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STATUS OF THE COMMISSIONING OF THE LOS ALAMOS NEUTRON SCATTERING CENTER, LANSCE

by
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INTRODUCTION

The Los Alamos spallation neutron source, formerly referred to as the Weapons Neutron Research facility has been upgraded through the use of a proton storage ring. The new capability has been referred to as the WNR/PSR facility which is at least difficult to pronounce and at worst somewhat misleading since we have several target areas associated with the entire facility. Consequently, we have chosen to give the name in the title, LANSCE, to the target area and experimental hall devoted primarily to materials. The other areas in the larger complex are principally used for nuclear and particle physics research. These areas will retain the designation WNR. The LANSCE has been in effect, separated from the WNR functionally, organizationally, and in name.

The first vugraph shows the relation of LANSCE to the Los Alamos Meson Physics Facility (LAMPF), and to the WNR complex.

UPGRADE

The LANSCE has been undergoing an upgrade from the capability we had when LAMPF beam was simply delivered to the spallation source. The addition of the proton storage ring (PSR, it really is an accumulator), permits us to increase the neutron flux delivered to an instrument as shown in Figure 2. The Table also shows projected capability as compared to the capability of SNS as reported by A.J. Leadbetter et al. It can be seen that the two facilities will be offering very similar neutron fluxes.

The improvement at Los Alamos is obtained by a substantial change to the LAMPF injector as well as by the addition of the PSR. The LAMPF injector has been modified to increase the H^- current from 100μa to 1ma. The LAMPF pulses are schematically shown in Figure 3. Each of the 750μs long macro pulses tailored for injection into the PSR consists of 2000 ea. 0.270 μs long packets of micropulses. These packets are injected into the storage ring, one after another. The timing is such that each packet is inserted on top of the pulse preceding it until the current density within the storage ring reaches 45A, at which time it is expelled from the ring and directed to the spallation target. At this point, the proton current is 100 μamps, has a pulse width of 0.27μs and a repetition rate of 12 Hz.

In order to insert the H^- beam into the ring, it is necessary to strip the H^- to H^o, then to ionize the H^o to produce protons. These operations take place as shown in Figure 4. The H^- beam is stripped by the use of an intense magnetic field, the neutral beam is then reionized with a carbon stripper foil. The H^- to H^o conversion is measured to be 100%, the H^o to H^+ is measured to be 98% efficient.

COMMISSIONING

Figure 5 is a picture of the storage ring under vacuum before first beam. The status of our work in shown in Figure 6. We are on schedule. Beam current we have extracted so far from the storage ring is 0.5 Amp.

We are projecting 20/μA for use this year and full current by the fall of 1986 and operational use of full current by October 1986.

