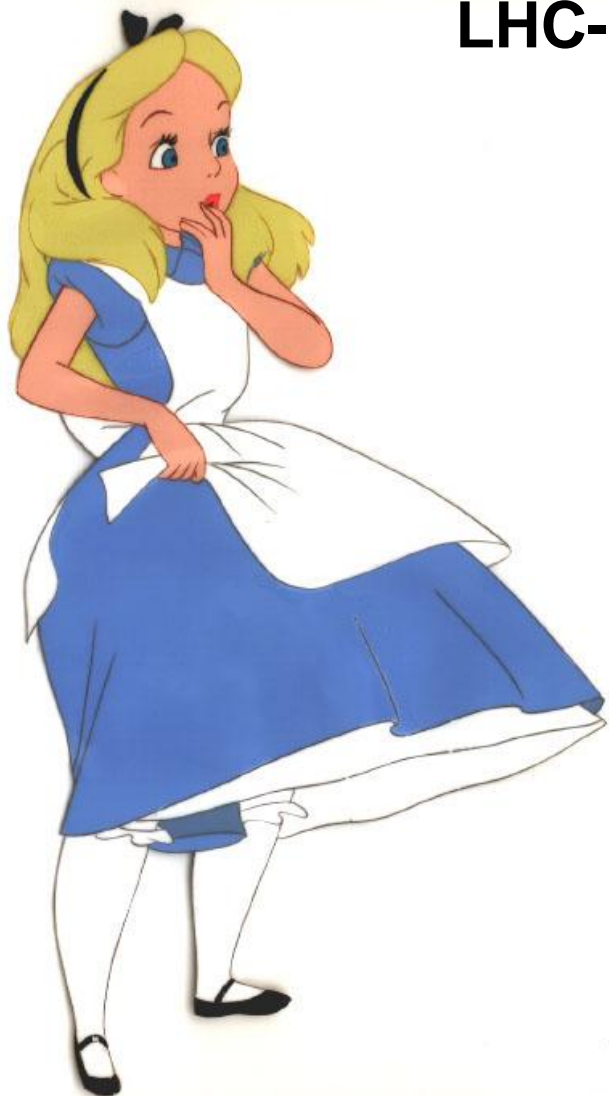
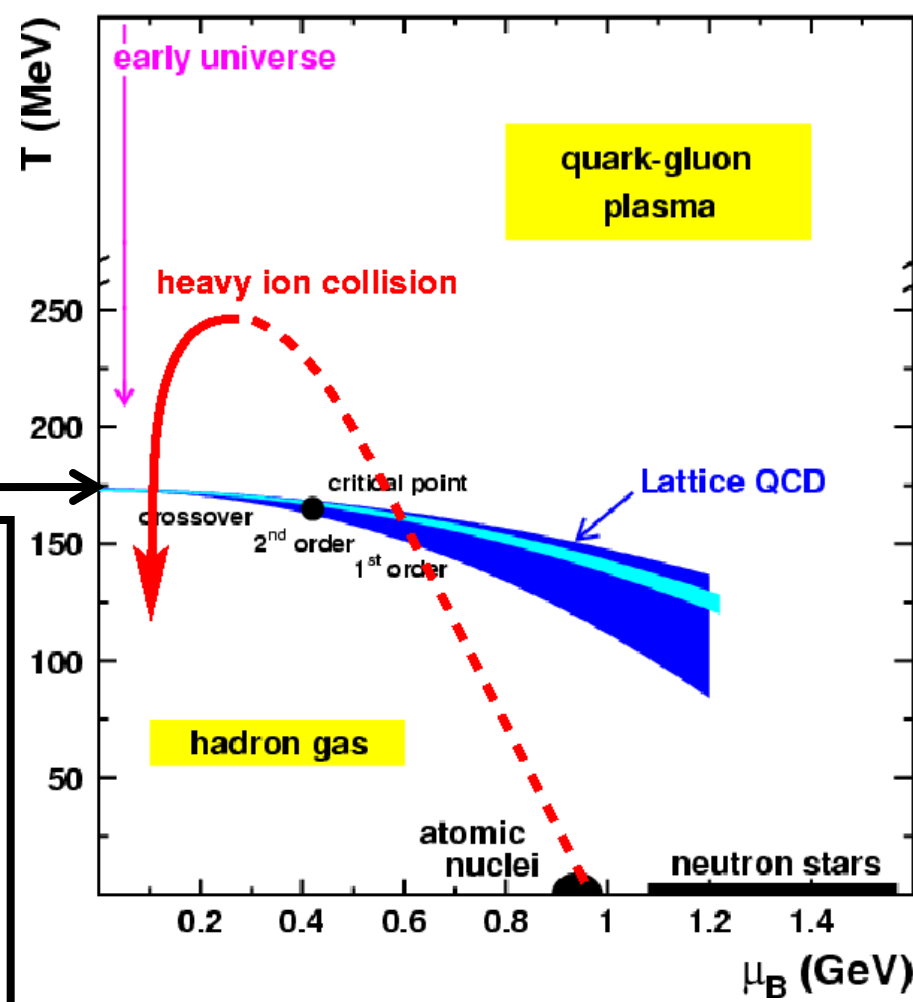
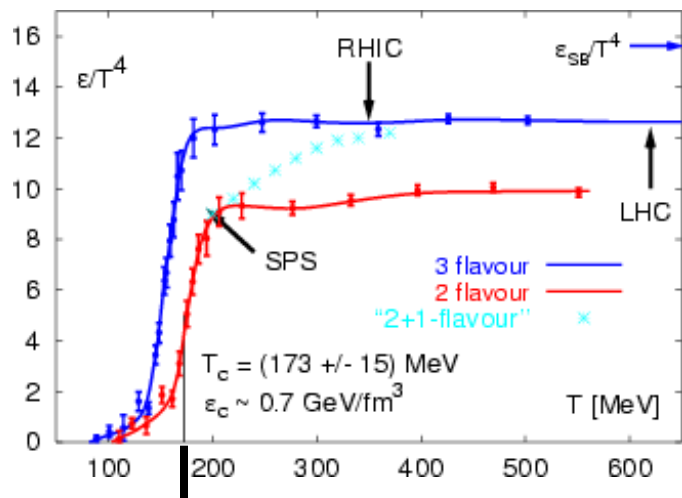


LHC-CCNU-IN2P3-ALICE



- heavy-ion collisions in short
- the ALICE experiment at the LHC
- Chinese & French groups in ALICE
- status of the FCPPL-ALICE project
- the FCPPL-ALICE project in 2009

The QCD phase diagram



- $\mu_B = 0$:
 - $T_c = 173 \pm 15$ MeV
 - $\epsilon_c = 0.7 \pm 0.3$ GeV/fm³
 - “crossover”-like transition
- $\mu_B > 0$:
 - large uncertainties
 - order of transition unknown
 - existence of a critical point
- chiral sym. rest. coincides with deconf.
- the QGP is not an ideal gas
- $\mu_B \gg 0$: color superconductivity (not shown)

