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Input from ALICE to the "Last Call for Predictions" Workshop

1. Introduction

Following a request from the organizers of the workshop "Heavy Ions at LHC: Last Call for Predictions" (http://fpaxp1.usc.es/nestor/predhiclhc.html), we provide in this document an overview of the kinematical windows accessible in ALICE. The information, given schematically in section 2, is complemented by a "wish list" presented in section 3.

2. Table of the kinematical ranges

The aim of this document is to provide condensed information about the physics reach of the ALICE experiment. A detailed description of the ALICE apparatus can be found in the ALICE Physics Performance Report, Vol. I (J. Phys. G 30 (2004) 1517).

The information on the accessible kinematical windows is summarized schematically in table 1. For each signal, we give the rapidity and transverse momentum range accessible in ALICE. In most cases we have also tried to provide an estimate of the maximum transverse momentum we expect to be accessible for a typical yearly run, which we have taken to correspond to either 10^7 untriggered central events (10% centrality) or to an integrated luminosity of 0.5 nb^{-1} for triggered events.

For the rapidity ranges: "mid" indicates acceptance in the central detector (roughly $|\eta| < 0.9$) and "backward" indicates acceptance in the muon arm (roughly $-4.0 < \eta < -2.4$).

All ranges must of course be taken to be only indicative: the table is just meant to provide an idea of the ALICE capabilities to help focusing the work of the theorists participating in the workshop. For accurate information on the ALICE physics performance, please refer to the ALICE Physics Performance Report, Vol. II (J. Phys. G 32 (2006) 1295). Of course, absence of a signal from the table does not imply that the signal will not accessible.

3. Wish list

Below, we provide an explicit list of predictions that we would like to call for:

3.1 Soft sector

- Particle production:
  - $dN_{ch}/d\eta$ distributions vs centrality (see 1st line of Table 1)
  - charged multiplicity (integrated over the range quoted, and in the restricted range $|\eta|<0.9$) vs. centrality, in particular vs. Npart and Ncoll
  - yields, ratios, rapidity and p_T spectra, R_{AA}, R_{cp} for $\pi^{\pm}$, π^o, $K^{\pm}$, K^o_S, p , $\overline{p}$, Λ, Ξ^-, Ω^- and resonances (ρ, ω, φ, K*) as a function of centrality and energy
  - hard-hard and hard-soft di-hadron angular correlations, in particular for Λ, Ξ^-, Ω^-

- HBT:
  - calculations for different equations of state in any model. In particular, predictions for azimuthally-sensitive correlations relative to the first-order reaction-plane
  - use of Koonin-Pratt equation to convolute squared wavefunction with two-particle emission source is preferred to simple calculation of "HBT radii"
  - calculation of the correlation function for unlike particles.
  - inclusion of realistic hadronic-afterburner. The best would be calculations both with and without afterburner.
- Flow:
  - v2,v4 versus pt and impact parameter for $\pi^{\pm}$, π^{o}, $K^{\pm}$, K^{o}_{S}, p , $\overline{p}$, Λ, Ξ^{-}, Ω^{-}
  - amount of viscosity at the LHC, effect on v2
- Event-by-event:
  - long-range correlations as a function of energy and centrality. Balance functions
  - net charge fluctuations and higher moments
  - temperature ($<p_T>$) fluctuations
  - hard-soft (mach cone type) correlations

3.2 Heavy Flavour /Quarkonia

- D^0, D^+ yield and p_T distribution for 5% central Pb-Pb
- R_{AA}, R_{cp} for D, D_s, Λ_c
- D_s/ D^+, Λ_c/ D^+, vs p_T and centrality
- e from B: yield and p_T distribution for 5% central Pb-Pb
- R_{AA}, R_{cp} for e from B (central rapidity)
- R_{AA}, R_{cp} for μ from B (backward rapidity)
- D v_2
- e from B v_2
- J/ψ / open charm vs p_T, centrality
- R_{AA}, R_{cp} for J/ψ, Υ, Υ' vs p_T, centrality. In particular, for J/ψ, up to the gluon splitting region.
- v_2 for J/ψ, Υ, Υ' vs p_T, centrality
- J/ψ polarization in central Pb-Pb (+ sensitivity to choice of polarization axis)
- D^0 differential cross section for $|y| < 1$, $p_T > 0$ in pp at 14 TeV
- e from B differential cross section for $|y|<1$, $p_T > 0$ in pp at 14 TeV
- μ from B differential cross section for, $p_T > 1.5$ GeV in pp at 14 TeV
- $\Delta\varphi$ (μ^+-μ^-) for $-4 < y < -2.5$ in pp

3.2 High pT / Jets, Photons

- jet quenching: energy loss distribution as a function of jet energy (down to a few GeV) and energy density
- jet quenching: phase space distribution of radiated gluons
- direct γ pT distribution for 5% central Pb-Pb
- direct γ R_{AA}, R_{cp}
- direct γ v_2
- $\gamma^* \rightarrow e^+e^-$ p_T distribution
- $\gamma^* \rightarrow e^+e^-$ R_{AA}, R_{cp}
- thermal photon yield and p_T distribution (1 to 5 GeV p_T)

Particle	Rapidity	p_T range (GeV)	One-year p_T reach (GeV)
charged multiplicity	$-3.4 < \eta < 5.1$		
π/K/p (track-by-track)	mid	0.1/0.3/0.3 – 50/3/50	
π/K/p (statistical)	mid	0.1/0.3/0.3 – 50	
π^0 (statistical)	mid	0.5 – 40	
π^0 (particle by particle)	mid	40 – 100	
η (statistical)	mid	2 – 20	
γ (statistical)	mid	1 – 40	
γ (particle by particle)	mid	10 – 100	
K^0_S	mid	> 0.2	20
Λ	mid	> 0.5	16
Ξ^-	mid	> 1	12
Ω^-	mid	> 1.5	10
$\rho^0/\omega/\varphi$	backward	> 1.5	3
ρ^0	mid	> 0.2	8
Δ(1232)	mid	> 0.25	2
Φ	mid	> 0.2	15
K*(892)	mid	> 0.2	15
Λ(1520)	mid	> 0.5	5
D0	mid	> 0.5	15
D+	mid	> 0.5	15
D_s	mid	> 1	under study
Λ_c	mid	> 1	under study
e from B	mid	> 1	20
μ from B	backward	1.5 – 25	
J/ψ ($\rightarrow e^+e^-$)	mid	> 0.5	10 (untriggered)
J/ψ from B	mid	> 0.5	10
J/ψ ($\rightarrow \mu^+\mu^-$)	backward	> 0	30
ψ' ($\rightarrow \mu^+\mu^-$)	backward	> 0	total σ only
ϒ ($\rightarrow e^+e^-$)	mid	> 0	total σ only (untriggered)
ϒ ($\rightarrow \mu^+\mu^-$)	backward	> 0	15
ϒ' ($\rightarrow \mu^+\mu^-$)	backward	> 0	10
ϒ'' ($\rightarrow \mu^+\mu^-$)	backward	> 0	6
d / t / ^{3}He / ^{4}He	mid	0 – 10	
μ from $W^\pm$	backward	> 25	80
Z^0	backward	> 0	total σ only
"jets" via leading particle	mid	> 0.5	150
jets (reconstructed)	mid	> 30	250

Table 1: kinematical ranges accessible in the ALICE experiment (see text)