CEA

A THE FACILITY

A.1 The accelerator infrastructures of the CEA/DPTA

The “Département de Physique Théorique et Appliquée” (DPTA) of the french Commissariat à l'Energie Atomique CEA (Bruyères le Châtel, France) operates two electrostatic accelerator facilities for several applications: measurement of neutron cross-section data, neutron or gamma detector calibrations, chemical analysis of matter with large or micro ion beams and also analysis of the damages induced by ion irradiations. The two electrostatic accelerator facilities, a 4 MV light-ion Van de Graaff (VdG) and a 7 MV tandem Van de Graaff, provide complementary ion beams in term of energies and intensities.

The 4 MV VdG is an HVEE-electrostatic accelerator which delivers $^{1}H^{+}$, $^{2}H^{+}$,$^{3}He^{+}$,$^{4}He^{+}$ions within the energy range 420 keV to 4 MeV. Pulsed or continuous ion beams are available. In pulsed mode, the repetition rate is fixed at 2.5 MHz (400 ns) and the FWHM is about 10 ns. The figure 1a presents the five beam-lines in the two experimental rooms, one of these beam-lines is dedicated to the neutron production with a Mobley buncher (to reduce de FWHM of the pulsed beam to 1-2 ns), a capacitive beam pick-off detector (to measure the FWHM of the pulsed beam) and two detectors, NE213 and BF3, to monitor the neutron flux on line. The mono-energetic neutron fields are created by nuclear reactions between accelerated $^{1}H^{+}$, $^{2}H^{+}$, with thin layer of lithium or deuterium, or tritium on Au-support backing. The neutron energy is defined by the specific reactions and by choosing the appropriate angle, the neutron emission rate is about 10^{8} n/s/sr. The facility is operated on an average of 10-hours/day basis, for about 50 hours per week; one night per week is possible.

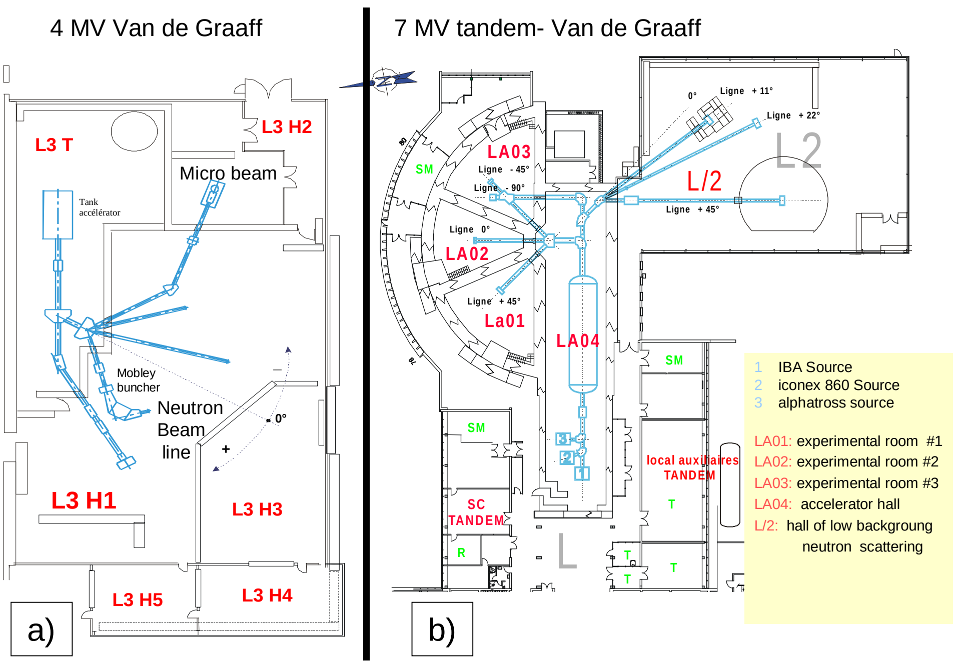

Figure 1a and 1b: presentation of the two accelerators infrastructures at the CEA, with their beam lines and experimental rooms.

