How Did the Big Bang Exhibition Work within Antenna?

Qualitative Evaluation with Science Museum Visitors

October 2007

Prepared for :
The Science and Technology
Facilities Council
in conjunction with
The Science Museum

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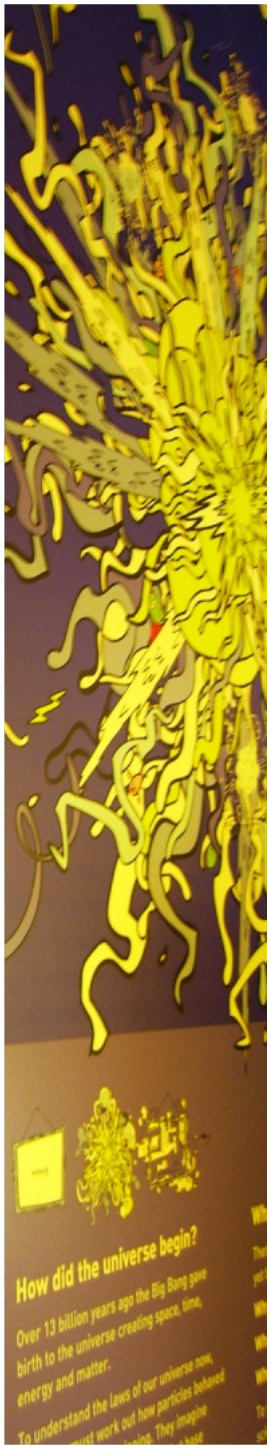


Contents

Aims and Objectives

Overall Aim

- To create understanding and interest in the LHC experiment and in the scientific questions it will address.

Evaluation Aims

- To understand what the exhibition communicates.
  - Top, single message.
  - How much of the message hierarchy.
- To explore the relevance of the agenda to visitors and their attitudes towards it.
- To evaluate how well the exhibition design works.
  - Title and expectations.
  - Physical layout.
  - Positive and negative features.
- To check whether visitors understand that this is an international project in which the UK is a contributor.
- To estimate the number of visitors who will have seen the Exhibition from April-October 2007.

Methodology • Qualitative

Two group discussions with visitors to the Exhibition.

- Independent, non-expert adults.
  Age 20-70 (6 per group, 1 hour 10 minutes)
- Teenagers 16-18 (7 per group, 1 hour)

Four accompanied visits with teenagers visiting the Museum.

- Age 13-16
  6 male, 7 female (20 minutes per visit)

Three accompanied visits with independent adults.

- Age 20s, 30s, 60s
  3 male, 3 female (45 minutes per visit)

Total sample for qualitative stage = 32.

All interviewed in depth.

Moderator • Susie Fisher

Date and location • Science Museum, October 2nd, 3rd 2007

Methodology • Quantitative

Estimating audience figures for Big Bang over its lifetime in Antenna.

The Principle

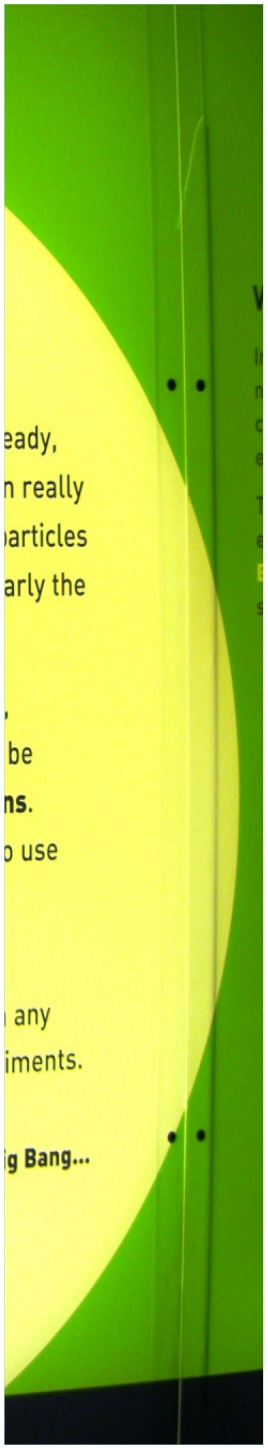
- Measure the number of visitors to Big Bang as a proportion of the total number of visitors to the Science Museum over a given period.
- Use measured visitor figures to Science Museum over April – October to estimate the total number of visitors to Big Bang.

Observation and counting periods

- October 2nd 1430-1600
- October 3rd 1100-1215
  1300-1415

Observers

Kenteas Brine (The Susie Fisher Group)
Susie Fisher (The Susie Fisher Group)
Alex Tyrell (Science Museum)



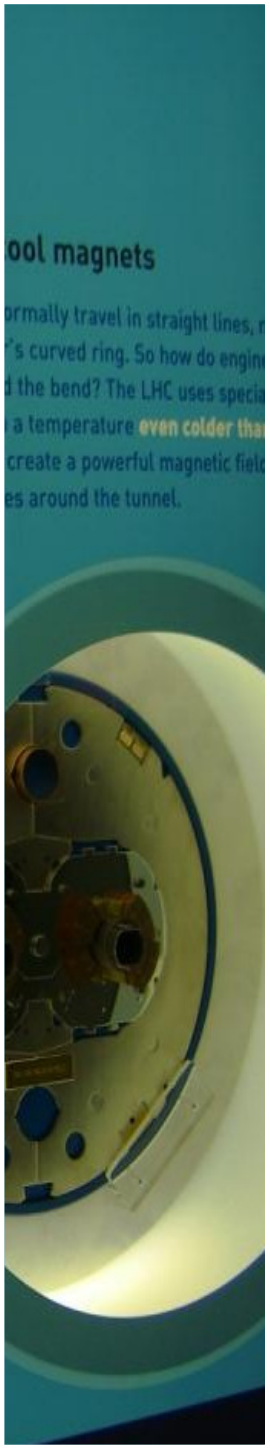
Stimulus Material

All respondents visited the Big Bang Exhibition itself.

Focus group respondents filled out

- bubble cartoons
- assessment forms.

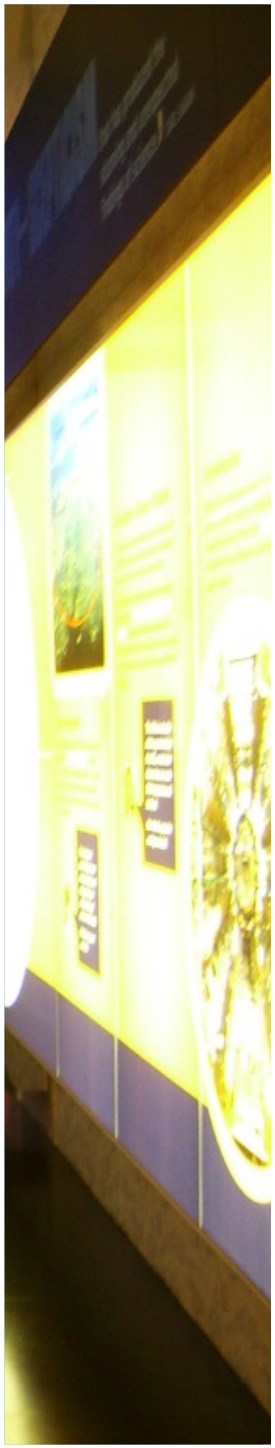
Photographs of the Exhibition were available as trigger material.



