Electronic Database Code Upgradation For ADITYA Experiments

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Abstract

Aditya is a medium size Tokamak (R_o = 0.75 m, a = 0.25 m) is operational since 1989 and nearly 25,000 numbers of shots have been fired till now. In order to keep track of such a large shots database, having varieties of operational as well as plasma parameters, and comparing them within a minimum possible time, an electronic database was developed in 2003, using Matlab programming tool. Sufficiently large numbers of plasma parameters as well as some of the control parameters (input) were chosen for comparing shots and they were recorded in a file. While using this database over a period of time, we realized some of the shortcomings of the database software. The major problems were identified as (i) any change in physical channel number for particular signal would require change in the software program (ii) change in hardware, such as amplifier gain would again require change in the program etc. In order to eliminate those problems and make the software more reliable, efficient and user friendly, we have recently modified the code by (i) introducing logical channel number instead of earlier physical channel number to avoid any problem related to change in digitizer or channel of a particular signal (ii) replacing constant values, used for some important input parameters as well as calibration factors with variables to improve performance and flexibility. In addition to that recently shot to shot information regarding calculated value of edge safety factor (q) was also introduced in the electronic database. The input parameters of edge safety factor like minor and major radius of the plasma was obtained from plasma position measurements. The modified program has been successfully tested for comparing a large number Aditya discharges for various plasma parameters such as maximum plasma current, duration, flat-top plasma duration, average loop voltage at I_p flat-top, plasma resistance during flat-top, minimum edge safety factor (q), hard X-ray status according to their energy level etc for particular shot. The details of the program development, testing procedure and finally comparison list for some Aditya discharges will be presented in this work.

Motivation

- To introduce and use of logical channel number as well as to replace constants with variables in database software to produce ensured error-free summarized result irrespective of any change in position of acquisition channels or digitizers configuration
- To enhance the database by providing edge safety factor (q) value
- To provide flexibility, long term support and easy maintenance to incorporate further modification as per the requirements of future diagnostic inclusion and/or experiments.

Introduction

- ADITYA
  - Medium size tokamak with major & minor radius 75 & 25 cm
  - No. of discharges a day ~ 20-25
  - Shot duration ~150-200 ms
  - Data acquisition channels ~232
  - Sampling rate up to 1 μ sec
  - Data can be accessed on any PC on Intranet

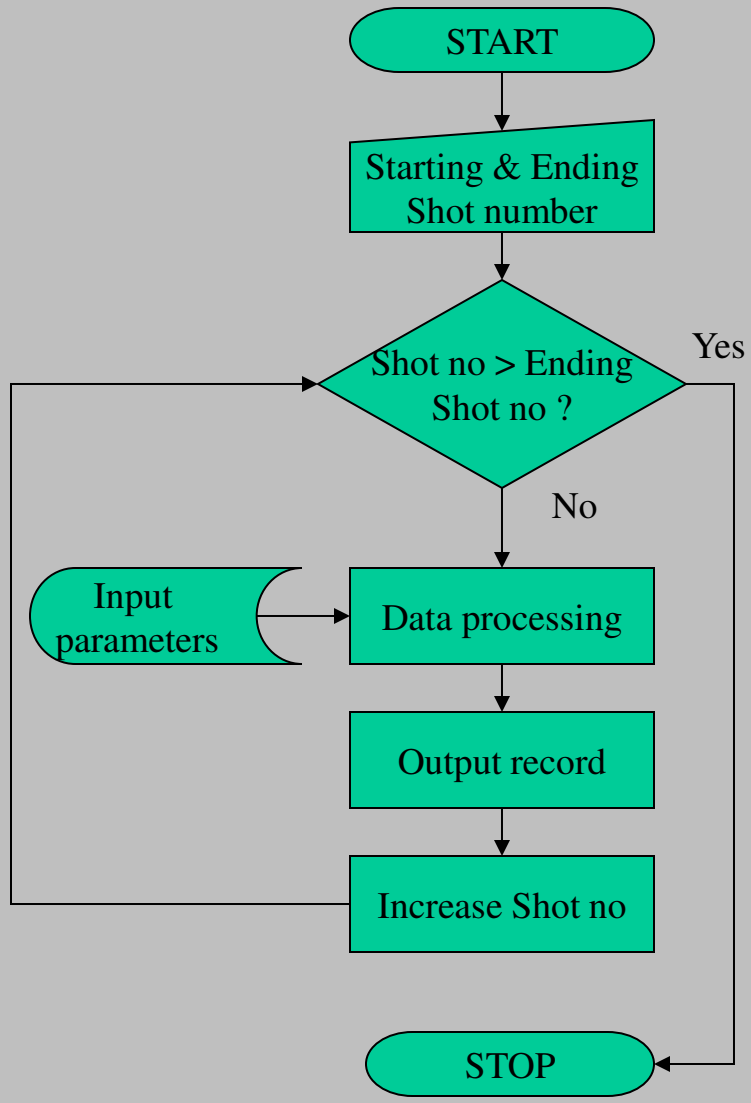
- Electronic Database
  - Plasma parameters
  - Edge safety factor (q)

