

LHC_8: Measurements of Jets and Photons in Heavy Ion Collisions at the Highest Beam Energy during the LHC-Run 2 by ALICE

Hiroshi Masui, University of Tsukuba



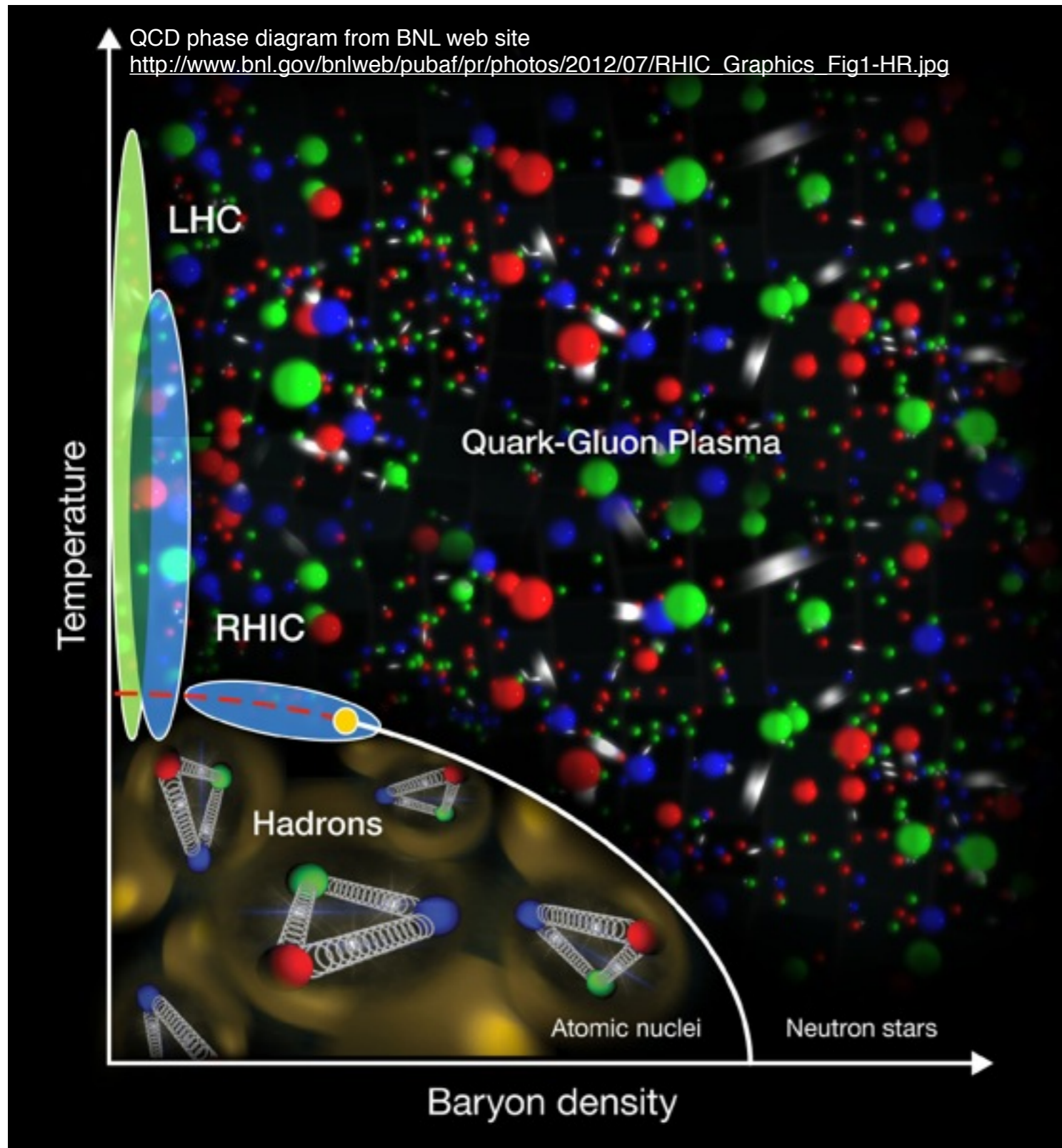
筑波大学
University of Tsukuba

2014 Joint Workshop of the France-Japan (TYL/FJPPL) and France-Korea (FKPPL) Particle Physics Laboratories, May 26-28, 2014

