pA@LHC workshop

http://indico.cern.ch/conferenceDisplay.py?confId=182223

The aim of this one-week workshop is to discuss expectations and open questions of the physics of proton-nucleus collisions in light of the upcoming p-Pb run at the LHC.

John Jowett

ABP-LCU meeting, 12 June 2012

Monday, 4 June 2012

09:00 - 16:00 pA@LHC: Machine and experimental capabilities

09:00 **pA in the LHC machine** *30'*
Speaker: Dr. John Jowett (CERN)
Material: Slides

More discussion elsewhere

09:30 **ALICE plans for pA data taking** *30'*
Speaker: Dr. Alberica Toia (Johann-Wolfgang-Goethe Univ. (DE))
Material: Slides

10:00 ~~**Coffee Break** *30'*~~

10:30 **Lessons from p(D)+Au at AGS, SPS and RHIC that will make pA at LHC a major milestone** *45'*
Speaker: Miklos Gyulassy (Columbia University)
Material: Slides

11:15 **Lessons from d-Au at RHIC for pA@LHC** *45'*
Speaker: Larry McLerran (BNL)
Material: Slides

12:00 **Common Discussion of presentations by Miklos Gyulassy and Larry McLerran** *30'*
Speaker: Urs Wiedemann (CERN)

Continuation of discussions started at Hard Probes 2012 (previous week)

14:00 **CMS plans for data taking** *30'*
Speakers: Ferenc Sikler (Hungarian Academy of Sciences (HU)), Ferenc Sikler (Wigner RCP, Budapest (HU))
Material: Slides

14:30 **Totem plans for pA data taking** *20'*
Speaker: Kenneth Osterberg (University of Helsinki)
Material: Slides

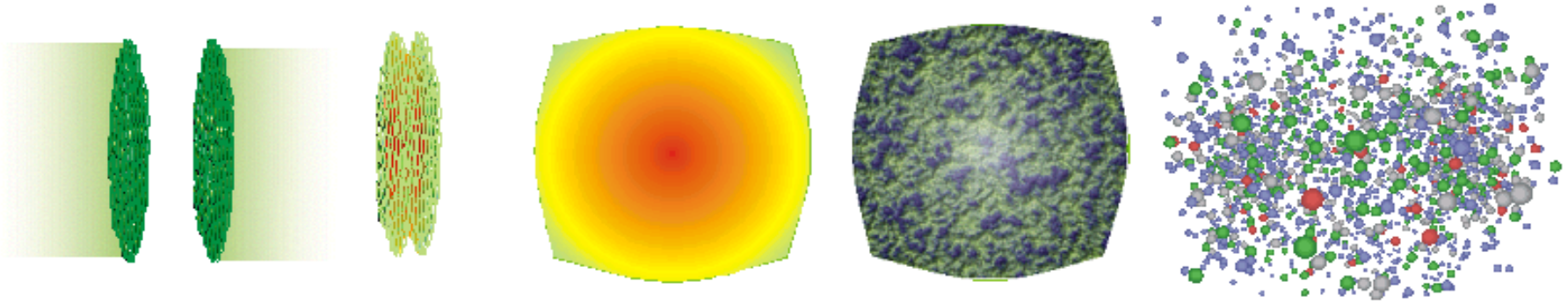
14:50 **LHCb plans for data taking** *20'*
Speaker: Michael Schmelling (Max-Planck-Gesellschaft (DE))
Material: Slides

15:10 **ATLAS plans for pA data taking** *20'*
Speaker: Alexander Milov (Weizmann Institute of Science (IL))
Material: Slides

15:30 **LHCf plans for pA data taking** *20'*
Speaker: Koji Noda (Universita e INFN (IT))
Material: Slides

