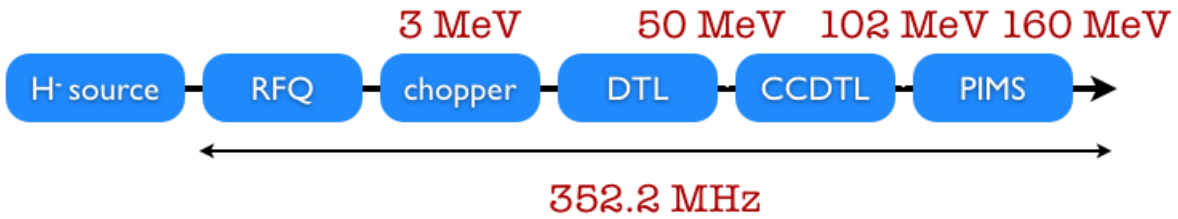


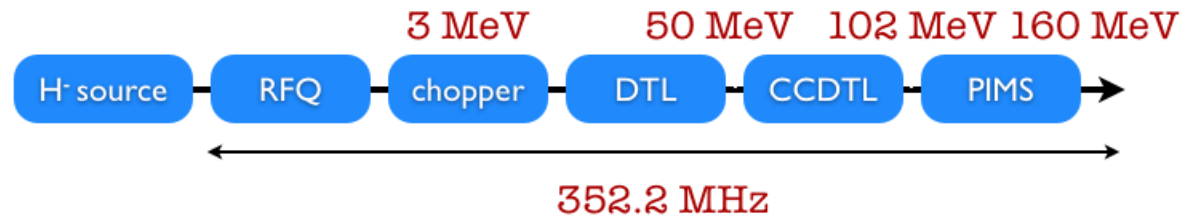
Instrumentation for the new H⁻ Source Test Bench