Outline

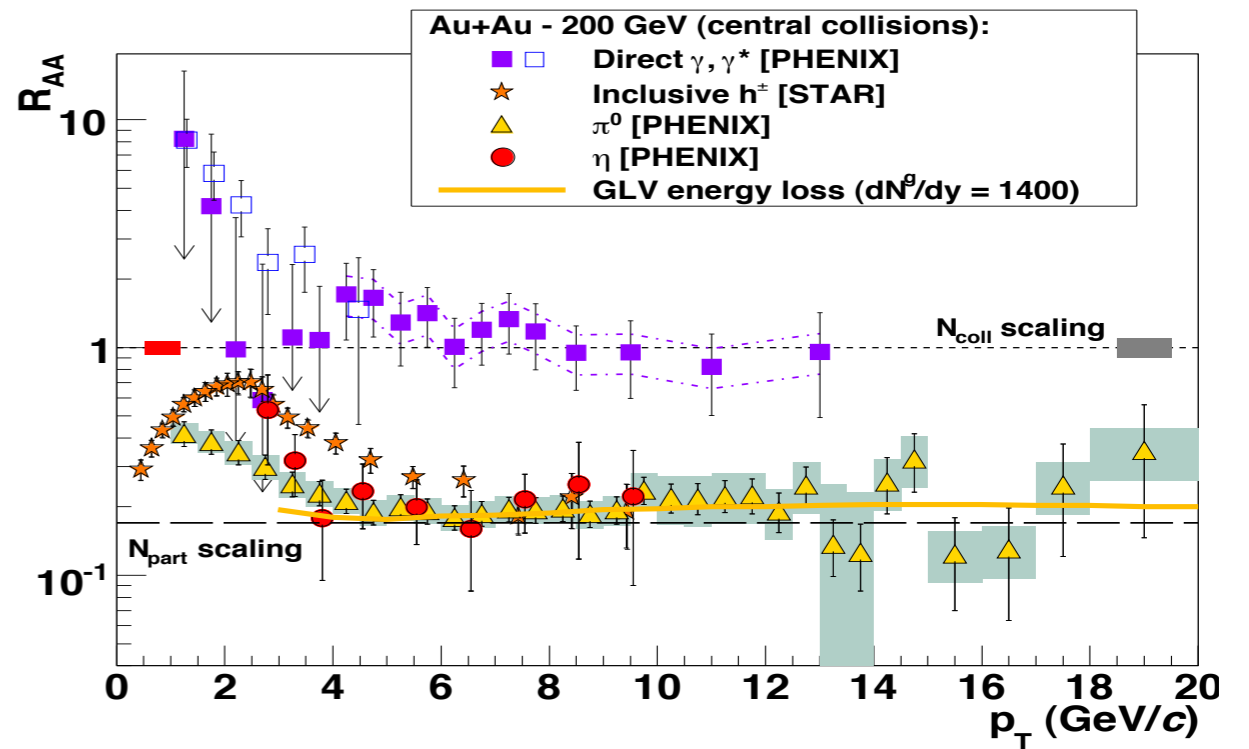
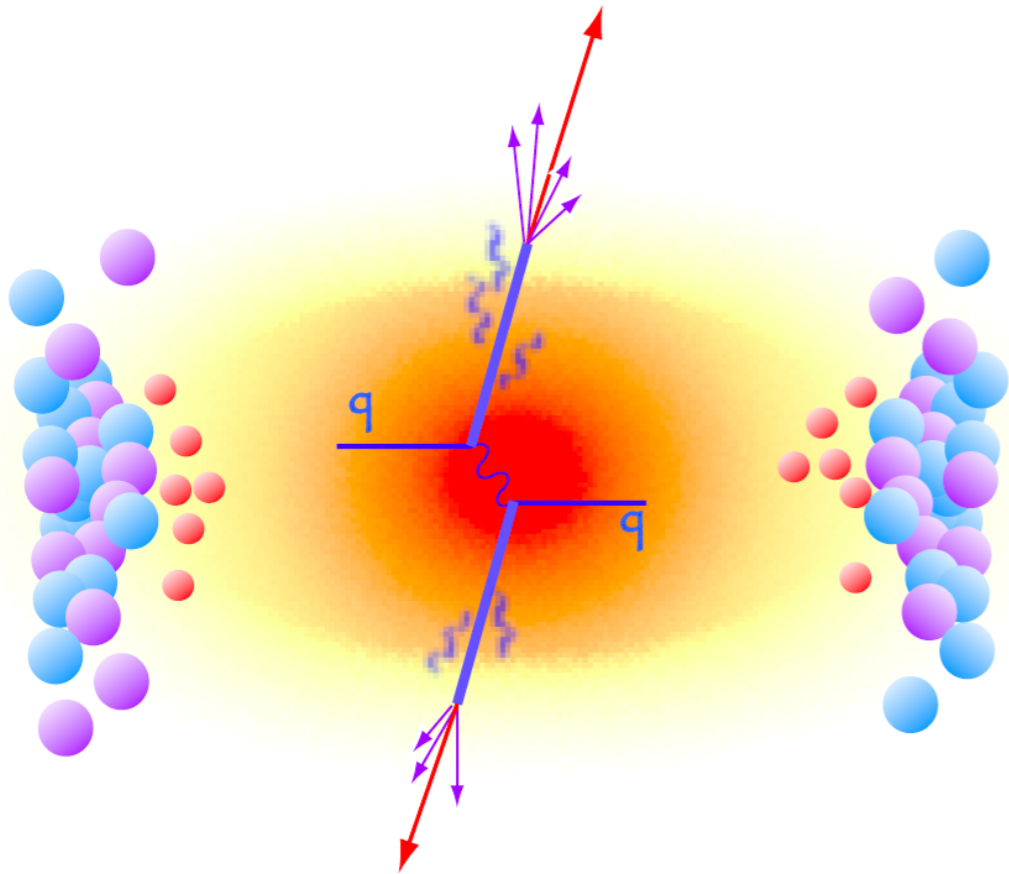
- Quark Gluon Plasma
- ALICE experiment & Di-jet Calorimeter
- Activities in FY2013
- Plan for FY2014
- Current & future activities
- Summary

