

UK Particle Physics Outreach Very Selective Highlights

Peter Watkins – Head of Particle Physics Group,
University of Birmingham

- **UK Particle Physics groups very active with strong support from STFC**
- **Wide range of activities including**
- **Masterclasses at ~15 UK Universities ,
Very large numbers of students at some
Many groups two successive days (some three!)
LHC computing exercises used in several**
- **Many talks to schools and general public**
- **Many contributions to local and national media-
CERN/LHC now in popular radio/TV programmes**

**Just time for a few recent highlights in this talk
(thanks to many UK groups for information)**

Accelerate!

Communicating accelerator physics to schools in the UK

www.physics.ox.ac.uk/accelerate



Φ xford
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What is 'Accelerate!'?

What is it?

- A 45-minute interactive science show about particle & accelerator physics

Who funds it?

- Funded July 2008, STFC (UK) Small Award for Public Engagement
- £7898 over 2 years

Who runs it?

- Set up in 2007 between Oxford Physics (Suzie Sheehy – PhD student and Prof. Brian Foster - head of Particle Physics) and CERN (Emmanuel Tsesmelis - Directorate Office)
- Run by Suzie Sheehy + team of ~20 volunteers (mostly Oxford Physics PhD students)

Who presents it?

- Around 10 Oxford Physics graduate students (+2 undergrads) who are trained in presenting style, safety etc... as part of program



Show Numbers:

(since launch event, Dec. 2008)

School shows: 32

Audience total = 3028

Public shows: 3

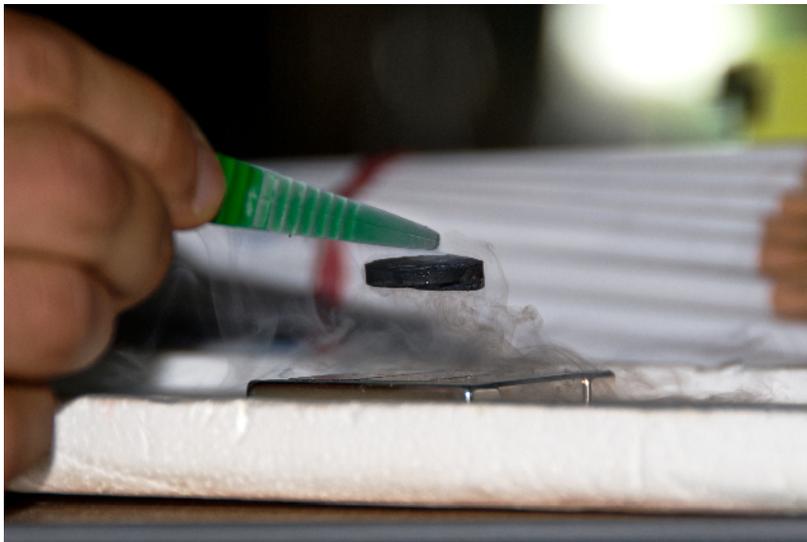
Audience total = 385

Teacher shows: 3

Audience total = 130

TOTAL = 3543

Projected total at 31/7/2010 = ~4500



Venues:

Shows in Oxford: 16

Manchester (Big Bang Fair): 8

Nearby (Oxfordshire): 3

Leeds/York: 6

Kent: 2

Leicester: 2

London: 1



Evaluation (489 respondents):

92.2% said the show was fun

91.4% viewed the presenters as role models

89.4% who weren't interested in physics said they were more interested after watching the show

We believe we have achieved:

- Public & schools engagement in PP & Accel Phys.
- Science communication skills for grad students
- Example of collaborative outreach program
- Set of demonstrations & ideas for outreach in future
 - Van de Graff, CLIC RF cavity, levitating superconductor, giant beach ball 'wave', plasma ball & fluoro tube etc...



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Learning with ATLAS at CERN

Hypatia

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INSTITUTE OF PHYSICS BELGRADE

H Y P A T I A

HYBRID PUPIL'S ANALYSIS TOOL FOR INTERACTIONS IN ATLAS

test_package

Selected Event Info

	Total
Tracks	361
Neutral Hadrons	11
Charged Hadrons	245
Photons	100
Electrons	11

Tracks

Name	q
1 gamma	1.51388
2 jet	10.104
3 gamma	1.7021

MINERVA

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Masterclass Involving Event Recognition Visualised with Atlantis.

