ICANS-XIII
13th Meeting of the International Collaboration on
Advanced Neutron Sources
October 11-14, 1995
Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

NEWS FROM KENS

Hironobu Ikeda

National Laboratory for High Energy Physics
1-1 Oho, Tsukuba, Ibaraki 305 Japan

ABSTRACT

The present status of the KENS Facility is reported and the recent progress in instrumentation is described. A brief outline of the present status of the future program (Japan Hadron Project) is also given.

1. Outline of the KENS Facility

The KENS Facility has been successfully operated since the last ICANS meeting at Abingdon. The operation time of the 500 MeV Booster synchrotron in the past year was about 3500 hours, and the beam time allocated for neutron experiments was about 1500 hours. The average proton-beam intensity was about 1.5×10^{12} protons per pulse (ppp). Figure 1 shows the record of the beam intensity in protons per pulse over the past six year. Since the repetition rate of the accelerator is 20 Hz, the average proton beam current was about 5 μ A.
Although the depleted uranium target has been operated trouble-free since the beginning of its operation in 1985, it was replaced with new uranium target on September, 1995. This is due to the detection of a small amount of Xe-135 in a cover-gas of primary cooling water (8000 atoms / liter). We experienced no serious problems with the cryogenic moderator (solid methane at 20 K) since 1988 because solid methane is renewed every two days before a "burp" can occur. During the last financial year, 106 experiments including 13 large proposals by groups responsible for the instruments were carried out. Scientists who visited the KENS facility spent about 5000 man-days. The oversubscription has become more serious in recent years; especially for LAM-40, SAN, WINK and VEGA.
A construction of a new cold-guide experimental hall ($1200m^2$ in area) was financially approved last May, and a construction will start on November 1995. At the same time, we will install a high-resolution multi-purpose diffractometer in the new experimental area (Fig.1).

2. Instrumental Developments

There are currently 16 instruments in the KENS Facility as listed in Table I. We have seen appreciable progress in instrumentation since the last ICANS meeting.
The construction of a new high-resolution powder diffractometer, VEGA, was completed, and HRP was replaced. Although the HRP is a prototype instrument equipped with only 12 normal

^3He counters, it has been very productive and busy. VEGA was designed to have large counter banks, comprising many 1D-PSD's at the backward, 90 degrees, and lower angles in order to improve the data-rates (about 5 times higher than the HRP) and the resolution ($\Delta d/d \sim 0.002$) and to increase the range of the d-spacing covered. Figure 2 shows the detector layout of VEGA.

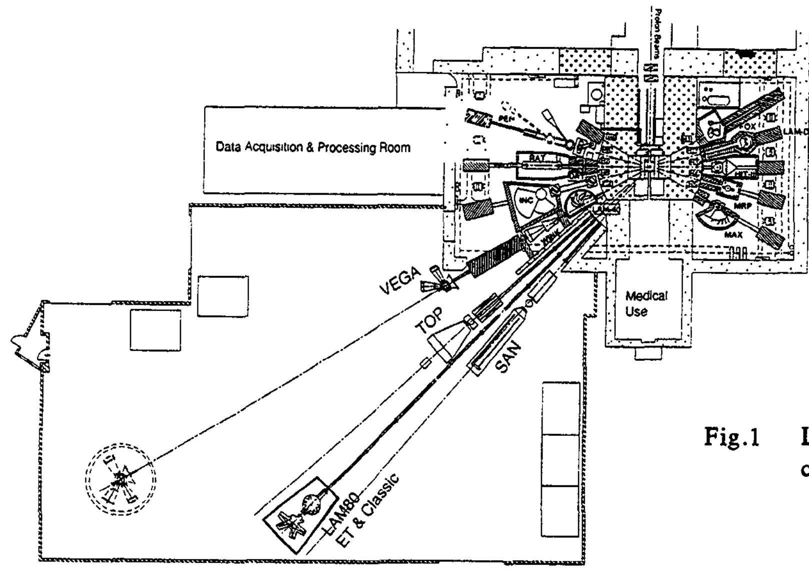

Fig.1 Layout of new KENS Facility to be completed in June, 1996

The development of polarized ^3He as broad-band neutron polarizing filter from thermal to epithermal energy region is in progress. Rubidium atoms are polarized by irradiation of circularly polarized photons. Atomic polarization is transferred to ^3He nuclei upon atomic collision. A ^3He polarization of about 50% was achieved for a 8-cm length and 2.5 cm diameter cell at 3-atm ^3He pressure. High power diode-laser system for the optical pumping is used to polarized higher pressure cell, 8 atm. The result will be reported elsewhere.
We are also making progress on the development of pulsed high magnetic field equipment for scattering experiments. The highest field (up to 20 T) in the horizontal direction has already been achieved, and we started, in 1993, the construction of a new magnet and very recenty we achieved 30T. This instrument will provide new opportunity for the sudy of magnetic phase transition.

