How to Start A Particle Therapy Center

Guo-Liang Jiang, MD, FACR (Hon.)

Shanghai Proton and Heavy Ion Center (SPHIC)

Fudan Univ. Shanghai Cancer Center

上海市质子重离子医院
Shanghai Proton and Heavy Ion Center
复旦大学附属肿瘤医院质子重离子中心
Proton and Heavy Ion Center, FUSCC

1. The need for particle therapy in China

Cancer Incidence and Mortality in Mainland of China (2010)

Incidence: 286/100,000

Mortality: 181/100,000

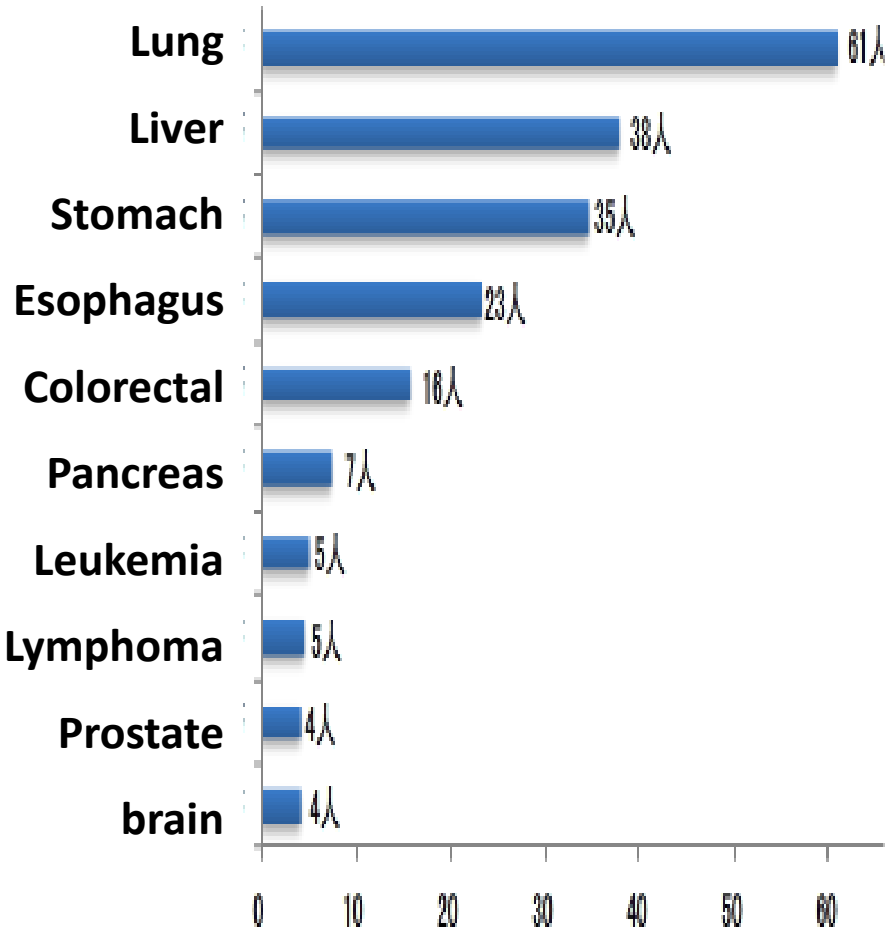
New patients:3,120,000

Cancer death: 2,700,000

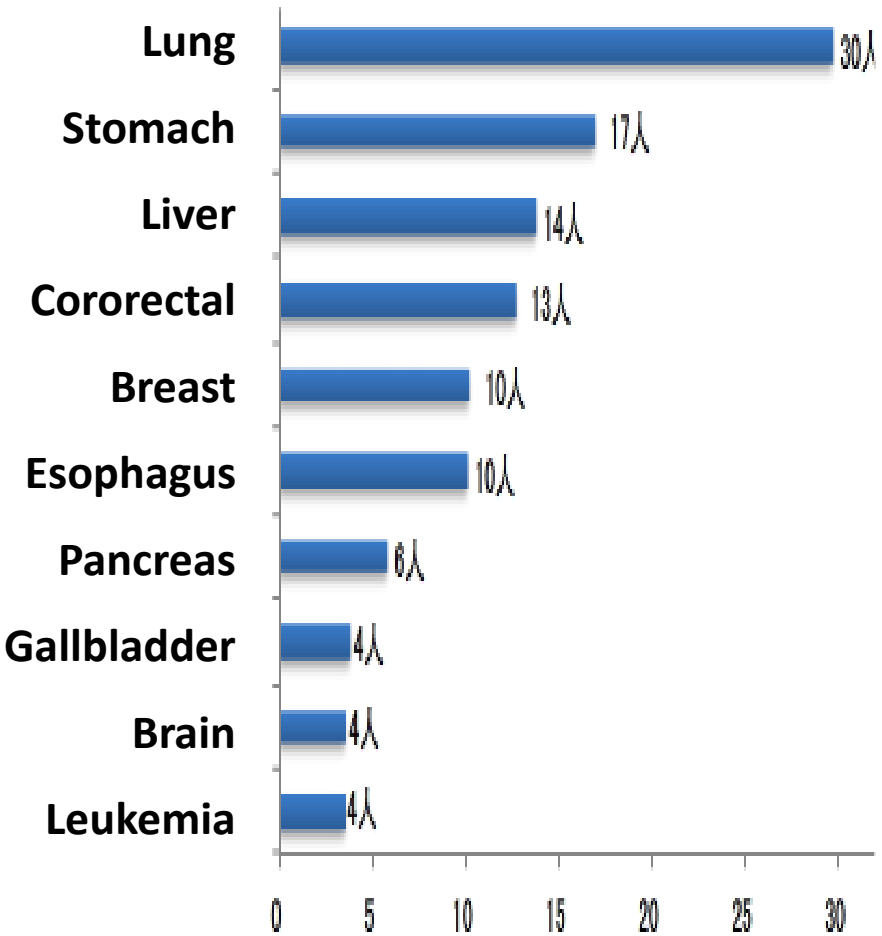
Mortality rate ranked the 2nd after cardiovascular disease

National Cancer Registration Center

Cancer Incidence in China



Male (/100,000)



Female (/100,000)

Photon radiation facilities in Shanghai

42 linear accelerators in 30 hosp in Shanghai
1 gamma knife (Eleckta) and 7 body gamma knifes (2.2/million)

Particle therapy in China

2004: Proton center, Wanjie, Shangdong, China
2006: Carbon irradiation: Institute of Modern Physics, Chinese Academy of Science, Lanzhou, China

It was needed to develop new radiation technology in terms of patient demanding and academic development in radiation oncology

Milestone

1999 started investigation of particle therapy

2005 got the lisence for importing particle therapy system from Ministry of Health

2007 initiated the project

2009 startted construction

2011 installed the system