Linac-4 Ion Source Review 2011
Uli Raich CERN BE/BI

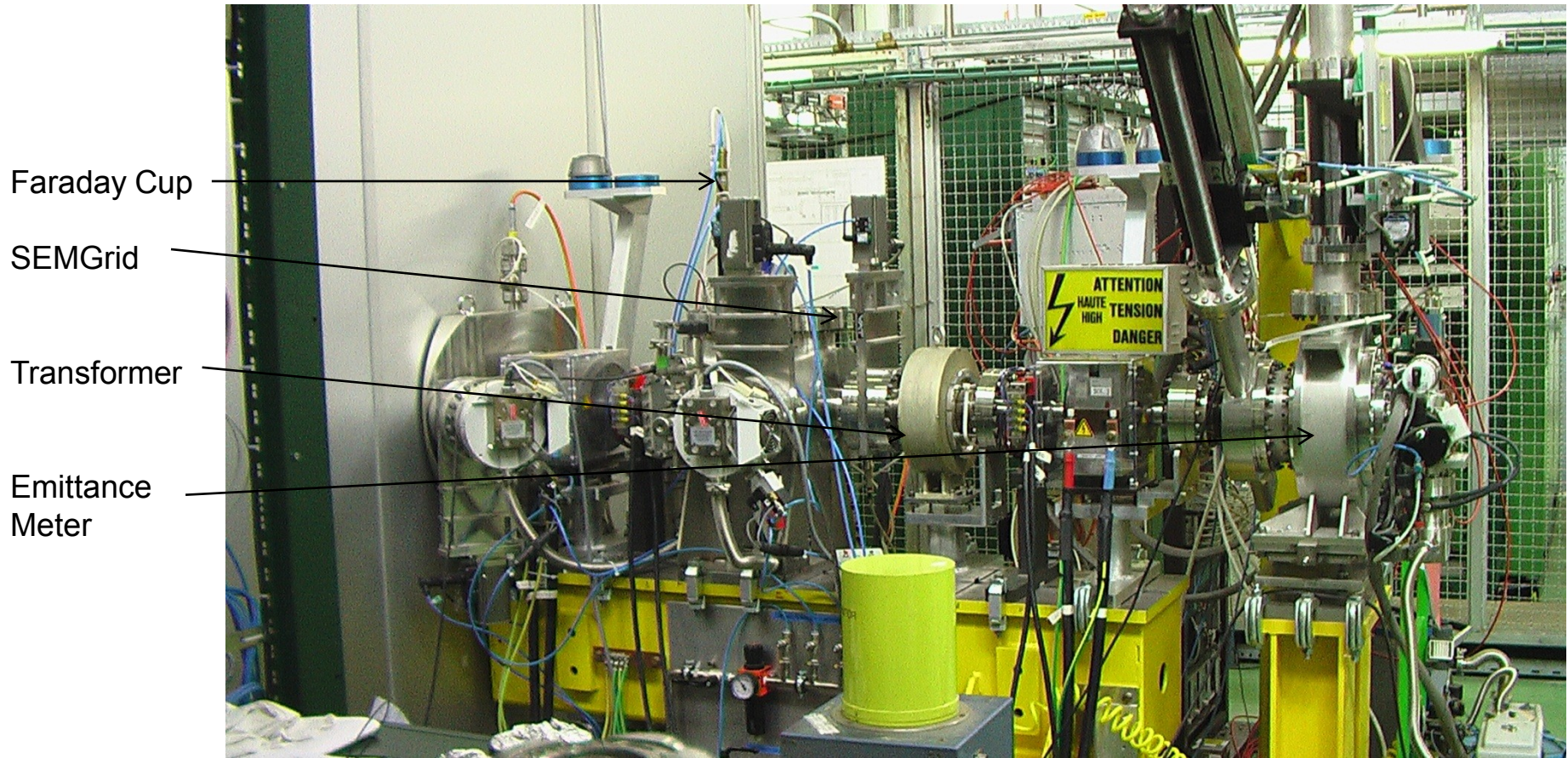


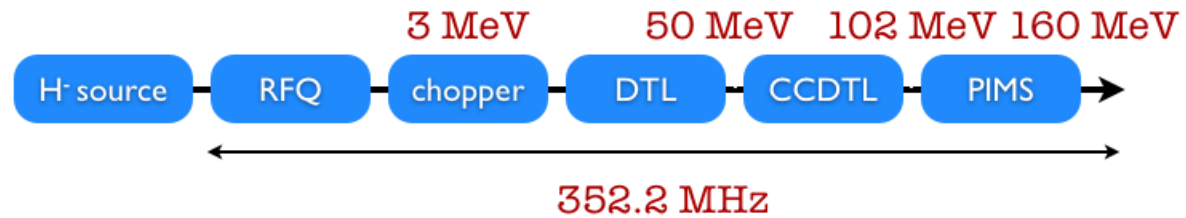
Parameters to be measured

- Beam intensity
- Transverse Profile
- Transverse Emittance
- Energy Spread



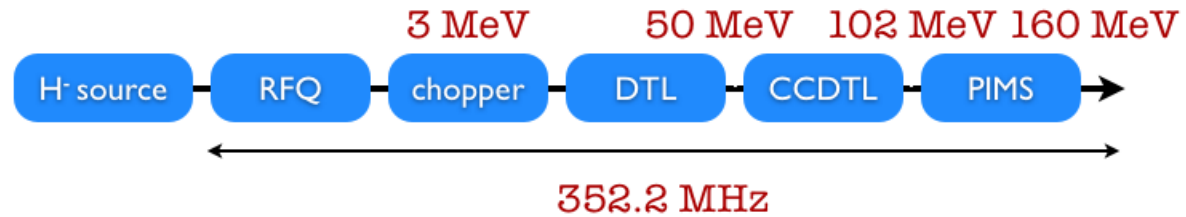
Instrumentation at current test bench



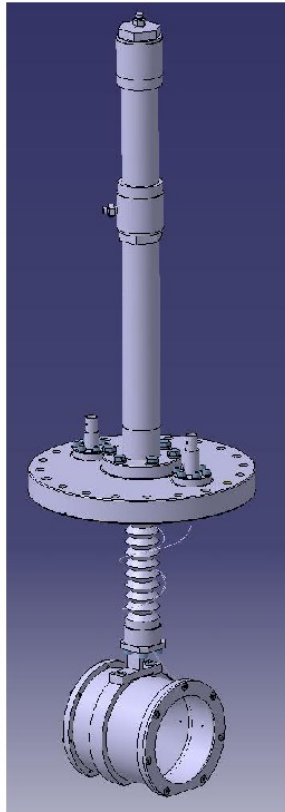


Installed Instruments

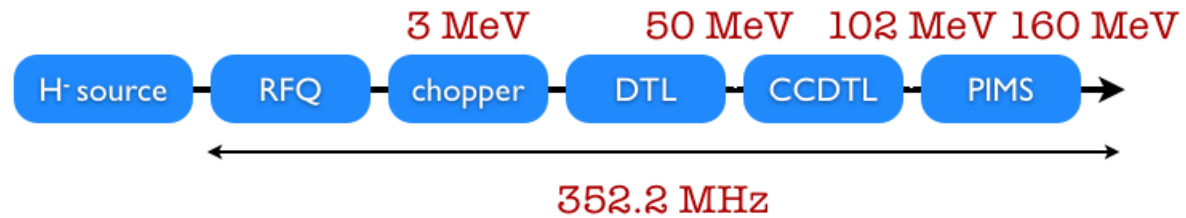
- Faraday Cup
 - Measures intensity
 - Used as beam stopper
 - Readout only with oscilloscope
- SEMGrid with 20 wires
 - 1mm wire distance in the center
- Beam transformer
 - Sampled at 10 MHz
- Emittance meter + Faraday Cup