Overview I • Communication

- The Big Bang Exhibition succeeds in creating interest and a greater understanding of the LHC experiment at CERN, plus a sense of privilege at being kept up-to-date.
- The elements in the Exhibition message hierarchy are largely communicated but disappointingly they often remain fragmented in people's minds. People are not necessarily emerging with a coherent story.
- The key message to emerge is that there is much new activity at the Big Ring in CERN. Particles will be smashed together and may generate new particles which will help illuminate what happened in the Big Bang.
- Visitors are energised by questions about antimatter and dark matter but are unclear how the LHC experiment relates to them.

  Higgs Boson and mass are too difficult for most.
- Some audience reactions were unexpected.
  - Not hugely impressed by the **scale** of operations. Do they assume scientists can just **do** this sort of thing?
  - Not clear about exactly what the experiment is and what outcomes to expect.
  - Critical of running the Exhibition before there are any results to report.
  - Very exercised about risks and dangers to society. What if it all goes wrong?
  - Want to hear that positive good will come out of it.
- People tended to see scientists in a world apart. They tended to assume this project would be run by the usual suspects. International, financial, scientific.



Overview II • Displays

- Big Bang is an inviting, but misleading, title. Visitors do not feel they get to see the Big Bang in this Exhibition.
- The cube structure works well, of manageable length and not crowded.
- The exception is the corridor between the cartoon theory panel and the introductory side of the cube. This is confusing and problematic.
    - Next to impossible to read both walls (wrong angle, distance).
    - The simple, illuminated wall dominates.
    - Direction of flow is confusing.
- This aggravated the non-take up of the theory wall which was essential to understanding the Exhibition.
- The bulk of the message was conveyed by a robust combination of display elements.

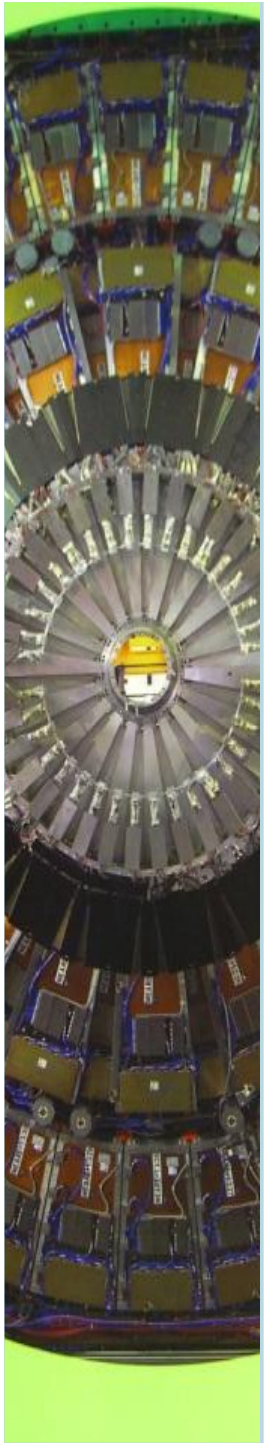
Headlines	Objects	Interactives -	textbooks on screen
Big images			illustrative games

- Less attention was given to

Paragraphs of text	Talking heads
Quotes from scientists	

- The hero of the displays was the 'Spot the Muon' interactive.

  It is likely that more graphics would have made theory and experiment much clearer.
- We estimate that close to a quarter of a million visitors visited this display from April to end September 2007.



How Many People Visited the Big Bang Exhibition?

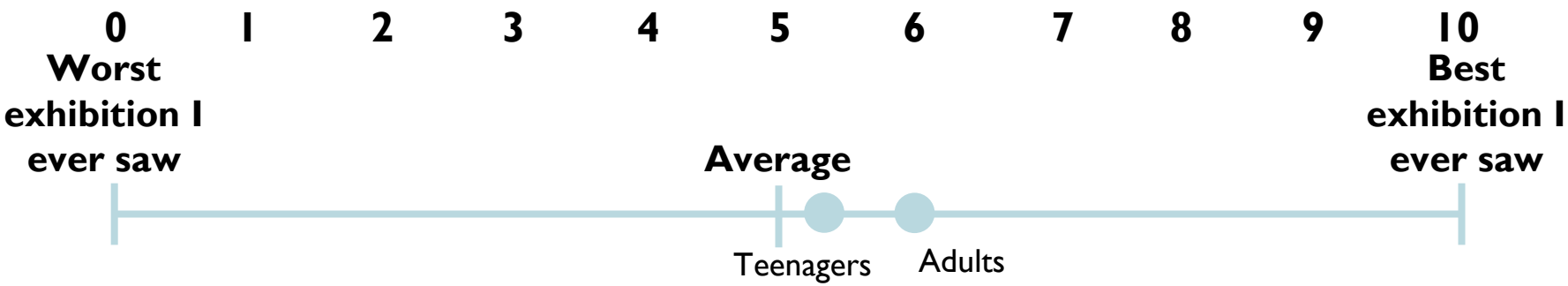
On average 17.5% of Science Museum visitors visited the Big Bang Exhibition.

1,391,365 visitors visited the Science Museum from April to end September 2007.

Therefore, the number of visitors to Big Bang is estimated at close to a quarter of a million.

243,489 visitors

How did focus group visitors rate Big Bang?



The target audience rated the Exhibition, on aggregate, at 5.7 out of 10. Just above average.

What Were our Different Audiences Like?

OLDER

- Moral, philosophical, ready to question
- Bored wives
- Science alarmists
- Teachers and academics

"What are they doing to our world? Research, you can see the harm."Older lady

- Old engineers, like to be updated

"It shows you the actual tubes. It's real kit. I couldn't believe it." Older man

NON-SCIENCE ORIENTATED

- Trendy, streety, on the watch
- Giggly girls, playful
- Humble, interested boys

"I looked at the drawings. They're so cute."Teenage girl

SCIENCE ORIENTATED

- Bright, intolerant, young physics students
- Life science oriented
- Thoughtful, balanced, aware of scientific method

We want something deeper. We know about magnetism and we know about CERN."Teenage boy

YOUNGER

IMPLICATION • **WHAT PEOPLE TOOK OUT OF THE EXHIBITION WAS STRONGLY DEPENDENT ON THE KNOWLEDGE AND ATTITUDES THEY TOOK INTO IT.**

How Did our Different Audiences React to the Exhibition?

OLDER

- Concerned with moral and philosophical issues not the 'how' of the experiment.
  "Can it be controlled?"
  "Will it do good?
  "Can you trust scientists?"
- Mainly women.