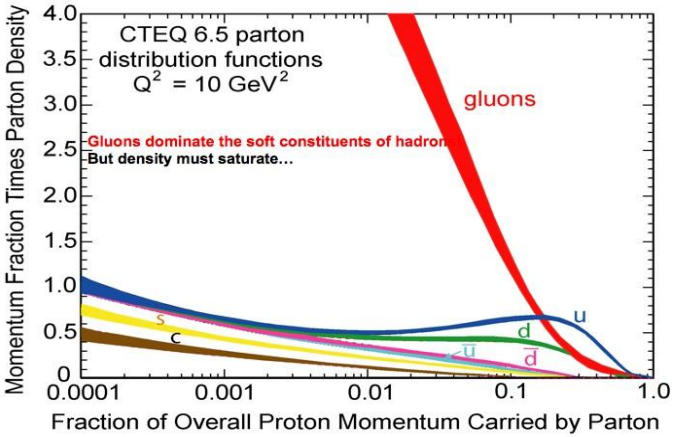
All LHC experiments

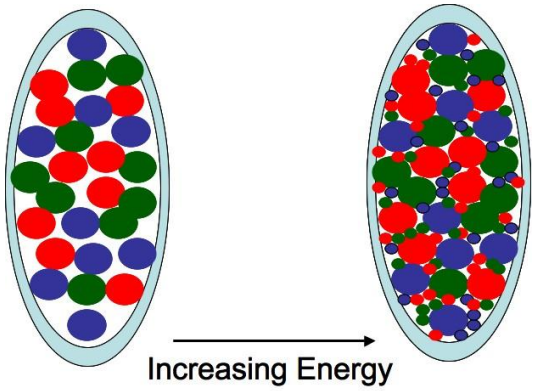
Implications for LHC pA Run from RHIC Results



---------- sQGP ----------

CGC | Initial Singularity | Glasma | Thermalized sQGP | Hadron Gas





Asymptotic Freedom: High density systems are weakly coupled because typical distances are short

$\alpha_S << 1$

Possible to understand from first principles

RIKEN BNL Research Center | RIKEN | RUPRECHT-KARLS-UNIVERSITÄT HEIDELBERG | HUAZHONG UNIVERSITY

ALICE requests

Running conditions

- Initial luminosity: L_0=10^{28}-10^{29} cm^{-2} s^{-1}
  → rates: 20-200 kHz
- σ(p-Pb) ~ 2 barn
- 22-24 operating days
  → Integrated luminosity: L_{int}= 15-25 nb^{-1}

J.Jowett (Chamonix, Feb 2012)

- ALICE can take ~ 1kHz MB triggers and can inspect most (80%) of the events at L0 with a rate to tape of ~ 200 Hz
  → Admixture of MB (1kHz) + rare triggers (~200 Hz)
  - Centrality
    Muons
    PHOS/EMCAL → photons, electrons, jets
    (TRD) → electrons, jets
  - MB: 1kHz x 2x10^4 (sec/day) = 2x10^7 events/day
  - Rare: 200 Hz x 2x10^4 (sec/days) = 4x10^6 events/day
    5 x 10^{28}cm^{-2}s^{-1} x 0.8 (lifetime) x 2x10^4 (sec/days) = 0.8x10^{33}cm^{-2}s^{-1}/day = 0.8 nb^{-1}/day

pA@LHC 04/06/2012 Alberica Toia

CMS requests

How much data? Which data?

- p-Pb reference
  - Need for a run corresponding to the binary-scaled statistics of PbPb (150 μb^{-1})

  $\Rightarrow$ **30 nb^{-1}**, that is, 60 billion p-Pb events
  - We prefer **a shorter but higher lumi run**, to accomodate pp
  - CMS could take the needed p-Pb, with few percent pile-up, in a week

Re-install CMS ZDC and CASTOR in Week 43

- pp reference
  - Now in PbPb we have 30 times more effective lumi than in pp
  - Need for a high luminosity pp run, "conditional strategy"
  - Current pp statistics limits the 2011 PbPb analyses, so far we have only 225 nb^{-1}, $\approx$ 20 billion pp events

  $\Rightarrow$ **6.4 pb^{-1}** @ 2.76 TeV pp events (factor 30), last chance before 2015

