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A Drift Chamber System for muon tomography

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Teesidel

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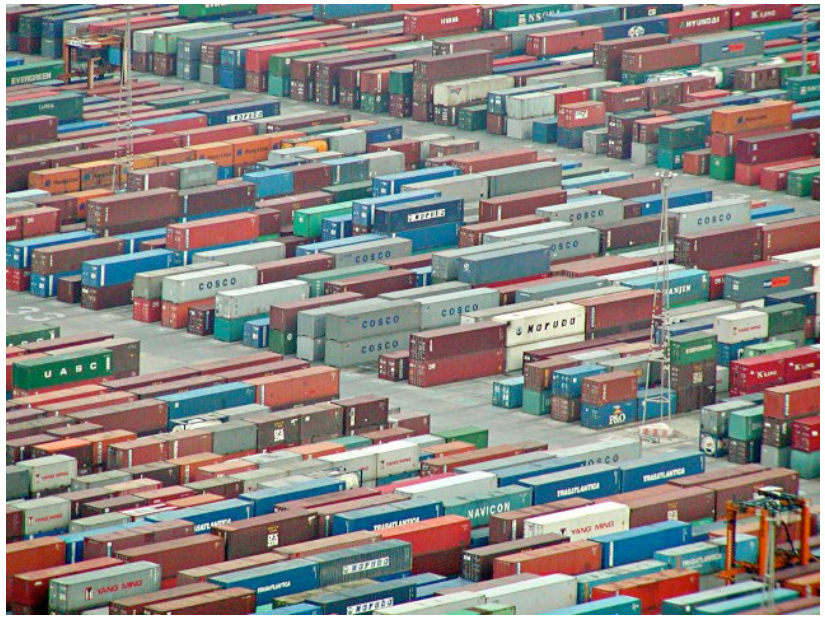
Smuggling of Uranium/ Plutonium

Much plutonium and weapons-grade uranium is unaccounted for. Unfriendly groups could assemble a device and transport it in a standard container lorry. Believed to be a real threat.



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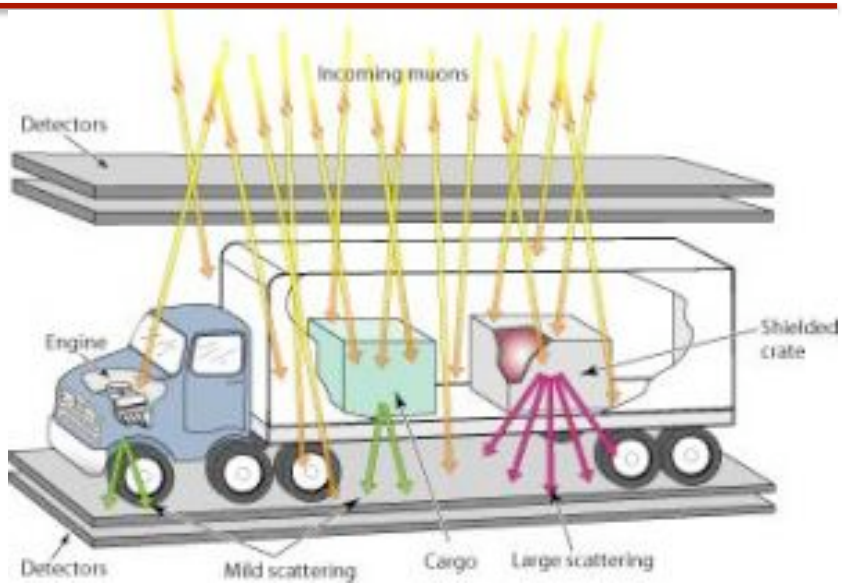
Border detection

- Radioactivity can be shielded
- X ray scanning can be blocked
- Detection must be rapid (few minutes) and not damage bona fide contents (+ stowaways)