2012 comissioniong and testing

2014 start patient therapy

2. To investigate particle therapy by literature searching and visiting the major proton centers in the world

We concluded that the proton irradiation had the potential advantages in radiation oncology, and was expected to grow widely in the world.

It was not cost-effective from the financial point of view.

We decided to start the particle therapy project
In 2005 we got the approval from Ministry of Public Health to import particle therapy facilities from overseas.

3. To find the capital investigator: a key point for the success of this project

Failed in finding capital investors because of the heavy financial burden

In 2007 Shanghai Municipal Government decided to invest this project as a non-profit hospital
Shengkang Hospital Development and Management Center, a hospital management agency in charge of building it on behalf of Shanghai Municipal Government.

4. To select facilities vendor

(1) Physical and mechanical parameters

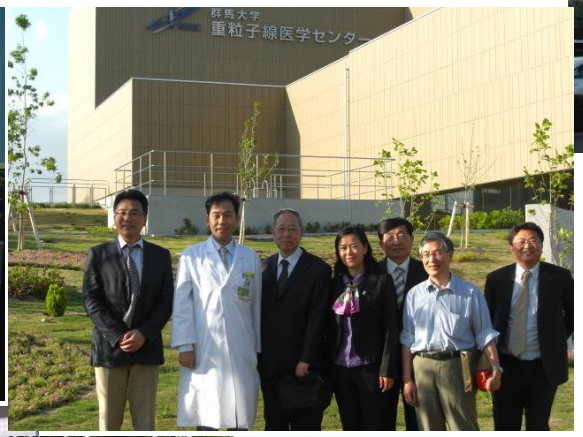
(2) The target patients

(3) Capacity of treating patient volume

(4) Cost-effective

(5) Maintenance and parts supply

(6) The potential for further development



Proton vs. Carbon vs. Proton + Carbon

(1) Proton: more experience; its advantage was decreasing

(2) Heavy ion: less experience, but more potential to cure photon resistant malignancies.

