

SLICE EMITTANCE MEASUREMENT PROCEDURE

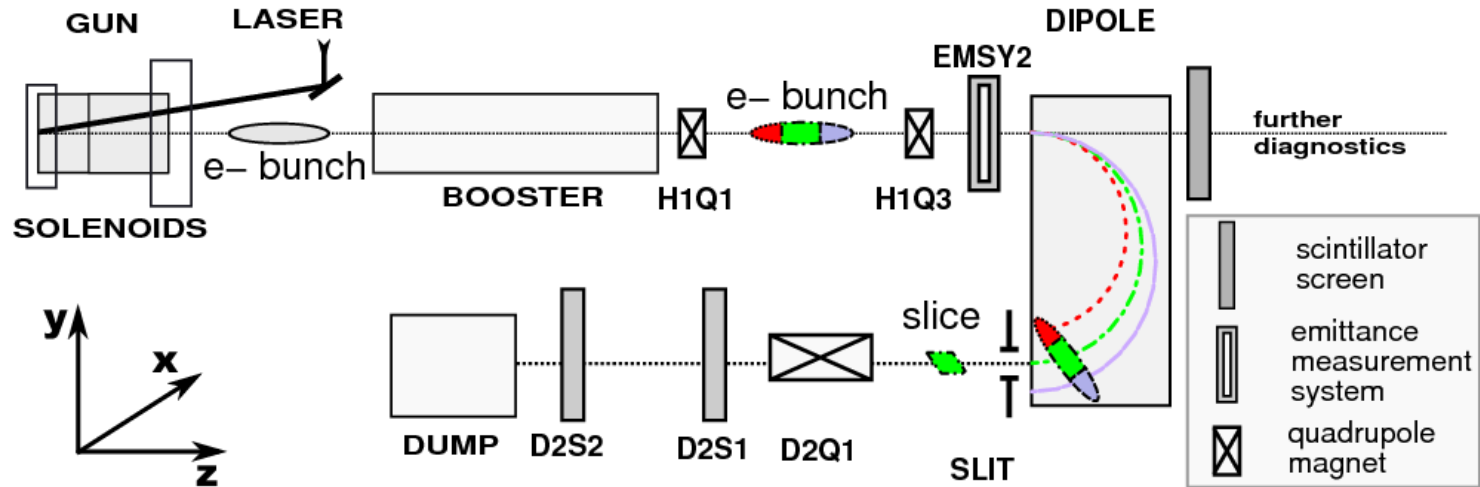


Yevgeniy Ivanisenko
PITZ Physics Seminar,
21 12 2012

- **Slice emittance measurement setup**
- **General scheme of slice emittance measurements**
- **Detailed step-by-step instruction**
- **On-line data analysis**
- **Summary**

> Operation principles:

- Nominal setup of the gun
- The booster in off-crest phase: induces an energy chirp of the beam
- Rotation of bunches in the dipole: turns the momentum distribution (correlated to the longitudinal) into a transverse one.
- A vertical slit picks up a transverse slice of the bunch and emittance of this bunch fraction is analyzed using quadropole or slit scans.



- **Data taking preparation in three steps**
- **The measurement protocol is required to start the automatic data collection procedure (Musthaves)**
- **Data collection procedure will take one data set for each dipole current. Each set can be analyzed separately.**

Fill in the measurement protocol

Set up the LE section

- Characterize the cathode laser
- Measure on-crest phase
- Use an established trajectory

Set up the HE section

- Measure on-crest phase
- Shift the phase to off-crest
- Adjust the trajectory in HEDA

Define the scan ranges

- Dipole current range
- Quad (slit) scan ranges
- Number of laser pulses

Start automatic data collection procedure

Make on-line analysis of the data

- **Input of 38 parameters is required**
 - A counter for convenience is introduced in the bottom part
 - More important: if not all fields are filled in the data taking program will complain and abort execution.

MUSTHAVES!