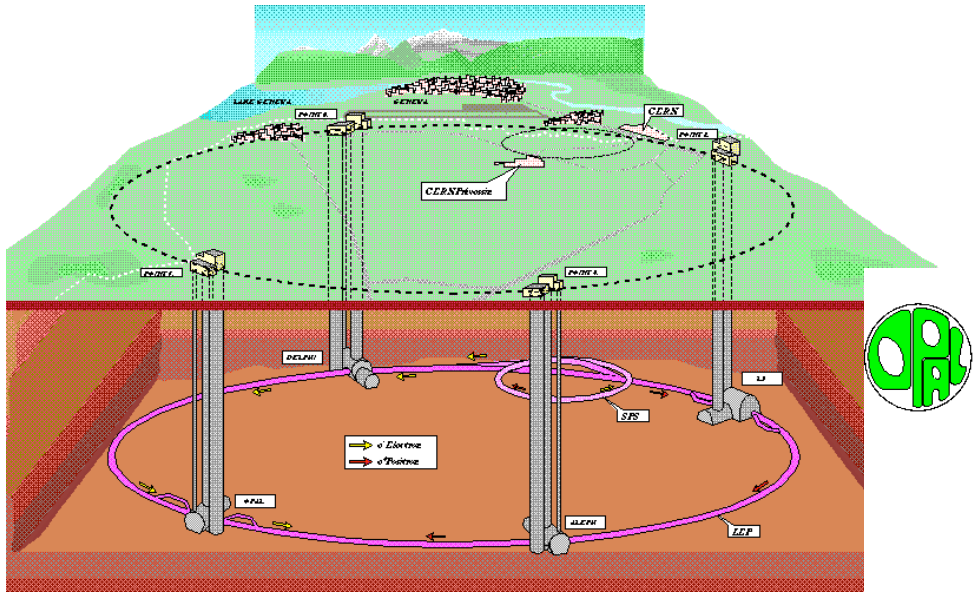


Muon Tomography looks like (part of) the answer.
Materials have high Z and large scattering power for the natural cosmic ray muons (1/ cm^2/min)