EXPERIMENTAL FACILITIES

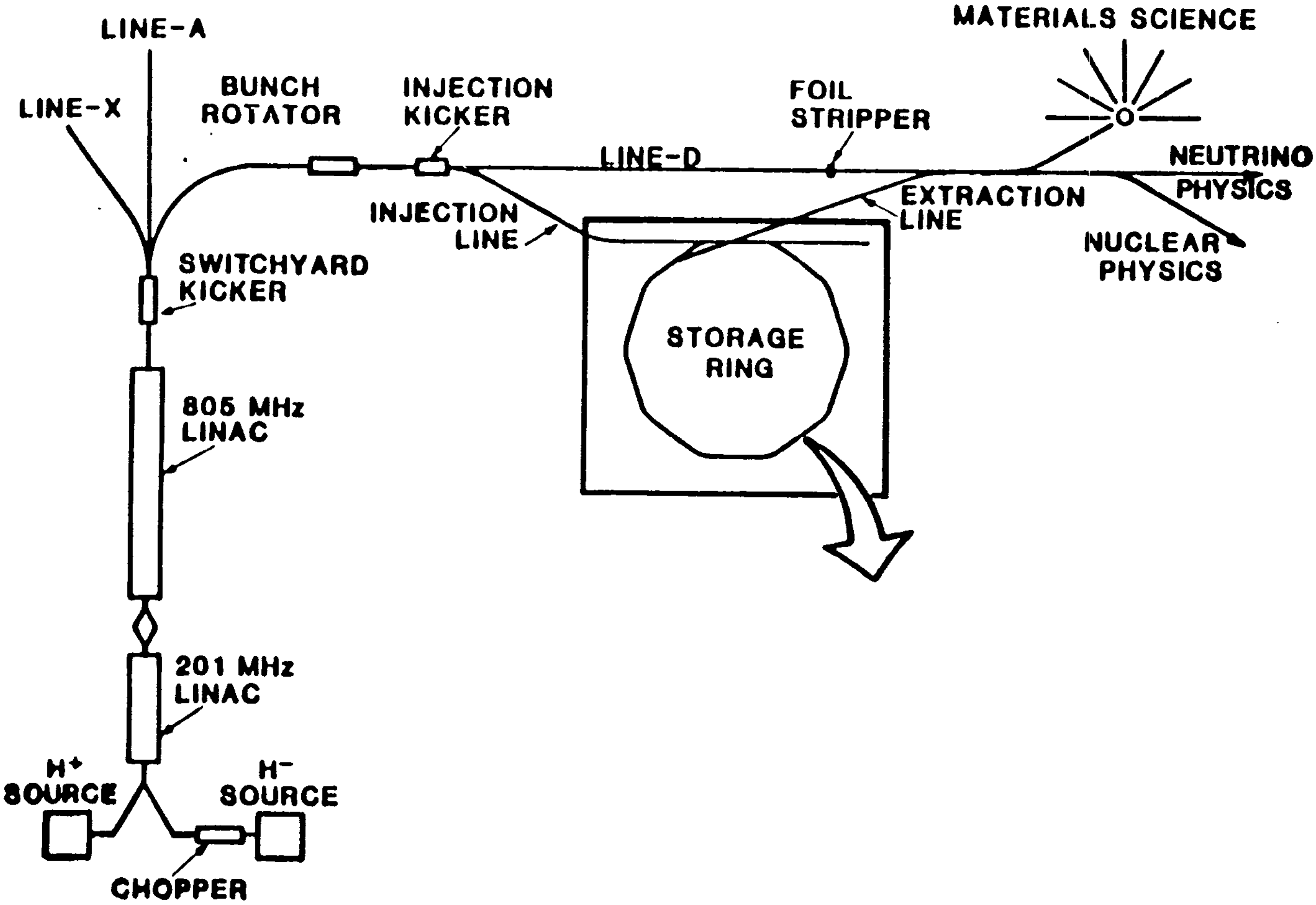
Figure 7 shows the existing layout of the experimental area with a list of operational instruments. Figures 8 shows the proposed expansion of the experimental hall and office space. The request is still under review in Washington D.C.

The moderators we've used in the past, expect to use this year, and those we expect to have operational by 1986 are given in Figure 9.

FUTURE

Future upgrades include, of course, the new hall. We are studying the appropriateness and design of a booster target and the utility of increasing the pulse frequency by a factor of two. The existing instrumentation will easily permit these changes. The new instruments on the drawing boards are given in Figure 10.

I show in figure 11, those people most responsible for these exciting new capabilities.



LINE-A
LINE-X
BUNCH ROTATOR
INJECTION KICKER
FOIL STRIPPER
MATERIALS SCIENCE
LINE-D
NEUTRINO PHYSICS
EXTRACTION LINE
INJECTION LINE
NUCLEAR PHYSICS
SWITCHYARD KICKER
STORAGE RING
805 MHz LINAC
201 MHz LINAC
H+ SOURCE
H- SOURCE
CHOPPER

