# The Wilson cloud chamber or how to observe natural radioactivity?

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It is difficult to talk about nuclear, particle or cosmic ray physics because we cannot see or feel objects as *alpha, beta, gamma* radiations or *muon, pion* particles.

Cloud chambers intend to show these particles/radiations live, to convince that they are real physical objects with measurable properties; they allow demonstrating that these ionizing particles can be detected via an interaction with a sensitive medium through which they leave a track of their passage like a plane leaves a track of its passage in a bright sky [1].

Cloud chambers are detectors invented by the Scottish physicist Charles Wilson(*) in 1911. They consist of a container filled with a gas-vapour mixture, e.g. air-alcohol mixture, at the vapour saturation pressure. By means of an adiabatic expansion or by lowering the temperature, the vapour gets supersaturated. When a charged particle traverses the chamber, it will ionize the supersaturated gas which will then condense on seeds or positive ions producing droplets of vapour which can be illuminated to show the particle trajectory [2].

Numerous physics experiments have been conducted using expansion type cloud chambers leading to great discoveries like that of the antielectron and that of the muon lepton or "heavy electron" in the 30s [3]. This kind of detectors are no more in use nowadays in experiments but nevertheless, diffusion type cloud chambers are often operated for exhibition in order to attract people or students towards the subatomic world.

Experiments with a diffusion cloud chamber can be used to approach or to extend the knowledge in several areas of the physics lessons, essentially related to modern physics: thermodynamics, nuclear physics, particle physics, cosmic-ray physics, special relativity, ionizing radiation detection …

We will present the history and the principle of operation of the Wilson cloud chambers and then focus on home-made cloud chambers, explaining "how to build a cloud chamber?" and "how to operate it in a classroom?". One home made cloud chamber will be showed in details followed by its operation using cosmic rays.

(*) awarded a Nobel Prize in Physics in 1927 for his invention, more exactly for "his method of making the paths of electrically charged particles visible by condensation of vapour"

## References

[1] http://www.scienceinschool.org/fr/2010/issue14/cloud

https://scool.web.cern.ch/sites/scool.web.cern.ch/files/documents/SCoolLAB_CloudChamber_DIY Manual_2017_v3.pdf
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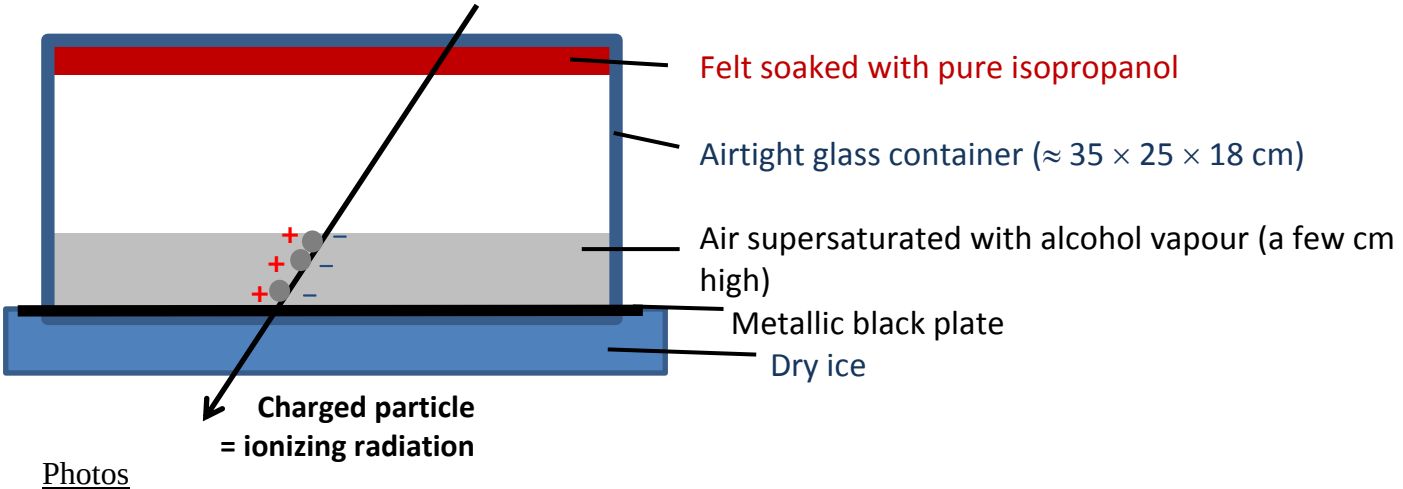
[2] E. Segré, Nuclei and Particules, W.A.Benjamin Inc., 1965, pp. 99-102
C. Grupen and B. Shwartz, Particle detectors, Cambridge University Press, 2008, pp. 160-162.
[3] R. Mermod, De l'électron aux quarks, Presses Polytechniques et Universitaires Romandes, 1999, pp. 9-23

Schematic representation of our home-made cloud chamber

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