Table 1. KENS neutron scattering instruments

Instrument Name		Range of Q & E		Resolution	
Liquid and Amorphous Diffractometer	HIT	$0.2 \le Q \le 100$	A^{-1}	$\Delta Q/Q = 0.006 - 0.05$	
Small-Angle Scattering Instrument	SAN	$0.003 \le Q \le 4$	A^{-1}	$\Delta Q/Q \approx 0.1$	
Small-/Medium-Angle Diffractrometer	WINK	$0.015 \le Q \le 20$	A^{-1}	$\Delta Q/Q \approx 0.1$	
Multi-Purpose Diffractrometer	MRP	$1 \le d \le 5$	A^{-1}	$\Delta Q/Q = 0.015 - 0\ 03$	
High Resolution Powder Diffractrometer	VEGA	$0.3 \le d \le 13$	A^{-1}	$\Delta Q/Q = 0.002$	
Single Crystal Diffractrometer	FOX	$0.2 \le Q \le 40$	A^{-1}		
Polarized Cold Neutron Spectrometer	TOP	$0.02 \le Q \le 0.6$	A^{-1}		
Polarized Epithermal Neutron Spectrometer	PEN	$0.02 \le E \le 100$	eV		
Ultra-Cold Neutron Machine	UCN				
High Resolution Quasi-Elastic Spectrometer	LAM-80ET	$E \le 0.3$	meV	$\Delta E = 1\text{-}5$	μeV
Quasi-Elastic Spectrometer	LAM-40	$E \le 10$	meV	$\Delta E = 100$	μeV
Molecular Spectrometer	LAM-D	$E \le 200$	meV	$\Delta E = 300$	μeV
High Resolution Spectrometer under Extrime Condition	LAM-80C	$E \le 1$	meV	$\Delta E = 5\text{-}20$	μeV
Sub-eV Spectrometer	CAT	$3 \le E \le 1000$	meV	$\Delta E/E = 2$	%
Coherent Inelastic Scattering Spectrometer	MAX	$0 \le E \le 100$	meV	$\Delta E = 2.5 - 10$	meV
eV Spectrometer	RAT	$E \le 100$	eV	$\Delta E = 50$	meV
Chopper Spectrometer	INC	$2 \le E \le 1000$	meV	$\Delta E/E = 2\text{-}4$	%

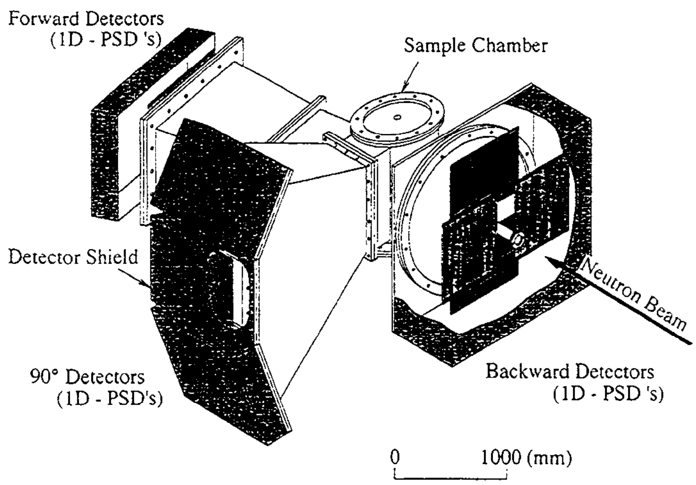

Fig.2 Detector layout of VEGA

3. Neuron Scattering Experiments

The determination of self-similar structure in the system near the percolation threshold in the diluted antiferromagnet, $RbMn_{0.34}Mg_{0.66}F_3$, has been made on HRP using a single-crystal sample. As the magnetic concentration (0.34) is very lose to, but above, the percolation threshold (0.312), a crossover from a resolution-limited Gaussian shape near q=0 to a power-law decay function with a fractal dimension of 2.48 has been observed in the elastic magnetic scattering near the Bragg position.

Critical inelastic scattering measurement has been made on high-resolution spectrometer LAM-80ET with an energy resolution of 5 μ ev of Mica (004) reflection. Experiments on a single-crystal sample of a two-dimensional Ising antiferromagnet, Rb_2CoF_4, have been made at q=0 as a function of temperaturen. From these measurements, dynamical critical exponent, z, was determined to be 2.0 $\pm$0.05 (Γ (q=0,T) $\propto \kappa_1(T)^z$), where Γ is a damping constant at q=0 and κ_1 is the inverse thermal correlation length (Fig.3).