The 7 MV-tandem VdG is an HVEE-electrostatic accelerator which delivers $^{1}H^{+}$, $^{2}H^{+}$, $^{3}He^{q+}$,$^{4}He^{q+}$ and heavy ions (C to Au ions). The energy of the ions depends on their charge state and mass. For protons and deuterons, the maximal energy is 14 MeV. Pulsed or continuous ion beams are available. In pulsed mode, the repetition rate is flexible from 1 Hz to 2.5 MHz (400 ns) with a FWHM of 2 ns. Note that two resonant cavities to bunch the pulse to a FWHM of 100 ps will be operational in 2007. The

figure 1b presents the seven beam-lines in the four experimental rooms of the 7MV- tandem VdG, three rooms with high neutron radioprotection are used to perform experiments with high neutrons flux and the last room is a low background scattering hall. This hall is a thin-walled rectangular hall 30 m x 50 m with a cylindrical "pit" in the floor useful for high resolution neutron time-of-flight experiment. A 4π neutron ball, named CARMEN, was designed for (n,xn) studies and is currently installed and being used on a time-of-flight neutron beam facility. We invite, in the framework of this project, scientific collaborations to extend measurements beyond those already performed, i.e. (n,2n) on various targets and fission measurements. A specific shielding with a concrete bunker assembled around the deuterium gazeous neutron source defines a neutron "collimated beam". Then, the flux of the neutron beam is $5\ 10^7$ n/s/sr.
The facility is operated on an average of 10-hours/day basis, for about 50 hours per week; one night per week is possible.

The accelerators are the facilities of a nuclear physics laboratory which covers all aspects of nuclear structure and nuclear reactions both from the experimental and theoretical aspects, mainly:

- Calculation of the structure of nuclei
- Measurement of moments of nuclei in their ground state and isomeric states
- Modelling and evaluation of nuclear data
- Measurements of nuclear data (fission, (n,*x*n) reaction, preequilibrium, …)

A.2 Quality of research

The nuclear physics laboratory of the CEA/DPTA gets a special expertise on neutrons, accessed all over the years, with the use of incident neutrons from accelerators and reactors and specific detections of the outgoing neutrons. It presents a unique example of complete chain of evaluation beginning with the conception and realisation of experiments and ending with evaluated data files submitted to the European nuclear data library like JEFF (Joint Evaluated for Fission and Fusion files).
On the experimental side, we have a long tradition of measuring nuclear data like the (n, *x*n) reactions already used for evaluation of actinides (^{235}U, ^{239}Pu) or other elements like copper, cerium or thallium. This program has been stopped in 1985 to focus all efforts on another project but restarted in 1995 due to the need of high quality nuclear data. A new low background beam line and a set-up dedicated to measure the neutron multiplicity CARMEN have been developed. Experiments are also done, especially on fission, in a close collaboration between our institute and the LANSCE (Los Alamos Neutron Science CEnter).
On the theoretical side, the laboratory is the largest theoretician group in France and one of the largest in Europe. They cover structure of nuclei aspect in the general frame of microscopic calculations with the Gogny force which has been created at CEA/DPTA and also reaction mechanisms, data evaluation and, in some cases, macroscopic validation on benchmarks. They are already involved in some evaluations in the IP-Eurotrans (NUDATRA) after their implication in an original evaluation of ^{238}U cross sections up to 200 MeV within the HINDAS project (PCRD5).
The laboratory has been recognized to be of a high scientific level by two scientific councils, independent from the CEA, in 2000 and 2005. The CEA/DPTA has a long tradition of collaborations and exchanges with other research organisations. The international character of the activities is further emphasised through contacts with the NEA Data Bank of the OECD at Paris and by engagement in Co-ordinated Research Projects organised by the Nuclear Data Section of the IAEA at Vienna.

