

FCC Design Study

R. Aleksan
Saclay

Avril 14, 2015



General News

Informations générales
CECP
Prochain RV

FCC@Washington meeting

Key Parameters FCC-hh

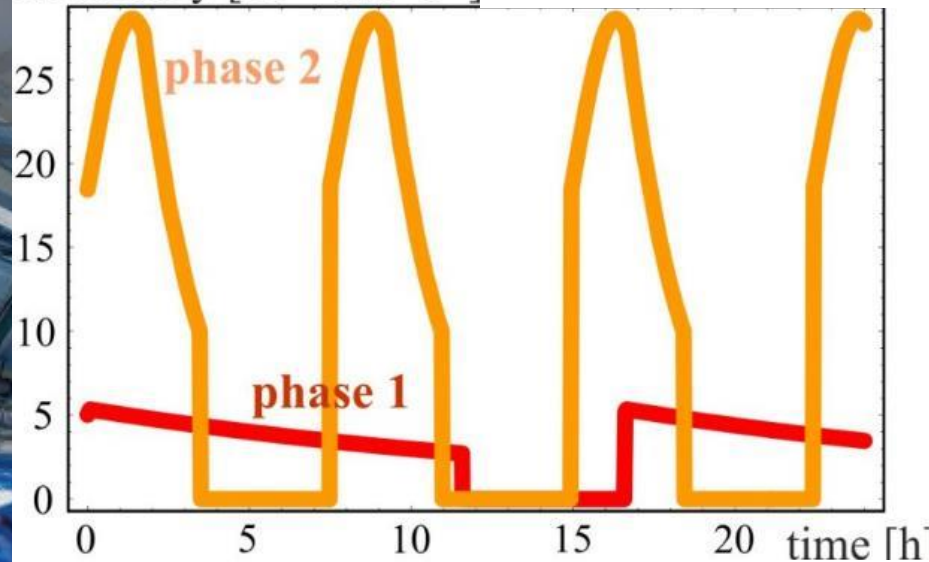
Parameter	FCC-hh	LHC
Energy [TeV]	100 c.m.	14 c.m.
Dipole field [T]	16	8.33
# IP	2 main, +2	4
Luminosity/IP _{main} [cm ⁻² s ⁻¹]	5 - 25 x 10 ³⁴	1 x 10 ³⁴
Stored energy/beam [GJ]	8.4	0.39
Synchrotron rad. [W/m/aperture]	28.4	0.17
Bunch spacing [ns]	25 (5)	25

FCC-hh Luminosity Goals

- **Two parameter sets for two operation phases:**
 - **Phase 1 (baseline): $5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ (peak),**
250 fb⁻¹/year (averaged)
2500 fb⁻¹ within 10 years (~HL LHC total luminosity)
 - **Phase 2 (ultimate): $\sim 2.5 \times 10^{35} \text{ cm}^{-2}\text{s}^{-1}$ (peak),**
1000 fb⁻¹/year (averaged)
→ 15,000 fb⁻¹ within 15 years
 - **Yielding total luminosity $O(20,000) \text{ fb}^{-1}$ over ~25 years of operation**

FCC-hh luminosity evolution 24 h

luminosity [$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$] radiation damping: $\tau \sim 1 \text{ h}$



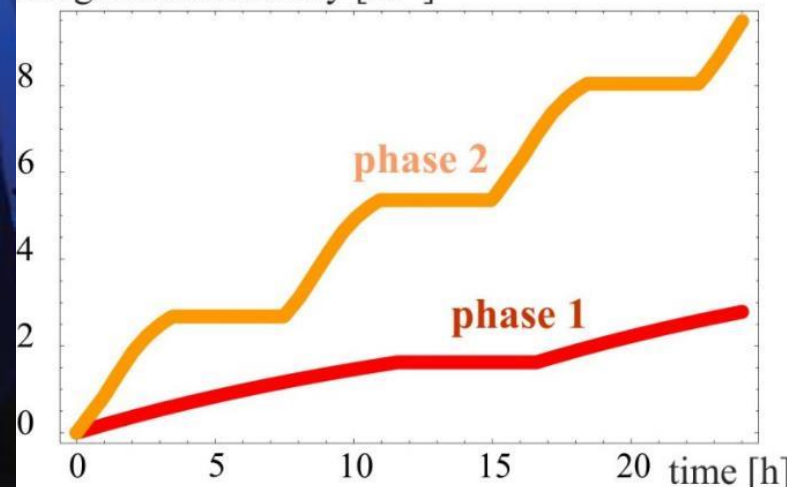
for both phases:

beam current
0.5 A
unchanged!

