9 - EXPERIMENTAL PROGRAMME AND USER ACTIVITIES

EXPERIMENTAL PROGRAMME AND USER ACTIVITIES

1. Operation of the Orphée Reactor and LLB facility

In 2001-2002, the LLB associates (CEA and CNRS) decided to reduce the operation of the Orphée reactor to 180 days per year (FPED, Full power equivalent days) for budgetary problems. The previous agreement between the two associates (CEA and CNRS) had fixed this number of operating days to 210 days during the previous two year-period, i.e. 1999-2000. In fact, the reactor operation has slightly exceeded these nominal numbers in the past three years, leading to a real availability greater than 100% (see table 1). The Orphée reactor is one of the most recent medium power reactors in Europe and has a very efficient operation.

Year	1995	1996	1997	1998	1999	2000	2001	2002
Reactor Days	215	245	188	218	205	213	186	183
% Availability	94,2	98,2	95,4	99,4	96,8	101,4	103,3	101,6

Table 1. Operation of the LLB-Orphée reactor for the last eight years. The nominal operation was of 245 days up to 1997, of 210 days in 1998-2000 and of 180 days in 2001-2002. The low figure in 1997 is due to the replacement of the zircaloy housing core.

The number of experiments and experiment days performed at LLB in 2001-2002 scaled closely with this 14% decrease of the available beam time, compared to the previous two-year period:
An average of 3642 experiment days in 2001-2002 (3670 exp. days in 2001 and 3613.5 exp. Days in 2002) to be compared with an average of 4074 experiment days in 199-2000 (4196 exp. Days in 1999 and 3953 exp. Days in 2000). The number of experiments decreased also in a smaller proportion: an average of 489 experiments in 2001-2002 (500 experiments in 2001 and 477 in 2002) to compare with an average of 509 experiments in 1999-2000

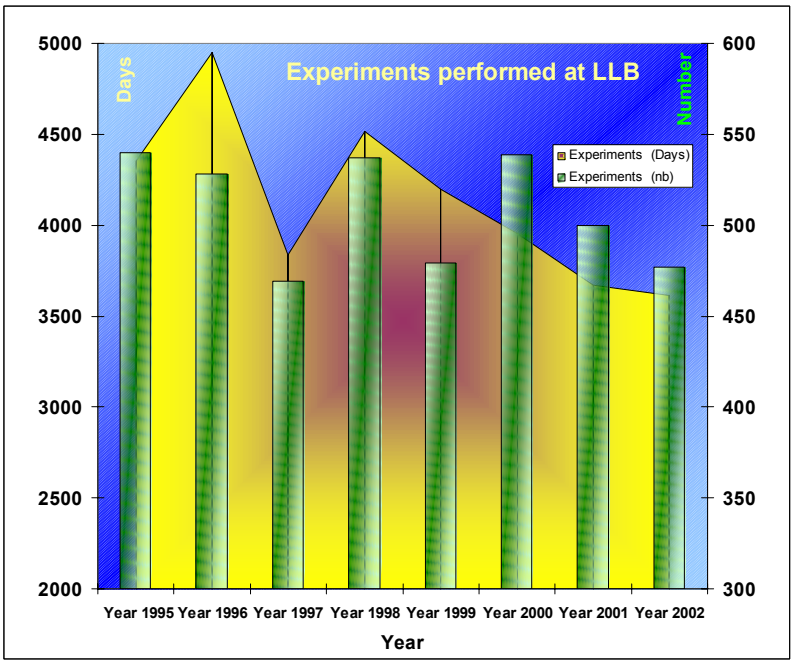

Figure 1. Graph of the number of experiments (green bars and right scale) and experiment days (yellow curve and left scale) performed at LLB-Orphée during the last eight years. The curves followed closely the number of operation days of the Orphée reactor (table 1).

Experiments at LLB are performed on various types of spectrometers. The four main groups are composed of three-axis spectrometers, powder diffractometers, small angle machines and single crystal diffractometers. They delivered more than five hundreds (500) experimental days per year and performed 60-120 experiments each year. The four smaller groups deal with diffuse scattering, quasi-elastic scattering, material science and reflectometry. They deliver around three hundreds (300) experimental days per year corresponding to 20-40 experiments each year.

