ICANS-XIV
14th Meeting of the International Collaboration on
Advanced Neutron Sources
June 15-19, 1998
Utica, IL USA

STATUS OF IPNS

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Abstract

Under the Scientific Facilities Initiative, IPNS has increased the beam time for users by 50% and is operating 25 weeks/yr. We have added scientific and technical staff to support the greatly expanded user program. Projects are underway to increase the capabilities for most IPNS instruments and an upgraded quasielastic spectrometer (QENS) is under construction. IPNS has been given lead responsibility for the neutron scattering instruments for the Spallation Neutron Source to be built at Oak Ridge, for which instrument teams are being formed.

1. User Program

In 1995 the US national laboratories put forth a highly coordinated successful effort to obtain funding for a number of Department of Energy (DOE) facilities that were operating well below their optimum level. For a relatively small increase in operating funds, facilities for physical sciences, high energy physics and nuclear physics research significantly increased their operating effectiveness. IPNS, along with the other DOE neutron, synchrotron and electron microscope facilities, received a significant increase in funds starting in 1996. This resulted in our hiring 23 new staff, primarily for scientific support, and an increase of 50% for instrument beam time for users.

IPNS continues to run one of the most active user programs at a US neutron scattering source and to foster scientific interactions with the user community (see table below of recent meetings).

1.1 Recent Meetings Organized by IPNS

Materials Research Using Cold Neutrons at Pulsed Neutron Sources, Aug. 1997

International Workshop on Cold Moderators for Pulsed Neutron Sources, Sept. 1997

Monte Carlo Simulation of Neutron Scattering Instruments, Nov. 1997

ICANS XIV, June 1998

IPNS operates 25 weeks, with slightly more than 200 users coming to IPNS for one or more experiments each year. Eleven instruments are in the user program, two more are under development, and a total of 15 stations are active on 12 beamlines. The 31st round of approved user experiments will begin in July, 1998. The oversubscription ratio remains at more than 2. The table below shows the results of recent operation. The decrease in the number of

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experiments performed following 1989-90 was due to the removal of the booster target and a decrease in operating time.

Table 1. IPNS User Program

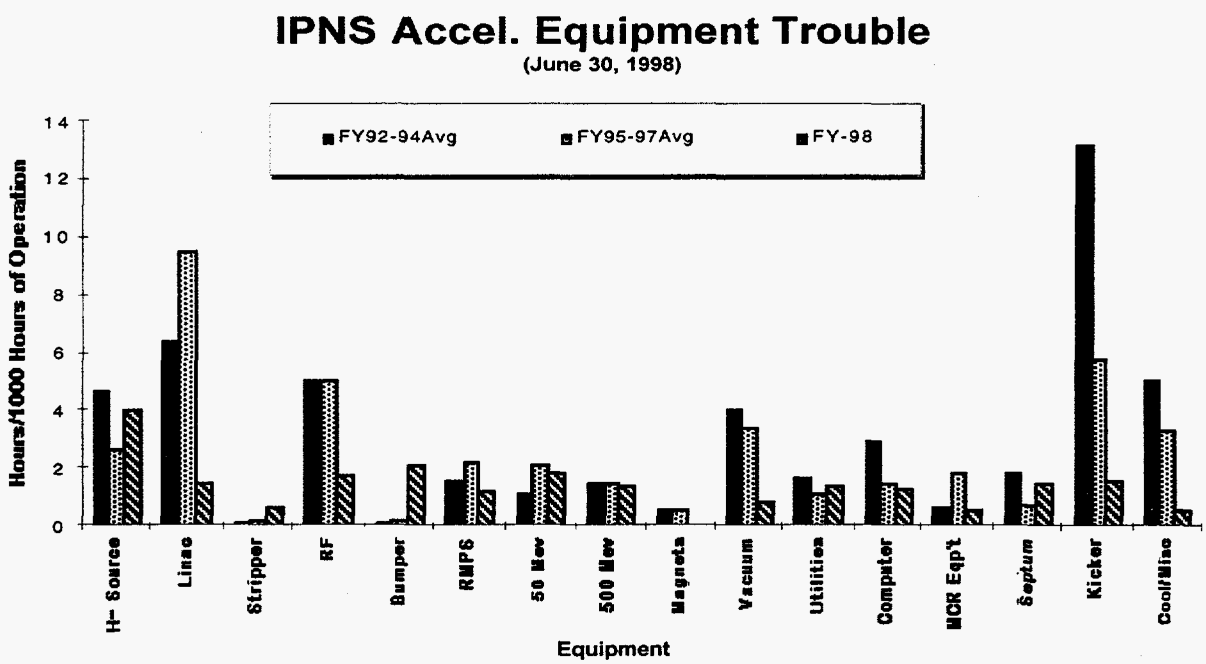
	FY87	FY88	FY89	FY90	FY91	FY92	FY93	FY94	FY95	FY96	FY97
No. of Experiments Performed:	223	257	323	330	273	210	248	281	279	320	353
VISITORS TO IPNS FOR AT LEAST ONE EXPERIMENT:											
ANL	55	57	60	61	60	53	48	49	55	58	60
Other Gov. Labs.	15	18	16	19	15	14	18	13	16	18	29
Universities	78	89	94	120	92	62	64	63	83	85	91
Industry	24	20	24	36	18	20	16	15	12	7	6
Foreign	24	17	26	18	27	14	25	32	33	33	42
TOTAL	196	201	220	254	212	163	171	172	199	201	228

