Spallation Neutron Source Amazing Science Facts

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The Spallation Neutron Source&acutes 1000-foot linear accelerator, shown from either end in this trick photo, is actually nearly perfectly straight, with an allowance of 7 millimeters to compensate for the Earth&acutes curvature. A proton is accelerated down the linac from a stop to nearly the speed of light in 2 microseconds.

The New Year is bringing the science community a grand present: The Spallation Neutron Source at Oak Ridge National Laboratory. On schedule for completion in 2006, the Department of Energy's new science facility will provide researchers with the world's most powerful and most advanced tool for analyzing a host of materials with neutrons.

As they home in on the fruition of seven years of construction, SNS staff members have compiled the following list of SNS Amazing Science Facts to illustrate what's in store for the neutron science community once this state-of- the-art, world-class materials research facility starts up around mid-year. Read on and prepare to say "Wow."

Around the world: The energy of the SNS's proton beam, expressed in terms of voltage, is 1 billion electron volts. That is equivalent to 666 million 1.5-volt D-cell batteries joined end to end. Such a string of these batteries would nearly reach around the Earth!

Fast off the line: The proton beam accelerates through the linear accelerator (linac) from a standstill to approximately 90 percent of the speed of light in two microseconds!

Now that's cold: The SNS's linac takes advantage of superconducting technology: Approximately two-thirds of the linac's total 1000 feet is at superconducting temperature, chilled with liquid helium to 2 degrees above absolute zero, or 2 Kelvin. How cold is that? By comparison, a December night-game spectator at the Green Bay Packers' Lambeau Field should dress to endure a comparatively toasty 275 Kelvin!

Flurry of punches: Following 1,060 turns around an accumulator ring, 150 trillion accelerated protons (150,000,000,000,000) strike the target in a pulse that lasts only one millionth of a second. These pulses strike the target 60 times per second!

Ouch: The pulses strike the target vessel at enough energy to release neutrons from atoms--neutrons that are then used for research. That energy is similar to a 200-pound block of steel hitting the vessel at 50 mph!

Over the horizon: The SNS requires the tuning of the beam lines to be so precise that the Earth's curvature was factored into the construction of the linear accelerator-a tiny but critical difference of 7 millimeters from one end of the 1,000-foot linac to the other!

Fine as frog's hair: All components on the SNS that comprise the accelerator and the target, independent of size, shape and weight, are installed to specifications within a mite-sized 2/10 of a millimeter!

Plugged in: Beam power in the linac is 1.4 megawatts, enough juice to power 1,400 homes. It will require 42 megawatts of electricity to generate those 1.4 megawatts of beam power. The total SNS electric bill will be, at current rates, $10 million a year, or enough power to serve a town of roughly 30,000!

Admiration from afar: The SNS will increase the number and intensity of neutrons for research by factors from 10- to 100-fold. So intense that, once the SNS is operational, no one will ever again enter the target bay. All maintenance operations inside the target--even changing light bulbs--will be performed remotely, with state-of-the-art robotic manipulators Because they have to be performed robotically, all anticipated remote operations inside the target facility, for the 40-year design life of the SNS, have been planned and practiced beforehand!

Thick as a brick: Shielding over the tunnel into the target facility "monolith" consists of 7 feet of steel and 2 feet of concrete. The target facility floor is 5 feet thick. There are 12 million pounds of steel shielding in the monolith alone, and 4 million pounds of concrete!

Chock full o'neutrons: The SNS is the first facility to use pure mercury as a target material. Why? The liquid mercury can be continuously circulated, thus dissipating the enormous heat and energy. Mercury is also rich in neutrons- -the average mercury nucleus has 120 neutrons--and consequently, has a very large mass. The target's 20 tons of mercury is only one cubic meter in size!

Come together: Five Department of Energy Office of Science laboratories--Argonne, Berkeley, Brookhaven, Jefferson and Los

Alamos--participated with Oak Ridge in the design of the SNS project. The $1.4 billion Basic Energy Sciences project has been constructed on time and on budget with an excellent safety record.

But the most remarkable aspect of the SNS is the science that will be performed there in the years ahead. Researchers from the United States and abroad--an estimated 2,000 a year--are poised to come to the SNS to study materials that will form the basis for new technologies in telecommunications, manufacturing, transportation, information, biotechnology and health. This broad range of scientific impact will strengthen the nation's economy, energy security and national security.

Source: ORNL