Roman pots at 220 m in ATLAS

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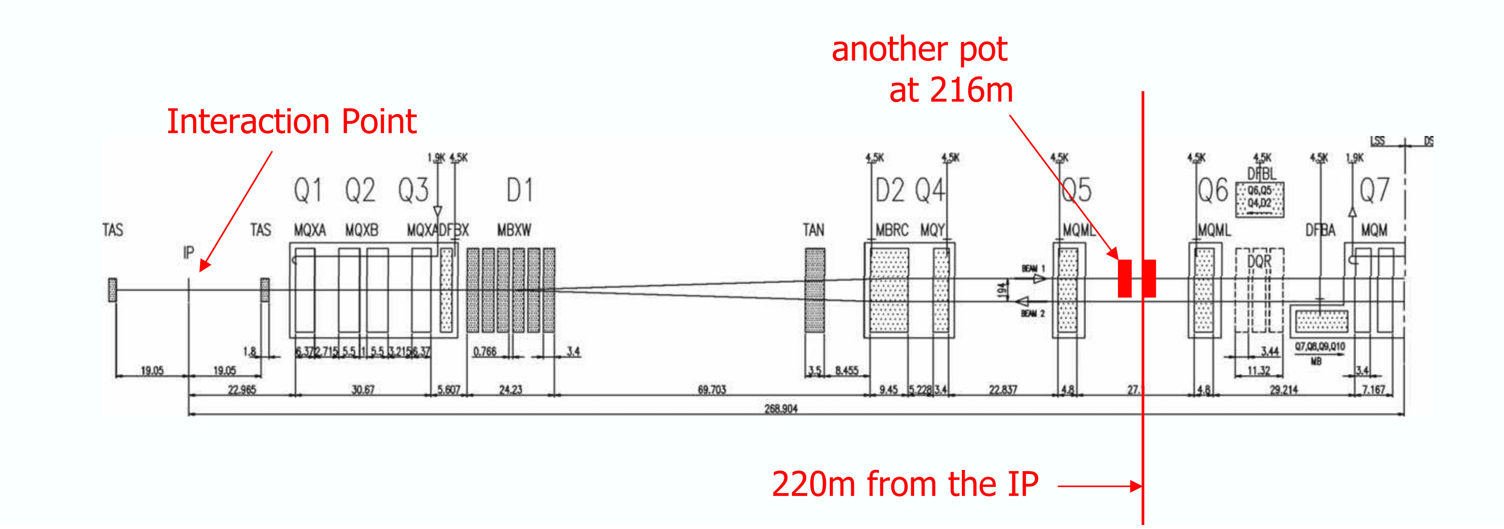
Contents:

- Roman pot location
- MAD simulation
- Roman pot construction
- Which detector?

Many results obtained in collaboration with Alexander Kupco, Marek Taseksky, Maarten Boonekamp, Vojtech Juranek...

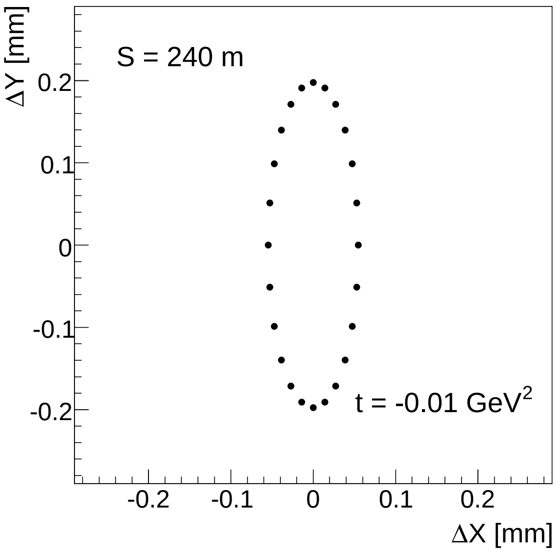
Roman pots at 220 m

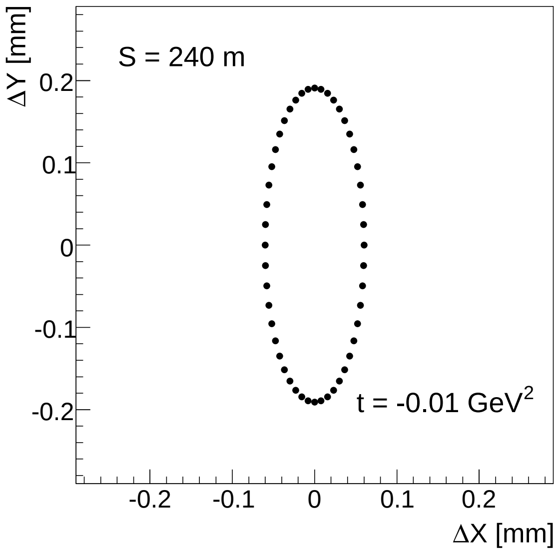
- Roman pot location: assume detectors at 216 and 224 m
- One open issue: what is the effect of the collimator at Q5 to be put at high luminosity?
- study the acceptance of the detectors at 220 m using MAD