A.3 New opportunities for access

This TA activity will give an access to the CEA laboratory specialized in nuclear data evaluation for the other European research teams. A total of 150 hours per year could be placed at disposal of the EFNUDAT committee on the two accelerators covering neutron energies from 30 keV to 20 MeV. EFNUDAT teams will also have access to a low background scattering neutron hall, a 4π multiplicity measurement of neutrons (CARMEN), …

B MANAGEMENT OF THE ACCESS PROVIDED

B.1 User access to the infrastructure

The CEA/DPTA accelerator infrastructures are located at Bruyères-le-Châtel (Essonne, France), approximately 35 km south to Paris, in the premises of the Direction des Applications Militaires of the CEA. Clearance is required to enter the site, with requires that the user provides specific information. The delay to obtain the required clearance is 3 weeks for one week stay and 6 weeks for one or two months stay for EU citizens. Since Bruyères-le-Châtel is located far from Paris, over 50 free buses run every day from the whole Paris area towards the centre to transport the CEA personnel. Therefore, it is easy to stay in Paris and come to Bruyères-le-Châtel.

B.2 Scientific, technical and logistic support

The experiments done in the frame of EFNUDAT will be made in collaboration with the local team. A scientific support will be organized to welcome the European teams during their stay (one physicist for half of his time during the preparation and beam time). Contacts with all physicists of the laboratory will be made possible for the physicists coming to the laboratory and for those who join EFNUDAT, in general.

The accelerators team, engineers and technicians, will support the physicists by continuous exchanges during the feasibility study and installation of the experiment and providing the beam.

Common electronic communications means will be available at the centre. Several offices equipped with PC’s will be open to the scientists.

B.3 Peer review procedure

The peer review procedure, common for all Transnational Access Activities, is described under Activity NA1-Management of the I3, part B.3.2.4.

C EUROPEAN ADDED VALUE: European interest in the infrastructure

C.1 Community interest in the infrastructure

C.1.1 International users in the past

Due to defense activities, only few Europeans laboratories have taken advantage of the accelerator facilities. In the past, the accelerators have been heavily used for internal needs of the CEA. With the evolution of the defense policy there is a wish of opening and give the opportunity to researchers from European countries to access the facilities. However, the accelerators have been already used for the space European community:

- for the irradiation by fast proton beam of the solar cells to evaluate the damages induced (like the solar emission), with a contract with ESA (European Spatial Agency), (2 weeks per year),
- for the γ-calibration of the spectrometer SPI of the satellite INTEGRAL (3 months in 2001).

C.1.2 Future demand

Several new specific data needs are foreseen like demands concerning transmutation of nuclear wastes, new generation of reactors, fusion demonstrator and homeland security.. Especially, nuclear data are needed for new materials in some different spectrum than the thermal reactors one. Some of the specificities of the CEA/DPTA infrastructure are unique in Europe (pulsed neutron beam, neutron hall, measurement of the neutron multiplicity, …). The access to our facility could provide a way to increase the accuracy of the data needed in all European institutions involved in nuclear data. Furthermore, nuclear data libraries ask for uncertainties and correlations between the data. This is needed for simulation and sensitivity analysis for different scenarios and cost estimations. The uncertainties and correlations will be studied theoretically but have to be constrained by measurements like the simultaneous measurement of (n, *x*n) reactions with a high efficiency.

Furthermore, the completeness of the offer, from beams to data evaluations, has a very high attractive power to develop new collaborations with our laboratory.

All future demands will be studied in collaboration with the EFNUDAT Physic Advisory Committee to dispatch the beam time.