Start MINERVA

Masterclass resources

MINERVA is a masterclass tool for students to learn more about the ATLAS experiment at CERN. It is based on a simplified setup of the ATLAS event display, Atlantis, which allows users to visualise what is happening in the detector. The aim is to look at ATLAS events and try to recognise what particles are seen in the detector. There are tutorial events, then a selection of events to categorise and finally a search for the Higgs! The project is a joint venture between the Rutherford Appleton Laboratory (RAL) and the University of Birmingham.

The Higgs search section is currently under construction

European Organization for Nuclear Research

ATLAS@CERN tool-box

Ideas for 3 Scenarios took shape



For schools

Identifying particles & their properties in detectors

An inquiry based learning scenario – for able A Level students who have recently studied the particle physics content -an extension & enhancement

or
use as a practice for synoptic questions at the end of the course

Time estimate/suggestion: ½ hr intro in one lesson + homework + 1 ½ hrs next lesson

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For schools (Minerva)

Practicing Physics Principles & Ideas with ATLAS at the Large Hadron Collider at CERN

An inquiry based learning scenario – for able GCSE Level students who have completed some of the basic units -revision of ideas and an extension & enhancement
or

For A Level students at the start of their course / prior to particle physics module to practice calculations, powers of 10 etc
or

A possible activity to prepare for a visit to CERN etc

Time estimate/suggestion: ½ hr intro in one lesson + homework + 1 ½ hrs next lesson

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Particle Physics Experiment – University Laboratory (Minerva)

In this experiment you will be visualizing events similar to those that will be seen in ATLAS, which is a particle physics experiment at the Large Hadron Collider at CERN. The ATLAS detector will search for new discoveries in the head-on collisions of protons of extraordinarily high energy. ATLAS will search for new particles and learn about the basic forces that have shaped our Universe since the beginning of time and that will determine its fate. Among the possible unknowns that will be probed are the origin of mass, extra dimensions of space, microscopic black holes, and evidence for dark matter candidates in the Universe.[2]

SIXTY SYMBOLS

Videos about the symbols of physics and astronomy

* = recently updated

	C	χ	\mathcal{A}	ρ	$\overline{\text{LHC}}$	♀	∞	$\bar{\eta}$	DM *
Γ	R_{\oplus}		K	Ψ	e^{-}	♂	\circ		[]
B		η		\rightarrow	Z	Q	Re	P *	\emptyset
♯	δ	E		π		Σ	w *	♀	γ
 *	T	R_s		μ	Δ			m	
D_f	\vec{L}	Ψ *	\ddagger	ω	n	N		r	



Industry Day - outreach to companies

Exhibition to raise awareness in the industrial sector of research and technology from the University of Glasgow.

Two of the fifteen stands were from particle physics: Particle physics detector technology and distributed computing.

109 companies visited and discussed opportunities for industrial applications and collaboration.

Quanta to Cosmos - outreach to people

A new adult education course given in spring 2010

Ten 2-hour evening classes

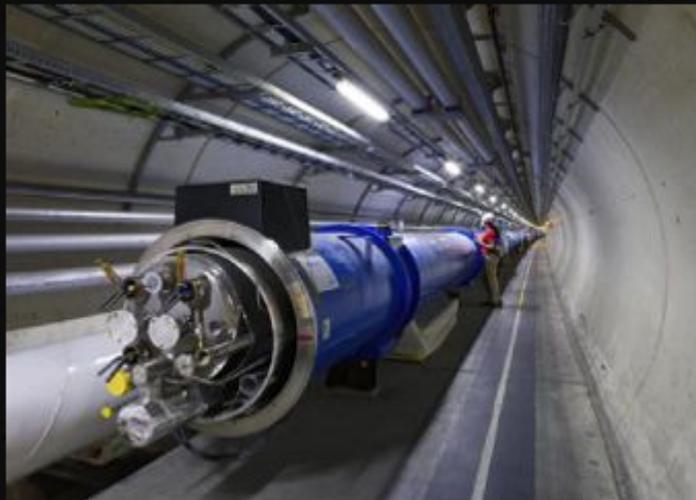
Delivered jointly by particle physicists and astronomers

Participants aged 30 – 70

Well-attended and well-received

About Colliding Particles

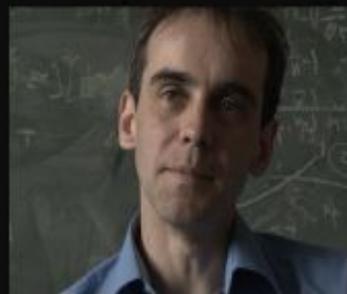
The Project



The Large Hadron Collider at CERN will look deeper into the nature of the universe than anything that has gone before, and its vast experiments are certain to change our understanding of the world around us. The scale of the engineering involved can sometimes obscure the fact that the project is designed and run by people - hundreds of teams of researchers and collaborators, all driven by the simple desire to increase our understanding of the universe we live in.