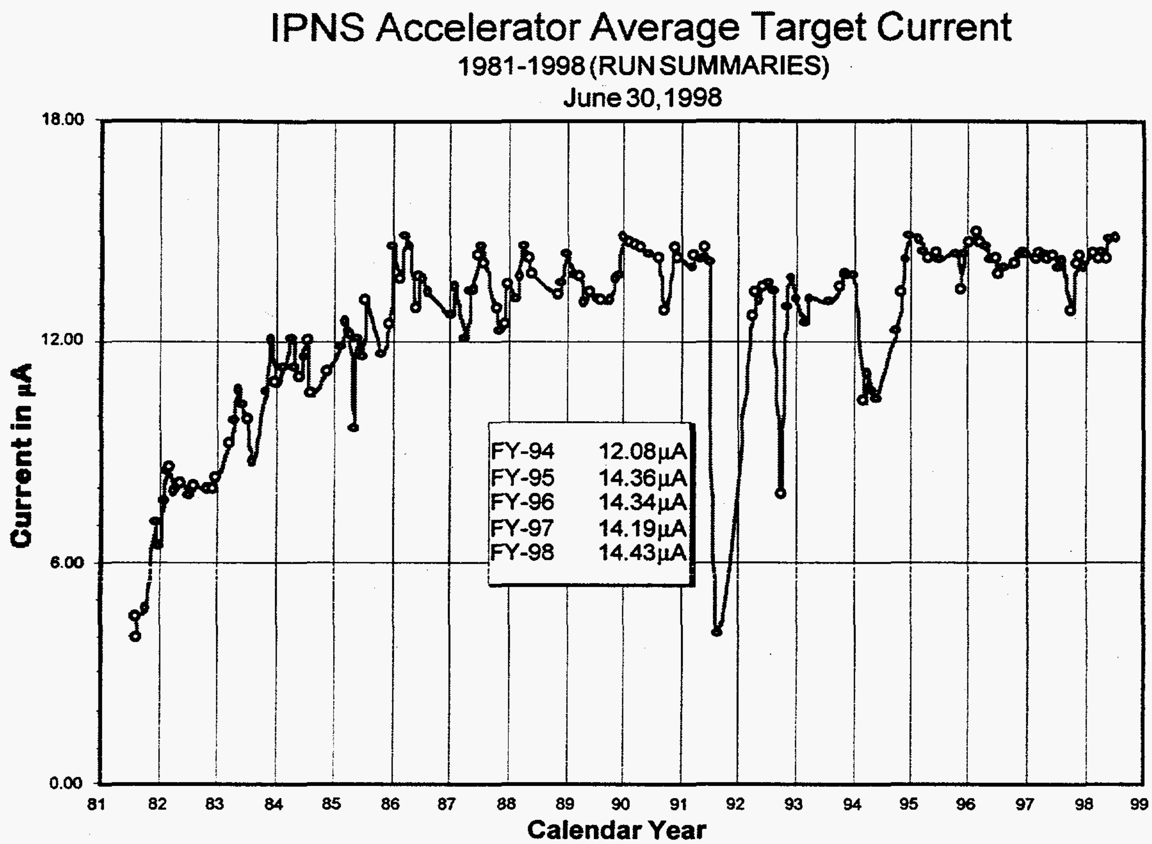
The figures for publications reflect the results of the additional operation.