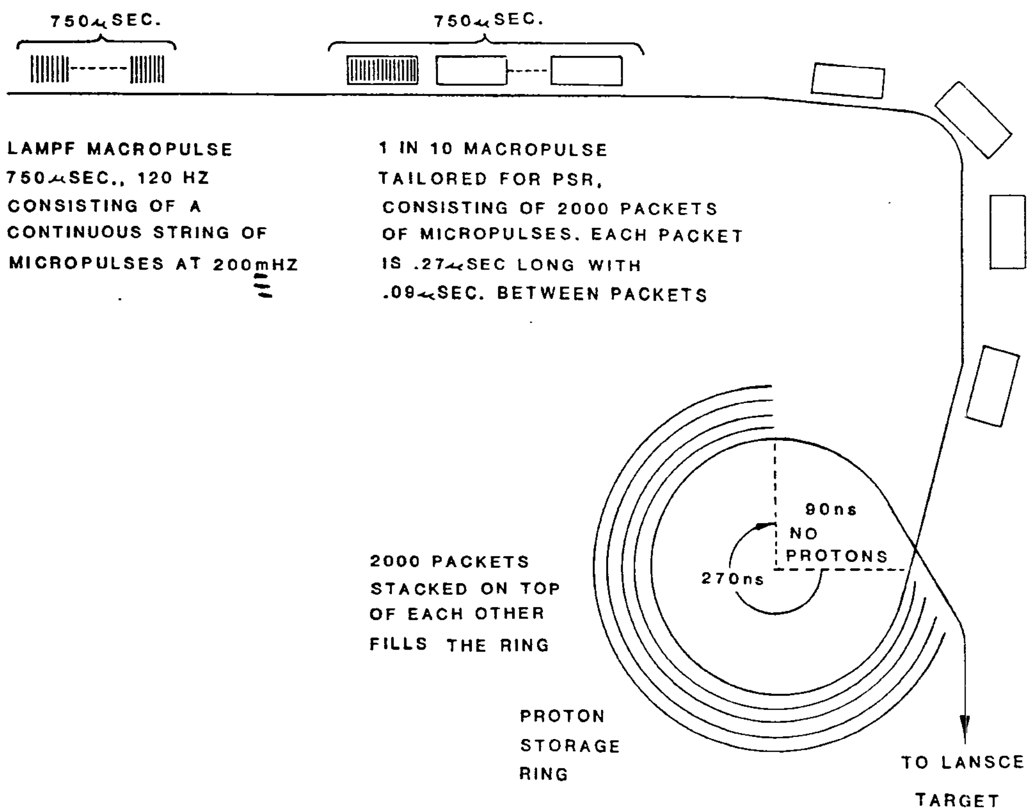
Figure 1

BASIC CHARACTERISTICS OF LANSCE BEAM COMPARED TO THE SNS

	LANSCE				SNS
	1984	MAY 1985	SEP 85	PROJECTED SEP 86	PROJECTED AT COMPLETION
Beam Energy	800 MeV	800 MeV	800 MeV	800 MeV	800 MeV
Protons/Pulse	2.8×10^{11}	2.6×10^{11}	1×10^{13}	5×10^{13}	2.5×10^{13}
Pulse Width	5 μs	.2 μs	.27 μs	.27 μs	.4 μs
Repetition Rate	120 Hz	12 Hz	12 Hz	12 Hz	50 Hz
Average Proton/Sec	3.4×10^{13}	3×10^{12}	1.2×10^{14}	6×10^{14}	1.2×10^{15}
Peak Current	10 mA	.2 A	6 A	30 A	10 A
Average Current	5.4 μA	.5 μA	20 μA	100 μA	200 μA
Moderators					
Ambient Poisoned Mod					✓
Liq H_2 Moderator				25°	25°
H_2O Ambient Temp				✓	✓
Liquid Methane				*	100°

* SEE FIGURE 9

(FIGURE 2)