QCD matter in high temperature



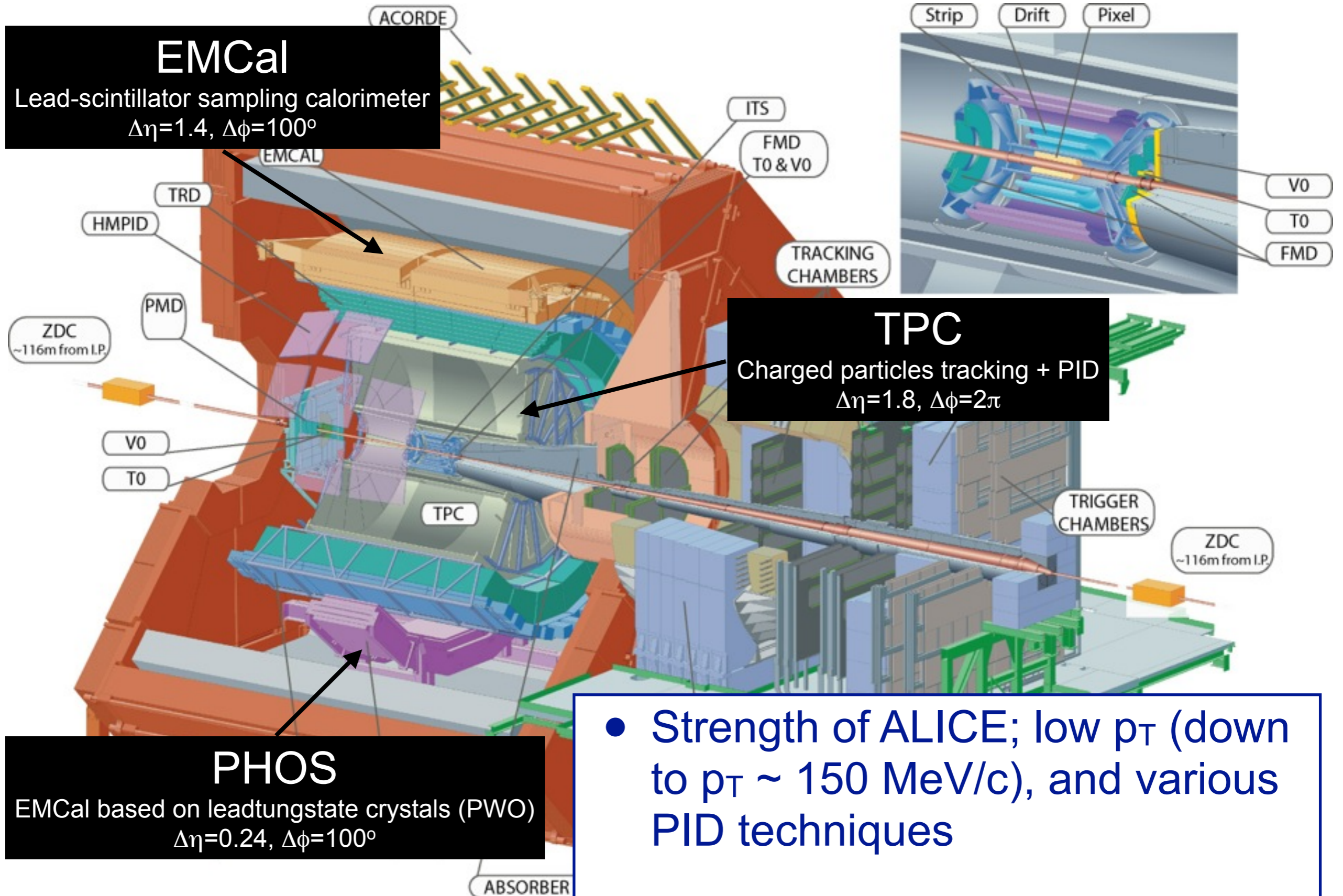
- Hadron gas to Quark Gluon Plasma (QGP) phase transition at $T \sim 150\text{-}170$ MeV
 - ▶ from Lattice QCD
- LHC (and RHIC) would be able to access such high temperature regime with ultra-relativistic heavy ion collisions
- Study the properties of QGP
 - ▶ QGP state in a few μsec after big-bang

Study QGP properties by hard probes



- Probe: hard processes (jets&photons) - calculable in pQCD
- Strong suppression of high p_T hadrons at RHIC & LHC
 - ▶ parton energy loss in QGP
- Jet tomography (di-jet, gamma-jet correlations), soft hadron production associated with jet