QGP signatures

modification of low-mass resonances

suppression of high-mass resonances

strangeness enhancement

hard probes **soft probes**

based on particles produced in the early stage

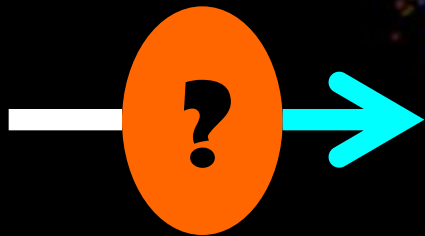
based on particles produced in the late stage

flow profile

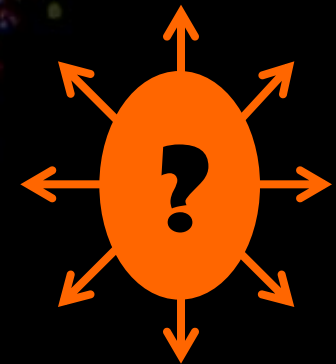
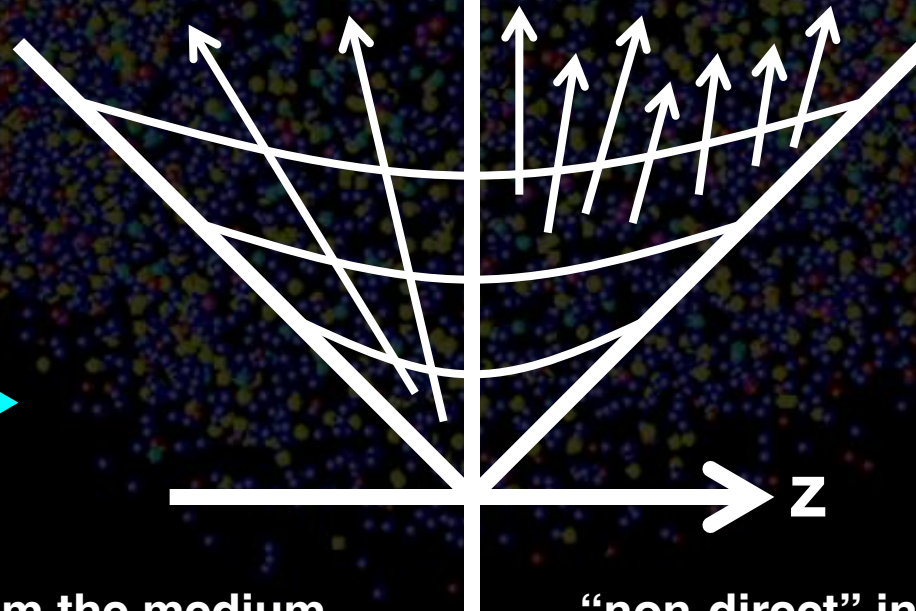
photon production