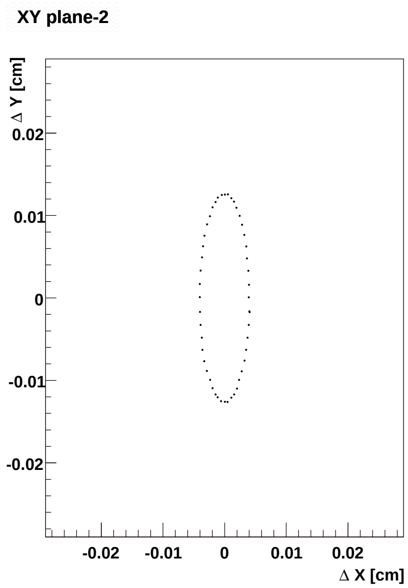


Acceptance for elastic events at 240 m (just a cross check)

- Comparison between MADX, HECTOR and FPTRACK for elastic events at 240 m
- (HECTOR was adapted to ATLAS interaction point)

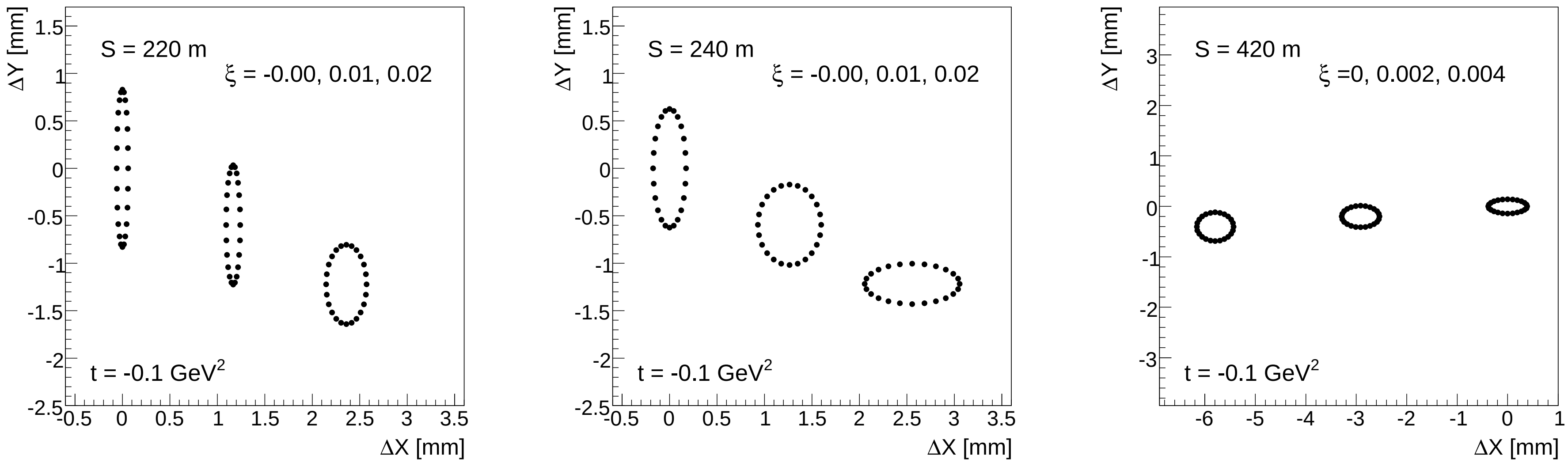






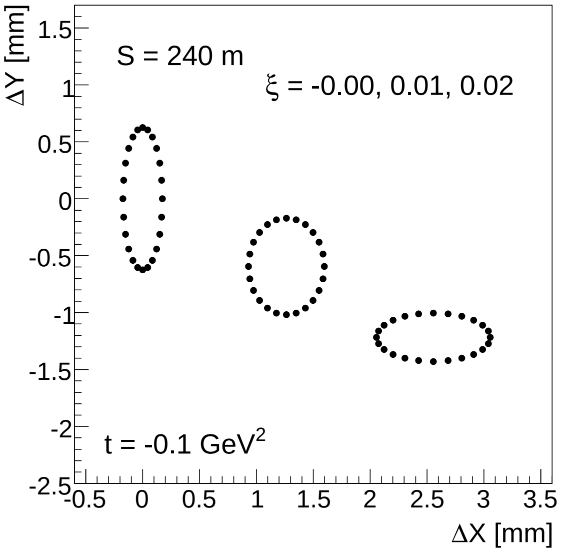
Acceptance for diffractive events

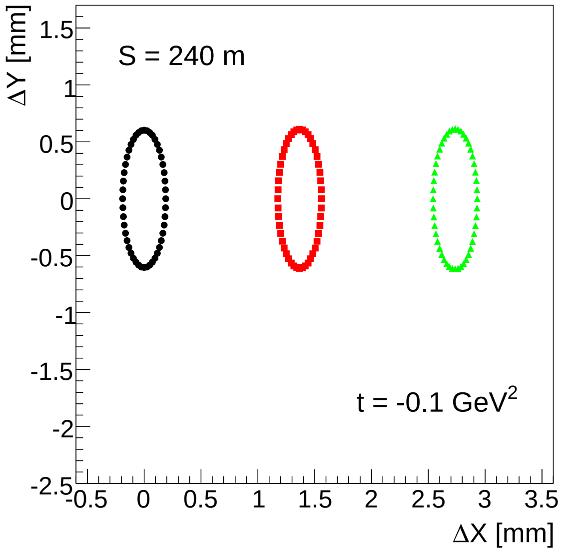
- Acceptance for diffractive events ($\xi \sim 0, 0.01, 0.02$) at 220, 240, and 420 m
- Note the difference of sign between 220-240 m and 420m

