

INTERNATIONAL MASTERCLASSES HANDS ON PARTICLE PHYSICS

IMC 18 Report
Uta Bilow + Ken Cecire

IPPOG meeting, CERN
02.11.2017



Dates

- IMC18: 15.02. – 28.03.
- Fermilab VC: 03.03 – 24.03.
- UN Int. Day of Women and Girls in Science: 12.02.

Registration to IMC18

- Sept 15: Announcement of dates
- Oct 27: Registration opened (Fri last week)
- Dates for LHCb and ALICE doodled beforehand
- max. 2 VCs in parallel at CERN, always 4-5 pm CET
- single VCs at Fermilab, variable times
- More slots will open if required

Masterclasses with CERN VC:

ATLAS W

<https://doodle.com/poll/gf4smt5y4q8k9efg>

ATLAS Z

<https://doodle.com/poll/v7qw2rhdqchhk9h3>

CMS WZH

<https://doodle.com/poll/s6wsmpvugt4fwzcp>

LHCb

<https://doodle.com/poll/uvtaus64bsiichxy>

ALICE Strange Particles

<https://doodle.com/poll/za5mc5rnm55w6c9z>

ALICE R_AA

<https://doodle.com/poll/zgvewvvp5tfsaza2>

Masterclasses with Fermilab VC:

ATLAS Z

<https://doodle.com/poll/9k6n5446xc9ebna2>

CMS WZH

<https://doodle.com/poll/79w2xssfa7bibu69>

www.physicsmasterclasses.org/downloads/Circular2017_10_27.pdf

Registration – the numbers

	ATLAS Z	ATLAS W	CMS	LCHb	ALICE S.P.	ALICE R_AA	ATLAS Z	CMS WZH
	CERN						Fermilab	
Slots offered	110	40	60	45	35	5	many	many
slots taken <i>(in 2017)</i>	85 <i>(103)</i>	32 <i>(34)</i>	56 <i>(52)</i>	36 <i>(41)</i>	14 <i>(21)</i>	4 <i>(4)</i>	1	15
Still available	25	18	4	9	21	1	many	many
Institutes <i>(in 2017)</i>	68 <i>(78)</i>	21 <i>(31)</i>	37 <i>(39)</i>	30 <i>(31)</i>	13 <i>(19)</i>	4 <i>(4)</i>	1	8

New Countries / Institutes / Groups for IMC18

Confirmed:

- Bulgaria: Sofia (CMS)
- Qatar: Doha (CMS)
- Iran: Tehran (CMS)

- Strasbourg: ALICE group

Interest expressed:

- India
- Palestine
- Lebanon

IDWGS

- UN International Day of Women and Girls in Science = Feb 11
- IMC pilot in 2017 on Feb 10+11
 - 10 institutes, 3 video conferences
 - 320 girls, very well received
- Talk at LCHP Shanghai (Julia Djuvsland) + proceedings
- Poster at EPS-HEP Venice + proceedings
- 2018: IMC IDWGS on Feb 12
- Few requests for celebrating March 8 (Int. Womens Day) in addition
 - No special event from our side
 - Female moderators
 - Diverse groups in the VC

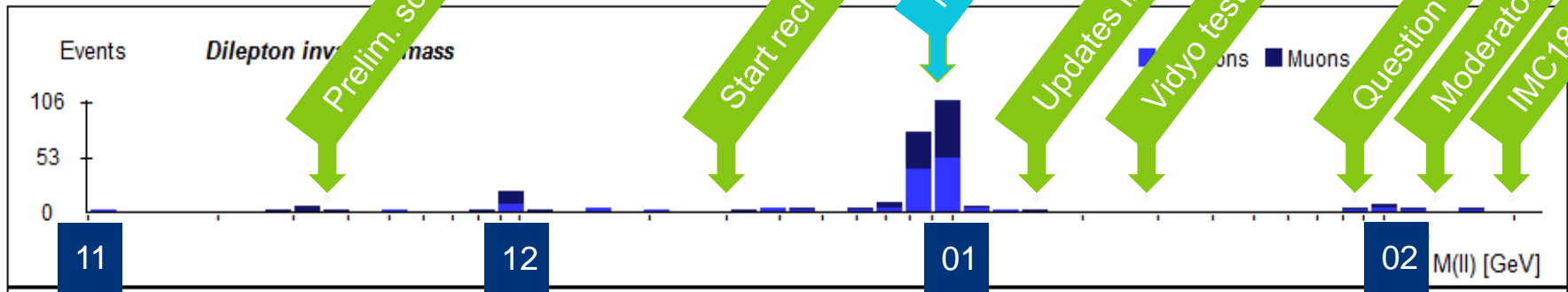


Communication

- Circulars
 - 2017: biweekly on Fridays
 - 2018: weekly on Fridays
- Twitter
 - @physicsIMC
 - #LHCIMC18
 - Team: Nicolas, Ken, Uta, more volunteers?
 - Schedule
 - Encourage institutes to tweet with specific tips (circular)
- Press release
 - Template for institutes