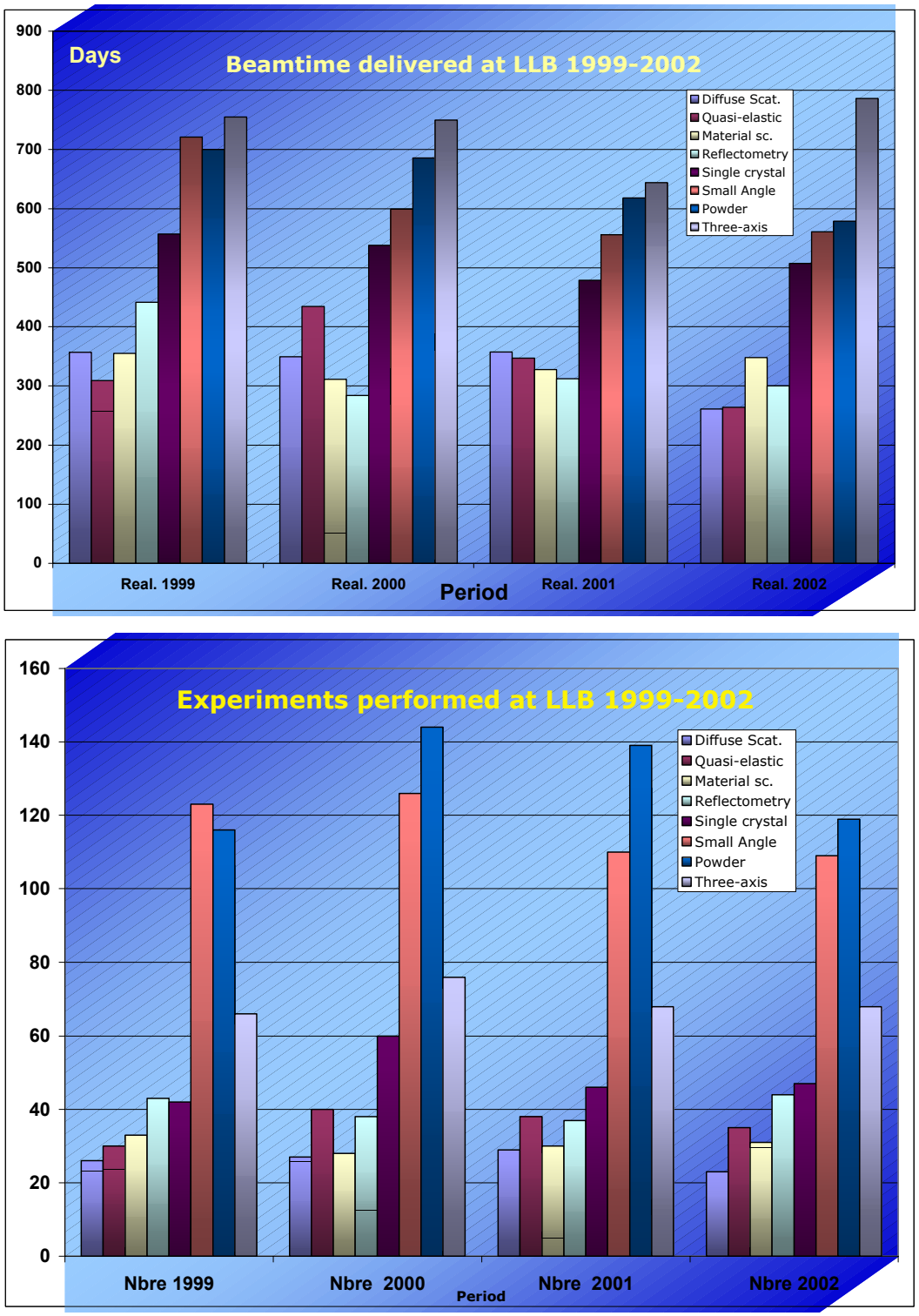

Figure 2**.** Beam time (upper figure) delivered at LLB-Orphée over the last four (4) years and experiments (lower figure) done in the same period as a function of the instrumental group (listing at the section end).