Faraday Cup

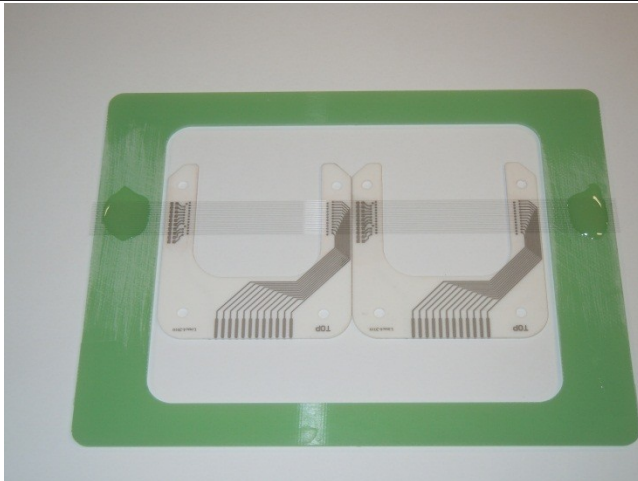
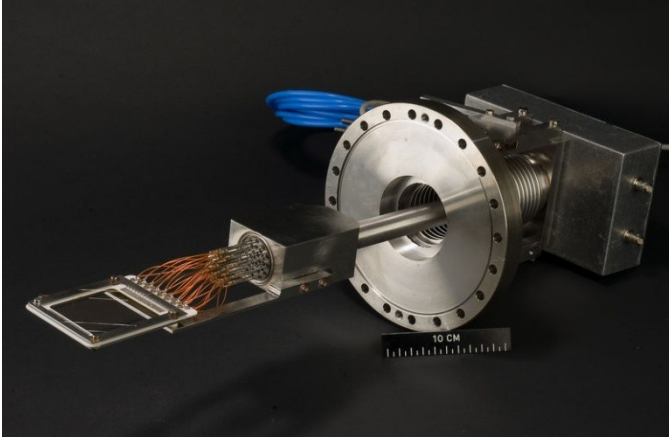
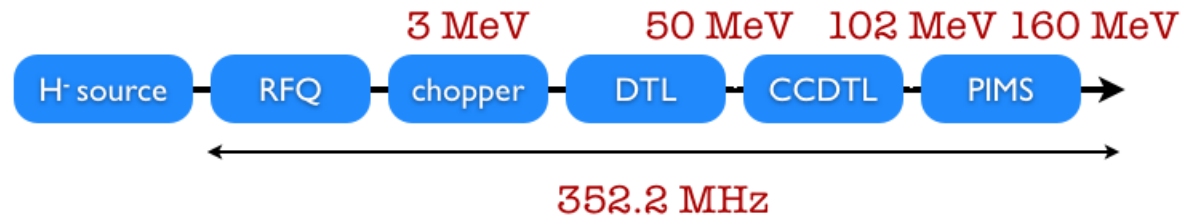


- Source intensity measured by a retractable Faraday Cup
- Secondary electron emission are suppressed by polarization voltage which also eliminates parasitic electrons created in the source
- Pneumatic in/out mechanism on PLC like LEIR is available and controlled by a knob
- Oscilloscope is used for signal observation
- For final operation a 1 MHz sampling ADC is foreseen



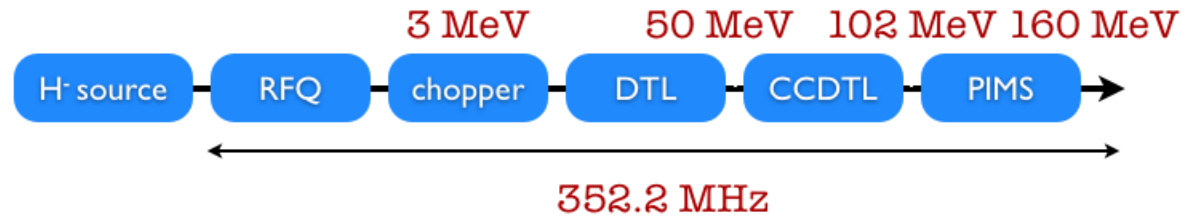
Energy Spread

- On the current test stand we used a spectrometer magnet + SEMGrid
- The spectrometer will be used for a short time in the L4 tunnel and will be free afterwards
- For the new test stand a 45 kV floating FC is under discussion
 - Needs new design
 - Electronics and program to do energy scan