PROTON STORAGE RING PULSE CONFIGURATION

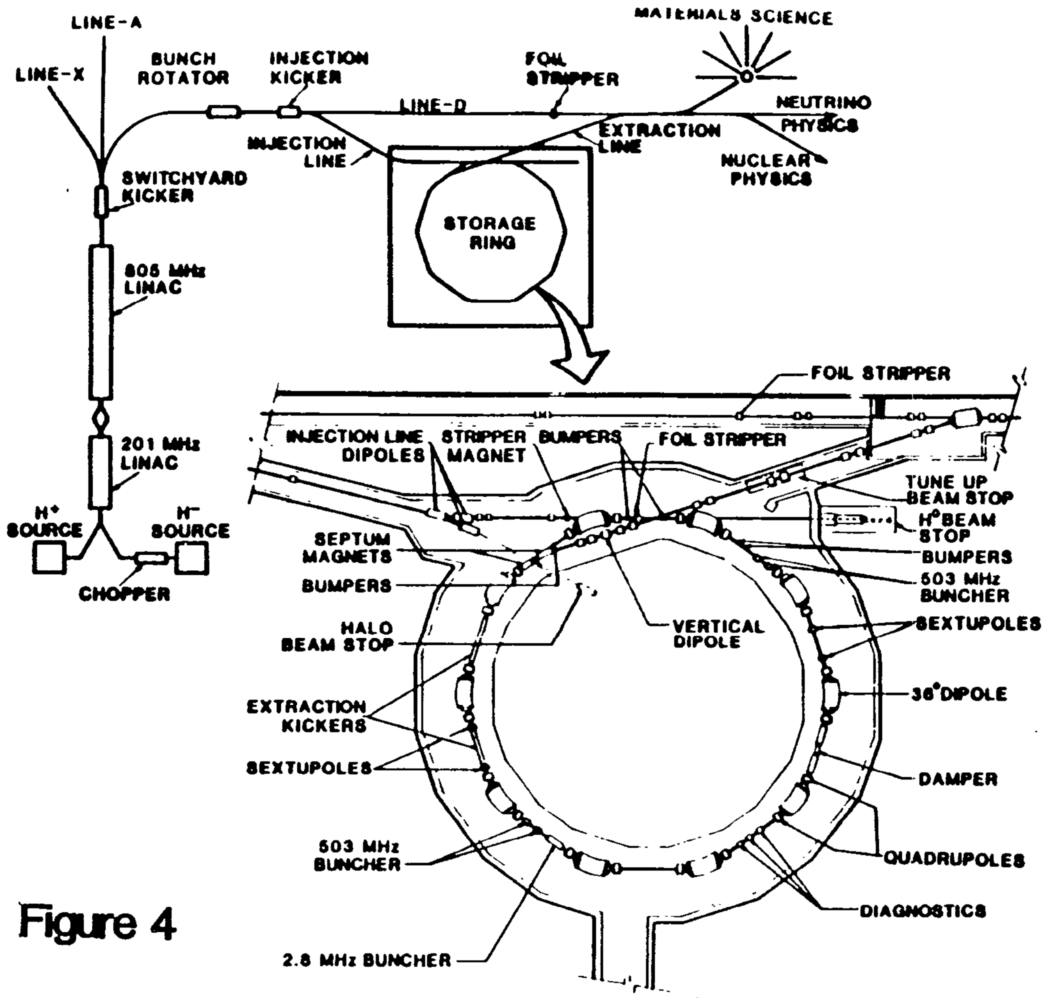


Figure 4

PSR MILESTONES

September 1979	Project authorized by Congress.
October 1980	Project reestimated and scheduled.
January 1981	$5M construction funds released. Start construction of staging building. Increased R and D activity.
July 1981	Occupy staging building.
September 1981	Major dipole magnet order placed.
May 1982	Start construction of ring and equipment building.
August 1982	Beneficial occupancy of ring tunnel. Start equipment installation.
February 1984	Beneficial occupancy of equipment building. Start equipment installation.
October 1984	LAMPF shutdown. Start final switchyard and Line-D installation.
March 1985	Ready for first beam into ring.
March 1986	Initial shakedown complete.

FIGURE 6A

PSR/WNR SCHEDULE

1985	
3/31	LAMPF and PSR ready for beam.
4/22	LAMPF starts production.
4/25	First beam in PSR.
4/25-6/3	Low current tuning $<$ 100 nA avg.
6/3-7/22	Tuning at up to 1 x e13 ppp.
7/1	WNR high-current target ready.
7/15	Beam-on-target demo at 20 μA.
7/25-8/30	PSR tuning at up to 20 μA avg. Some beam for friendly users.
9/1-12/15	Production at 20 μA (70% time). PSR tuning at $>$ 1 x E13 ppp (30%)
1986	
5/86-9/86	PSR tuning to 100 μA avg. Production at increasing flux.
9/86	100 μA production at 12 Hz
9/87	Upgrade to 200 μA at 24 Hz
9/88	Upgrade to 400 μA at 48 Hz