- Awed by the scale of the engineering.
- Impressed by the idea of smashing atoms at high speeds.
- Glad to have a more up-to-date perspective and to take an informed view.
- Mainly led by men.

NON-SCIENCE ORIENTATED

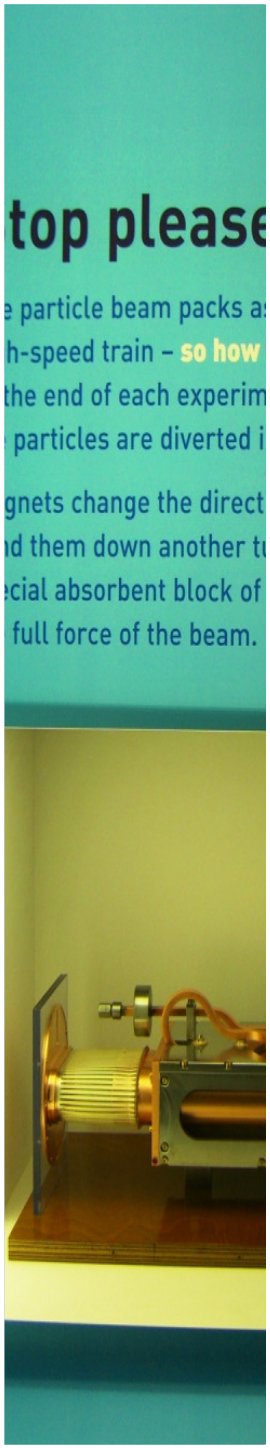
SCIENCE ORIENTATED

- Curious, impatient, looking for entertainment.
- Want to know the **results** of the experiment, not the planning.
- Refuse to labour the issues. In and out.

- Sympathetic to the scientific goals. The hunt for knowledge for its own sake
- More interested in theory than hardware.
- Want much more detail on the experiment and its probable results.

YOUNGER

IMPLICATION • **THE EXHIBITION GAVE A LITTLE BIT TO EVERYONE BUT PROBABLY NOT ENOUGH OF WHAT THEY WERE INTERESTED IN. MOST SATISFIED WERE THE OLDER SCIENCE-ORIENTATED SECTOR.**



High Low Interest
Features of the Exhibition From the Visitors' Perspective

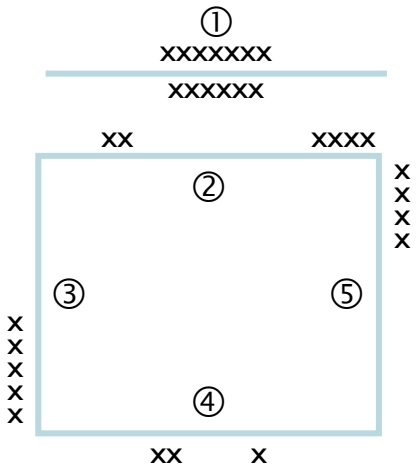
OVERVIEW

High Interest

Cartoon work (1)
Big Bang title
Horizontal 'find out more' screens
Big, white circle against coloured background
Big picture celebrity quotes
Cartoon wall questions (1)
Image of changer with standing men (2)
Image of Geneva countryside with superimposed circles (2, 3)
Cross-section of the tube (3)
Stopping the process with carbon (3)
Young scientist talking head (4)
Big questions (5)
Higgs Boson Game (5)

Low Interest

Cartoon wall (1)
Narrow corridor (1, 2)
Scientist wall quotes
Ink drawing (2)
Description of apparatus (3)
Detector and detecting (4)
Grid video and text (5)



Exhibition hotspots xxx

‘Big Bang’ Lures People In, Then Disappoints

- ‘Big Bang’ is an irresistible title.

  “It’s part of human nature to wonder about the beginning.”
  Teenager

  “The Big Bang is the start of the Universe, the beginning of the world.” **Teenager**

- Almost universally visitors felt initial disappointment at the actual content because, in their view, it did not deal with the Big Bang.

  “I wasn’t expecting to find it all about CERN. I thought it was about the actual Big Bang.” **Adult Visitor**

  “The Big Bang was not in the Exhibition. It was more about particle physics and how to recreate the Big Bang.” **Teenager**

- The expectation of an exhibition about the Big Bang involves

Drama	Vast black spaces
Spectacle	Excitement
Mystery	The beginning of time and space
Stars	Explosions

There is something filmic about this which is not delivered by the media within the Exhibition.

“There’s not enough info on the Big Bang, not anything. I would like a film as intro.”
Adult

“You’re looking for a picture of the Earth but there wasn’t one. How it got to look like it does now.” **Adult**

IMPLICATION • **THE TITLE IS SUCCESSFUL IN GETTING PEOPLE IN, HOWEVER, THERE IS A BIG JOB TO BE DONE IN EXCITING PEOPLE’S INTEREST IN THE ACTUAL CONTENT RATHER THAN THE IMAGINED ONE.**

About Half Make the Link Between Big Bang and CERN in the End

"How scientists would like to explain the main questions, like where do we come from? So they want to recreate a tiny Big Bang and see what happens." **Teenager**

"Looking at what happened immediately after the Big Bang." **Adult**

- Everybody realised that CERN was going to recreate a mini Big Bang by smashing particles together. This would recreate what had happened immediately after the original Big Bang. Second best.

"A very detailed description of the LHC at CERN. It wasn't really about the Bang, just how they would attempt to recreate the seconds after the Big Bang." **Teenager**

Those people with existing scientific knowledge, realised there was a theoretical justification for all of this which had far reaching implications for scientific knowledge.

"What scientists are doing to prove how the Big Bang happens. They are attempting to answer questions that may never be answered." **Adult visitor**

"Scientists are at the brink of discovering what precisely happened when the Universe began. They are trying to discover why some of the stuff is missing. Antimatter and so on, Dark stuff." **Teenager**

- Not everybody is left with a clear message.

"To try and work out if the Big Bang actually exists." **Adult visitor**

IMPLICATION • **PEOPLE GRASP THE IDEA THAT A MINI BIG BANG IS TO BE CREATED BUT BY NO MEANS ALL ARE SURE WHAT IT'S BEING CREATED FOR. IN SOME WAY, A SENSE OF THE SCALE OF THE UNDERTAKING IS MISSING.**

What Do They Know About CERN?

- The majority had not heard of CERN by that name.

  Estimated split 60% unaware

  40% aware

- Gradually a few connect up this story with vague memories of a big research place in Switzerland which they once heard something about.
- Levels of knowledge

Informed

- Particle physics, a big accelerator for smashing particles together. CERN is a familiar name, leading edge research.

  "Don't know much. They have offices underground. They make things collide hard." **Teenager**

- Underground, mysterious, (sinister?), Science establishment. Dan Brown's Angels and Demons. In Switzerland, Geneva?

  "Religion. The Vatican is funding this project as well." **Adult Visitor**

None

- Never heard of it.

  "They should talk about the consequences. Why they're doing it. Why it's important for the average person." **Teenager**

- The Large Hadron Collider is an unfamiliar term to everyone and difficult to remember.