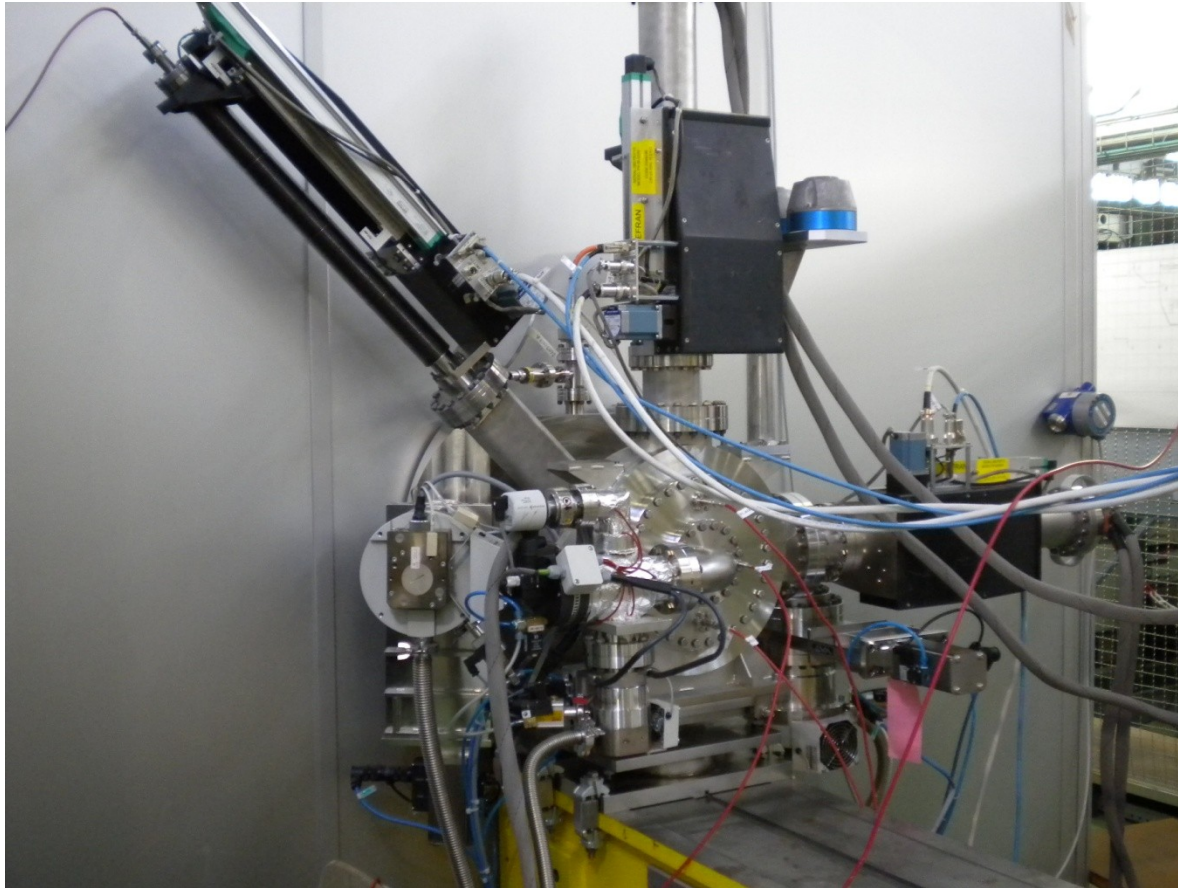


SEMGrids for Profile Meas.

- SEMGrid resolution: up to 0.5mm, up to 36 wires
- New analogue electronics for 36 under design
- Needs time resolved measurements (200 kHz)
- New VME readout card has been developed (36 channels), series of 50 cards have been produced
- In/out mechanism by motor with PLC control



Transverse Emittance Measurement



Slit and grid phase space scanner

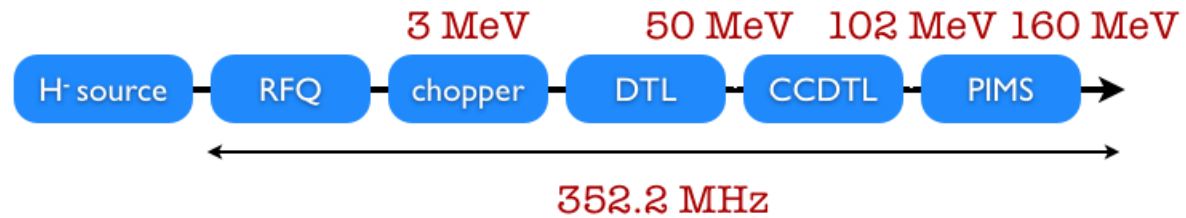
L-shaped 0.1mm slit moves under 45 degrees

