



A view of the status of the DESIR beam lines

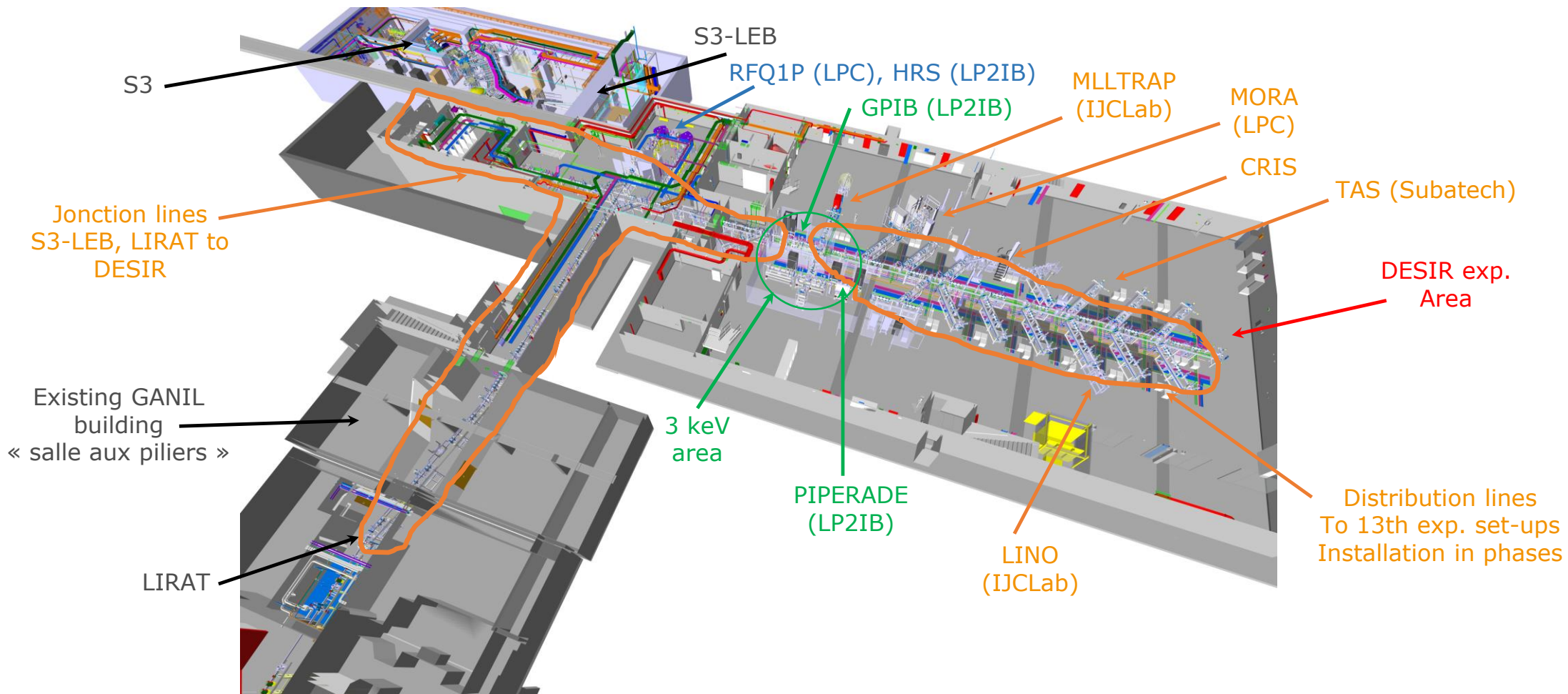
Luc Perrot, CNRS/IN2P3/IJCLab for the DESIR project group

- What have been already build ?
- A mounting test : 45° deflector with electrodes on insertion
- Development of the LT section 2 at GANIL
- 2 correctives actions examples
- Hall : lines from GPIB 2 experimental set-ups
 - 3 keV beam transport,
 - 60° deflectors,
 - 3 keV to 60 keV



Beam lines for DESIR project

What we are talking about ?





Beam lines for DESIR project



Which systems already available ?

System	Sub-system	Number of items	Manufacturer	Delivery	Cost (kEuros)
Optics	Quadrupole	117	VATEC, PFEIFFER	2019-2020	962.17
	Steerer	45	SOMINEX, PFEIFFER	2019-2020	355.34
	10° deflector	2	PFEIFFER	2020	30.2
	45° deflector	3	PFEIFFER	2020	117.6
	Insrtable deflectors	6	PFEIFFER + MBS	2020	48.73
	90° deflectors	2	PFEIFFER	2020	52.83
Diagnostic boxes	Simple PR	37	VACOM	2020	176.38
	double PR-PFE	5			161.31
	double PR-CF	8			
	double AF-AF	3			
	Triple	8			
Vacuum tube	3 differents types	41	PFEIFFER	2019	25.3
Bellows	10 diffrents types	156	MEWASA	2020	130.8
Mechanical frame	Various types / length	295	NORTEMECANICA	2019	104.8
Vacuum valves	4 different types	89	PFEIFFER + VAT	2020	78.33
Pumping devices	Primay, secondary, connection, power, interface	186	EDWARDS + PFEIFFER	2020	561.07
Vacuum jauges	Pirani, cable, electronics	290	LEYBOLD / EDWARDS	2020	40.5
HV power supply	Crate 300W & 600W, 10kV, 6kV, +/-3kV	135	ISEG	2020	327
Automatism	Siemens, switches ...	59	CONRAD + SIEMENS	2020	95.99
Racks		32	KOLB + SCHNEIDER	2019	11.16
ITEM profiles	Various size & sub elements		ITEM	2019	39.54
Others supports	Quad + steerer	86	MSA	2019	29.02
Brass blocks	all sub-systmes	495	SCHÄFER	2019	16.88

- Build in the SPIRAL2-FAIR agreement
- Tot = 3365k€
- Concern junction lines and ~10% of hall lines
- Stored in GANIL



DESIR is real !