..etc

jet quenching

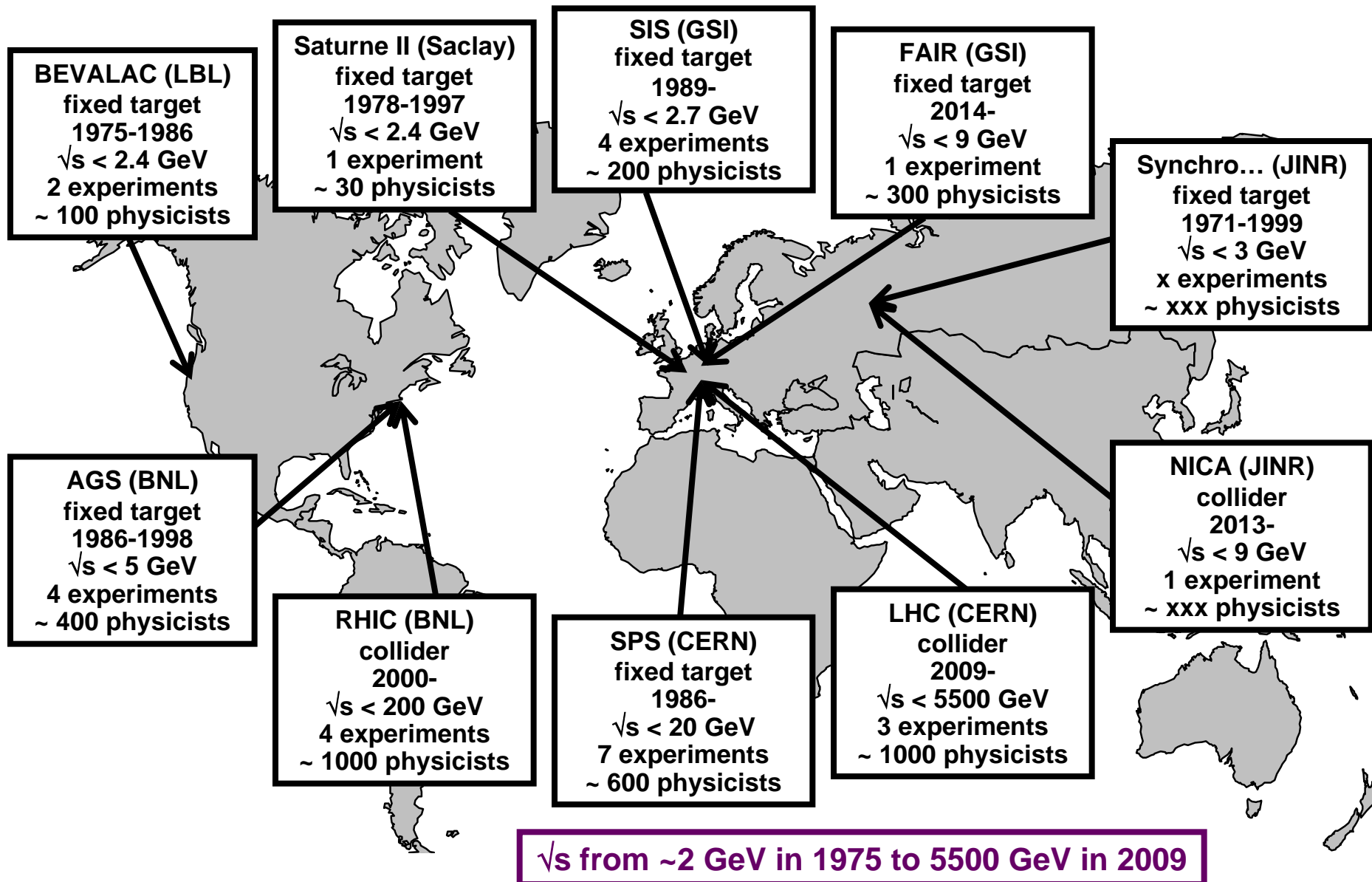


“direct” info from the medium



“non-direct” info from the medium

1975-2009: 34 years of heavy-ion collisions

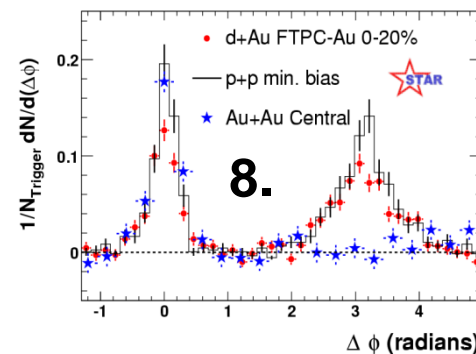
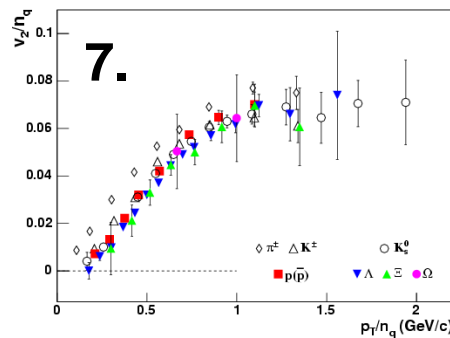
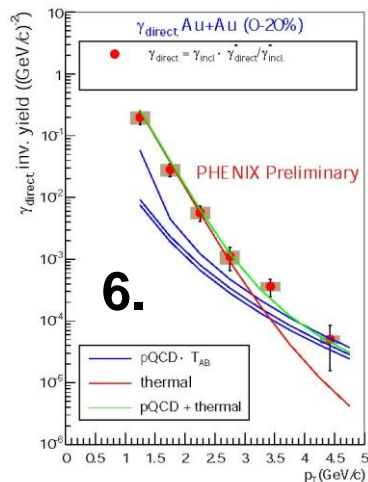
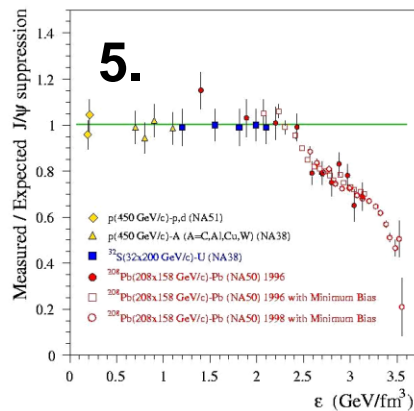
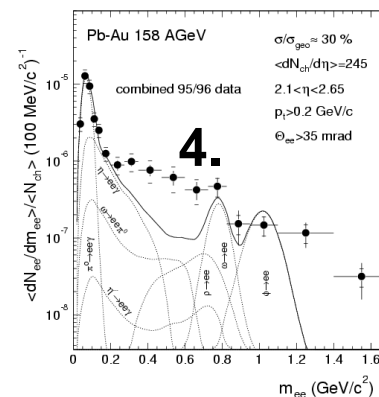
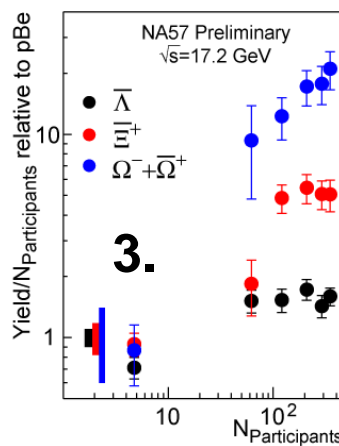
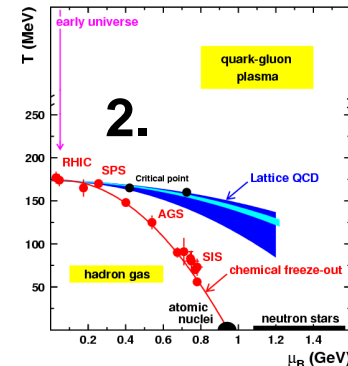
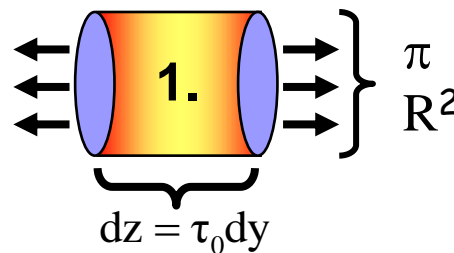


SPS & RHIC results in 8 plots



the medium produced in heavy-ion collisions:

1. has an energy density > than ϵ_c
2. has a freeze-out temperature $\sim T_c$
3. produces strangeness
4. modifies properties of low-mass resonances
5. dissolves high-mass resonances
6. radiates photons
7. exhibits partonic degrees of freedom
8. absorbs jets



the medium behaves like a quark-gluon plasma

So why going for the QGP @ LHC?



assumption: QGP has been established @ RHIC prior to LHC

SEARCH for the QGP may be essentially over

DISCOVERY of the QGP is well under way

MEASURING QGP parameters has hardly begun

QGP @ LHC versus RHIC = Z/W @ LEP versus SppS

the LHC is the ideal place for studying the QGP (next slide)

