GROUP 3: FUTURE ACCELERATORS

ITW 2019
CERN

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<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CURRICULUM</th>
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</thead>
<tbody>
<tr>
<td>ENGLAND</td>
<td>Electric and magnetic fields, superconductivity, rotational dynamics, magnetic flux density, (cross-curricular link to Chemistry – mass spectrometry: ionisation, acceleration, ion deflection, ion detection)</td>
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<tr>
<td>GREECE</td>
<td>Electromagnetic field and movement of charged particles in it, calculating velocity and mass to charge ratio. Until recently there was a lesson about basic concepts related with laser, elementary particles and radiation and decay rates. That lesson was cancelled but we hope that will change soon.</td>
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<tr>
<td>PAKISTAN</td>
<td>Precision, electromagnetic induction, ionisation, accelerating particle in E &amp; B field, plasma, conservation Laws, radioactivity, decay rates, introduction to elementary particles, basic forces of nature and Standard Model.</td>
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<tr>
<td>SRI LANKA</td>
<td>What is Atom and the Electron, radiation and matter</td>
</tr>
<tr>
<td>TURKEY</td>
<td>Electric and magnetic fields, atoms, subatomic particles</td>
</tr>
</tbody>
</table>
KEY IDEAS – future high energy colliders

- Pushing energy limits
- Higher luminosity
- Stronger and superconductive magnets
- Lasers
- Plasma
- Future theory and application
KEY IDEAS – factors for consideration

- Economic factors
- Technical options
- Social and cultural factors
- Particle choices
- Hopes for the future
POTENTIAL STUDENTS’ Conceptions

• Students have prior knowledge of:
  • Precision
  • Electromagnetism
  • Motion of charged particle in E & B fields
  • Ionization
  • Conservation Laws
  • Standard units and conversion
  • Plasma
  • Basic principles of particle acceleration
POTENTIAL STUDENTS’ CHALLENGES

- What a particle is
- Students cannot realise that you can get higher energy without increasing size and cost
- No one knows where to look for the unknown
- Difficult to forecast the discovery of new particles
- They usually believe that with higher energy there will be new discoveries of elementary particles
- Introducing beam luminosity
- Interaction of the laser with matter
- Overlap of micro and astronomical black holes
BEST PRACTICE EXAMPLE (1/2)

1. Elicitation - Attract the attention
2. Thought shower - Hypothesis
3. Experimentation – Project based learning
Circular or linear accelerators
Build your own particle accelerator
Design a future accelerator (art competition)
Sharing ideas through debate competition
4. Conclusion (of the hypothesis)
5. Application of future accelerators - project based learning
6. Outreach programmes
HELPFUL MATERIAL AND RESOURCES

- Chine Colliders: [http://cepc.ihep.ac.cn/](http://cepc.ihep.ac.cn/)
- FCC Designer report: [https://fcc-cdr.web.cern.ch/](https://fcc-cdr.web.cern.ch/)
- Muon Accelerator Program: [https://map.fnal.gov/](https://map.fnal.gov/)
- Build your own particle accelerator: [https://www.scienceinschool.org/2014/issue30/accelerator](https://www.scienceinschool.org/2014/issue30/accelerator)
- S Cool Lab Resources
Conclusion
Diaventi, del Cenac. Maffiasc nella Villa Chiesa, al disotto di vari arazzi e ritratte nella direzione delle Case.

Monte

1. Casa
2. Casa
3. Casa
4. Casa
5. Casa
6. Casa
7. Casa
8. Casa
9. Casa
10. Casa

Ricev. Ingresso alla casa di alta alla gara, dietro alla prima porta. La parte centrale è la parte di esterna. La parte esterna di estagna.

L'uscita del faro della casa.