- Logical channel
  - Unique number assigned on physical channel
  - Channel data
  - Configuration

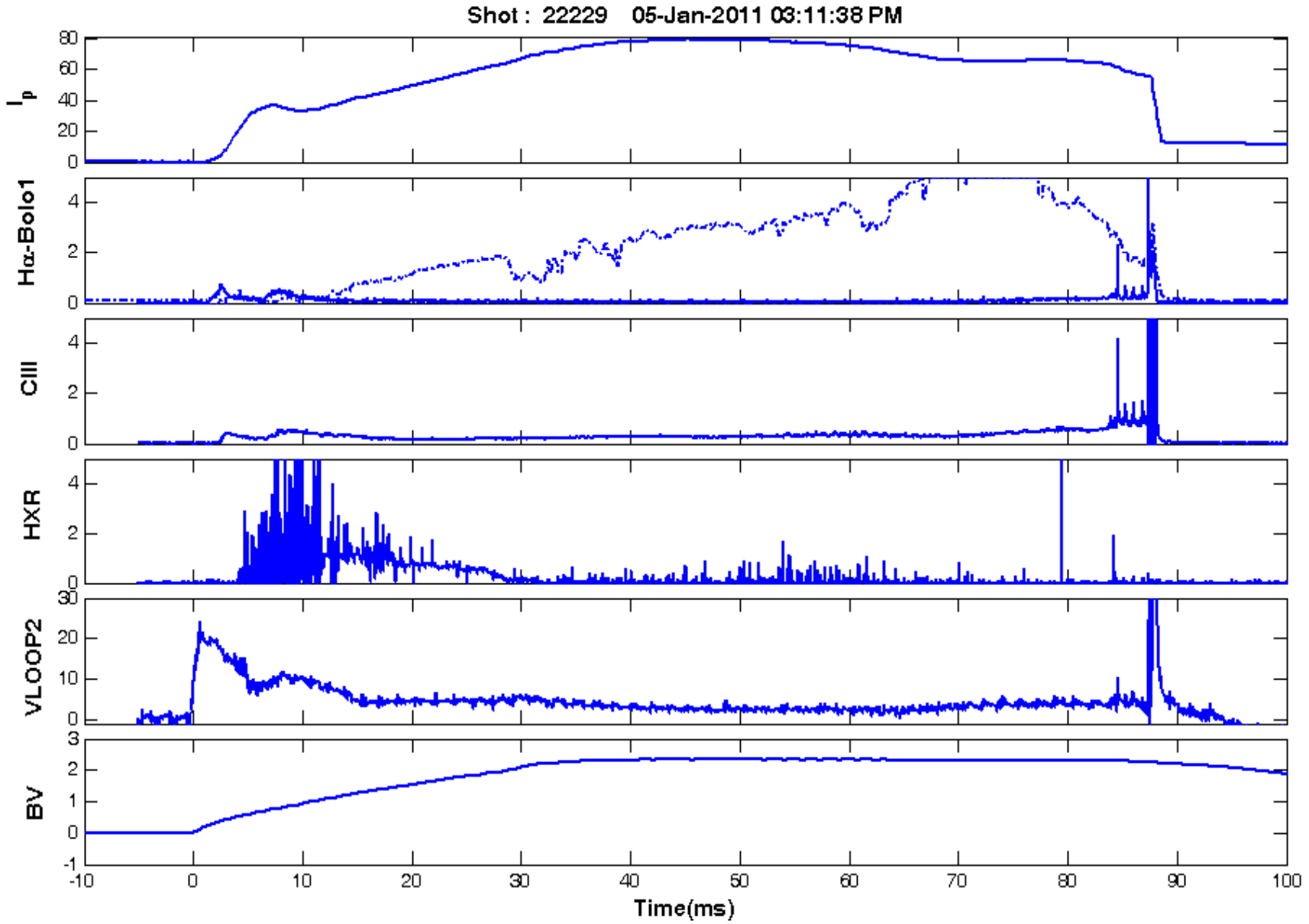
Database Code - Flow chart and Input Output

