# Information from the ALICE IPN Orsay group

# 1. Nature of the thematics

- Main Scientific goals (of ALICE in a nutshell):
  - Study fundamental aspects of QCD
    - Test of perturbative QCD calculations (heavy flavours at IPNO)
    - Influence of multiple parton interactions
    - Correlation of soft - to - hard particle production:
      - possible collective effects (small impact parameter, large multiplicities),
      - saturation (at low x), string percolation, ...
  - Study the ‘cold’ nuclear effects in a not too dense environment (pPb like or photo-production)
    - Modification of PDFs in nuclei, or gluon saturation (low-x) in nuclei
    - Influence of the nuclei in particle production
      - Parton energy modification by collisional and/or radiative processes, multiple parton scattering, coherent energy loss
  - Emphasis on the nature of QCD matter at high temperature and energy density (QGP)
    - Test of lattice QCD calculations reflecting the fundamental symmetries of the theory
    - Nature and characteristics of the phase transition
    - Precise determination of QGP properties:
      - Critical temperature, degrees of freedom, transport coefficients and equation of state

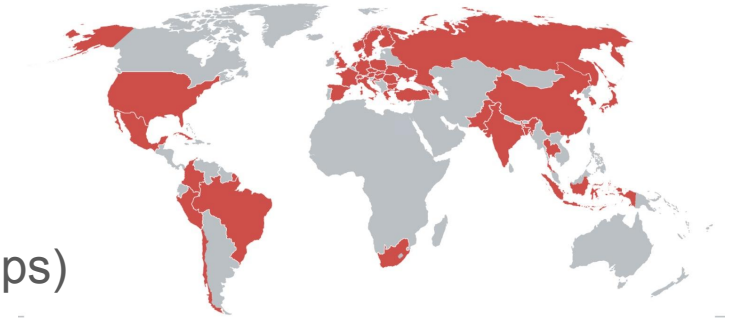
# 1. Nature of the thematics

- Main analysis activities of the IPNO group:
  - Observables:
    - heavy flavours (HF): D0→K$\pi$ at central rapidity, c+b →μ at large rapidity
    - quarkonia (onia): J/ψ → μμ, ψ' → μμ at large rapidity
    - W(→ μ$\nu$) and Z(→ μμ) bosons at large rapidity
  - Focus on:
    - Test pQCD, multiple parton interactions, saturation and collective effects in pp collisions (differential yields, multiplicity dependence + prospects for double production)
    - Study of nPDFs
      - W and Z production in pPb and PbPb
      - HF in pPb
      - Onia in photo-production
    - Influence of 'cold' nuclei in particle production (pPb): HF and onia
    - Transport properties in QGP (PbPb): high pt HF
    - Temperature and density of the QGP (PbPb): low pt HF and onia
- Strong Overlap between Hadronic Physics and Particle Physics (50-50%)

# 1. Nature of the thematics

- “Publishing number”:
  - Current ALICE author list from IPNO for physics publication:
    - 6 members (+1 in oct 2017) signing (no engineers, 2 PhD students included)
  - Technical internal Notes and publications related to detectors signed also by engineers:
    - Ex: Alice Technical Design Report (18 members signing)

# 2. Context



- International collaboration:
  - 42 countries, 174 institutes, 1800 members*
- National coordination “ALICE France” (7 groups)
- Interaction with labs in the valley:
  - CEA-Saclay (ALICE), LLR (CMS), LAL (LHCb)
    - Joint P2IO requests for postdoc with CEA-Saclay (ALICE)
    - Collaboration with CEA-Saclay in hardware and analysis activities (ALICE)
    - Joint workshops (IPNO/LAL/LLR) on prospects for fixed target physics
    - GDR-QCD
- Regular seminars inter-lab. theory+experiment:
  - IPNO, CEA-Saclay/IPHT, LLR, LAL, LPT, CPhT