FIGURE 6B

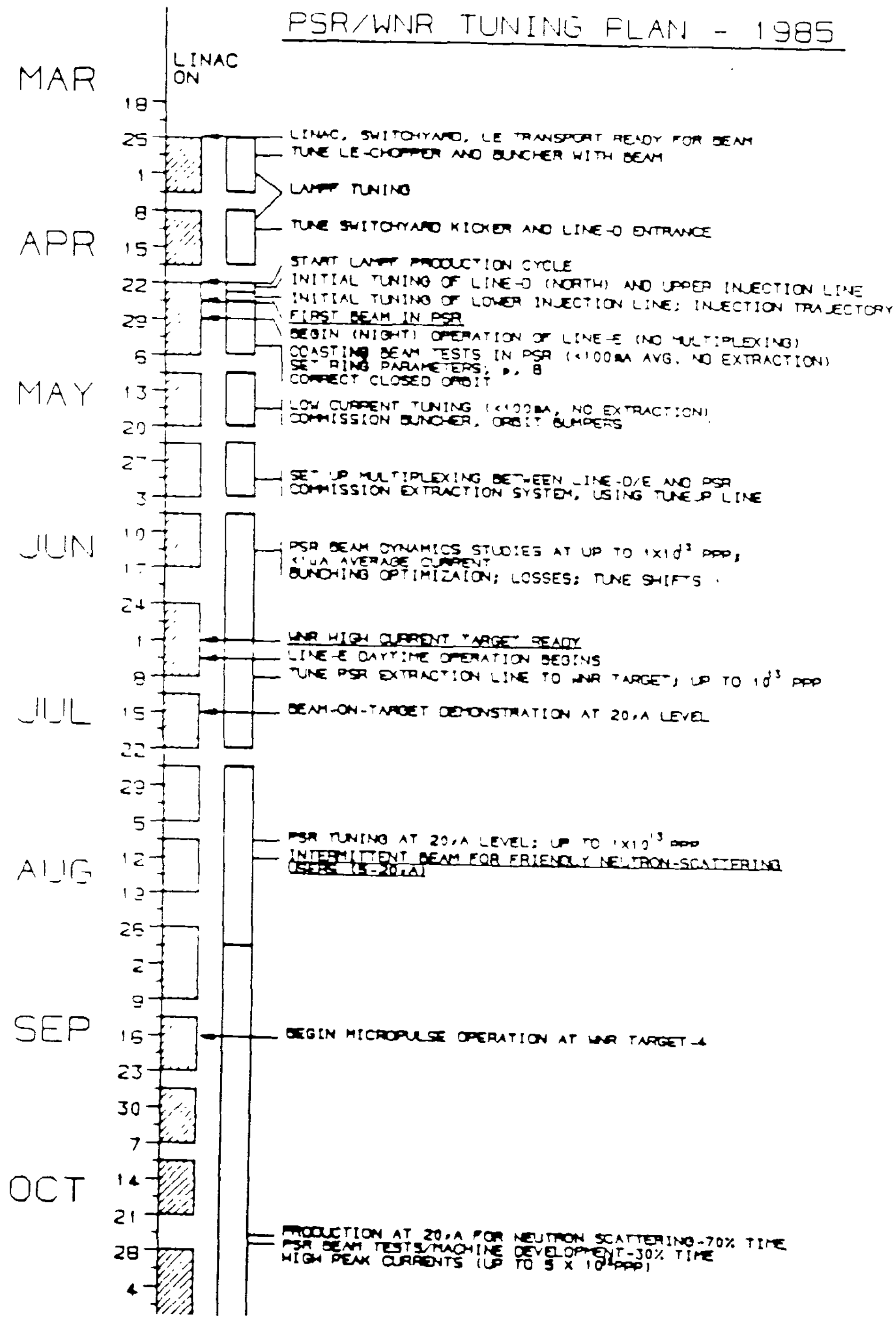
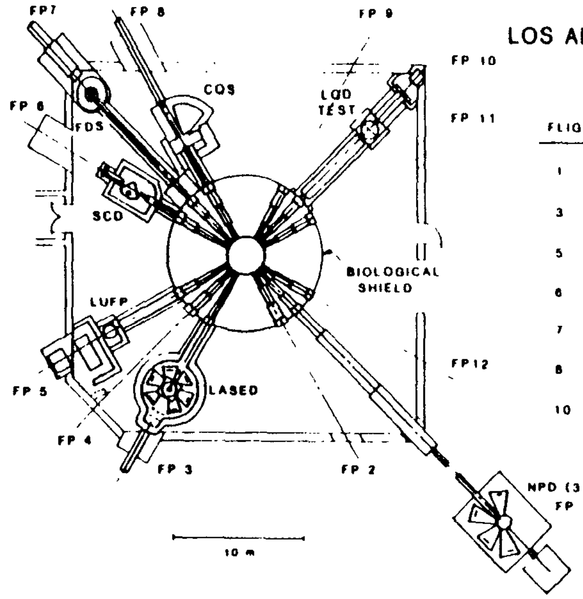