Both proton and heavy ion beams + photon

Siemens won the bidding in 2008 and signed the contract in 2009

5. Construction 2009-2011 (2 yrs)

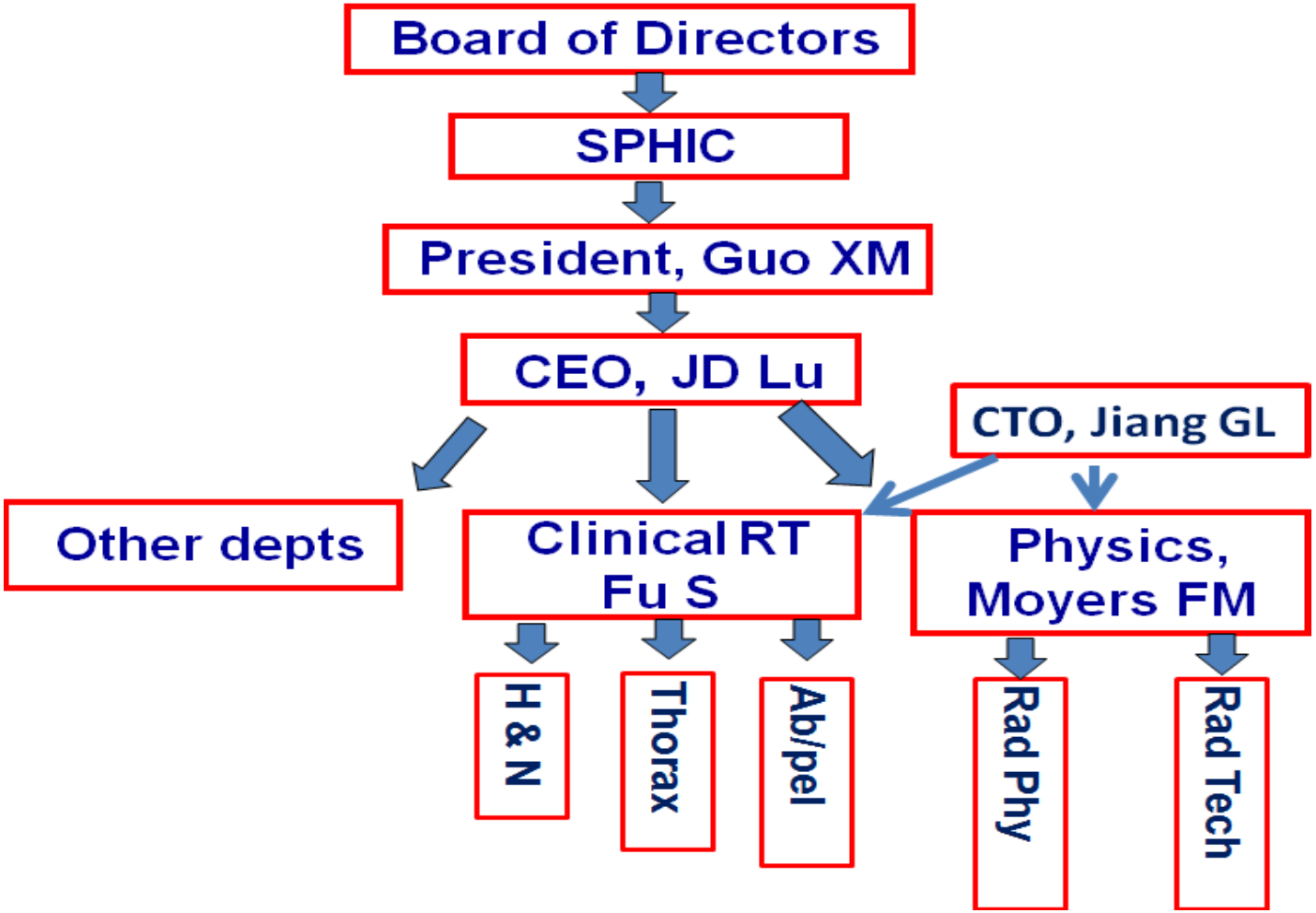
(1) Co-ordinate with construction company, Siemens, electric supply and water supply companies, and IT companies

(2) Attention to the irradiation safety and protection associating with the environment protection committee in Shanghai.

Installation of facilities 2012 (1 yr)
Testing, commissioning and acceptance tests 2013-2014 (1.5 yrs)

Early involvement of our staffs in this period gradually learnt and got familiar with the facilities.

6. Infrastructure of SPHIC



7. Staff recruitment and training

(1) Recruit staffs:

* Dept. Radiat Oncol, FUSCC
* Other hospital
* USA, 4 full time staffs, 2 part-time

(2) The clinical team, medical physics team and therapists trained in HIT, GSI, CANO and NIRS.

