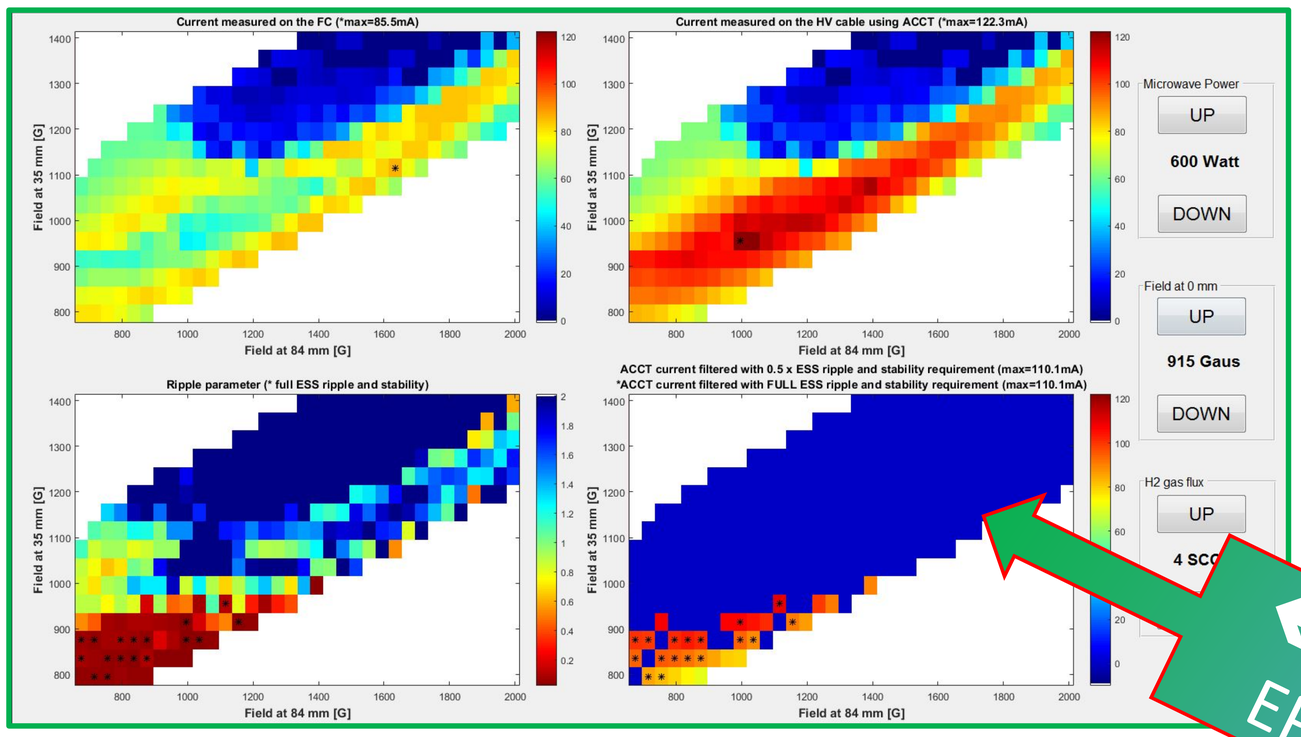
HIGH LEVEL CONTROL SYSTEM CODE WITH AUTOMATIC PARAMETRIC CHARACTERIZATION CAPABILITIES

L. Neri†, L. Celona, S. Gammino,

Istituto Nazionale di Fisica Nucleare – Laboratori Nazionali del Sud, Catania, Italia

Several degree of freedom have been introduced in the design of the proton source (named PS-ESS) and in the Low Energy Beam Transport line (LEBT) developed at INFN-LNS for the European Spallation Source (ESS) project. The beam commissioning was focused on the most important working parameters in order to optimize the beam production performance taking into account the ESS accelerator requirements. The development of a MATLAB custom code able to interact with the EPICS control system framework was needed to optimize the short time available for the beam commissioning. The code was used as an additional high level control system layer able to change all source parameters and read all beam diagnostics out-put data. More than four hundred of thousand configurations have been explored in a wide range of working parameters. The capability to connect Matlab to EPICS enabled also the developing of a genetic algorithm optimization code able to automatic tune the source towards a precise current value and stability. A dedicated graphical tool was developed for the data analysis. Unexpected benefit come out from this approach that will be shown in this paper.



MATLAB CHANNEL ACCESS TO EPICS

Guide: https://github.com/EPICSTools/mca/blob/master/README_WIN7.txt

Matlab can interact with EPICS by using three simple functions:

- **pvhandle=mcaopen(pvname);** acronym of Matlab channel access open, that open the link to the process variable on the host epics environment of the source control system.
- **pvvalue=mcaget(pvhandle);** acronym of Matlab channel access get, that provide the value of the process variable in the epics environment.
- **[]=mcaput(pvhandle,value);** acronym of Matlab channel access put, that insert a value in the process variable of the epics environment.