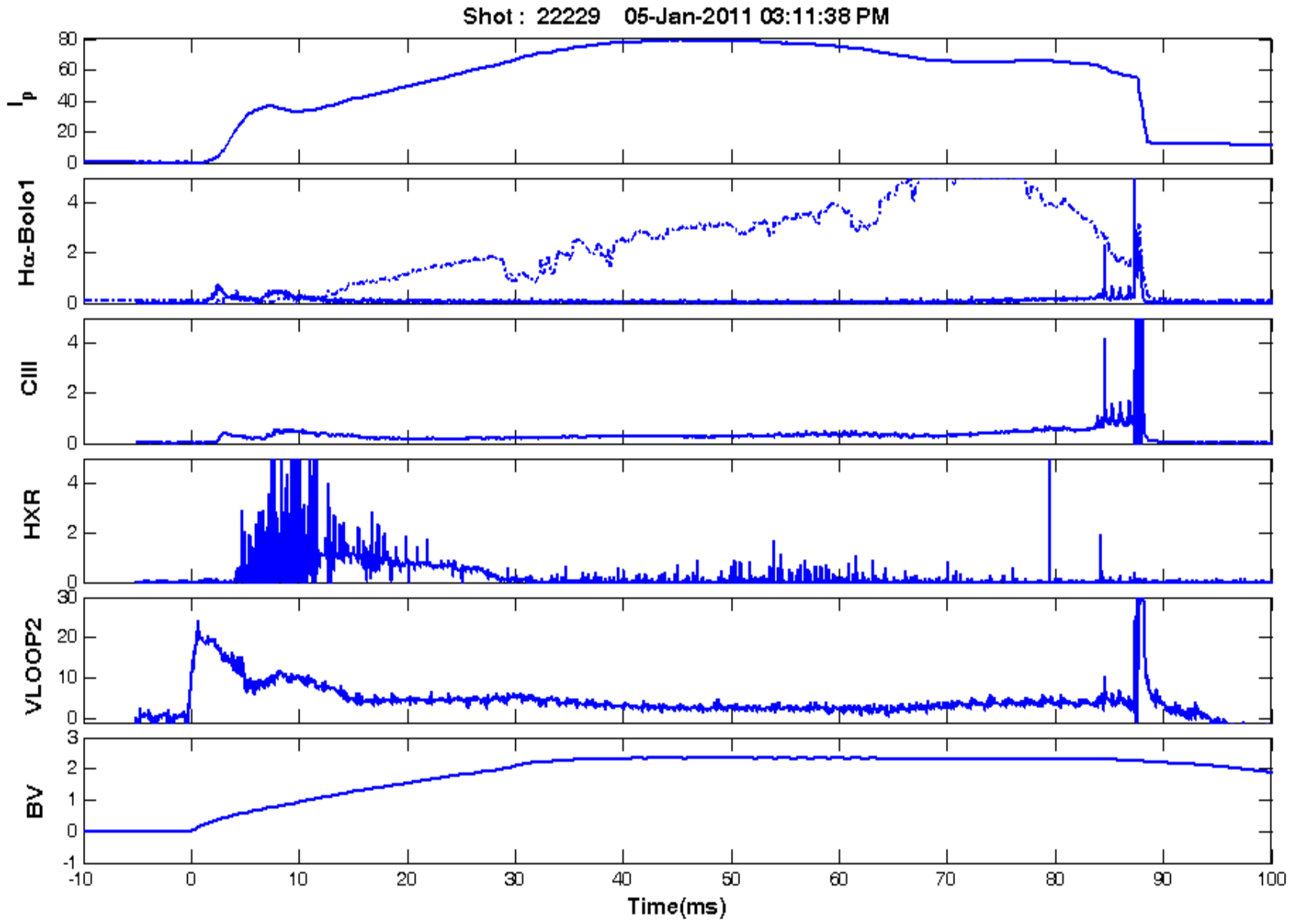
- **Input parameters**
  - Obtained from various diagnostics
  - Rogowski coil for plasma current measurement
  - Voltage loop for loop voltage
  - Toroidal field value (Gauss)
  - Position probes for Plasma position
  - Optical detectors for Hα
  - Hard X-rays
  - Logical channel information