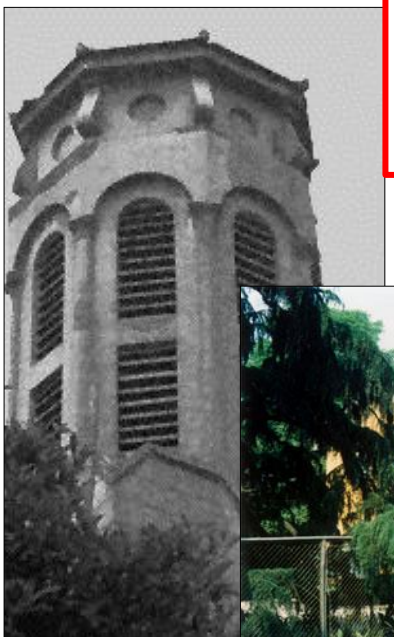
(3) Experts for short working in SPHIC

8. Treatment strategy

(1) Multidisciplinary approach

Combining irradiation therapy and surgery, chemotherapy, biotherapy, herb, etc

Relying on
Fudan Univ Shanghai Cancer Center
Founded in 1931 as "Sino-Belgium Radium Institute" by Kingdom of Belgium
Comprehensive cancer center



(2) Combine proton and carbon, or photon and carbon to provide the appropriate treatment

Rely on Dept. Radiati Oncol, Shanghai Cancer Center

Patients irradiated by photon in 2013: 6200

3-DCRT, IMRT, IGRT, SBRT, 4-DCT, RGS, ABC, etc.

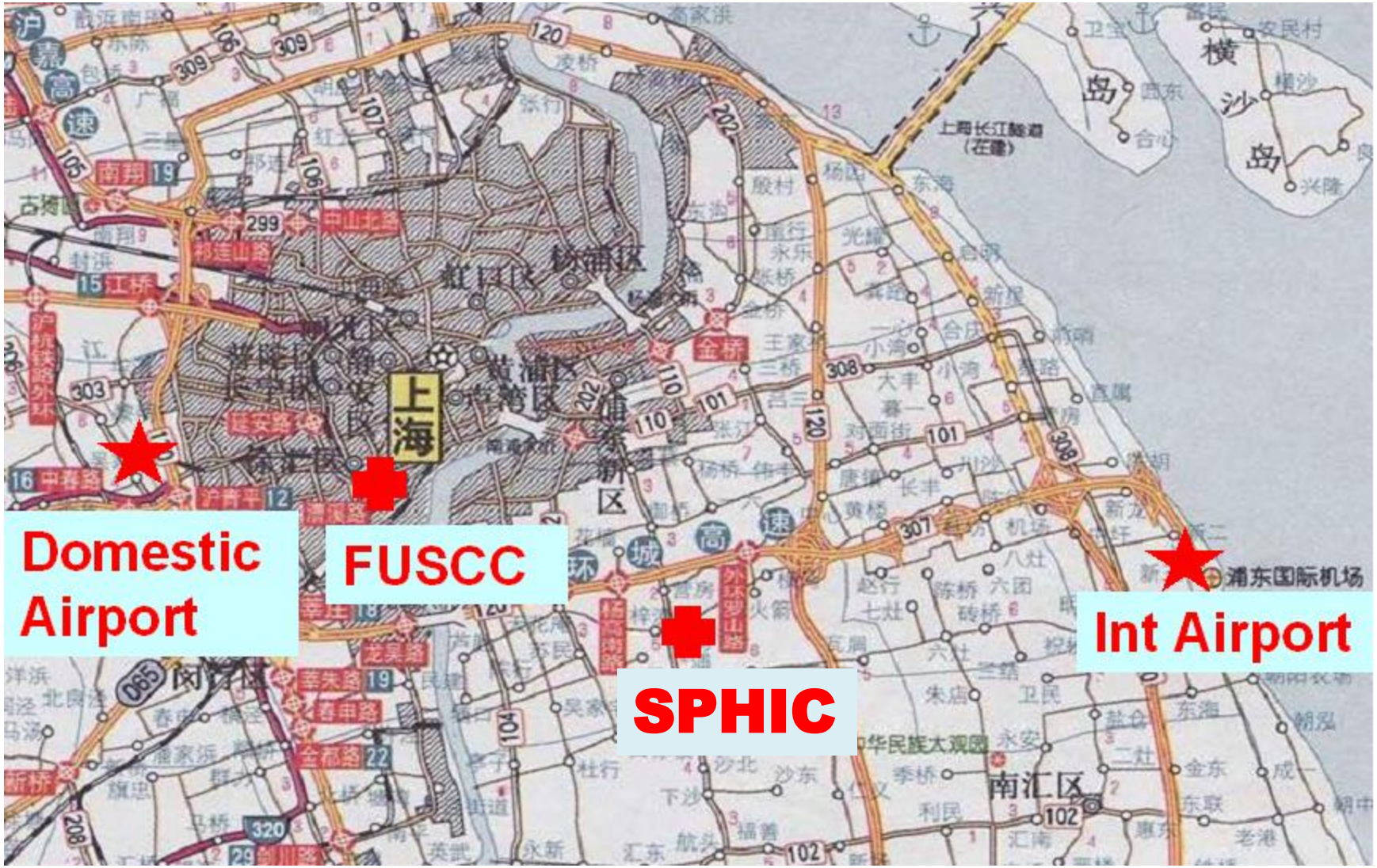
Except for the malignancies with large number of pts treated by carbon in the literature.

