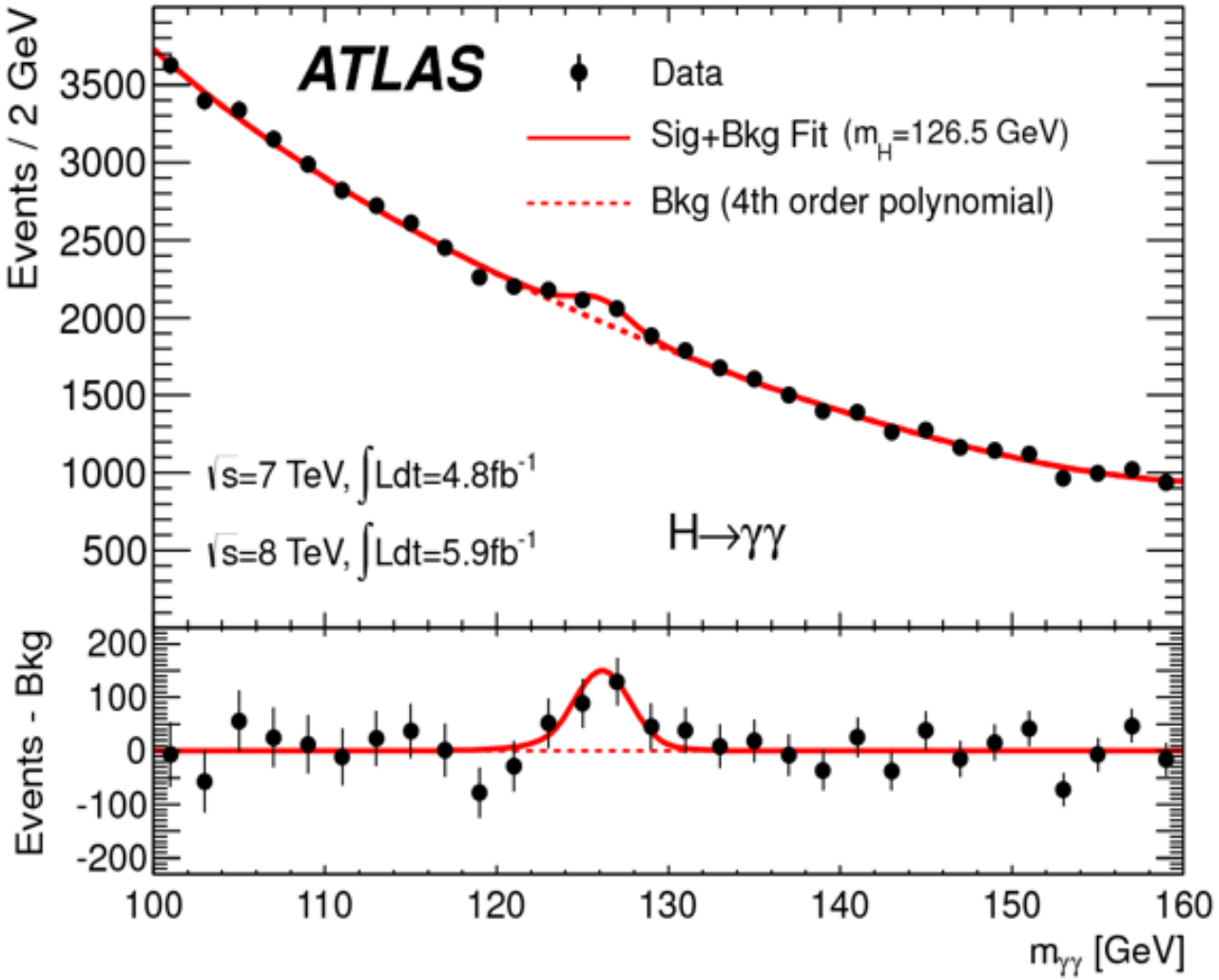
Before the particle accelerator

GUIDELINE 3:

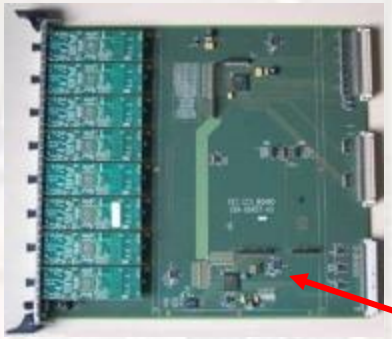
DON’T MAKE THE AUDIENCE WORK TOO HARD TO UNDERSTAND PLOTS/FIGURES. USE IMAGES CAREFULLY.

AND DARE TO BE (A LITTLE!) DIFFERENT

We are all familiar with the concept of signal-to-background (or s-to-noise)



ECAL Electronics Chain

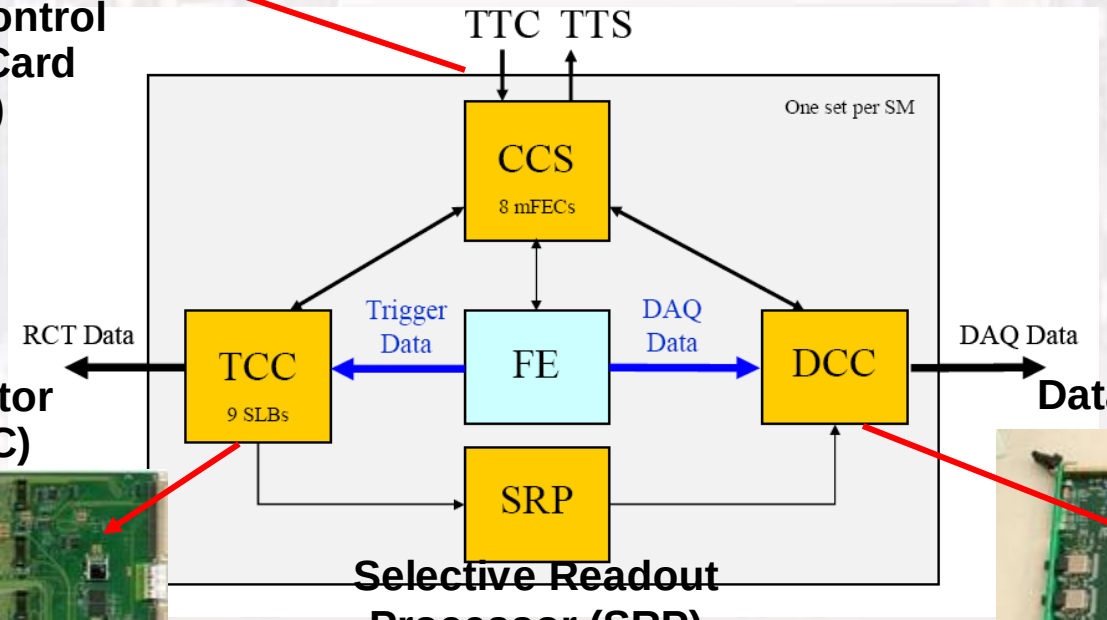


Clock & Control System Card (CCS)

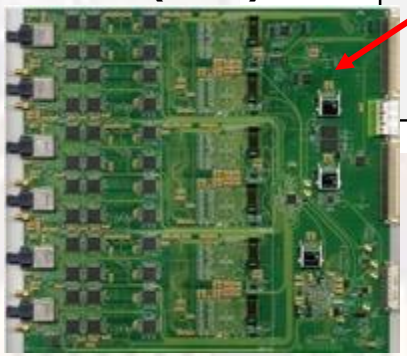
Trigger Concentrator Cards (TCCs) receive FE card trigger primitives

TCCs send trigger tower energy sums to Regional Calorimeter Trigger (RCT) at 40 MHz

Data Concentrator Card (DCC) reads FE data and TCC information upon L1 accept; performs data reduction and transfers to DAQ

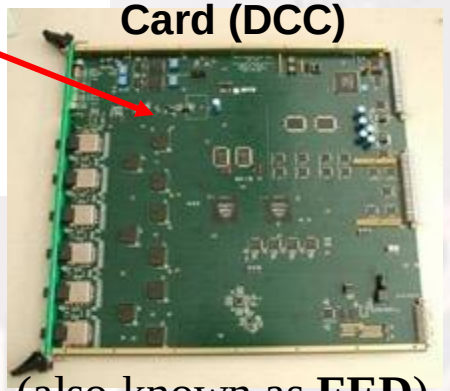


Trigger Concentrator Card (TCC)



Selective Readout Processor (SRP)

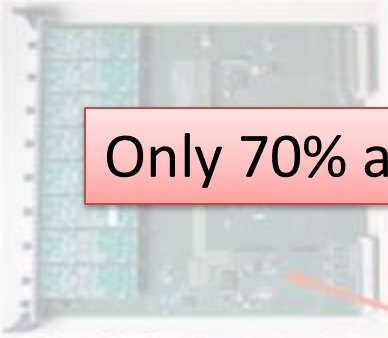
Data Concentrator Card (DCC)



(also known as **FED**)

TTC: Trigger and Timing Card
TTS: Trigger Throttling System
mFEC: mezzanine Front End Controller card
(connects to FE card via token ring)
SLB: Synchronization and Link Board
mezzanine

ECAL Electronics Chain



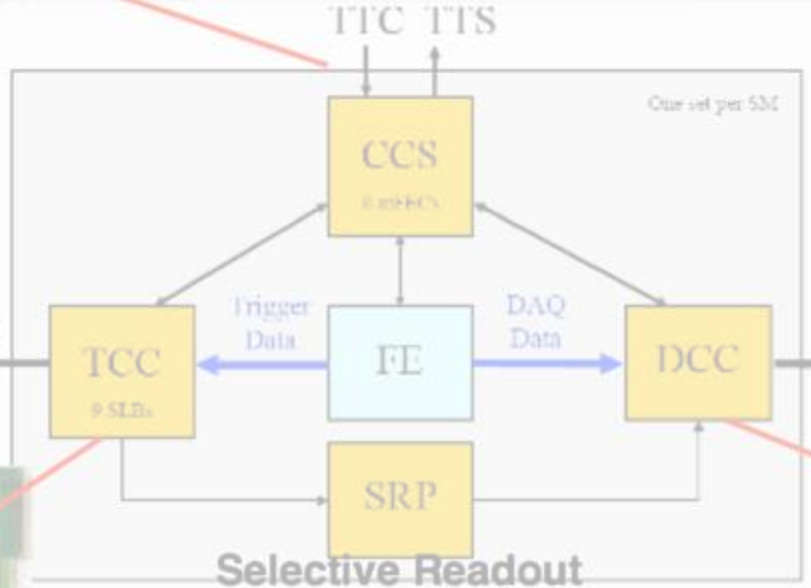
Trigger Concentrator Cards (TCCs) receive FE card trigger primitives

TCCs send trigger tower energy sums to Regional Calorimeter

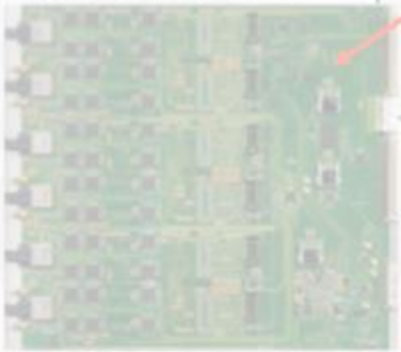
Data Concentrator Card (DCC) reads FE data and TCC information upon L1 accept; performs data reduction and transfers to DAQ

Only 70% area can be used for something useful!