- **Output - Plasma parameters**
  - Maximum I_p value (kA)
  - Duration (msec)
  - Average loop voltage (V) at I_p flat-top
  - I_p flat-top duration (msec)
  - Flat-top plasma resistance (μΩ)
  - Total area under I_p profile (Amp*sec)
  - Minimum value of Edge safety factor (q_{min})
  - Hard X-Rays status according to their energy level (Low,Medium,High,Full)
  - Discharge status (No Discharge,Small,Disrupted,Normal)

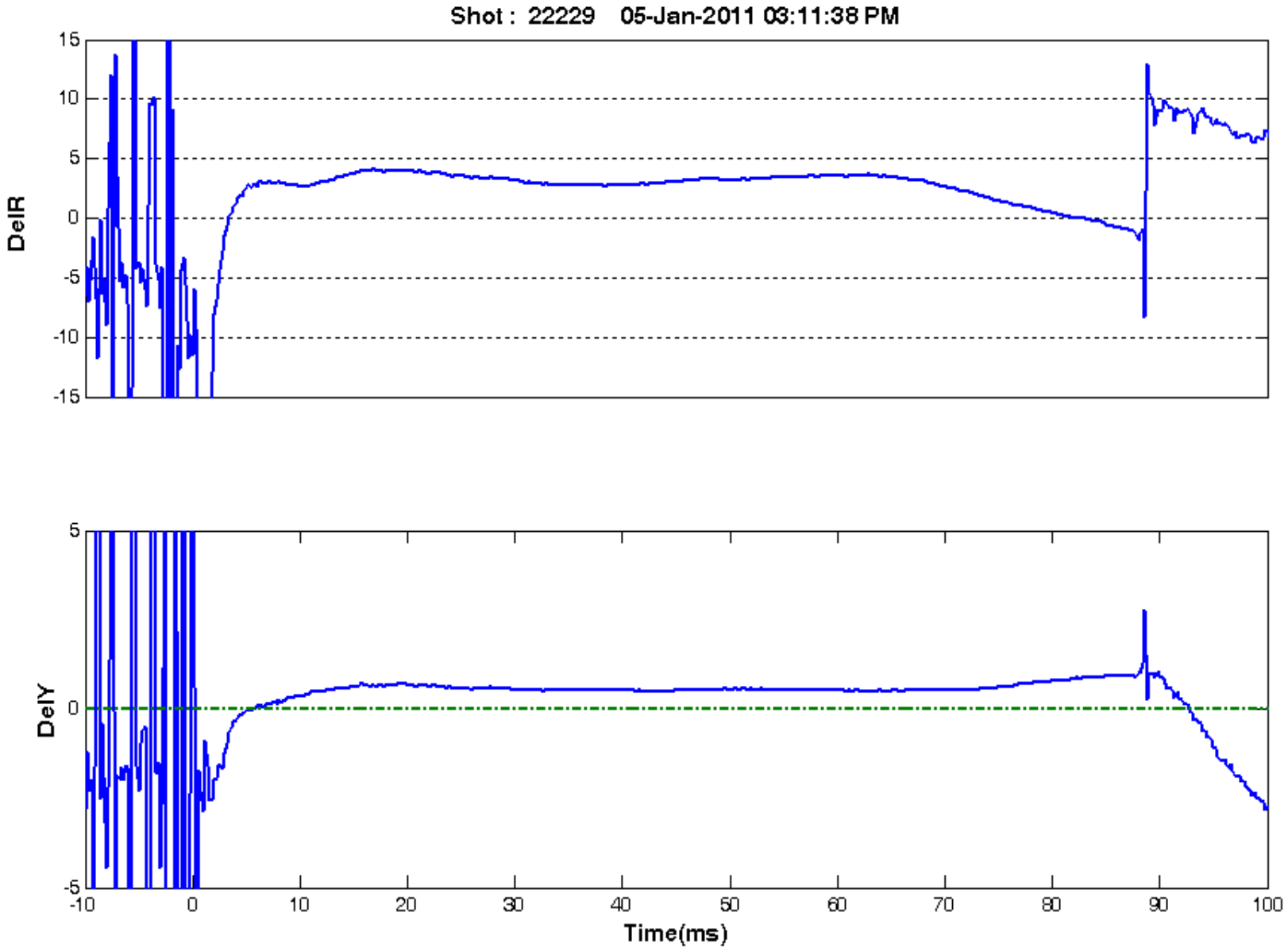


Aditya Discharge Data

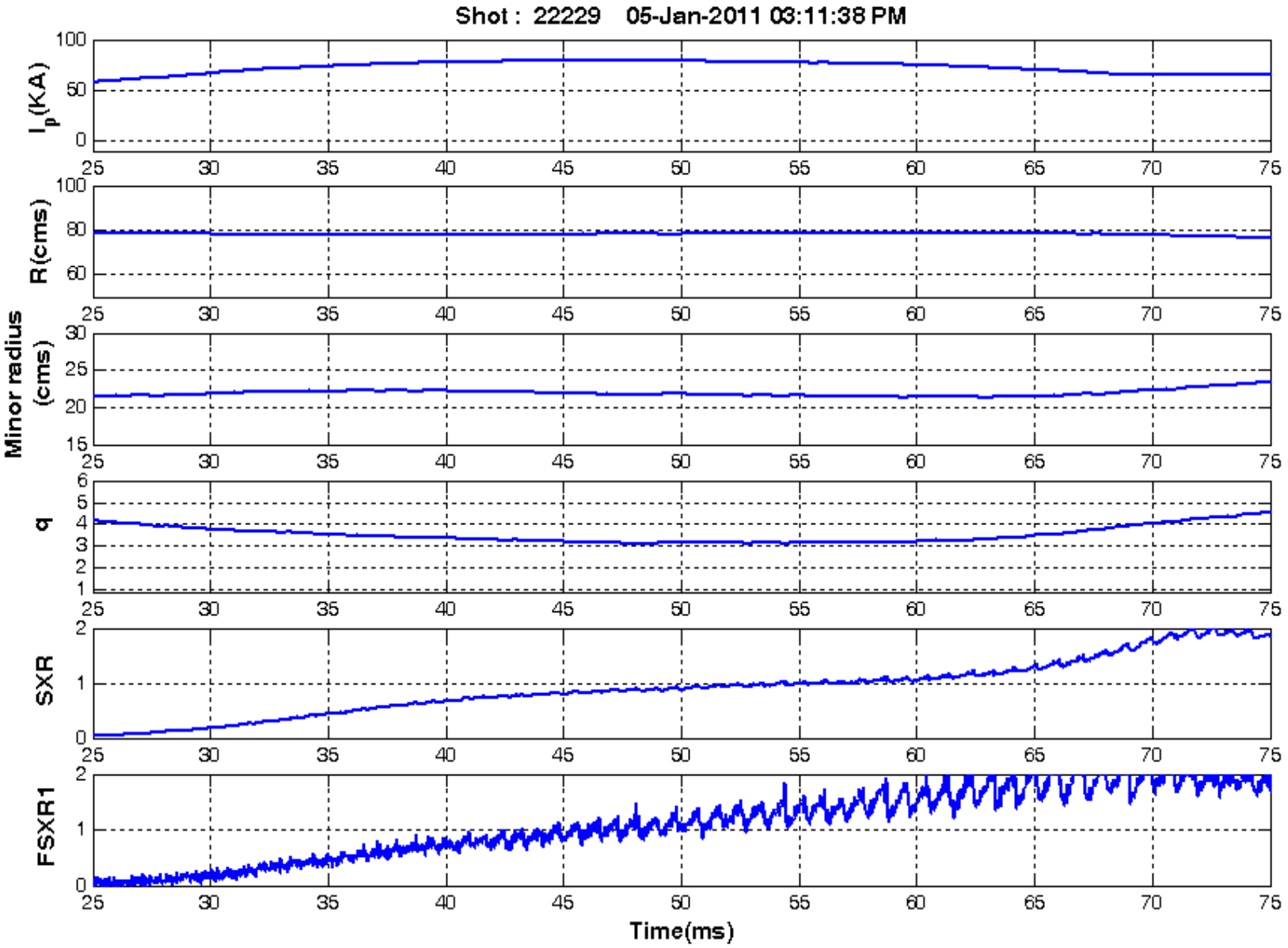



Shot : 22229 05-Jan-2011 03:11:38 PM
I_p
Hα-Bolo1
CIII
HXR
VLOOP2
BV
Time(ms)

Plasma Position Data



Plasma Parameters (Graphical view)



Output – Electronic Database

shot_no	Max Ip (kA)	Time (ms)	V_F.T (V)	T_F.T (ms)	R (micro-ohm)	I_p*T (kA*ms)	Min_q	Remarks
22221	83.1	90.6	2.6	28.8	31.7	5763	3.03	Normal shot,Low HXR
