Compact Pulsed Hadron Source

Science & Technology of University-Based, Accelerator-driven, Compact Neutron & Proton Sources: A Case in Point for China (II)

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Compact Pulsed Hadron Source

(II): The Proton Side

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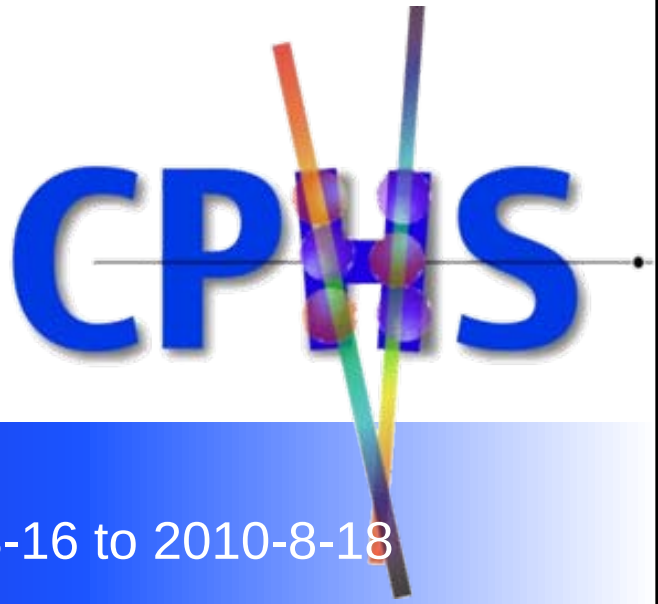
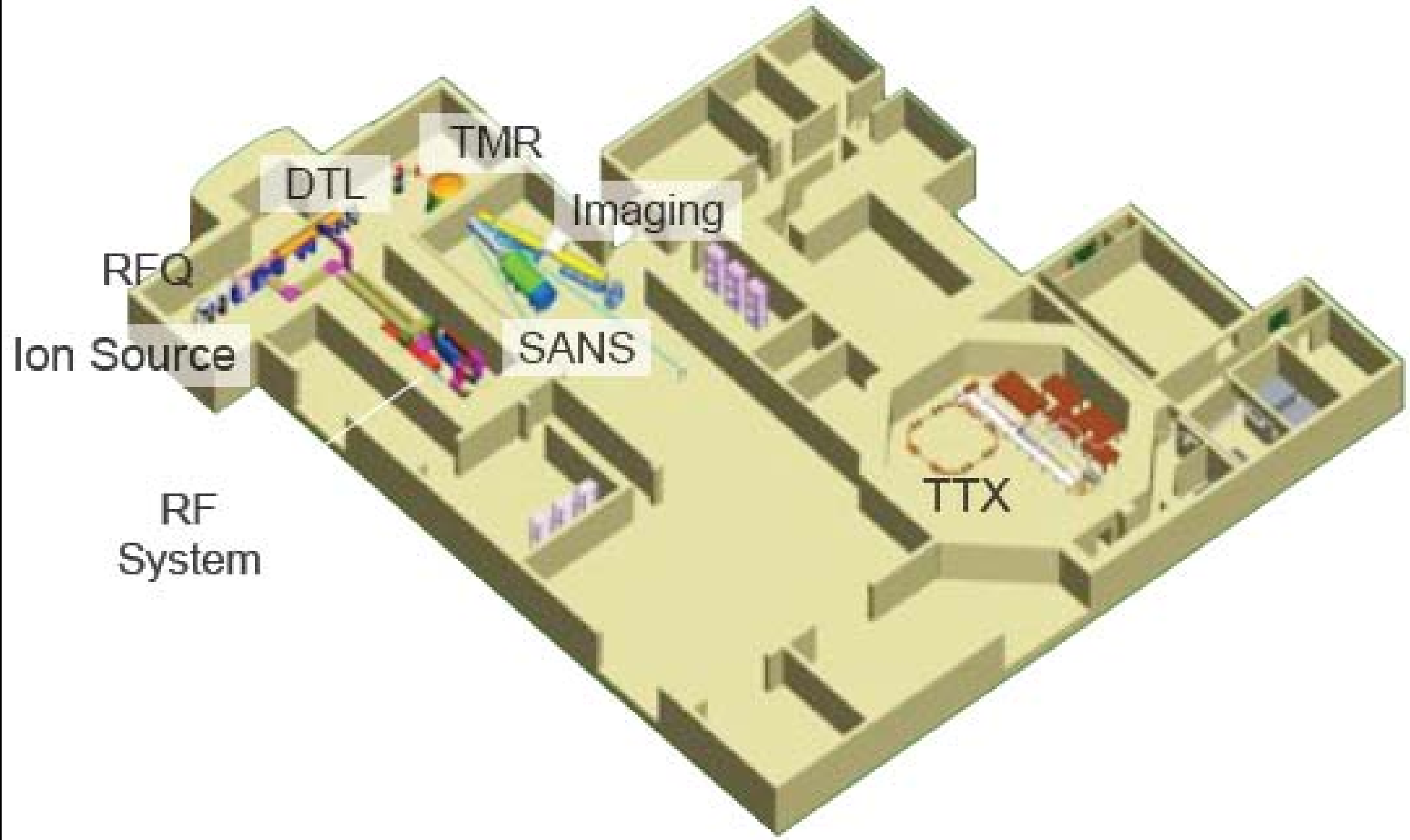