Clock & Control System Card (CCS)

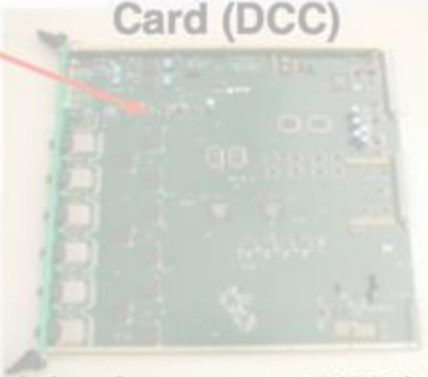


Trigger Concentrator Card (TCC)



Selective Readout Processor (SRP)

Data Concentrator Card (DCC)



(also known as FED)

TTC: Trigger and Timing Card
TTS: Trigger Throttling System
mFEC: mezzanine Front End Controller card (connects to FE card via token ring)
SLB: Synchronization and Link Board mezzanine

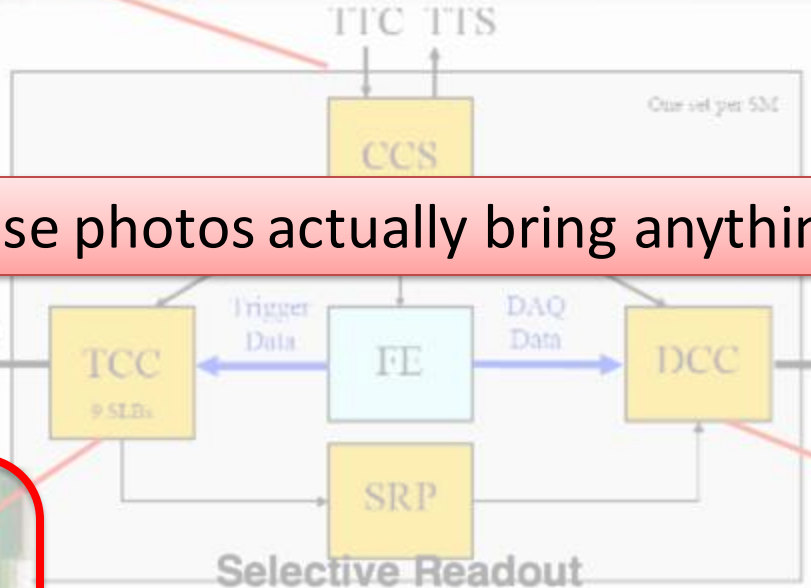
ECAL Electronics Chain

Clock & Control System Card (CCS)

Trigger Concentrator Cards (TCCs) receive FE card trigger primitives

TCCs send trigger tower energy sums to Regional Calorimeter Trigger (RCT) at 40 MHz

Data Concentrator Card (DCC) reads FE data and TCC information upon L1 accept; performs data reduction and transfers to DAQ



Do these photos actually bring anything useful?

Trigger Concentrator Card (TCC)

Selective Readout Processor (SRP)

TTC: Trigger and Timing Card
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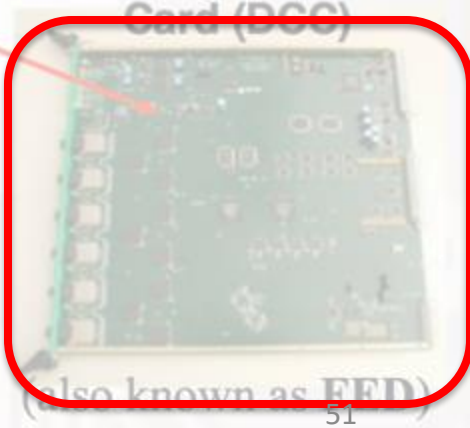
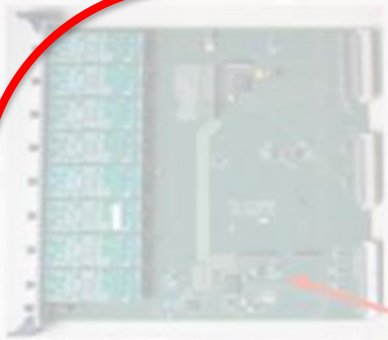


(also known as FED)

ECAL Electronics Chain



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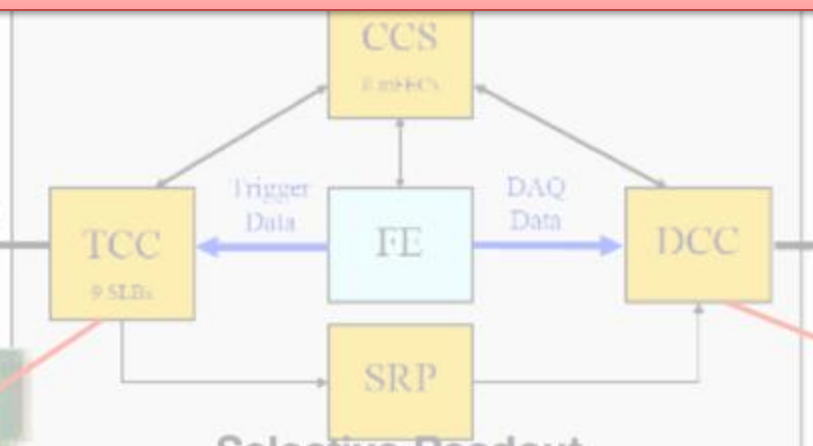
Clock & Control System Card (CCS)

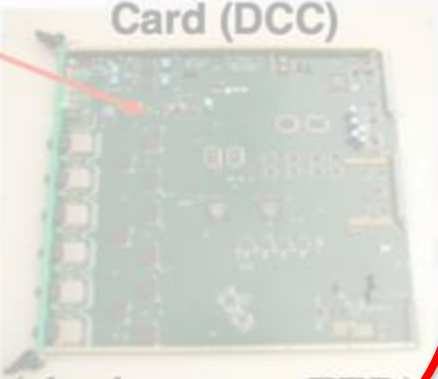
Background image is distracting



Trigger Concentrator Card (TCC)

Selective Readout Processor (SRP)

Data Concentrator Card (DCC)



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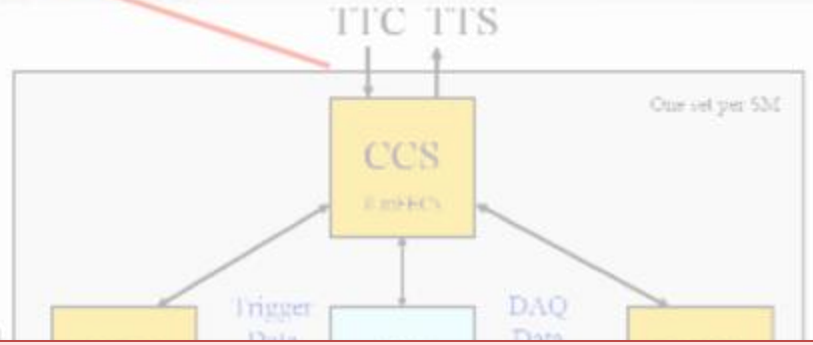

Trigger Concentrator Card (TCC)

Concentrator Card (DCC)

So many abbreviations - need a glossary! People will read this and perhaps miss the main message!

Processor (SRP)

TTC: Trigger and Timing Card
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(also known as FED)

ECAL Electronics Chain

Clock & Control System Card (CCS)

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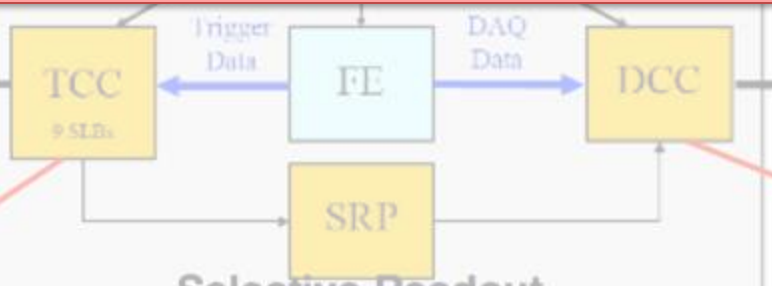
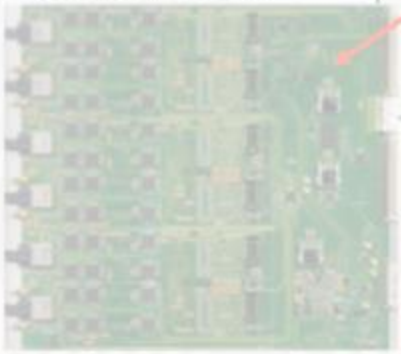
Data Concentrator Card (DCC) reads FE data and TCC information upon L1 accept; performs data reduction and transfers to DAQ

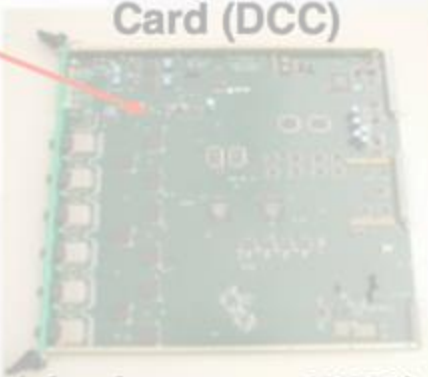
Where should the audience look?
What is important?
Where is the message?



Trigger Concentrator Card (TCC)

Selective Readout Processor (SRP)





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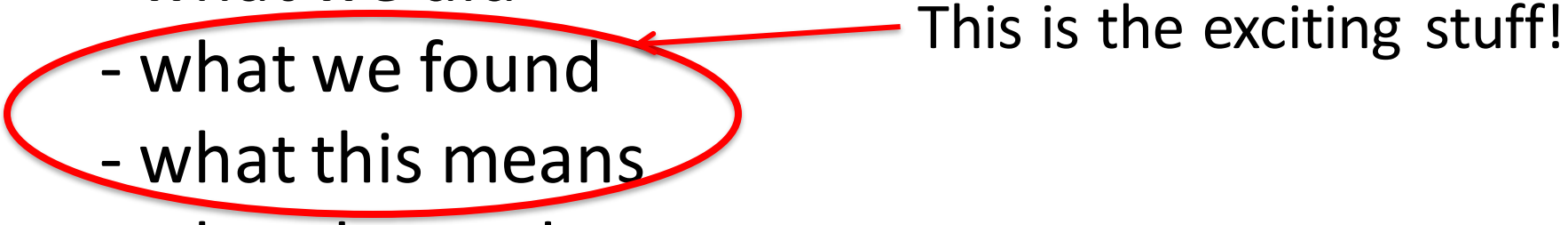
GUIDELINE 4:

MAXIMIZE YOUR S/N RATIO!