Slit and grids move independently
Positioning precision: 50 μm
Movement PLC controlled

Slit and grids mounted in 2 independent vacuum boxes which can be separated

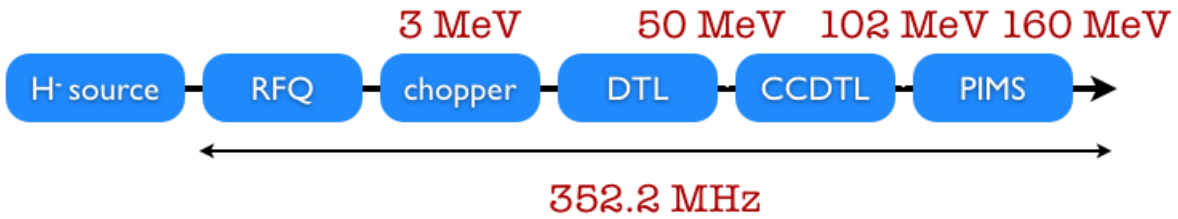
Horizontal and vertical SEMGrid

- wire distance .75 mm
- 30 signal wires
- readout with home built 36 channel 250 kHz ADC
- time resolved profiles

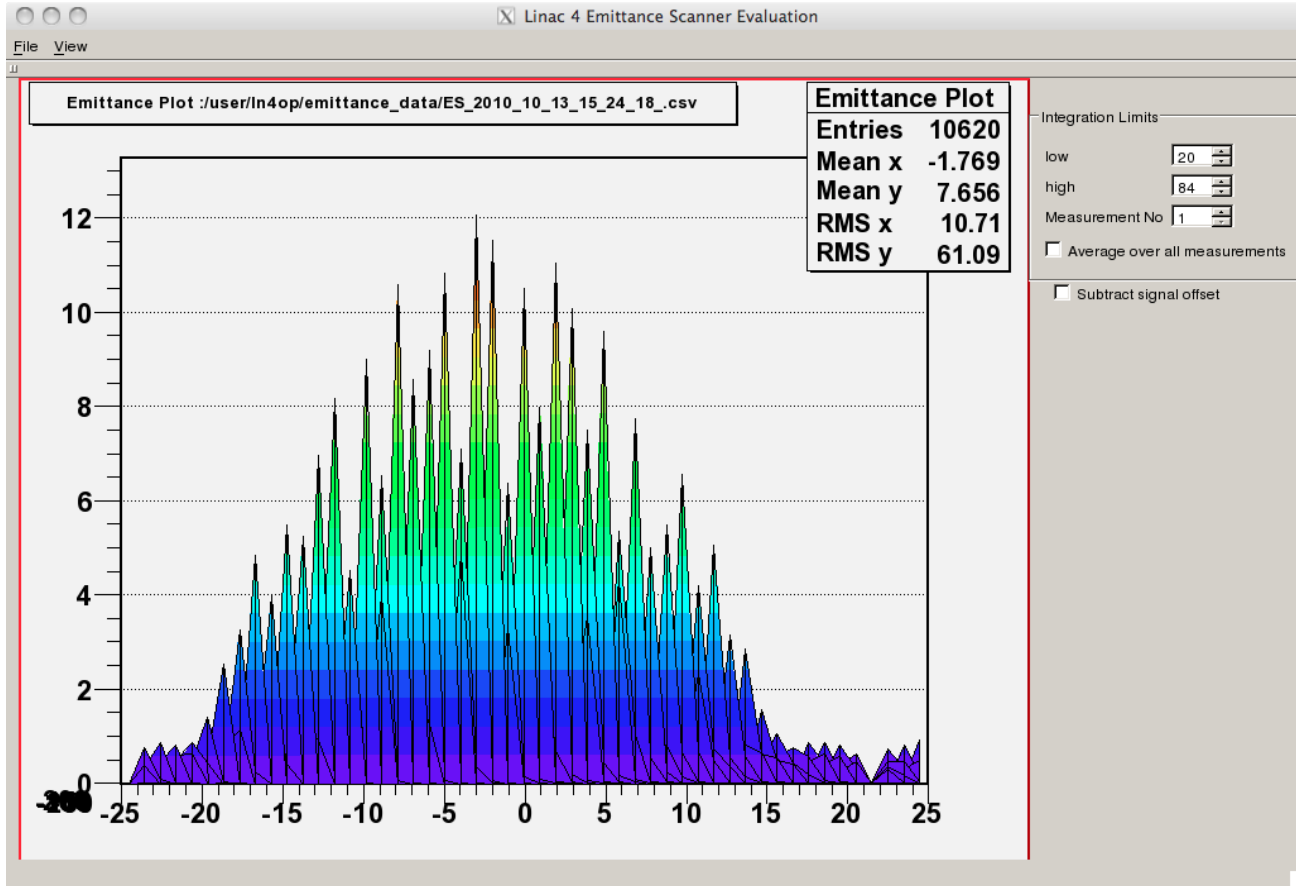


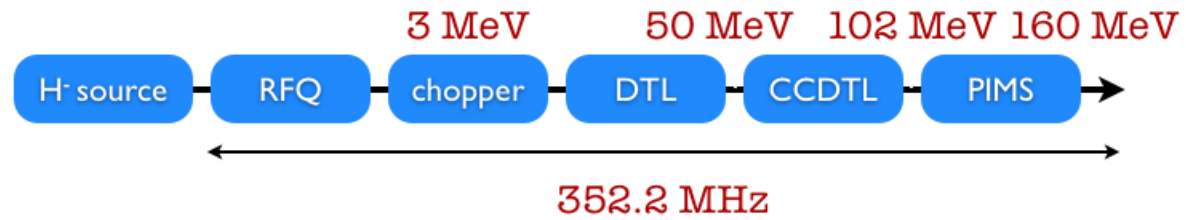
Modifications to the Emittance Meter

- Long arm for the combined hor/ver slit poses mechanical problems
- Use shorter separate slits or install stiff guiding
- Program was designed for commissioning only
 - LabView for readout, write raw data onto big files
 - Evaluation program in C++ / Qt / Root
 - Either these programs must be adapted and maintained or replaced by standard CO Java application (problem of frequent adaptations)