- **Download from web**
 - In linux terminal
`wget http://www.ifh.de/~ivanis/stuff/meas_prot.ods`
- **Open with OpenOffice and fill in**
- **Save as csv file with default settings**
- **Don't forget the file name you give it**

	A	B	C	D	E	F	
1	DATE						
2	SHIFT						
3	SHIFT CREW	Leader	Operator	Other persons			
4							
5	Comments						
6							
7	Laser	Please, don't forget to save obtained profiles in the appropriate folders					
8	Long. Shape	Type	Rise [ps]	FWHM [ps]	Fall [ps]	Modulations	
9							
10	Transv. Shape	BSA diameter	xmean VC2	ymean VC2	xrms VC2	yrms VC2	
11							
12	Comments						
13							
14	Charge adjustment before LEDA measurement @ FCL				Charge [nC]	RMS	
15							
16							
17	Gun Phase	SPPHase	Value	Error	Statistics		
18	MMMG						
19	MMS						
20	Comments						
21							
22	Booster Phase	SPPHase	Value	Error	Statistics		
23	MMMG						
24	MMS						
25	Comments						
26							
27	Beam size	lmain_min	lmain_max	Scan			
28	Disp2_Scr1						
29	High1_Scr3	0	0				
30	High1_Scr5	0	0				
31							
32	Slice emittance section						
33	BooPh off phase	MeasType	lmain [A]	Disp2_Scr2 scan		Lens F	
34							
35							
36	Dimple Current [A]	off start	off stop	off dete	No P	Emittance	
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49	input fields to fill in					38	

```
[ 12-12-06 18:23 blade83 ] ~AFS/programming/py3dec $ wget http://www.ifh.de/~ivanis/stuff/meas_prot.ods
--2012-12-06 18:23:34-- http://www.ifh.de/~ivanis/stuff/meas_prot.ods
Resolving www.ifh.de... 141.34.27.11
Connecting to www.ifh.de[141.34.27.11]:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 21258 (21K) [application/vnd.oasis.opendocument.spreadsheet]
Saving to: `meas_prot.ods'
```

100%[=====>] 21,258 ---K/s in 0s

> Start the data taking procedure

```
[ 12-12-12 17:35 blade83 ] SliceEmittance/20121212/lmain_394A $ slemquad HEDA HEDA meas_prot_1.csv
```

```
[ 12-12-12 17:35 blade83 ] SliceEmittance/20121212/lmain_394A $ slemslit HEDA HEDA meas_prot_1.csv
```

Shortcuts for device names

slemQS:

- HEDA (1) = HIGH1.DIPOLE
- HEDA (2) = DISP2.Q1

slemSS:

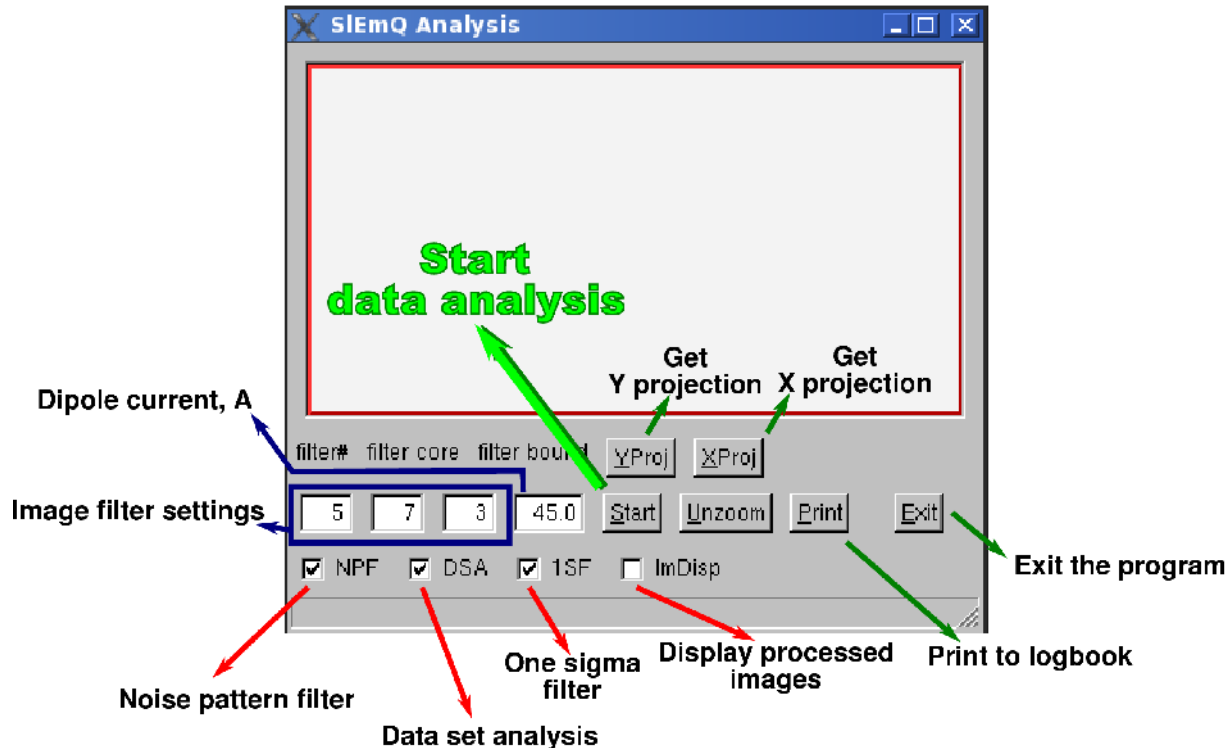
- HEDA (1) = HIGH1.DIPOLE
- HEDA (2) = HIGH1.EMSY2X

