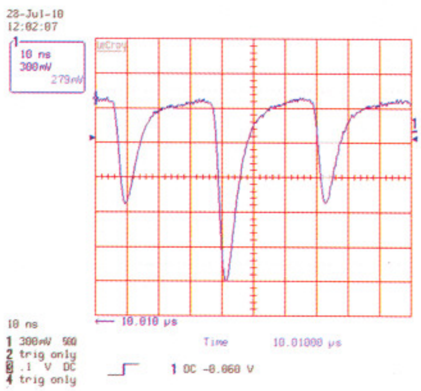
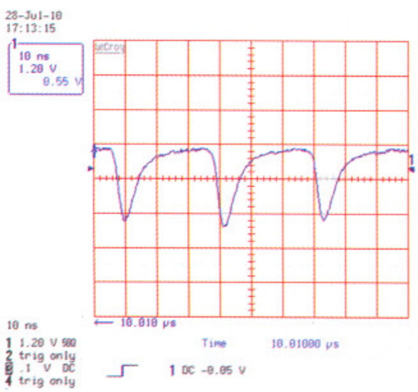
This system uses pickup signal of Wall Current Monitor (WCM) installed in Indus-1 storage ring for measurement of the bunch current. The pickup signal of WCM is fed to a digital storage oscilloscope (DSO) kept in the control room. The digitized signal from DSO is transferred on GPIB bus to a PC for calculation of individual bunch current. Software has been developed to interface DSO with PC. The required settings of DSO are automatically done by the software during initialization. During measurement, software automatically changes the volt/div setting of DSO according the input signal level to improve resolution. The software processes the acquired data to calculate the bunch current from the height of the pulses. The bunch current, bunch current ratio and total beam current are displayed online and also stored in a file for later analysis. The system was calibrated with DC current transformer (DCCT) of Indus-1 to get calibration factor for measurement of absolute bunch current. DCCT gives the average current of the storage ring. To calculate the calibration factor, a linear fitting was done between sum of individual pulse heights and average current measured by DCCT. The accuracy of this measurement system is better than 2%.



(a)



(b)

Fig. A.10.1: Typical WCM signal traces captured on DSO for a) 60% and b) 92% bunch current ratio

The bunch symmetry is indicated by ratio of the two bunches. Fig. A.10.1 shows typical traces of WCM signal on digital storage oscilloscope for the case of 60% and 92% bunch symmetry. Fig. A.10.2 shows a screen shot of GUI showing results of online measurement of individual bunch currents and the bunch current ratio. It also shows plot of bunch currents during decay of store beam in Indus-1. Beam life time of individual bunches can be studied using the logged data.

This system is now routinely being used by Indus accelerator operation crew for adjusting the injection timings to achieve symmetric filling and recording bunch symmetry for beam related studies.

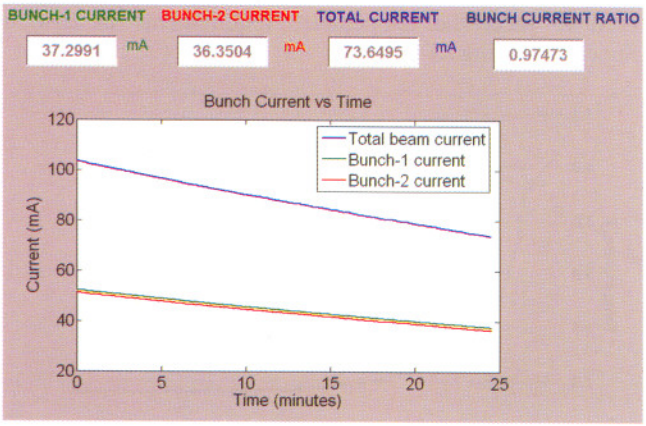


Fig. A.10.2: Screen shot showing plot of bunch currents and total beam current in Indus-1

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A.11: Development of 2 K Cryostat

A Pool type Liquid Helium Cryostat for operating down to 2 K was designed at Cryo-Engineering and Cryo module Development Section. In this cryostat, the temperature of liquid helium, which has a normal boiling point of 4.2K is brought down further by pumping over the liquid. (Cryostat is a specially designed container to keep liquids of very low temperature, typically below -150 Deg C)

This system operates under sub-atmospheric conditions. Below 2.17 K, liquid helium is in "Super Fluid" state. Properties of liquid helium, amongst others, its low viscosity, puts stringent conditions for the inner vessel integrity. Apart from efficient thermal design to minimize the heat in-leak through different mechanisms, there are several technical issues, which are to be tackled in making a cryostat of this type. One of them is the problem of cold leaks. These are leaks, which are not traceable using conventional leak detection methods at room temperature. However, as soon as the temperatures go below say 20 K, the insulating vacuum starts degrading. Due to this reason, the fabrication procedure with intermediate inspection/ testing steps needs to be worked out carefully.