Emittance Evaluation





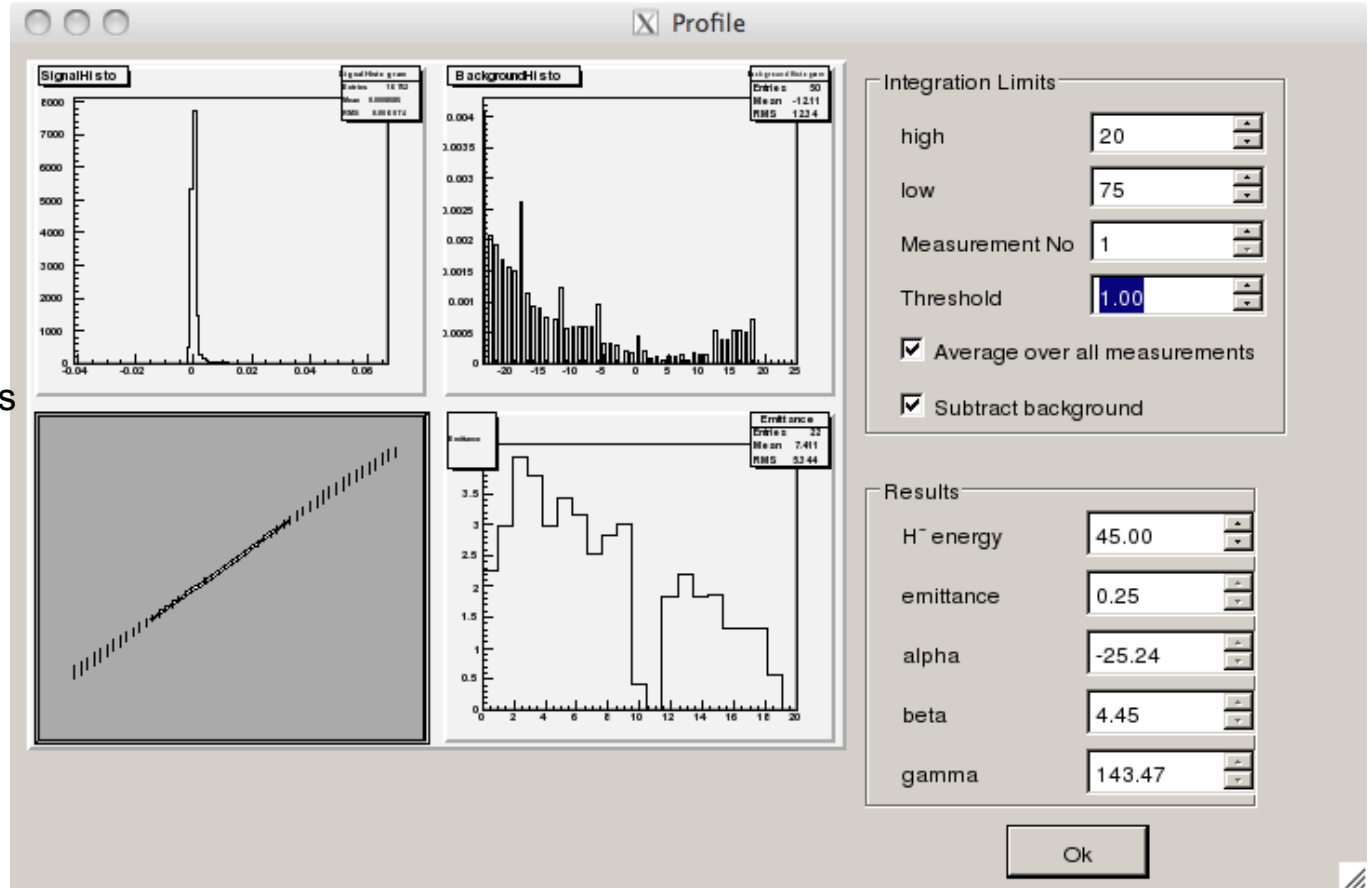
Pseudo Scubexx evaluation

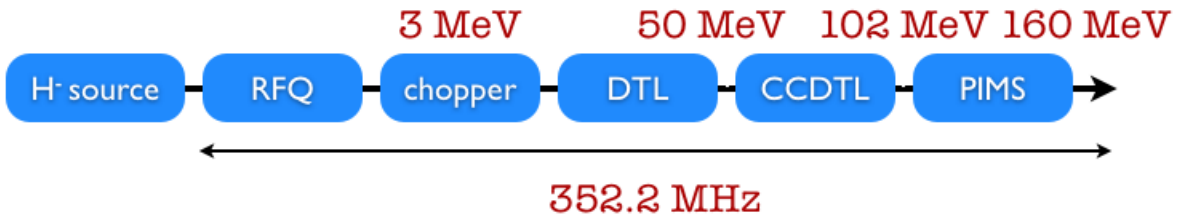
Histogram of signal levels

Background for each slit