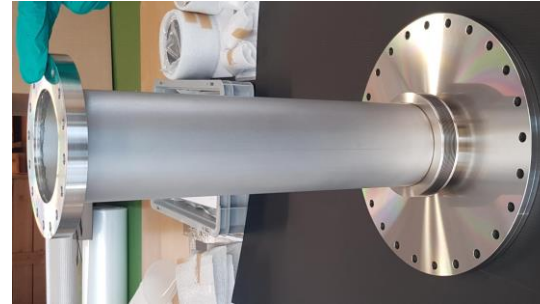
Electrostatic quadrupole during vacuum test in 04/2019 at VATEC



Electrostatic steerers during fabrication in 10/2019 at SOMINEX



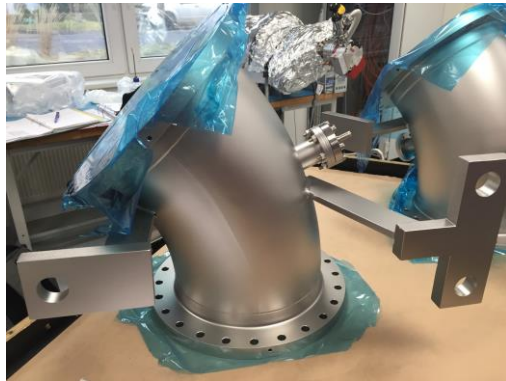
Vacuum tube / bellow in 11/2019 at PFEIFFER / MEWASA



Nortemecanica frames ready to deliver at GANIL in 12/2019



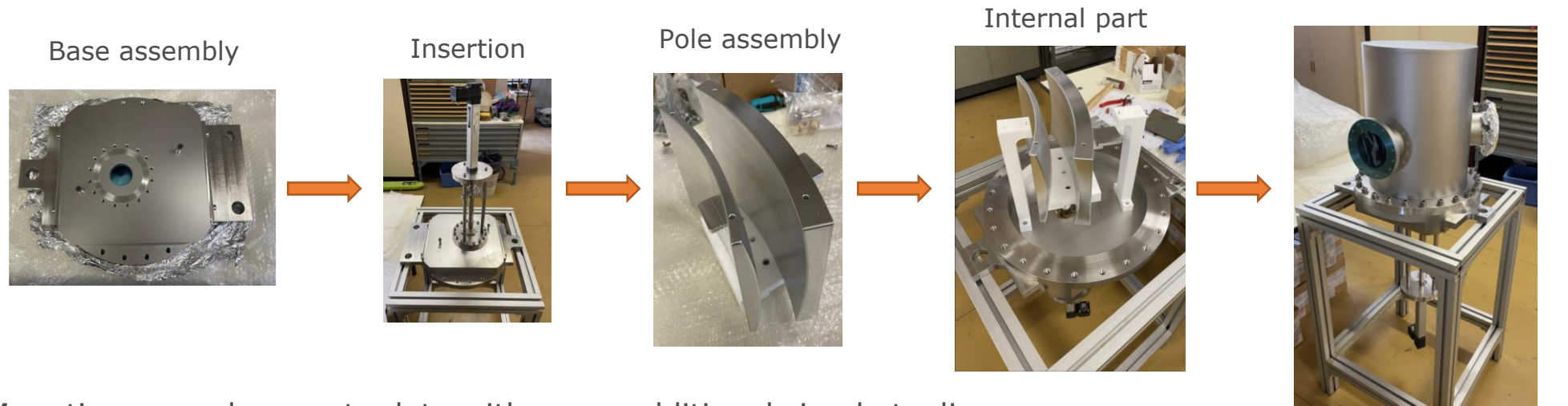
45°, 90° and 10° electrostatic deflector during FAT in 01/2020 at PFEIFFER





The case of 45° deflector with insertion

- Deflector type dedicated to versatile beam transfer from LIRAT and S3-LEB to RFQ1P/HRS or direct to DESIR
- Project decide to build sub-element and test the assembly to validate/adjust the mounting method
- Material received in 2020 and test with internship spring 2022 at IJCLab



- Mounting procedure up to date with some additional simple tooling
- System can be easily disassembly
- Material can be put in box and send to GANIL

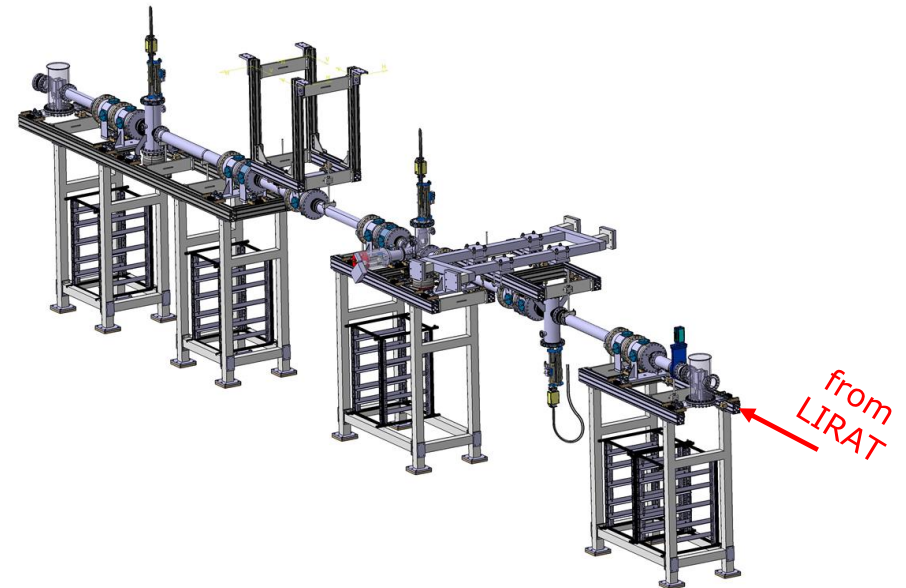
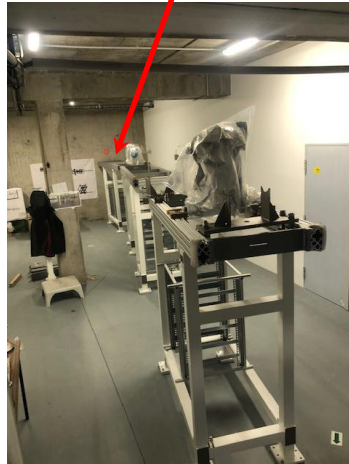
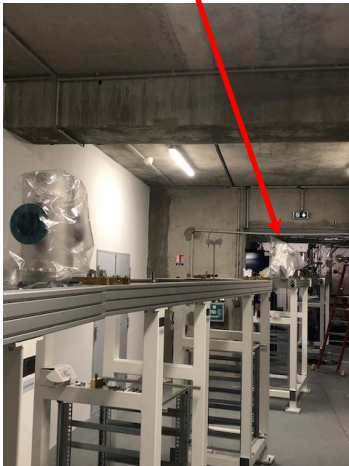


Validation of a real line section test assembly at GANIL

- Useful test for validate a lot of technical aspects : mounting, alignment, connection, vacuum, C&C ...
- A good support to learn the electrostatic specificities at GANIL
- All systems available at GANIL
- A good opportunity and feedback for the all DESIR beam lines
- But where it's done ? In the existing GANIL in the "salle aux piliers" = LT section 2 ~ 20m long

From LIRAT object point to DESIR wall (soon ...)