PSR/WNR TUNING PLAN - 1985
LINAC ON
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
LINAC, SWITCHYARD, LE TRANSPORT READY FOR BEAM
TUNE LE-CHOPPER AND BUNCHER WITH BEAM
LAMPF TUNING
TUNE SWITCHYARD KICKER AND LINE-D ENTRANCE
START LAMPF PRODUCTION CYCLE
INITIAL TUNING OF LINE-D (NORTH) AND UPPER INJECTION LINE
INITIAL TUNING OF LOWER INJECTION LINE; INJECTION TRAJECTORY
FIRST BEAM IN PSR
BEGIN (NIGHT) OPERATION OF LINE-E (NO MULTIPLEXING)
COASTING BEAM TESTS IN PSR (<100 nA AVG. NO EXTRACTION)
SET RING PARAMETERS; ν, B
CORRECT CLOSED ORBIT
LOW CURRENT TUNING (<100 nA, NO EXTRACTION)
COMMISSION BUNCHER, ORBIT BUMPERS
SET UP MULTIPLEXING BETWEEN LINE-D/E AND PSR
COMMISSION EXTRACTION SYSTEM, USING TUNE-UP LINE
PSR BEAM DYNAMICS STUDIES AT UP TO 1x10^13 PPP;
<1 μA AVERAGE CURRENT
BUNCHING OPTIMIZAION; LOSSES; TUNE SHIFTS
WNR HIGH CURRENT TARGET READY
LINE-E DAYTIME OPERATION BEGINS
TUNE PSR EXTRACTION LINE TO WNR TARGET; UP TO 10^13 PPP
BEAM-ON-TARGET DEMONSTRATION AT 20 μA LEVEL
PSR TUNING AT 20 μA LEVEL: UP TO 1x10^13 PPP
INTERMITTENT BEAM FOR FRIENDLY NEUTRON-SCATTERING USERS (5-20 μA)
BEGIN MICROPULSE OPERATION AT WNR TARGET-4
PRODUCTION AT 20 μA FOR NEUTRON SCATTERING-70% TIME
PSR BEAM TESTS/MACHINE DEVELOPMENT-30% TIME
HIGH PEAK CURRENTS (UP TO 5 X 10^13 PPP)

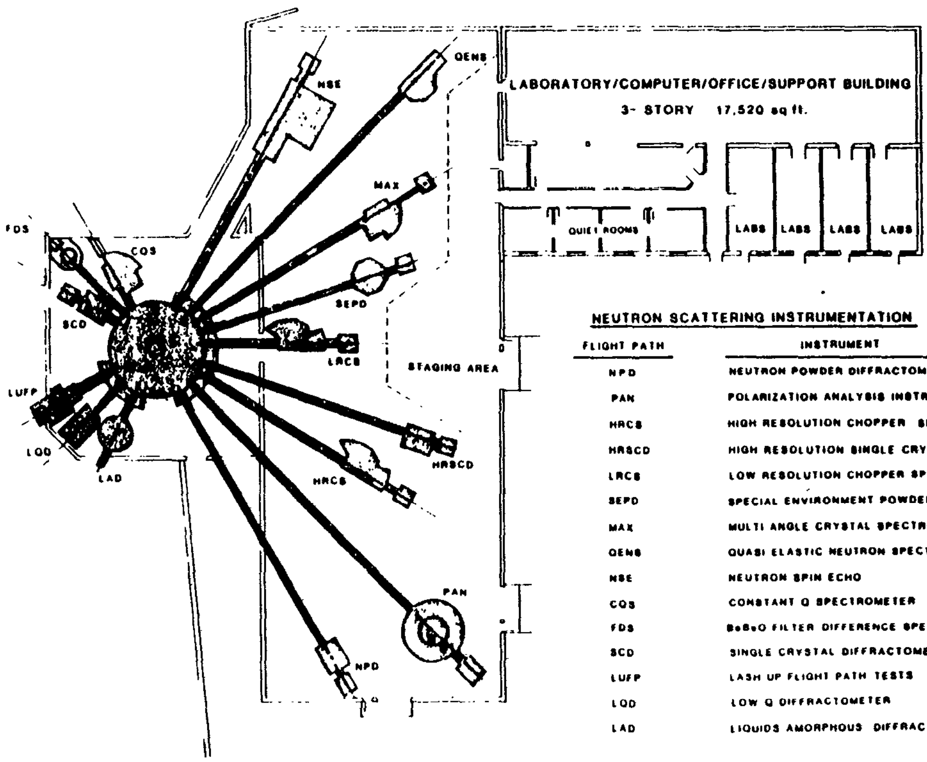
Figure 6C

LOS ALAMOS NEUTRON SCATTERING CENTER (1985)