total
synchrotron
radiation power
 $\sim 5 \text{ MW}$.



integrated luminosity [fb^{-1}]



phase 1: $\beta^* = 1.1 \text{ m}$, $\Delta Q_{\text{tot}} = 0.01$, $t_{\text{ta}} = 5 \text{ h}$

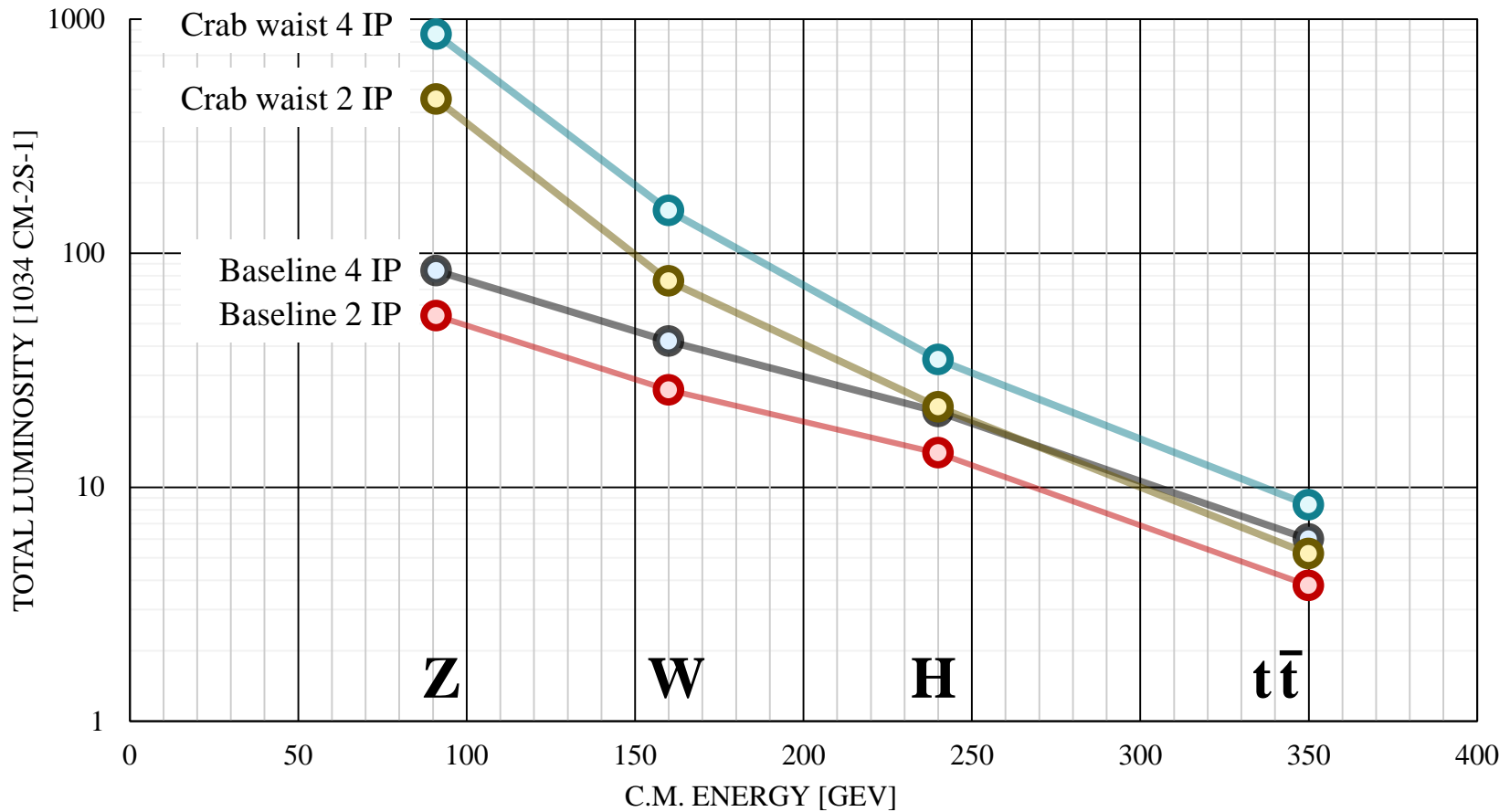
phase 2: $\beta^* = 0.3 \text{ m}$, $\Delta Q_{\text{tot}} = 0.03$, $t_{\text{ta}} = 4 \text{ h}$