Timeline

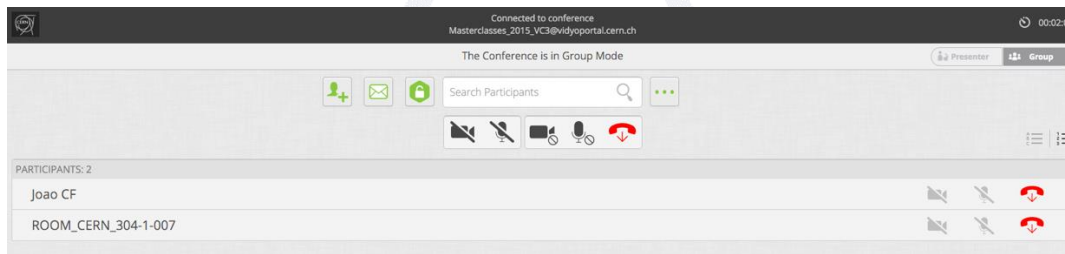


Measurements

- ALICE working on improvement of measurement
 - Change geometry, do reconstruction
 - To ROOT or not to ROOT
 - Non-ROOT more accessible to students; ROOT has a measure of authenticity
 - Event display should be what physicists use
- ATLAS Z exploring new physics but measurement stable
 - Add missing Et plot?
- CMS, LHCb, ATLAS W stable
 - CMS intro Drell-Yan

Vidyo

- New client with new features and different look
 - Moderator rights will change

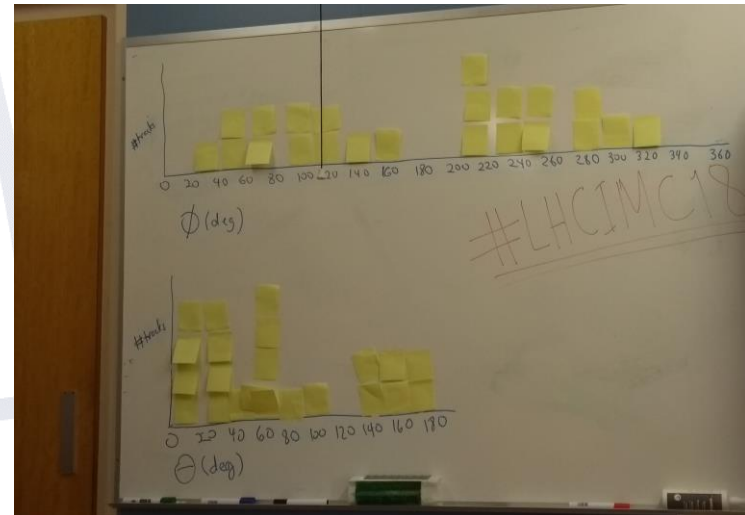


→ Not before or during IMC18!