Content ordering

Most presentations follow a standard format:

- title
- overview of talk
- what we did
- what we found
- what this means
- what do we do next



Higgs-discovery talk

https://indico.cern.ch/event/197461/contributions/1478916/attachments/290953/406672/ATLAS_Higgs-CERN-seminar-2012.pptx

But compare to a newspaper…

Trump back-pedals on Russian meddling remarks after outcry

Republicans and Democrats attack president's comments in press conference with Putin

Opinion: Republicans followed Trump off a cliff of treachery

▲ Trump backflips on Russia interference - video

Donald Trump sought to partially reverse course on Tuesday in the face of furious, bipartisan criticism of his public undermining of US intelligence agencies during a press conference with Vladimir Putin in Helsinki.

The US president sought to bring closure after more than 24 hours of bitter recrimination by saying he had simply misspoke when he said in Finland that he saw no reason to believe Russia had interfered in the 2016 US election.

- Headline – get attention!
- Image – get attention!
- Give the main message(s)
- details
- links to more information

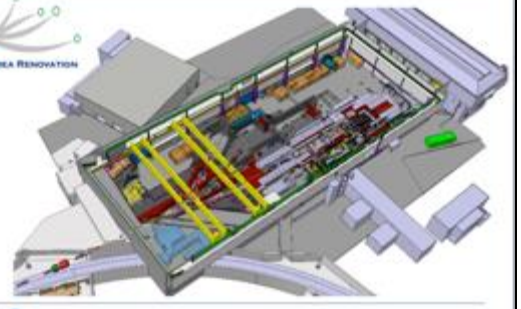
So how *could* the Higgs discovery have been announced?

GUIDELINE 5:

DON’T BE AFRAID TO BE DIFFERENT

How to finish a talk?

Thank you for your attention!



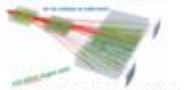
Thank you !

Questions ?


part of ATLAS detector waiting for beam in H8 (2004)


LHCb telescopes being tested in H8 (2015)


CALICE calorimeter @ H2 (2015)


ArrSc @ 150AGeV @ H2 @ NA61 run (2015)

Thanks for attention!

THANK YOU!

irradiation-facilities.web.cern.ch
Contact: Irradiation.Facilities@cern.ch

CERN

Thank you for your attention!

The end ! Thank you. Questions ?

Thank you

CMS

INFN

Thank you for your attention!

Università di Pisa

8th Beam Telescopes and Test Beams Workshop 2017, Barcelona 24-27 January 2017 15

Thank you for your attention

The authors gratefully acknowledge the financial support from the projects
"AIDA-2020-TA", "MSMT INGO II, č. LG15052", "MSMT č. LG1305 (RCPTM-NPU)",
"MSMT č. LM2015058", "IGA no. PrF/2016/002"

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Thanks

Thank you for your patience ...

... unlikely many many issues not covered:

- signal formation and digitization
- readout
- buses
- hw configuration
- hw control
- sw configuration
- sw control
- monitoring
- ...

How to finish a talk?

Could include in a summary an overall “so what”?

And what about posters?

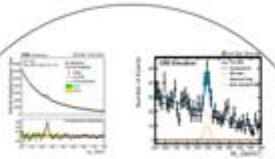
Even more important to grab the attention as you do not have a captive audience!

A poster is essentially an abstract for a paper: summarize main points and show reader where to get more information

The CMS ECAL Upgrade for Precision Crystal Calorimetry at the HL-LHC

SCINT2017
Chamonix - France

Arash Jofrehei
on behalf of CMS Collaboration
arash.jofrehei@cern.ch



Physics Motivation

Mass resolution with ~1% precision crucial for discovery of Higgs boson.

Analyzing di-Higgs production will shed light on vacuum stability of universe.
+
many other beyond standard model studies

End Caps

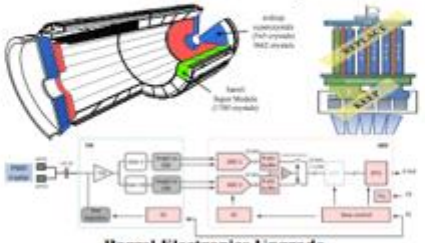
- cumulative hadron damage
- fission tracks: transparency loss
- fully replaced by HGCal
- no pre-shower

Dark Current

- APD hadron damage
- gets worse in HL-LHC
- cooling from 18 to 9 °C
- 35% noise reduction

ECAL Legacy

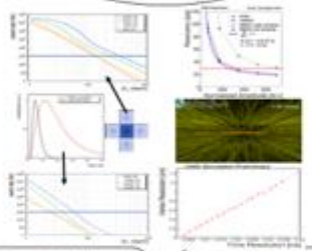
5x5 arrays of crystals
APDs in barrel
Vacuum Photo Triodes in end caps
5 identical Very Front End readouts
one Front-End (FE) card for transmission
separate readout per channel, triggered by overall sum
40 MHz sampling ADC with 3 gains



Barrel Electronics Upgrade

faster optical links (4 fibers needed) – No buffer
single crystal trigger primitive
160 MHz sampling with two gains
mitigate dark current, out-of-time pile up, spikes
precision timing is possible

For further details, please refer to TDR-17-002 which will come out soon.



Spike Rejection

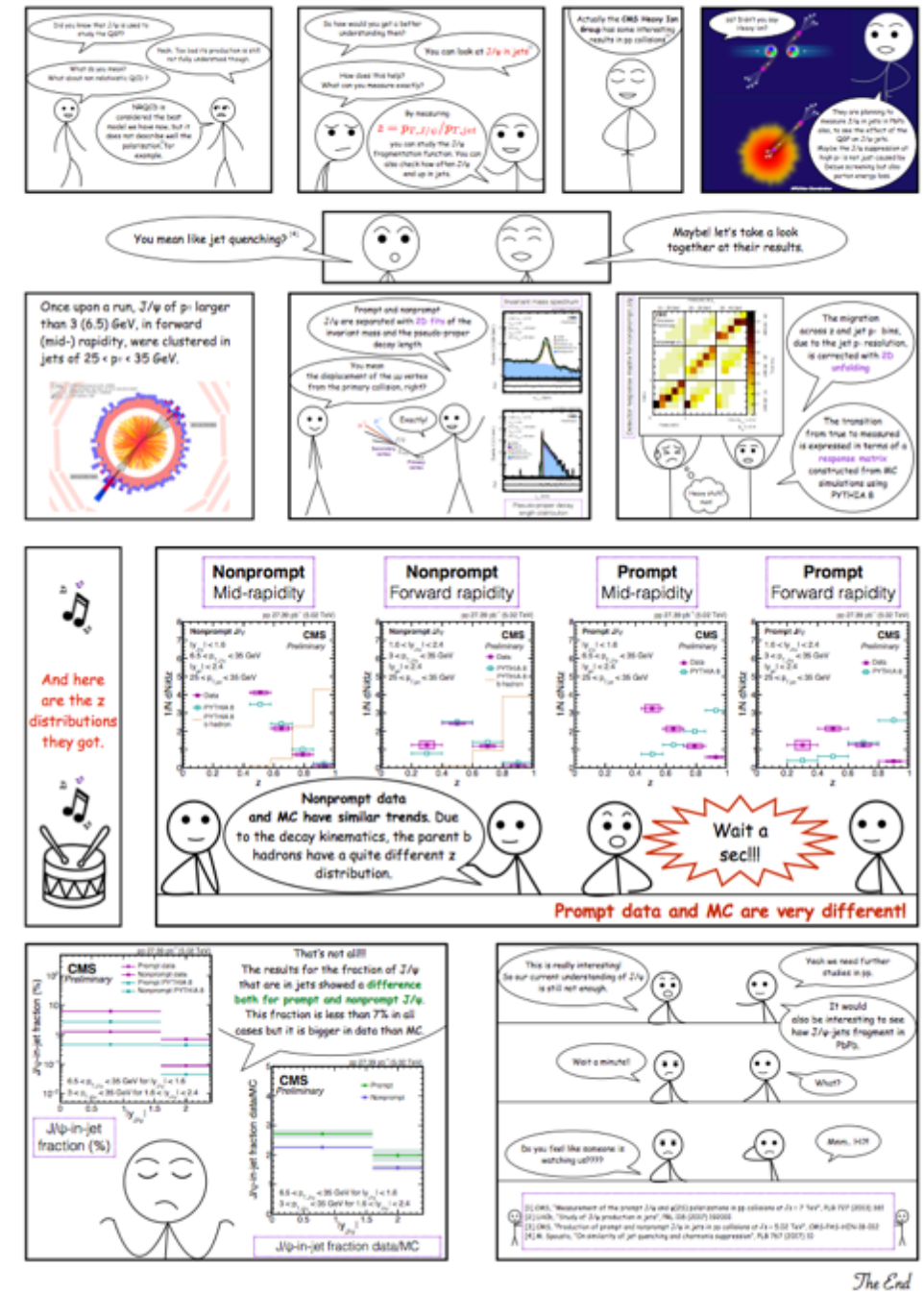
energy deposit in the APD bulk
EM-shower-like but faster
currently rejected by topological cuts
single crystal triggering + pulse shape discrimination will be added

Precision Timing

higher sampling rate
measuring time-of-flight from vertices
precise vertex discrimination
precise angle between di-photons
enhancing mass resolution

Fragmentation of jets into J/ψ with CoMicS

Batoul Diab

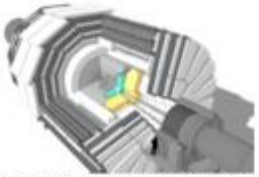


The Silicon Sensors for the High Granularity Calorimeter of CMS

Peter Paulitsch on behalf of the CMS collaboration

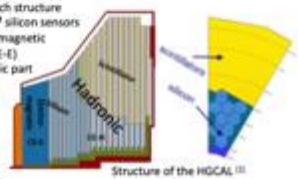
Background

The High Luminosity LHC (HL-LHC) will have a factor 5 higher instantaneous luminosity compared to the end of LHC operation, resulting in a proportionally higher event rate and a factor 10 increase of integrated luminosity (3000 fb^{-1}). Therefore, unprecedented levels of radiation and particle shower densities will affect experiments such as CMS. To address these challenges, the CMS collaboration will replace the existing endcap calorimeters with a new High Granularity Calorimeter (HGCAL) during the Phase-II Upgrade, around 2024-2026, which will include more than 600m^2 of silicon sensors to allow efficient mitigation of pileup and facilitate particle-flow calorimetry.



