## MODIFICATION OF THE THERMAL BEAM TUBE 2T

(Orphée reactor team)

Triple-axis spectrometry is the ideal technique to determine the complete set of vibrational and magnetic excitation dispersion curves in crystalline solids. Important results were obtained recently at the LLB by this technique, in particular on high Tc superconductors and GMR manganites, due to the high flux on thermal and cold instruments, 1T/2T and 4F1/4F2 respectively, built very close to the Orphée reactor core. Nevertheless, the method is limited by the (relatively) low counting rates, and therefore by the necessity to work on large single crystals (typically 0.1 $cm^3$).

In 1996, it was decided to increase the size of the 2T neutron beam cross-section and to rebuild the corresponding thermal triple-axis instrument with optimized neutron optics, in order to obtain largely increased counting rates, and to install a (new) polarized neutron option. This would make of 2T a world leading instrument.

The aim of this operation was of course to allow to work on smaller samples or to detect weaker effects, owing to the higher flux, but in priority to allow an experimental separation of the magnetic and lattice excitations in solids, in the energy range 10 to 100 meV, using polarized neutrons and polarization analysis.

The first stage of this project consisted to modify the 2T beam output, with an increased beam cross-section of $50 \times 120$ $mm^2$ (instead of $40 \times 75$ $mm^2$ in the "old" version).

This required a safety study in order to optimize the thickness of the zircaloy window, the dimensions of the screws and of the safety gate (made in neutron absorbing Al-Gd alloy), taking into account the case of a BORAX accident (water splash inducing a shock wave of 40 bars during 5 ms) in the new geometry. The safety tests were realized on a mock up (scale 1/2) by the Company SODERA in 1997-98, with direct pressure measurements in front and behind the zircaloy window during the tests, and measurement of the residual strains induced by the tests. Their results were submitted for agreement to the safety authorities (DSIN). The optimization of the new zircaloy window thickness (3.5 mm instead of 1 mm in the "old" version) required an elasto-plastic finite element calculation.

The technical study and detailed plans were performed by GEC-Alsthom. The new beam output was realized in 1998-99 by the Company OMG. The quality (homogeneity and density) of the filling with heavy neutron absorbing concrete (biological shielding) was checked on a transparent mock-up.

The dismounting and the removal of the old 2T neutron beam output, and the installation of the new one, were performed during the reactor shut-down of april 1999 by the team of reactor Orphée. The operation was a full success.

The three following figures show :

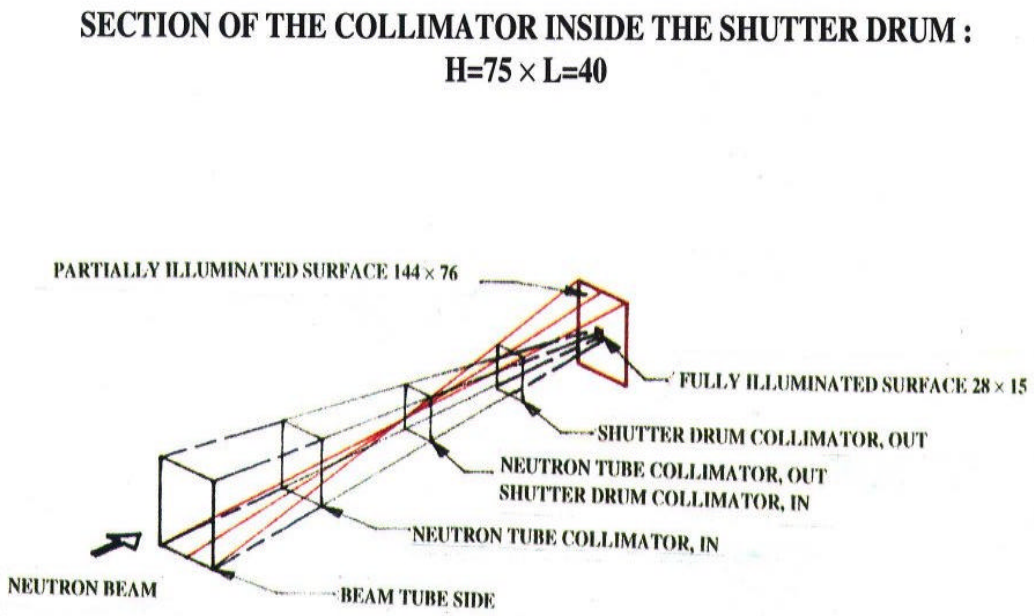
*Figure 1* : the change of incident neutron beam geometry allowed by the increase of 2T neutron beam cross-section;

*Figure 2* :the disposition of beam 2T relative to the reactor core, and a plan of the 2T output (barrel, plug, collimator, shielding device);

*Figure 3* : a series of photos, taken during the replacement of the beam tube part, in april 1999, and showing the different stages of the operation.

The description of the new 2T triple-axis instrument and first results are given as a highlight.