World Wide Data Day

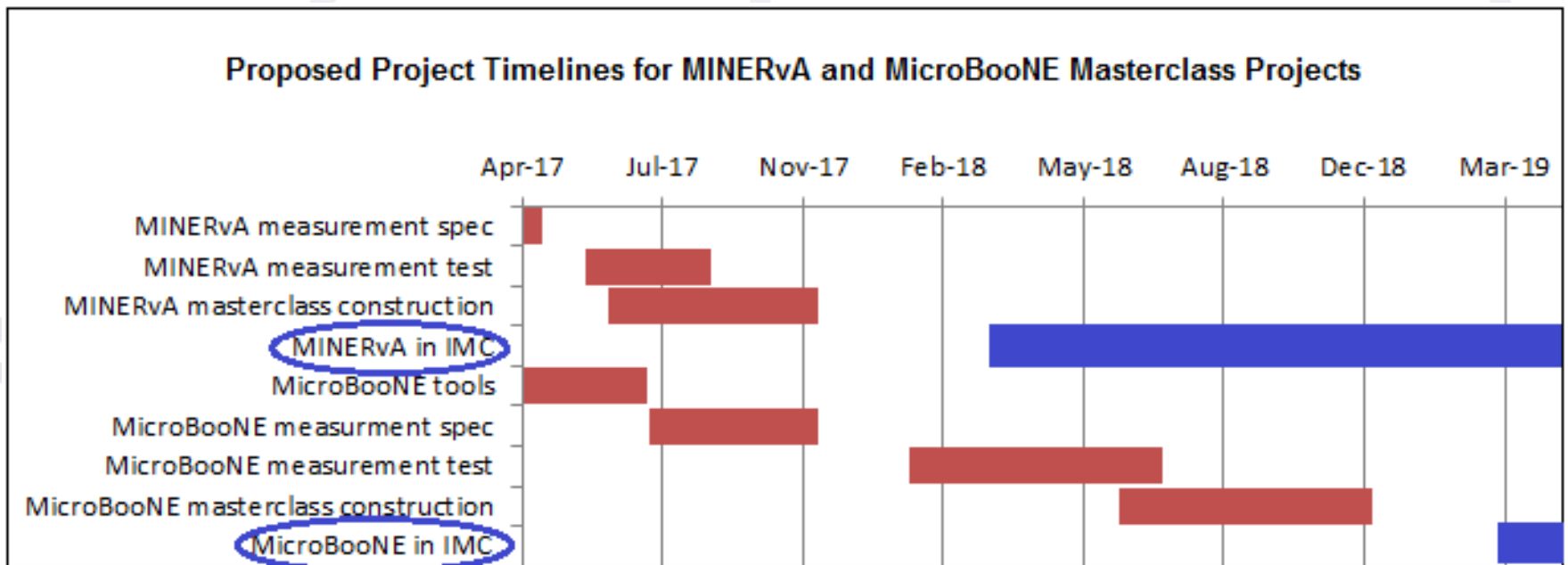


- “24-hour shift” for simple but meaningful measurements from ATLAS, CMS
- Students measure theta and phi for dimuon events, plot histograms.
- School do measurements, have VCs
- November 14, 2017 – 36 groups, ~480 students so far
- <http://tiny.cc/w2d2-17>
- We need moderators!
 - Continue
 - Maybe change focus/topic



Fermilab Neutrino plan

- Still in development
- Big goal: DUNE
- More neutrino masterclasses welcome – and not just at Fermilab



MINERvA masterclass

- First IMC neutrino masterclass
- Roll out in March and May (1 week each)
- Simple measurement
 - reject background; select signal events
 - find p_x , p_y , p_z of neutron in nucleus from ejected proton and muon
- p_z implies neutrino beam energy
- Uncertainty in p_x and p_y \rightarrow diameter of nucleus

Belle II Masterclass



- Super KEKB – 40x luminosity of KEK
 - Upsilon resonance – B mesons
- Target audiences of B2MC: students, high school, primary, public
- General intro: VR with Oculus Rift (make Google Cardboard version?)
- Two versions:
 - Web version, simpler, on server
 - Virtual appliance for download, more sophisticated analysis
- Start with Belle masterclass based on [B-Lab](#)
 - Analysis based on Blockly
 - Create histograms: J/Psi, upsilon, pi
 - Can add a fit to curve