Aspects of the CPHS project

- Compact
  - State-of-the-art accelerator technology
- Extendable
  - Relates to major directions of hadron accelerator developments worldwide
- On a fast-track
  - Training of students & staff
  - Grow of domestic technology
  - In-time to support the development of major projects in China


TMR
DTL
Imaging
RFQ
Ion Source
SANS
RF
System
TTX

Tsinghua University Compact Pulsed Hadron Source

Table 1: Primary parameters of CPHS

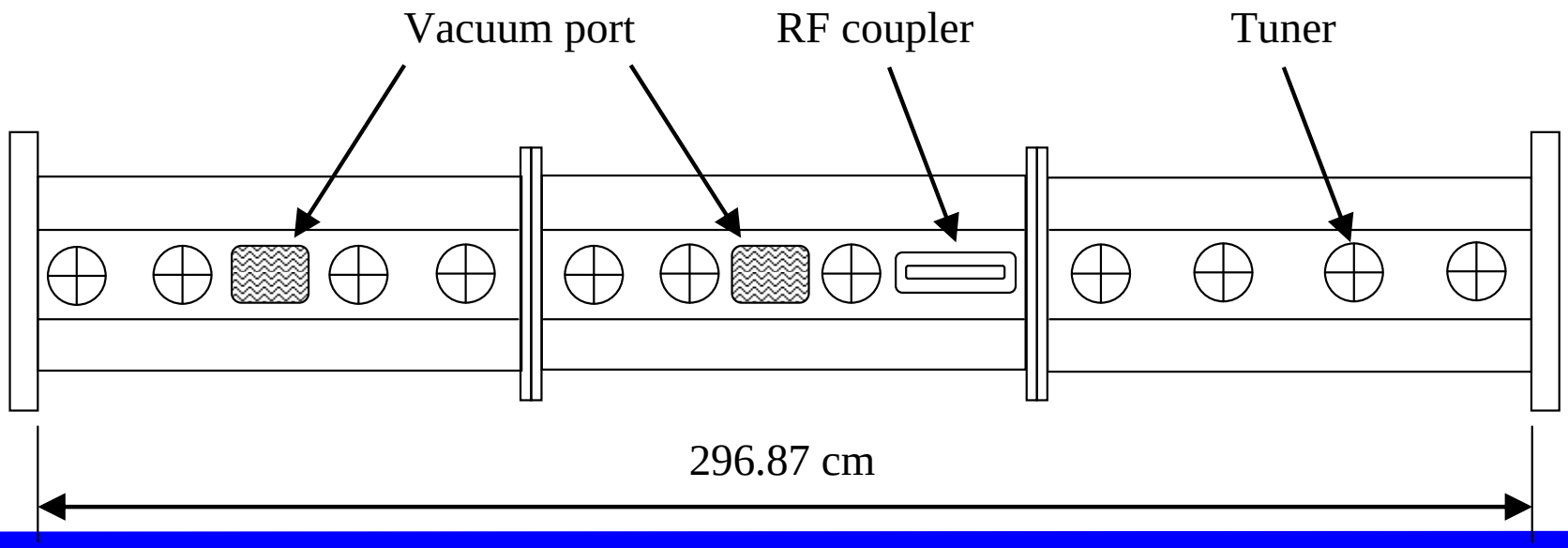
Proton power on target	16	kW
Proton energy	13	MeV
Average beam current	1.25	mA
Pulse repetition rate	50	Hz
Protons per pulse	1.56×10^{14}	Protons
Pulse length	0.5	ms
Peak beam current	50	mA
Target material	Be	
Moderator type	H_2O (300K), CH_4 (20K)	

