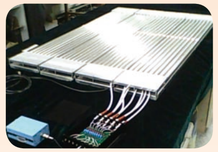
The CSNS target station and neutron instruments are the core components of its construction.The R&D results will directly affect the operation of the Spallation Neutron Source. Since 2007,great progress has been made by overcoming a variety of design and technical challenges through R&D.

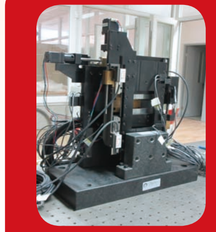


A neutron detector based on the ^{3}He-tube PositionSensitive Detector (LPSD) array

A neutron beam monitor based on GEM technology

The high pressure He-3 neutron detector based on MWPC

A prototype of bandwidth limiting neutron chopper



The high resolution neutron beam slit

The cryogenic accumulator

The prototype of the shutter

INSTITUTE OF
HIGH ENERGY PHYSICS

>> Milestones

On October 20, 2011, the cornerstone for the China Spallation Neutron Source (CSNS) Project was laid.

- Feb. 2001 proposal of CSNS discussed
- Jun. 2005 project proposal approved in principle by central government
- Feb. 2007 CAS President LU Yongxiang and Guangdong Governor HUANG Huahua signed a Memorandum of Cooperation on behalf of the two sides.
- Apr. 2007 a grand plate-unveiling ceremony was held to celebrate the birth of Dongguan Neutron Science Center (DNSC) in Songshan Lake S&T Industry Park, which is located in Dongguan, Guangdong Province.
- Dec. 2007 project proposal reviewed
- Sep. 2008 project proposal approved by central government
- Feb. 2011 project Feasibility Study Report approved
- May. 2011 the Preliminary Design Report (PDR) of the CSNS Project passed the expert review, which was organized by the Chinese Academy of Sciences.
- Oct. 2011 the groundbreaking ceremony of the CSNS Project was held in Dongguan
- May 2012 civil construction of the CSNS Project began. The Dongguan government is in charge of the civil engineering and takes care of the deficit of the budget of civil engineering, if any.

>> Radiation protection

- CSNS is a large ray device, and the radiation produced is prompt. As soon as the accelerator is shut down, the prompt radiation field will vanish, and the activation of the air, cooling water, and soil will stop as well.
- CSNS will be built in 5-meter-deep tunnels and will be surrounded by concrete shielding that will be between 0.5m and 1.5m thick. The tunnel entrances will have either a maze structure or shielding doors made of steel and concrete. These precautions will shield the surroundings from the secondary particles produced from the CSNS and from the induced radioactivity caused by activation, and will keep the environmental dose under 0.1mSv per year, which is 1/10 of the national standard.

China Spallation Neutron Source

Institute of High Energy Physics

>> What is a neutron?

■ A neutron is one of the basic constituents of matter. This uncharged particle exists in the nucleus of a typical atom, along with its positively charged counterpart, the proton. Neutrons are abundant in the universe, making up more than half of all visible matter. Because of their unique sensitivity to hydrogen, beams of neutrons can be used to precisely locate hydrogen atoms, enabling a more accurate determination of molecular structure. Neutrons, like x-rays, are a powerful means to probe the structure of the microscopic world.

>> What is neutron scattering?

■ Neutron scattering provides information about the positions, motions, and magnetic properties of solids. When a beam of neutrons is aimed at a sample, many neutrons will pass through the material. But some will interact directly with atomic nuclei and "bounce" away at an angle, like colliding balls in a game of pool. This behavior is called neutron diffraction, or neutron scattering.

■ Using detectors, scientists can count scattered neutrons, measure their energies and the angles at which they scatter, and map their final position (shown as a diffraction pattern of dots with varying intensities). In this way, scientists can glean details about the nature of materials ranging from liquid crystals to superconducting ceramics, from proteins to plastics, and from metals to micelles to metallic glass magnets.

>> Neutron spallation science

■ Neutrons, like x-rays, are a powerful means to probe the structure of the microscopic world. Moreover, neutrons have some special properties that x-rays do not possess:

1) Neutrons bear no charge, but have a magnetic vector;

2) Neutrons have the ability to penetrate through matter;

3) Neutrons are much more sensitive to light elements and isotopes;

4) Neutrons can detect both the structure and dynamics behavior of matter.