  $\Rightarrow$ and similar amount of pp @ 5 TeV, for p-Pb reference

Important discoveries with help of 2011 p-p to complement 2010 Pb-Pb

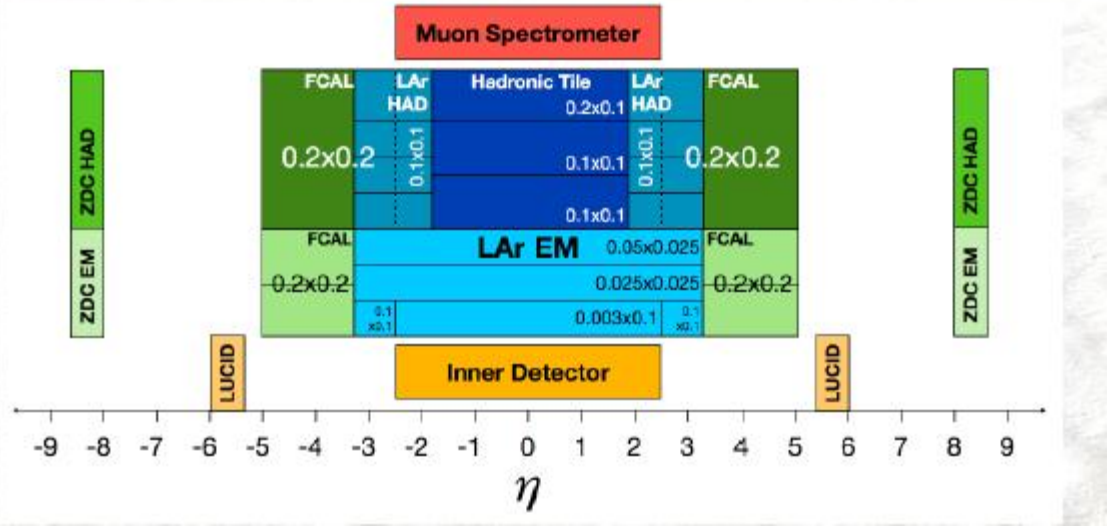
- p-Pb and Pb-p?
  - Both settings are interesting for systematic study
  - If only one, then p $\rightarrow\leftarrow$ Pb in CASTOR, to probe lower x_{Bj} in the Pb (same side as ALICE muons)

ATLAS request

Re-install ATLAS ZDC and LHCf in Week 43

The Input

p+Pb,	
$\sqrt{s_{pN}}$	5TeV
L_{int}	25nb^{-1}
total number of events	5x10^{10}
Total number of N_{coll}	3x10^{11}
For 10% most central	5x10^{10}
Pileup (assuming 300 b.c.)	0.1 not negligible