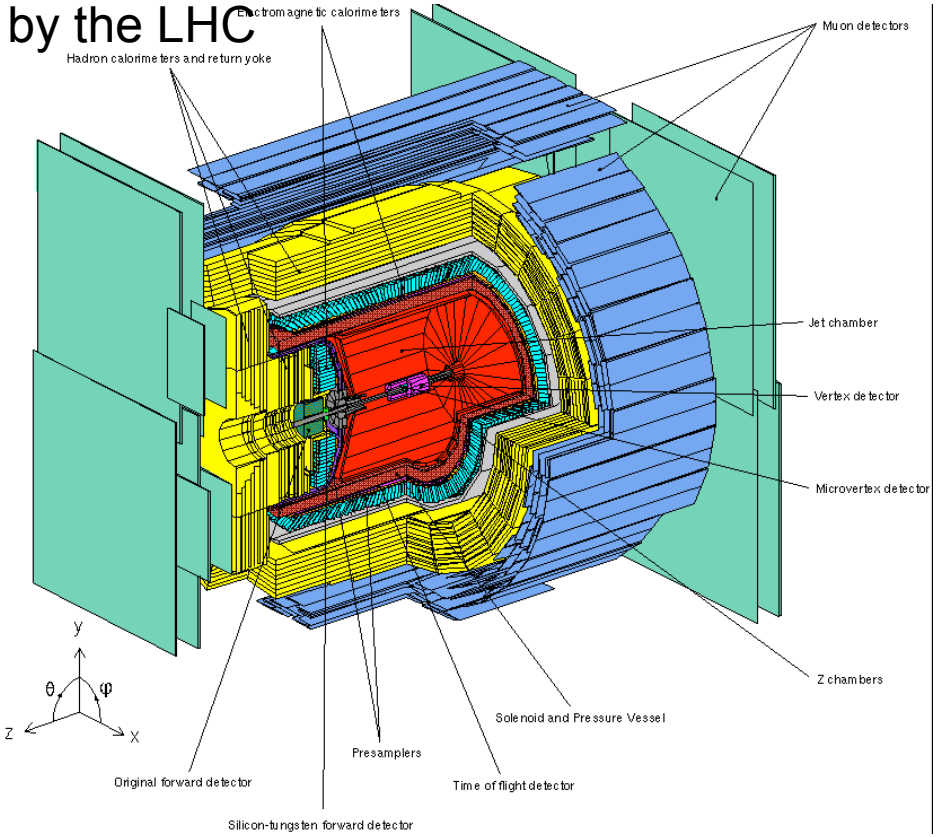
Muon chamber criteria

- Cover large area at reasonable cost
- Precision ~1 mm to measure scattering angle
- Ability to run for years without major maintenance
- Running in an open environment with non-expert operators

LEP and OPAL



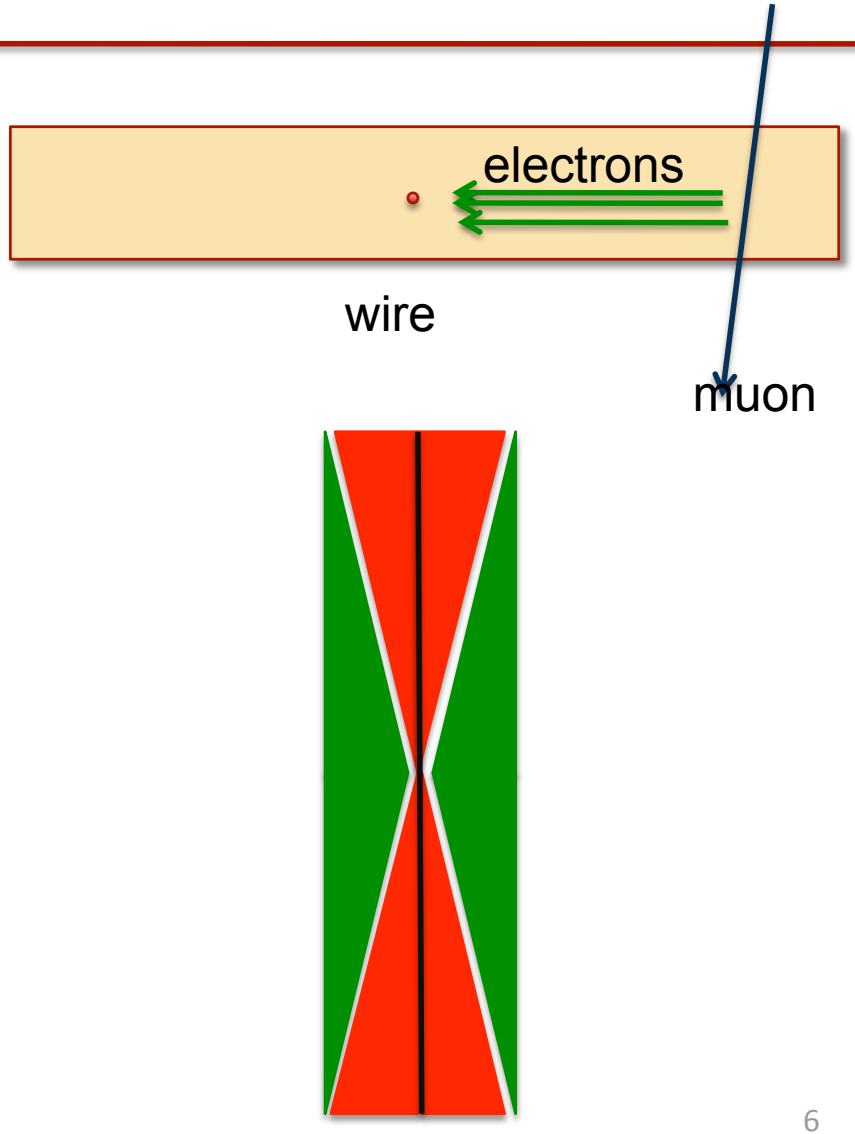
LEP – the Large Electron Positron machine – ran at CERN from 1989 to 2000 in the tunnel now occupied by the LHC