Location of the HGCAL at the CMS experiment [1]

- Sandwich structure
- >600m^2 silicon sensors
- Electromagnetic part (CE-E)
- Hadronic part (CE-H)



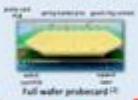
Structure of the HGCAL [1]

Sensor design

- **8" wafers**, two cell densities (LD/HD)
- Thicknesses 120, 200, 300µm to cope with different levels of radiation
- 8" process is a **new experience** in HEP, important differences from well-known 6": oxide charges, oxygen concentration of bulk, and fragile thin metal backside of 8"
- **Hexagonal shape**: A hexagon is the largest tileable, regular shape on a circular wafer
- Sensing elements are hexagonal, n-in-p, **DC-coupled** diodes
- Additional smaller, circular calibration diodes with lower capacitance to maintain MIP sensitivity after 3000 fb^{-1}
- Two guard rings (biased+floating)

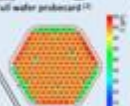
Sensor testing

- Laser-TCT for charge collection efficiency
- Sensors DC-coupled, no common biasing
- ☹ Single, consecutive diode measurements do not represent IVCV situation on module
- ☺ **Full wafer probecard with spring-loaded pins**

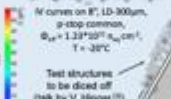


Full wafer probecard [2]

IV curves on 8", LD-300µm, p-stop common, Φ_{eq} = 1.33*10^{15} n_{eq}cm^{-2}, T = -20°C



Test structures to be diced off (talk by V. Hinger [3])

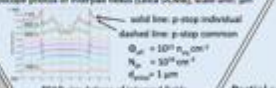


Cell capacitance 8", 300µm, p-stop individual

Interpad structure

- **Metal overhang** to move peaks in E fields into oxide
- p+ implants (**p-stops**) to increase interpad resistance
- Two p-stop geometries under investigation: common and individual

microscope photos of interpad nexus (Leica DCM8), scale unit: µm



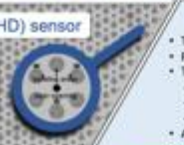
TCAD simulations of interpad fields

Low-Density (LD) sensor

- 192 diodes/sensor
- Full diodes: 1.1cm^2
- 200 and 300µm active thicknesses (float-zone)

High-Density (HD) sensor

- 432 diodes/sensor
- Full diodes: 0.5cm^2
- 120µm active thickness (epitaxial)



"mousebites" for mounting purposes

Partial sensors

- Endcap is circular → partial sensors provide better coverage of inner- and outermost regions, as well as the boundaries between silicon and scintillator parts
- Common design from which different versions can be diced
- Dicing streets and full periphery in the **middle** (!) of sensor

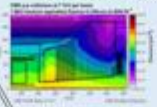
Types of partial sensors

Partial sensor type "Three"

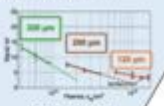
Partial sensor type "Three"

Radiation hardness

- Total Ionizing Dose up to 2 MGy
- Fluence Φ dominated by neutrons (90%)
- Three sensor types for different Φ regions
  - 120µm (HD): 1x10^{16} n_{eq}/cm^2
  - 200µm (LD): 2.5x10^{15} n_{eq}/cm^2
  - 300µm (LD): 5x10^{14} n_{eq}/cm^2
- A full campaign was done on 6" sensors



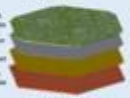
FLUKA study on expected hadron fluences during 10-year operation of the HGCAL [1]



Signal (ke-) from TCT measurements for different sensor thicknesses and fluences, 400V [4]

Outlook

- > 600m^2 sensors will be produced and tested by **Hamamatsu Photonics**, CMS collaboration will test 2-5%
- **30,000 modules** will be assembled by CMS institutes



Module stack [4]

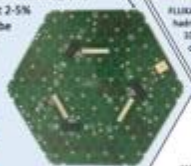
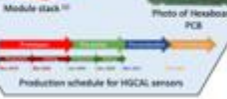


Photo of Hexaboard PCB



Production schedule for HGCAL sensors

About the author

Peter Paulitsch
Institute of High Energy Physics
of the Austrian Academy of Sciences
Nikolsdorfer Gasse 18, A-1050 Vienna
peter.paulitsch@cern.ch
Tel.: +43 (1) 5447328 - 41

References

[1] CMS Collaboration, *The Phase-2 Upgrade of the CMS Endcap Calorimeter, Technical Design Report*, 2017

[2] E. Brondolin et al., *ARRAY: An open source, modular and probe-card based system with integrated switching matrix for characterisation of large area silicon pad sensors*, Nucl. Instrum. Methods A 8940 (2019) pages 168-173

[3] V. Hinger, *Process quality control strategy for the Phase II upgrade of the CMS tracker and endcap calorimeters*, HSTD12, 2019

[4] M. Valentan, *The CMS high granularity calorimeter for the high luminosity LHC*, Nucl. Instrum. Methods A A936 (2019) , page 103

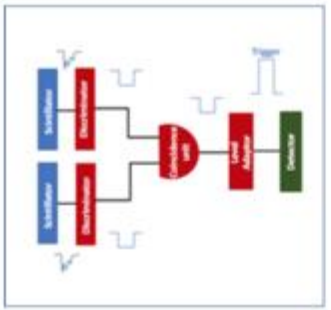
High Granularity Calorimeter NIM Replacement

kathryn_aggie Following ...

6 posts 50k followers 100 following

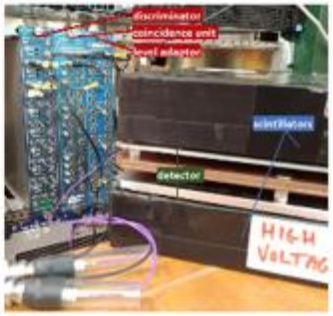
Kathryn Coldham & Agustina Quesada

Queen Mary University of London & Johns Hopkins University
kathryn.coldham@cern.ch & agustina.quesada@cern.ch
Supervisor: Dr. Dave Barney
Acknowledgements: Thanks to Dave Barney & Paul M. Rubinov!



45,120 likes

kathryn_aggie 1 Nuclear Instrumentation Modules (#NIM) are electronics modules used for triggering in data acquisition. An example of their usage is to create a trigger when a particle is incident on scintillators. If an input signal in the scintillators is above a certain threshold voltage, a NIM called a #discriminator converts the signal into a square wave output, removing any unnecessary information. The #coincidence #unit NIM then triggers when input signals from multiple scintillators are simultaneous, indicating that the signals are not likely to be noise. Finally the #level #adaptor formats the signal to send a trigger to a detector, for example a calorimeter.



42,102 likes

kathryn_aggie 2 An image of the NIM setup is shown above. There are several #disadvantages associated with NIMs. The NIM system is quite bulky and not convenient for transportation. Also, the module parameters must be manually adjusted; there is no computer system to remotely take care of this. During precious beam test time, the beam must be stopped to adjust module parameters. Beam time is expensive and only a certain amount is allocated per project. Therefore, it would be convenient to replace the NIM system with something smaller and more transportable that can alter parameters easily and remotely. In addition, this new system could be easily reproduced in laboratories around the world.

39,656 likes

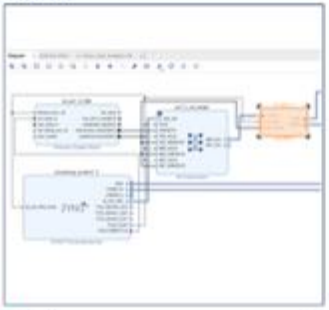
kathryn_aggie 3 A #NIM+ can replace NIMs, as was proposed at Fermilab by Lorenzo Uplegger. The NIM+ contains a ZedBoard and a custom discriminator. With approximate dimensions of 13 cm by 23 cm, it is much smaller than the existing NIMs so will be easier to transport. In addition, parameters can be adjusted using a computer system, making the use of the NIM+ much more efficient.

kathryn_aggie Biery, K *et al.* *The Fermilab Test Beam Facility Data Acquisition System Based on otsdaq.*

36,396 likes

kathryn_aggie 4 The #ZedBoard is a #computer with a Zynq All-Programmable System on a Chip (#APSoC). This incorporates a Processing System (#PS) that uses an ARM processor and Programmable Logic (#PL) that is #FPGA based. This enables it to handle two types of processing: the PL is useful for deterministic, high-speed processing while the PS can run software and an operating system.

kathryn_aggie Crockett, L *et al.* (2014). *The Zynq Book.* Scotland: Strathclyde Academic Media.



32,009 likes

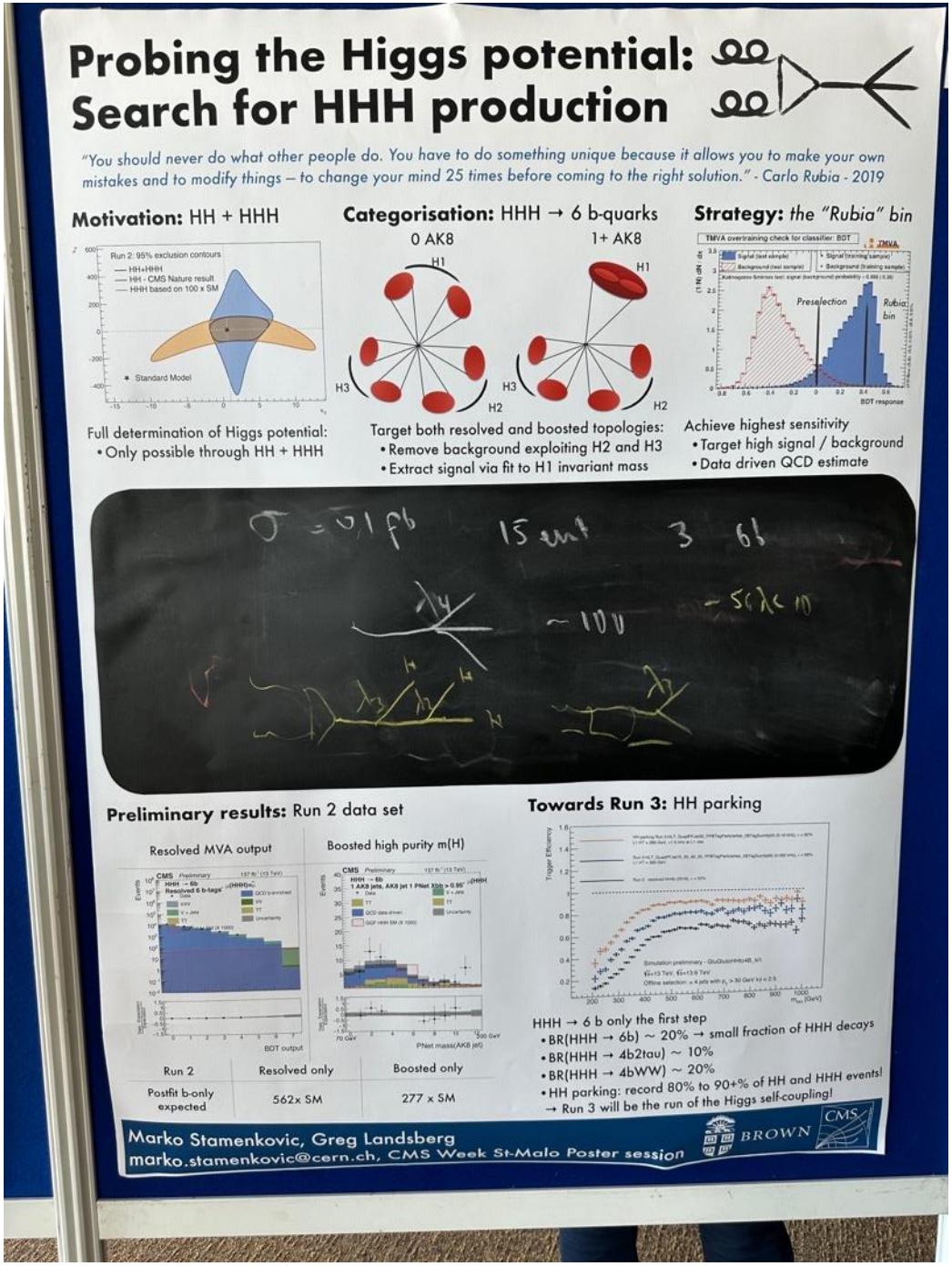
kathryn_aggie 5 #Vivado is being used to program the Zynq APSoC, so the NIM+ can replace the NIM system. The FPGA-based PL provides the flexibility to create the necessary #peripherals for the project. Shown in the image is a #block #diagram with an added peripheral (highlighted in orange).

