Muon detector status LDC

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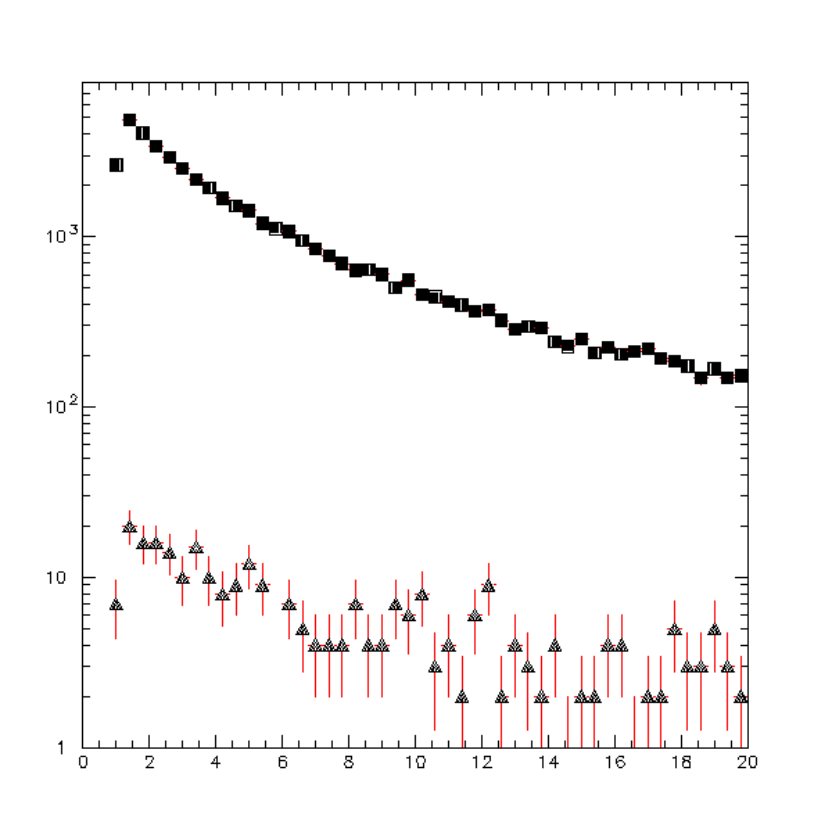
Agenda

- Few words on basic design.
- *Detector independent* simulated performances.
- Detector options
- A first attempt at costing
- Conclusions

Main design ingredients

- At the ILC μ-detection can use inner tracking:
  - No need of stand alone momentum measurement.
    - Might in principle give us an handle on decay un flight background
    - Spatial resolution set by cluster association between detector planes.
- Radiator (longitudinal) segmentation set by the requirement of having some calorimetric capability.

Standard Model background to μ's



Here is a single particle momentum spectrum.

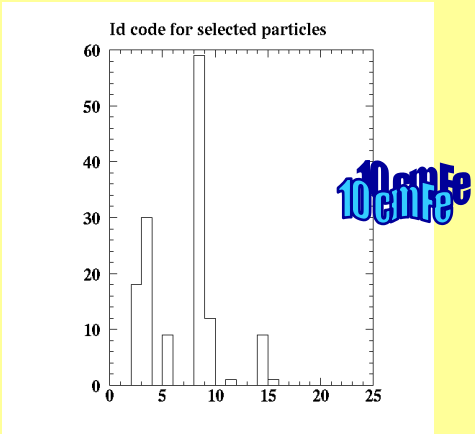
Process used are ZZ Zγ WW.

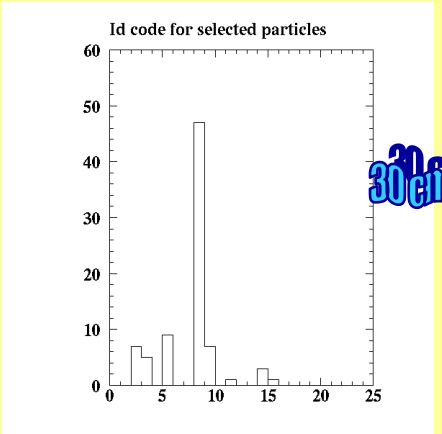
In black are hadrons in red μ's

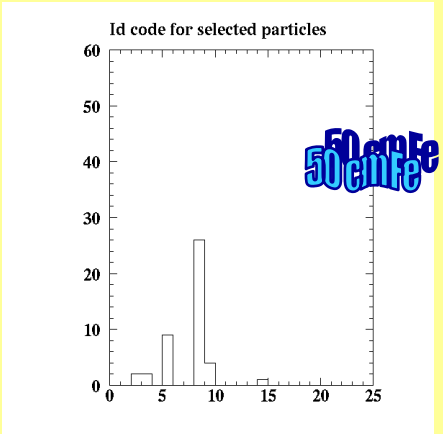
A little less than 1,000 μ are produced with 50,000 hadrons.