adapted from J. Schukraft @ Split06

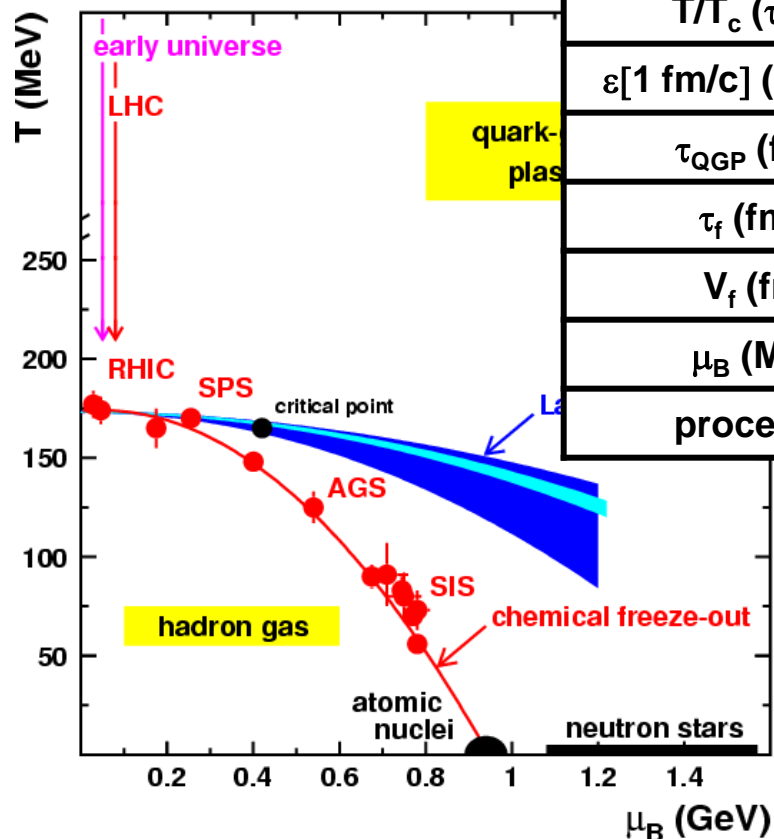
Heavy ion collisions & QGP @ LHC



the biggest step in energy in the history of heavy-ion collisions

machine	SPS	RHIC	LHC
\sqrt{s} (GeV)	17	200	5500
N_{ch}	1000	4000	50 000
τ^0_{QGP} (fm/c)	1	0.2	0.1
T/T_c (τ^0_{QGP})	1.1	1.9	3.0-4.2
$\varepsilon[1 \text{ fm/c}]$ (GeV/fm ³)	3	5	15-60
τ_{QGP} (fm/c)	≤ 2	2-4	≥ 10
τ_f (fm/c)	~ 10	20-30	30-40
V_f (fm ³)	$\sim 10^3$	$\sim 10^4$	$\sim 10^5$
μ_B (MeV)	250	20	1
processes	soft \rightarrow semi-hard \rightarrow hard		

- \Rightarrow faster
- \Rightarrow hotter
- \Rightarrow denser
- \Rightarrow longer
- \Rightarrow bigger
- \Rightarrow cleaner
- \Rightarrow harder



ε , vol. & τ QGP $\times 10(4)$ from SPS(RHIC) to LHC

“...the LHC will become the ideal facility for a systematic exploration and quantitative confirmation of the insights obtained at RHIC, aided by the plentiful abundance of hard probes.”