IMPLICATION • **CERN NEEDS TO SPEND QUITE A BIT OF TIME ESTABLISHING WHAT IT IS. WHAT IT IS FOR AND PERHAPS A WHISPER OF WHAT IT HAS DONE UP UNTIL NOW. THIS SHOULD BE DONE WITH A VIEW TO FIRING THE IMAGINATION OF THE LAYPERSON.**

Setting the Stage for the LHC Experiment

- The visitors in the evaluation virtually all failed to appreciate the sheer scale, difficulty and complexity of the LHC experiment.
- Because they had little idea of the baseline (i.e. what physicists normally get up to) they **assumed** that physicists can just do these impossible things, even if they can't themselves.

  i.e.
  - construct the coldest, emptiest place on earth.
  - approach the speed of light.
  - build a 27km underground ring.
  - recreate a mini Big Bang.

  For the majority, there is little sense of awe, although they faithfully report that the equipment is massive.

  "They built a huge machine. You need more details." **Teenager**

- A big part of the problem lies with whether they appreciate the meaning, importance and worthwhileness of the scientific endeavour. Scientists do but non-scientists largely do not.

  "You have to have had a previous interest. This is not enough." **Teenager**

  "They're going to create more antimatter. But what about the environment? The atmosphere?" **Adult**

IMPLICATION • **IS MORE BASIC STAGE SETTING NEEDED SO THAT PEOPLE CAN SEE WHAT'S BEING ATTEMPTED IN ITS REAL PROPORTIONS? SO FAR, IT SEEMS LOGICAL AND UNEMOTIONAL. AN ENGINEERING ISSUE. NO MORE.**

A More Satisfying Story Might Sound Like This

In the beginning

THEORY

What do we know?

What don't we know?

Why does it matter?

How could we find out?

EXPERIMENT AND EQUIPMENT

What should our experiment look like?

What might happen?

What might go wrong?

How can we build the experiment?

OUTCOMES

What happened?

What do we know now?

What does it mean for us all?

Useful knowledge in the world

Let's Examine the Exhibition from Four Standpoints

I. Grasping the theory.
II. Grasping the experiment.
III. Grasping the equipment.
IV. Grasping the outcomes.

At each standpoint

We will consider what is communicated and in what frame of mind it is received.

How this relates to the execution of the displays.

1 Grasping the Theory

"You need the base at first." **Teenager**

- On the whole, visitors did not grasp enough of the theory to give full meaning to the experiment. To get the most out of it, they needed to grasp

  What gives things mass?

  What's missing in our universe?

  Where did the antimatter go?

  These were all mentioned on the theory wall. So what happened?
- Barriers to understanding were

  The physical layout of the Theory Wall.

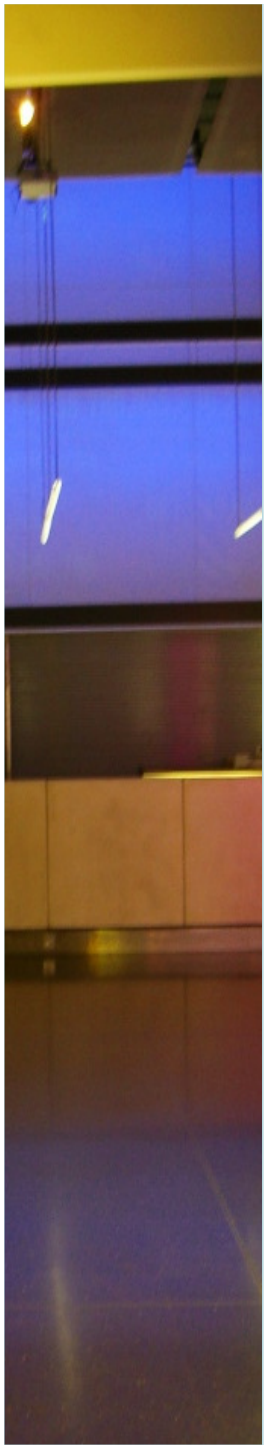
  The profound, conceptually demanding nature of the concepts.

  The choice of cartoons as a medium of explanation.
- Non-scientists were left with incomplete, but stirring, ideas about antimatter and, perhaps, missing parts of the universe. Virtually no-one could grasp the 'mass' issue. However, they seemed like random ideas rather than fundamental questions and the next logical step for physics.

  "They're looking for three types of particles. What is the 95%? They're looking to create an atom." **Adult**
- Those with Science Training understood the issues and why they were important but were not adequately able to connect them with what was being done at CERN.

  "How does that relate to us? The Higgs Boson? Put it on an everyday footing." **Teenager**

IMPLICATION • **THE ESSENTIAL, THEORETICAL QUESTIONS AND SUPPORTING THEORY NEEDED TO BE EXPRESSED MORE SALIENTLY AND IN A PARED DOWN FORM AT THE OUTSET.**



Let's Examine the Barriers • Physical Layout

- The theory wall was part of an uncomfortable, narrow corridor. It was not possible to stand back far enough to take in the whole thing.

  Headlines and paragraphs were too low and fun cartoons too high for eye level.

  "It needs to be more on eye level. The paragraphs are not high enough to see. And too long." **Teenager**

  "There were a lot of people in that wee passage. You didn't know which side to go. It's a corridor." **Adult**

  "In the corridor, there was not enough room. There are two walls which have to be read. It's a bit manic, a bit close." **Teenager**

IMPLICATION • **MORE SPACE TO STAND BACK AND TAKE IN THE WALL AS WHOLE, AS WELL AS HEADLINE INFORMATION AT EYE LEVEL, WOULD HAVE HELPED PEOPLE TO ABSORB THE THEORY.**

Let's Examine the Routes Through

- Person A, entering to the right of the Big Bang sign is attracted by the bright lights and simple style of Wall ②. She moves down the corridor in order to read from left to right. She may stop around the middle of Wall ① to see what it's about.

  i.e. what are the big questions?

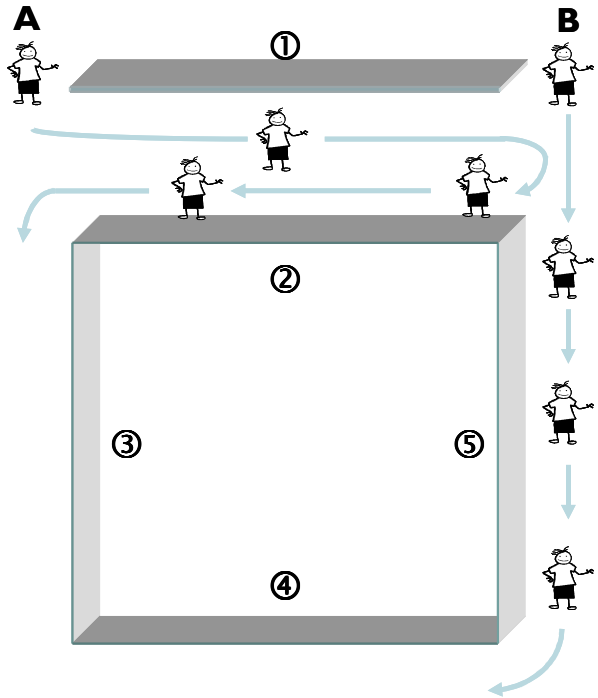
  Big Bang cartoon.