Start with proton, and carbon as the boost

Shanghai Proton and Heavy Ion Center
Fudan University Shanghai Cancer Center

Location: Pudong, Shanghai. To the metropolitan: 45 min;

To Int Airport: 45 min; To Domestic airport 1 hr.

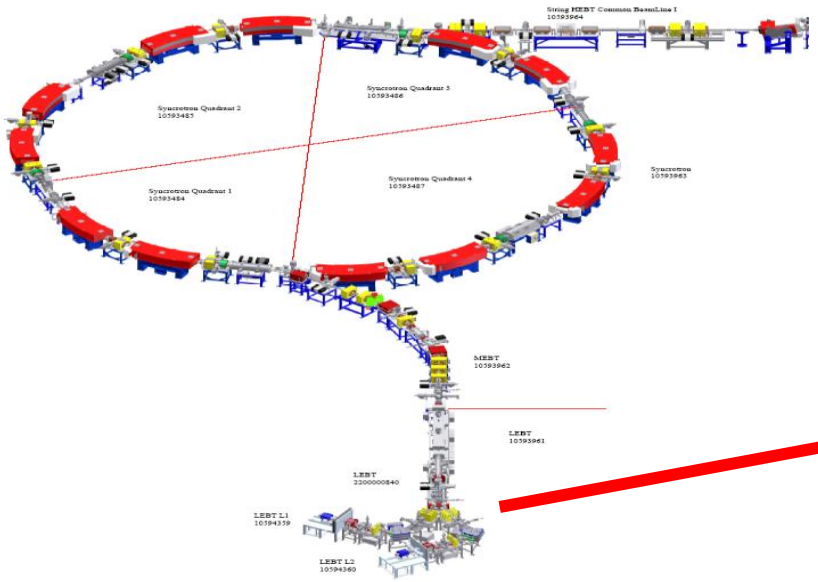


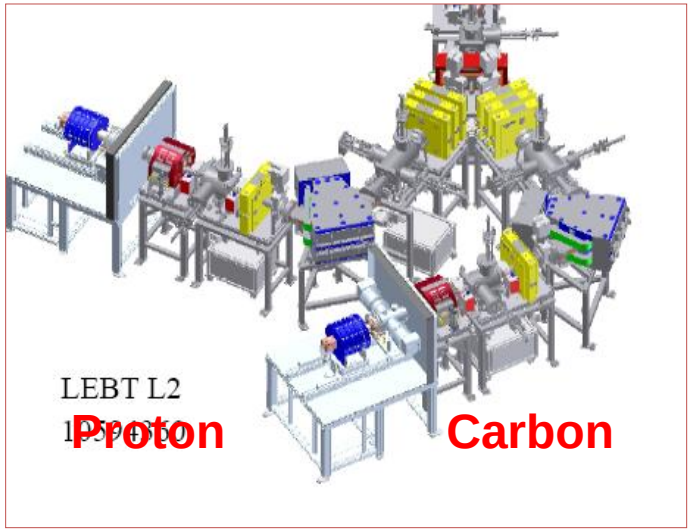
Siemens Synchrotron

Produces proton 50-220MeV and carbon 85-430MeV/u

Slow extraction of beam over 1-10 s

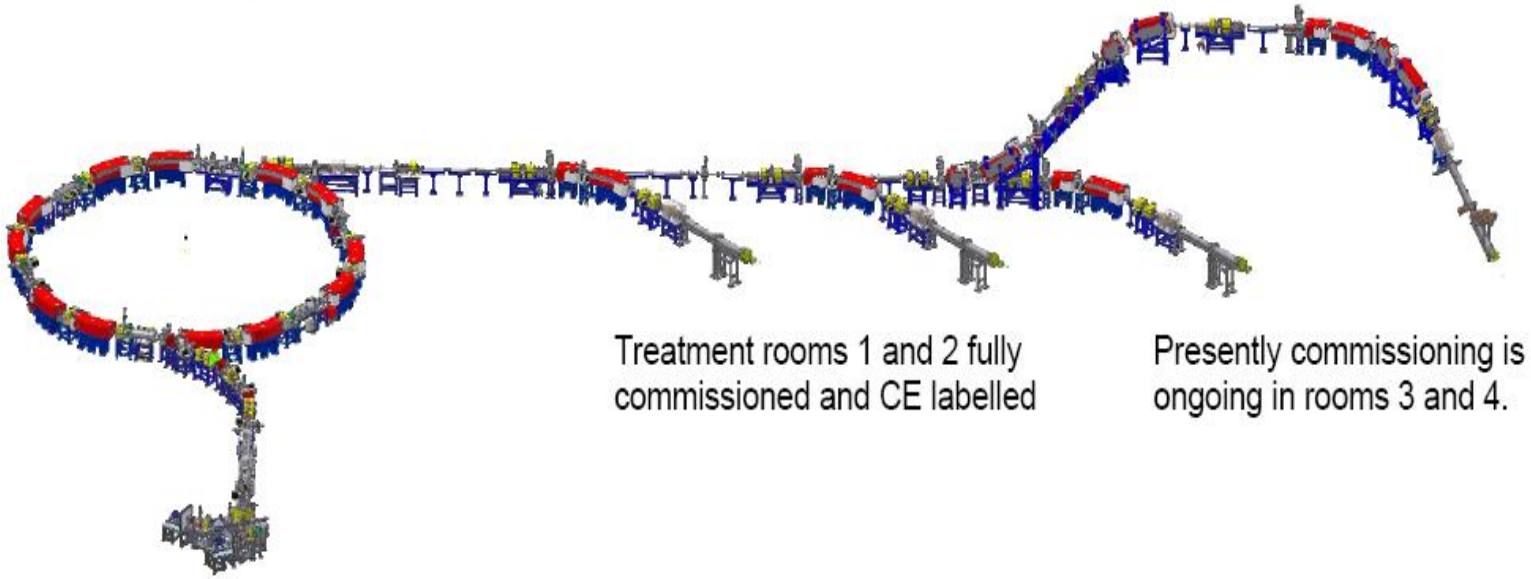
Shift from carbon to proton: less than 1 min.