'Colliding Particles' is a series of films following just one of the teams of physicists involved in the research at the LHC. The project documents their work at the frontiers of particle physics, exploring the

The Physicists



Gavin Salam

Gavin is a theoretical particle physicist at the French National Centre for Scientific Research in Paris. He completed his PhD at Cambridge in 1996, and went on to hold postdoctoral fellowships in Milan and at CERN. His research has mostly been centred on the area of quantum chromodynamics, the theory which describes the behaviour of quarks and gluons. He likes to play the piano in his spare time.



Jonathan Butterworth

Jon is an experimental particle physicist at University College London, and a member of the ATLAS collaboration at the LHC. He completed his doctorate at Oxford in 1992, and worked on the ZEUS experiment at DESY in Hamburg. He now divides his time between CERN and London, where he lives with his wife and 2 children. In his spare time he enjoys skiing and playing the guitar.



Adam Davison

Adam studied at University College London for his undergraduate degree and decided to stay on at UCL for his PhD. Although he currently works at CERN in Switzerland he still tries to spend time back in the UK. In addition to particle physics, he is also works on the Mixxx Digital DJ project and plays 5-a-side football.

Particle Physics Sixth Form Seminar, November 2009
100 A-level students attended an afternoon of four lectures
This is the third year we have run this event.

Physics Teacher Seminar on Particle Physics and String Theory, March 2010
Series of evening seminars for teachers.
Two talks from researchers with plenty of opportunity for teachers
to discuss what ideas can be communicated in schools.
This is carried out in a relaxed atmosphere with food and wine available.

Feedback

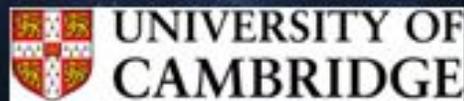
The feedback from students and teachers has been excellent.

**“I really enjoyed listening to real experts in particle physics,
and the way they freely spoke to the crowd.”**

**Since the events for students we have been contacted by two schools
to say that some of their students are planning to study physics at university
and cited the Sixth Form Seminar or Masterclass as what had influenced them.**

Cosmic Rays schools projects

... HiSPARC and LUCID



HiSPARC



<http://www.hisparc.nl/>

• **High School Project on Astrophysics Research with Cosmics**

Background:

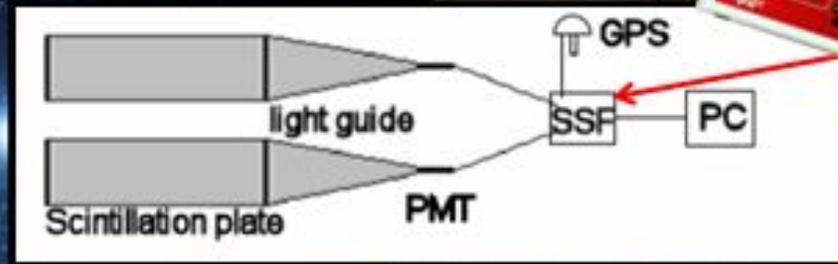
- Started at NIKHEF 2002
 - Ground scintillator detectors
 - 5 ground cluster sites
 - 1 cluster >3 schools spaced ~1-1.5km apart (optimal spacing used in ground expts)
 - Total of 30+ schools collaborating

Aim:

- Search for direction of UHE cosmic showers ($< 10^{20}$ eV)
 - Look for signal coincidences between sites
 - Direction determined via simple triangulation of three detectors

Results:

- Energies of $>10^{18}$ eV have been measured
 - highest measurement ever made in the Netherlands



- Students design and build detectors
 - Simple design: Scintillator + PMT + HiSPARC electronics (SSF) + GPS
- Data uploaded to central server via HiSPARC software
- Coincidence analysis performed by students on collective data across sites

Cosmic school projects...