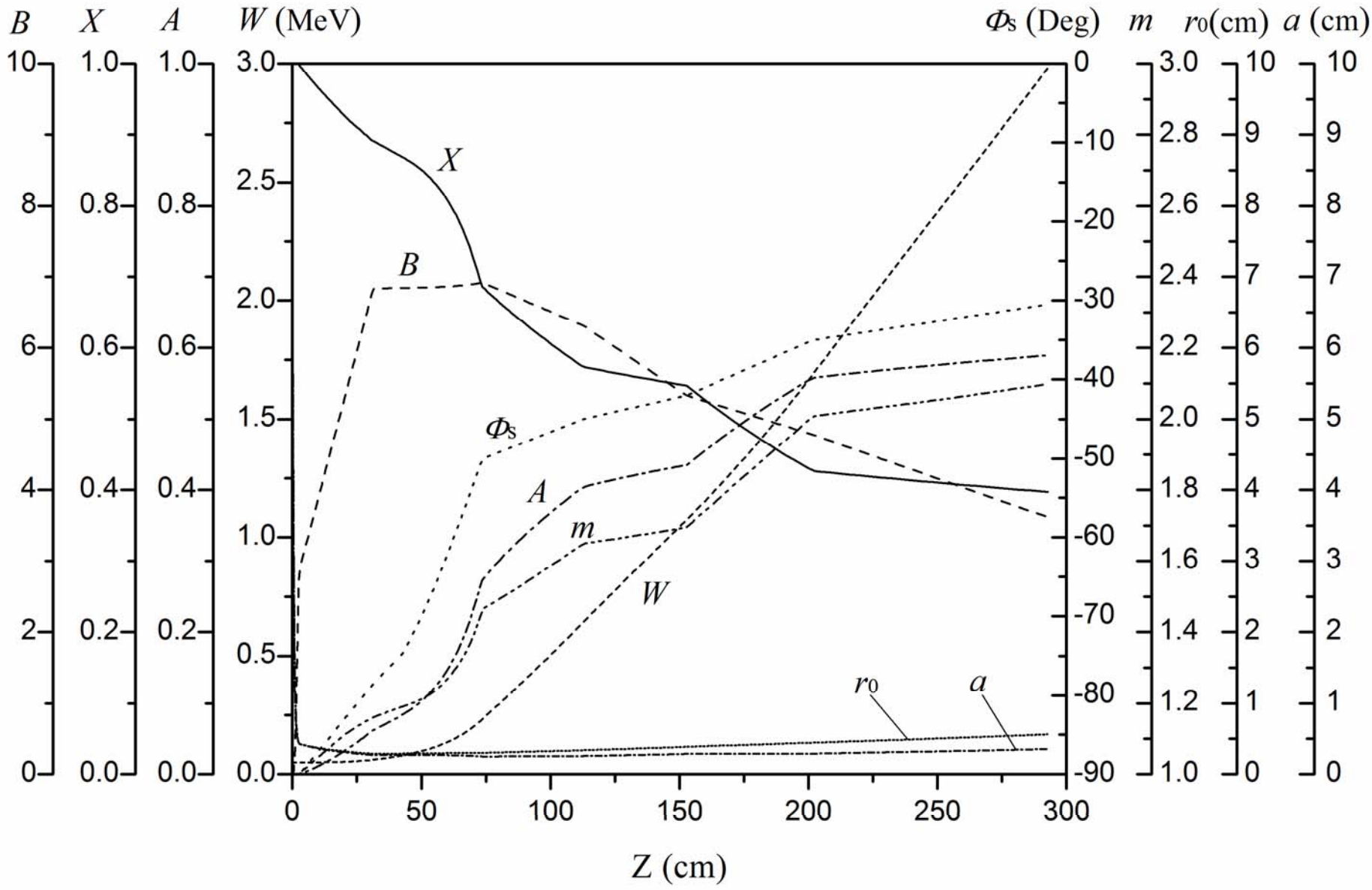
- Cost at $12M; funded $3M
- 3 year for phase I