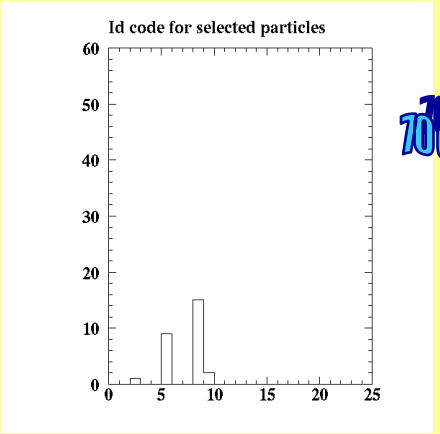
This number sets the rejection ratio the μ-identifier has to provide.

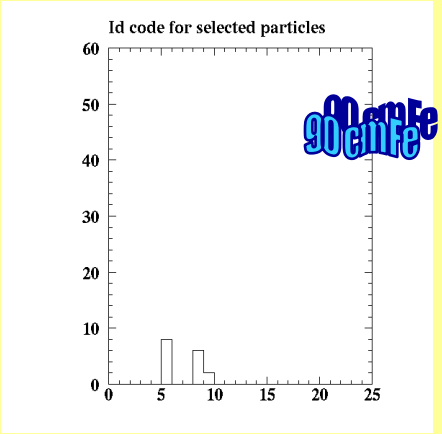
π Misidentification vs. thickness











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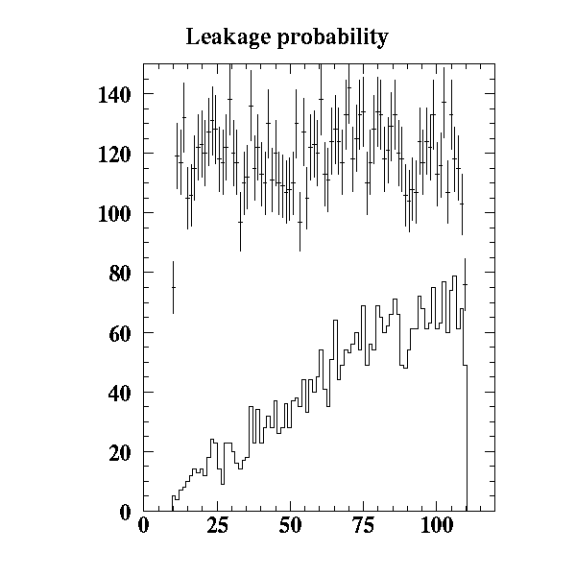
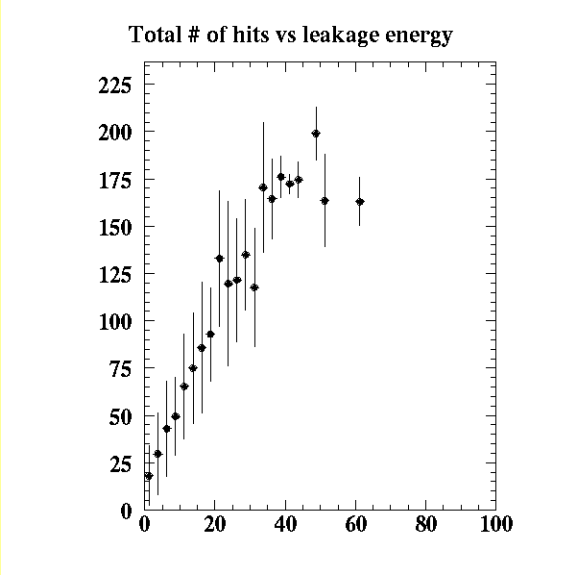
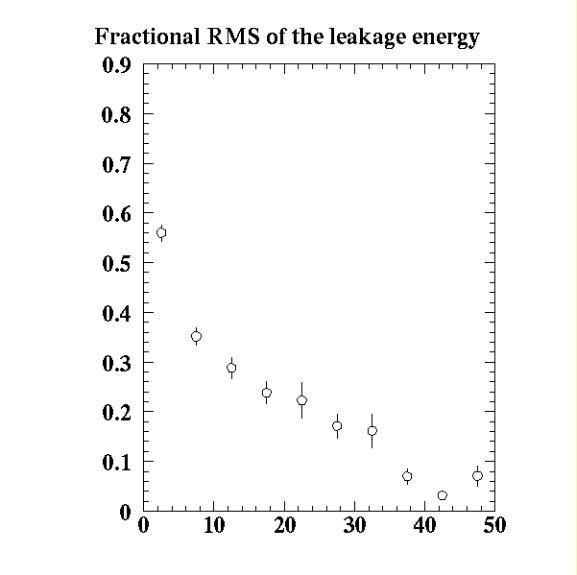
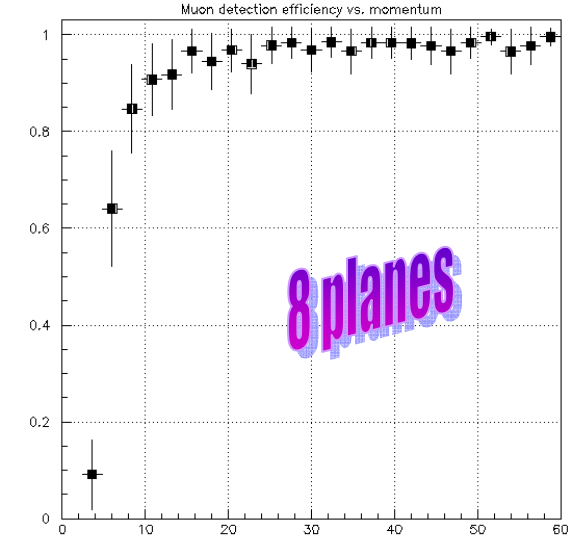
Energy leakage
single π