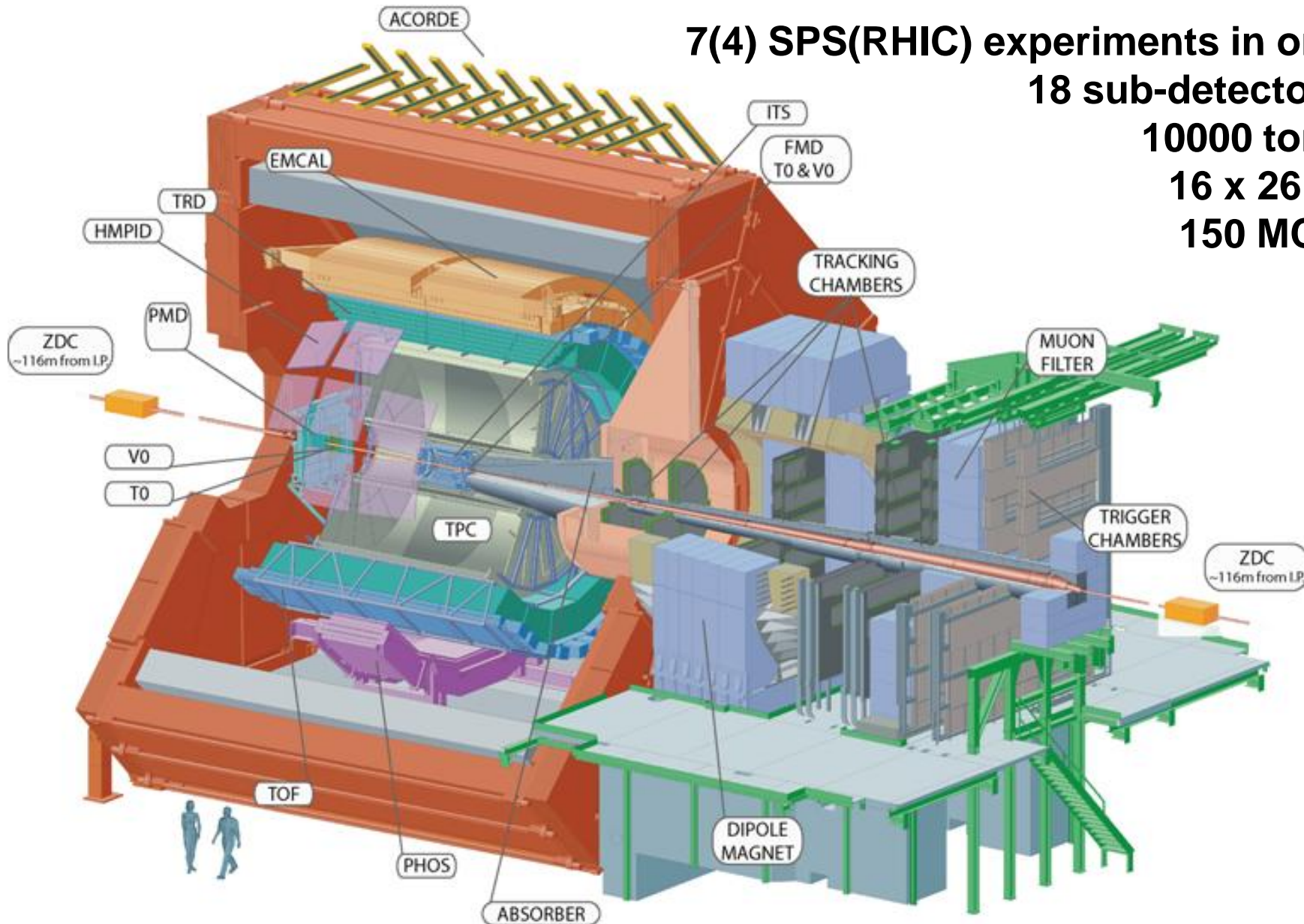
B. Müller, hep-ph/0410115

J. Schukraft, Nucl. Phys. A 698 (2002) 287

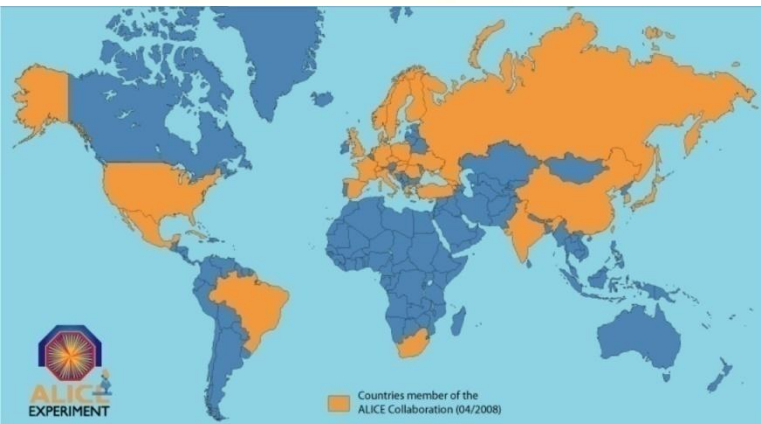
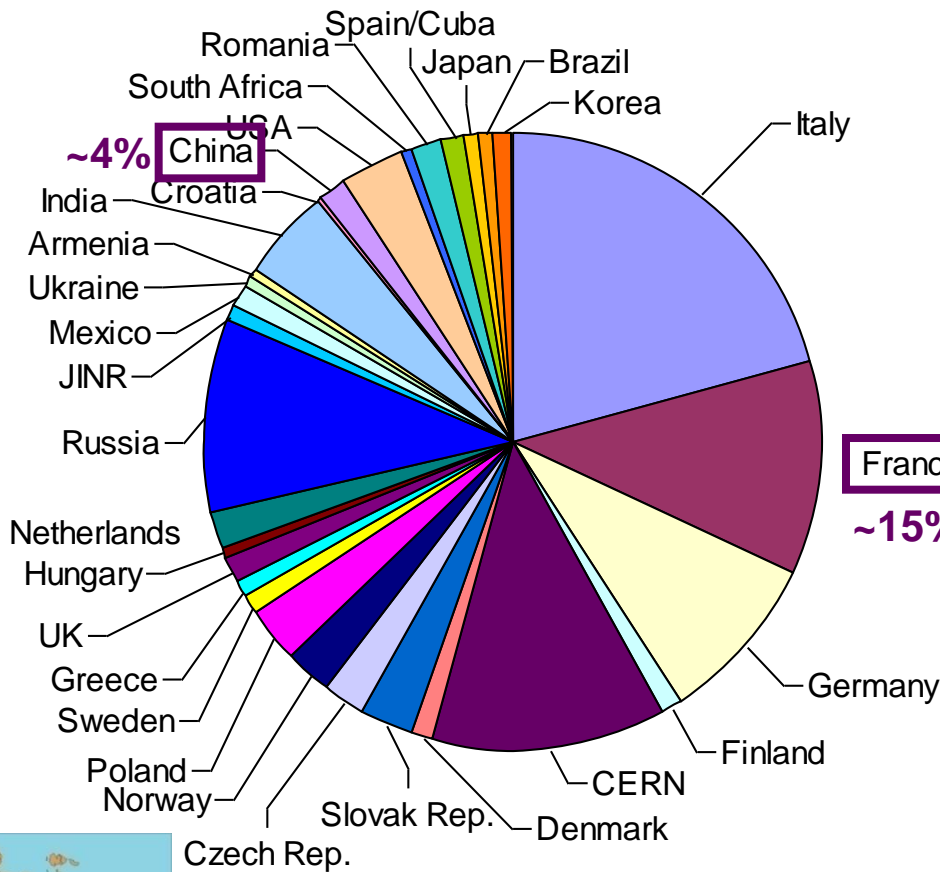
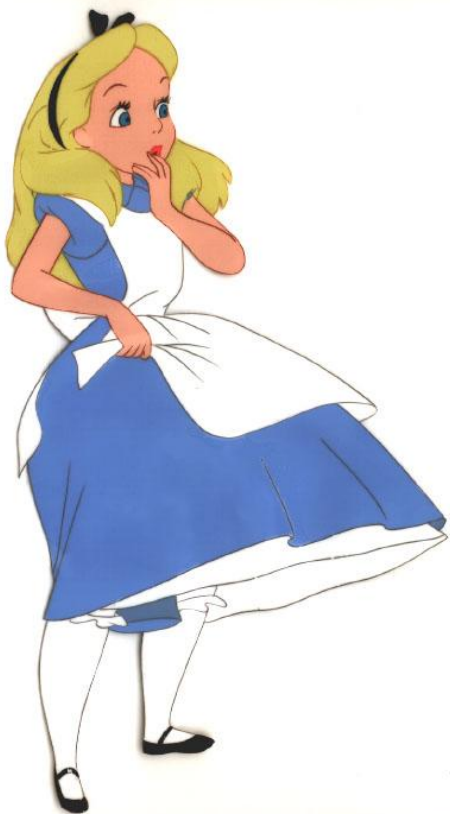
ALICE (A Large Ion Collider Experiment)



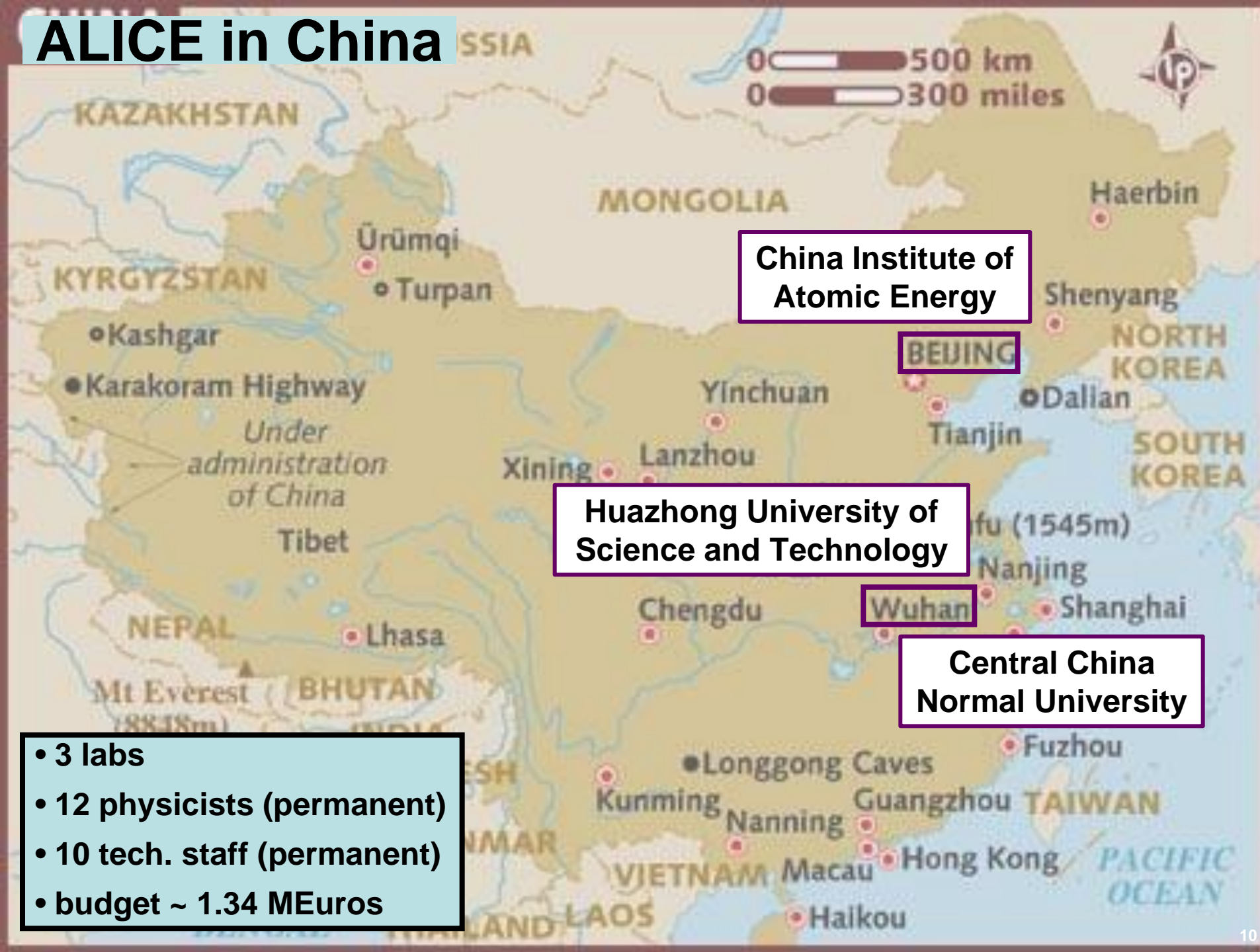
7(4) SPS(RHIC) experiments in one
18 sub-detectors
10000 tons
16 x 26 m
150 MCH