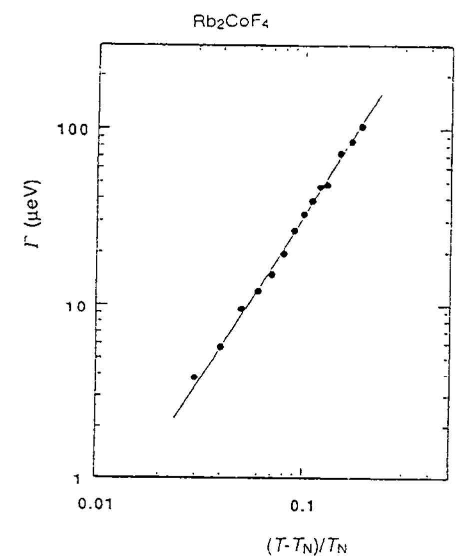

Fig.3

One of the current topics in the research of amorphous materials is dynamics near the glass transition. Neutron scattering measurements on the fast process of polybutadien have been performed with LAM-40 (energy resolution is about 200 μ ev) (Fig.4). It was made clear, from the observation of the damping constant of a quasi-elastic component as a function of q and T, that the fast process is related to the localized cage motion.

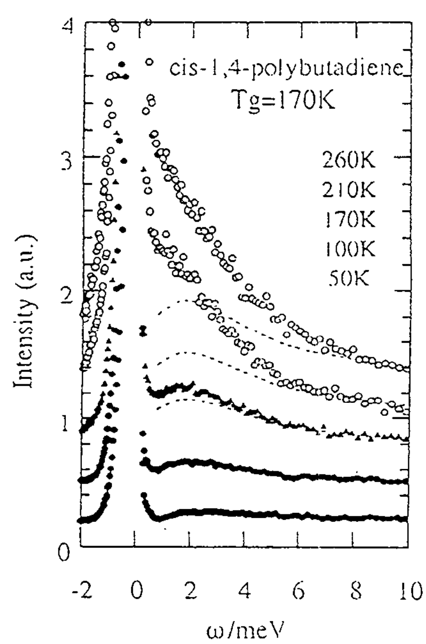

Fig.4

The hexagonal $CsCuCl_3$ has linear chains of Cu^{2+} ions along the c-axis and it makes triangular lattices in the c-plane. It shows 120° magnetic structure in the c-plane due to the imterchain antiferromagnetic interaction. In such a magnetic system, if an external field is applied parallel to the c-axis, the magnetic moments tilt from the c-plane and the magnetization is supposed to be linear up to saturation with respect to the field intensity. However. the change of the umbrella-like structure at low fields to the coplanar one at high fields was observed at about 12 T in the field-dependence of the magnetic elastic intensities (Fig.5). The result is explained as a transition due to the quantum effect in the system with one-diumensionality and S = 1/2.

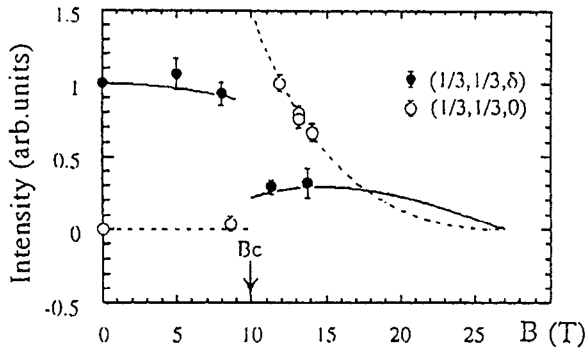

Fig.5 Field dependence of diffraction intensities as a function of field intensity.

Great prgress in P,T violation study in neutron nucleus resonance is realized. Parity-violating neutron-spin rotation was firstly observed in a neutron-nucleus p-wave resonance. A compound nucleus resonance theory predicts large enhancement in the p-wave resonance in eV region and a dispersion like shape for the parity violating effect as a function of the neutron energy. The experiment verified the theoretical prediction. For the T-violation study, a large lanthanum nuclear polarization is realized for the measurement of T-odd triple correlation, $\sigma \cdot k \times I$. σ is the neutron spin, k the neutron momentum and I the lanthanum nuclear spin.

4. Future Program

For a long time we have been anticipating funding for Japan Hadron Project (JHP). Within these several months great advance in the JHP was seen. At this moment, discussions are being made on the governmental base. Institute of Nuclear Science (INS), University of Tokyo, which has been a leading institute of JHP, will move to KEK-area and be reconstructed together with KEK. This reorganization will hopefully start on April, 1997, and a construction of new proton acclerator will be started in 1998. New organization will have a responsibility for the construction of JHP and scientific activities of high energy physics, synchrotron radiation sciemce, nuclear science and neutron scattering. In the present program, a 200 MeV proton linac and 3GeV and 50 GeV proton synchrotrons are being considered for neutron science, muon science, nuclear science. For neutron scattering facility, 3GeV-200 μ A (25 H_z, 0.6 MW) proton beam is injected to a neutron target, and as the second stage of JHP there exists possibility of upgrading to 1.2 MW (50 H_z).