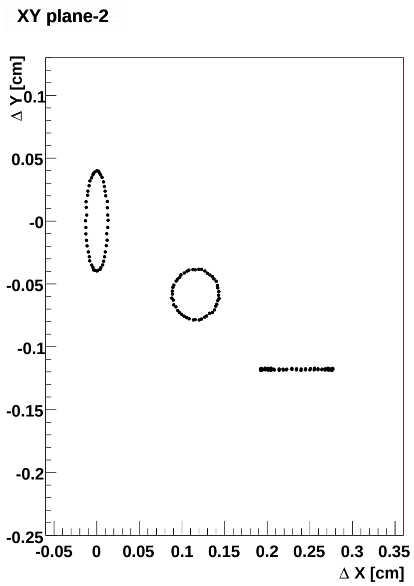


Comparison between MADX, HECTOR and FPTRACK

Comparison between MADX, HECTOR and FPTRACK for diffractive events at 240 m

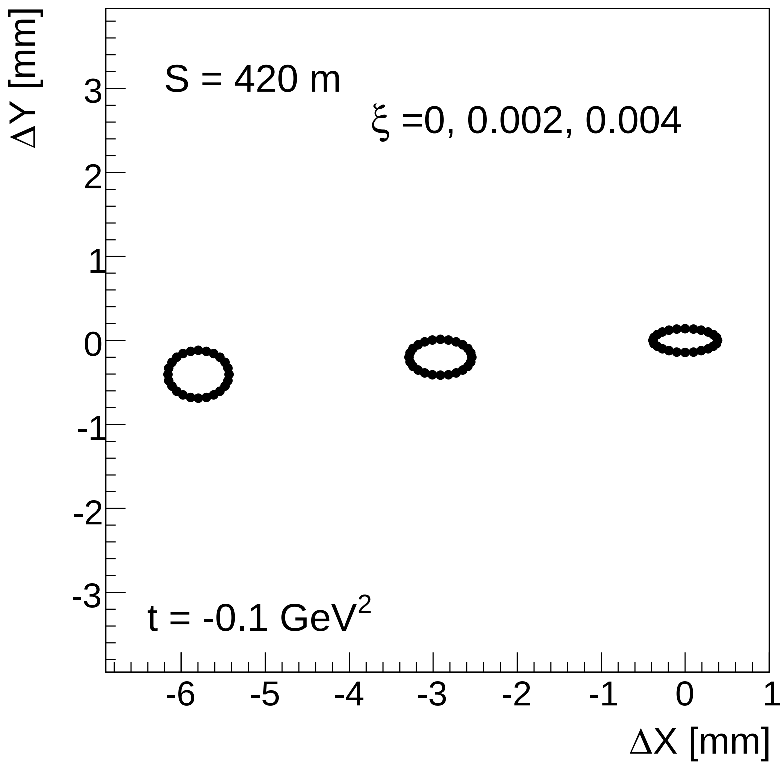


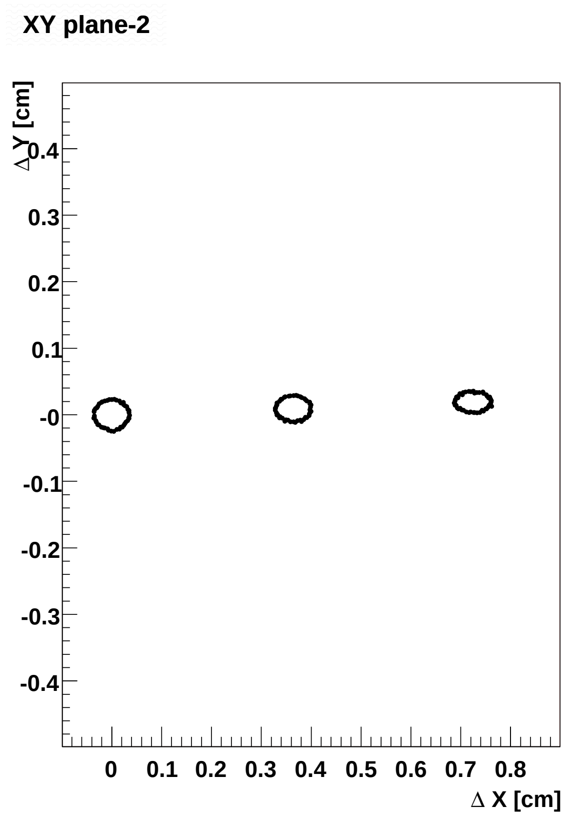