ALSO IMPORTANT

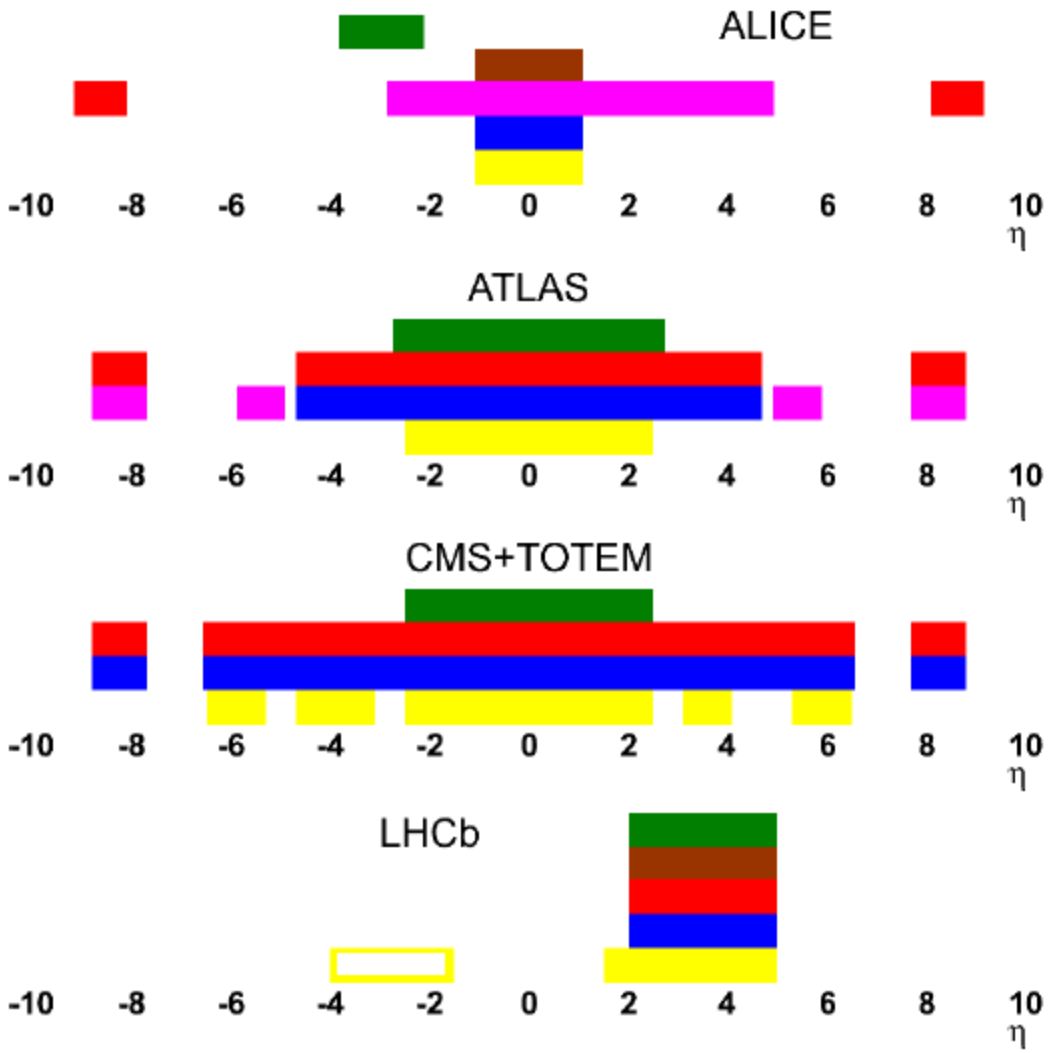
More instantaneous luminosity, or lesser number of b.c. ⍰ more pileup, affecting centrality determination. An approach would be to <u>have low luminosity running for some time and then switch to full luminosity.</u>

Centrality can be estimated vertex-by-vertex, probably with some loss of resolution.

How much statistics we need? Obviously the more the better, however <u>at some point getting p+p data at 5 TeV is more beneficial</u>, since using peripheral bin for normalization costs a factor of 4-6 in statistics. Having p+p run at P+Pb energy is very important.

LHCb joins heavy-ion physics

Comparison of Angular Coverage



- strengths of LHCb
  - → hadron particle-id
  - → tracking, particle-ID and calorimetry in full acceptance

TOTEM in pA run

TOTEM conclusions

- Will participate in pA data taking (together with CMS)
- Trigger:

low intensity: minimum bias, single proton
any intensity: double arm proton and CMS (jets & leptons)

- Charged particles: $3.1 \leq |\eta| \leq 6.5$
- Protons (assuming $\varepsilon_N = 2.5\ \mu m$ & RP@$15\sigma_{beam}$):

$0.028 \leq -\Delta p/p \leq 0.25$ OR $|t| \geq 5.9\ GeV^2$

|t|-acceptance improved going closer with vertical RPs

- Will need time for RP beam-based alignment
- Minimum bias physics, small x, quasi-elastic processes, diffraction, p+X+d etc...

LHCf will be re-installed in Technical Stop

LHCf in pA runs: Letter of Intent

CERN-LHCC-2011-015 / LHCC-I-021

- Physics goals
  - model discrimination with a cosmic-ray point of view, by photons, neutral pions & neutrons
  - nuclear modification factor
  - inelasticity and others?