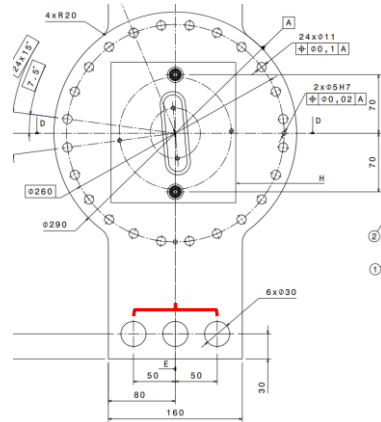
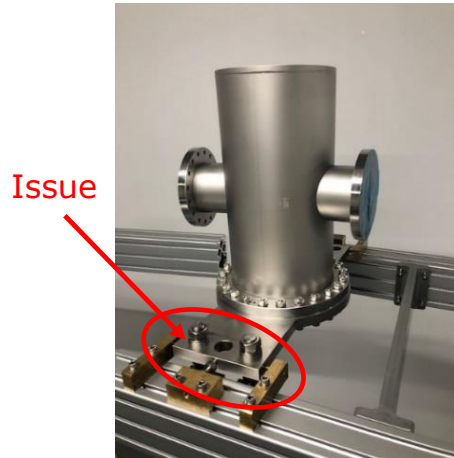
thanks to V. Morel





Some current correctives actions (ex. 1)

1. Technically issue to adjust the 10° deflector (LT section 2) within the required tolerance due to the insufficient spacing of 2 of its 3 support points => need correction (FNC)



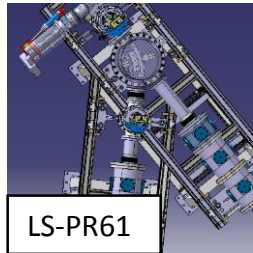
=> Issue can concern other optical system

=> potential solution : install a 250mm bar that spreads the center distance

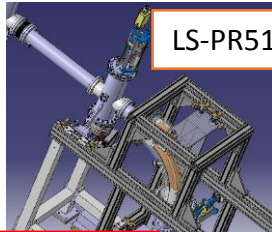
=> Study on all beam lines

=> Solution valid except for some specific and compact locations (asymmetry of the 250mm bar solution)

Corrective action to finalize

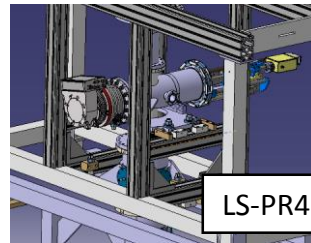


LS-PR61

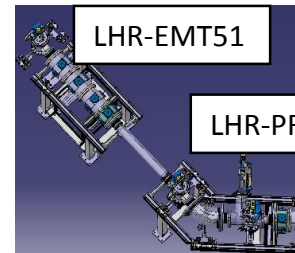


LS-PR51

LS-DE42

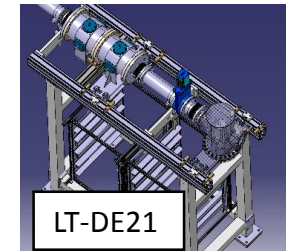


LS-PR42

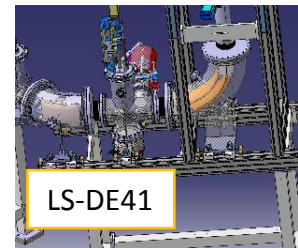


LHR-EMT51

LHR-PR51



LT-DE21

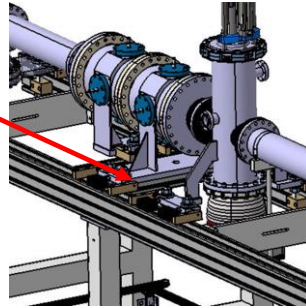
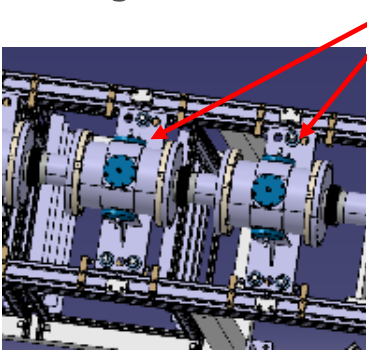


LS-DE41

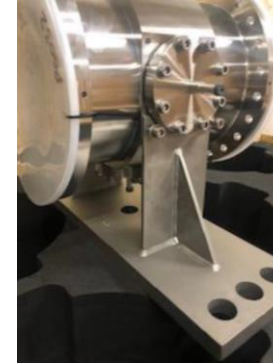


Some current correctives actions (ex. 2)

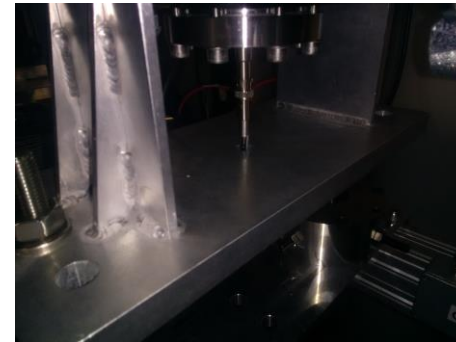
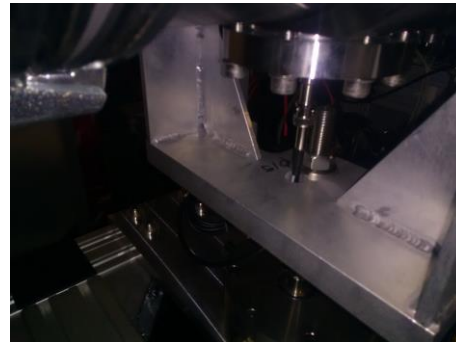
- Issue see at LP2IB (C&C tests) during some assembly of the quadrupole & steerers : HT connection difficulty through mechanical support => need correction (FNC) => solution : drill the plate (N=86)