Comparison between MADX, HECTOR and FPTRACK

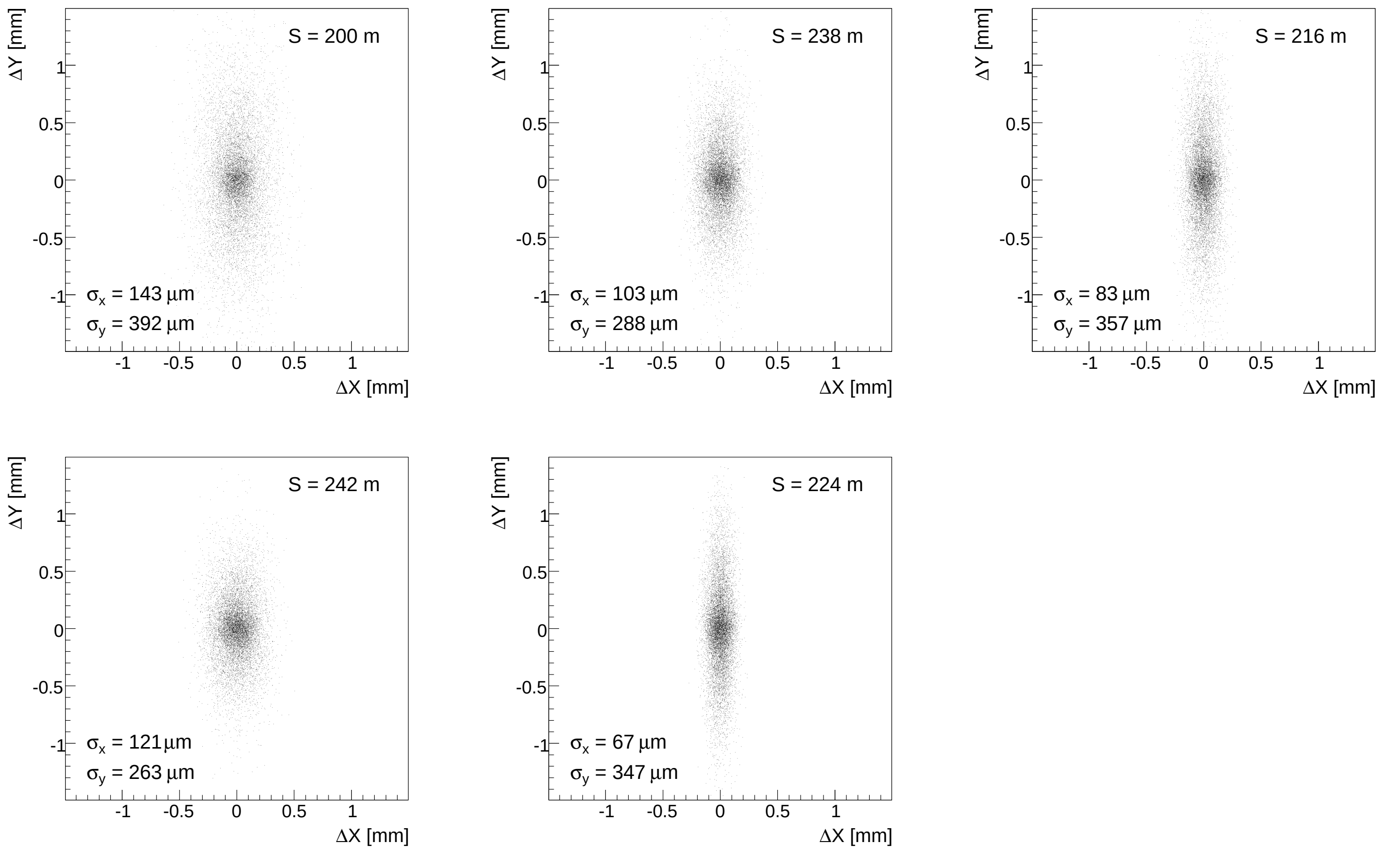
- Comparison between MADX, FPTRACK for diffractive events at 420 m
- Signs are different for MADX and FPTRACK because of a different convention