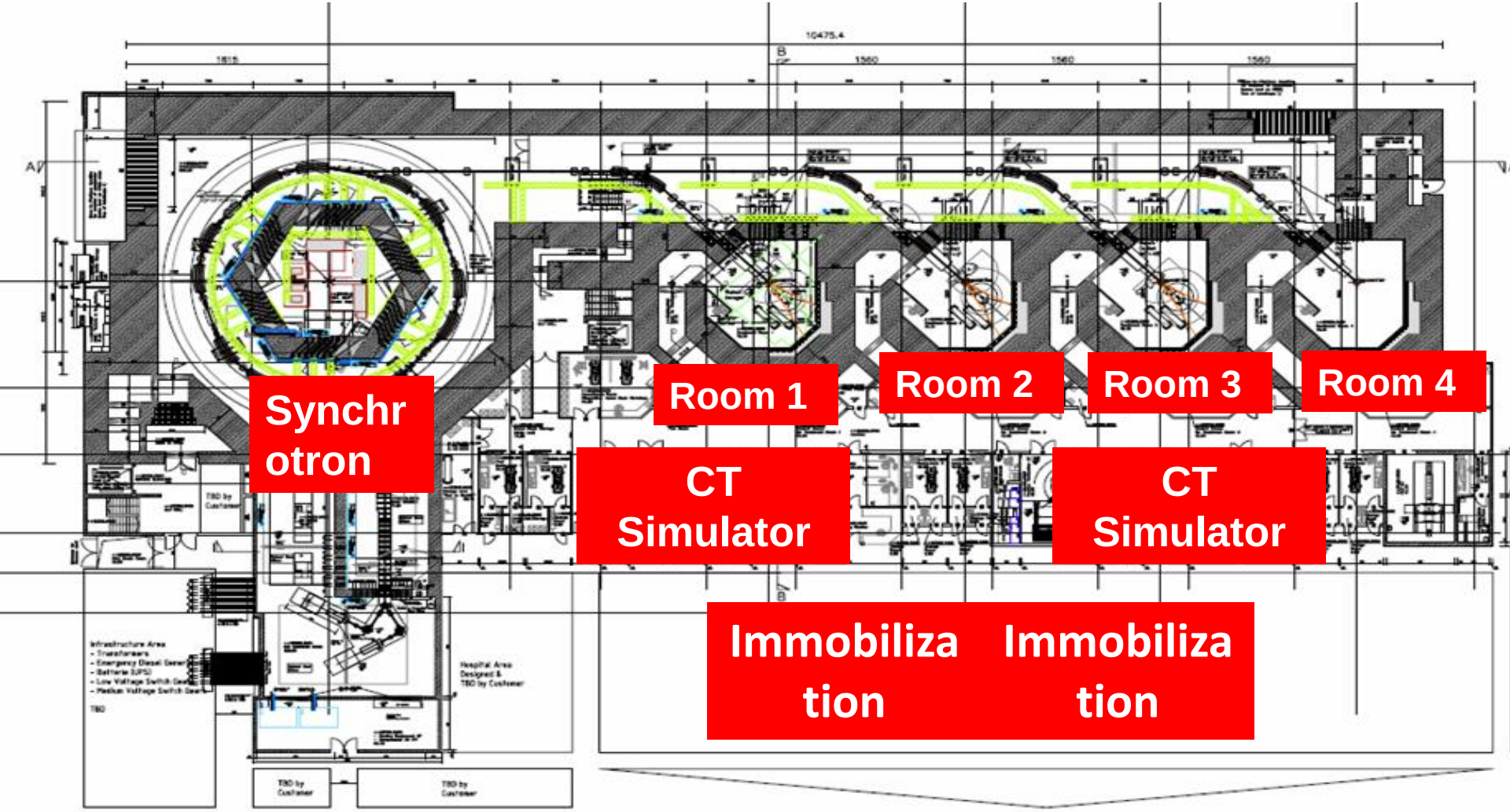
Siemens Synchrotron

Project specific variations exist.
(e.g. number of on sources, treatment room configuration – beam outlets)



4 treatment rooms: 3 horizontal; 1 45 degree beam

Layout of synchrotron and treatment rooms



PET/CT and PET/MRI near by

Techniques