  She moves on without paying real attention to the ends of Wall ①.

- Person B entering to the left of the Big Bang Wall, typically wanders off down Wall ⑤ where he will probably pick up the 3 main questions but not the supporting theory.

  "I wasn't sure which way to walk. Anti-clockwise didn't work and clockwise is confusing." **Teenager**

  "It's hard to remember. It's basically about Science. I got the gist of it." **Adult**



IMPLICATION • **SPACE TO STAND BACK AND CONTEMPLATE THE WHOLE. PLUS EQUIVALENT ILLUMINATION ON BOTH WALLS, WOULD HAVE HELPED BOTH SETS OF MESSAGES**

Let's Examine the Barriers • Cartoons and Text

- The cartoon format misled people. Many adults assumed, at a glance, that it was meant for children and dismissed it.

  "What the hell am I looking at this for? It's childish." **Adult**

- Young people found the cartoons engaging.

  "Is it to make people interested, the start with the drawings?" **Teenager**

- Cartoons were fun to look at.

  "They should have broken down the cartoons into other parts of the Exhibition." **Adult**

- The problem was that the viewer needed to know in advance what the cartoons were trying to say before they could decode them.

  "The Higgs field, they had little fields. It was misleading. It was difficult to connect the text with the field. I don't know what that meant." **Teenager**

- When they were read, the short paragraphs were clear and helpful.

  "The writing was interesting, all about our universe and the Big Bang. I read some paragraphs." **Adult**

  "There was enough for people not doing A' Levels. It didn't go overboard." **Teenager**

  "I read the paragraphs. It explained that it was a connection with the questions. It tells you about the particles, then you look up and see all the pictures." **Teenager**

- By and large, people scanned the bold headlines and dipped into the paragraphs below if they were particularly drawn to the issue. People read different amounts according to interest. But almost nobody read the whole board. It was too overwhelming.

  "That was a hardcore wall." **Teenager**

IMPLICATION • **THE THEORY WOULD HAVE BENEFITED FROM BEING BROKEN UP AND INTEGRATED INTO THE BODY OF THE EXHIBITION AT EYE LEVEL. CARTOONS ARE ENGAGING AND ACCESSIBLE BUT SHOULD LOOK LESS CHILDISH IN ORDER TO BE ACCEPTABLE TO ADULTS.**

Some People Wanted More, And Deeper

- Physics students and science confident adults were not satisfied.

  "I didn't get the wall on how two protons collided. I need something really deep about that particular interaction." **Teenager**

  "I expect more physics." **Teenager**

- They started from an acceptance that Particle Physics was a discrete subject and that they were on the fringes. They were impatient to have it explained.

  "This is a beginner's guide, they need a way to dig deeper." **Teenager**

  "The paragraphs end with a question. How do they do this? I want to know." **Adult**

  "It all comes down to the Higgs Boson. More about the bosons!" **Teenager**

- These people will be the scientists of the future. They grasped the three big questions and wanted to get to grips with how they were going to be answered. They were frustrated rather than excited.

  "The questions came up again. They're going to get a lot of data out of it. But how are they getting the answers? How do they get to the conclusions they did?" **Teenager**

  "A cliff-hanger that leaves you feeling unfulfilled." **Teenager**

IMPLICATION • **THIS SMALL GROUP OF ENTHUSIASTS WOULD HAVE BENEFITED FROM A SMALL SCREEN PRESENTATION WHICH ALLOWED THEM TO PLUNGE DEEP INTO THE THEORETICAL UNDERPINNINGS.**

II Grasping the Experiment

- This was the biggest gap in the information supplied by the Exhibition. There was no single clear exposition of what the CERN experiment in the Large Hadron Collider was.

  "It was just a run through of how they theorised and how, maybe, they could find out. I didn't get 'when we do this, this might happen'" **Teenager**

  "It doesn't say what the particles were, what they were going to fire, particles of what?" **Adult**

- There was a general sense of particles smashing into each other and bits flying off but there was no clear link to show why this would answer the big questions about antimatter, 95% missing universe, etc. Visitors asked for
  - a visual of two particles smashing together and the probable outcomes.
  - a description of the actual particles which the experiment would start with.
  - a description of what might be expected as a result.

  "You need a more technical description. There was no result." **Adult**

  "They should have like a computer image of two atoms, smashing on the big screen, projected onto the Big Bang screen." **Adult**

- Many felt that the exhibition had been dominated by the engineering.

  "They explained too much about the construction and not what would happen. There should be a balance between the engineering and the physics." **Teenager**

IMPLICATION • **A SIMPLE, CLEAR, IMAGE-BASED ACCOUNT OF THE PROJECTED EXPERIMENT AND ITS LIKELY OUTCOMES WOULD HAVE FORGED A MORE SATISFACTORY LINK BETWEEN THEORY AND PRACTICE.**

What Did People Take the Purpose of the Experiment To Be?

- There was a widespread assumption that the purpose of the experiment was in fact to **prove** the Big Bang.

  "They made the assumption about what happens until now. Now they're trying to prove the Big Bang did happen by looking at split seconds after the Big Bang on a small scale version." **Adult**

  "Scientists are spending money on a huge underground tunnel that smashes particles together to create new ones, like the so-called Big Bang." **Teenager**

  "You expect it to explain how the universe began. The questions are not answered in the Exhibition. I didn't get the connection." **Teenager**

- There was a disconnect between the mysterious, other worldly, scientific questions raised and the mental picture of smashing particles together in a tube.

- Was there also a disconnect between the task of explaining the Big Bang (History) and solving problems in the future?

- Only a minority were satisfied 'blue sky' science was justified anyway.

  "Question after question. Will there ever be an answer?" **Adult**

  "They're going after knowledge, they won't ever stop. They'll count more and more. They'll want more and more." **Adult**

IMPLICATION • **THERE WAS A CERTAIN VAGUENESS ABOUT THE OVERALL PURPOSE OF THE EXPERIMENT. SCIENTISTS MUST KNOW.**

III Grasping the Engineering

- Everybody grasped the idea of a huge impressive engineering project, a 27km ring in which particles would be smashed together.
- Most took a genuine, but not deep, interest in the physical objects involved.

  Cross-sections of the tunnel

  Pipes

  Detector cross-section

  Enough to see what was going on.
- But engineers revelled in the enterprise.