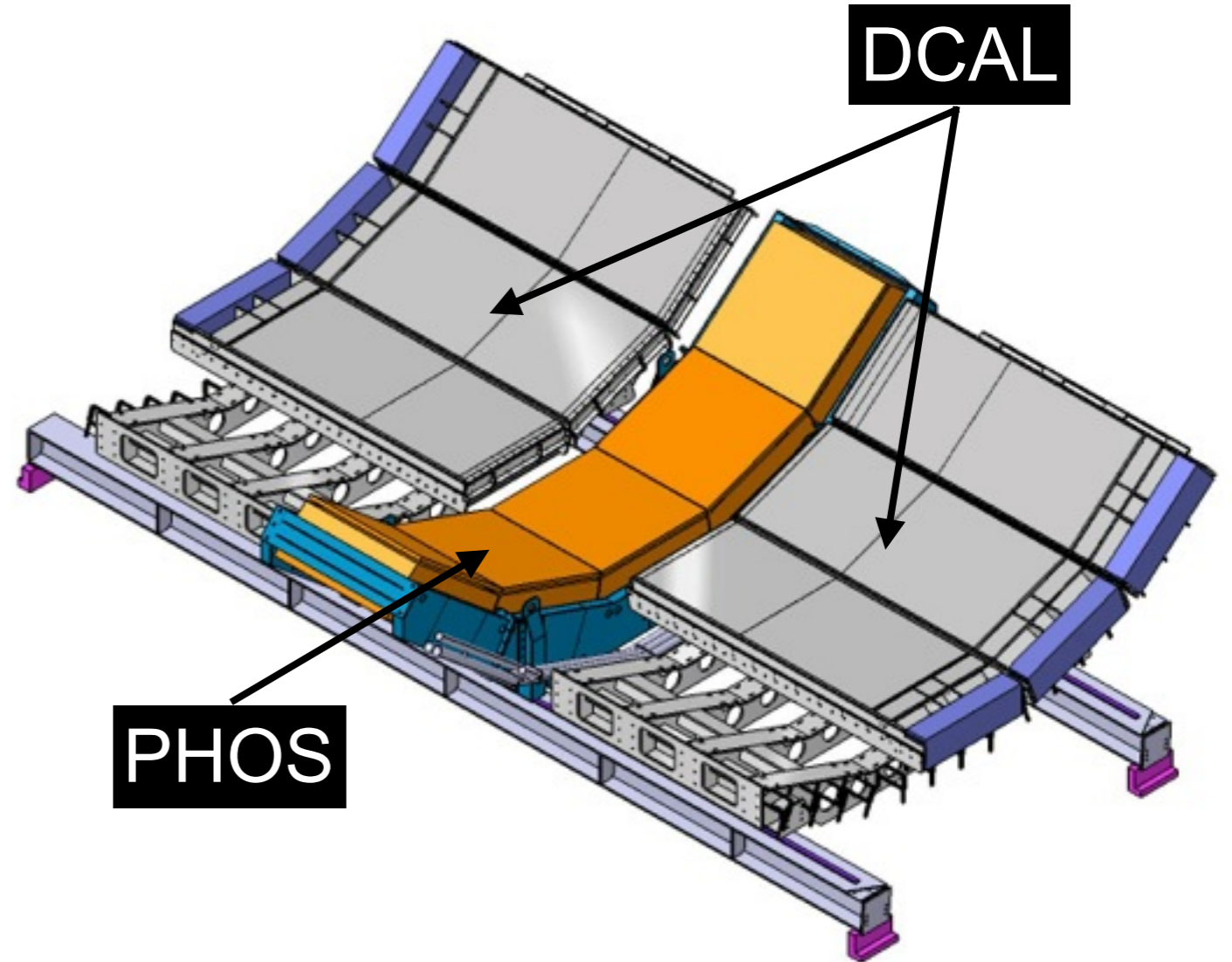
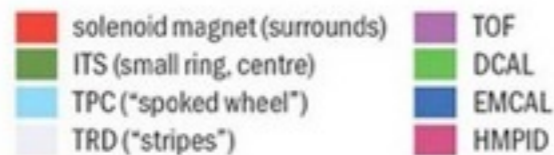
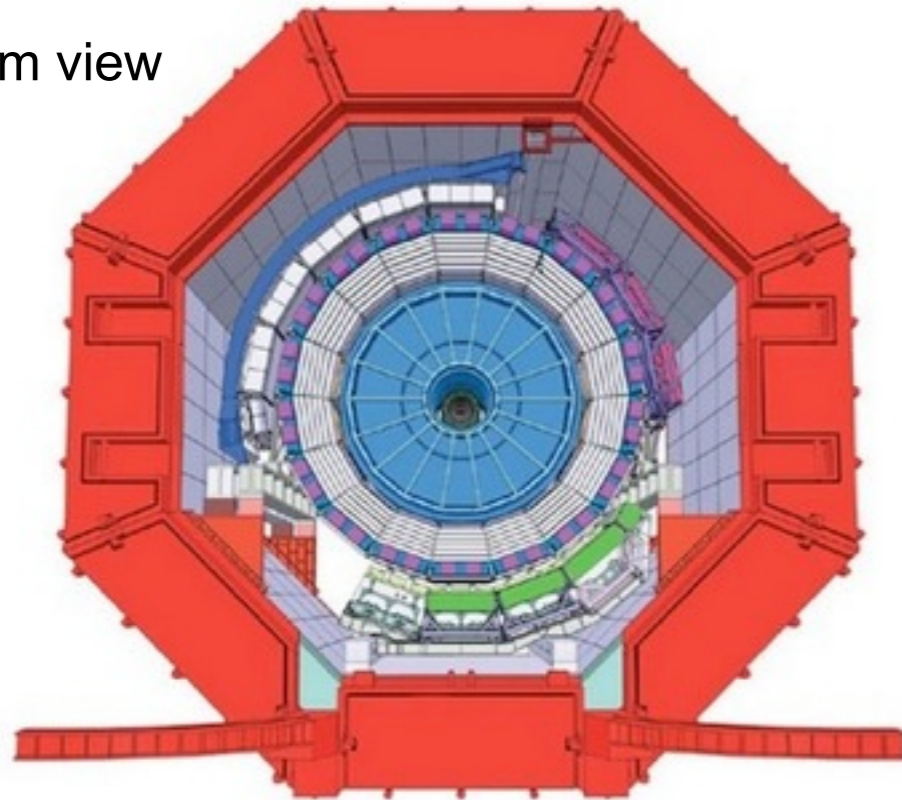
ALICE experiment