*Numbers from november 2016

# 2. Context

Specificity/Novelty/Impact/Limit

- Expertise of the group internationally recognized
  - Organisation of conferences and workshops
  - Write-up of review(s)
  - Invitations to conferences / workshops
  - Convener of working groups in GDR-QCD and European network
- Expertise of the group recognized in the collaboration
  - Analyses conducted for all systems (pp, pPb, PbPb) at various energies
  - Chairs and members of the corresponding Paper Writing Committees
  - Members of paper and analyses Internal Review Committees
  - Talks on behalf of ALICE in (main) international conferences
- Responsibilities in ALICE at various levels (technical and physics)
  - Deputy of the Muon Tracker Project (since 2013)
  - Co-responsible for Muon Data Quality Assurance (2011-2013)
  - Convener of the Heavy Flavour Physics Working Group (2015 - Feb 2017)
  - Coordinator of the Physics Analysis Group D to hadron (2011 - 2014)
  - Coordinator of the Physics Analysis Group J/psi to dimuon (2011 - 2014)
  - Coordinator of the Event and Track selection Performance Group (2011 - 2013)
- Limited manpower, difficulties to get PhD/postdocs

# 3. Objectives

- Impact on the thematics on the short and mid-term
  - Data taking in ALICE approved for the next 10 years
  - Heavy ion Physics is part of the European Strategy for Particle Physics
  - Clear physics cases, as ex. for heavy-ion data:
    (collect more data for precise measurements of rare probes)
    - Thermal photons and low-mass dileptons
      → temperature and equation of state of the medium
    - Thermalization of partons in the QGP (with low pt heavy quarks)
      → interaction of heavy quarks with the medium (dynamics),
      density of the medium
    - In-medium parton energy loss as testing ground for multi-particle aspects of QCD and probe of the QGP density (with high pt light and heavy quarks)
      → transport properties of the medium
      (parton color and charge dependence)
    - Regeneration (vs. suppression) pattern of low-momentum quarkonia as probe of deconfinement
      → medium temperature and density

ALICE upgrade LOI

- 2019: Pb-Pb 2.85 $nb^{-1}$
- 2020: Pb-Pb 2.85 $nb^{-1}$ at low magnetic field
- 2021: pp reference run
- 2022: LS3
- 2023: LS3
- 2024: Pb-Pb 2.85 $nb^{-1}$
- 2025: 50% Pb-Pb 1.42 $nb^{-1}$ + 50% p-Pb 50 $nb^{-1}$
- 2026: Pb-Pb 2.85 $nb^{-1}$

# 3. Objectives

- Long-term future (15 years)
  - Plans for ALICE after 2029 are not settled
  - Continue to run not excluded?

- New possible axis / evolution (> 10/15 years)

  → No positioning of the group yet

  → Individuals start to express their interests

  → Several opportunities
  - Electron Ion Collider
  - FCC
  - Fixed Target Programme at the LHC
  - Others…

# 3. Objectives

- Profile of the ALICE group members and engineers involved in the project:
  - Scientific profile :
    - Data analyses (quarkonia, heavy-flavour, electroweak probes in pp, pA, AA)
    - Software development
    - Construction of the muon tracker chambers
    - Instrumentation for the upgrade of the muon tracker electronic readout
  - Technical profile :
    - Electronics engineers
    - Computer science engineers

- Technical needs for the future:
  - Upgrade of the muon tracker front end electronics during LS2
  - Experts in software development
  - 2 members of the group started discussions about implementation of a solid fixed target in ALICE ( timescale >= LS2). If pursued:
    - Technical skills on integration, instrumentation to be foreseen

# 4. Organisation of the thematics

How to reach the objectives (among the 5 laboratories + external links to other laboratories)?
Ex : Do we prefer a big lab or several labs? We Can give opinion on the structure in this section

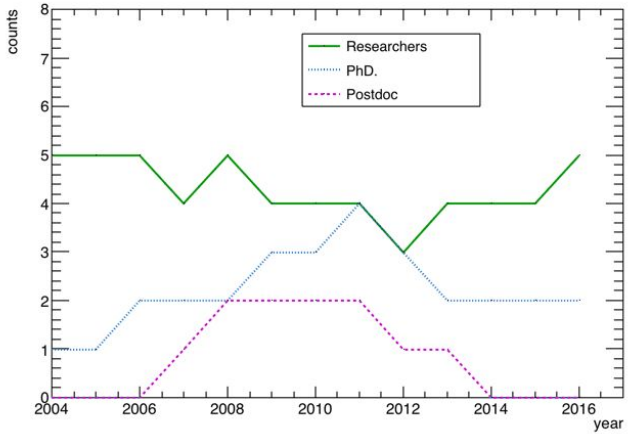
- No strong opinion from the group members
- Feeling that the new structure has no influence on the fact of reaching the objectives
- Technical needs but fusion not necessarily needed for that (expertises already shared among the labs)