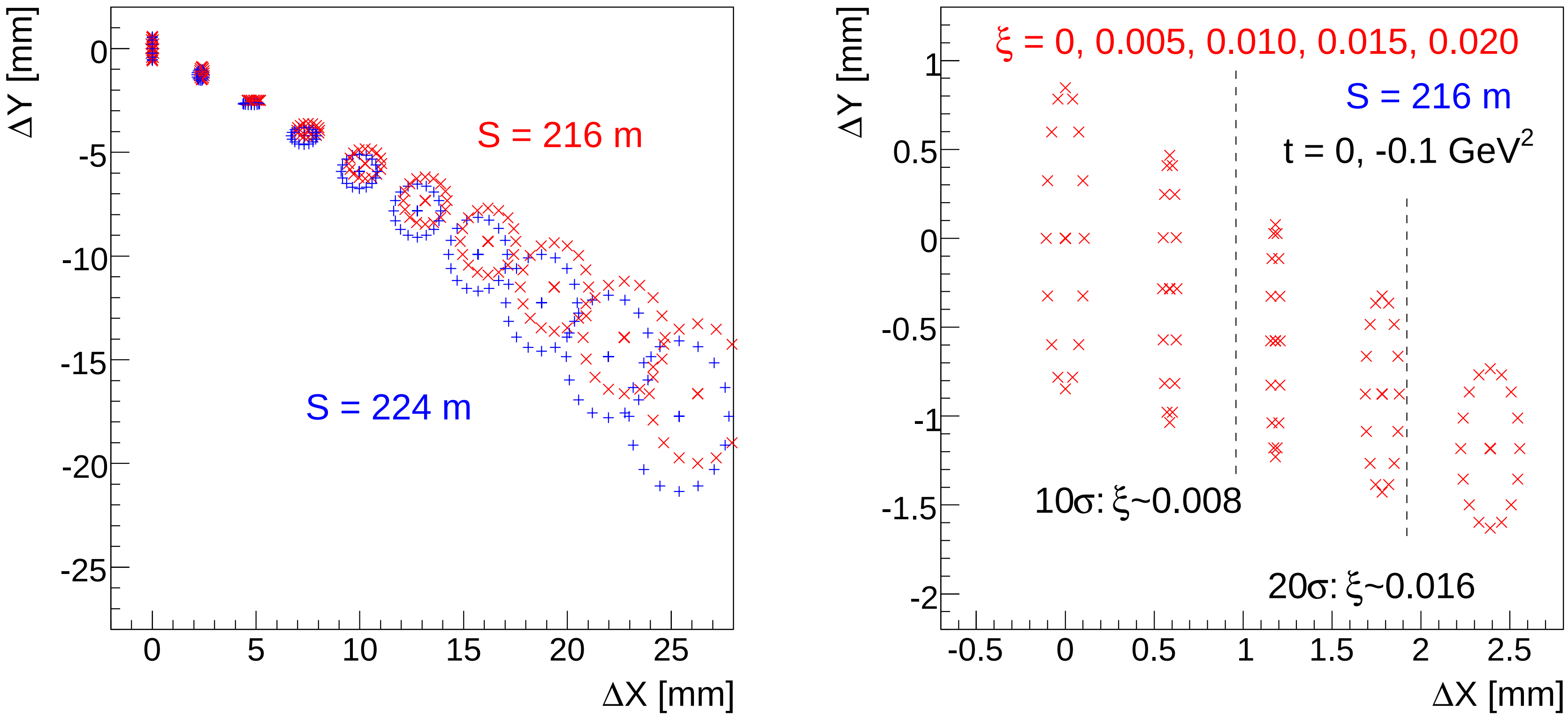
Beam spots

- Use MADX to compute beam spots
- Difference in time between 2 protons coming from the same vertex with different t and ξ less than 50 μm



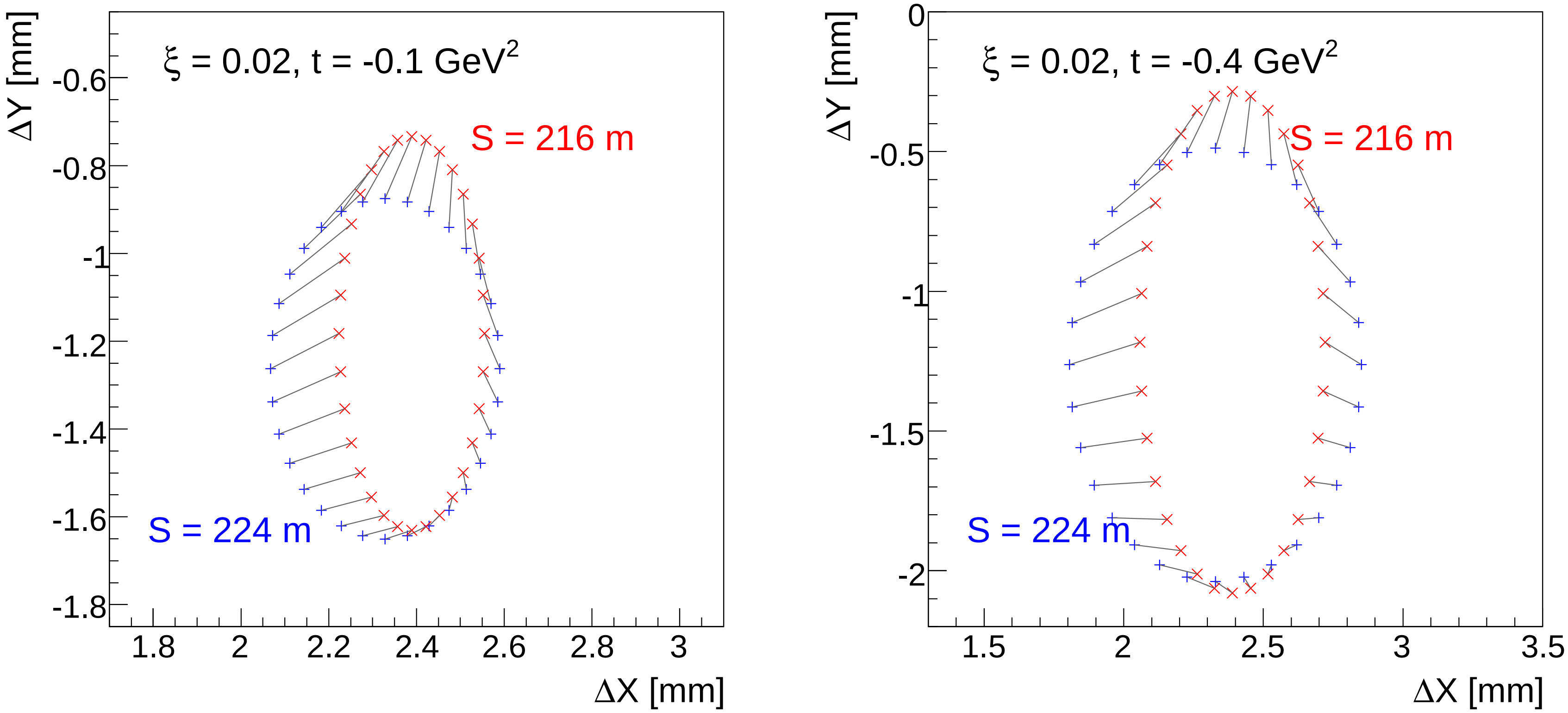
Acceptance for 220 m pots

- Steps in ξ: 0.02 (left), 0.005 (right), $|t|$=0 or 0.05 GeV^2
- Detector of 2 cm $\times$ 2 cm will have an acceptance up to $\xi \sim 0.16$, down to 0.008 at 10 σ, 0.016 at 20 σ
- NB: for pots at 240 m: ξ acceptance up to 0.14 and down to 0.010 (10 σ) and 0.020 (20 σ)