Position

Emittance Plot

Emittance when taking less
and less channels around
peak



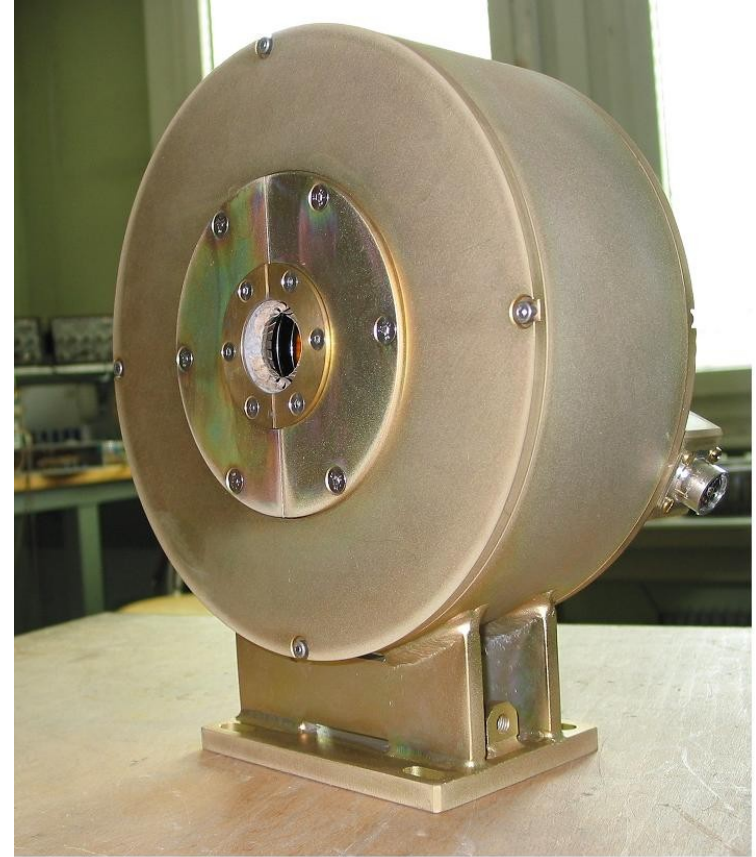
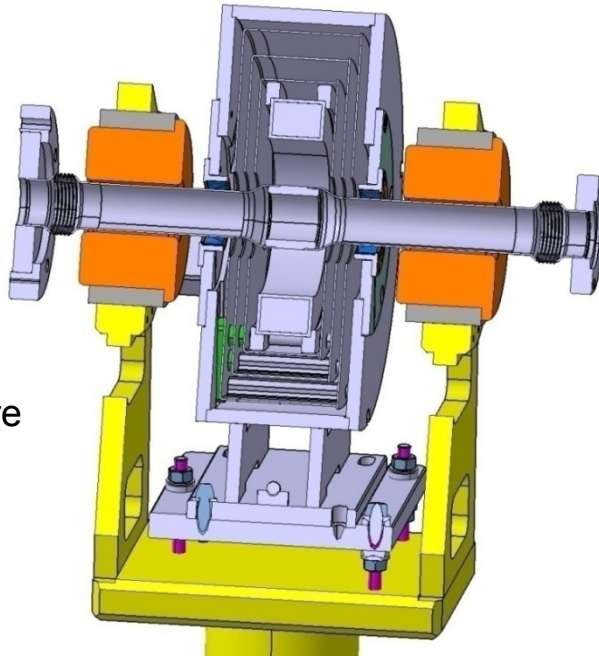