  "I'm on the engineering side and when I look at it, the extra strength of the tube, how they inserted the two little pieces …" **Adult**

  "There are millions of other pieces, computerised equipment to track smaller particles, computers under construction." **Adult**

  "I didn't really understand the basics of particle physics but I found the engineering part very interesting." **Teenager**
- Non-engineers thought it had taken over too much of the exhibition. This was exacerbated by the fact they might have read next to nothing of the theory wall.
- Essentially, people were trying to make sense of what they were seeing within the context of their lives – to witness the technical superiority but then reduce it down to its real meaning. For example, the three accelerator ring screen was readily understood and remarked on.

  "It's such a massive project, they have three rings to accelerate it." **Adult**

IMPLICATION • **THIS WAS A MORE CONCRETE PROPOSITION AFTER ALL THE THEORY. A MIX OF RELIEF AND A BIT OF TECHNOPHOBIA.**

How Were Elements of the Exhibition Communicating? Wall ②

Overall

This wall introduced and established what was happening at CERN.

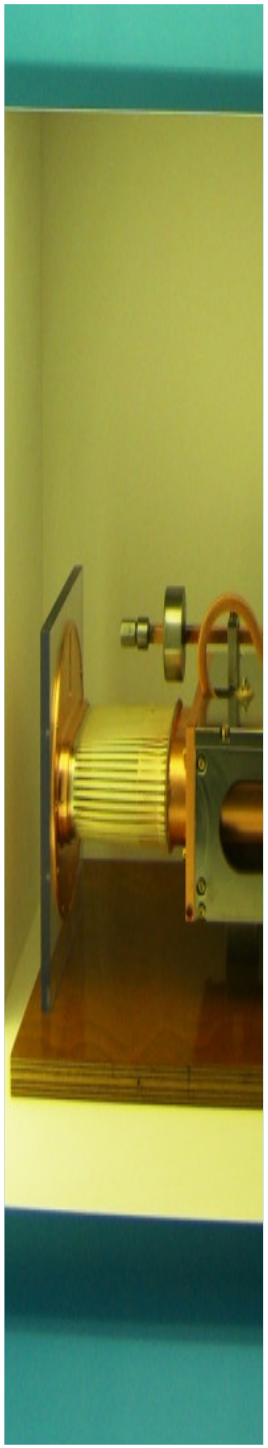
Executional Details

- Colourful, illuminated background, lots of space.
- Big headlines with short paragraphs to pick up on if you're interested.
- Pictures and photographs.
- The big white circle containing large text signalled where to begin.
- The key image was the Geneva countryside with the superimposed circle. In second place, the huge cavern, with a tiny human for comparison.
- The little black and white drawing failed to attract. Why?

  Too small and dull to look at.

  Too complex an idea for the speed at which they wanted to go round.
- Wall ② stole most of the audience away from Wall ①. It looked simpler to take in, although not as much fun.

IMPLICATION • **AN INTRODUCTORY OVERVIEW USING KEY HEADLINES AND A COUPLE OF BIG ARRESTING PICTURES IS A GOOD COMBINATION.**



Wall ③ • The Equipment Itself

Overall

This wall showed people the engineering task and what equipment was being used.

Executional Details

- Visitors skated quite quickly over text, detailing the physical conditions and how you achieve them.

  Coldest, emptiest.

  Vacuum.

  Magnets.

  Not as impressed as you'd think, not anxious to go into the detail.

  High speeds and smashing was all they really needed to know.
- Those wanting detail were well satisfied with touch screens.

  "If a title's good enough, I'll read it. If it's a boring title I don't read. The screen told me more."

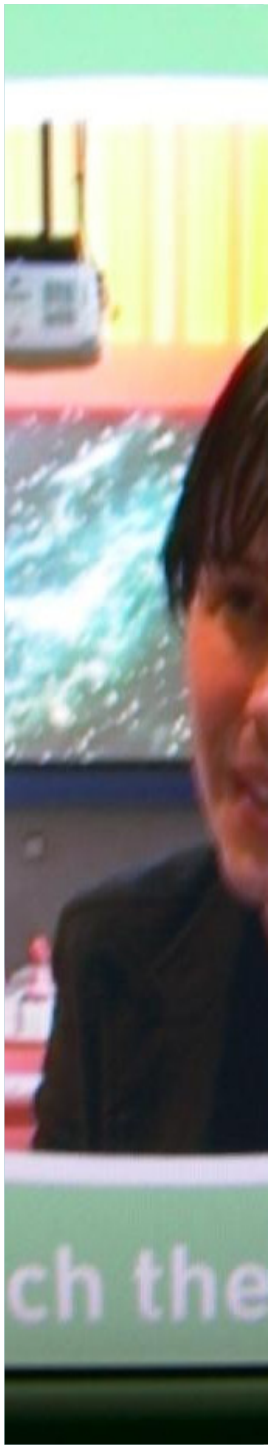
  Adult
- The physical cross-section was worth a look but difficult to decode.
- Surfing up to speed was satisfying, easy to grasp, with the 'three rings' photograph.
- Perhaps the most relevant, meaningful and controversial item was the piece on getting the process to stop. People read it and assessed it. Could it be possible that such extremes (Big Bang, speed of light, smashing particles) could be halted by a small piece of graphite?

  "It's stopping it at all. It's the speed of light, faster than the speed of light." **Adult**

  "There's very little info other than the graphite block. What if it doesn't stop it? We're taking their word for it." **Adult**

  This releases a raft of insecurities.

IMPLICATION • **VISITORS WILL SKIM AN UNFAMILIAR TECHNICAL AREA, USING HEADLINES RATHER THAN GETTING INTO THE TEXT. EMPHASIS WILL BE ON THOSE ISSUES WHICH WERE ALREADY PERSONALLY RELEVANT TO THE INDIVIDUAL.**



Wall ④ • Detection

Overall

This story was at the same time obvious and difficult to grasp. At the mid point of the exhibition, visitors were getting impatient. They didn't spend long on this wall.

"The detector and how it worked. Not that impressive." **Teenager**

Executional Details

- The white circle is repetitive.
- The physical cross-section was beautiful but impossible to decode.
- It was not clear what the bright concentric circles (particle trails) represented, nor that the diagram might superimpose on the detector.
- Attention was diverted to the personable young scientist, explaining things on screen. Also to the touch screen below.

  "There's a lot of text, reading was repeated quite a lot. I liked the interaction on screen, it was clear and big." **Adult**
- As for Wall ③ people's insecurities were raised by the mention of risk and black holes.

  "A black hole, doesn't it suck you into it? Inside it, suck you into space?" **Adult**

IMPLICATION • **AUDIENCES WERE NOT SUFFICIENTLY ENGAGED WITH THE EXPERIMENT TO WANT TO MASTER THE DETAILS OF DETECTION. THEY ASSUMED THAT IF SCIENTISTS WERE INTERESTED IN THESE PARTICLES THEN THEY WOULD KNOW HOW TO DETECT THEM.**

Wall ⑤ • Wrapping Up

Overall

Visitors cruised this wall looking for titbits of interest. It was hard to work out whether it had a particular theme.

Executional Details

- Asking three big questions was a clear and helpful way of summing up the main goals. Especially for those entering the Exhibition at this point.
- The Grid, illustrated by CD pile and talking head was of passing interest for a few but was mostly skipped over.