Belle II Masterclass



→ Virtual appliance

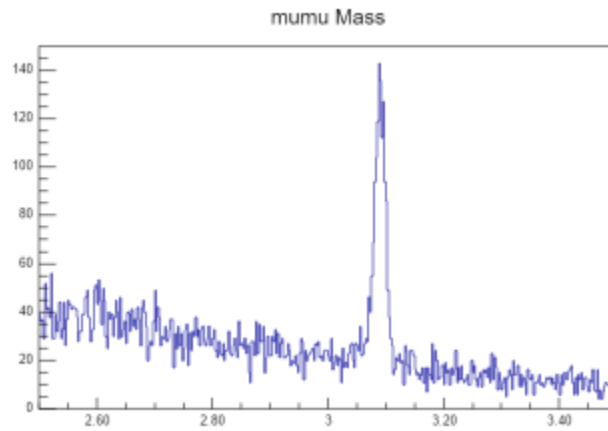
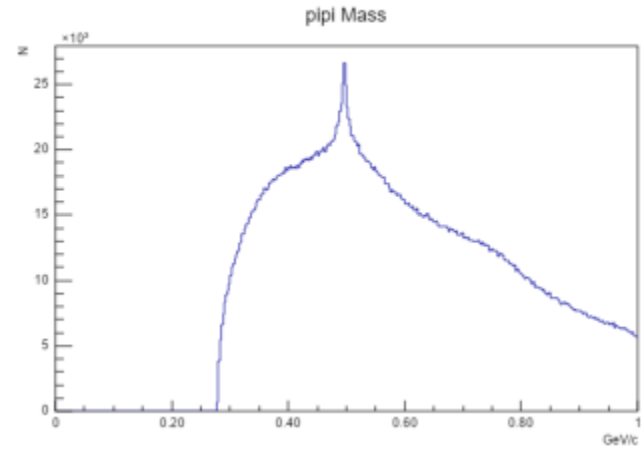
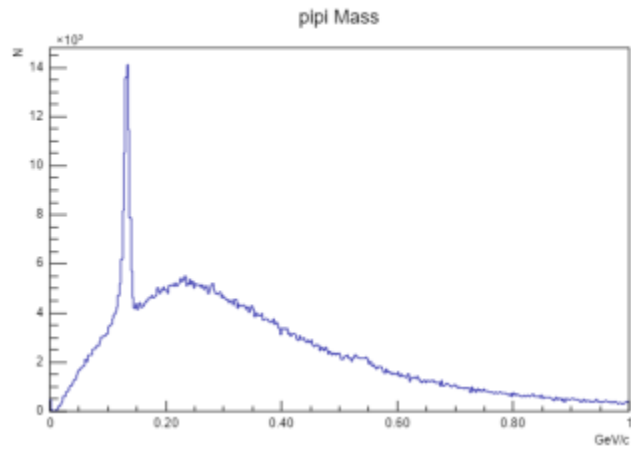
- VirtualBox VM: <http://belle2.ijs.si/bellelubuntu16.04.3.7z>
- unpack with <http://www.7-zip.org/>
- run with <https://www.virtualbox.org/>
- Start the VirtualBox
- Open the browser inside the virtual appliance and navigate
- to <http://localhost/masterclass>

→ Ideas, observations

- Look for matter-antimatter asymmetry in Belle/Belle2?
- More analysis, fewer events (students manipulate analysis code but do not examine event-by-event)
- Measurement takes 2 hr

Example table to be filled by students

Particle		Proces	Mass (GeV/c ²)	Number of entries	Number of detected particles	Probability	Decay width (GeV)
π^0	$\frac{1}{\sqrt{2}}(u\bar{u} - d\bar{d})$	$\pi^0 \rightarrow \gamma \gamma$					
Ks	$\frac{1}{\sqrt{2}}(ds\bar{s} + \bar{d}s)$	$Ks \rightarrow \pi^+ \pi^-$					
ϕ	$s\bar{s}$	$\phi \rightarrow K^+ K^-$					
J/ ψ	$c\bar{c}$	$J/\psi \rightarrow e^+ e^-$					
		$J/\psi \rightarrow \mu^+ \mu^-$					
D ⁰	$c\bar{u}$	$D^0 \rightarrow K^+ \pi^-$					
		$D^0 \rightarrow K^- \pi^+$					
D ⁺		$D^+ \rightarrow D^0 \pi^+$					
D ⁻	$d\bar{c}$	$D^- \rightarrow D^0 \pi^-$					
B ⁺	$u\bar{b}$	$B^+ \rightarrow J/\psi K^+$					
B ⁻	$\bar{u}b$	$B^- \rightarrow J/\psi K^-$					



Belle II Masterclass: Define process → Analyse data → Visualise results → Save/load process locally

Run Analysis Interrupt Switch between Diagram and Results Save Diagram Load Diagram