2. Experimental programme and user activities

Experiments performed at the LLB in 2001-2002 have been realised by French teams coming from all over the country (figure 3 below). The French experiments stand for nearly two-thirds (2/3) of the total beam time delivered during this two-year period. The neutron teams from European and associated countries have benefited of nearly one fourth (1/4) of the total beam time, part of this use being supported by the European support for large-scale facilities (see next sub-section). The rest of the beam time has been used mainly by Russia, PECO countries and for a small fraction by the remaining countries (USA, Japan, Switzerland, …, see beam time allocation subsection for a detailed analysis by countries).

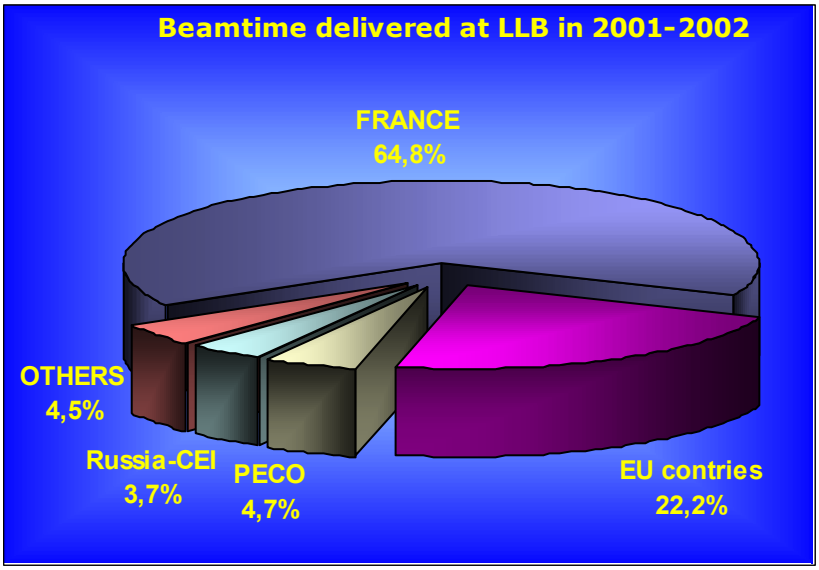

Figure 3. Beam time delivered at LLB-Orphée in 2001-2002 as a function of the nationality of the neutron teams involved (upper graph) and geographical repartition of the experiments realised by French teams (lower graph).

3. European access programme

Since 1993, the LLB is a large-scale facility for the transnational access of European users in the framework of the Human Capital and Mobility (HCM, 1993-1997) and Training and Mobility of researchers (TMR, 1996-2000) programmes of the European Commission. In 1999, The LLB applied successfully for the new HPRI European programme opened also to associated countries (e.g. central Europe). The first contract HPRI-CT-1999-0032 started on 1 February 2000 for three years until 31 January 2003, thus covering this two-year report. The initial plan was to deliver five hundred and ten (510) days of beam time for seventy (70) projects involving one hundred (100) individual users. The access really delivered by the LLB during the total three-year period amounted in fact up to five hundred and fifty (550) days of beam time, delivered to ninety-four (94) projects and concerned one hundred and thirty-five individual users coming from EC countries or associated countries. Amongst the ninety-four (94) projects, sixty-three projects came from EC countries and thirty-one projects from associated countries.

The LLB has signed a new contract in 2002, HPRI-CT-2001-0170 for two years until February 2004. This contract will concern one hundred and eighty-five (185) days of beam time for twenty-five (25) projects involving thirty-seven (37) individual users. This second contract will end up the transnational access programme of the FP5 scheme and will be replaced by new contracts in the FP6 scheme. Indeed, the LLB has applied successfully to continue in participating to the transnational access of European users to large-scale facilities in the Neutron-Muon integrated initiative in the forthcoming years.

The LLB is particularly keen to attract new user groups from EC or associated countries and those wishing to apply neutron techniques to novel scientific areas. Researchers wishing to apply under the EC programme can do so via the normal LLB proposal mechanism. The LLB will provide travel and subsistence cost for up to two researchers in an accepted experiment.

