The Beamline for Schools (BL4S) Competition

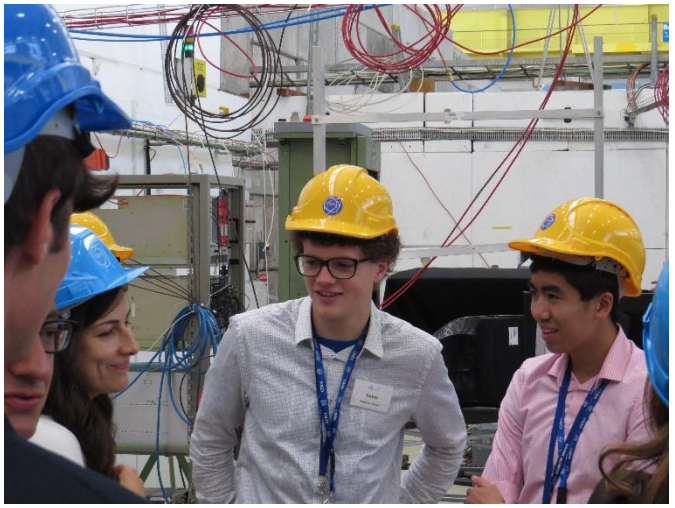
HEP 2017, 8.7.2017, Markus Joos, CERN

beamline for schools

cern.ch/bl4s

powered by CERN

Not long ago...



...two teams of high school students from Poland and the UK were performing their experiments in one of CERN's beamlines

BL4S – motivation and history

- CERN has a large potential to engage high school students and teachers with science
  - 120.000+ visitors per year (70% travel more than 600 km)
  - Among visitors are 45.000 high school students and their teachers
  - Since 1998 more than 10.000 teachers joined the CERN Teachers programs
- Idea of a worldwide high school competition was born in 2009 at the workshop “New Opportunities in the Physics Landscape at CERN”
- The “Beamline for Schools” competition started in 2014 as part of the “CERN 60” celebrations

BL4S - taking part

- BL4S: worldwide competition for teams of high school students, guided by a teacher / coach, to design and carry out an experiment at a beamline at CERN's Proton Synchrotron (PS)
- Teams have to design an experiment which uses a particle beam. They have to submit a written proposal (max. 1000 words) and a one-minute video
  - The main goal is to motivate the students to learn about physics by treating them as if they were professional scientists
  - Launch: summer, proposal submission: 31 March of the following year
  - Publicity made via: CERN social media, alumni of teacher programs and BL4S, visitors of CERN, IPPOG and many other channels

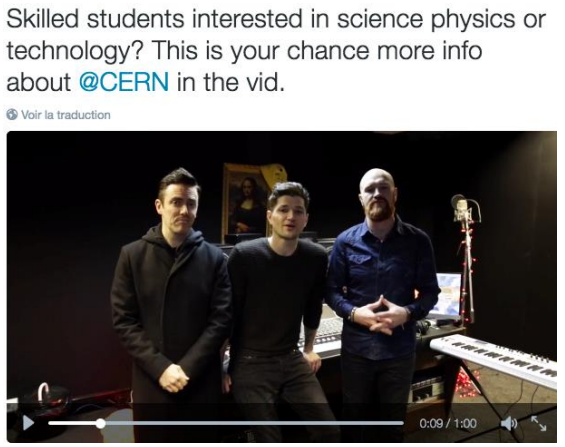
"CERN is a symbol of scientific progress itself, and it would be a pleasure for us to work in this magnificent factory of innovation and to be a part, even if a very small one, of the "acceleration of science". "
I Tauresini – Candidate team of 2016

BL4S - taking part [2]

- Equipment provided by CERN that can be used for the proposed experiments:
  - A beam providing electrons, muons, pions, kaons and protons with momenta between 0.5 and 10 GeV
  - State-of-the-art particle detectors (delay wire chambers, lead glass calorimeters, multi-gap resistive plate chambers, scintillators, silicon pixel detectors) read out by (a simplified version of) the ATLAS data acquisition system

BL4S - Support

- Teams can get support and advice from CERN's BL4S team or from volunteer physicists from all over the world, mainly via the International Particle Physics Outreach Group (IPPOG)
- The students may also ask other experts for help



- Celebrities visiting CERN help us to promote BL4S among the target group
  - 2014: Will.I.am (viewed 5000+ times on YouTube)
  - 2015: The Script (viewed 2500+ times on YouTube)
  - 2016: Bastille (viewed 2000+ times on YouTube)

BL4S - selection

- The evaluation of the proposals and videos is based on these criteria:
  - motivation of the students
  - creativity
  - feasibility of the proposal
  - demonstration of ability to follow the scientific method
- Step 1: Volunteers from CERN (including member state universities and laboratories) select the best 20 proposals and 10 winners of a special prize
- Step 2: A team of physicists as well as accelerator, beamline, detector, and safety experts selects 10 proposals from the short-list of 20
- Step 3: Members of CERN's SPS and PS Experiment Committee, SPSC, review the 10 proposals from step 2 and select the winners

The prizes

- An invitation to CERN for two teams (up to 9 students and 2 teachers each) for 10-11 days to conduct their experiment
- Additional prizes for shortlisted and noteworthy* teams
  - BL4S t-shirts
  - CosmicPi detectors
- Certificates for all participants

The main prize: All participants will have gained new and exciting knowledge of particle physics!

