MODULAR BEAM DIAGNOSTICS INSTRUMENT DESIGN FOR CYCLOTRONS

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- 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 & µc 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
  - µC are being planned to be replaced by small FPGAs / CPLD (Complex programmable logic device)

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