Key Parameters FCC-ee

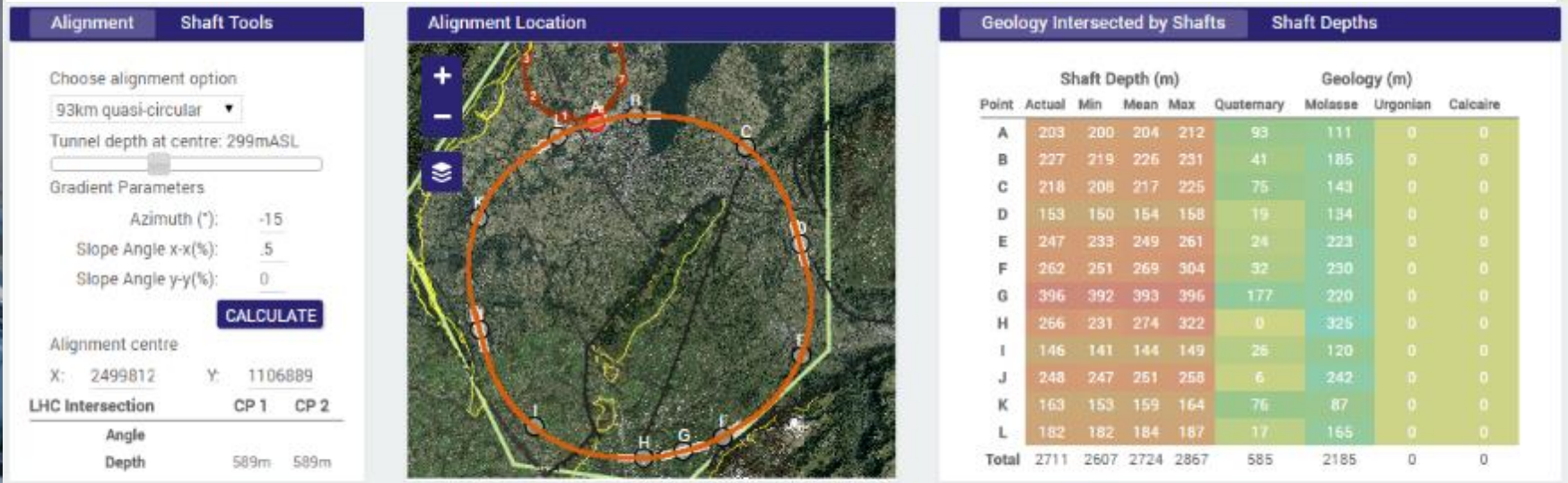
Parameter	FCC-ee			LEP2
Energy/beam [GeV]	45	120	175	105
Bunches/beam	13000- 60000	500- 1400	51- 98	4
Beam current [mA]	1450	30	6.6	3
Luminosity/IP x $10^{34} \text{ cm}^{-2}\text{s}^{-1}$	21 - 280	5 - 11	1.5 - 2.6	0.0012
Energy loss/turn [GeV]	0.03	1.67	7.55	3.34
Synchrotron Power [MW]	100			22
RF Voltage [GV]	0.3-2.5	3.6-5.5	11	3.5

Dependency: crab-waist vs. baseline optics and 2 vs. 4 IPs

FCC-ee: Luminosity vs. Energy



Geology Studies – Example 93 km



- 90 – 100 km fits geological situation well, better than a smaller ring size
- LHC suitable as potential injector

Collaboration Status

- 51 institutes
- 19 countries
- EC participation



51 FCC collaboration members & CERN as host institute, 22 March 2015

ALBA/CELLS, Spain
Ankara U., Turkey
U Bern, Switzerland
BINP, Russia
CASE (SUNY/BNL), USA
CBPF, Brazil
CEA Grenoble, France
CEA Saclay, France
CIEMAT, Spain
CNRS, France
Cockcroft Institute, UK
U Colima, Mexico
CSIC/IFIC, Spain
TU Darmstadt, Germany
DESY, Germany
TU Dresden, Germany
Duke U, USA