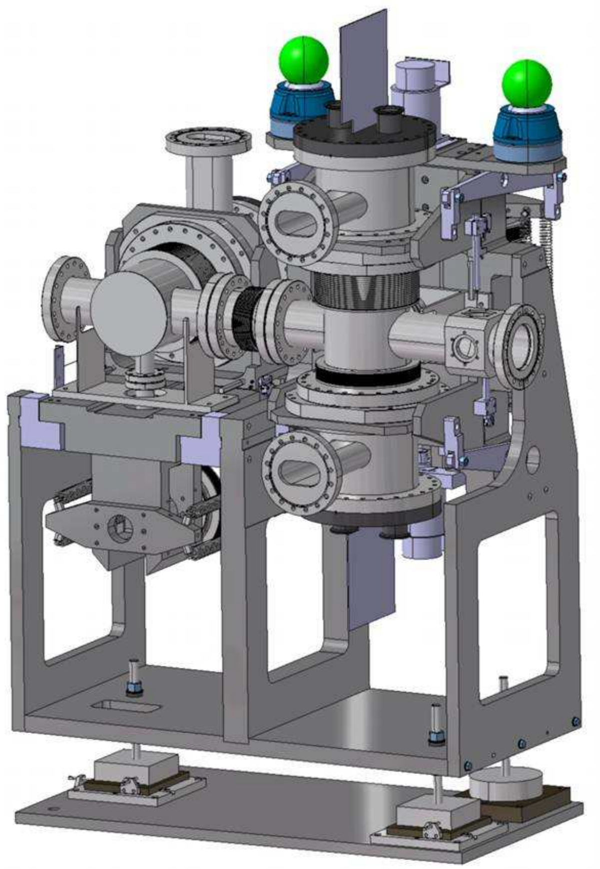
Hit maps at 216 and 224 m

- Study difference between hit maps at 216 and 224 m: test the idea of using displacement at the trigger level to distinguish with halo
- No unique shift direction between 216 and 224 m



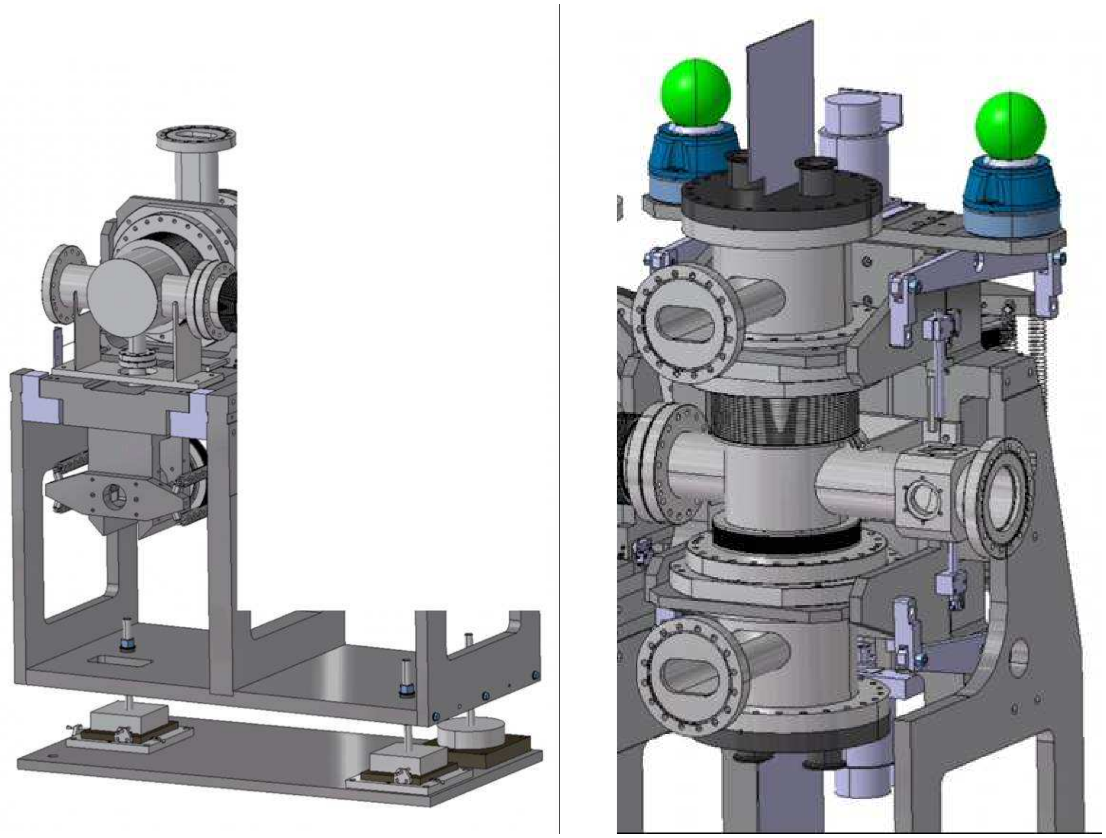
TOTEM roman pots

- Idea: Use roman pots as close as possible to the ones used by TOTEM
- Roman pots to be built by Czech group (the same firm which builds the TOTEM pots)
- Use horizontal arms only, restudy the supports