The ALICE collaboration



ALICE in China



China Institute of Atomic Energy

BEIJING

Huazhong University of Science and Technology

Wuhan

Central China Normal University

- 3 labs
- 12 physicists (permanent)
- 10 tech. staff (permanent)
- budget ~ 1.34 MEuros

ALICE in France (alice-france.in2p3.fr)



PARIS



Strasbourg



Nantes



Lyon



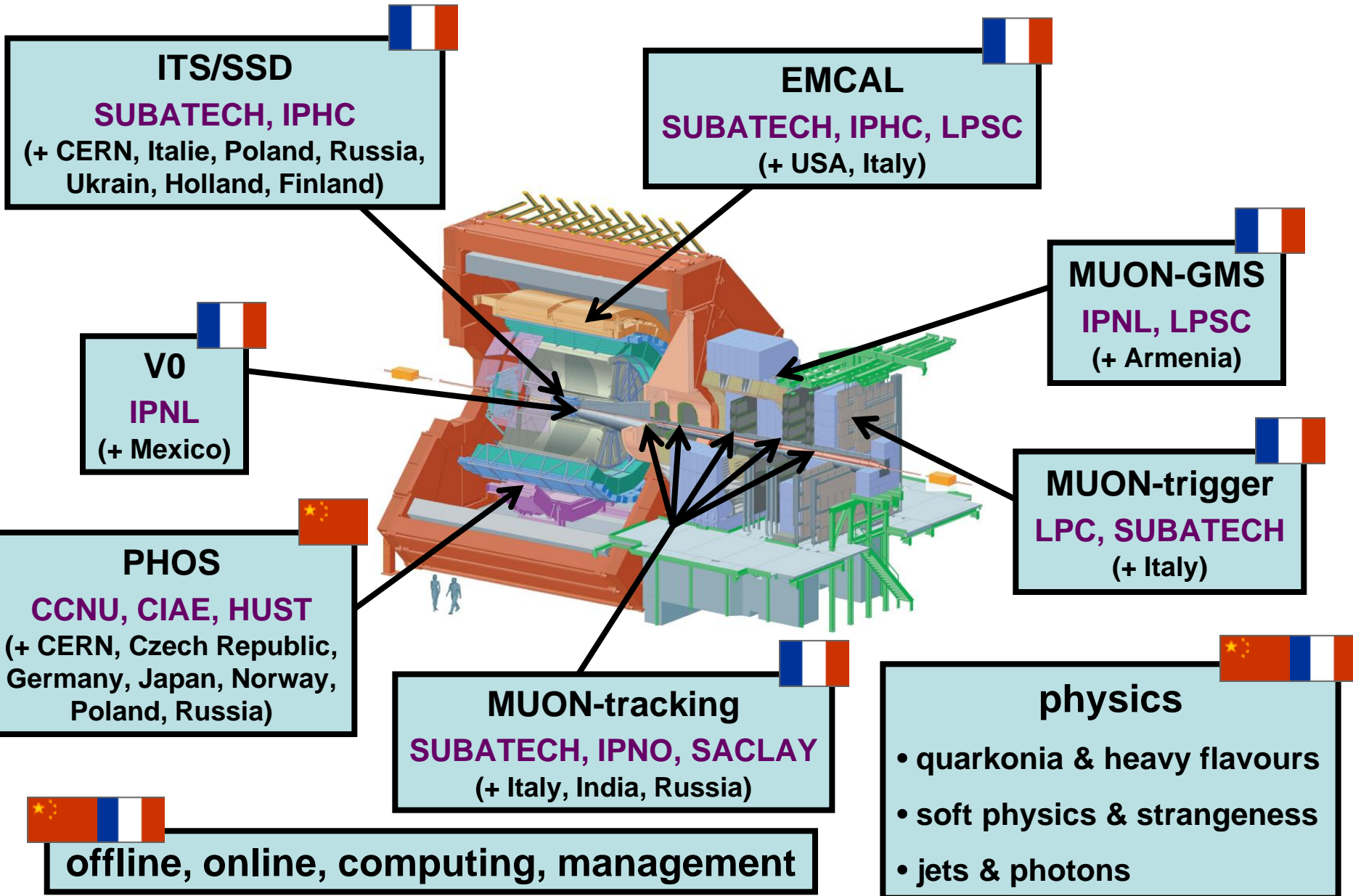
Clermont-Ferrand

Grenoble



- 7 labs
- 47 physicists (permanent)
- 86 tech. staff (permanent)
- budget ~ 7 MEuros

Chinese & French contributions in ALICE



LHC-CCNU-IN2P3-ALICE: Study of QCD matter with the ALICE detector

	French Group			Chinese Group		
	Name	Title	Affiliation	Name	Title	Affiliation
Members	<u>Leader:</u> Crochet Philippe and Roy Christelle	CR	IN2P3	<u>Leader:</u> Zhou Daicui	Prof.	CCNU
	Bastid Nicole	PR	IN2P3	Cai Xu	Prof.	CCNU
	Batigne Guillaume	MC	IN2P3	Yang Chunbin	Prof.	CCNU
	Benhabib Lamia	Dr. Student	IN2P3	Yin Zhongbao	Ass Prof.	CCNU
	Cheynis Brigitte	CR	IN2P3	Xu Chuncheng	Ass Prof.	CCNU
	Delagrangue Hugues	DR	IN2P3	Zhou Daimei	Ass Prof.	CCNU
	Ducroux Laurent	MC	IN2P3	Ma Ke	Post-Doc	CCNU
	Dupleux Pascal	DR	IN2P3	Sun Liang	Post-Doc	CCNU
	Estienne Magali	CR	IN2P3	Wang Yaping	Lecturer	CCNU
	Germain Marie	CR	IN2P3	Ding Hengtong	Dr. Student	CCNU
	Grossiord Jean-Yves	DR	IN2P3	Xiang Wenchang	Dr. Student	CCNU
	Nendaz Fabien	Dr. Student	IN2P3	Yuan Xianbao	Dr. Student	CCNU
	Martinez-Garcia Ginès	CR	IN2P3	Mao Yaxian	Dr. Student	CCNU
	Massacrier Laure	Dr. Student	IN2P3	Wan Renzhuo	Dr. Student	CCNU
	Pillot Philippe	CR	IN2P3	Zhu Jianlin	Dr. Student	CCNU
	Rosnet Philippe	MC	IN2P3	Zhang Xiaoming	M. Student	CCNU
	Tieulent Raphaël	CR	IN2P3	Wang Mengliang	M. Student	CCNU
	Schutz Yves	DR	IN2P3			