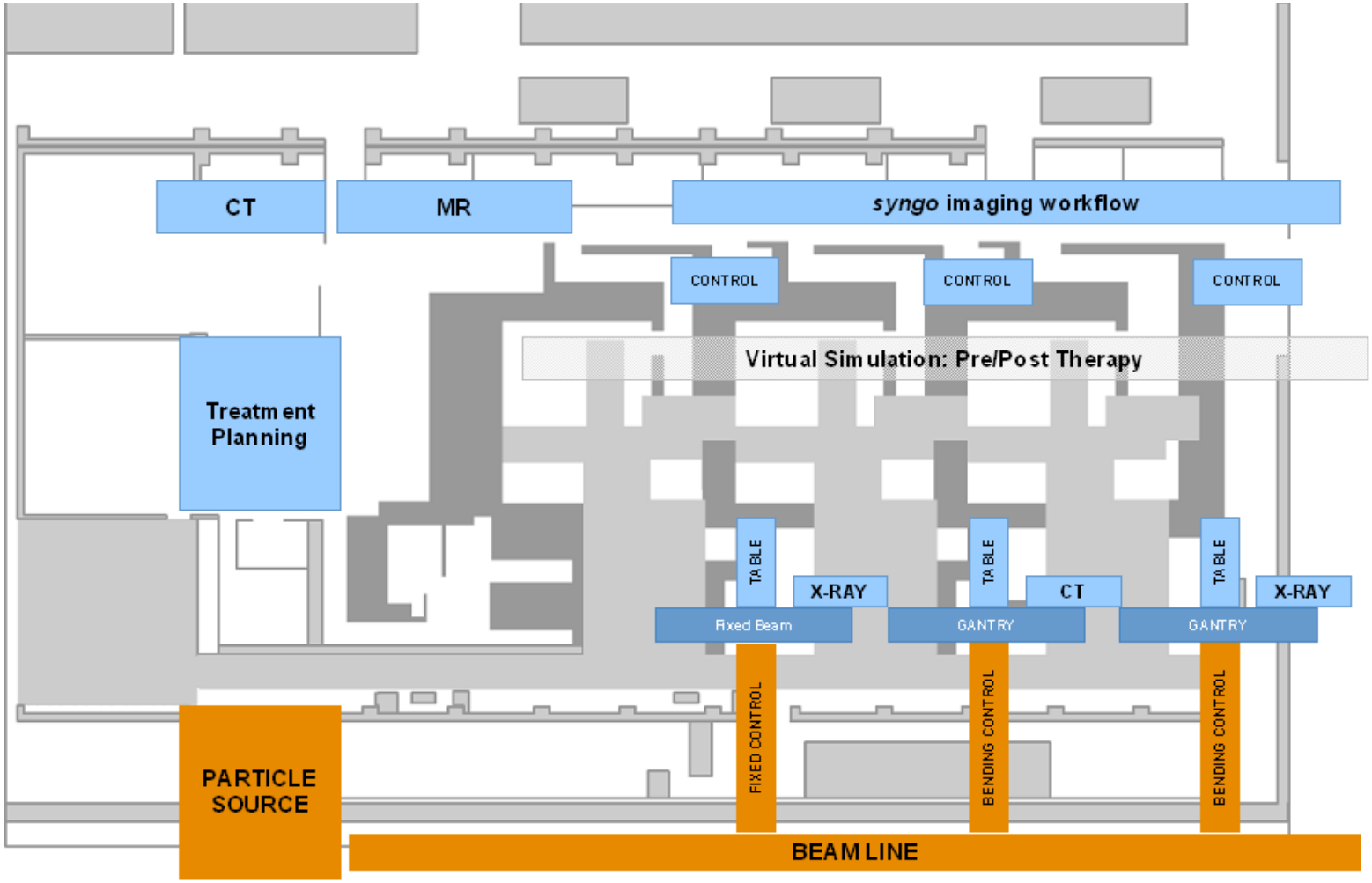
1. 3 horizontal beam rooms and 1 45 degree beam room
2. Raster beam scanning only
3. Treatment planning: biological dose by LEM
4. Robotic arm for patient positioning
5. 2-D imagers for position verification
6. Water phantom for dose verification
7. Respiratory gating: Anzai (belt)