Table 2. IPNS Publications (fiscal year)

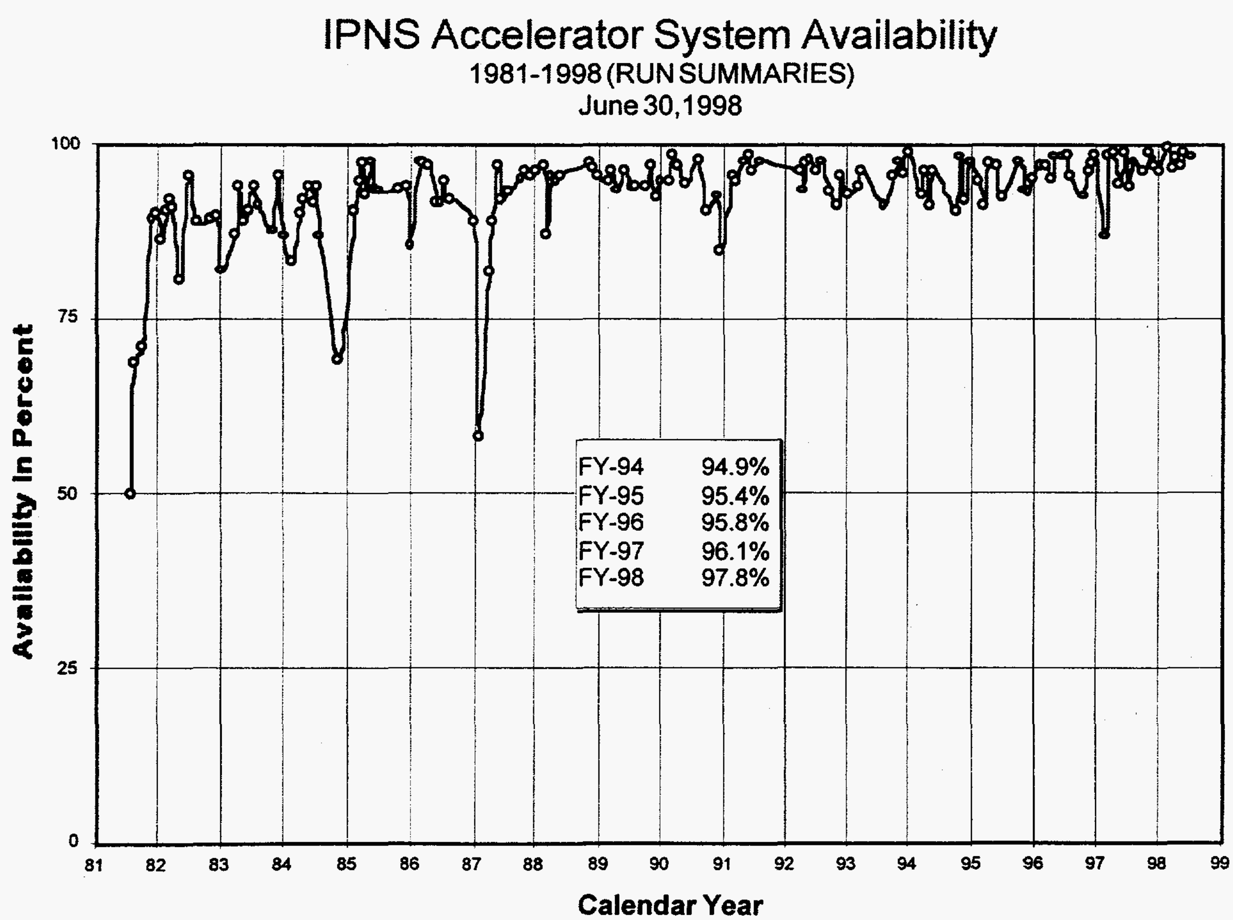
1992	1993	1994	1995	1996	1997
121	124	112	115	140	170

The IPNS accelerator system has maintained its already excellent operating record and even improved upon it. Reliability and average current figures are shown below. Also shown below are historical records of time lost for various systems. Key to the outstanding and improving reliability is identifying the subsystems that are most responsible for the downtime so that the available effort can be concentrated where it may have the greatest effect. As can be seen from the figure, a few systems (kickers, linac, rf and source) have been responsible for most of the downtime, and we are having some success in reducing these worst offenders.





IPNS Accelerator Average Target Current
1981-1998 (RUN SUMMARIES)
June 30, 1998
18.00
12.00
6.00
0.00
Current in µA
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
Calendar Year
FY-94 12.08µA
FY-95 14.36µA
FY-96 14.34µA
FY-97 14.19µA
FY-98 14.43µA



IPNS Accelerator System Availability
1981-1998 (RUN SUMMARIES)
June 30, 1998
100
75
50
25
0
Availability in Percent
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
Calendar Year
FY-94 94.9%
FY-95 95.4%
FY-96 95.8%
FY-97 96.1%
FY-98 97.8%

2. IPNS Enhancement Project

2.1 Instruments

Over the last 20 years, the United States has fallen alarmingly behind other nations in the availability to their scientific communities of up-to-date neutron sources and instrumentation. This is being addressed with the planned Spallation Neutron Source at Oak Ridge (discussed below and in other ICANS papers) and with the LANSCE enhancement, also discussed in these proceedings. We at IPNS asked what could be accomplished in the short term, 2-3 years, to increase our scientific productivity, and a number of projects have begun. Some immediate ("off the shelf") upgrades to existing IPNS instruments are possible that can be done in 2 years with no technical risk that will have a significant impact on instrument performance.