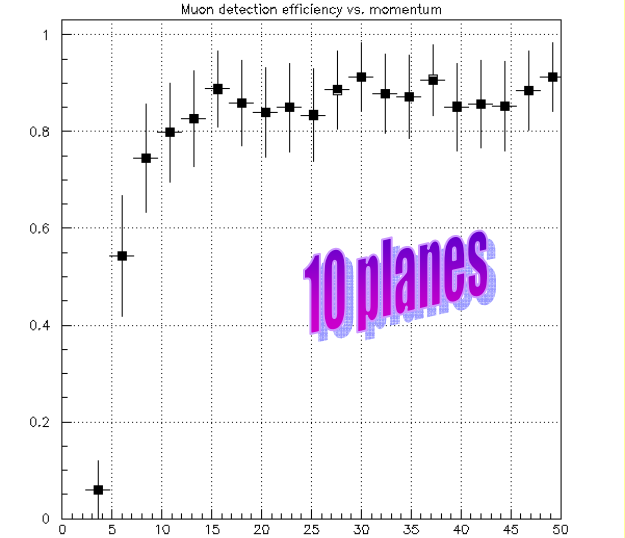






What about efficiency ?



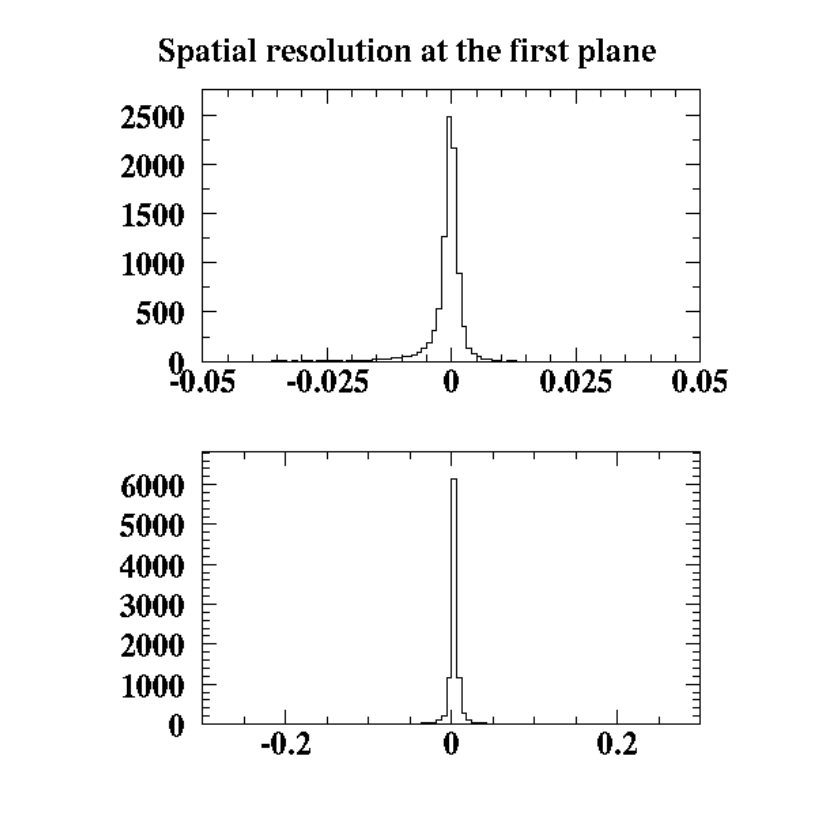


- **Single μ detection efficiency vs. momentum**
- **Requiring xx planes for the stub**

Requirements on spatial resolution

- The process of building a stub inside the μ-identifier requires spatial resolution of the order of few centimeters. $\mathcal{O}$(1cm)
- A good matching of an inner detector track with a muon stub needs a very good efficiency at the first plane. (Might require a double detector layer)
- At any rate many device can offer such performances easily.

Requirements on spatial resolution



- θ and ϕ r.m.s. at the first detector plane due to multiple scattering.
- The distribution width sets the spatial resolution scale for the detectors: working out the figures one gets 1.-2. cm.

Detector choice

- Many detectors offer the performances needed here:
  - Choice can be made on the basis of reliability, ease of construction and installation and **COST.**
- Gas devices:
  - Limited streamer tubes
  - Resistive plate chamber
- Scintillator based detectord
  - Scintillator strips a la Minos

Detector choice (cont.)

- Pro and cons:
  - Gas detector are easier and less expensive to build.
  - Small segmentation is relatively inexpensive for them.
  - Operational regimes, like limited streamer can yield big pulses that in turn mean less expensive electronics.
  - Scintillator strips, in conjunction with Si-PM can offer the same kind of performances; small segmentation, in this case, would result in bigger costs. The rate capability of this device is much better: one might be forced to use it in the small angle region where background might push detector rate up.

How about costing

- In order to start the long term involvement of INFN in the ILC program, a first attempt to roughly evaluate costing for the expt'l apparatus was carried out.
- For the μ identifier, the exercise has been done scaling the μ trigger system for CMS.
- So, the detectors chosen are RPC's: this does not imply a technological decision, but merely reflects the ease of the scaling process.