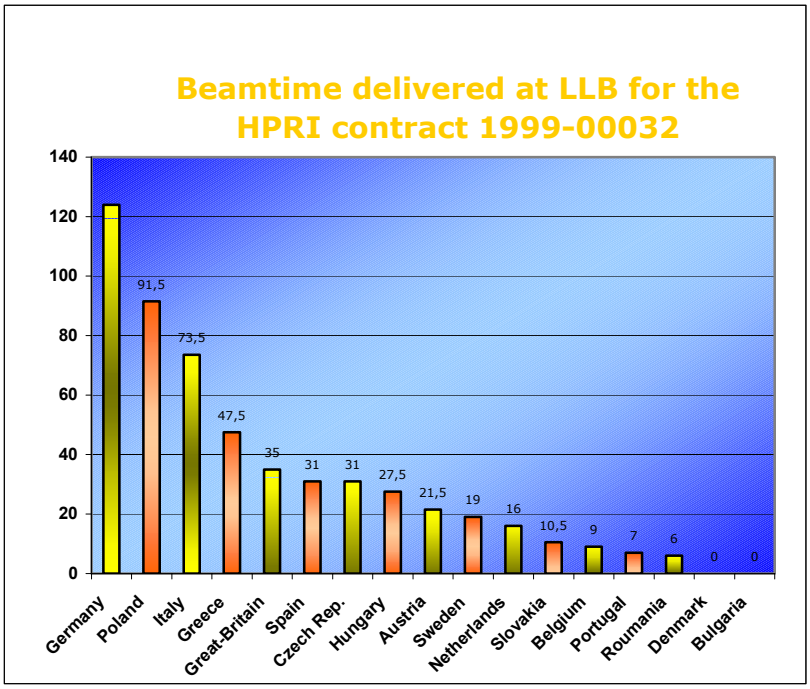

Figure 4. Beam time delivered at LLB-Orphée in 2001-2002 in the framework of the transnational access program supported by the European FP5 scheme for large scale facilities, as a function of the nationality of the neutron researchers invited by the LLB.

4. Selection panel and Beam time allocation

Proposals for experiments are selected and beam time allocations are made through peer review. Review committees of specialists from France and the most parts of European countries have been set up in the following scientific areas:

Session A for physical chemistry and biology
Session B for structural studies and phase transitions
Session C for Magnetism and superconductivity
Session D for disordered systems and material science.

The relative importance of these four committees of the selection panel at LLB is depicted in the figure 5 below this paragraph. The largest committee of the LLB is the one dealing with magnetism and superconductivity, domain where the LLB expertise is acknowledged worldwide. The three other committees are roughly equivalent in importance and share the rest of the allocated beam time, each of them getting around 20% of the total beam time.

The review committee meet twice a year, some six weeks after the deadline for submission of proposals (1 April in spring and 1 October in fall). Accepted proposals submitted by April receive beam time in the second half of the year and those submitted by October, in the first half of the next year. More detailed information on applications for beam time and deadlines are given on the LLB web site at http://www-llb.cea.fr

There are three different ways of submitting a proposal to the LLB:

- Standard submission of a research proposal, twice a year in Spring and Fall
- Long term research project over three (3) years, twice a year in Spring and Fall
- Fast access procedure for short experiment or test, without time restriction.

Special access for proprietary research and industrial users and firms are considered separately.

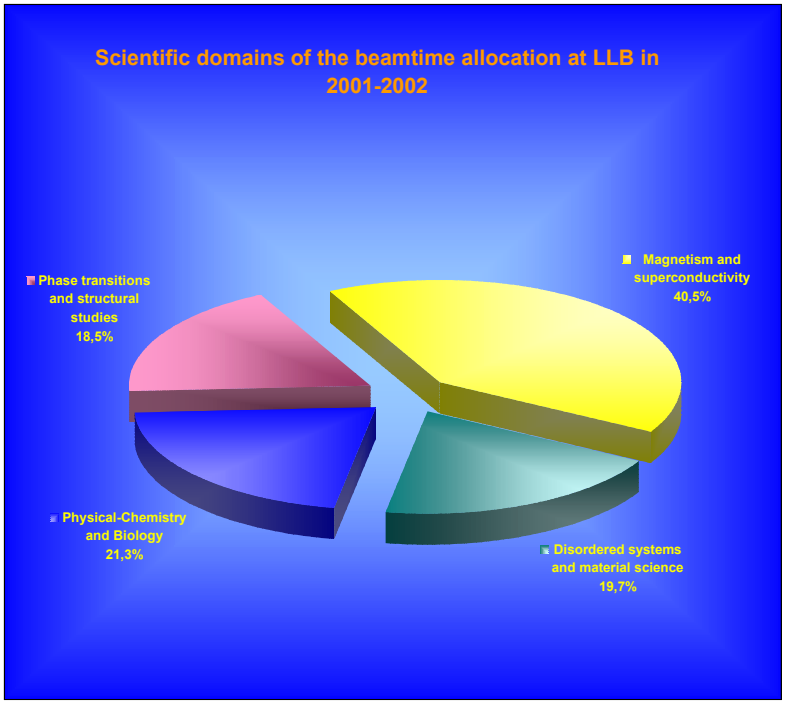

Figure 5. Repartition of the beam time delivered at LLB-Orphée in 2001-2002 amongst the four committees of the selection panel with the corresponding percentage.