Action already started at GANIL



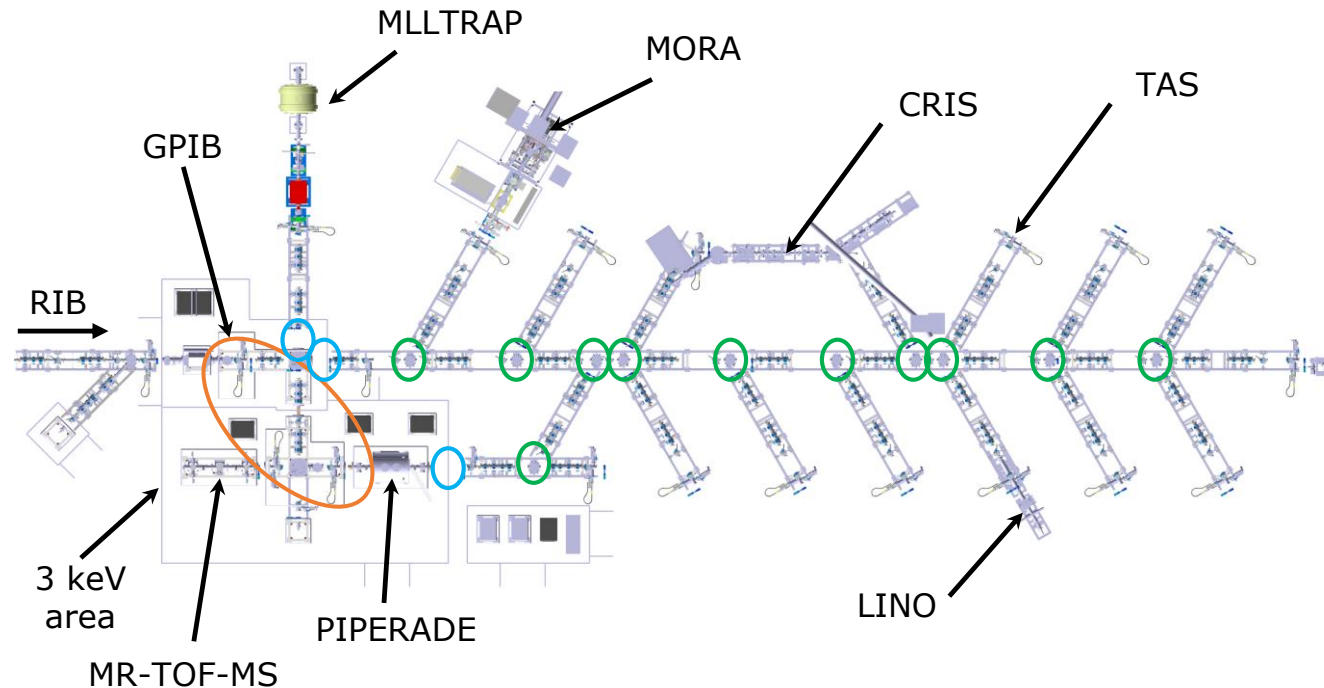
Same action already done with the new line at ALTO-LEB





Development in the hall

Distribution lines to 13th exp. set-ups : installation in phases



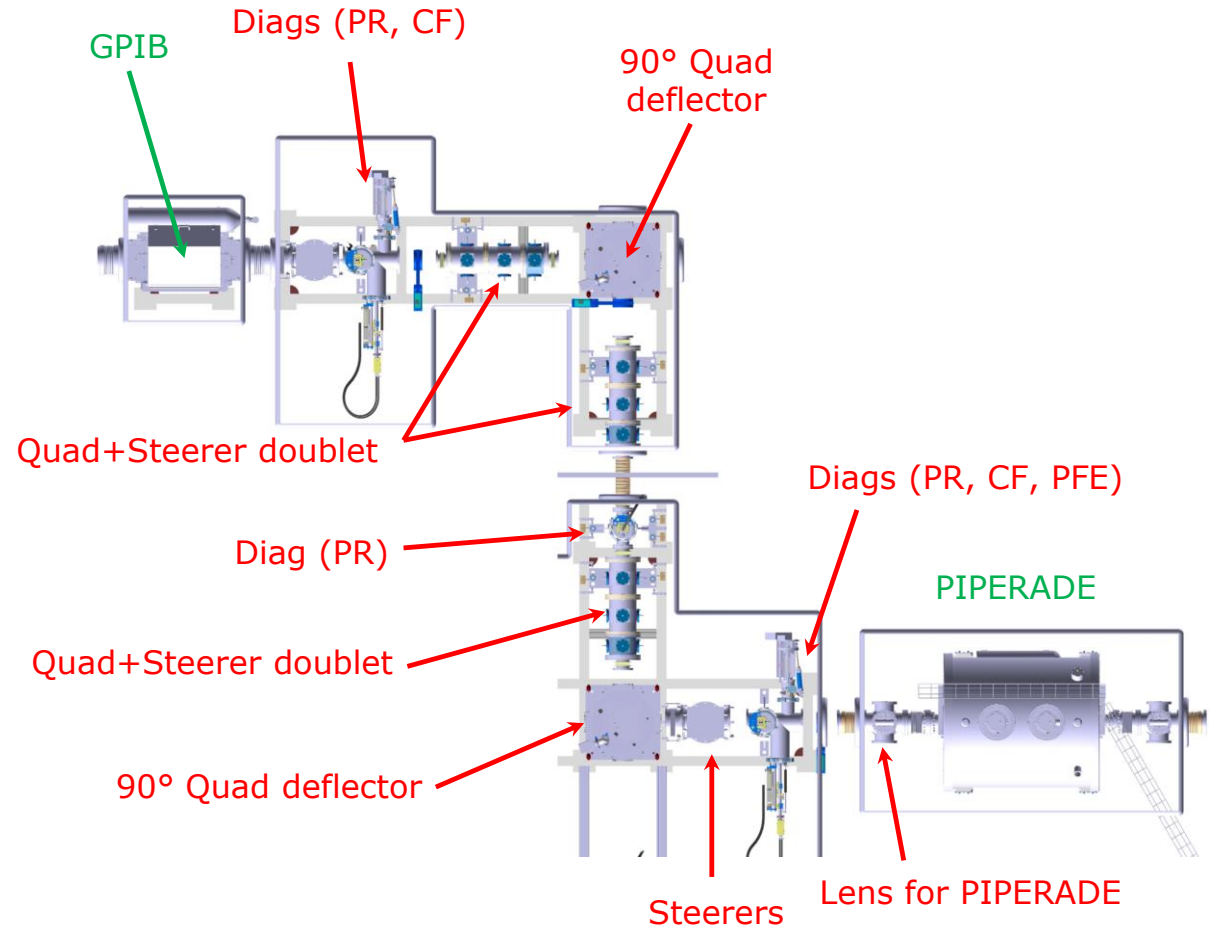
- Transfer lines with basic and simple bricks structure
- Mechanical integration at a sufficient high level for the building/network ... integration
- Beam optics study from GPIB to PIPERADE at 3 keV
- 2 new elements to design :
 - 60° electrostatic deflector for beam switch
 - Device do reaccelerate the beam from 3keV to 60keV