EPFL, Switzerland
GWNW, Korea
U Geneva, Switzerland
Goethe U Frankfurt, Germany
GSI, Germany
Hellenic Open U, Greece
HEPHY, Austria
IFJ PAN Krakow, Poland
INFN, Italy
INP Minsk, Belarus
U Iowa, USA
IPM, Iran
UC Irvine, USA
Istanbul Aydin U., Turkey
JAI/Oxford, UK
JINR Dubna, Russia
FZ Jülich, Germany

KAIST, Korea
KEK, Japan
KIAS, Korea
King's College London, UK
KIT Karlsruhe, Germany
Korea U Sejong, Korea
MEPhI, Russia
MIT, USA
NBI, Denmark
Northern Illinois U., USA
NC PHEP Minsk, Belarus
U. Liverpool, UK
PSI, Switzerland
Sapienza/Roma, Italy
UC Santa Barbara, USA
U Silesia, Poland
TU Tampere, Finland



Next general meeting in Rome : 11-15 April

Documents and Publications



Study internal CERN EDMS

- Notes, drawings, slides, minutes
- Source files of scientific papers
- <http://cern.ch/fcc-edms>



Public documents CERN CDS

- PDF of scientific papers, public slides, official reports, videos
- <http://cern.ch/cds> > R&D and Studies > Future Circular Collider Documents

Collaborative Work Platform



Meetings

- Structure in CERN Indico
- <http://cern.ch/fcc-meetings>



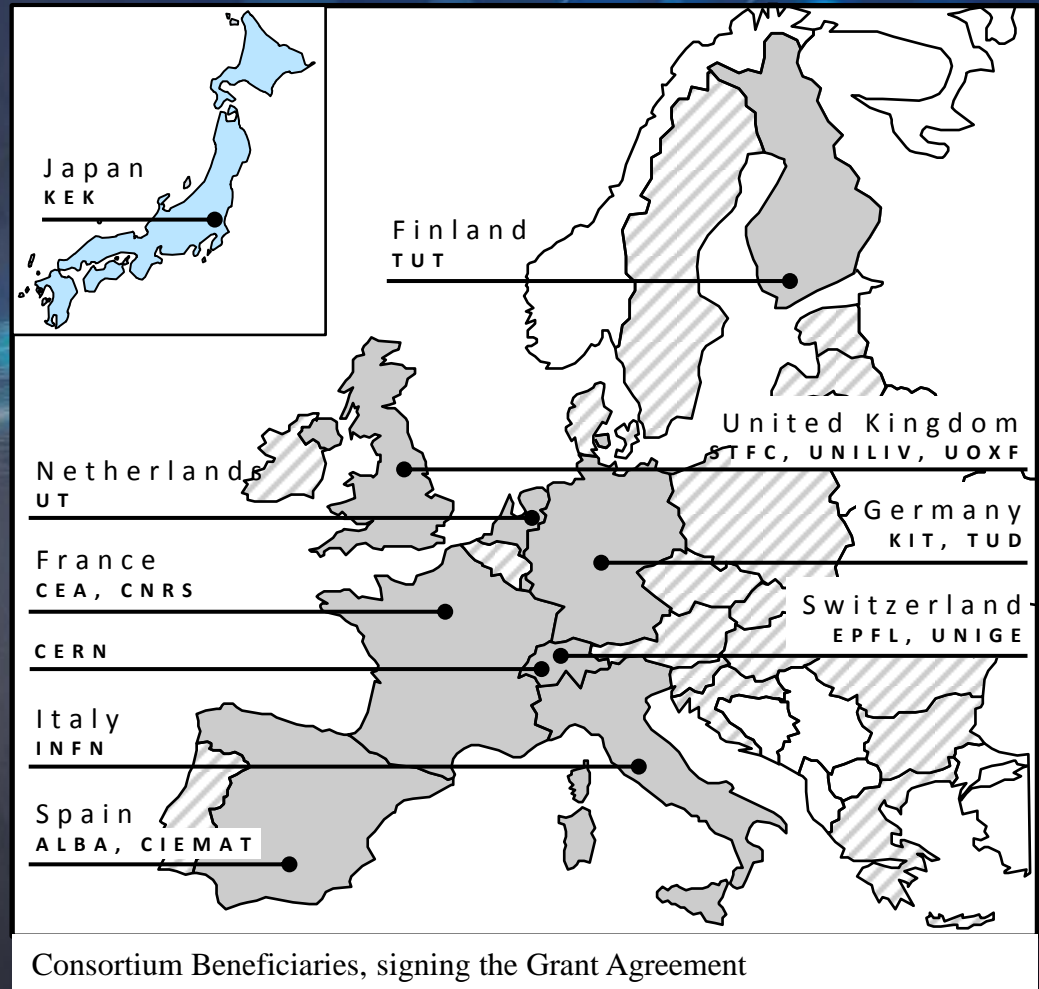
Collaboration Tools

- Institutes and work breakdown overview
- Growing platform for information exchange
- <http://cern.ch/fcc/collaboration>