The four review committees of the selection panel of the LLB comprise fifty (50) international scientists (see table) who meet twice a year at the LLB and have the difficult job of assessing the scientific quality and timeliness of submitted proposals and to advise on the allocation of beam time. The four committees report to the direction of the LLB who regulate the beam time allocation.

Overall, the four review committees of the selection panel scrutinised nine hundred thirty-two (932) proposals requesting 8666.5 days of beam time for 2001-2002, out of which seven hundred forty-one (741) proposals received beam time, allocating 5321.5 days on the twenty-five (25) LLB instruments.

The distribution of beam time requested and allocated amongst the different European and other counties is shown in the table 2. Nearly two-thirds of the allocated beam time go to the French proposals covering all domains of science and nearly all regions of France. One fourth of the beam time is devoted to European proposals coming from the major "neutron-wise" countries, i.e. Germany, Great Britain, Spain, Austria and Italy. Half of this European beam time goes to German experiments in long term collaborations, initiated on all instruments and not only on the CRG ones. Collaborations with Austria and Italy suffered with the closedown of the corresponding CRG instruments. On the contrary, the collaborations with Russia and PECO countries are still very active and count for nearly seven percent of the allocated beam time, comparable with the rest of the internationally allocated beam time.

Country	Proposals 2001-2002	Experiments 2001-2002	Beam time asked (days)	Beam time all. (Days)	Beam time asked (%)	Beam time all. (%)
France	520	436	5012.5	3269.5	57.8%	61.4%
FRANCE	520	436	5012.5	3269.5	57.8%	61.4%
Germany	93	82	809	611	9.3%	11.5%
Austria	17	13	165	105	1.9%	2.0%
Italy	20	15	134	75.5	1.5%	1.4%
Great-Britain	23	18	217.5	132	6.9%	5.0%
Spain	10	9	117	71.5	1.6%	2.0%
Others	68	43	511	264	5.9%	5.0%
EU countries	231	180	1953.5	1259	22.5%	23.7%
Poland	24	15	244	113	2.8%	2.1%
Hungary	15	10	128	75.5	1.5%	1.4%
Czech Rep.	6	5	46.5	36.5	0.5%	0.7%
Others	8	6	55	28.5	0.6%	0.5%
PECO	53	36	473.5	253.5	2.6%	2.6%
Russia	50	37	409	196.5	4.7%	3.7%
Ukraine	10	1	215	7	2.5%	0.1%
RUSSIE-CEI	60	38	624	203.5	7.2%	3.8%
United-States	23	21	190	132.5	2.2%	2.5%
Japan	18	12	159	94	1.8%	1.8%
Switzerland	6	5	69	38	0.8%	0.7%
Magrheb	13	8	105	47	1.2%	0.9%
Others	8	5	80	24.5	0.9%	0.5%
Others	68	51	603	336	7.0%	6.3%
TOTAL	932	741	8666.5	5321.5	100%	100%

Table 2. Compilation of the proposed and accepted experiments at LLB by the four series of selection panels done in 2001-2002 with the corresponding beam time demand and allocation in days and percentage for France, the EC countries, PECO and Russia and the rest of the world. The main "neutron-wise" countries have been highlighted.

The LLB is the French national neutron source and one of its primary missions is to deliver neutron beam time to all the French laboratories involved in neutron science. The figure 6 shows the geographical repartition of the French proposals.