3 keV beam transport lines (GPIB 2 PIPERADE case)

Many years of exchange between :

- Requirements by PIPERADE
- Beam characteristics from GPIB
- Constraints
- Beam dynamic
- Mechanical integration





Beam lines for DESIR project



3 keV beam transport lines (GPIB 2 PIPERADE case)

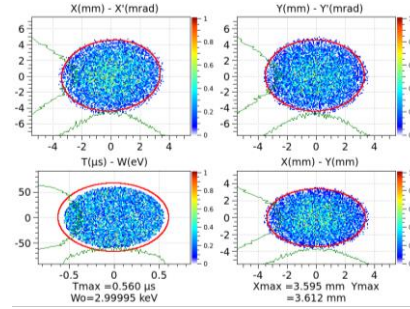
- Calculation done with full field-maps
- Potential quadrupoles :

124.078V / -110.021V

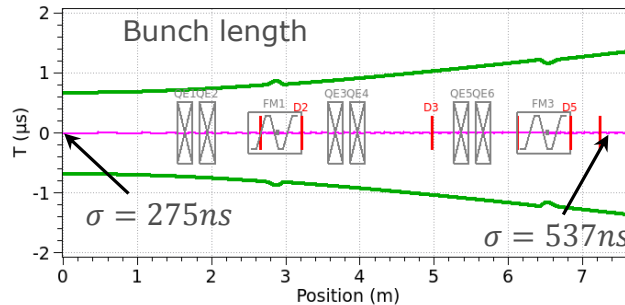
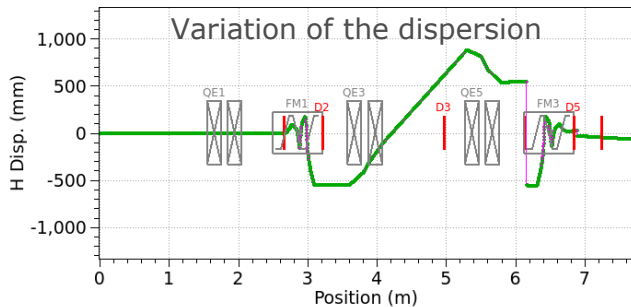
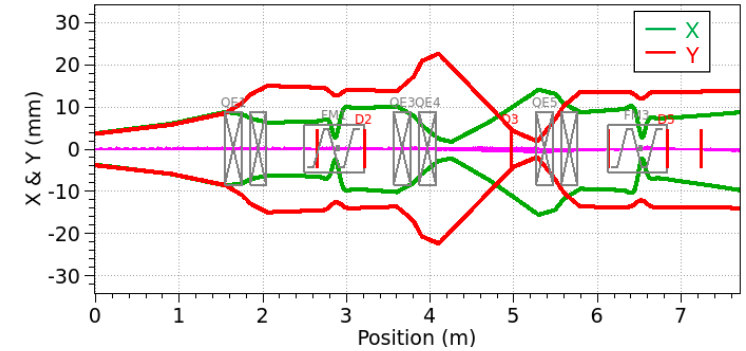
190.0V / -190.0V

190.0V / -190.0V

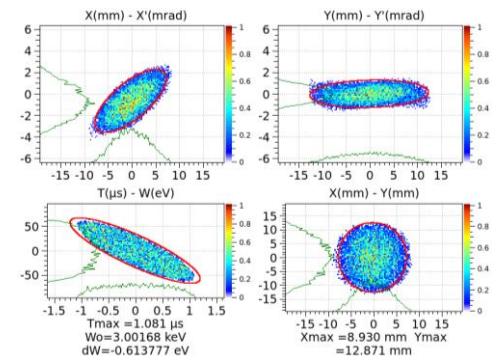
Input beam parameters from exit GPIB
Extrapolated from LP2IB calc.