kathryn_aggie Xilinx (2018). *Vivado Design Suite Tutorial.*

29,794 likes

kathryn_aggie 6 As an example, this NIM+ replacement can be used in High Granularity Calorimeter (#HGCAL) testing. The photograph shows the NIMs as part of the test set-up. HGCAL will replace the CMS detector endcaps, to survive the tough radiation environment and high pileup of the High-Luminosity LHC.

kathryn_aggie CMS Collaboration (2018). *The Phase-2 Upgrade of the CMS endcap calorimeter Technical Design Report.* CERN.



The "blackboard" part is real – stuck on to the poster. Presenter can interact with people whilst describing the poster!

Guideline #1:

the presentation is for the audience

Guideline #2:

focus on your main messages

spend 70% of your time in planning; 30% in using ppt

Guideline 3:

don't make the audience work too hard to understand plots/figures

Guideline #4:

maximize your s/n ratio (& don't be afraid to use more slides!)

Guideline #5:

Don't be afraid to be different

Exercise 3: Working **in pairs**: you have ~15 minutes to produce a max. 3-minute presentation with max. 5 slides **based on another topic of your choosing!**
Include at least one plot and make sure your main messages are clear!
This could be a modification of an existing presentation you have made!

Send any slides to David.Barney@cern.ch using filename: **3_<Yourname>.<extension>**
I will choose some at random for presentation!

Guideline #1:

the presentation is for the audience

Guideline #2:

focus on your main messages

spend 70% of your time in planning; 30% in using ppt etc.

Guideline 3:

don't make the audience work too hard to understand plots/figures

Guideline #4:

maximize your s/n ratio & don't be afraid to use more slides!

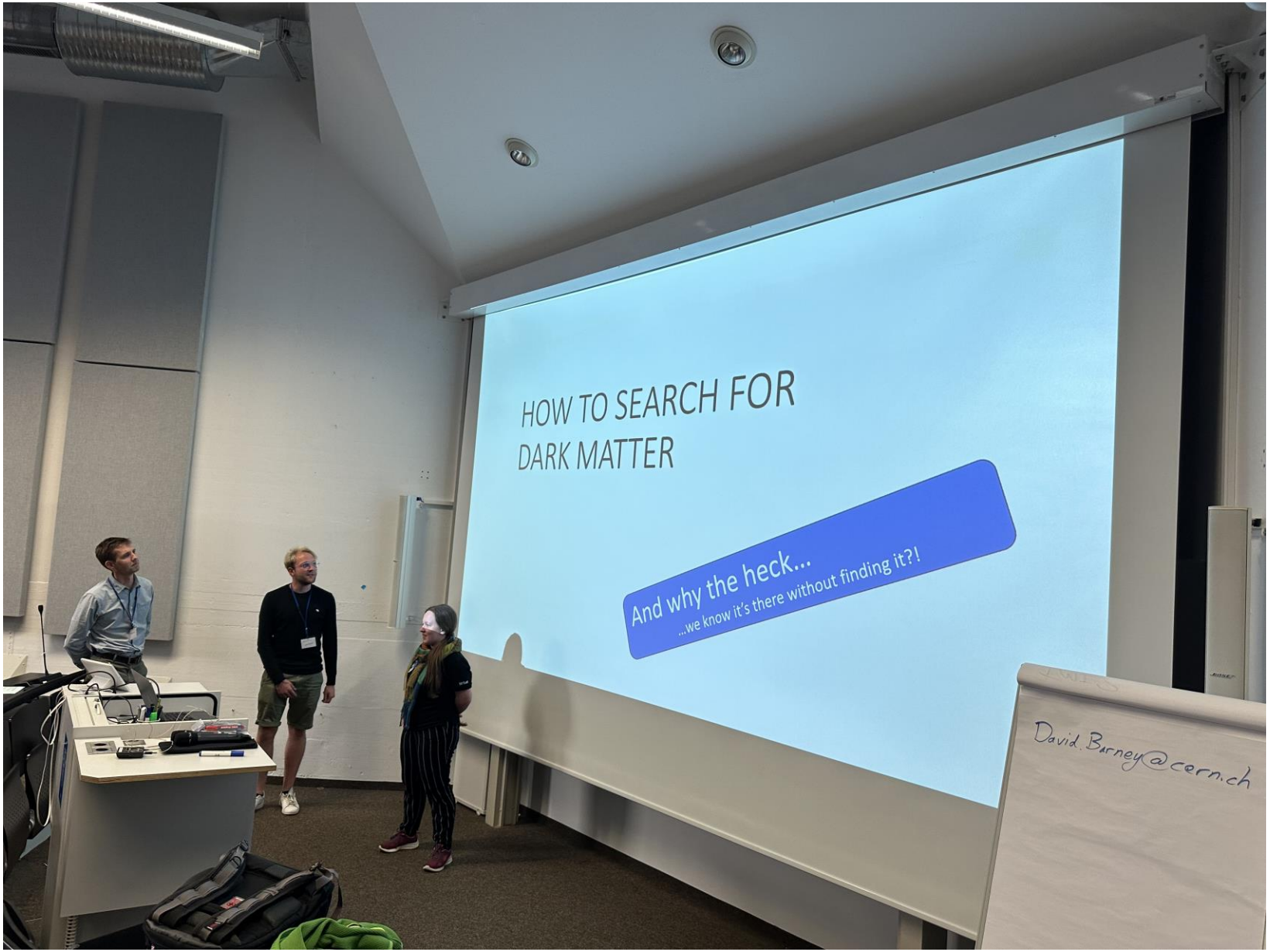
Guideline #5:

don't be afraid to be different

THANK YOU FOR STAYING AWAKE!

PARTICIPANT PRESENTATIONS

#1

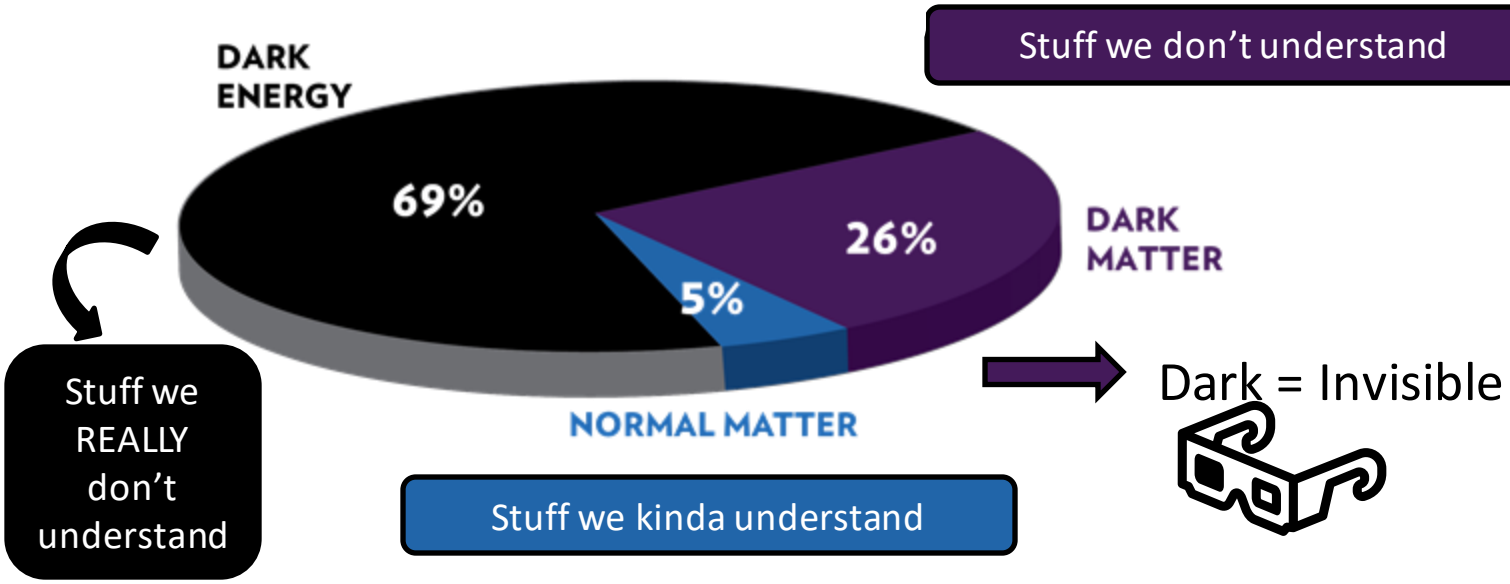

HOW TO SEARCH FOR
DARK MATTER
And why the heck...
...we know it's there without finding it?!
David.Barney@cern.ch


One way to find Dark Matter is cosmic 8-ball
8
Milky Way
galactic DM 'mist'
DM
Earth
Detector
detection medium
nucleus
recoil nucleus
Photons
Phonons
Electrons
7
David.Barney@cern.