- ECR source
- RFQ
- DTL
- RF(325 MHz)
- Be target
- SANS
- Imaging
- Irradiation

The RFQ example

- 4-vane technology for high intensity, high duty proton beams
- 3 MeV acceleration in about 3 m length
- 325 MHz (expected to be operated at the 4th harmonic of 1.3 GHz)
- Cavity cross section and vane-tip geometry are tailored as a function of longitudinal position
- No MEBT between the RFQ and DTL
- No coupling plate between the sections
- Injects into DTL with permanent magnet quadrupole magnets (compact)





Design parameters versus longitudinal position

Chief engineer

X.L. Guan

In charge of CPHS accelerator system

Expert consultants

L.M. Young

J.E. Stovall

J.H. Billen

Physical design of CPHS RFQ

Shanghai KELIN Technology Development Co., LTD

RFQ Fabrication

Cavity design of CPHS RFQ

Q.Z. Xing

In charge of RFQ system

C. Cheng

T.B. Du

RF Power system

H.Y. Zhang

Vacuum system

J.C. Cai

Structure design

Y.J. Bai

W.Q. Guan

Cooling system

Z.F. Xiong

Power coupler

Q. Du

Control system

H. Gong

Z. Zeng

Shielding system

W.Q. Li

Y. He

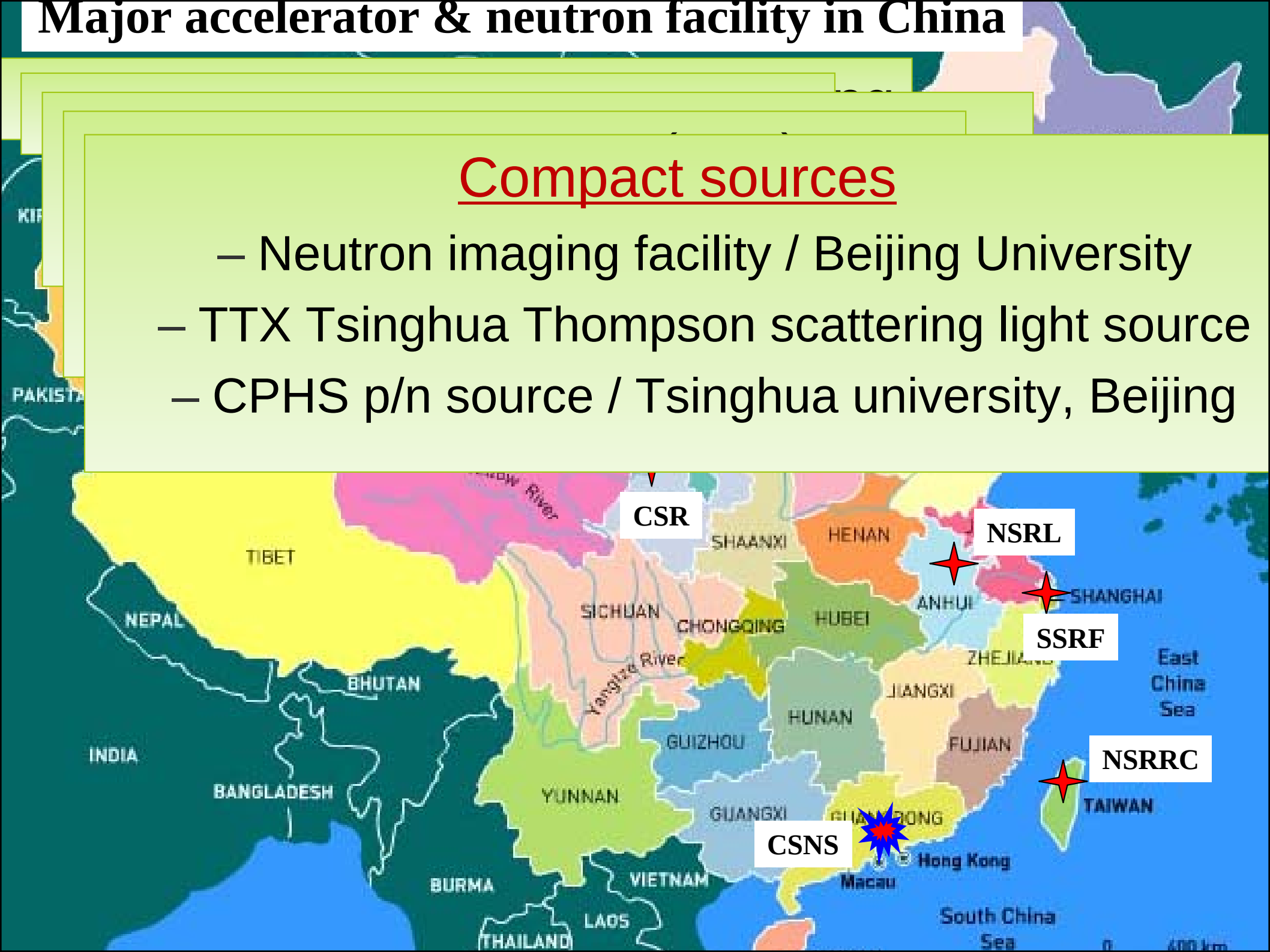
Mechanical engineer

J. Li

Major accelerator & neutron facility in China

Compact sources

- Neutron imaging facility / Beijing University
- TTX Tsinghua Thompson scattering light source
- CPHS p/n source / Tsinghua university, Beijing



Major demands for hadron accelerators

- Multi-disciplinary user neutron source
- Ion (proton/carbon) beam therapy & BNCT
- ADS for nuclear waste (minor actinides and long-lived fission-products) transmutation and for alternative fuel (Thorium, U^{238}) utilization
- Rare isotope beam (RIA) facility
- Compact neutron and proton sources