C.2 Expected impact

C.2.1 Scientific impact

The scientific collaborations relies on extended visits of nuclear physicists, training of PhD and post-doc. The laboratory is well-known from other European institutions for two reasons: the expertise in the neutron field of its experimentalists and the know-how of its theoretical teams. We have been involved in the HINDAS project of the 5^{th} PCRD and in the actual 6^{th} PCRD. We are also involved in basic research needed for the NUMADE project which have candidate for the last PASR.
However, few Europeans laboratories have taken advantage of the accelerator facilities and the collaboration could be extended for the benefit of the scientific community. Funding from the European Community would help to enlarge the user group facility that could have a significant impact in creating links with all Member States especially New Members and give the opportunity to young physicists to work in a highly specialized laboratory in providing nuclear data.
This will also enlarge the scientific scope on the nuclear experimental and theoretical programme of the laboratory.

C.2.2 Technical impacts

Access to the facilities in the transnational access programme will increase the exchange of technical innovative development on accelerator set up and on neutron -TOF analysis. This will be a very concrete complement to network activities.
For the management of the infrastructure, the access being offered to new external users will impact on the present working conditions in two ways. It will induce an increase of annual beam-time and of the workload of local staff (scientist and technicians) and of technical, logistic and administrative support.

C.3 Attracting potential new users

First, the European nuclear data community will be informed via a general communication organized by the EFNUDAT management board. This information will be also included in the web-site of our laboratory (open before the end of 2005). Publications and communications in conferences, presentation of results obtained in the frame of EFNUDAT will always mention it.
On the other hand, we will inform all the users of our facilities, in particular non-nuclear physicist users, on the creation of the EFNUDAT I3 and invite them to complete their data need in other complementary European infrastructures.

D ACCESS OFFERED BY THE INFRASTRUCTURE

D.1 Annual implementation plan

The implementation plan covers a project duration of 48 months. If the proposal is accepted a reasonable estimate is that we can offer each year a maximum of 150 hours (3 weeks) of beam time on the two accelerators (100 hours (2 weeks) on the 7MV- tandem VdG and 50 hours (1 week) one the 4MV VdG). This corresponds to 600 supplementary hours of data-taking for the whole project. The scientists will spend 15 days in the infrastructure per year. For a visiting experimental group access will be financed for 2 users at the most.

D.2 Activities connected with access

Access offered to the external users will include user training, scientific and technical support during the experiment, office services, computers and administrative and logistic backing. The costs (on the basis of user fees) are justified in detail in part D.3. Also travel and subsistence costs related to visits of users will be supported at charge of the contract.

D.2.1 Training

All starting projects at the CEA are submitted to a specific procedure for hazard identification and risk assessment. Special training sessions are organised for newcomers on health and safety at work, including radiation protection issues for activities in controlled areas. In addition, the main user of a beam line will accompany the new users and will be given a detailed facility-specific training. If needed, first-time users will get training on the different measurement techniques or new detectors we developed at our facility.

D.2.2 Scientific and technical support

A local senior scientific contact per experimental user group will be designated by the CEA/DPTA VdG accelerator commission. He/she will be in charge of the external users during their whole measurement period. He/she will introduce the users to all facility aspects. He/she is a liaison with the machine operators, with the other scientific staff of the nuclear unit and with the administration and technical service of the CEA.

Technical support laboratories are available on site for small mechanical works (preparing, setting up, special sample handling and mounting). The CEA/DPTA VdG accelerator commission defines the level of technical support charged to the contract.

Computer and data storage facilities could be made available for the user groups.

The CEA’s radiation protection service will ensure appropriate radiation protection and personnel operational dosimeter (DOSICARD) as indicated on a medical certificate. This medical certificate will be written in English, dated from three months at the most and sent to the CEA one week before the experiment date.

D.2.3 Administrative and logistic support

Users will get access to the several services : standard office services (telephone, fax, internet services) and meeting rooms, restaurant. The CEA/social services can be contacted for administrative or personal problems, such as lodging, contacts with local administration, schools and hospitals.

D.2.4 Travel and subsistence costs

The travelling expenses will be reimburse on the basis of the receipts or bills for lodging, subsistence and transport.