36 members, activities: computing & physics (photons, jets, muons)



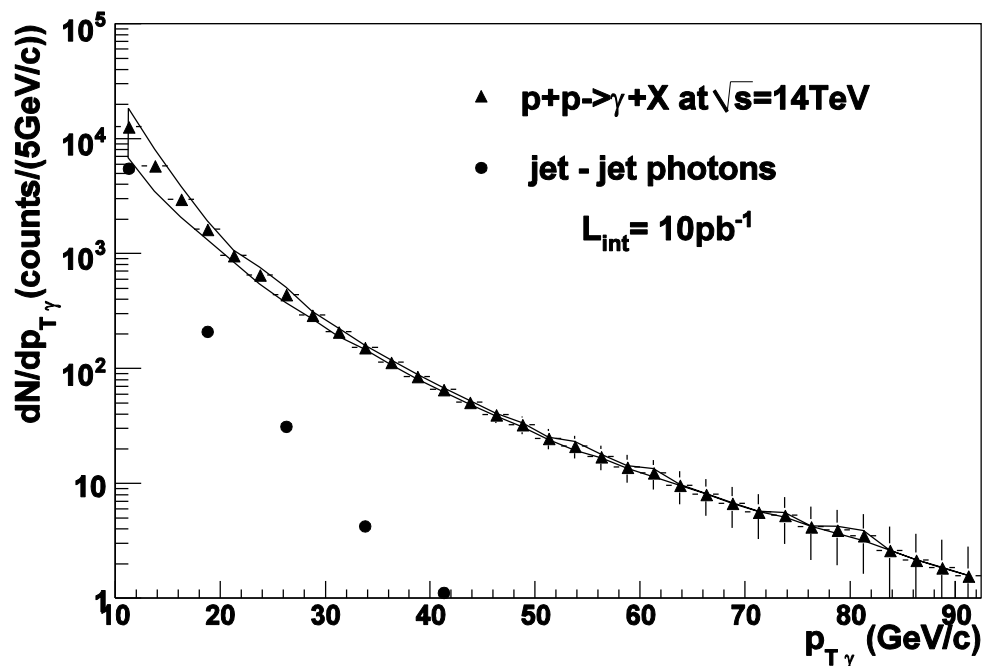
- **Three French physicists visited CCNU**
 - Yves Shutz from Subatech (photons, offline, computing)
 - Jean-Yves Grossiord & Raphaël Tieulent from IPNL (low-mass dimuons)
- **Two Chinese students @ Subatech (2 months stay funded by French Embassy)**
 - Hengtong Ding (single muons)
 - Yaxian Mao (photons & jets)
- **One Chinese student in CERN summer school**



- “International workshop on heavy-ion physics at LHC”, Wuhan, 21-24 May 08
 - ~120 participants, 6 French physicists from ALICE-FCPPL
- Xiaoming Zhang @ LPC (master, 3 months stay funded by French Embassy)
- Liang Sun @ LPNL (post-doc, 1 year stay funded by CNRS/IN2P3)
- Yaxian Mao @ LPSC (PhD thesis, 18 months stay funded by French Embassy)

- “Extra FCPPL”: Wenchang Xiang @ LPC (postdoc, 1 year stay from Sept. 09)
 - funding requests to “Université Blaise-Pascal” and “Région Auvergne”
 - final decision to be taken in summer 09

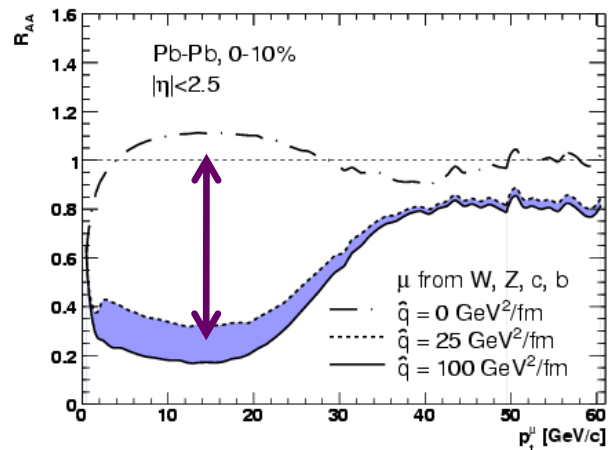
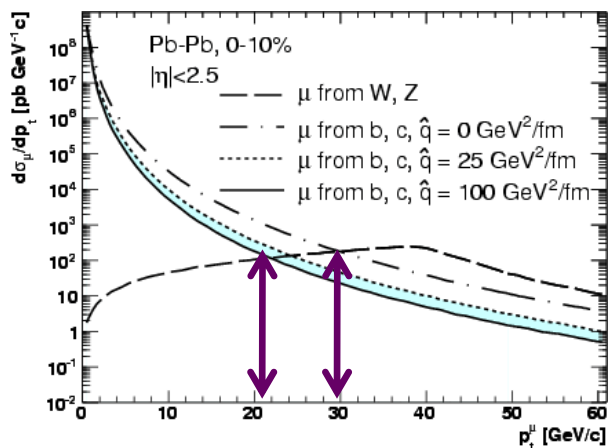
1 month @ Subatech in 2007, funding: French Embassy
now @ LPCS (PhD), funding: French Embassy



γ -hadron correlation
measurements to study jets
fragmentation with ALICE

see Yaxian's talk later

- collaboration with G. Conesa Balbastre, Y. Schutz, M. Sano, D.C. Zhou
- scientific production: 1 EPJC, 1 poster & proc. (Int. J. Mod. E) at QM08, 1 ALICE Internal-Note



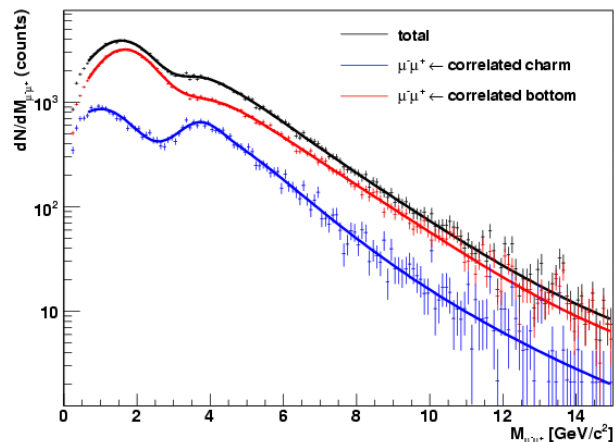
1 month @ Subatech in 2007, funding: French Embassy