HOW TO SEARCH FOR DARK MATTER

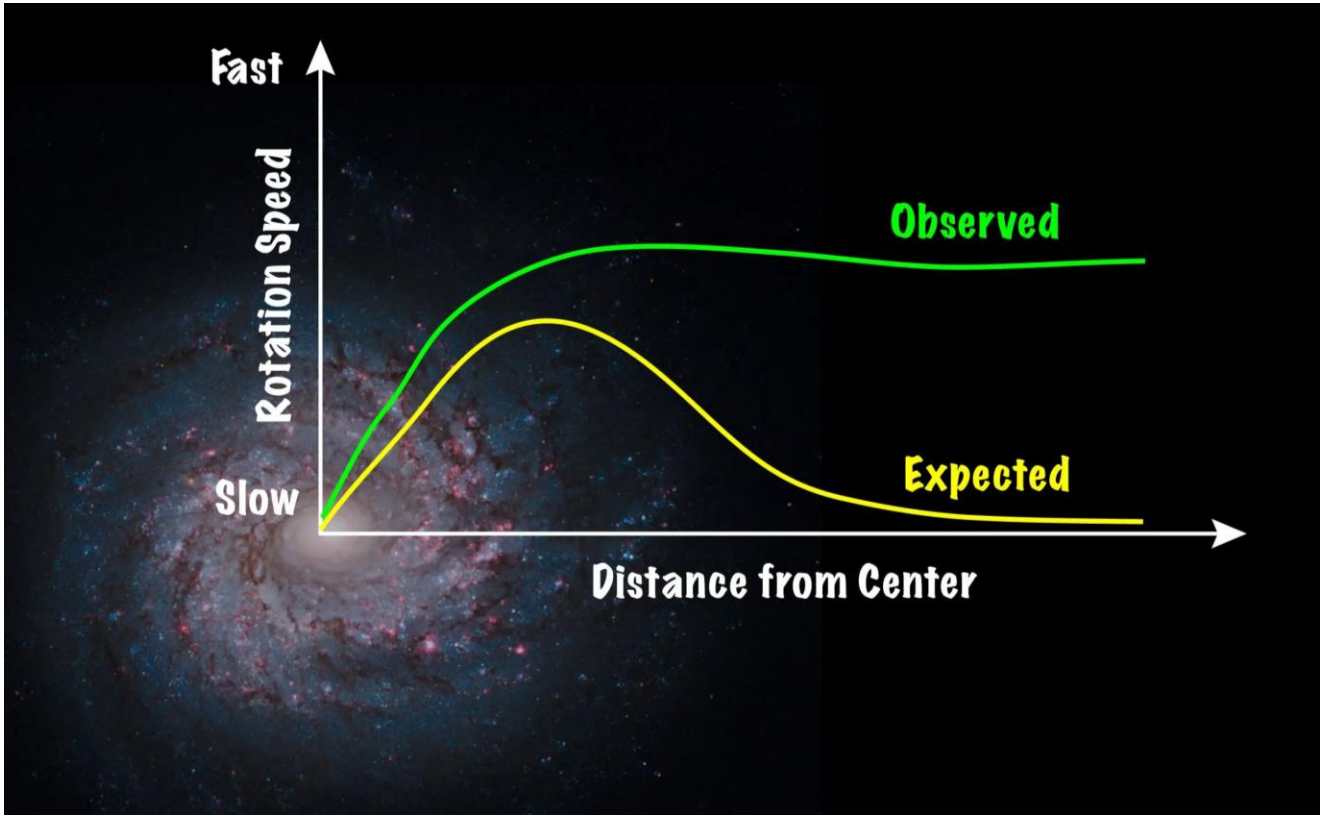
Dark Matter is 26% of the universe energy