Therapy facility proposals under work

- Proton and/or carbon beam facilities
- Driven by synchrotron accelerators

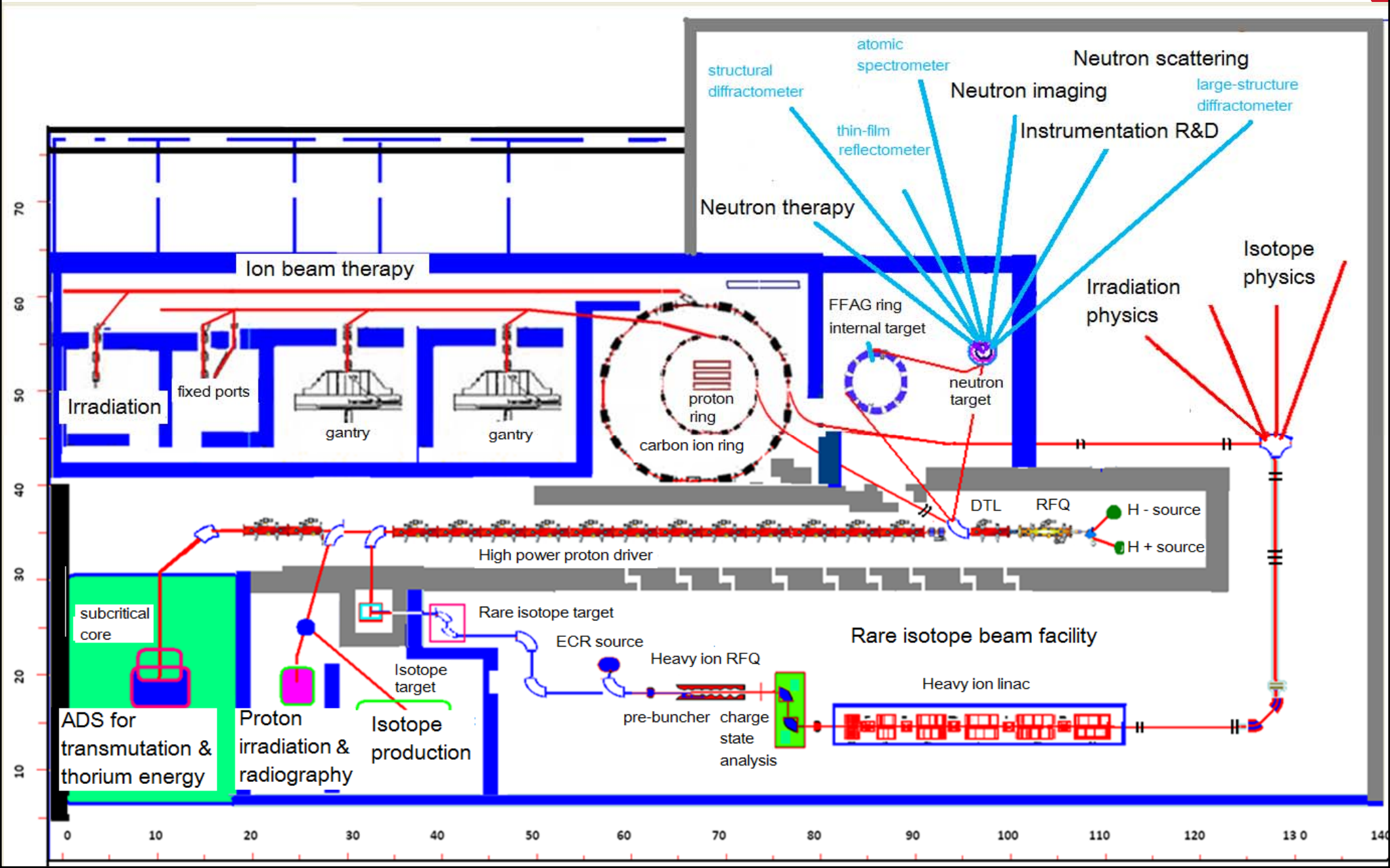
- **Shanghai Proton Heavy-ion Hospital**
  - A $330M investment by Shanghai municipal government; contract with Siemens for equipment
- **Gansu province contract signed**
  - A $150M contract by a private investor
  - Domestic developments by IMP / Lanzhou
- **Guangdong province**
  - A $120M facility commitment with IMP / Lanzhou

ADS & RIA proposals under work

- By 2020, addition of nuclear power of 40 GWe, by 2050 reaching 240 GWe. 25 tons of waste per 1 GWe reactor plant.
- Transmutation of MA and LLFP material.