- Strength of ALICE; low p_T (down to $p_T \sim 150$ MeV/c), and various PID techniques

Di-jet Calorimeter (DCAL)

beam view



- DCAL - extension of EMCal acceptance
 - ▶ $\Delta\eta=0.7$, $\Delta\phi=66^\circ$ on opposite side of EMCal \rightarrow allows hadron-jet, di-jet measurements in ALICE, with $R=0.4$, up to $p_T \sim 150$ GeV/c
 - ▶ Energy resolution $\sim 10\%/\sqrt{E}$
- Enhance photon, jet trigger capability

Activities in FY2013, LHC_5

- DCAL

- ▶ Installed half of DCAL super modules (C-side) in Nov. 2013
 - see short movie for installation in youtube <http://www.youtube.com/watch?v=91BQB405rkQ>
- ▶ Firmware preparation for readout electronics since Dec. 2013
- ▶ EMCAL, DCAL C-side commissioning in Mar. 2014

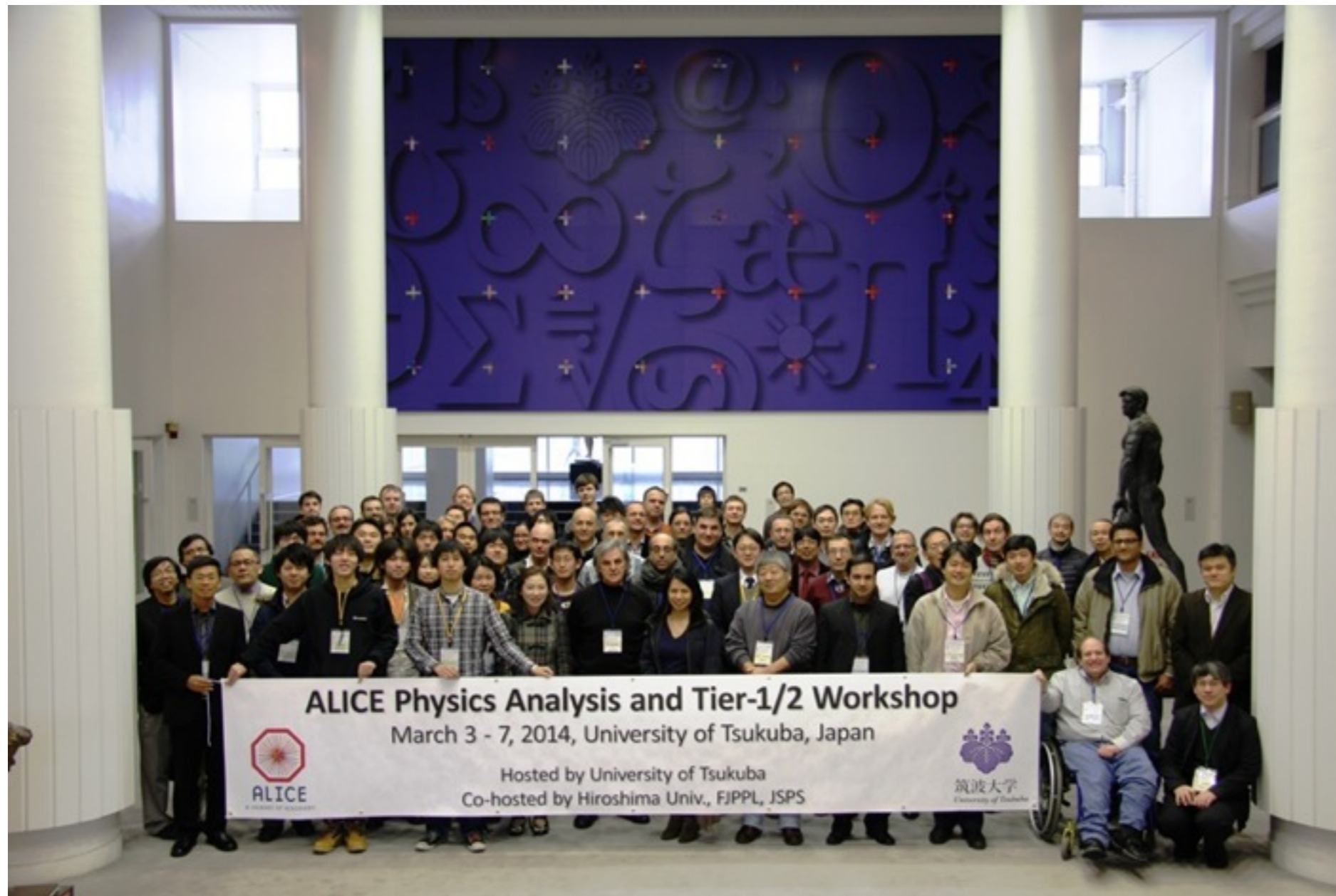
- ALICE Physics analysis and Tier-1/2 workshop at Tsukuba in Mar. 2014

- ▶ <http://indico.cern.ch/event/274974>

- Data analysis

- ▶ Preliminary results on π^0 -hadron in p+p and Pb+Pb, π^0 -jet correlations in p+p collisions are presented in Quark Matter 2014 conference last week