22222	81.0	99.2	2.5	50.2	32.2	6337	3.62	Normal shot,High HXR
22223	72.0	22.2	0.0	0.0	0.0	801	4.09	Small discharge
22224	78.0	107.8	2.2	50.4	29.6	6487	3.43	Normal shot,High HXR
22225	76.5	106.4	2.5	41.0	34.2	6182	3.71	Normal shot,High HXR
22226	76.0	100.2	2.3	48.0	31.4	6046	3.72	Normal shot,High HXR
22227	57.7	40.4	6.7	21.0	129.5	1725	3.70	Disruption,Low HXR
22228	85.4	63.4	2.8	24.2	33.6	3754	2.78	Disruption,Low HXR
22229	79.0	87.8	2.8	30.2	36.7	5325	3.10	Normal shot,Low HXR

Benefits

- ✓ Easy access, no need to know location, format of physical channel data
- ✓ User can easily search shots of their particular interest on their own computer without looking in manual data entry logbook
- ✓ A summarized remark with measured parameters for each shot
- ✓ No need to change in database code in case of change of channel location

Limitations

- Attentive changes in configuration file is required in case of any change in channel location
- Channel shifting/mixing problem due to hardware problem could lead to generate wrong result
- Wrong input information generates mis-leading result
- Coding is required if new type of acquisition module introduced

Conclusion

Electronic database code for ADITYA discharge data has been successfully upgraded by using logical channel number and by replacing variables in place of constants.

The output of the upgraded database has been tested with more than 5000 discharges and showed good agreement with actual discharge characteristics.

The code has been made flexible enough to incorporate further modifications as per the requirements of future diagnostic inclusion and/or experiments