The success of this "2T operation" shows that increase of the size of neutron beams issued from presently existing reactors can be performed satisfactorily, if safety tests and calculations are carefully made, and this results in strong improvements of the flux on the instruments. In the case of Orphée, this gives confidence that the ORPHEE-PLUS (second cold neutron guide hall with increased 4F beam size) and ALTOR (enlargement of the 8F neutron output allowing to duplicate the guides G1 to G4) projects are quite feasable technically and would considerably improve the quality of the ORPHEE-LLB neutron source.



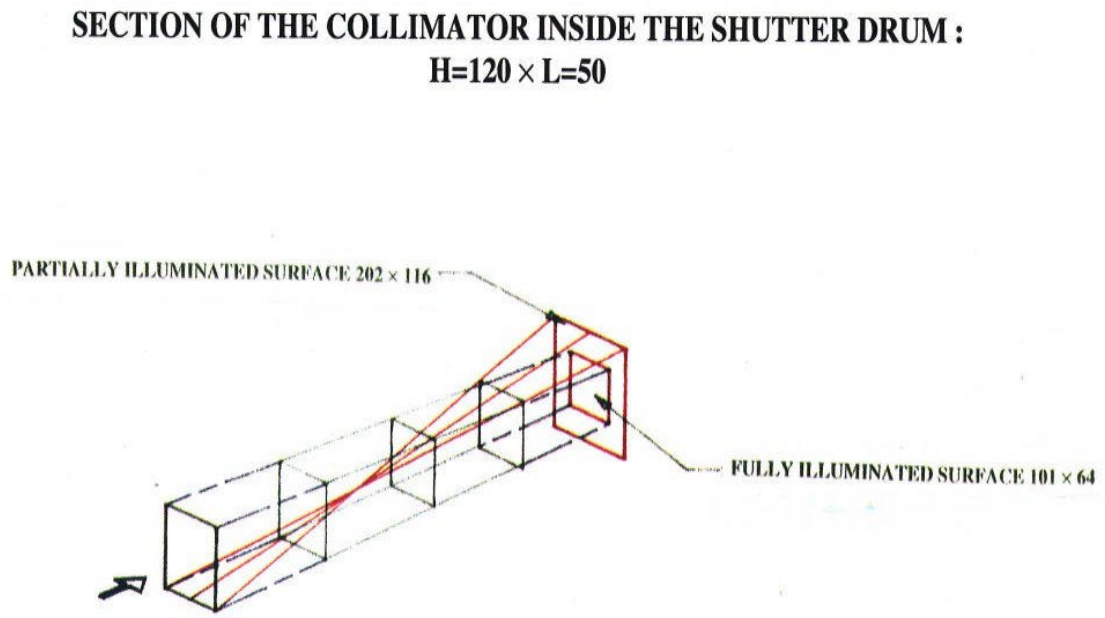




**Figure 1.** View graphs of the geometry of 2T chanel.

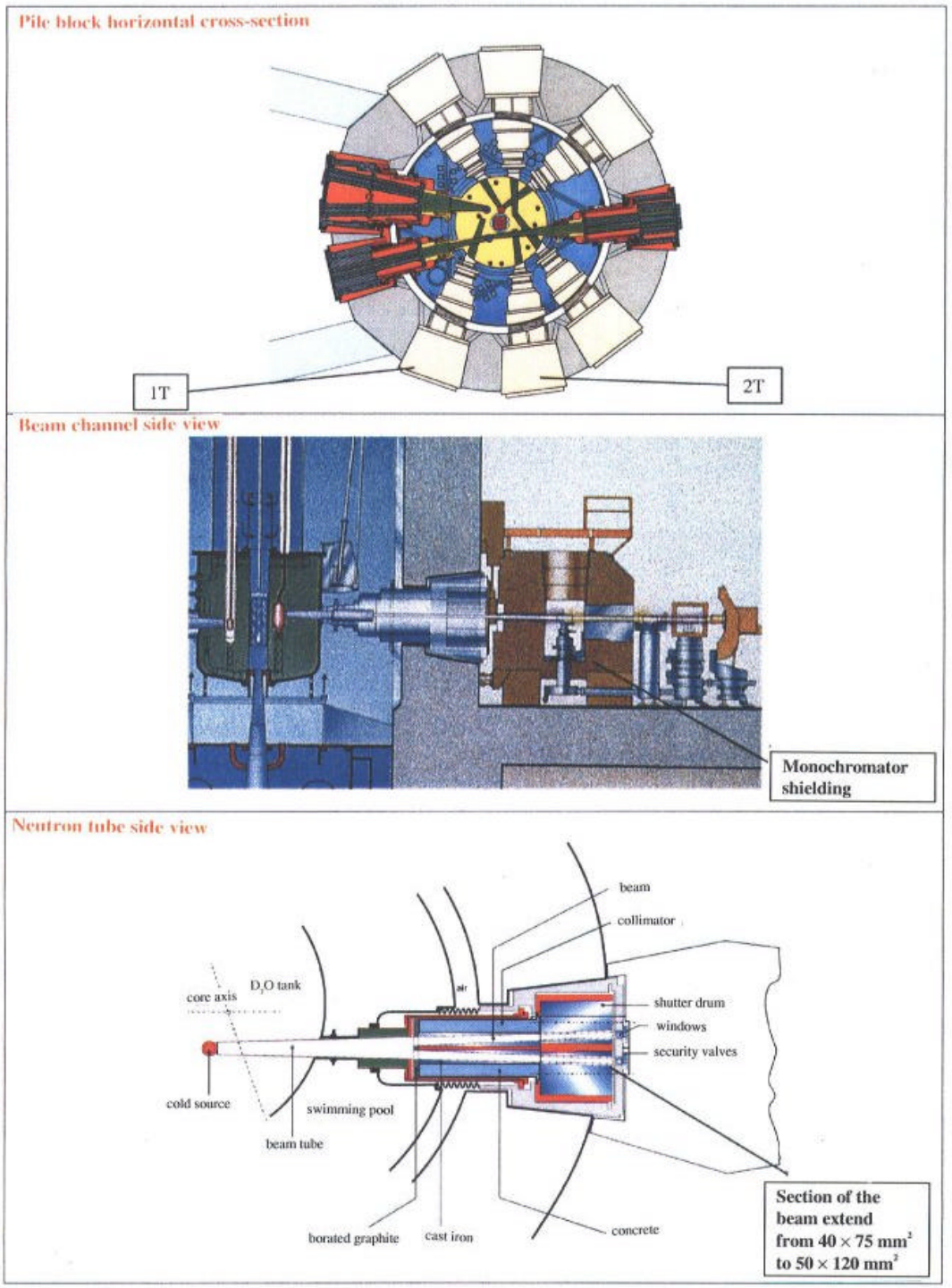
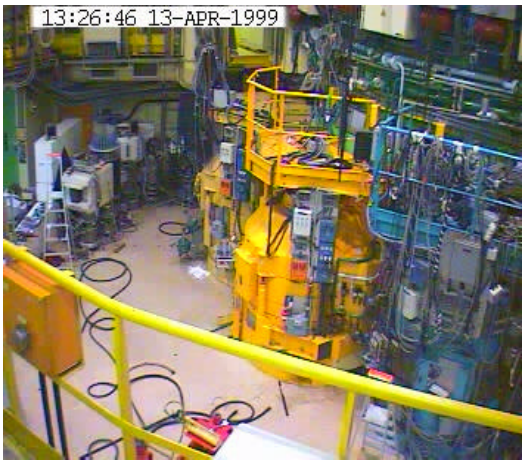