Basically, there are two methods by which one can reach at 2 K or low using Liquid Helium. The first one is by pumping over the liquid bath. This method is also called "saturated temperature" type. In this method, temperature of the liquid remains constant due to the latent heat of evaporation. Heat loads only results in higher boil-off. In this method, the stability of temperature is directly linked with the stability in pressure over the bath. This method is normally used to meet the temperature requirements in case of Superconducting RF Cavities.

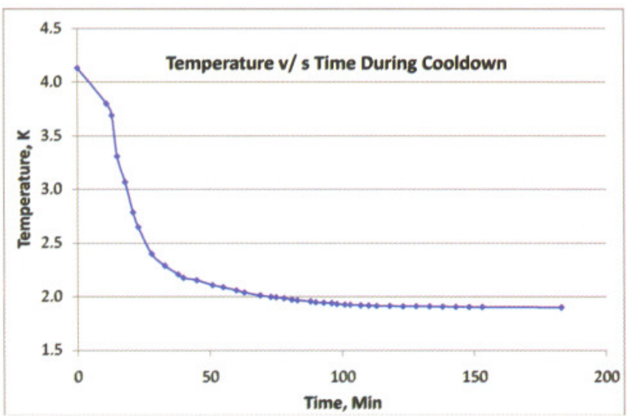

Fig. A.11.1: Cooling down from 4.2 K to 1.9K

In the second method, a portion of liquid helium at 4.2 K is separately expanded through a J-T valve, and using heat exchangers, the remaining liquid is cooled. In this method the liquid helium is in "Super Cooled state". Special cooling properties of Liquid helium at 2 K viz. Super Fluid properties - property to flow through fine capillaries and large thermal conductivity are utilised, at the same time the bulk of the liquid in the cryostat remains at pressure above atmospheric pressure. Normally, this method is used to cool Superconducting magnets operating in 2 K region. This method relaxes conditions for system integrity of the peripheral systems, i.e., in case of very small leaks, helium gas can leak to atmosphere. Limitations of this method are: in case of excessive heat load, the temperature of the liquid will start rising that gives poor temperature stability. The first case has very good temperature stability due to involvement of latent heat, but small leaks in the system will result in air and moisture entering the system, thereby limiting the reliability or operation time of the system.

Cryostat designed by us is based on the first method viz. saturated liquid type. It was fabricated by a local fabricator. It was first tested at normal liquid helium temperature (4.2 K). Heat in-leak calculated from the boil-off was less than 70 mW. These values of heat in-leak match closely with the designed values.

The 2 K Temperature was reached in about 73 min after starting the evacuation pump at 4.2 K. We started with about 08 liters of liquid in the cryostat, and when we reached 2 K it was still left with about 4.5 liters. After reaching 2 K the helium boil-off was quite low for maintaining 2 K to 1.9 K, as the self heat load of the cryostat to the 2 K liquid chamber is about 70 mW. In next two hours, less than 0.5 litres got boiled. This cryostat will be used among others, to calibrate cryogenics temperature sensors in 4.2 to 1.8 K range.

Fig. A.11.2: Experimental setup with 2 K cryostat

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A.12: Prototype solid state bouncer modulator designed and developed by RRCAT has been commissioned at CERN

A prototype solid state bouncer long pulse modulator for LEP 1MW klystrons was successfully designed, developed, tested and shipped to CERN by RRCAT under the DAE CERN Novel Accelerator Technology Project. The First acceptance tests were done at RRCAT by CERN engineers. Additional features and modifications requested by CERN team were then incorporated and tested. The modulator was then dismantled and shipped by RRCAT. RRCAT engineers completed the integration and commissioning of the