TOTEM roman pots

Schematic view of 220 m pots: keep horizontal pots only



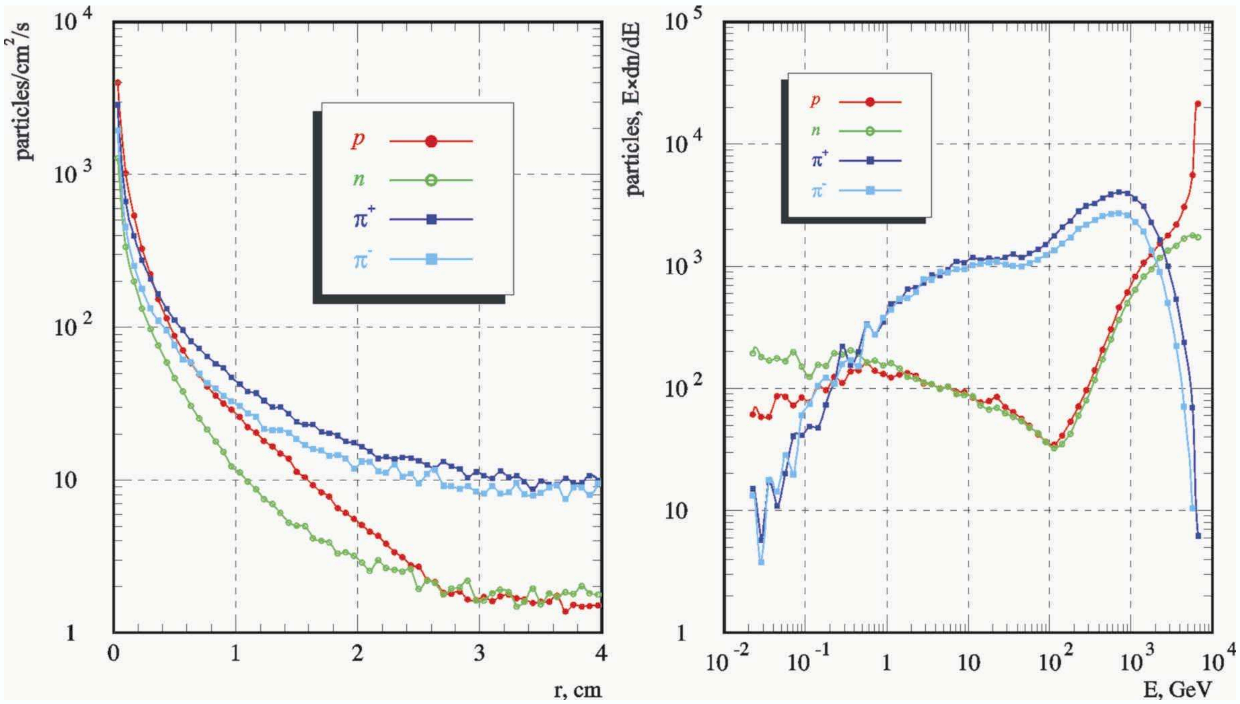
Fluxes in roman pot detectors (from Vadim Talanov)

Fluxes at 220 m at high lumi (10^{34}) (plots for 2.10^{29})

RATE EVOLUTION WITH CUTS [MD2005]

Particle flux in [Hz]

	p	n	π^+	π^-	e^+	e^-	γ
Pot at 220m	344	174	616	406	4630	3361	9.4×10^4

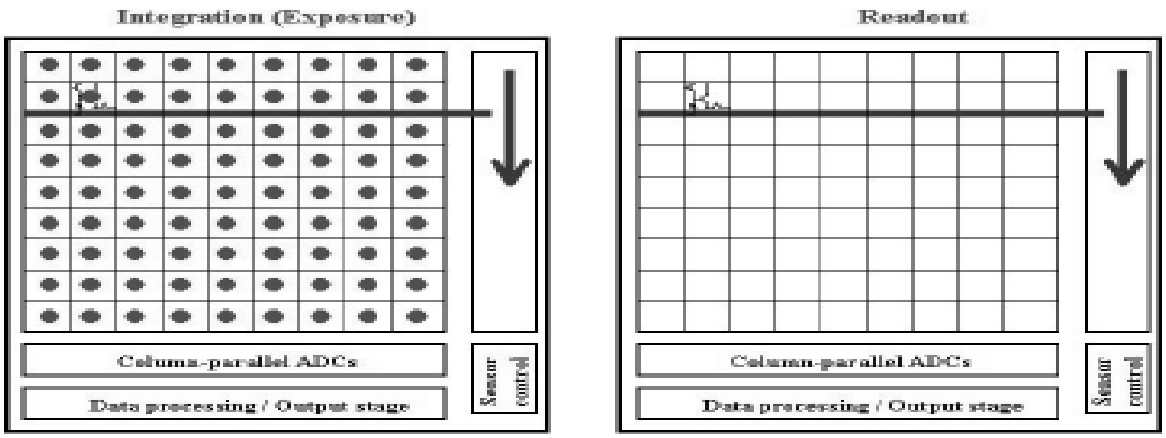


Which kind of detectors to be used?

- Good space resolution: of the order of 10-15 μm per plane, leads to a few μm per detector, useful if one wants to see (and use) the displacement from one station to another to distinguish halo from real event
- Good timing resolution: of the order of 5 ns to know from which beam crossing the event is coming
- Little dead material at the edge: of the order of 100 μm, to minimize the distance between the beam and the active part
- Very good timing resolution: to say from which vertex the protons are coming, use Cerenkov counters built also for FP420
- Readout or integration time: of the order of 5 ns to avoid pile up (we expect at high lumi 0.3 diffractive event by bunch crossing plus halo)

Pixel detectors

- Pixel detectors: First idea to use them for roman pots because of their good space resolution allowing to distinguish between halo and diffractive events
- Unfortunately long readout time: of the order to 10 μs, move to silicon strips