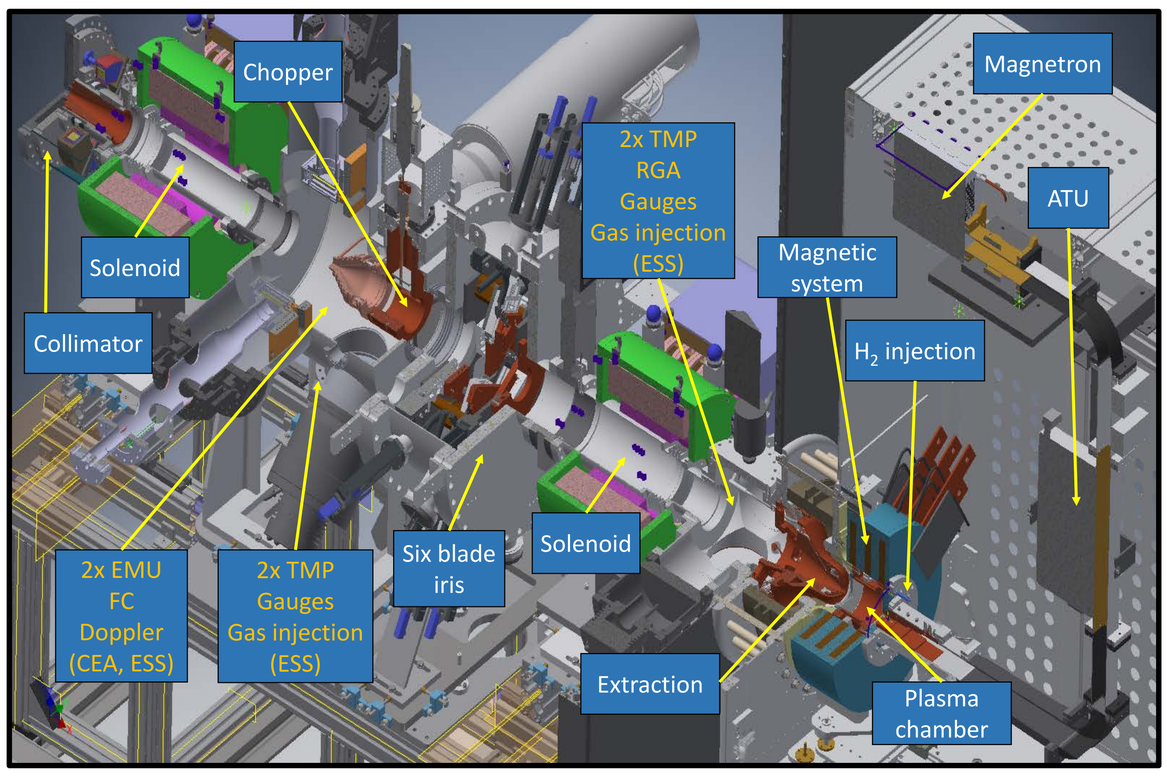
Only three functions were enough for the design of a higher control system level able to enhance the human interaction with the machine.

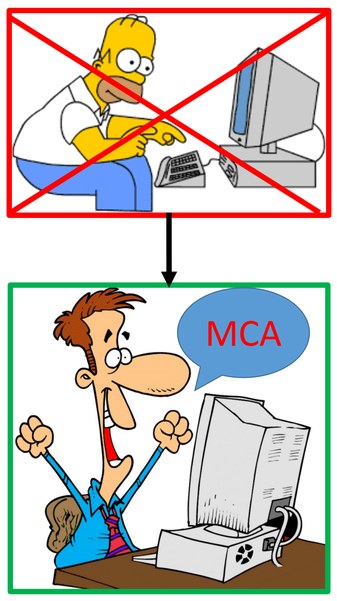
Plasma modelling ➔
parameters range to be tested:

Field @ 0 mm ==> 835:20:975 Gauss
Field @ 35 mm ==> 795:40:1395 Gauss
Field @ 84 mm ==> 675:40:1995 Gauss
H2 flow ==> 2:1:5 SCCM
RF power ==> 600:200:1200 Watt