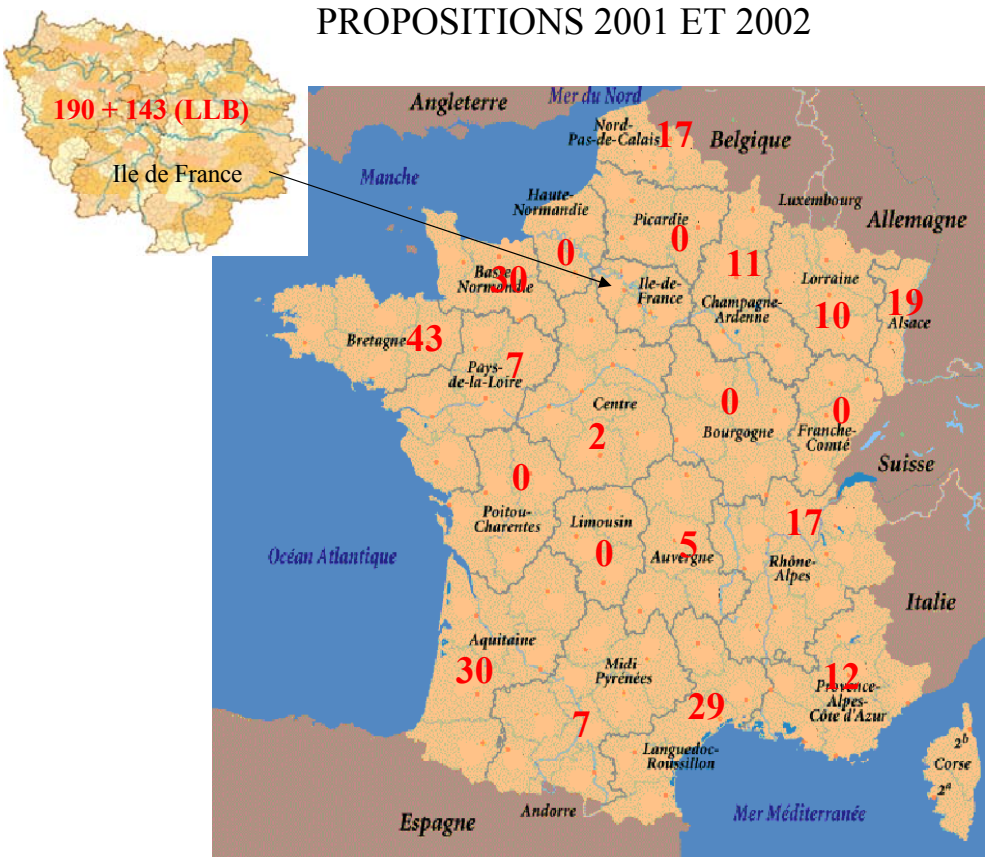

Figure 6**.** Geographical repartition of the experiments realised by French teams (lower graph).

The LLB has kept in 2001-2002 the system of Round Tables and User Selection panels with a spring and fall sessions put in place in 1996. Each session of the Selection Panel comprises typically nine (9) members (3 French members, 3 foreign members and 3 LLB members). The list of the selection panel for Fall 2002 is given at the end of this section.

The Spring session of the selection panel consists of a two-day meeting of the committees at the LLB and for the Fall session, the Selection Panel is preceded by a user meeting, called “Tables Rondes du LLB”. This user meeting consists of:

- Invited talks and topical scientific reviews in each committee
- Presentation of recent scientific results of external and internal users (Poster sessions)
- Technical presentations
- And discussion with users.

In the future, It has been decided to discontinue the “Tables Rondes du LLB” that will be replaced by thematic workshops organised in close collaboration with other Large-scale facilities and laboratories from the Saclay Plateau. These workshops will focussed on the major scientific areas of the LLB:

Physical chemistry and biology (Session A)
Structural studies and phase transitions (Session B)
Magnetism and superconductivity (Session C)
Disordered systems and material science (Session D).

5. Instrument operation in 2001-2002

The instrumental operation at LLB in 2001-2002 was smooth and efficient. The major point was the end of the refit of the 2T triple-axis spectrometer with the installation of the full-polarized mode. The LLB has continued in 2001-2002 to upgrade its instrument park, specially on the material science spectrometer G5.2 "Diane", the resonant spin-echo spectrometer G1.Bis "Muses" and the polarised Small Angle Spectrometer G5.5 "Papol". The LLB has progressed in the development of the Very small angle spectrometer TPA and finished the validation tests on the prototype spectrometer. The spectrometer will be built in the forthcoming years. In the near future, the high resolution powder diffractometer 3T2 will be completely rebuilt and upgraded. Upgrade of the time of flight reflectometer G3.Bis "Eros" is also under study and will be rapidly undertaken.