- UHE cosmics are rare \Rightarrow need large surface area coverage
- Other than
 - **HiSPARC** (*High School Project on Astrophysics Research with Cosmics, NIKHEF, Netherlands*) <http://www.hisparc.nl/>
 - and **LUCID** (*Langton Ultimate Cosmic Ray Intensity Detector, The Langton Star Centre, UK*)
 - several other cosmic ray outreach projects are also ongoing
- **NALTA** (**N**orth **A**merican **L**arge-scale **T**ime-coincidence **A**rray), US
 - Ground scintillator detectors <http://neutrino.phys.washington.edu/~walta/NALTA.html>
 - Made up of several smaller projects
 - **ALTA** (*Alberta, Canada*), **CHICOS** (*California*), **CosRayHS** (*Pittsburg, Southern Illinois, Jackson and Florida*), **CROP** (*Nebraska*), **WALTA** (*Seattle*)
 - Cosmic rays project, Kings College London
 - Uses similar setup to WALTA (**W**ashington **L**arge **A**rea **T**ime **C**oincidence **A**rray) <http://www.kcl.ac.uk/schools/physics/cosmic-ray-project.html>
 - And many others...
- No real collaboration between projects in Europe
- We want to pool data across projects, increasing surface coverage
 - Data collected shared among the schools for analysis by students
- Cambridge is beginning work with HiSPARC and LUCID, start by looking to combine their data
 - Ground based detectors – **HiSPARC** Scintillator detectors installed in Netherlands and UK sites
 - Satellite detector – **LUCID** Timepix detector (first time launched into space!)

See talk by B. Parker

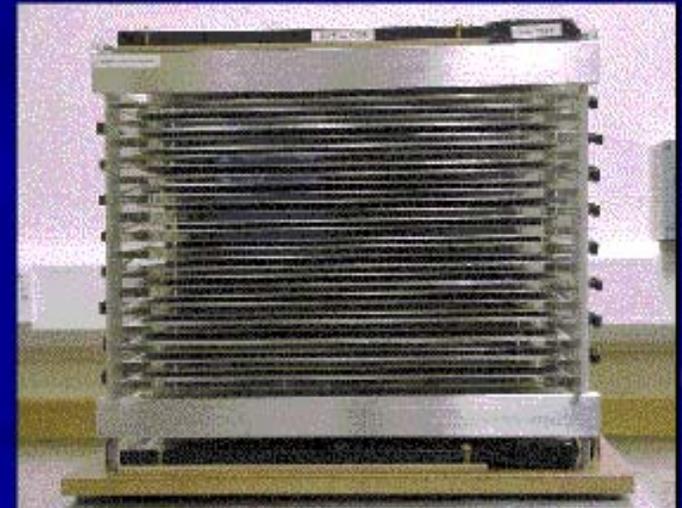
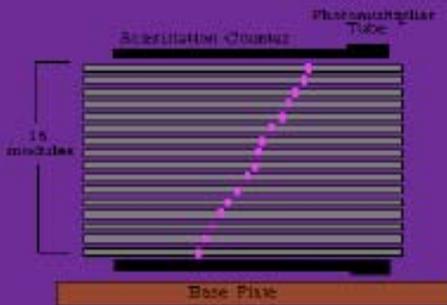


Spark Chamber demos in schools...