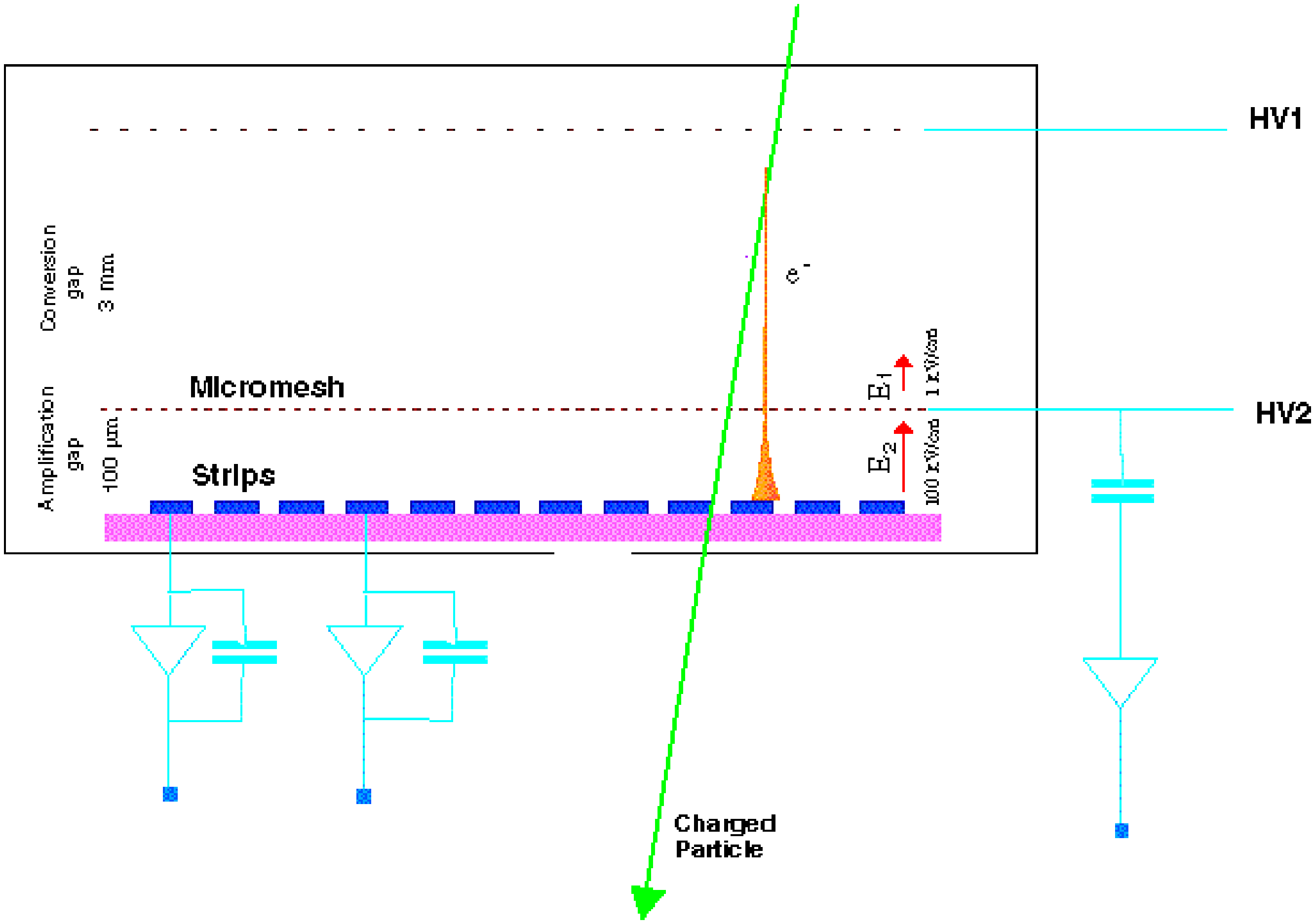
Si strip detectors

- Use Si strip detectors: fast readout of the order of 5 ns
- As an example, HAMAMATSU S6933: AC-coupled single sided Si strip detectors $67.8 \times 65.2 mm^2$, thickness of 300 μm, pitch of 25 μm, 2540 strips, price: 2900 Euros
- Due to thickness, possibility to use 5-10 planes
- One difficulty: how are these detectors sensitive to electromagnetic noise which might affect the Si signal?
- Timing: provided by Cerenkov counters (what is the space occupation? How to distinguish between halo particles and real proton at the PM level (contamination from halo?)?)

Micromegas detectors

- Micromegas: MICRO-MEsh GAseous Structure: based on a simple planar electrodes geometry: the combination of a two-stage parallel-plate avalanche chamber of small amplification gap (about 100 microns) together with a conversion-drift space
- The two gaps are separated by a thin electroformed micromesh (about 4 microns thick) resting on small insulating pillars of 200 microns diameter. The anode, on which the pillars are set, consists of small strips printed on an insulating support.
- Advantages: good timing resolution (1 ns), space resolution of 15 μm or better, good behaviour in radiative environment, non sensitive to electromagnetic noise, space occupancy of 4 mm per detector
- Potential problems: Put gas circulation in tunnel (safety problem? but the volume will be very small), what is the size of the dead material close to beam?

Micromegas detectors



Conclusion

- Started to study the project to install roman pot detectors at 220 m in ATLAS
- MADX program working with the help of beam division: acceptance studies...
- Project complementary to FP420 and "natural" follow-up of the luminosity project in ATLAS at 240 m: many things can be done together (simulation, acceptances, Cerenkov counters for timing....)
- Roman pots as close as possible to TOTEM ones, detectors still to be defined (Si strips, micromegas?)