T-shirt

CosmicPi detector

* Teams that made a well motivated but unfeasible proposal

BL4S – Impact

	2014	2015	2016	2017
Full proposals	292	119	151	180
Countries	50	28	37	43

- 2/3 boys, 1/3 girls
- 1/3 from non member states
- In total ~7000 students have participated since 2014
- Teams spent on average 30 hours on making their proposal
- Short listed teams spent on average 40-50 hours (effort pays out…)
- Two winning teams have written scientific papers about their experiment
  https://beamline-for-schools.web.cern.ch/bl4s-winners

"The chance to do our experiment at CERN is a stimulating opportunity to learn physics extensively" - Simone Pierantozzi, winner of 2017

Country	Number of Applications	Country	Number of Applications	Country	Number of Applications	Country	Number of Applications
Australia	1	Georgia	1	New Zealand	5	Switzerland	6
Austria	1	Germany	26	Norway	2	Thailand	3
Bangladesh	1	Greece	32	Oman	1	Timor-Leste	2
Belgium	1	Hungary	4	Peru	1	Tunesia	1
Brazil	2	India	30	Philippines	4	Turkey	47
Bulgaria	1	Indonesia	1	Poland	22	United Arab Emirates	1
Canada	8	Iran	12	Portugal	22	United Kingdom	78
Chile	1	Ireland	2	Qatar	1	United States	50
China	1	Israel	10	Romania	14	Vietnam	1
Colombia	3	Italy	122	Russia	6		
Chile	3	Japan	1	Serbia	9		
China	5	Jordan	4	Singapore	9		
Colombia	3	Kenya	1	Slovakia	5		
Czech Republic	3	Lebanon	1	Slovenia	2		
Denmark	1	Malaysia	1	South Africa	6		
Egypt	3	Malta	1	South Korea	1		
Estonia	3	Mauritius	1	Spain	81		
Ethiopia	1	Mexico	7	Switzerland	2		
Finland	2	Montenegro	2	Sri Lanka	1		
France	8	Netherlands	18	Sweden	1		
						Applications received	Total 741

Participating team by nation 2014-2017

BL4S - Impact [2]

- Teachers tell us BL4S helps a lot to motivate their students
- Previous winners report that BL4S had a great impact on their choice of studies and university

Even though the impact of BL4S on the Web is still small compared to other activities of CERN, statistics show that BL4S helps to reach special target groups (women, teenagers and people in non-member states) in an efficient way.

National efforts:

USA in 2014 and 2015 (and maybe 2016):
US highly commended teams were invited to run their experiment in the Fermilab test beam by one of their physicists

Italy (INFN):
2015: Team “The fellowship of the ring” was invited to CNAO (Pavia)
2016: Team “Athomos” will be invited to LNS (Catania)

Support for BL4S

- CERN offers, in kind:
  - 10 days of beam time at a beam line of the Proton Synchrotron
  - the work force of a project leader, one administrative support person and a large number of volunteers that make small contributions
- BL4S annual budget is primarily funded by the CERN & Society Foundation with the support of private donors (companies and charitable foundations)
- Thanks to:
  - Arconic Foundation (former Alcoa) Foundation)
  - Motorola Solutions Foundation
  - National Instruments
  - Ernest Solvay Fund, managed by the King Baudouin Foundation
  - Danfysik

"The students in our country are forced to believe that science is only limited within text books. Just like our participation in this competition changed the way we look at science, this opportunity can help us inspire them to believe that miracles can only be achieved through science, that science can create revolutions and that the discoveries like the Higgs Boson and initiatives like the Montreal Protocol are the thoughts of scientists who weren't born genius but turned out to be ones because they too were like us, children with dreams of getting the answers to their life through science itself, believing that they could make a difference." -- The Rocket Bros, candidate team of 2016 from Bangladesh

The BL4S team at CERN

- One project leader (~0.5 FTE)
- Two support scientists (full time for 8-9 months)
- One person for administrative support (~0.2 FTE)
- 40+ volunteers for the evaluation of the proposals
- Help from the CERN & Society foundation for the fund raising
- ….and a lot of help from many kind colleagues

The winners

2014:
Odysseus' Comrades from Greece
Dominicuscollege from the Netherlands

2015:
Leo4G from Italy
Accelerating Africa from South Africa

2016:
Relatively special from the UK
Pyramid hunters from Poland

2017:

Team "TCO-ASA" from Italy:
Their project is to test at CERN a Cherenkov detector that they have build at their school

Team "Charging Cavaliers" from Canada:
The team proposed to challenge the Standard Model looking for particles with a fractional charge

2018 and beyond

- Personnel and funding for 2018 secured
  - The 5th edition has already been announced
  - More publicity will be made in autumn
- 2019 and 2020
  - CERN's accelerators will be switched of for maintenance and upgrade
  - BL4S may be hosted in another institute
- 2021+: BL4S will be possible in the refurbished East Hall
- The main challenge every year: Funding & Publicity
  - World wide there are ~470 million students of the right age….

Thank you!

2015

2014

2016