EuroCirCol Consortium + Associates

16 partners and 4 associates

CERN	IEIO
TUT	Finland
CEA	France
CNRS	France
KIT	Germany
TUD	Germany
INFN	Italy
UT	Netherlands
ALBA	Spain
CIEMAT	Spain
STFC	United Kingdom
UNILIV	United Kingdom
UOXF	United Kingdom
KEK	Japan
EPFL	Switzerland
UNIGE	Switzerland
NHFML-FSU	USA
BNL	USA
FNAL	USA
LBNL	USA



Contract and MoU

- **Contract with the EC for EuroCIRCOL being finalized (official start in June 2015)**
- **Kickoff meeting 2-3 June 2015**

MoU with CERN for FCC

2 parts:

- **General framework**
- **Addendum with specific activities**
 - **Study of TPC for FCC-ee**
 - **Study of magnetic configuration for FCC-hh detectors**
 - **Design and arcs layouts for FCC-hh**
 - **Study and design of dipole magnets for FCC-hh**

MoU is waiting to be signed by G. Fioni

Addendum can be modified if we want to add topics, e.g.

- **RF systems**
- **WIFI and/or Calorimetry**

- **CPEC**
 - Pre-study, R&D and preparation work
 - Pre-study: 2013-15
 - Pre-CDR for R&D funding request
 - R&D: 2016-2020
 - Engineering Design: 2015-2020
 - Construction: 2021-2027
 - Data taking: 2028-2035
- **SppC**
 - Pre-study, R&D and preparation work
 - Pre-study: 2013-2020
 - R&D: 2020-2030
 - Engineering Design: 2030-2035
 - Construction: 2035-2042
 - Data taking: 2042 -



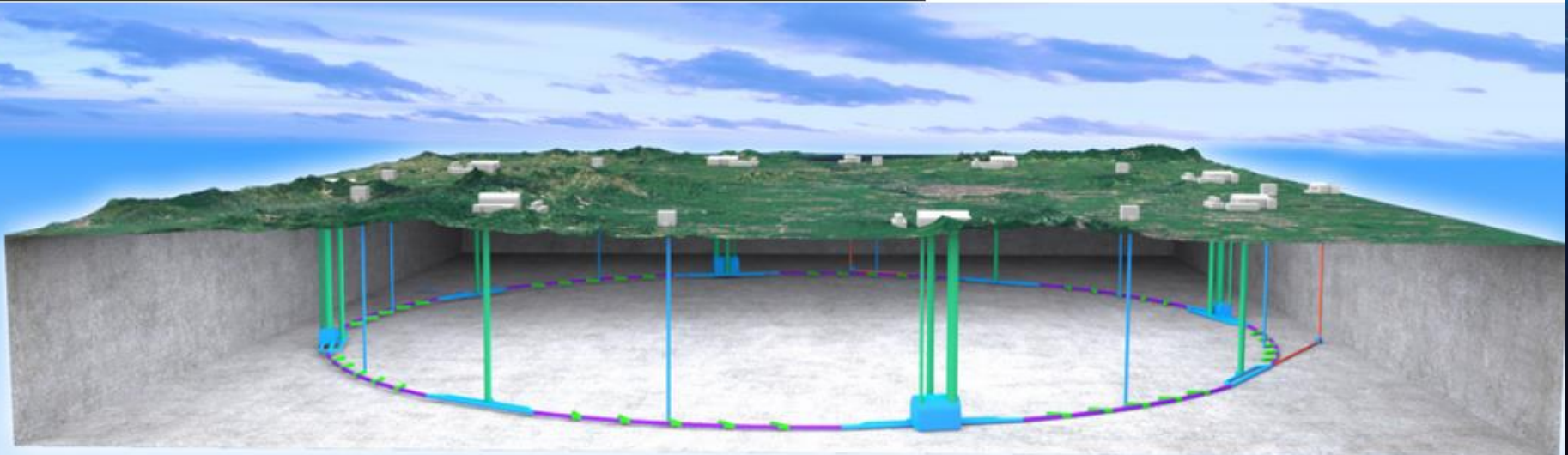
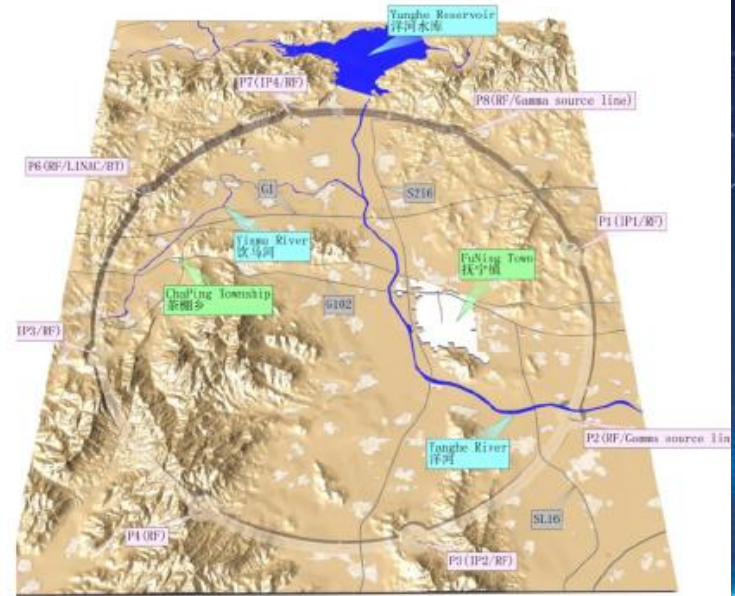
CEPC-SppC Physics Program