- CAS planning a joint ADS/RIA center at Inner Mongolia with a budget of near $1B
- A possible collaboration of several institutes
  - Linear accelerator
  - Neutron target
  - Sub-critical reactor assembly
  - Partitioning

A possible layout of 10,000 m² building




2010-07


2010-08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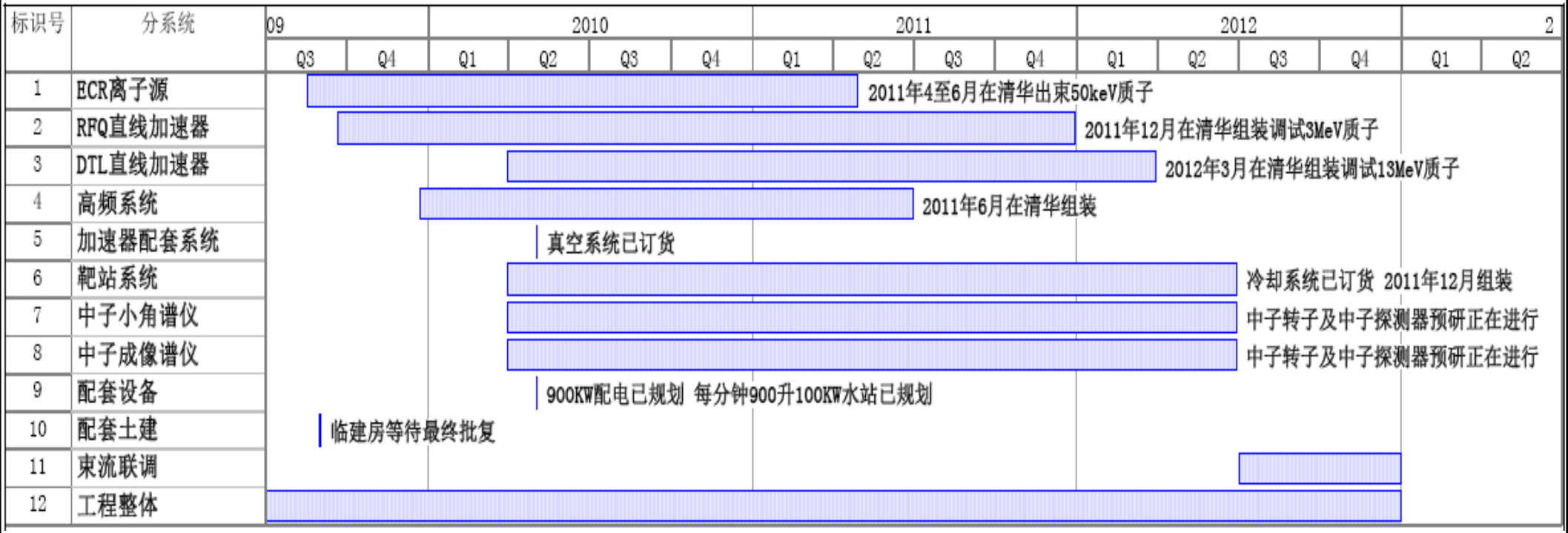
- CPHS is on track to fulfill its preset goals