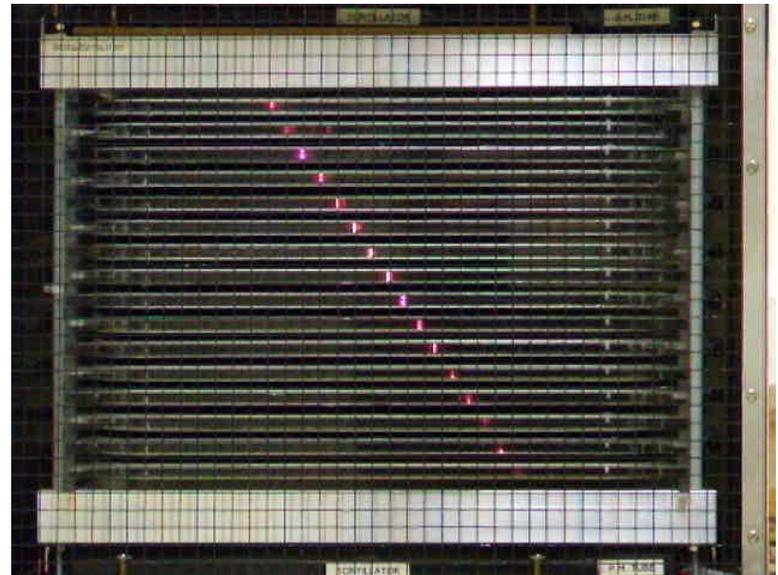
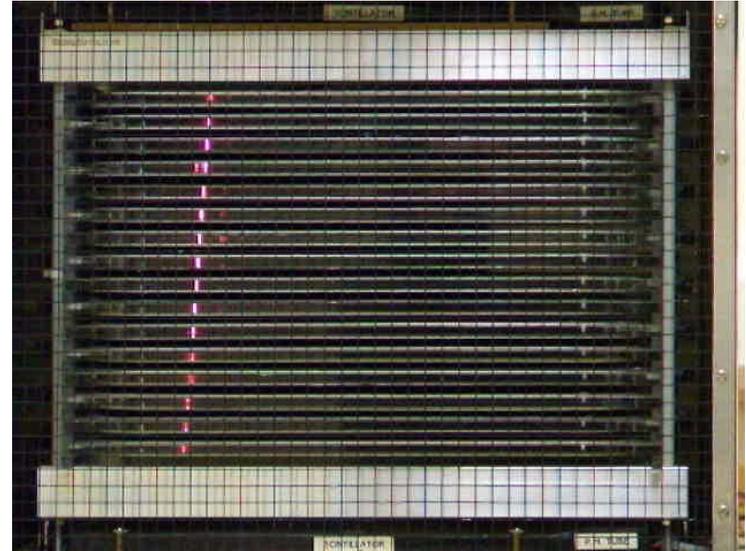
University
Birmingham

John Wilson visits up to 30 different schools per year, taking out the spark chamber to demonstrate cosmic rays and talk about particle detection

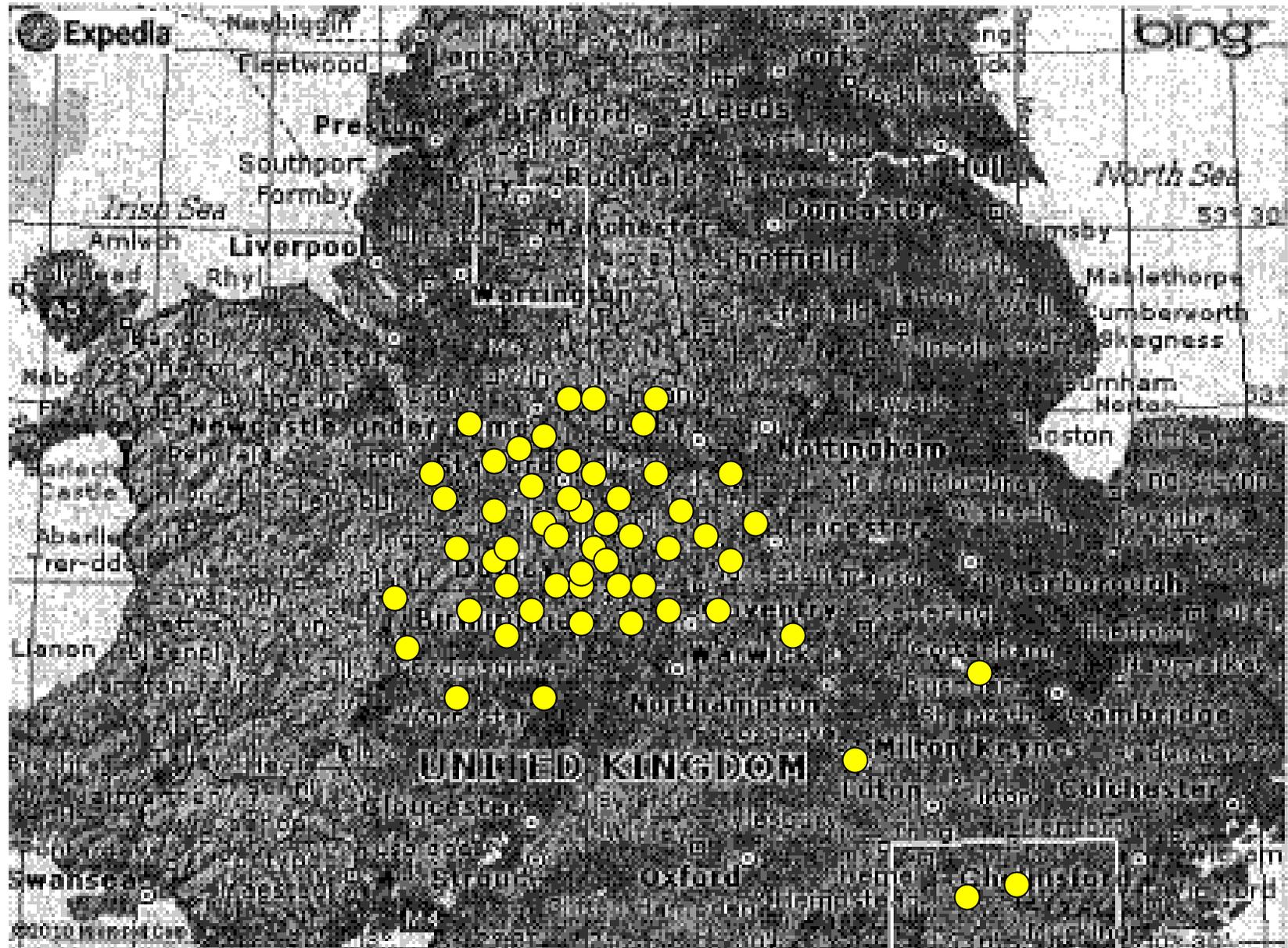
Feedback is excellent – and regular repeat bookings are made!