Transverse envelopes @ $\sqrt{6}\sigma$



Beam parameters before deceleration to PIPERADE

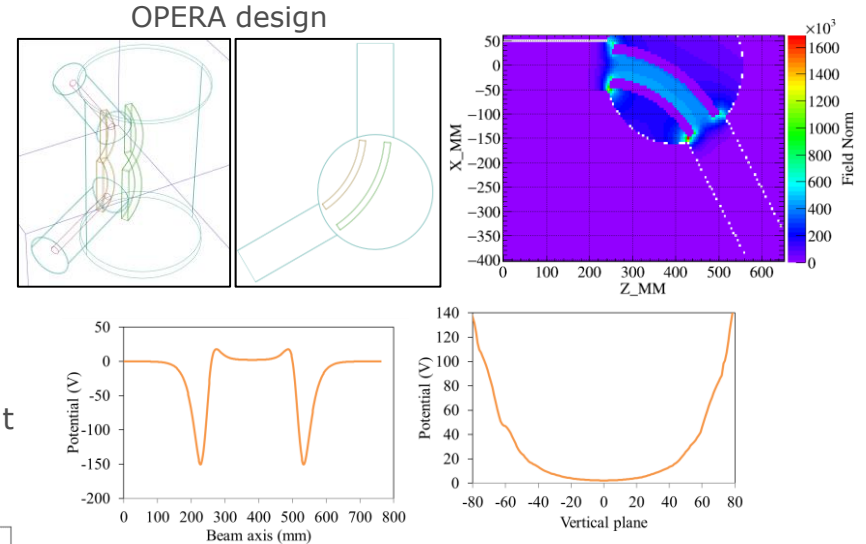


- **Satisfying RIB transport along 3keV beam line**

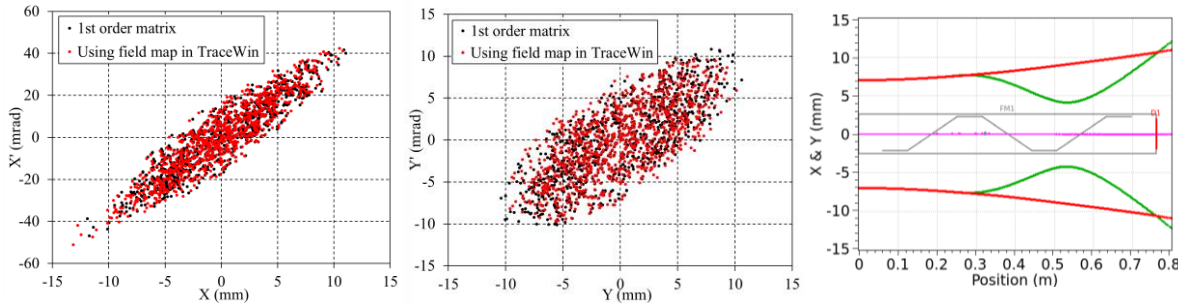


60° deflector for Hall distribution line

- Skeleton was study first => Dimensional constraints fixed
- Same vacuum chamber as 45° deflectors along transfer lines
- Objective : obtain a system valid at 1st order calculation
 - Cylindrical form for the poles (no focus effect in vertical plane)
 - Pole height = 160mm (minimization of vertical field effect)
 - $\rho=287\text{mm}$, Gap = 50mm
 - Potentials: $-10937.5\text{V} / 10023.3\text{V} : V = -2E_{beam} \ln(\rho/(\rho + x))$
 - Aperture angle of electrode = 51° (see H. Wollnik, Septier), central trajectory close to center of mechanical structure => any misalignment introduce by the deflector



Tracking calculation



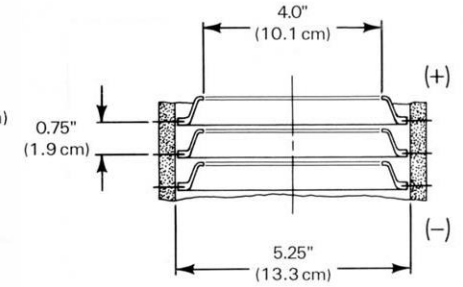
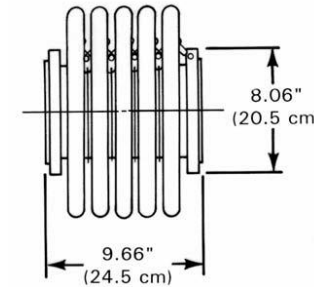
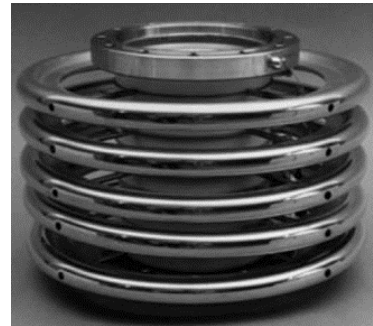
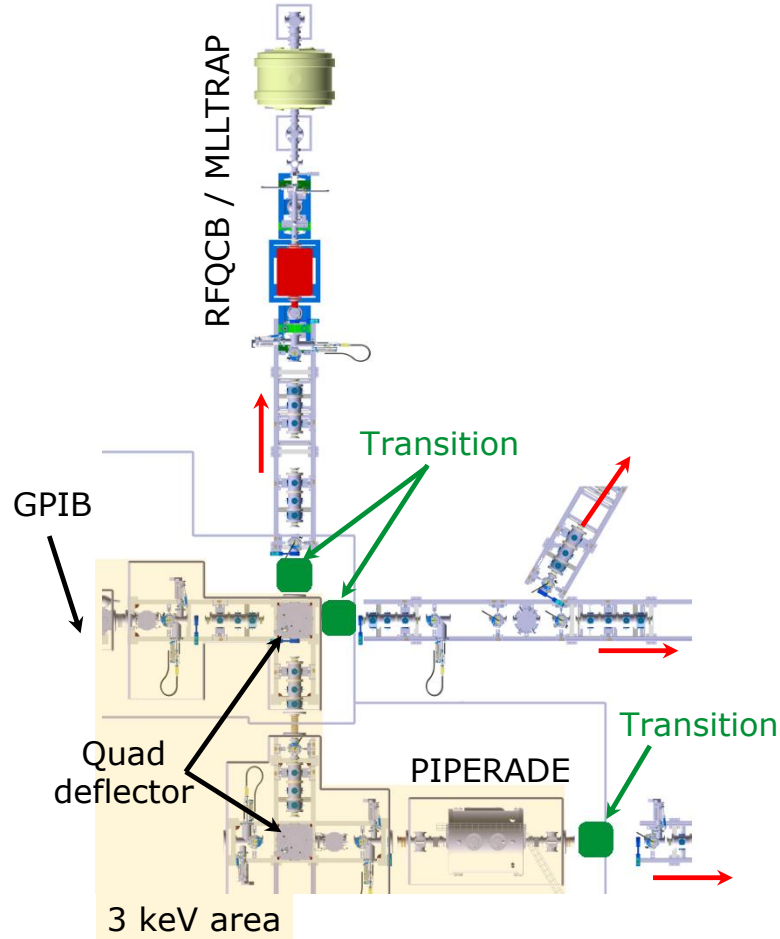
As other deflectors along DESIR beam lines, use of 1st order model for the 60° deflector

Mechanical conception, mounting procedure + 2D drawings validated by the project



Transition 3 keV – 60 keV

- Possibility : using the General Purpose Accelerator Tube from NEC
- Electrode number adjustable
- Potential at each electrode adjustable