FLIGHT PATH		INSTRUMENT
1	NPD	NEUTRON POWDER DIFFRACTOMETER
3	LASED	LIQUID AMORPHOUS AND SPECIAL ENVIRONMENT DIFFRACTOMETER
5	LUFP	LASH UP FLIGHT PATH
6	SCD	SINGLE CRYSTAL DIFFRACTOMETER
7	FDS	FILTER DIFFERENCE SPECTROMETER
8	CQS	CONSTANT Q SPECTROMETER
10	LQD TEST	LOW Q DIFFRACTOMETER TEST

Figure 7



NEUTRON SCATTERING INSTRUMENTATION

FLIGHT PATH	INSTRUMENT
NPD	NEUTRON POWDER DIFFRACTOMETER
PAN	POLARIZATION ANALYSIS INSTRUMENT
HRCS	HIGH RESOLUTION CHOPPER SPECTROMETER
HRSCD	HIGH RESOLUTION SINGLE CRYSTAL DIFFRACTOMETER
LRCS	LOW RESOLUTION CHOPPER SPECTROMETER
SEPD	SPECIAL ENVIRONMENT POWDER DIFFRACTOMETER
MAX	MULTI ANGLE CRYSTAL SPECTROMETER
QENS	QUASI ELASTIC NEUTRON SPECTROMETER
NSE	NEUTRON SPIN ECHO
CQS	CONSTANT Q SPECTROMETER
FDS	BeBeO FILTER DIFFERENCE SPECTROMETER
SCD	SINGLE CRYSTAL DIFFRACTOMETER
LUFP	LASH UP FLIGHT PATH TESTS
LQD	LOW Q DIFFRACTOMETER
LAD	LIQUIDS AMORPHOUS DIFFRACTOMETER

Figure 8

LANSCE MODERATOR CAPABILITY

	#	TYPE	TEMP	BEAM LINES SERVED
WNR 1984	3	H_2O	AMBIENT	8
LANCE 1985–86	3	H_2O	316 ± .5K	9
	1	H_2	25 ± 1K	3
WITH NEW EXPERIMENTAL HALL	4	H_2O	316 ± .5K	12
	1	H_2~~O~~	25 ± 1K	3
	1	CH_4	96 ± 1K	3

FIGURE 9

INSTRUMENT STATUS

NAME	STATUS	INST. RESPONSIBLE
● Be–BeO Filter Difference Spectrometer	Operational	J. Eckert
● Single Crystal Diffractometer	Operational	P. Vergamini/ G. Christoph
● Liquids, Amorphous; Special Environment Diffractometer (9m)	Operational	A. Williams
● Neutron Powder Diffractometer	Operational, Reconfigure to 32 m	J. Goldstone
● Constant Q Spectrometer	Development	R. Robinson
● Low Q Diffractometer (1986)	Design, Anger Camera Development	P. Seeger
● Chopper Spectrometer (1986–87)	Design, Magnetic Bearing Operational	R. Silver/ R. Heffner
● High Resolution Powder Diffractometer (1988)	Workshop Planned	----
● Quasielastic Neutron Spectrometer (10 μeV) (1988)	Nat'l Lab–Industry Collaboration Begun	----
● Polarization Analysis Instrument (1988)	F. Mezei Conceptual Design	----
● Lash Up Flight Path (Tests)	To Be Operational (1985)	M. Nutter

FIGURE 10

J. Browne — Associate Director for Experimental Physics
G. Sawyer — Construction Project Manager

Accelerator Technology Division

G. Lawrence
R. Hardekopf
P. Clout
A. Jason

Physics Division

C. Bowman
R. Woods
R. Ryder
G. Russell
D. Clark
H. Robinson

LAMPF

D. Hagerman
O. Van Dyck
D. Fitzgerald
R. Macek
H. Butler
R. Stevens

FIGURE 11