How about costing (cont.)

- The RPC technology has been completely tranfered to industry, so detector construction, within some dimensional limits, may be as easy as writing a P.O. (in principle…)
- In this situation the costing is easier to evaluate , even if it as always a snap-shot done at a given time.
- ….here we go….

How about costing (cont.)

rivelatore						area totale			
	n. rpc	area media (m^2)			prezzo unitario				prezzo totale
barrel	1152	2.3305			384	2684.736			442368
endcap	308	4.16			495	1281.28			152460
						3966.016			
strip									
	n piani di strip								
barrel	1344	2.3305			80				107520
endcap	336	4.16			135				45360
pads	1240				130				161200
meccanica									
	1460				250				365000
elettronica	discriminatori								
	<nstrips> x	<nstrips> y	tot x	tot y			n. schede	prezzo unitario	
barrel	70	40	47040	26880					
endcap	100	40	16800	6720					
			63840	33600	97440		6090	70	426300
elettronica tdc							n.canali	prezzo unitario	
							2500	50	125000
elettronica adc							n.canali	prezzo unitario	
							2500	50	125000
HV/LV	n.canali								
									750000
cavi trad.									
									150000
gas									
									2,850,208.00

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Conclusions from costing exercise

- A detector “TESLA/LDC” style with a single gap RPC per slot, 3 cm. wide strips and some (coarse) timing capability would result in an upper limit for cost of roughly 4 Meuro.
- This figure does not include installation expenses and the gas system.
- It is not clear to me how one would account for installation; the gas system has not been evaluated in detail, but it might add of the order of 5% to the above figure.

Summary and conclusions

- The LDC design for the muon system has crystallized over the last few months.
- Performances have been simulated and are not critically dependent on the operational details of the active detector.
- An effort has been carried out to evaluate as realistically as possible total costs, and within the options considered previously one might quote an overall figure of 4 Meuro.