Option with 54 km circumference

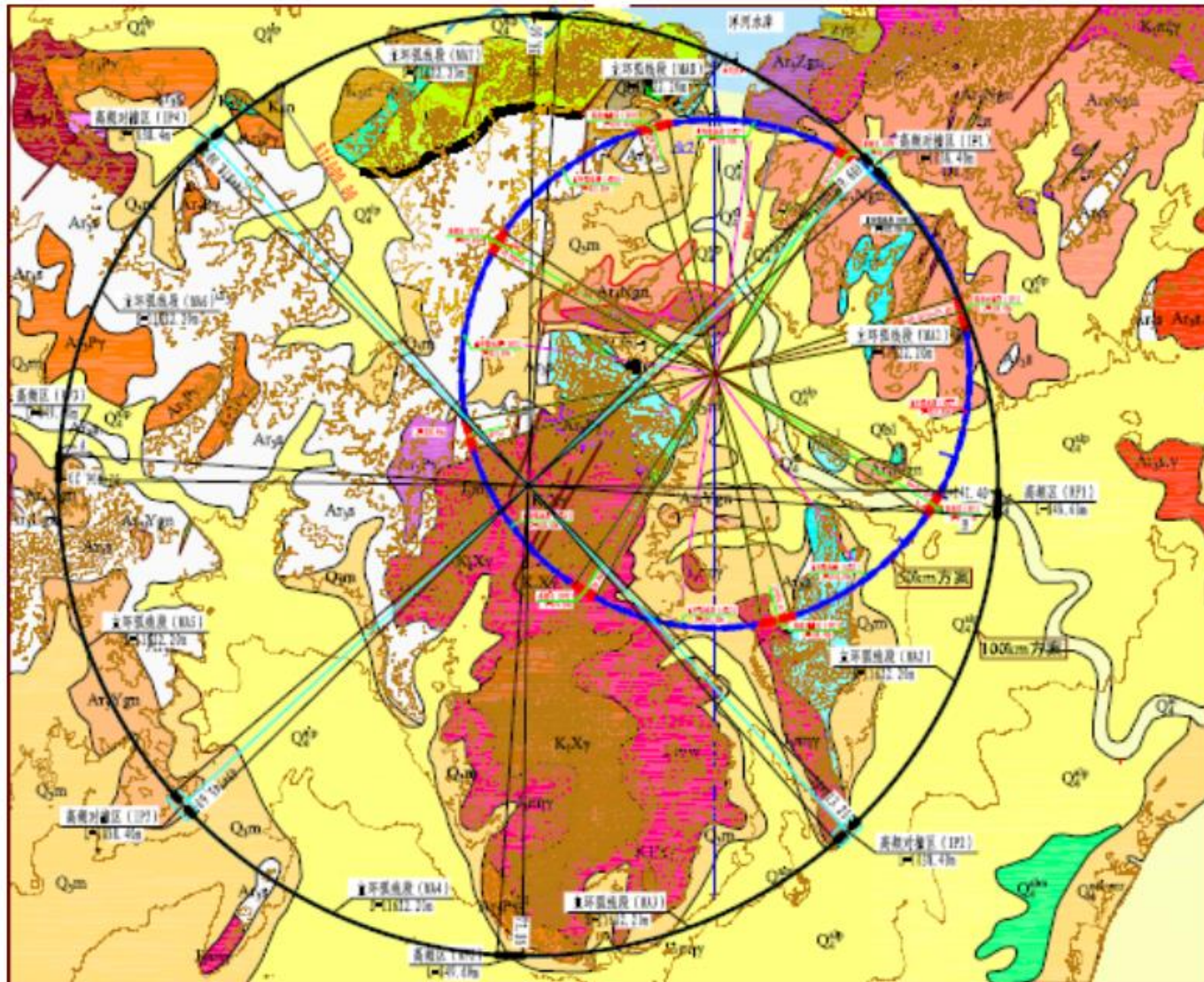
- CEPC **$L = 2 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1} @ 240 \text{ GeV}$**
 - 5 ab^{-1} for Higgs studies @240-250 GeV
 - 10^{10-12} Z's @~ 91 GeV
 - 10^{6-8} W's @~160 GeV
- SppC **$L = 1.2 \cdot 10^{35} \text{ cm}^{-2} \text{ s}^{-1} @ 70 \text{ TeV}$** with 20T magnets
 $E_{\text{cm}} = 70 \text{ TeV}$ or Higher