Group	Proposals 2001-2002	Beam time 2001-2002	Session A	Session B	Session C	Session D	TOTAL Alloc.	F_over
Diffuse Scatt.	45	520.0	50.0	7.0	4.0	231.0	292.0	1.78
Quasi-elastic	78	810.0	227.0	44.0	35.0	119.0	425.0	1.91
Materials	44	673.0	0.0	0.0	0.0	366.0	366.0	1.84
Reflectometry	59	635.0	157.5	0.0	186.0	34.0	377.5	1.68
Single crystal	118	1532.0	0.0	327.0	579.0	0.0	906.0	1.69
Small Angle	238	1603.5	679.0	10.5	88.5	131.0	909.0	1.76
Powder	193	1132.0	6.0	217.0	519.0	84.0	826.0	1.37
Three-Axis	154	1736.0	14.0	379.0	742.0	60.0	1195.0	1.45
TOTAL	**932**	**8666.5**	**1133.5**	**984.5**	**2153.5**	**1050.0**	**5321.5**	**1.63**

Table 3 Compilation of the proposed experiments at LLB by the four series of selection panels done in 2001-2002 with the corresponding beam time demand and allocation in days by the four committees: Session A stands for physical chemistry and biology, Session B for structural studies and phase transitions, Session C for Magnetism and superconductivity, Session D for disordered systems and material science. Last column displays the overload factor in the eight instrument categories and the global overload factor calculated on the beam time allocation.

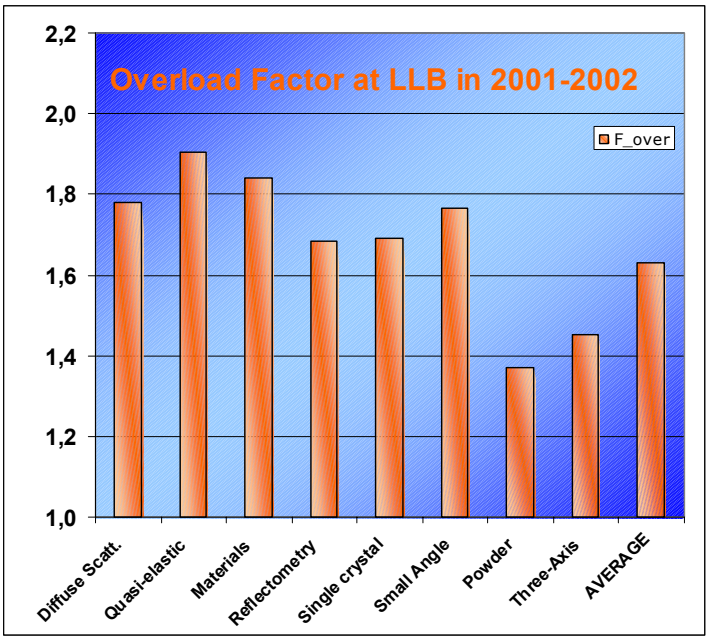

Figure 7**.** Overload factor of the various instrument groups at LLB 2001-2002 calculated on the beam time demand and allocation.

INITIAL MEMBERSHIP OF THE USERS SELECTION PANEL AUTUMN 2002

SUBPANEL A : Physical Chemistry, Biology

F. Nallet (President)	France	M. Geoghegan	United Kingdom
J. Combet	France	T. Hellweg	Germany
B. Demé	France	P. Mariani	Italy
O. Diat	France	P. Stepanek	Czech Republic
M. Ferrand	France		

SUBPANEL B : Structural Studies, Phase Transitions

T. Fernandez-Diaz	Spain (ILL - France)	H. Boysen	Germany
S. Klotz	France	M. Braden (President)	Germany
M. Latroche	France	J.-M. Perez-Mato	Spain

SUBPANEL C : Magnetism, Superconductivity

C. Dufour	France	J.-L. Garcia-Munoz	Spain
A. Ivanov	Russia (ILL - France)	G. Mc Intyre (President)	Australia (ILL - France)
H. Noël	France	L. Paolasini	Italy (ESRF - France)
		P.G. Radaelli	Italy (ISIS - UK)