  How much data will be required?
- Also, 1 detector has only 2 calorime
  so the particle *multiplicity* should be checked

Highest energy proton-nucleus accelerator data available for understanding of cosmic ray interactions with Earth's atmosphere (would prefer N to Pb but still …).

=> Monte Carlo simulation study

CERN Scientific Information Policy Board
7 June 2012

John Jowett

(BE Dept representative)

Experience from publication of first 150 ATLAS papers

ATLAS Top 10 by citation (4/6/12)

776 Expected Performance of the ATLAS Experiment - Detector, Trigger and Physics

566 The ATLAS Experiment at the CERN Large Hadron Collider

194 Combined search for the Standard Model Higgs boson using up to 4.9 fb-1 of pp collision data at $\sqrt{s} = 7$ TeV

161 The ATLAS Simulation Infrastructure

150 Search for squarks and gluinos using final states with jets and missing transverse momentum (Feb 11)

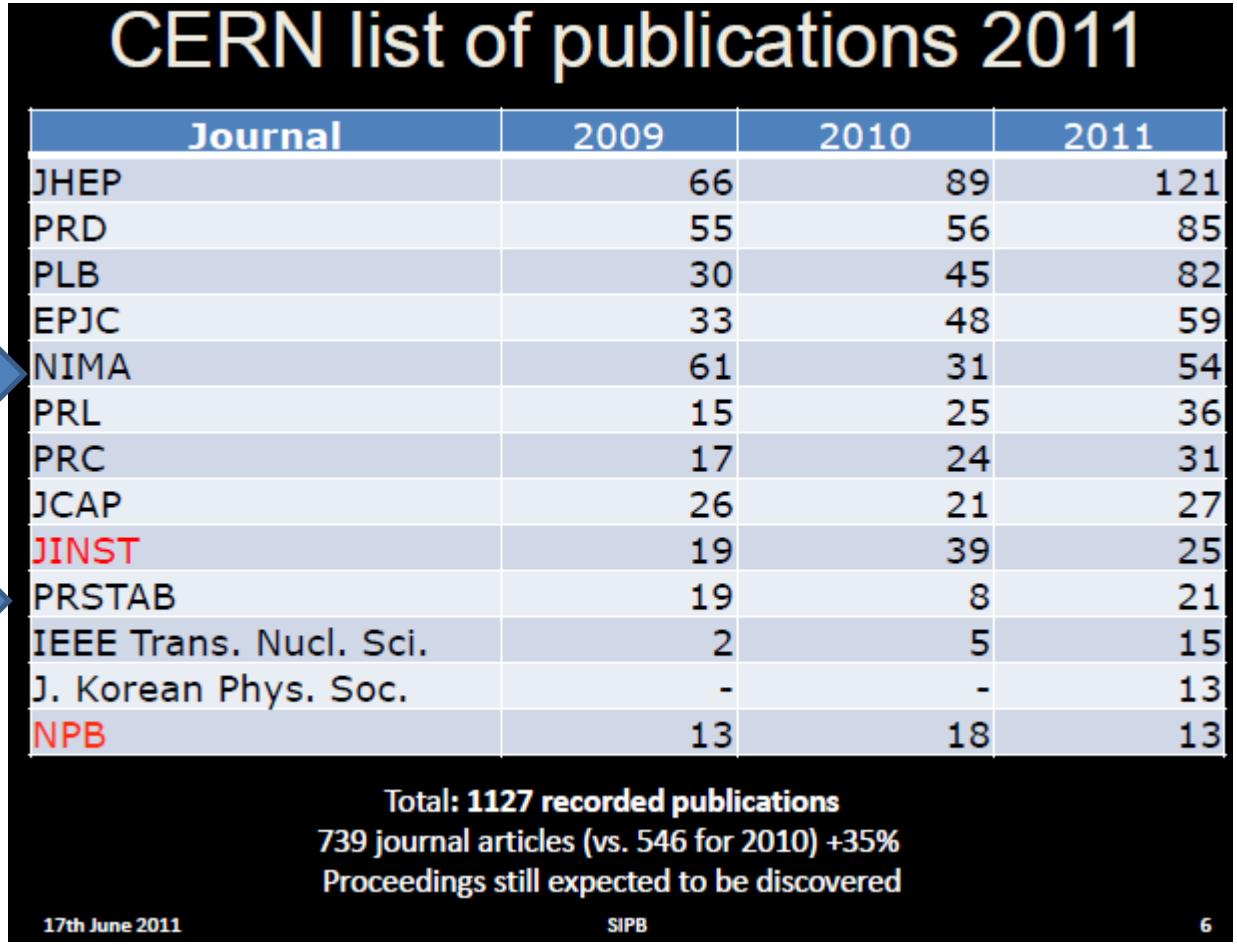
145 Search for squarks and gluinos using final states with jets and missing transverse momentum (Sep 11)