Particles
Analysis
Variables

Belle II Masterclass
Number of events: 50000
Data Source: hadron2
Particle List

Combine 2 particles

1. Partide
Select Particles
Particles
Charge: 0
Type: photon
Histogram

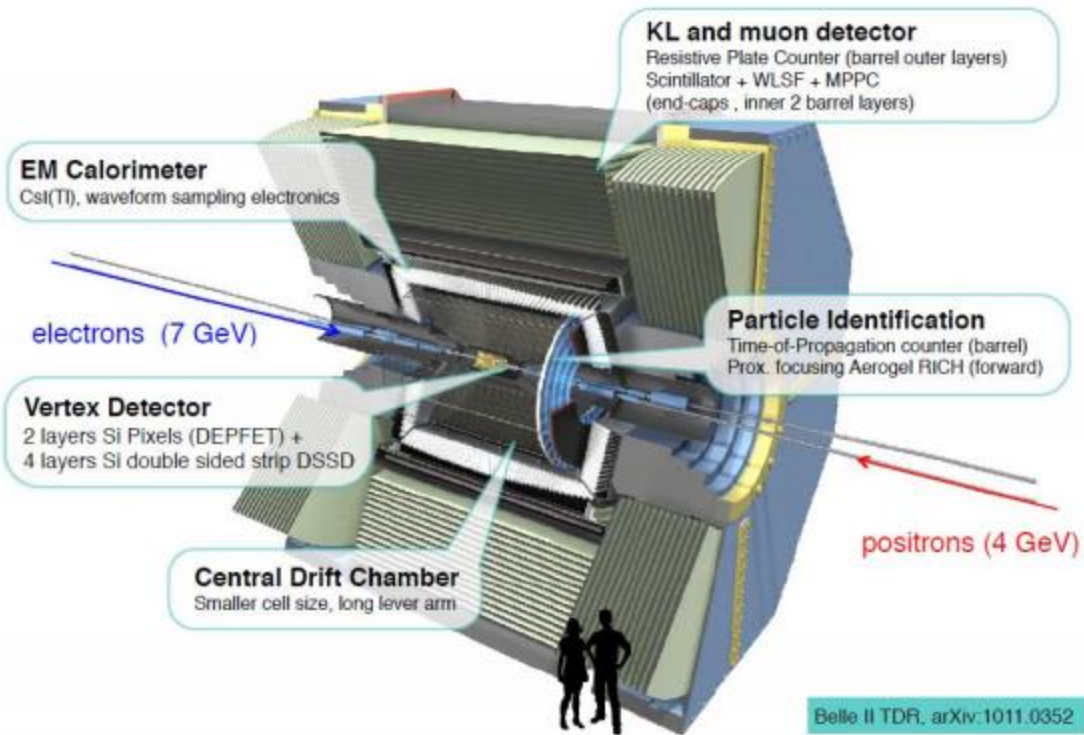
2. Partide
Select Particles
Particles
Charge: 0
Type: photon
Histogram

New Particle pion
Min mass [GeV]: 0.001
Max mass [GeV]: 1
Histogram

Histogram
Title: pi pi Mass; GeV; N
Number of bins: 400
Min: 0
Max: 1
Variable: mass

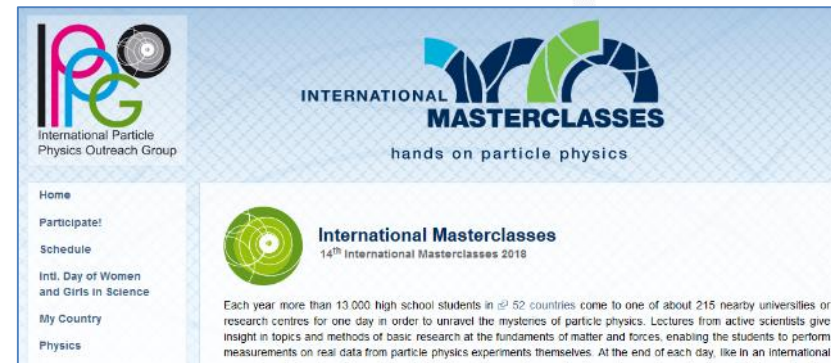
User describes a decay by blocks:

Belle II spectrometer

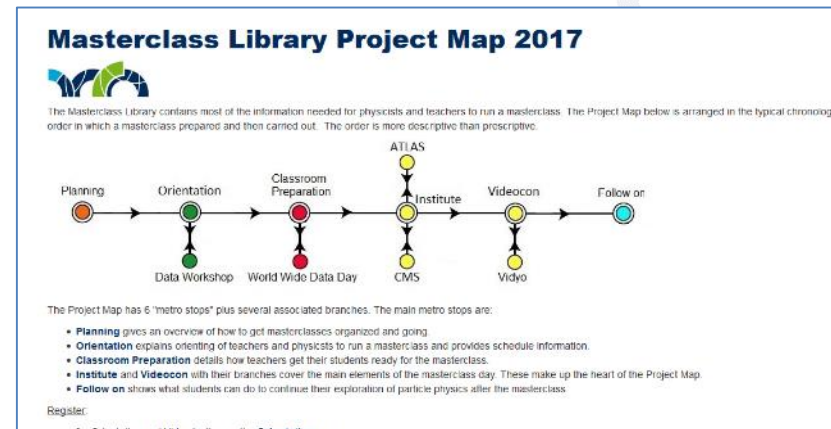


Website

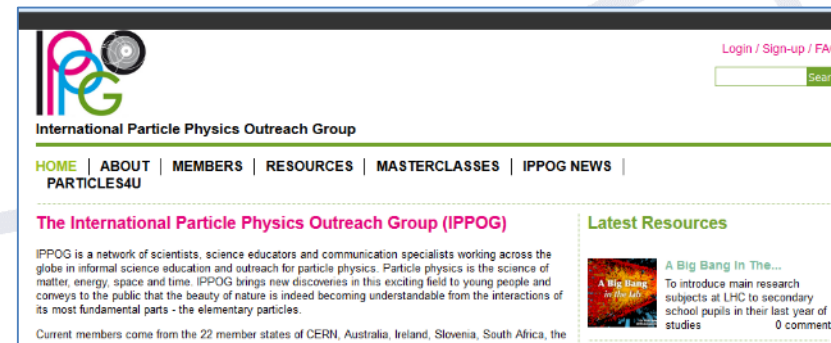
- www.physicsmasterclasses.org
 - hosted at TU Dresden
 - html
 - <https://quarknet.org/page/masterclasses-library-project-map-2017>
 - hosted at Fermilab
 - Drupal 7
 - ippog.org so far only links to physicsmasterclasses.org
- content will be integrated in ippog.org
- Only project, not individual measurements



The screenshot shows the top section of the International Masterclasses website. On the left is the IPPOG logo (International Particle Physics Outreach Group). On the right is the 'INTERNATIONAL MASTERCLASSES' logo with the tagline 'hands on particle physics'. Below the logos is a navigation menu with links: Home, Participate!, Schedule, Intl. Day of Women and Girls in Science, My Country, and Physics. To the right of the menu is a circular graphic and the text 'International Masterclasses 14th International Masterclasses 2018'. Below this is a paragraph of introductory text.



The screenshot displays the 'Masterclass Library Project Map 2017'. It features a central horizontal timeline with six main stops: Planning, Orientation, Classroom Preparation, Institute, Videocon, and Follow on. Each stop has associated sub-stops: Data Workshop under Orientation; World Wide Data Day under Classroom Preparation; ATLAS, CMS, and Institute under Institute; and Video under Videocon. A descriptive paragraph explains that the map is arranged in a typical chronological order. Below the diagram is a list of bullet points describing the main metro stops and a 'Register' link.



The screenshot shows the homepage of the International Particle Physics Outreach Group (IPPOG). It includes the IPPOG logo, a navigation menu with links for HOME, ABOUT, MEMBERS, RESOURCES, MASTERCLASSES, and IPPOG NEWS | PARTICLES4U. Below the menu is a section titled 'The International Particle Physics Outreach Group (IPPOG)' with a paragraph of text. To the right is a 'Latest Resources' section featuring a book cover for 'A Big Bang In The...' and a short description.

Particle Physics Masterclasses

Existing

- LHC-MC = IMC
- IceCube MC
- Pierre-Auger MC
- Neutrino MC (Minerva)
- Neutrino MC (Univ. York)
 - Activity demonstrating half-lives and the random nature of radioactive decay
 - Computer simulation of the liquid drop model of neutron stars
 - Use of advanced gamma detectors to analyse energy spectra and identify unknown sources and materials

Under development

- Neutrino MC (MicroBoone)
- Belle II MC

More ideas

- TOTEM
- CLIC
- SESAME
- ...

IMC as a roof?

- Is this all a Masterclass?
- Can/should IMC be a roof for this?
 - Not meant in terms of organisation, coordination
- Create a common webpage?
 - Short presentation of all MC projects with links to each project
 - URL and location of such page
 - Enhance visibility
 - Support general idea of IPPOG
 - URL of this webpage?

IMC Budget

- *IPPOG supports efforts to develop and improve the programme, including activities to broaden its scope in content, as well as geographical and social reach.*
- 5 k€ budget per year
- Draft of policies on spending
- Discussion in SG not finished yet, only minor details