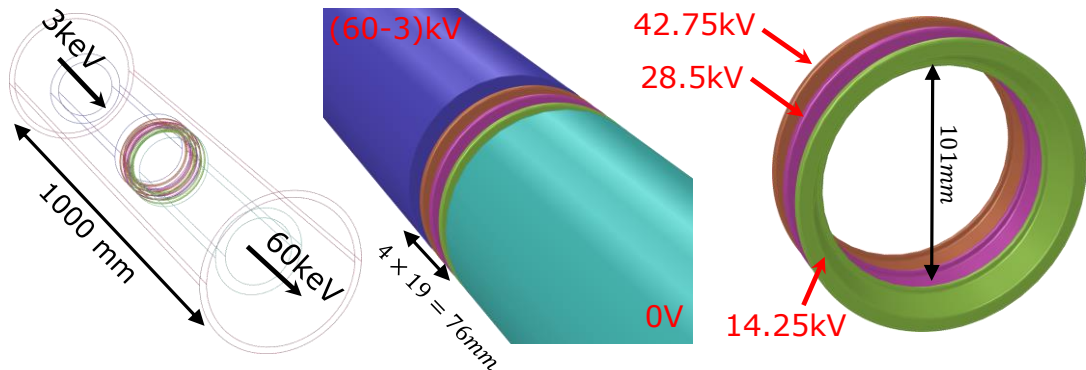


➔ Study with OPERA

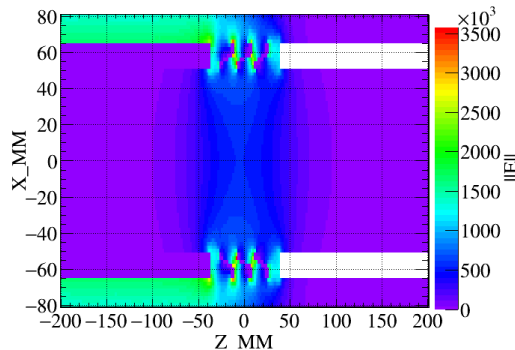


Transition 3 keV – 60 keV

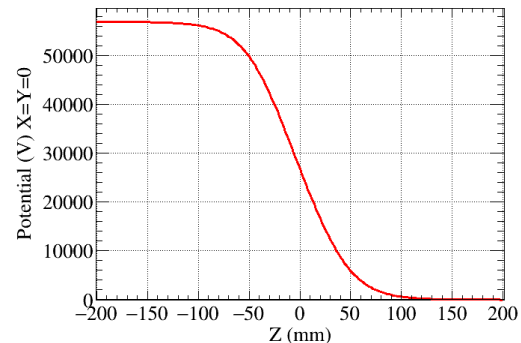
OPERA conception : ex with 3 electrodes



$|E|(X,Z)$

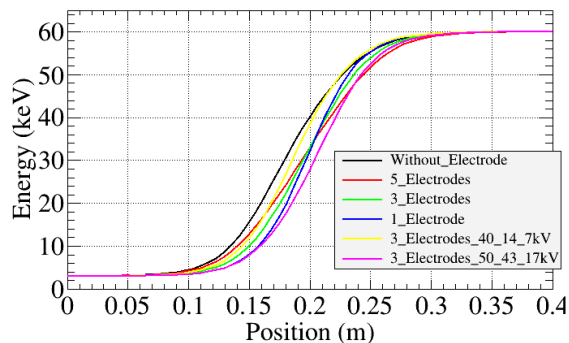


$V(Z), X=Y=0$

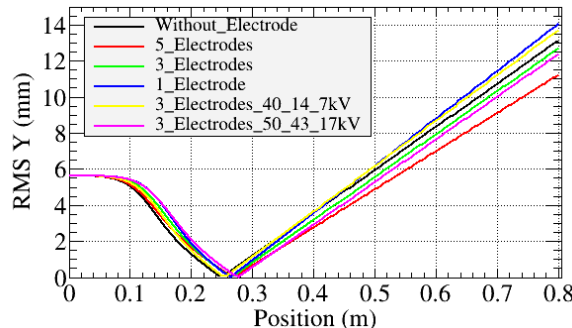
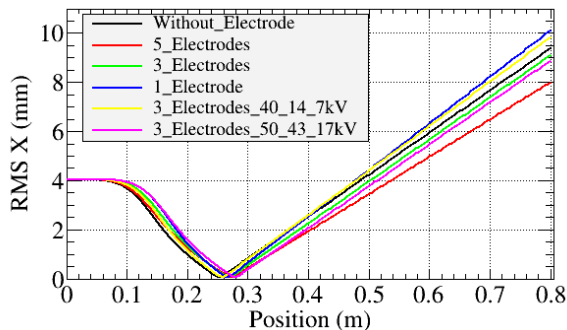


TraceWin Results for ≠ configuration

Beam energy



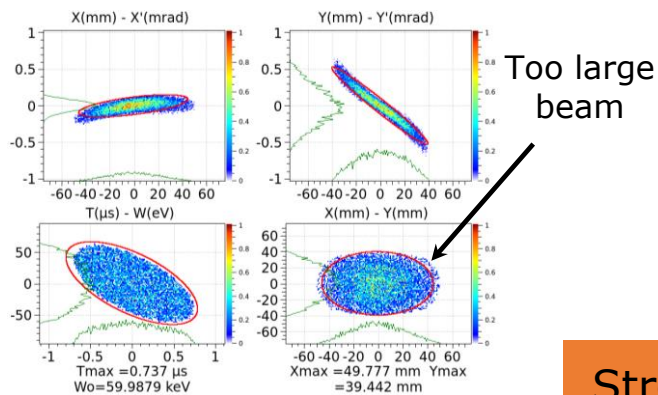
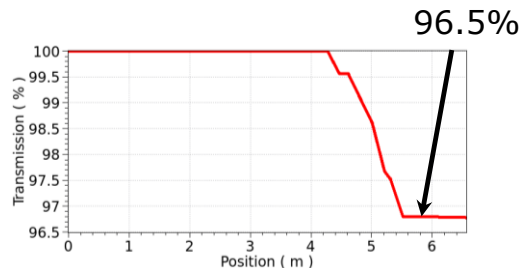
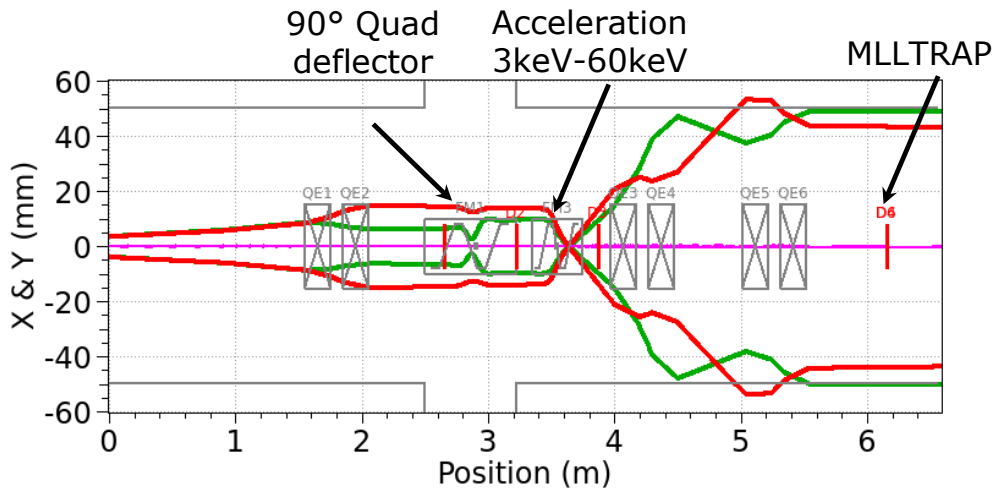
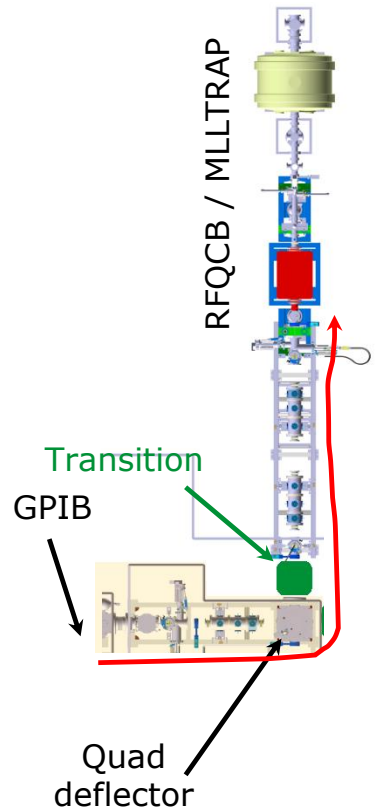
Transverse beam size