Civil Construction

- A credible design with cost estimate
- The key to keep the cost low
 - Find a site geologically the best (granite)
 - Optimize of the design
 - Choose the right designer & construction contractor
 - Management



Geology of a Candidate Site -- Qinhuangdao



Objective CepC:

- **End 2014: First Draft pre-CDR** collection of existing information
 - from ILC, FCC on physics and accelerator
 - for detector (ILD)
- **On-going internal review of the document with external reviewer also**
 - Accelerator part done
 - Physics part done
 - Detector (?)
- **Spring 2015: Submission for funding CDR during next 5 years**
- **Request in the range 1-1.5BYuan (150-200M€)**
- **Summer/fall 2015: Decision from Government for R&D support**

Financements pour R&D détecteur à Saclay

H2020

INFRAINNOV-1-2017 – Fostering co-innovation for future detection and imaging technologies

Scope: The aim is the establishment of an open initiative oriented towards a novel research and innovation collaborative framework engaging both the research communities in Europe using Research Infrastructures and the industry (including SMEs), for the mutual benefit of these stakeholders and the European society at large.

As a pilot initiative, the proposals should mainly address the development of future detection and imaging technologies, which have applications in the fields of medicine, manufacturing industry, aerospace, ICT, engineering and beyond, and should constitute a driver enabling the transfer of fundamental research towards industrial application.

Deadline(s)¹³:

INFRAINNOV-1-2017 and INFRAINNOV-2-2017	29/03/2017 at 17.00.00 Brussels time
--	--------------------------------------

Overall indicative budget: EUR 30.00 million from the 2017 budget¹⁴

	2016 EUR million	2017 EUR million	
INFRAINNOV-1-2017		20.00	Single stage
INFRAINNOV-2-2017		10.00	Single stage

Appel "Projets Emblématiques« du LabEx P2IO

Ces projets devront apporter une forte visibilité au LabEx et avoir un effet très structurant pour les laboratoires de P2IO. Ils bénéficieront d'un financement pluri-annuel qui s'étendra de 2016 à 2019 (fin du LabEx) ; le financement total demandé pour un projet pourra aller jusqu'à un **maximum** de 900 k€^[1]. Une fraction significative du budget du LabEx sera consacrée à ces projets ; il est envisagé de financer 3-4 projets.

Suggestion :

faire un projet sur « détecteurs pour futurs accélérateurs »

Selection en 2 étapes : pre-selection courant Septembre 2015

Fiche à soumettre au format .pdf par voie électronique au coordinateur de P2IO (coord@labex-p2io.fr) au plus tard le **4 septembre 2015 à 17h**

La taille maximale ne doit pas dépasser 4 pages.