but we [illegible] what it is

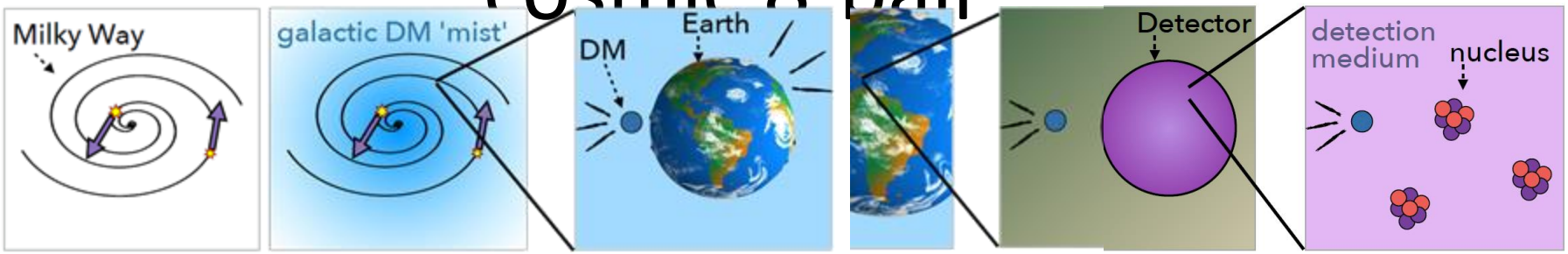


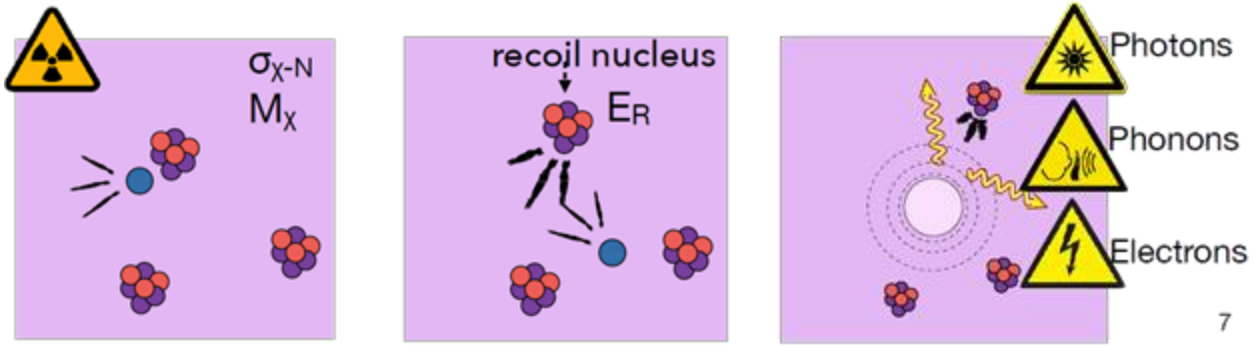
Pie chart taken from physconomics blog

Rotation Speed proves there is missing mass

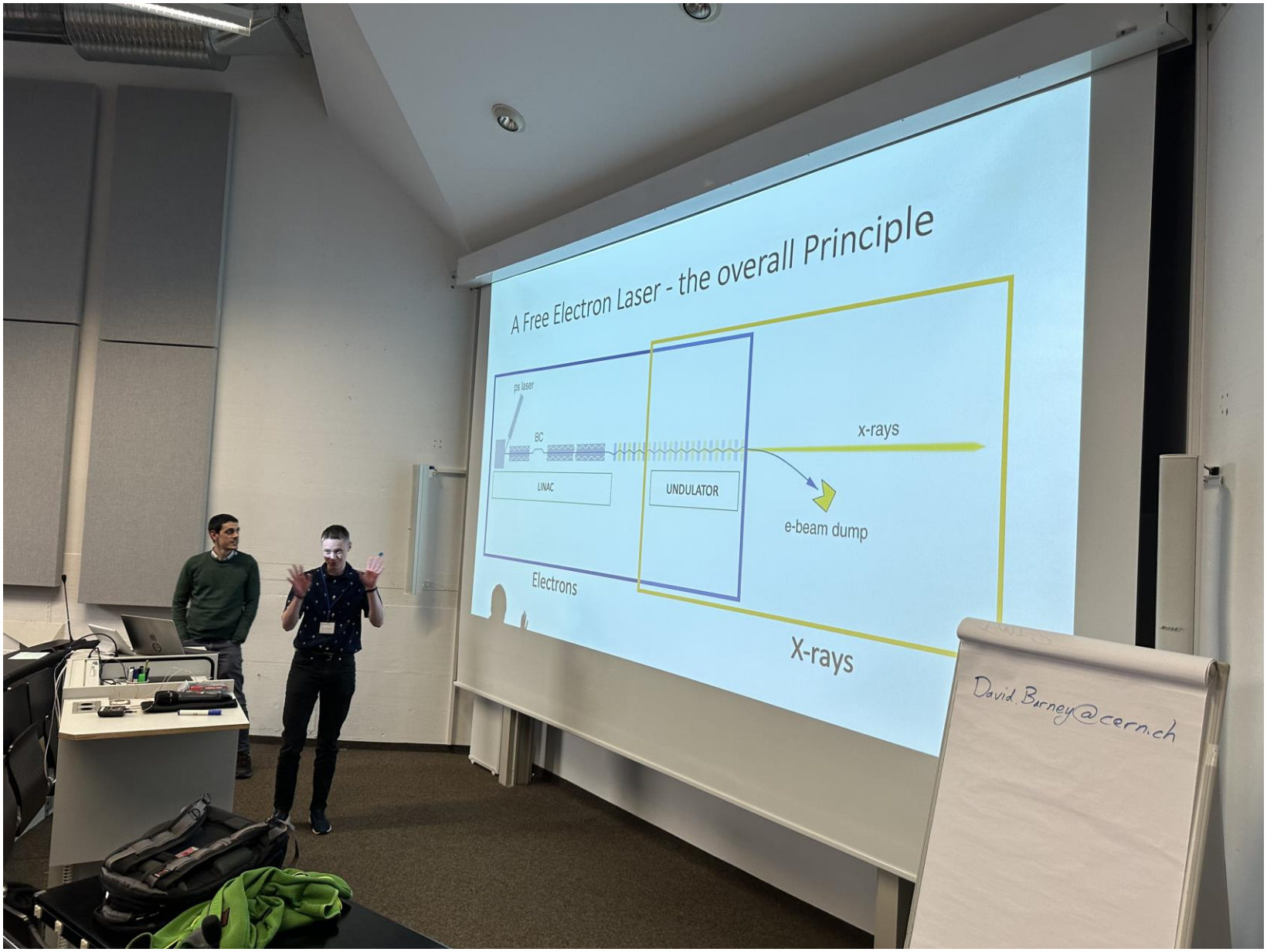


One way to find Dark Matter is cosmic 8-ball



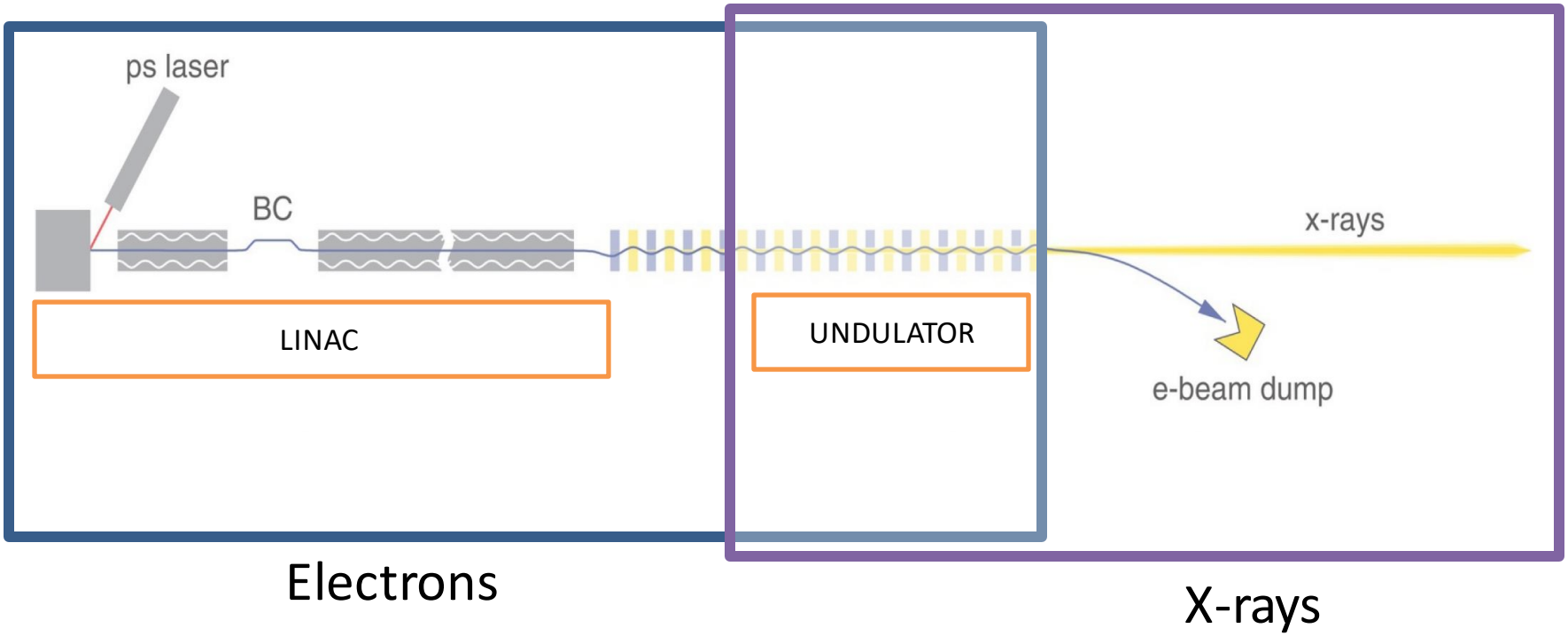


#2

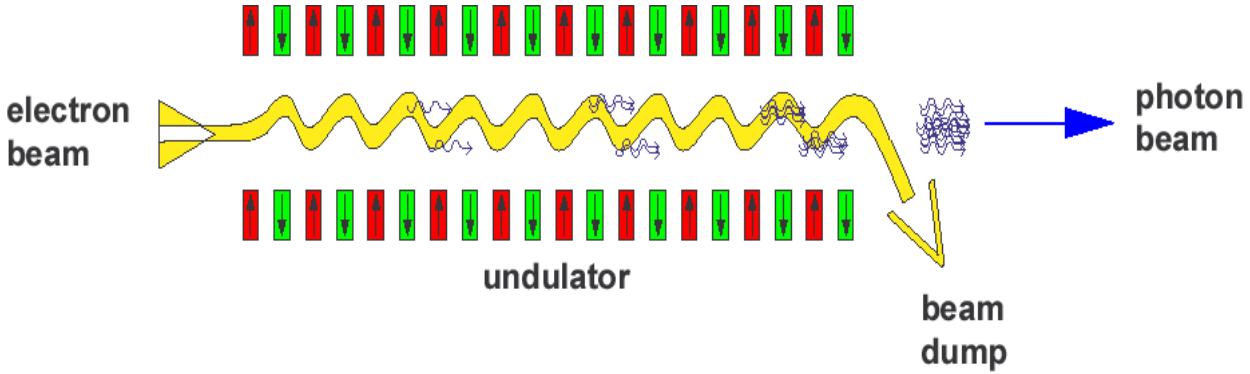

A Free Electron Laser - the overall Principle
ps laser
BC
LINAC
UNDULATOR
x-rays
e-beam dump
Electrons
X-rays
David.Barney@cern.ch

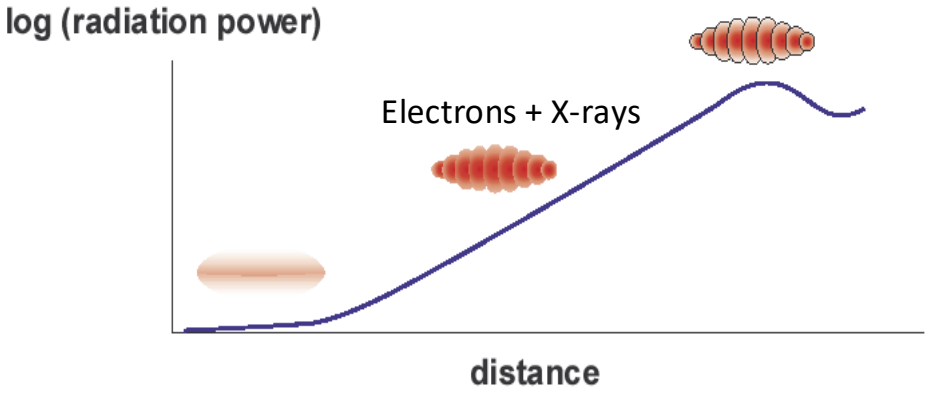
How does Free Electron Laser generate light?

A Free Electron Laser - the overall Principle



Microbunching → coherent light



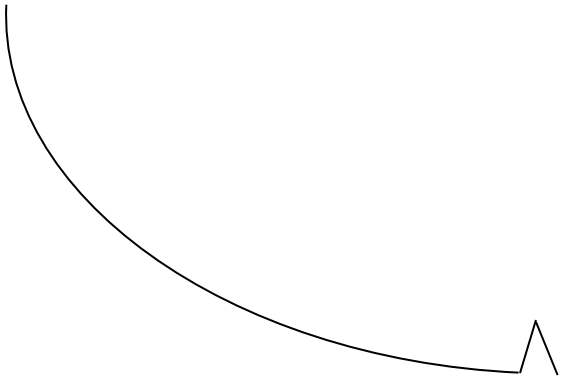



The attention span of people during a presentation
Richard & Ulrich

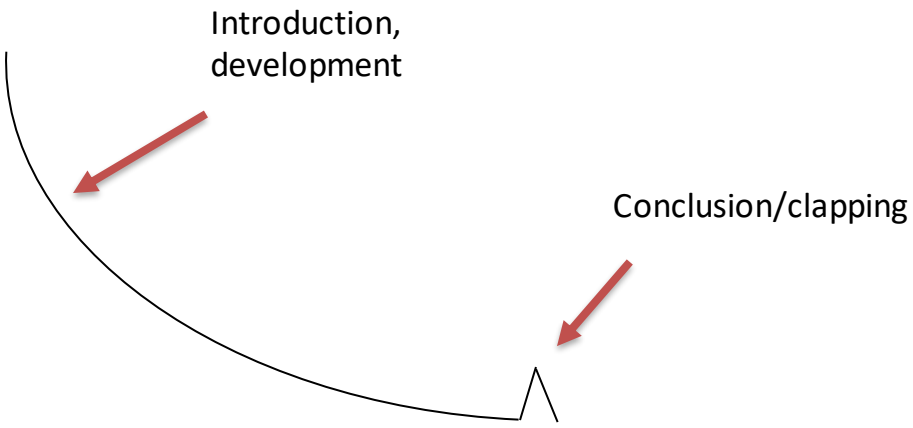
#3

The attention span of people during a presentation

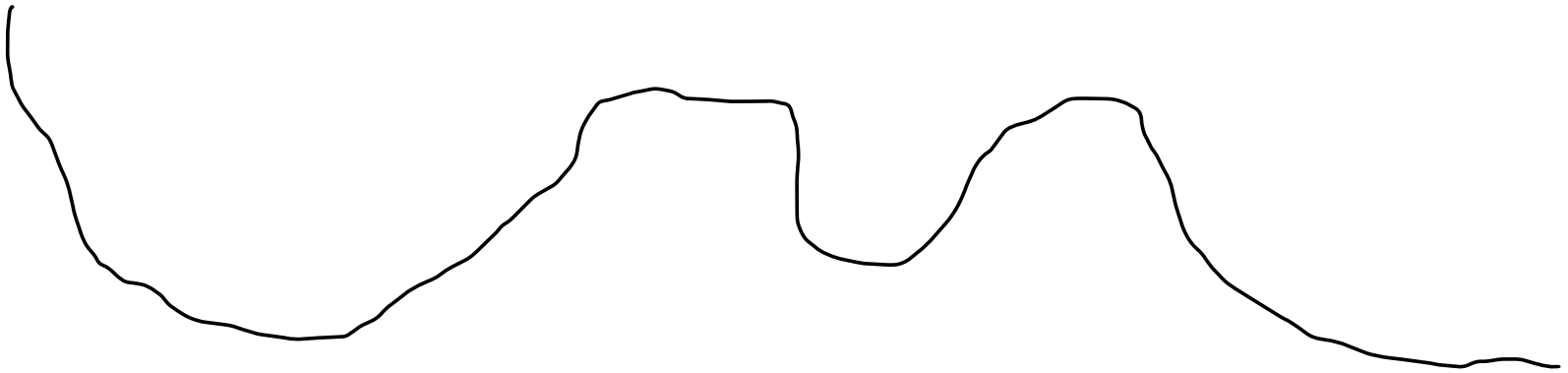
Richard & Ulrich



If nothing is done, the audience loses interest



We need to capture and keep the audience's attention



What do you think?