SUBPANEL D : Disordered Systems, Materials Science

M. Bee	France	I. Cabaco-Fialho	Portugal
D. Fruchart	France	A. Wiedenmann	Germany
F. Hippert	France		
J.-M. Sprauel (President)	France		

List of LLB instruments scheduled for external users

Powder diffractometers

3T2	"Thermal neutrons" 2-axis (20 detectors) high resolution, mainly for nuclear structure determination
G4.1	"Cold neutrons" 2-axis (multidetector 800 cells) high flux, mainly for magnetic structure determination
G4.2	"Cold neutrons" 2-axis (7x10 detectors) high resolution, for structure determination on polycrystalline samples with large unit cell.
MICRO (G6.1)	"Cold neutrons" 2-axis (multidetector 400 cells) with long wavelength (-5A) and high flux, for the study of very small powder samples (<1 mm'). Very high pressure cell available (40 GPa).

Diffractometers for material science studies

6T1	"Thermal neutrons" 4-circle for texture determination
DIANE (G5.2)	"Cold neutrons" 2-axis for internal strain mapping in bulk samples with spatial resolution ~1 mm^3.

Single crystal diffractometers

5C1	"Hot neutrons" 2-axis with lifting arm, polarised neutrons, magnetic field (8 Tesla) for spin-density maps determination
5C2	"Hot neutrons" 4-circle for nuclear structure determination.
6T2	"Thermal neutrons" 2-axis, lifting arm and 4-circle, mainly for magnetic structure determination. 12 Tesla magnetic field available

Diffuse scattering instruments

7C2	"Hot neutrons" 2-axis (multidetector 640 cells) for local order studies in liquid or amorphous systems. Cryostat and furnace available (1.2K 1300°C).
G4.4	"Cold neutrons" 2-axis (48 detectors, elastic/inelastic discrimination by Time-of-flight technique) for local order studies in single crystals. Furnace available (1400°C).

Small-angle scattering instruments

PACE (G1.1)	"Cold neutrons" (annular detector, 30 rings) for study of large scale structures in isotropic systems (mainly polymers and colloids).
PAXY (G2.3)	"Cold neutrons" (X-Y detector, 128×128 cells) for study of large-scale structures (10 to 500 Å) in anisotropic systems (polymers under stress, metallurgical samples, vortex in superconductors ..).
PAXE (G5.4)	"Cold neutrons" (X-Y detector, 64x64 cells) for multipurpose studies of large scale structures
PAPOL (G.5.5)	“Cold polarized neutrons” with dynamic nuclear polarisation facility

Reflectometers

EROS (G3bis)	"Cold neutrons" reflectometer operating in time-of-flight mode for multipurpose surface studies.
PRISM (G2.4)	"Cold neutrons" reflectometer with polarised neutrons and polarisation analysis for the study of magnetic layers.

Triple-axis instruments

1T	"Thermal neutrons" high-flux 3-axis instrument with focusing monochromator and analyser, mainly devoted to phonon dispersion curves measurements. Very high pressure cell (100 Kbar) available.
2T	"Thermal neutrons" high-flux 3-axis instrument with focusing monochromator and analyser, mainly devoted to spin-waves and magnetic excitations studies (1.5 to 80 meV).
4F1	"Cold neutrons" high flux 3-axis instrument with double monochromator and analyser, mainly devoted to the study of low-energy (15µeV to 4meV) magnetic excitations. Polarised neutrons and polarisation analysis option available.
4F2	"Cold neutrons" high-flux 3-axis instrument for the study of low-energy excitations (e.g. soft modes) or modulated structural studies in single crystals.
G4.3	"Cold neutrons" high resolution and low background 3-axis instrument, mainly devoted to elastic diffuse scattering studies.

Quasi-elastic instruments

MIBEMOL G6.2	"Cold neutrons" high resolution (~15 µeV at 10Å) time-of-flight instrument for the study of low energy excitations, mainly in disordered systems.
MESS (G3.2)	"Cold neutrons" small-angle high resolution spin-echo instrument, for the study of slow dynamics (Fourier time ~40 ns) of disordered matter (movements of large molecules in biology or physical chemistry, relaxation of magnetic moments).
MUSES (G1bis)	"Cold neutrons" large-angle high flux spin-echo instrument for the studies of biological or colloid systems

GENERAL IMPLANTATION OF LLB INSTRUMENTS