ALICE workshop at Tsukuba in Mar. 2014



The workshop is sponsored by *Japan Society for Promotion of Science (JSPS)*, *France-Japan Particle Physics Laboratory (FJPPL)*, *University of Tsukuba*, and *Hiroshima University*

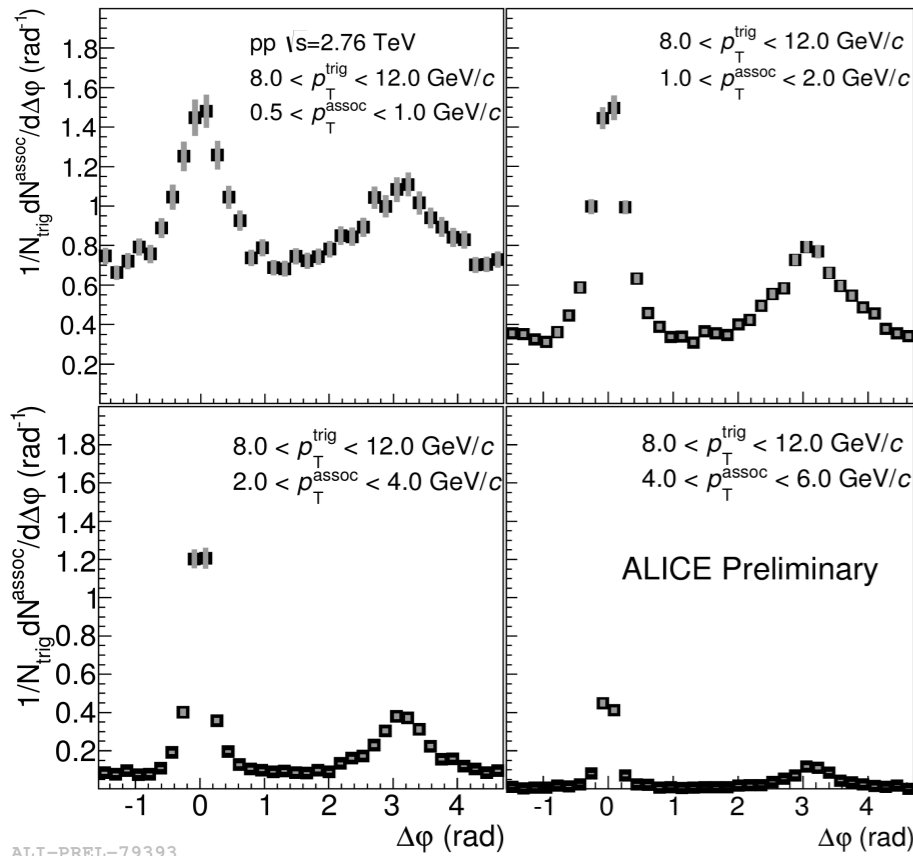
- France-Japan analysis workshop to discuss ALICE physics, ALICE detector upgrades
- T1-T2 workshop for the status of Grid computing in LS1

π^0 -hadron and π^0 -jet correlation

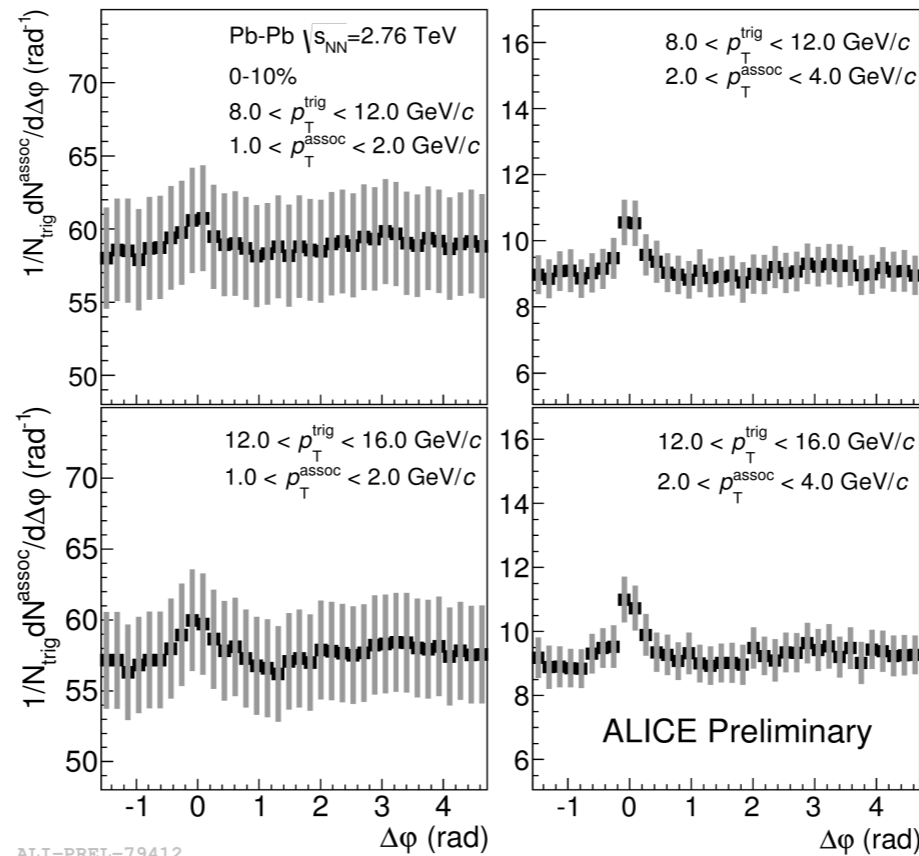
pp

Pb-Pb

Xiangrong Zhu (CCNU/LBNL)