OPAL – one of the experiments at LEP. Measured tracks emerging from collisions from inner vertex chambers to outer muon detectors

OPAL muon chambers

- 220 chambers ~10m long by 60 cm wide
- Two coordinate readout from a single wire with 1-2 mm precision
- First from time taken for electrons to drift to anode wire
- Second from tapered cathode pads along wire



OPAL muon chamber criteria

- Cover large area at reasonable cost
- Precision ~ mm
- Ability to run for years without maintenance
- Running in a controlled environment with expert operators

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Adapt OPAL muon chambers for tomography

Chambers can be shorter: 2 m rather than 10 m

(single pad system rather than double)

Need a non-flammable gas.

Take advantage of modern electronics

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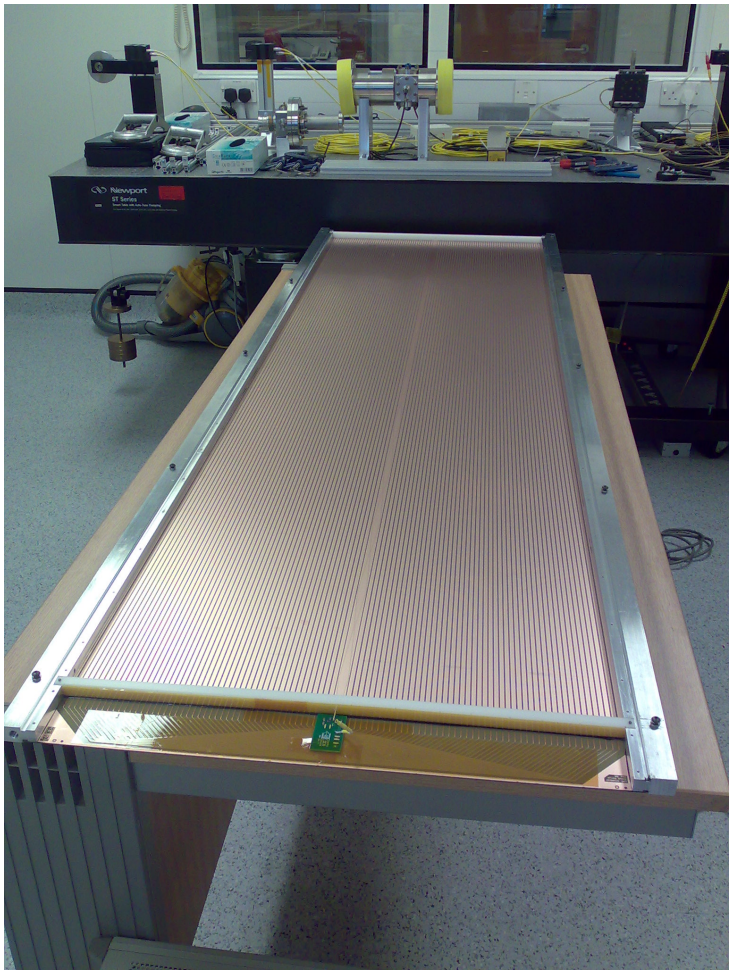
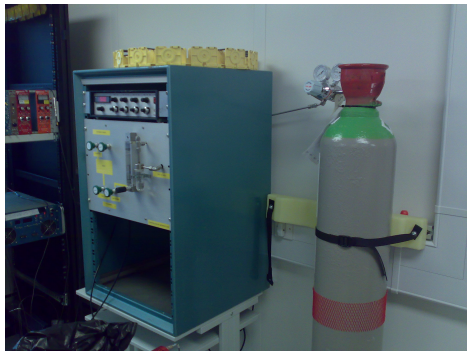
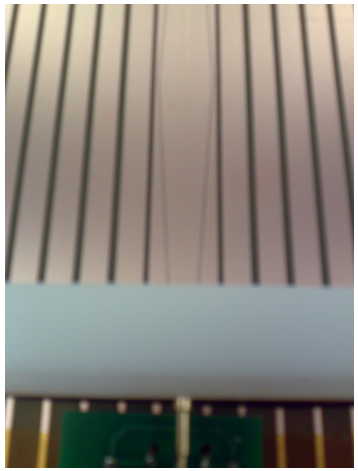
Now being built