  "The Grid, that's interesting. It's a pool. It's impressive how much data …" **Teenager**

  Most people take processing power largely for granted.
- Research spin offs are not really noticed. Too embedded in text?
- On screen displays seem less relevant/exciting. (International research centres was not working on Day 1.)
- The undoubted star of Wall ⑤ and the show as a whole was the Muon game. Especially with the young.

  "It was a really easy Higgs Boson game. I won on the game." **Teenager**

  "I wish there had been more interactive games and less text on the same subject." **Teenager**
- But at the same time.

  "I didn't understand what the particles were." **Teenager**

IMPLICATION • **A FEW CLEAR POINTS, SUPPORTED BY AN INTERACTIVE WHICH BRINGS THE MAIN POINTS ALIVE, IS A A WINNING COMBINATION.**

A Small Digression on the Higgs Boson Game. Why Did It Work?

- The game looked inviting and easy on screen, so lots of people touched the screen and got launched.
- Once they got going the task was intelligible and at exactly the right skills level. It made people feel clever and they kept going.
- Participants were not lectured with information. The actual information they had to take in was needed in order to play the game.

  i.e. spotting a pattern which was equivalent to four muons.
- Giving people firsthand experience of the detector process, the puzzle which physicists are trying to crack, deepened their appreciation of what the whole enterprise meant.

  Because people engaged with the task, the issue of detecting muons was raised in status.
- The problems came at the end of the task. What was the relationship between 'muon spotting' and the Higgs Boson?

  "When they collide, you get all these particles. It could be a Higgs particle. Isolate the lonely Higgs particle." **Teenager**
- The relationship between the Higgs Boson and particle mass had failed to come through.

IMPLICATION • **ON SCREEN GAME PLAYING IS THE MOST POTENT WEAPON IN THE ARMOURY. THERE COULD BE MORE OF IT AND IT COULD BE PLUGGED IN MORE EFFECTIVELY TO THE OVERALL MESSAGE.**

IV Grasping the Outcomes

Exhibition and visitors diverged dramatically at this point. Adult visitors were noticeably more anxious than teenagers.

OUTCOMES

EXHIBITION AGENDA

- Pride in the engineering, design.
- Excitement about actually running the experiment and what might be found.
- Belief in advancing scientific knowledge as an unquestioned good.

OPTIMISTIC

VISITOR AGENDA

- Why have they given us this Exhibition before they have any results to report?
- Will it do more harm than good?
- It's interesting to be updated, see what's going on but

"It's just knowing." **Adult**

WARY

IMPLICATION • **VISITORS REMAIN WARY, EVEN THOUGH THE EXHIBITION IS OPTIMISTIC AND INFORMATIVE. HOW FAR DO THEIR CONCERNS NEED TO BE MET HEAD ON?**

An Exhibition With No Results to Report

- Many people felt this Exhibition had been set up too early in the process.

  They were incredulous that the questions had been raised but there was nothing with which to answer them.

  "There was no result, just the experiment." **Adult**

  "They're attempting to find answers to questions which were unanswerable. But they didn't follow up on the questions." **Teenager**

- Only the science minority had genuine understanding and sympathy for the pursuit of knowledge and hypothesis.

  "It's to see what happens when atoms collide, what's produced. Getting closer to the beginning. Evidence about the Big Bang and dark matter. Find out where it goes." **Adult**

  "We'll find out about the big questions." **Adult**

- For the non-scientist, it was important to gauge what effect this was all going to have in the world at large

  "Why aren't they actually trying to find a cure for cancer?" **Adult**

  "Three billion Euros, it's a waste of money." **Teenager**

IMPLICATION • **IT WILL BE EASIER TO ENGAGE THE SYMPATHY OF THE MAJORITY WHEN THERE ARE SOME LHC EXPERIMENTAL RESULTS TO REPORT ON.**

What Were Visitors' Worries?

AUDIENCE WORRIES

DON'T TRUST SCIENTISTS

"Scientists won't tell you what they don't want you to know." Adult

"You don't know what they're going to find out." Adult

ACCIDENTS

"Where does it go to if everything goes wrong? Adult

"We could just be dead, it could just blow up." Teenager

BOMBS

"They'll use it in catastrophic wars. Wipe out everything. Boom boom. They'll have antimatter bombs." Adult

"The explosion will be a vast area." Adult

BLACK HOLES

"How long, how big is a small black hole?" Adult

"It's not a good idea creating a mini Big Bang or a Black Hole." Teenager

GETTING INTO THE WRONG HANDS

"In the right hands, yes. In the wrong hands it might be a danger. A bigger bomb." Adult

"This could go horribly wrong in the wrong hands." Adult

MEDDLING WITH NATURE

"Are they interfering where they shouldn't?" Adult

"They shouldn't meddle with nature."

DESTROYING THE ENVIRONMENT

"It isn't going to do any good." Adult

"Scientists destroying the atmosphere." Adult

"It utilises massive amounts of energy." Adult

QUESTION • **IS IT BETTER TO DEAL WITH THESE DIRECTLY OR WOULD THIS JUST FUEL ANXIETY?**

The Counterbalancing Force is Doing Good in the World

- People ask questions which amount to an invitation to convince them that great benefits will ensue from the experiment.

  "They're trying to find answers. But what will they do with them? If it all turns out well, how will it benefit mankind?" **Adult**

  "They're hoping to see a black hole. But if a black hole is formed, what will they do?" **Adult**

  "How will this impact on the Big Bang in the future? How will they move science on? In the scientific field, it's a big thing." **Adult**

  "I will want them to say how they find the Higgs Boson beneficial to mankind. What will happen? You need something constructive." **Adult**

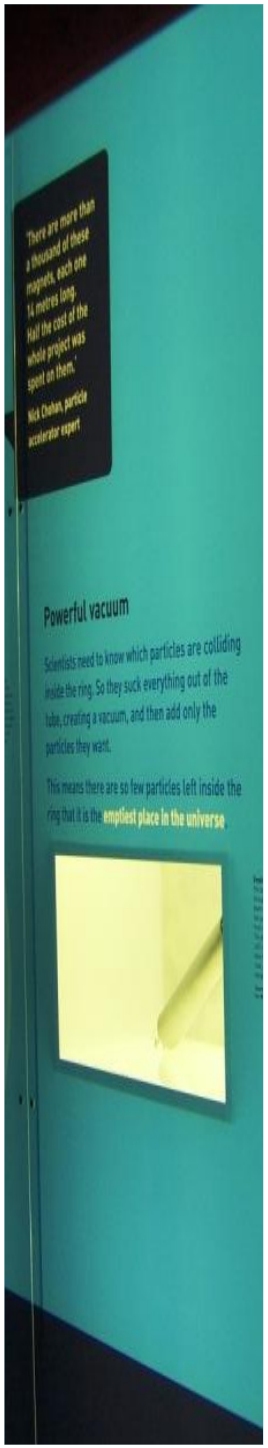
- Almost no-one spots the positive spin-offs from the last CERN research. Perhaps more emphasis should be given to these.