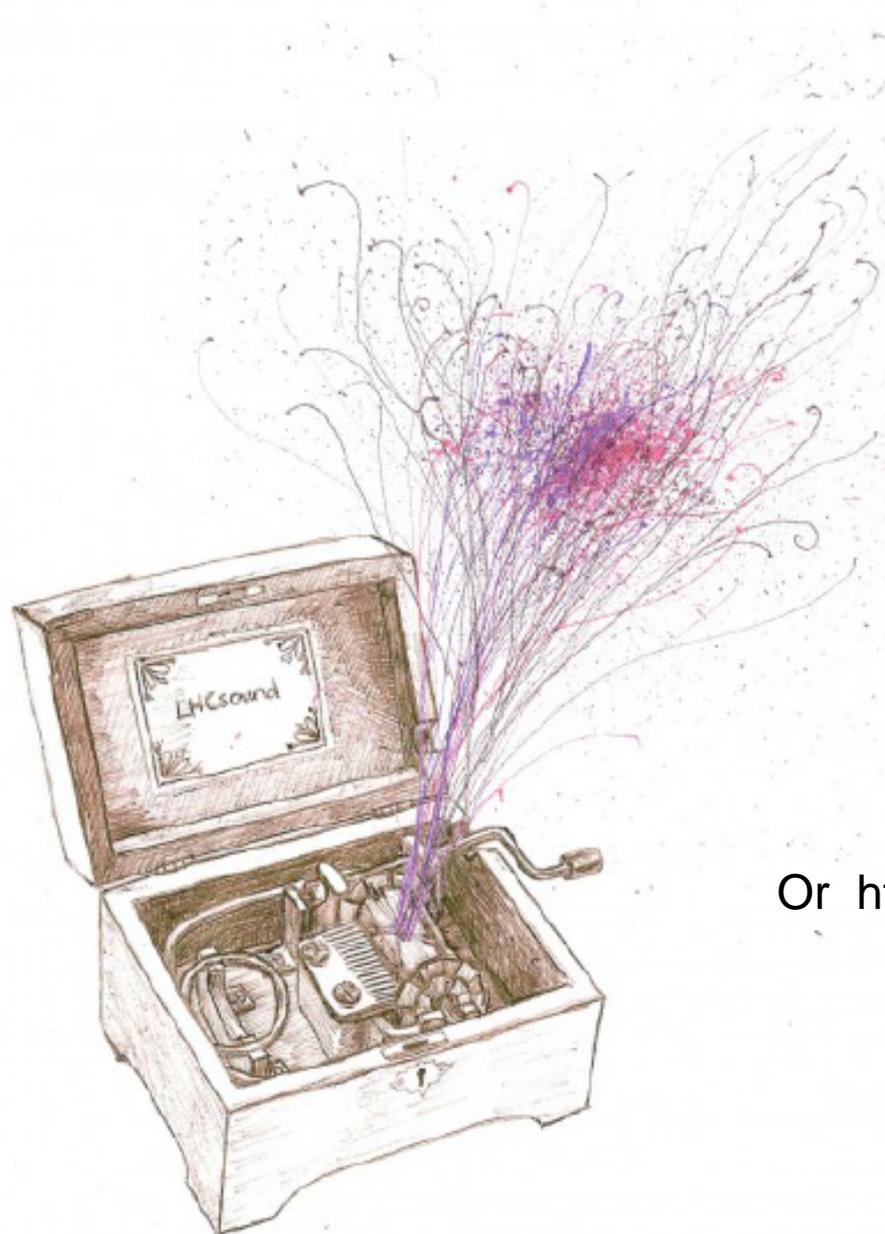
Transportable spark chamber: designed by final year undergraduates