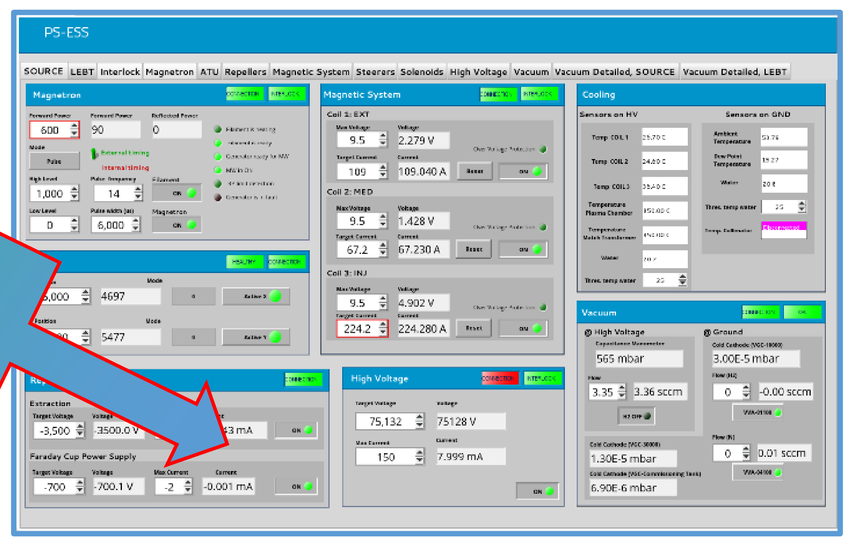
40192 configurations for each mechanical setup were tested

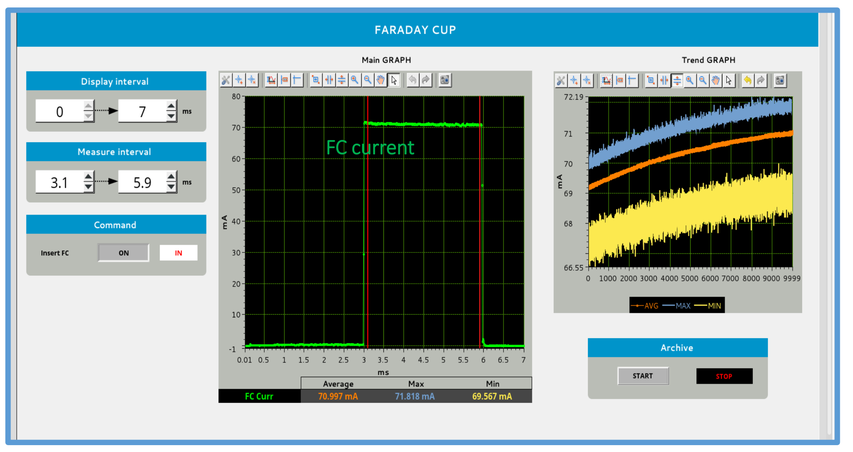
With Matlab Channel Access to EPICS it was possible the design of different codes that were used for an intensive, precise and automatic characterization of the source.
Capability to change source parameters and read the measurement equipment output enable an impressive improvement in the quality of the source commissioning. A huge amount of configuration were tested (more than 400˙000) providing the capability to identify different source configurations that fully satisfy the ESS accelerator requirements. A clear view of the parameters effect on the beam production was obtained improving the understanding of the source behaviour.
Same result would not be possible with only a standard control system.

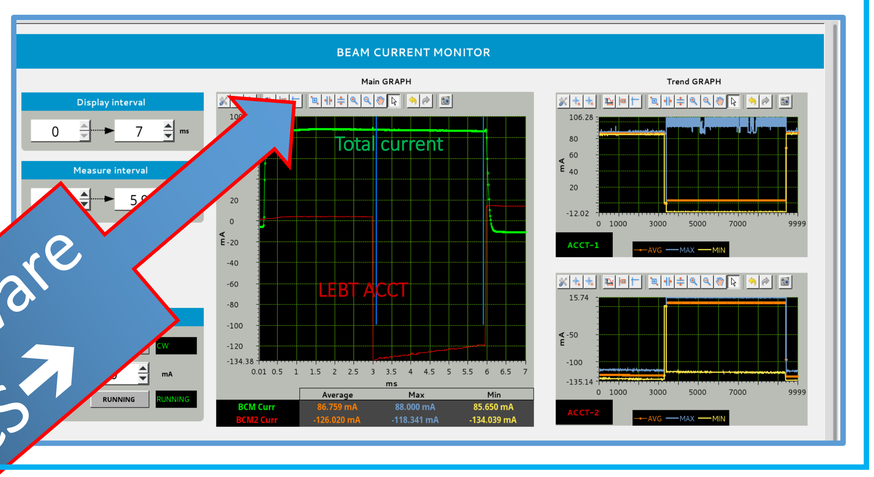




Matlab ➔ EPICS







Hardware ➔ EPICS