Study of heavy-quark energy loss via single muon pt spectra

- heavy quark energy loss:
 - shifts down the (c,b)/W crossing point by $\sim 5-7$ GeV/c
 - suppresses muon yield by a factor 2-5 for $2 < p_t < 20$ GeV/c
- W affected by shadowing only

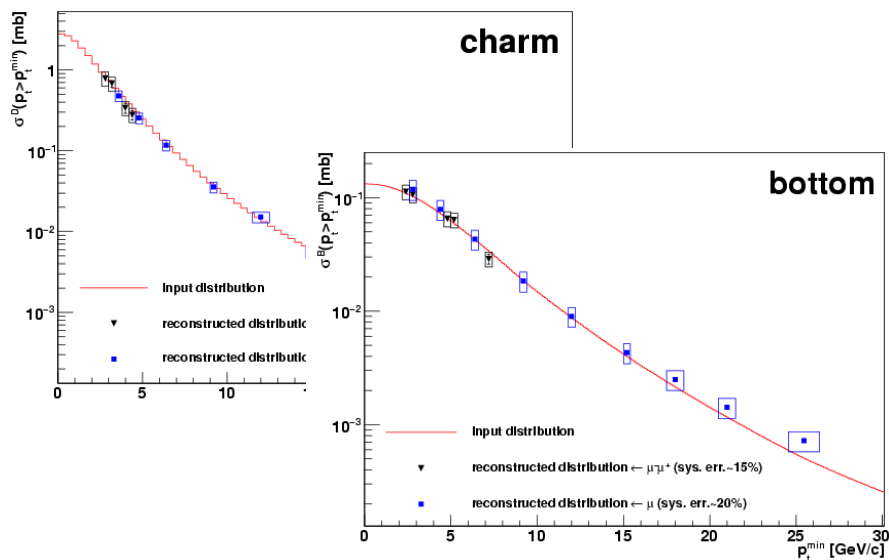
- collaboration with Z. Conesa del Valle, A. Dainese, G. Martinez-Garcia, D.C. Zhou
- scientific production: 1 PLB, 1 poster & proc. (Int. J. Mod. E) at QM07, 1 talk & proc (J. Phys. G) at SQM08, 1 contribution in a review article (J. Phys. G)

3 months @ LPC in 2008, funding: French Embassy

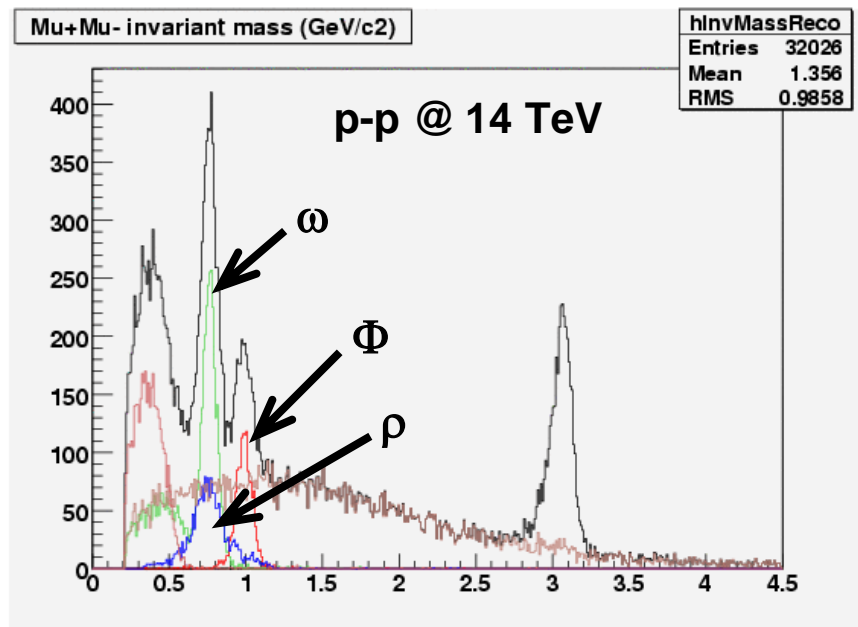


Heavy-hadron production cross-section in pp collisions from muon spectra

- method: unfold muon spectra, correct for efficiency, acceptance & decay kinematics (UA1, CDF, D0)
- large p_t reach
- (very) small statistical errors
- systematics ~ 10-15%



- collaboration with L. Manceau, N. Bastid, P. Crochet, S. Grigoryan, D.C. Zhou
- scientific production: 1 talk at CERN, 1 ALICE Internal-Note, submitted



Low-mass resonances

- participation in data taking at CERN
- preparation of tools for data analysis
 - fits
 - background subtraction
 - efficiency correction

work done in the framework of ALICE Physics Working Group

The FCPPL-ALICE 2009 project application



Funding from France						
Description	Euro/unit	Nb of units	Total (euros)	Requested to: *		
Travels costs	~1000	5	5000	IN2P3		
Stay costs	150 * 5 days	5	3750	IN2P3		
Accommodation for one student from Wuhan at LPC Clermont-Ferrand	350	3 (months)	1050	IN2P3		
Stay for one student from Wuhan at LPC Clermont-Ferrand	1550	3 (months)	4650			
Total			14450			
Funding from China						
Description	Yuan/Unit	Nb of units	Total (Yuan)	Requested to: **		
Travel costs (for Yaxian Mao PhD thesis, Liang Sun's post-doctor, a student visit LPC for three months, Xiaoming Zhang for co-PhD program)	~11,000	4(travels)	44,000	CCNU		
Travel costs (three physicists)	~11,000	3	33,000	CCNU		
Stay (at LPC and IPNL) cost for three physicists	1,100*15	3	49,500	CCNU		
Total			126,500			
Additional funding	Funding from France			Funding from China		
	Provided by or requested to ***	Type	Euro	Provided by or requested to	Type	Yuan
	French Embassy PhD Program	18 months (Xiaoming Zhang, PhD thesis at LPC Clermont-Ferrand)	19080			

- a few travels & stays for Chinese/French physicists in France/China

- 3 months stay for one Chinese student at LPC

- 3 x 6 months stay for Xiaoming Zhang at LPC (co-PhD Wuhan/LPC)

- continuation of the work started in 2008
- participation in data taking at CERN
- analysis of first pp data



The FCPPL-ALICE Chinese/French collaboration is solid, healthy and very fruitful

- **excellent contributions of students**
- **large production: publications, talks, proceedings, internal notes**

looking forward to the first physics results with real data