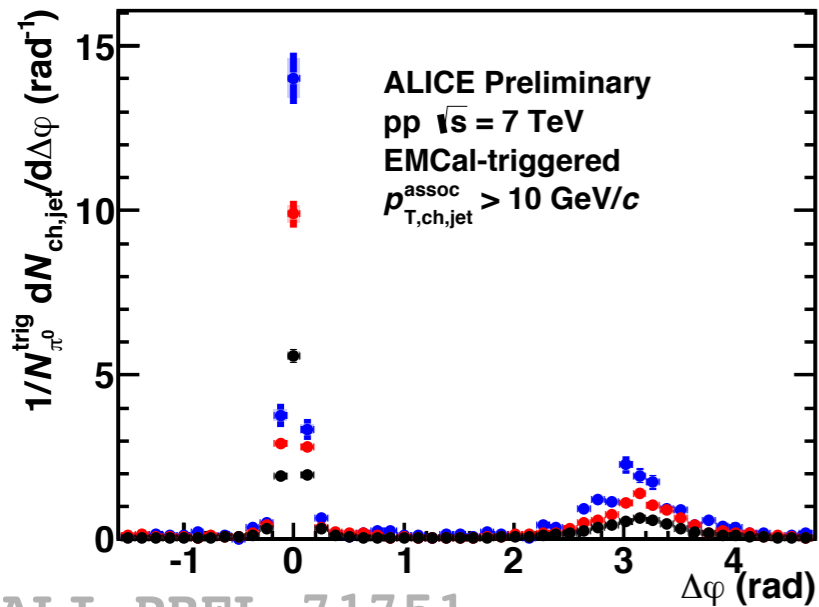


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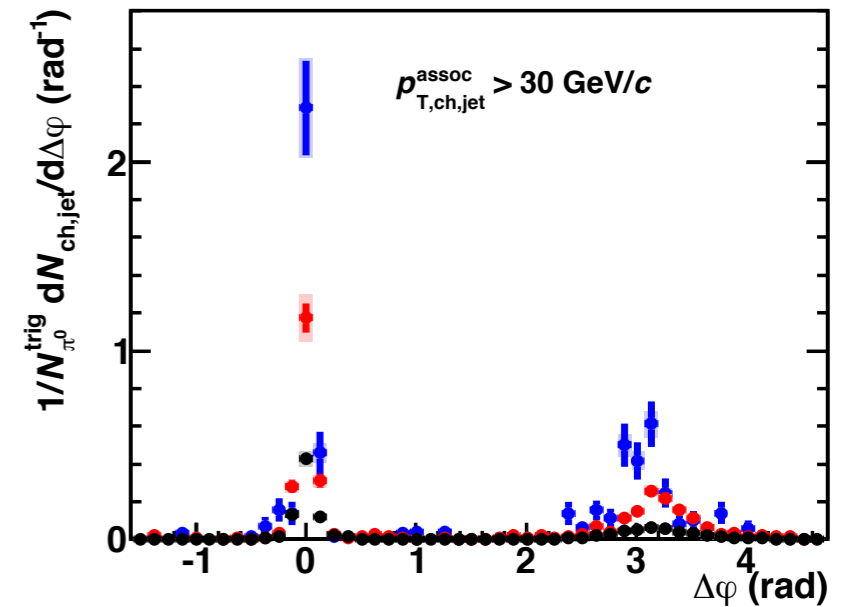
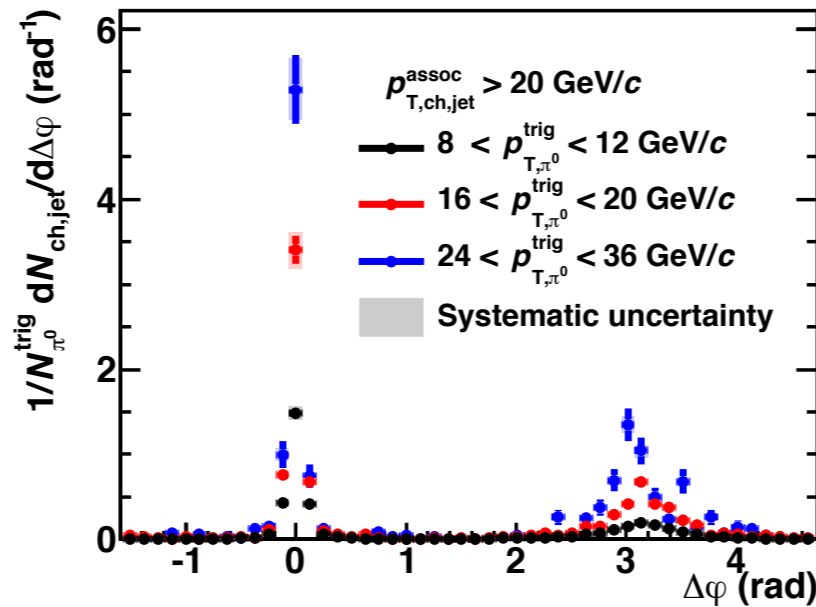


ALI-PREL-79412

Daisuke Watanabe (Univ. of Tsukuba)