# 5. Formation and valorisation

- 1 Professor teaching in Licence/Master
  - “M1 physique fondamentale”: nuclear and particle physics course
  - “M2 Rayonnement et énergie”: detectors in high energy physics course
  - All teaching at Paris Sud University
- Contributions from group members to:
  - CERN ALICE Master class
  - Seminars for the general public / Seminars at high school
- Deputy director of ED MIPEGE (2010-2015)
- Formation:
  - 5 PhD thesis completed over the last 10 years (2 ongoing)
  - 12 L3/M1 and M2 students since 2006
- Future of the PhD students since 2007:
  - 3 in research, 1 got a permanent position, 1 left research
- Teaching at Ecole IN2P3
- Participation to “Fetes de la Science”, Main à la pâte, “60 ans du CERN” (palais de la découverte), guided tour of the detector at CERN

# 6. Statistical elements

- Current (wo)manpower:
  - 5 researchers (4 CNRS, 1 prof.)
  - 2 PhD students
  - 3.5 FTE engineers
- Evolution of the (wo)manpower since 2004 (detailed table in next slides)




- Number of people who participated in building the detector: 11.5 FTE engineers
  - 5,9 FTE au SEP, 3,1 au RDD et 2,5 au S2I (year 2005)

# 6. Statistical elements

- Current (wo)manpower:
  - To avoid double counting all %FTE should be shared equally between hadronic physics and particle physics

| Name | arrival | departure | %FTE ALICE | %FTE AFTER | %FTE PBC | Status |
|---|---|---|---|---|---|---|
| Espagnon Bruno* | 01/09/2001 | | 10 | 0 | 0 | PR |
| Suire Christophe** | 01/01/2004 | | 100 | 0 | 0 | CR |
| Hadjidakis Cynthia | 01/10/2008 | | 80 | 10 | 10 | CR |
| Conesa del Valle Zaida | 01/01/2013 | | 100 | 0 | 0 | CR |
| Massacrier Laure | 01/10/2016 | | 80 | 18 | 2 | CR |
| Tarhini Mohamad | 01/10/2014 | 01/10/2017 | 100 | 0 | 0 | PhD |
| Crkovska Jana | 01/10/2015 | 01/10/2018 | 100 | 0 | 0 | PhD |

* Lab deputy director ** Head of the group

# 7. “Additional informations from IPNO”

Guillaume Martinet (accelerator division) contacted us and couldn’t be present at previous meeting. Informations from him:

- Wanted to contribute to the WG to make the link between high energy physics PHEN IPNO group and future accelerators projects
- Accelerator division of IPNO has contributed to the LHC upgrade (SPL)
- Currently involved in ESS
- Foresee to participate to FCC and/or ILC
- Link with “Accelerator and Associated technologies” Working Group

# Back up

# 6. Statistical elements

- Past years
  - To avoid double counting, all %FTE should be equally shared between particle and hadronic physics working groups

| Name | arrival | departure | %FTE ALICE | Status |
|---|---|---|---|---|
| Le Bornec Yves | 1996 ? | 2011 | 100 | DR |
| Bimbot Louis | ? | 2010 | 10-20% | DR |
| Willis Nicole | 1996? | 01/09/2008 | 50 | PR |
| Comets Marie-Pierre | ? | 01/12/2006 | 50 | CR |
| MacCormick Marion | 1996? | 01/11/2003 | 100 | CR |
| Das Indranil | 01/10/2011 | 01/10/2014 | 100 | Postdoc |
| Tapia Takaki Daniel | 2008 | 2013 | 100 | Postdoc |
| Lopez Noriega Mercedes | 12/2007 | 12/2010 | 100 | Postdoc |

# 6. Statistical elements

- Past years
  - To avoid double counting all %FTE should be shared equally between hadronic physics and particle physics

| Name | arrival | departure | %FTE ALICE | Status |
|---|---|---|---|---|
| Lakomov Igor | 01/10/2011 | 01/10/2014 | 100 | PhD |
| Valenzia Palomo Lizardo | 01/10/2010 | 01/10/2013 | 100 | PhD |
| Bianchi Livio | 01/10/2009 | 01/10/2012 | 100 | PhD (shared with INFN Torino) |
| Boyer Bruno | 01/10/2008 | 01/10/2011 | 100 | PhD |
| Malek Magdalena | 01/10/2006 | 01/09/2009 | 100 | PhD |
| Charpy Alexandre | 01/10/2004 | 01/10/2007 | 100 | PhD |