- Worldwide cooperation between scientists provokes no excitement. Somehow, these are the usual suspects. Who's running it …?

  "Private investors, education, government, All Europe." **Teenager**

  "Different countries, France, Switzerland, the Russians and the Germans. Obviously the British." **Adult**

IMPLICATION • **A DISCUSSION OF THE BENEFITS FOR MANKIND IS NOT SUFFICIENTLY SPELT OUT HERE. IT MIGHT GO SOME WAY TOWARDS ALLAYING THE FEARS.**



Points of Execution • Last Details

- The cube design works well. It has a spacious feel and yet is not too big. The corridor at the outset was confusing and difficult to negotiate.
- Backlighting was popular. Attractive, easy to read, glamorous.

  "The lights were really good, really impressed." **Teenager**

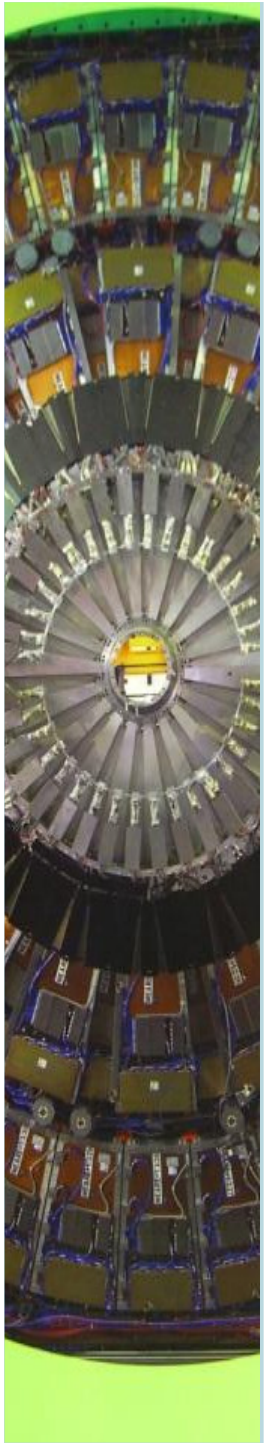
  "The light is very relaxing." **Adult**

  However, one person (out of 32) found it a problem.

  "The neon lighting and the reflection off the glasses. It was a bit too bright." **Adult**
- Quotes. Quotes from famous people were popular, particularly with women. They were both profound and human.

  The scientist quotes were not read. Was it a bit of, 'He would say that, wouldn't he?'?
- Text is dealt with by scanning the headlines for interest and following up short paragraphs which appeal. Long paragraphs are invariably scanned rather than read.

  Interactive screens work better at engaging the visitor who is interested in the subject and wants to go deeper. Interactive games are the best of all.
- Big pictures, objects, headlines and interactive games determine the bulk of what is communicated. The key elements of the message should all be summarised within them.



Summarising What Was Communicated About the LHC

LEVELS ① AND ② MESSAGE HIERARCHY

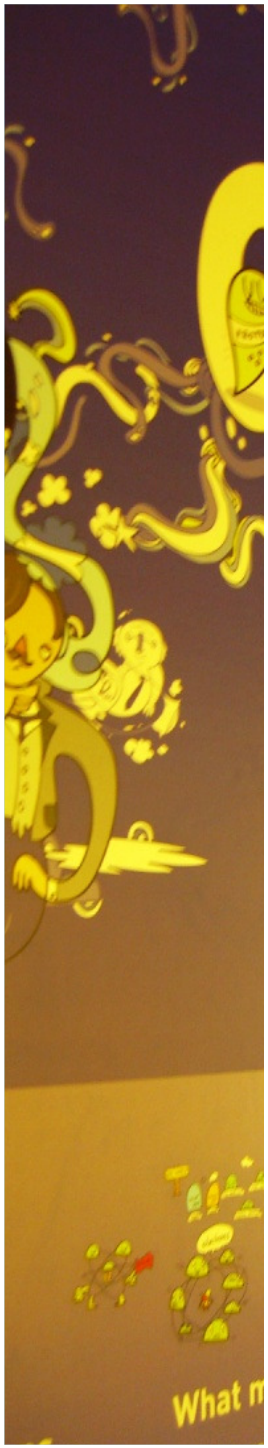
Level 1

Scientists and engineers are building a massive underground experiment to smash particles together, which will help them to answer how and why our Universe exists. ✓✓

The Large Hadron Collider, launching in 2007, will recreate what the universe was like a billionth of a second after the Big Bang and should discover new particles and physics. ✓✓

Level 2

1) The LHC is one of the biggest scientific endeavours ever attempted and could not have happened without international collaboration. ?
2) Building the LHC presents a huge engineering challenge. ✓
3) The data produced by particle collisions will pose an unprecedented computer processing challenge. ✓?
4) Scientists hope the LHC will help fill some fundamental gaps in our knowledge about the Universe: why some particles have mass, where all the antimatter is, and what is dark matter. ✓ ×



How Much of Level ③ Message and Hierarchy Was Communicated?

1)	This is the first time scientists will be able to recreate the conditions that existed less than a billionth of a second after the Big Bang. This will help them to better understand the very first particles that existed in the Universe.	✓
2)	Engineers are building four very large detectors on the largest ring collider in the world to enable scientists to detect the smallest particles known to science.	× ?
3)	When the particles smash together they create other particles.	✓✓
4)	To provide the massive computer processing power required for the LHC, scientists have developed a global computer network called the Grid.	?
5)	The LHC will cost £6 billion and involve thousands of scientists from 44 countries.	×
6)	The challenges associated with building and using the LHC mean that engineers and scientists are often having to create new solutions.	×
7)	Most scientists believe that the LHC will produce evidence of the Higgs Boson, helping them to understand why some particles have mass and others don't.	✓ ×
8)	Most scientists believe that the LHC will produce evidence of supersymmetric particles, confirming the supersymmetric theory and possibly explaining what makes up a large proportion of the dark matter in our Universe.	× ×
9)	Most scientists believe that antimatter and matter were created in equal parts in the Big Bang, but our Universe seems to be made of matter. The LHC should help them find out what happened to the antimatter.	✓?
10)	The LHC project will provide long-awaited physical evidence to prove or disprove some theoretical physics for the first time. It could also lead to discoveries that no-one has predicted.	? ✓

In Carrying the Exhibition Further

Three forces working in your favour are

- People are allured by the mysteries surrounding antimatter, dark matter, Big Bang.
- Smashing and splitting off is a simple idea to grasp.
- People feel a sense of privilege to be shown what is happening at Science's leading edge.

Three forces to be ignored at your peril

- People need a clear mental (and physical?) picture of theory, experiment and outcomes in order to see the significance of it all.
- Where there are fragments and confusion, people will build mistrust and a sense of danger, anxiety.
- Only a minority accept that building knowledge is good in itself, the rest want to see tangible benefits emerging for the modern world.