■ For the above reasons, neutron scattering has become a complementary means to x-rays in advanced research in physics, chemistry, biology, life science, material science, alternative energy, as well as in commercial applications.

>> The spallation neutron source in China

■ Two high performance x-ray sources based on synchrotron radiation facilities are operated for users at Beijing (BSRF at IHEP) and Hefei (NSRF at USTC), and another is being completed in Shanghai (Shanghai Light Source). However, there is no high performance pulsed neutron source in China. To meet the increasing demand from the user community, China has decided to build a world-class spallation neutron source, called the China Spallation Neutron Source (CSNS).

■ The CSNS facility is designed to provide multidisciplinary platforms for scientific research. The site of the CSNS has been selected at Dongguan, Guangdong Province. It can provide users a neutron scattering platform with high flux, wide wavelength range and high efficiency. The pulsed-beam feature allows studies not only of the static structure but also of the dynamic mechanisms of the microscopic world. The high-flux pulsed neutrons, muons, and protons from the CSNS will also complement continuous-wave neutrons from the China Advanced Research Reactor (CARR).

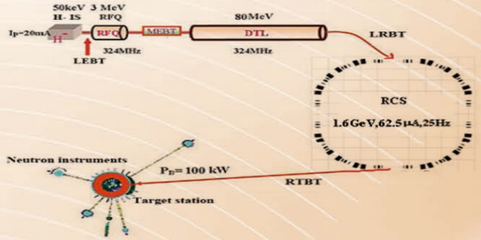
Layout of the China Spallation Neutron Source

■ The China Spallation Neutron Source will be available to researchers from all over the world with varying degrees of experience. Submitted research proposals will be reviewed by independent scientists from within the neutron scattering community, and the most promising ones will be chosen.

>> CSNS facilities

■ In Phase I of the project, the facility will consist of an 80-MeV H- linac, a 1.6-GeV proton rapid cycling synchrotron (RCS), beam transport lines, a solid tungsten target station, and 3 initial instruments for the pulsed spallation neutron applications. The RCS provides a beam power of 100 kW with a repetition rate of 25 Hz.

■ The accelerator is designed to deliver a beam power of 100 kW with the capability to upgrade to 500 kW by raising the linac output energy and increasing the beam intensity.



>> Site

■ The CSNS construction site is located in Dongguan, Guangdong province. It is about 85 km from Guangzhou and about 125 km from Hong Kong. CSNS will be the first large scientific facility in south China where the economy is growing very rapidly. It is expected that the CSNS construction and operation will have positive effects in promoting the sciences and high-tech development in the area.

■ The final area of the construction site will be about 0.67km^2, while 0.27km^2 has been planned for the first phase of construction. Main buildings include the Linac, RCS, transport line, and target, which will have a total area of 30,431m^2. Auxiliary buildings, including the administration office, will have a total area of 36,258m^2.

■ A new branch of IHEP has been opened in Dongguan, with 400 new positions. 175 new staff have been hired by the new branch. Prof. Yuanbo Chen, Deputy Manager of CSNS project, is in charge of the branch. The administration of the branch is established.

>> R&D of CSNS prototypes

■ A series of R&D projects for major components have been performed since 2006. The project design proposal was approved by the Chinese central government in September 2008. Over 30 prototype items (covering most key technologies) have been completed.

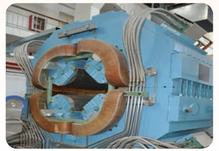
■ The CSNS accelerator, the first of such a high-power and high intensity proton machine in China, is a great challenge in its design and technology. A series of R&D on the key technologies started in 2006 and have been successfully completed, laid a solid foundation for the project construction.

The prototype of CSNS H-ion source was developed in collaboraotin with ISIS, RAL.

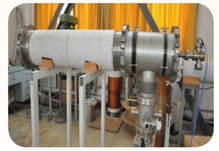
The choke and capacitor for CSNS RCS resonant power supply

The CSNS RCS dipole magnet prototype with stranded aluminum coil

The prototype of CSNS RCS ferrite-loaded RF cavity



The prototype of CSNS RCS ceramic chamber for quadruple magnet



The prototype of CSNS RCS ceramic chamber for quadruple magnet

The resonant power supply for CSNS RCS dipole magnet

The prototype of 324MHz DTL for CSNS LINAC