Table 3

Instrument	Improvement
POWDER DIFFRACTOMETER (GPPD)	add 300 detectors (x3)
Chopper Spectrometer (HRMECS)	add 400 detectors (x2)
Glass and Liquids Diffractometer (GLAD)	add 180 detectors (x2)
Powder Diffractometer (SEPD)	add 50 detectors (x1.3)
Single Crystal Diffractometer (SCD)	add 2nd area detector

All upgrades can be done in 2 years with no technical risk.
All instruments will at least double their data rate and some (*) will have new capabilities

Table 4. Impacts of the IPNS Instrument Enhancement Project

Instrument	Data rate gain factor	Other new capabilities
QENS	10	All Q settings measured simultaneously
MIGS	---	New instrument, unique in the US
HRMECS	2	Continuous angle coverage, improved Q and E resolution
GPPD	2	Continuous angle coverage, improved ±90° resolution
SEPD	---	Improved low-angle resolution for magnetic scattering, large cells
GLAD	1.5	Range extended to higher Q
SCD	2	Capture larger volume of Q space

Funds have been limited for these improvements, but some changes have occurred since ICANS XIII in 1995:

Instrument	Improvement
HRMECS	-130 LPSDs purchased for low angles -moved low angle detectors to high angles -new DAS installed and in testing
SAND	-delayed neutron chopper is operational -high angle detector bank in commissioning -started doing user experiments
GLAD	-improved low angle window resulting in lower background
GPPD	-180 detectors purchased for high angle banks, to be installed in summer, 1998

2.2 QENS Upgrade

QENS is a crystal-analyzer spectrometer at IPNS optimized to provide ~70 μeV resolution for quasielastic scattering, but it also has very good resolution for chemical spectroscopy at excitation energies up to ~150 meV. The "white" beam from the source is incident on the sample, so a separate detector can be mounted to monitor diffraction from the sample. This allows a careful following of phase changes, in situ sample growth or modification, etc., concurrently with the quasielastic- and inelastic-scattering measurements. QENS has three focused-crystal-analyzer arms mounted on a rotating table so that a wide range of scattering angles can be covered. A recently accomplished modification has provided QENS a solid CH_4 moderator at 25K, and this has resulted in a factor of ~5 increase in data rate for most experiments, when compared to the previous liquid CH_4 moderator which operated at ~100K. This higher intensity has made the instrument even more attractive, and demand is rapidly increasing.

An upgrade of QENS, now in the construction stage, will replace the rotating instrument table having 3 detector banks with a fixed instrument having 20 analyzer-detector arms plus 2 diffraction detector banks. Quasielastic resolution will be kept at ~70 μeV for each of the banks. The incorporation of 20 analyzers will allow sampling of the full angular range (~15°- 165°) for inelastic scattering without rotating the instrument. Eliminating the need to rotate will allow the use of improved shielding and will simplify the types of sample environment required. The upgrade will also result in a factor of ~10 increase in the analyzer solid angle, leading to an additional factor of ~10 increase in useful data rate. QENS Upgrade is scheduled for installation in Dec. 1998.

2.3 Target and Moderator Systems

IPNS is currently operating with two solid CH_4 moderators (C and H positions) and a modified C with grooves in the vertical direction to better serve the POSY reflectometers will be installed soon. Plans are also underway to change the third moderator, currently liquid CH_4, to solid CH_4 in July 1999. Meanwhile, we have launched a program of calculations and measurement to evaluate a number of potential improvements to the IPNS target/moderator/reflector system. Improved computational capabilities support these efforts as does a program of measuring and benchmarking the intensity spectra and the wavelength-dependent pulse shapes of the existing moderators, which is described elsewhere in these proceedings. We coordinate these pursuits widely with workers at other laboratories. These collaborations are of great benefit to us, and, we hope, similarly beneficial to others. The paper by E. Iverson in these proceedings discusses further the IPNS moderators.