“Have spark chamber – will travel” :
visits to about 20 schools per year since 2002



LHCsound: Sonification of ATLAS data



Using current state-of-the-art techniques employed in the music industry, we are producing audio representations of the LHC data which we hope will be musically interesting and therefore will engage and involve people who would not ordinarily have access to, or interest in, the ongoing experiments at CERN.

<http://www.lhcsound.com>

Or <http://www.lhcsound.moonfruit.com/>

We are funded by:



LHCsound: Sonification of ATLAS data

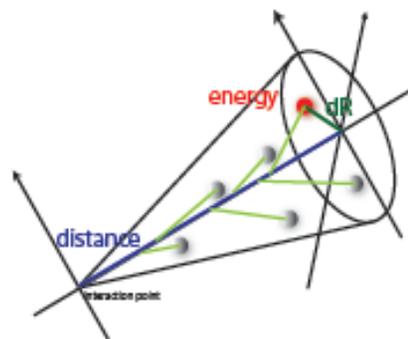
- ATLAS data → [Athena software] → log file → breakpoint file → [Compositional software] → audio file.
- Map objects tracks, clusters, jets, missing energy to pitch, timbre, and volume.

Fat Higgs jet example: (Click pic to play)

cluster energy : volume

cluster dR from jet axis : pitch

cluster distance from IP : time

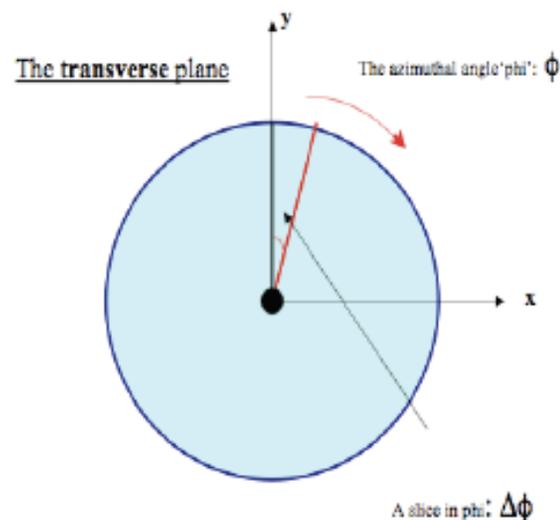


Tracking 'Phi-sweep' example:

track pt: pitch

track ϕ position : time

(analogous to radar)



<http://www.einsteinsuniverse.com/>

EINSTEIN'S UNIVERSE

Since 2005, Professor Brian Foster of Oxford University and **[Jack Liebeck]** have collaborated on lectures highlighting Einstein's love of the violin and how his ideas have shaped our modern view of the Universe. The lectures and associated violin and piano recitals present Einstein's Universe in the context of the music he loved - Mozart, Bach and others.

Widely acclaimed in the press and featured on Radio 4, RTE Ireland and the World Service, the lectures have been given all round the world. To book a performance at your school, theatre, science club or other venue, [contact](#)

[\[Professor Brian Foster\]](#)

[\[Press coverage\]](#)

For more details of the two available lectures, go to the respective pages:

[\[Einstein's Universe\]](#)

[\[Superstrings\]](#)

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Summary

- Only a few examples included
(apologies for all I have missed!)
- Many outreach activities now student led
- Very wide age range attracted to talks
- Next big challenge – Maintain interest in LHC through the pre-discovery phase!