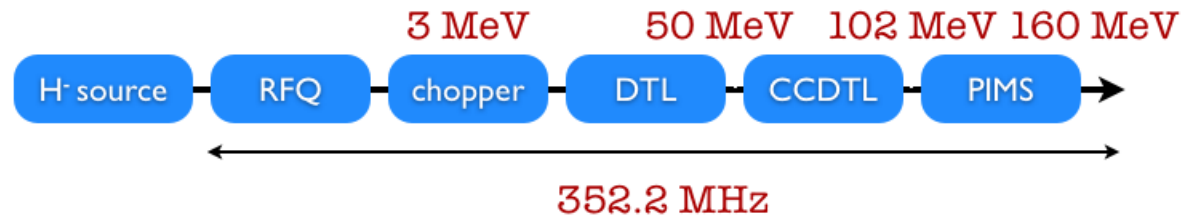
Current Transformers

Good magnetic shielding avoids interference from nearby pulsing quads

Shielding simulation and test measurements have been done

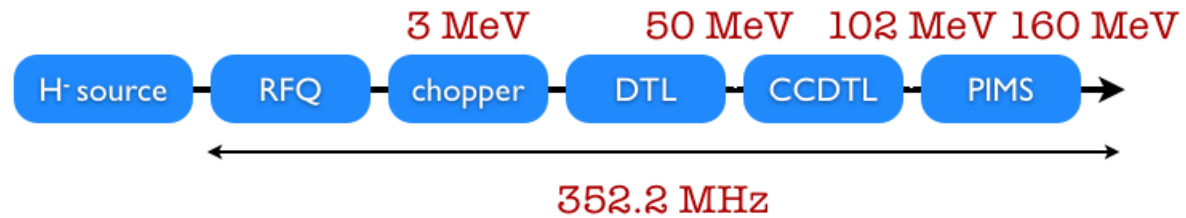
New electronics and software has been developed for L4
Needs no additional work





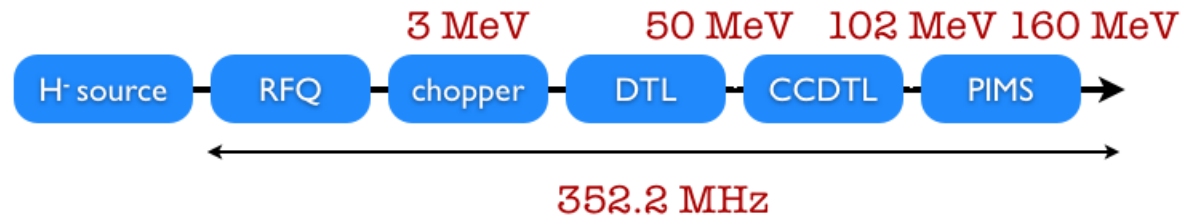
Instruments for new test stand

- SEMGrid
 - Same mechanism as current device
 - Wires can be polarized in addition to polarisation wires
 - New analogue electronics (foreseen for Linac-4)
- Faraday Cup
 - Possibility to polarize up to 46 kV (variable) to measure energy spread
 - Alternative: spectrometer which will not be used for Linac-4 any more
- Chinese copy of LEBT transformer



Instruments for new test stand (2)

- New emittance meter
 - Mechanical changes foreseen (2 independant slits?)
 - Software was designed for commissioning only
either needs to be maintained or replaced by standard CO Java application (4-5 months of work)
- Diagnostics of electrons from source to be specified and not counted



Cost table

Device	Material cost	manpower
Faraday Cup	20 kCHF	2 weeks
Floating 45 kV Faraday Cup	70 kCHF (new design, 45 kV HV supply)	3 months including programming
Transformer	25 kCHF	2 weeks
SEMGrid	80 kCHF	2 weeks
Emittance Meter	350 kCHF (includes mechanical modifications)	3 months if software stay the same 4-5 months for new software
VME crates	30 kCHF	
Grand Total	575 kCHF	7.5 months 12 months if new emittance meter software