Raster beam scanning techniques

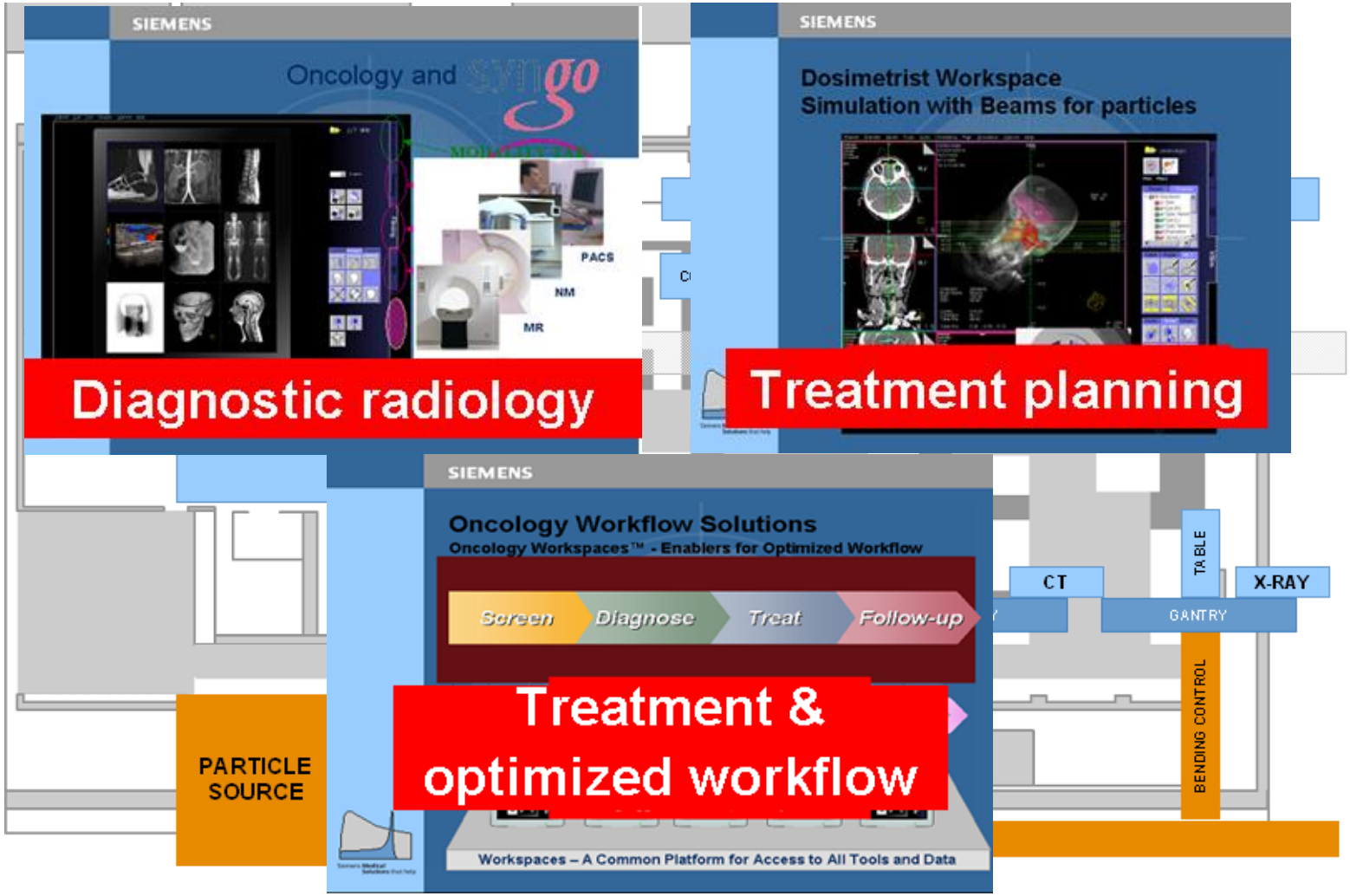
Raster beam scanning techniques

This picture was scanned by raster beam scanning

8. Patient-oriented IT based workflow design (Syngo)



8. Patient-oriented IT based workflow design (syngo)



In patient building (220 beds)