- > The procedure can be interrupted at any time by **Ctrl+c**, if restarted it will start from the point two steps before the interrupt has occurred.
- > If an IL is detected the procedure stops and waits for operators to confirm that the situation is stable and the measurement can be continued.

> In the directory a new folder is created for each dipole current. Choose one of those and start in it

```
[ 12-12-12 17:35 blade83 ] SliceEmittance/20121212/lmain_394A/HIGH1.DIPOLE_CurSP_-83.5A $ slemanq
```

```
[ 12-12-12 17:35 blade83 ] SliceEmittance/20121212/lmain_394A/HIGH1.DIPOLE_CurSP_-83.5A $ slemans
```



> Push start button and wait until finished. All relevant messages will appear in the terminal.

> Output to the terminal window and files

```

12-12-17 9:09 blade83 ] ~DMEA/20110516M/ph-30Imain380A/HIGH1.DI POLE_CurSP_-83.0A $ It
total 18255
-rw-r--r-- 1 ivanis pitz      3687 Dec 17 09:09 emDistr.root
-rw-r--r-- 1 ivanis pitz       264 Dec 17 09:09 emittance.res
-rw-r--r-- 1 ivanis pitz        34 Dec 17 09:09 emittance_stat.res
-rw-r--r-- 1 ivanis pitz        72 Dec 17 09:09 fitCurve.res
-rw-r--r-- 1 ivanis pitz       586 Dec 17 09:09 slice.res
-rw-r--r-- 1 ivanis pitz      1158 Dec 17 09:09 res.res
drwxr-xr-x 2 ivanis pitz      2048 Dec 17 08:57 old_res
-rw-r--r-- 1 ivanis pitz      8413 Aug 23 2011 sliceFit0.eps
-rw-r--r-- 1 ivanis pitz    171875 Aug 23 2011 qscanSP_HIGH1_Q3_-0_500A_proc.imc
-rw-r--r-- 1 ivanis pitz    166130 Aug 23 2011 qscanSP_HIGH1_Q3_-0_580A_proc.imc
-rw-r--r-- 1 ivanis pitz    160691 Aug 23 2011 qscanSP_HIGH1_Q3_-0_660A_proc.imc
-rw-r--r-- 1 ivanis pitz    157154 Aug 23 2011 qscanSP_HIGH1_Q3_-0_740A_proc.imc
-rw-r--r-- 1 ivanis pitz    155057 Aug 23 2011 qscanSP_HIGH1_Q3_-0_820A_proc.imc
-rw-r--r-- 1 ivanis pitz    154260 Aug 23 2011 qscanSP_HIGH1_Q3_-0_900A_proc.imc
-rw-r--r-- 1 ivanis pitz    147058 Aug 23 2011 qscanSP_HIGH1_Q3_-0_980A_proc.imc
-rw-r--r-- 1 ivanis pitz    147764 Aug 23 2011 qscanSP_HIGH1_Q3_-1_060A_proc.imc
-rw-r--r-- 1 ivanis pitz    144596 Aug 23 2011 qscanSP_HIGH1_Q3_-1_140A_proc.imc
-rw-r--r-- 1 ivanis pitz    141641 Aug 23 2011 qscanSP_HIGH1_Q3_-1_220A_proc.imc
-rw-r--r-- 1 ivanis pitz    140408 Aug 23 2011 qscanSP_HIGH1_Q3_-1_300A_proc.imc

```

```

[ 12-12-17 9:09 blade83 ] ~DMEA/20110516M/ph-30Imain380A/HIGH1.DI POLE_CurSP_-83.0A $ cat emittance_stat.res
Emittance = 0.440619 +- 0.0248421

```


- **More careful image processing, therefore requires longer processing time.**
 - Done with the same tool, a different configuration file

That's it

- **More careful image processing, therefore requires longer processing time.**
 - Done with the same tool, a different configuration file

That's it*

***except**

- The whole stuff is not yet available for pitzop :(
- Refer to expert documentation for more development information.