2.4 Accelerator System

A proposal was recently submitted to DOE for $1.9M for the addition of a second harmonic cavity to the IPNS synchrotron which would increase the current-handling capability by 30 to 40%. A test of the concept using laboratory discretionary funds (recently requested) would make use of existing cavity components, and would significantly reduce the risk for the full-scale DOE proposal.

A prototypic cathodefollimer (CF) amplifier and ferrite loaded cavity will be built using some existing parts, which includes ferrite for the cavity and a ceramic window and vacuum pipe assembly. The assembly will be bench tested, installed in an IPNS Rapid Cycling Synchrotron (RCS) straight section, and tested with beam. It will be possible to demonstrate capture and acceleration through a considerable part of the acceleration cycle using the system on the second harmonic frequency using the existing ferrite. At present, only computer calculations of beam performance exist for the RCS facility. This experimental test using the prototypic system will confirm these studies without large expenditures. Scientists from the Rutherford-Appleton Laboratory in England and the National Laboratory for High Energy Physics (KEK) in Japan are pursuing similar studies and seek to collaborate with ANL to further extend the study base and share resources. A CF amplifier model has been built in Japan and is being tested on a small ferrite cavity, but this model is not designed to go onto an accelerator. The English and Japanese propose to build a system for testing on the accelerator for the ISIS source.

As an additional benefit, the cavity and amplifier would be able to operate throughout the accelerating cycle at the fundamental frequency, providing an on-line spare if either of the existing cavities or amplifiers failed, and providing extra capability by permitting operation with three cavities (either at increased total voltage, or with the two present cavities operating at reduced voltage). This capability would enhance performance under normal operation, and provide another "knob" to adjust to optimize accelerator performance.

3. IPNS Involvement with the SNS

A 1 MW spallation neutron source upgradeable to higher power will be built at Oak Ridge National Laboratory, starting in Oct. 1998, and is scheduled for competition in 2005. Argonne has lead responsibility for the neutron scattering instruments and is forming a team of scientists and engineers under the leadership of Kent Crawford, the Senior Instrumentation Scientist at IPNS. Scientists are being hired by ORNL to work at IPNS during the R&D, design and procurement phases of the instruments; moving to ORNL with the instrument. Based on the fact that IPNS is the DOE's most active pulsed neutron user facility and technology development center, we will continue the role of training the user community as we will lead in the development and construction of the neutron scattering instruments. K. Crawford's paper on SNS instruments in these proceedings provides more detail.

Argonne is also involved in the liquid Hg target and moderators. Jack Carpenter is a primary consultant for all target and moderator issues and serves as Senior Scientific Advisor to the project while Erik Iverson is participating in IPNS moderator tests and SNS moderator calculations. Argonne carried out a study of a solid metal back up target for SNS, and frequent visits to ANL by ORNL engineers and moderator neutronics analysts are taking place.

4. Procedure for Fast Access to the IPNS Powder Diffractometers

IPNS implemented a procedure beginning in October, 1995 for obtaining fast turn-around on the Special Environment and General Purpose Powder Diffractometers. A small fraction of the operating time on each of these instruments is available on a first-come first-served basis, without the need to write the standard four page proposal. A short, one-page form is all that needs to be completed, indicating any potential hazards. Interested users should contact the instrument scientists, J. Jorgensen (SEPD) or J. Richardson (GPPD), to learn the backlog for each instrument. Samples will be shipped to IPNS and data will be collected when time becomes available without requiring the user to come to IPNS. The raw data are then accessed on the instrument computer. Similar to other experiments performed at IPNS, users are responsible for data analysis. This service will be limited to short (less than one-day) experiments involving only room-temperature data collection for samples that present no special handling problems. The time allocated to a single user will be limited to allow access for as many different users as possible.

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5. Future plans

The IPNS user program will continue to grow as instrument capabilities are improved and operation will continue to increase as funds permit. The Enhancement Project continues to be our top equipment priority and instrument improvements are proceeding. An accelerator plan incorporating the rf 2nd harmonic (with an increase in current of ~40%) has been submitted to DOE and calculations and measurements will proceed in developing an improvement program for the target/moderator/reflector system.

Key to the future plans will be incorporation of the SNS instrument development into the IPNS program. The new scientists and instrument development will be closely integrated with existing IPNS developments, for example prototypical components will be tested on IPNS instruments and beamlines.

Acknowledgments

Almost all of the work discussed in this article and many of the words of the article are the result of effort by other members of IPNS, the neutron scattering group and the APS at Argonne. The operation of IPNS is funded by the U.S. Department of Energy, BES-Materials Science, under contract W-31-109-ENG-38, and the National Science Foundation (DMR-91-20000) through the Science and Technology Center for Superconductivity.