**Figure 2.** Schemes of the new beam output 2T

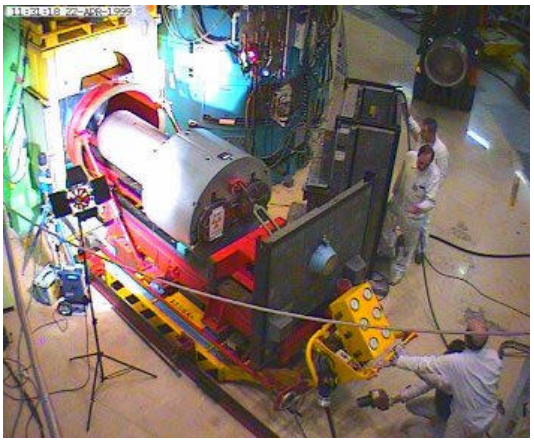
**1. Before disassembling**


2. The instruments are removed

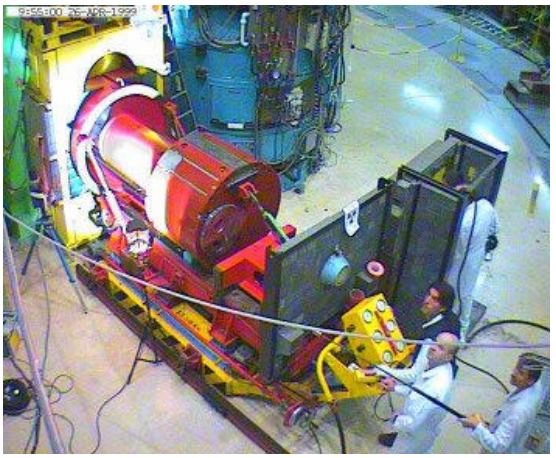



**2. The monochromator shielding is displaced**


4. The plug is pulled out



5. Installation of the new



**6. Reassembling of the shielding**

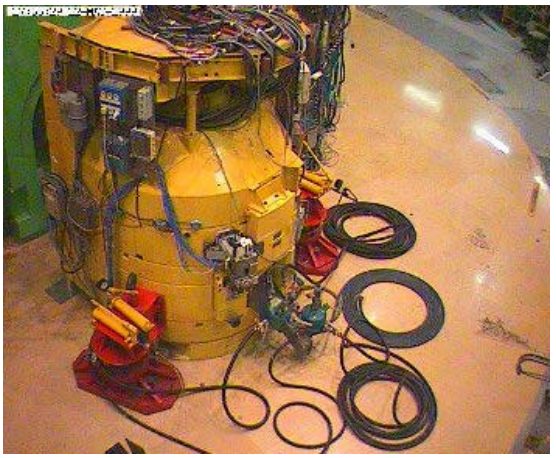


**Figure 3.** Replacement of the beam tube 2T in april 1999