142 Search for supersymmetry using final states with one lepton, jets, and missing transverse momentum

136 Observation of a Centrality-Dependent Dijet Asymmetry in Lead-Lead Collisions

115 Charged-particle multiplicities in pp interactions at $\sqrt{s} = 900$GeV

112 Luminosity Determination in pp Collisions at $\sqrt{s} = 7$ TeV



CERN list of publications 2011

Journal	2009	2010	2011
JHEP	66	89	121
PRD	55	56	85
PLB	30	45	82
EPJC	33	48	59
NIMA	61	31	54
PRL	15	25	36
PRC	17	24	31
JCAP	26	21	27
JINST	19	39	25
PRSTAB	19	8	21
IEEE Trans. Nucl. Sci.	2	5	15
J. Korean Phys. Soc.	-	-	13
NPB	13	18	13

Total: **1127 recorded publications**
739 journal articles (vs. 546 for 2010) +35%
Proceedings still expected to be discovered

17th June 2011 SIPB 6

Problems raised and awaiting implementation of solutions in CDS:

1. Accelerator papers generally not included in arXiv.com
   - do it manually for now, then ask CDS to link
2. Email announcements in CERN before document is available
   –meanwhile make sure secretary doesn't generate your document number until approved and finalised for submisstion to CDS !!

Bookshop and library desk now combined.

Literature update

- 20 000 eBooks accessible from CERN
  - Another load of books have been added from Springer and EBL
- IEEE eBooks
  - We have acquired access to the full Wiley-IEEE Press collection, ~500 books. Will be loaded in CDS sh
- CINDAS databases
  - includes among others data from "Thermophysical Properties of N
- The Review of Particle Physics
  - To be published this summer by
- Springer plus – new OA journ
  - Editorial Board includes an edito
- OA Books: http://versita.com/Home/
  - EB member: Claude Amsler, University o

SIPB 7th June 20

Use INSPIRE and CDS for literature searches – disambiguate yourself.

Open access (EU, UK, USA, …)

A "picture" of a CERN Library user…

Why coming?

The services

Scan/Photocopy/Print	43.8%
Request an item	30.1%
Public terminals	23.3%
Bookshop	20.5%
Ask for information	16.4%
Cultural event	1.4%

The working space

I need a quiet space to work	74.6%
The atmosphere inspires me	48.5%
I don't have an office	14.2%
My office is inadequate for my activities	12.7%
I like to work in the library garden	9.0%

The collections

Consult books on place	56.5%
Borrow a book / Return a book	52.2%
Read a journal/magazine	23.9%
Get a free publication (PDG, Poster...)	9.8%

SIPB 7th June 2012, Jens Vigen

Other points from SIPB

- External copy-editing now going on
  - Chamonix proceedings, CLIC CDR,
  - Schools, etc
- Library would gratefully receive any paper copies of past CAS Yellow Reports that you don't need for return to stock
- CERN Physical Heritage preservation – 2008 policy not implemented, new effort
- CMS Data preservation, open access policy, eg, schools