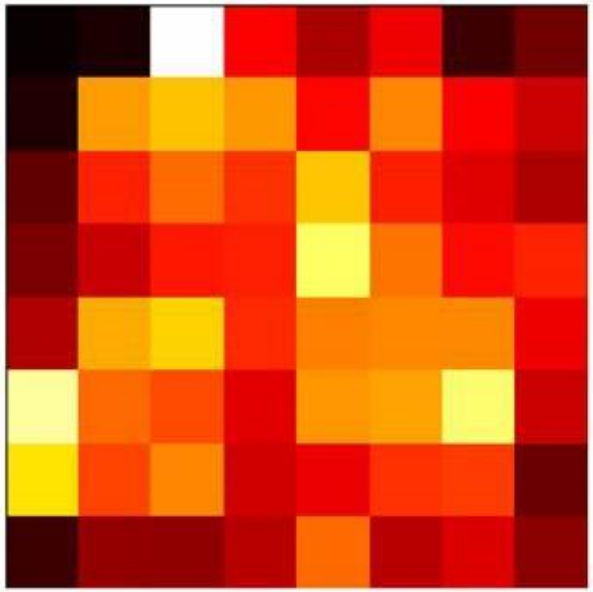
#4


Is Munich under threat
by sea level rise?
David.Barney@cern.ch

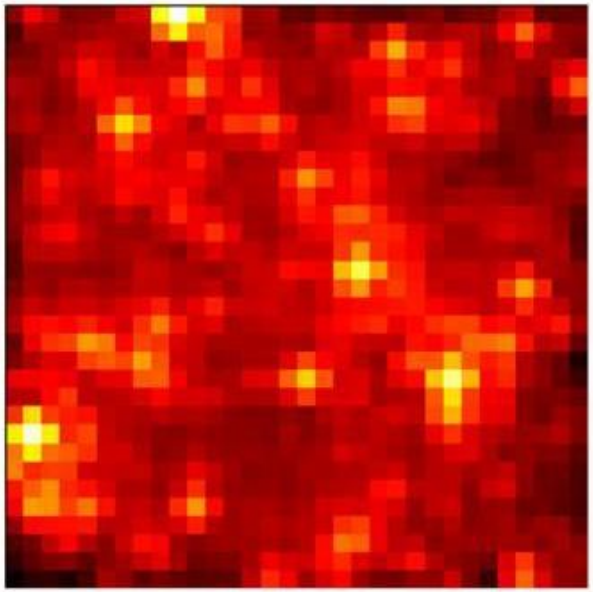
#5


140 M
120 M
100 M
80 M
60 M
40 M
20 M
ELT is big!

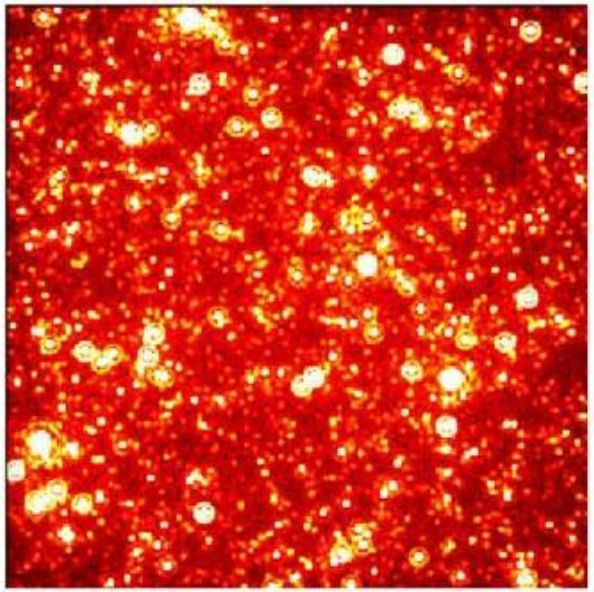
HST / WFC3



JWST / NIRCam



ELT / MICADO




We might finally see it

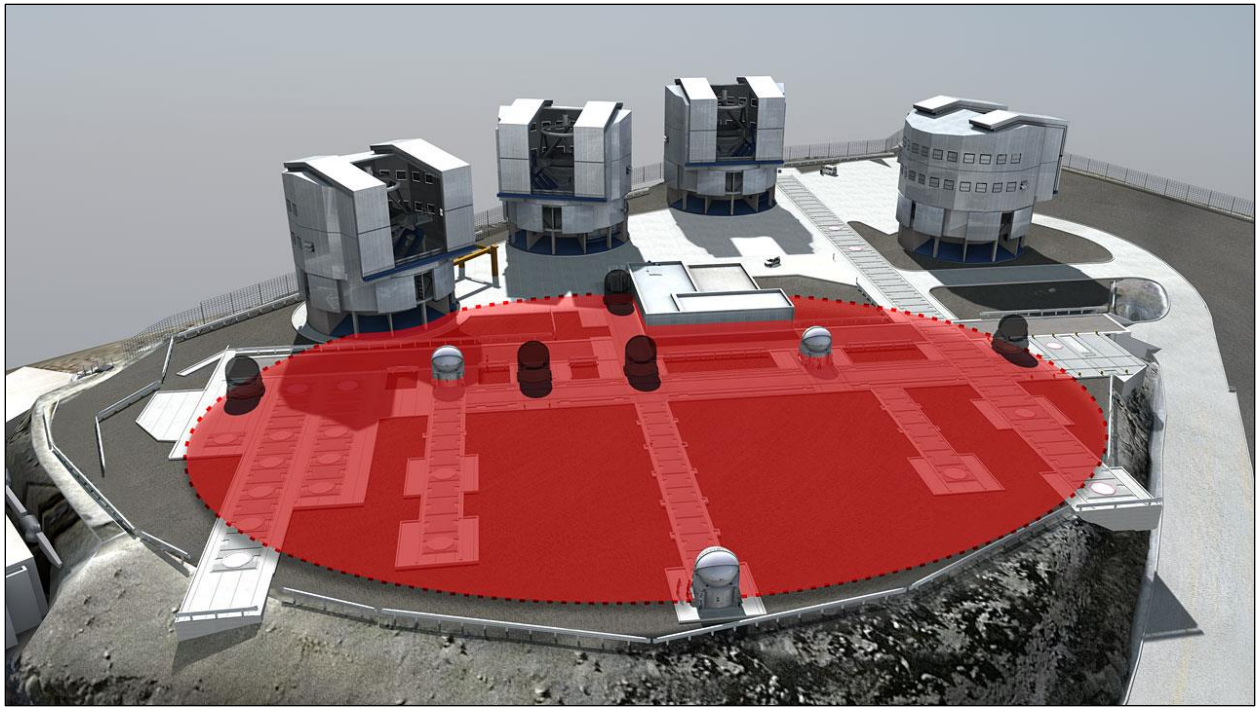
#6

GRAVITY PLUS: Upgrade of GRAVITY Interferometer

GRAVITY instrument

The Beam Combiner Instrument during installation into the VLTI laboratory.
© MPE

Nobel Prize Project



Interferometry @ VLTI

Unit Telescope (UT) X 4
Mirror Diameter 8.20 m

Auxiliary Telescope (AT) X 4
Mirror Diameter 1.82 m

Virtual Telescope X 1
Mirror Diameter 140 m

Photo Credit: ESO; https://www.eso.org/public/teles-instr/technology/interferometry/

Improved AO Architecture of GRAVITY+

Photo Credit: ESO/Y. Beletsky; https://www.eso.org/public/teles-instr/technology/adaptive_optics/

Laser Guide Star:

Bright Reference Star can be artificially created using a laser.

Sodium Layer:

Laser excites the Neutral atoms of Sodium within Earth's Mesophere – 80 to 105 km

Many Sub-Systems:

- Deformable Mirror
- Laser Guide Star
- Delay Lines
- Wavefront Sensor

Wavefront Sensor for Improved Real-Time Distortion Correction

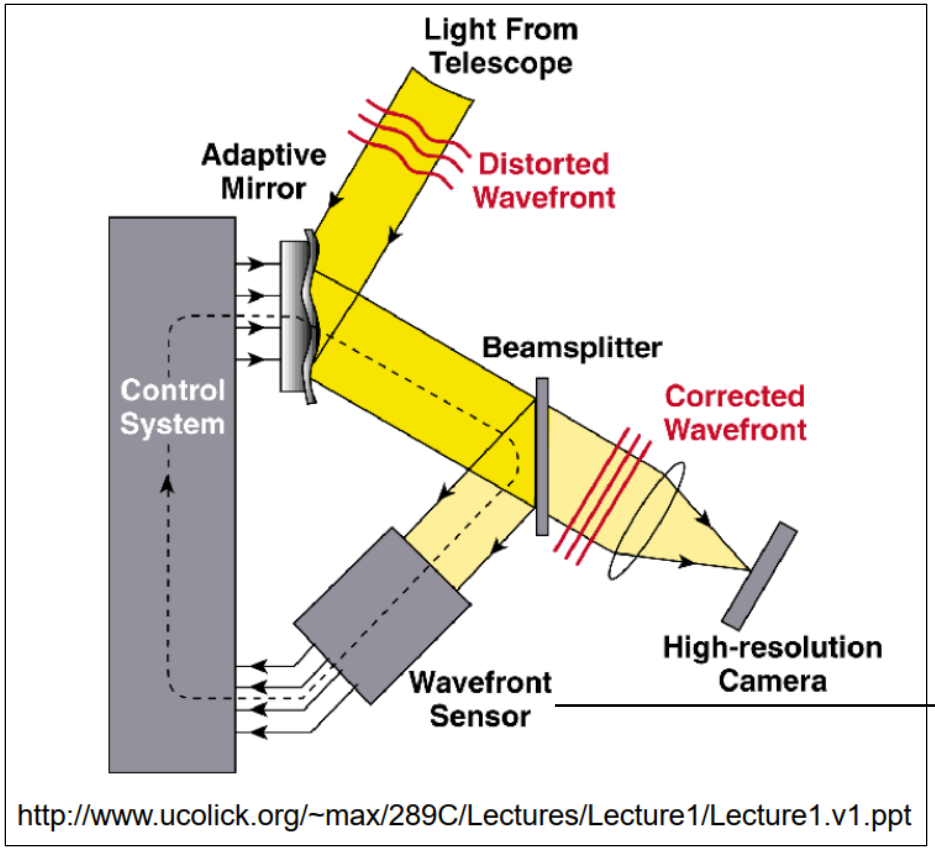


Fig.: Schematic of an Adaptive Optics System

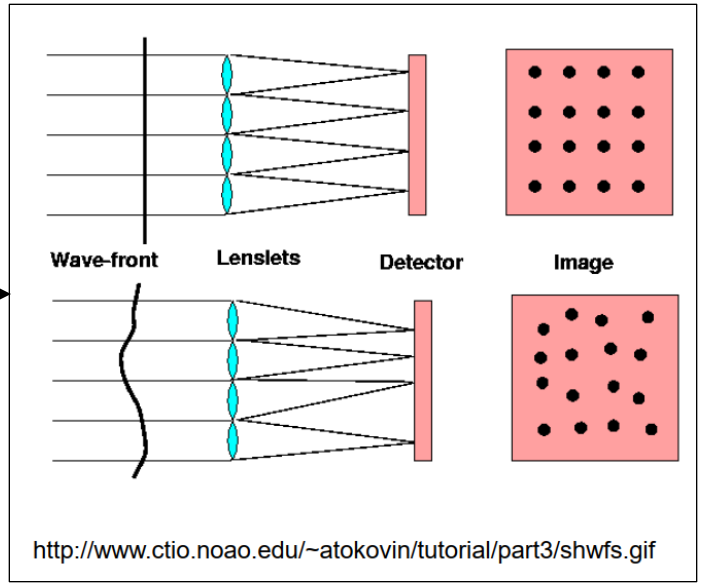


Fig.: Schematic of a Shack-Hartmann Wavefront Sensor

#7

Tribute to Concorde


Made in 70s
2,04 Mach


Speed
Concorde
A350
Development
year

It is not enough having the best technology available, success is related to safety and commercial viability

- Best technology ever
- Safety concerns
- Environmental concerns
- Not profitable enough for redesign


A350
AIRBUS