ALI-PREL-71751



Proposal for FY2014, LHC_8

FJPPL (TYL) application 2014-2015

Fiscal year April 1st 2014 – March 31st 2015

Please replace the red examples by the appropriate data in black

ID ¹ :LHC_8	Title: Measurements of Jets and Photons in Heavy Ion Collisions at the Highest Beam Energy during the LHC-Run 2 by ALICE					
Leader Members	French Group			Japanese Group		
	Name	Title	Lab./Organis.²	Name	Title	Lab/Organis.³
	<u>Leader:</u> Yves Schutz	DR1	SUBATECH	<u>Leader:</u> Tatsuya Chujo	Dr	U. Tsukuba
	Marie Germain	CR1	SUBATECH	Yasuo Miake	Pr	U. Tsukuba
	<u>Deputy leader :</u> Christophe Furget	Pr	LPSC	ShinIchi Esumi	Dr	U. Tsukuba
	Renaud Vernet	Dr	CCIN2P3	Toru Sugitate	Pr	U. Hiroshima
	Magali Estienne	CR1	SUBATECH	Kenta Shigaki	Pr	U. Hiroshima
	Gustavo Conesa	DR	LPSC	Hideki Hamagaki	Pr	U. Tokyo
	Rachid Guernane	CR1	LPSC	Taku Gunji	Dr	U. Tokyo
	Julien Faivre	MC	LPSC	Motoi Inaba	Pr	U. Tsukuba Tech.
	Alexandre Shabetai	CR1	SUBATECH	Hiroshi Masui	Dr	U. Tsukuba

- **Special emphasis on jets and photons**
 - ▶ by utilising DCAL combined with other ALICE subsystems

Proposal for FY2014, LHC_8

Research Plan:

- **Year 1 (2014 - 2015):** DCAL/EMCAL/PHOS detector commissioning & operation (including Level-1 photon and jet trigger development), Jet and photon analysis using Run 1 data.
- **Year 2 (2015 - 2016):** 1st year of Run-2, DCAL/EMCAL/PHOS operation and 1st data of DCAL
- **Year 3 (2016 - 2017):** 2nd year of Run-2, Data analysis & publications, DCAL/EMCAL/PHOS operation.
- **Year 4 (2017 - 2018):** 3rd year of Run-2, Data analysis & publications, DCAL/EMCAL/PHOS operation.

In the first year (2014-2015), we concentrate on the detector commissioning especially on DCAL and PHOS (new electronics), and also development of Level-1 trigger for photons and jets by the collaboration between Grenoble and Tsukuba. On the analysis part, we will perform neutral pions and jets measurements using EMCAL, DCal (the first data), PHOS and TPC. We will perform π^0 -jet, hadron-jet and gamma-jet correlation measurements in p-p, Pb-Pb and p-Pb, as well as di-jets measurements for the study of QGP path length dependence and energy re-distribution following the transport of jets through the medium. The Japan-France ALICE data analysis workshop in France in 2014 is also planned. We also utilize the support by JSPS (Bilateral Research, CNRS-JSPS, 2013.04 – 2015.03) in order to keep strong this collaboration.

- **Main task in FY2014; detector commissioning**
 - ▶ DCAL installation
 - ▶ Level-1 photon & jet triggers for DCAL (and PHOS)
 - ▶ Keep working on Run 1 data analysis

Current activities and future plan

- **DCAL commissioning**
 - ▶ Preparation of firmware for Level-1 photon & jet trigger
 - Commissioning at test-bench & at ALICE sometime this summer
 - ▶ Install other half (A-side) of DCAL super modules (Sep. - Nov.)
 - depending on PHOS installation
- **Data analysis**
 - ▶ Correlation measurement between π^0 & photon with hadron & jet in Pb+Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV to understand parton energy loss mechanisms
- **France-Japan ALICE workshop 2015 in Saint-Tropez, France**

Summary

- France-Japan collaboration plays important role on DCAL project
 - ▶ C-side DCAL super modules installed
 - Level-1 trigger commissioning for DCAL will take place in this summer
 - ▶ Full DCAL will be installed this year (Sep.-Nov.), start physics data taking from Run-2 (2015-)
 - ▶ Physics analysis in Run-1 data proceed well, preliminary results of correlation measurements have been presented in QM2014 conference last week
- Request for travel support in FY2014 to keep strong France-Japan collaboration for detector upgrade as well as physics data analysis

back up

FY2014 request for LHC_8

Funding Request from France					
Description	€/unit	Nb of units	Total (€)	Requested to ⁴ :	
Student stay in France	90/day	30 days	2700		
Visit to Japan (local expense)	100/day	10 days	1000		
Travels	1500	1 travel	1500		
Total			5200		
Funding Request from KEK					
Description	k¥/Unit	Nb of units	Total (k¥)	Requested to:	
Visit to France	10/day	32 days	320	KEK	
Travels	150	4 travels	600	KEK	
Total			920		
Additional Funding from France			Additional Funding from Japan		
Provided by/Requested to ⁵	Type	€	Provided by/Requested to ⁶	Type	k¥
			MEXT & U. Tsukuba	Travel	3,000
			JSPS (Kiban B, Y. Miake)	Travel etc.	2,400
			JSPS (Bilateral Research, CNRS-JSPS, T. Chujo)	Travel	2,500
Total			Total		7,900