Chamber ready for wire stringing



Nonflammable Argon/methane mix



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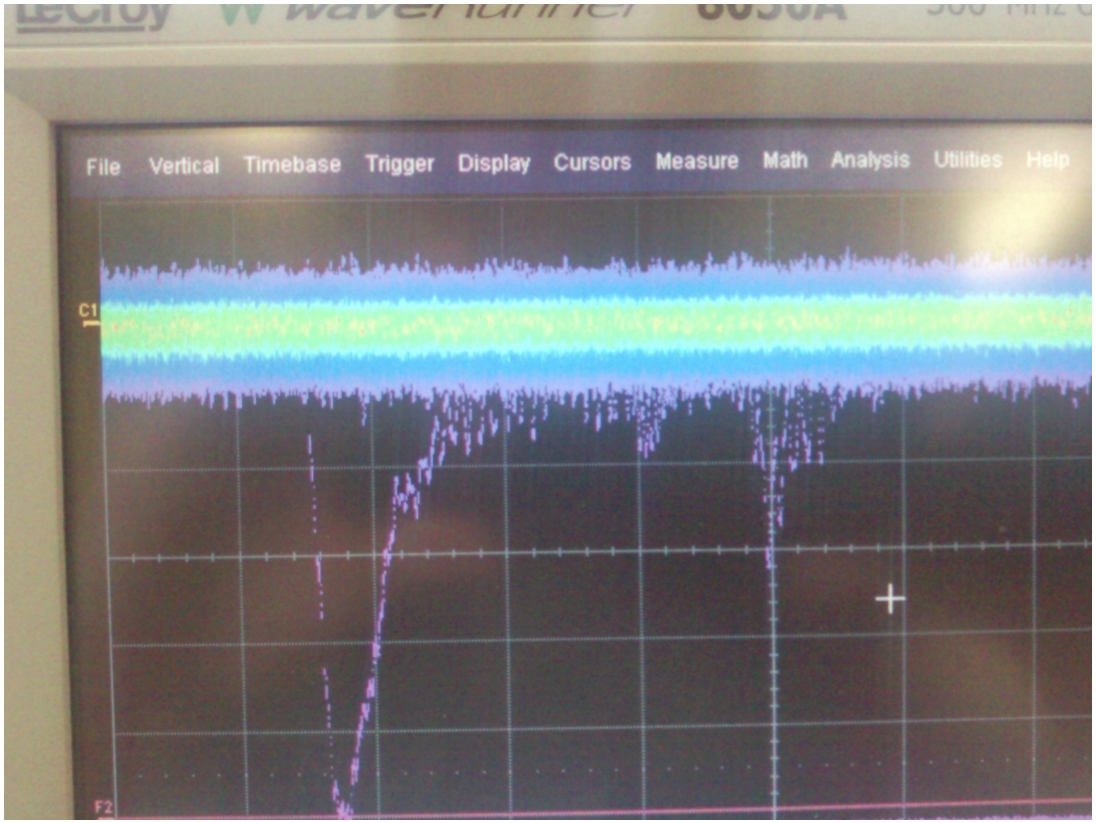
Signal pulses



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Conclusions

We have a drift chamber system adapted to muon tomography covering large areas with simple technology

Applicable wherever there is a need to scan a container for high Z material

If you're interested – see

http://www.hep.manchester.ac.uk/MuonTomography