

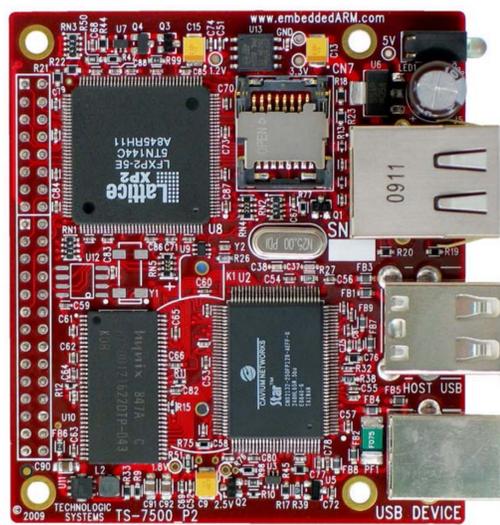
## MODULAR BEAM DIAGNOSTICS INSTRUMENT DESIGN FOR CYCLOTRONS

Niraj Chaddha\*, R.B.Bhole, Shantanu Sahoo, P.P. Nandy, Sarbajit Pal\*  
Variable Energy Cyclotron Centre, DAE, 1/AF Bidhannagar, Kolkata-700 064  
\* e-mail: nchaddha@vecc.gov.in, sarbajit@vecc.gov.in

THPD-10

### ✿ Beam Diagnostic requirements ✿

- ✦ Various beam diagnostic stations with different set of diagnostic components in all the beam regions (internal & external) of K-130 and K-500 Cyclotron).
- ✦ Different types of control & monitoring hardware requirement for each type of component.
- ✦ Requirement of unified hardware with unified control architecture with other subsystems.
- ✦ Parameters : position, intensity, beam profile, visual impression of ion beam, and operational control



### ✿ Modular Design Criteria ✿

- ✦ 32 bit ARM based Controller card &  $\mu$ C based functional cards on communication oriented backplane
- ✦ EPICS IOC (Input/ Output controller) runs on Linux embedded Controller card and EPICS OPI (Operator Interface) runs on PCs to handle communication and to control & monitor beam diagnostic components
- ✦ Modules are designed with basic functionalities like valve operation, probe/ slit/ viewer control, position read-out, Interlock, aperture control of beam line and communication
- ✦ Individual Serial port for each card for pseudo-parallel operation

### ✿ Tools Used (Hardware & Firmware) ✿

- ✦ 32 bit ARM based Controller card (TS-7500) with SD card support for storing Linux operating system
- ✦ ATMEL AVR family and C51 family controllers for functional cards
- ✦ IDEs (Instrument development Environment) like ATMEL Studio-6 and Keil-uVision 4 are used.
- ✦ Serial port programmers and In-Circuit serial programmers are used for Flash programming

### ✿ Salient Features ✿

- ✦ Customised instruments are easy to assemble according to requirement
- ✦ Modular design hence easy maintenance & upgradation, minimum downtime
- ✦ EPIC introduction has removed PC dependency
- ✦ Liberty in developing functional cards using any tool and by keeping the same command set
- ✦ Other EPICS oriented features

### ✿ Control Architecture ✿

- ✦ A distributed control system (DCS), designed in a 3-layer architecture, monitors and controls all parameters
- ✦ The client-server data communications using channel access protocol of EPICS architecture
- ✦ Defined set of PVs (Process Variables) for each beam diagnostic component operation
- ✦ The IOC (Input-Output controller) on controller card communicated with PCs to controls the diagnostic components and parameters and displayed using EPICS based (OPI) Operator Interface

### ✿ Present Status & Future Plans ✿

- ✦ SCC inflector control and RTC X-Y Slit control are operational. Main-probe instrument is under development
- ✦  $\mu$ C are being planned to be replaced by small FPGAs / CPLD (Complex programmable logic device)

✦ Presented at: Personal Computer and Particle Accelerator Conference (PCaPAC-2012), December 04-07, 2012, VECC, Kolkata