Department of Engineering Physics

University Oversee Committee

Hadron Application & Technology Center

International Advisory Committee

CPHS Headquarter

Director Deputy director Lead scientist Chief engineer Facility manager

J. Wei X.W. Wang C.K. Loong X.L. Guan T.B. Du

Project Office

D. Xu

User Office

Safety & Health

Z. Zeng

Frontier accelerators

W.Lu

Z.Q.He

ADS

X.L.Guan

S.X.Zheng

J.Y.Yu

G.L.Yu

Z.H.Zheng

Accelerator

X.L. Guan

Neutron Source

C.K. Loong

Instrument

C.K. Loong B.B. Shao

Control & integration

Q. Du

Conventional facility

T.B. Du

Ion source

Z. Feng

RF

C.Cheng T.B. Du

Target System

B.Zhong T.J.Liang

SANS

J.Z.Tao T.C.Huang

Optical devices

X.Z.Zhang K.Zhang

Timing & integration

Alignment & installation

Y. He

RFQ

Q.Z. Xing J.C.Cai

Y.J.Bai Z.F.Xiong

Vacuum

H.Y. Zhang

Cooling & cryogenics

Q.X.Feng B.Zhong

Neutron imaging

Z.F.Huang Y.S.Xiao

X.X.Huan Y.J.Li

R.Zhang R.K.Li

Detector System

Y.G.Yang Y.Tian

Radiation Protection

Water Cooling

W.Q. Guan

HEBT

G.H. Li

Shielding & beamline

W.Q. Li

Data acquisition

Accelerator Control

Q. Du

Layout Drawing

J. Li

DTL

S.X.Zheng D.S.Zhang

X.F. Xie Y.L.Zhao

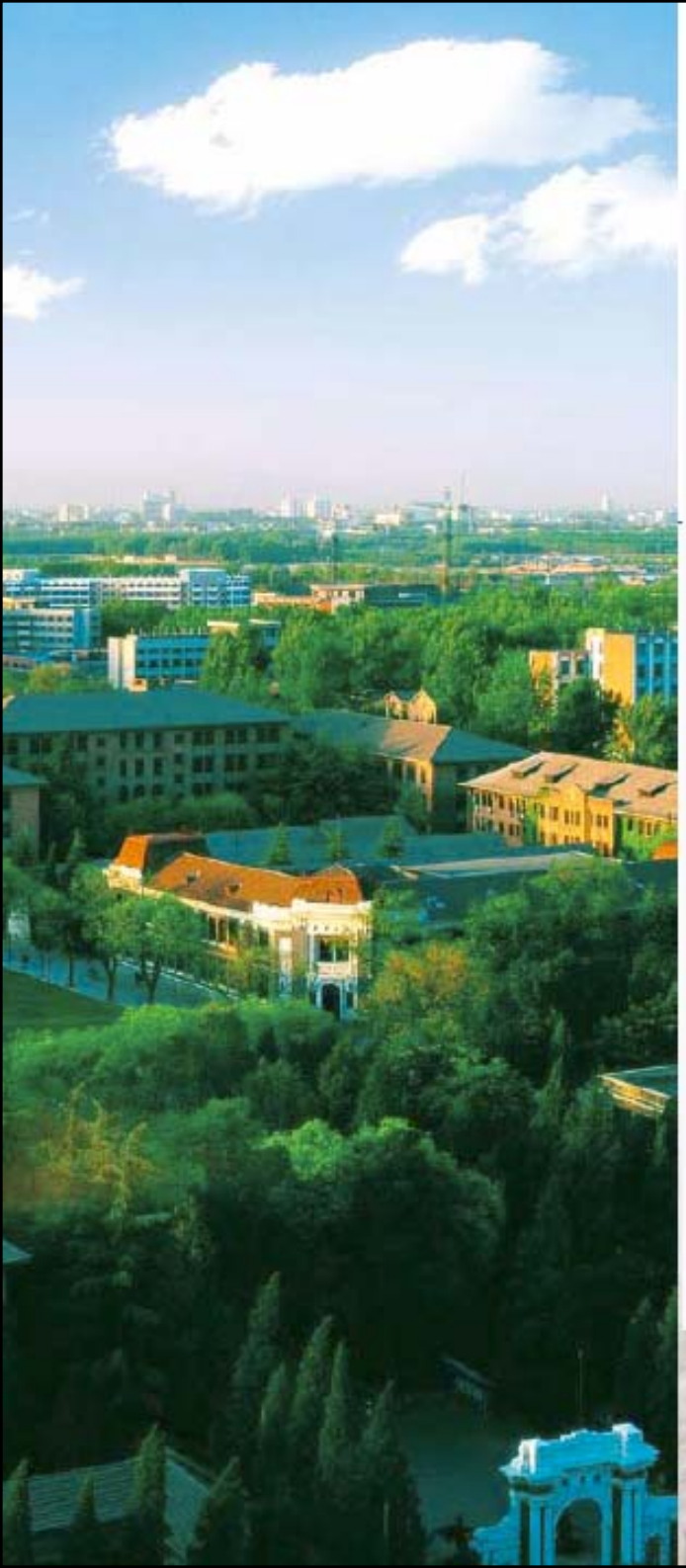
Diagnostics

Diagnostics

Proton irradiation

Target & instrument control

H. Gong



清華大學

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Thank you!