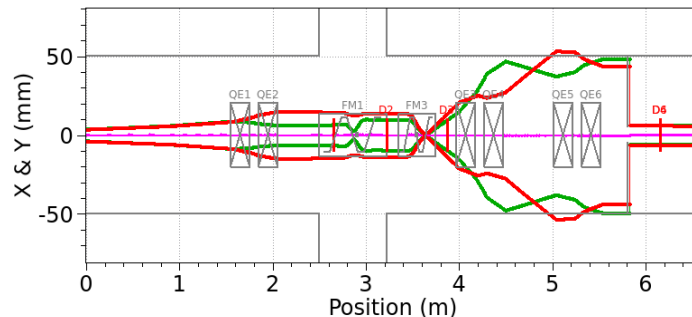
- **Strong focusing effect introduce**
- **Must be taken into account in the beam lines**



GPIB 2 MLLTRAP beam transport



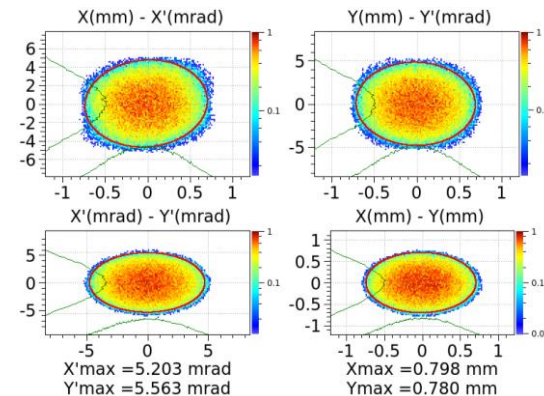
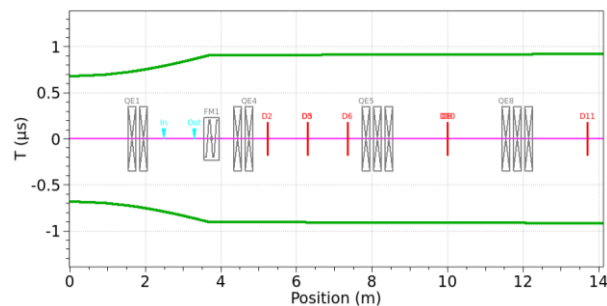
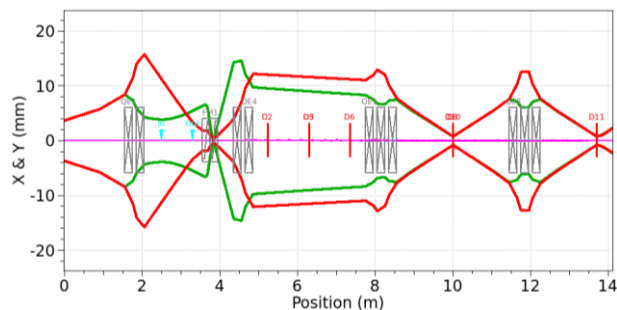
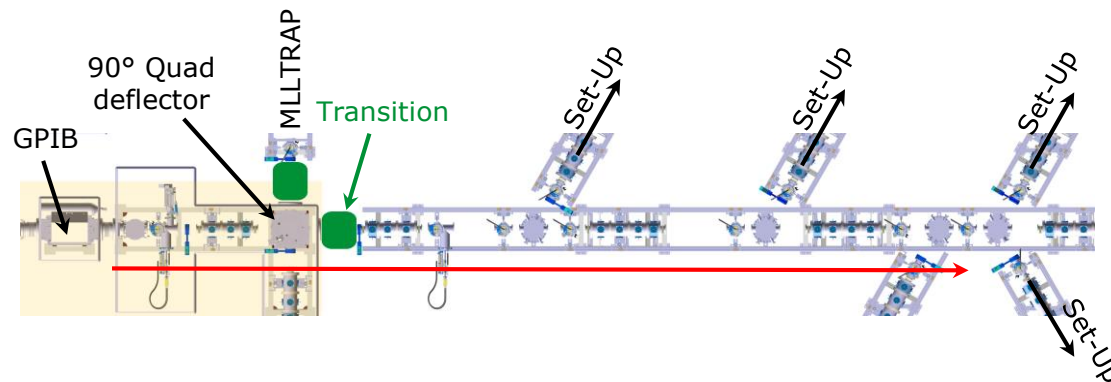
Aperture to 5mm radius => 5% transmission !



Strong impact of the transition from 3keV to 60keV



GPIB 2 "Fishbone" beam transport



Small impact of the transition from 3keV to 60keV



Conclusion

- Pursue on the integration and optimization of the beam lines in the hall
- Fully freeze the 3 keV zone
- Freeze the short stable source injection line in the hall
- Few small adjustment along the junction line (pepper-pot)
- Link with S3-LEB / DESIR interface
- Solve the correctives actions
- Adjust the modifications of LINO and MLLTRAP for DESIR hall
- Full drawings of section for mounting operation
- Pursue the test integration on LT-section-2 (LIRAT)