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MOSCAB (Materia OSCura A Bolle)

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Abstract. This kind of detector (Geyser) has never been realized for the Elementary Particle Physics (it was constructed once in BERNA in 1964 by Hahn and Reist to detect transuranic nuclei. The Geyser is substantially a Vessel consisting of a "FLASK" containing a superheated liquid (f.i. some kind of freon) and a "NECK" (containing partially a separation liquid and partially the freon vapor). The Geyser was realized in Milano by setting the two different parts of the detector (flask and neck, filled in our case by freon C^3F^8,at different temperatures. The part of the overheated liquid was kept at higher temperature (f.i. 25 degree) and the gaseous part was kept at lower temperature (f.i. 18 degrees).

1. Introduction

The overheated liquid was in condition of weak superheat so it was insensitive to the minimum ionizing particles like electrons, but well sensitive to the recoiling low energy ions. In these conditions the ions deposit their energy in a very small region (size of the order 0.05-0.1 micron); a bubble can grow and reach 1 mm of radius (well visible). A local energy release due, for instance, to a recoiling ion induced by a WIMP interaction, can produce a vapor bubble which can grow (if over a threshold in energy) to visible size.

This vapor bubble rises in the liquid and pushes up part of the liquid in the neck(this is the reason of the name Geyser).When the equilibrium pressure is reached the hot vapor in the top of the vessel recondenses, and the liquid returns into the main volume. The original metastable state returns in a few seconds and the system is ready to record a new event. The system doesn't require external interventions or recompressions. In Figure 1 the Ideal Cycle of a Geyser is shown.

Furthermore the degree of superheat must be adjusted in such a way to exlude the detection of MIP (like electrons and gammas) and on the contrary to detect with high efficency the recoilinng ions. So the principal advantages of the Geyser and the Bubble Chambers are the following: 1)The strong rejection of the MIP particles. 2)The simplicity of the mechanical construction(for Geyser) also for large size Detectors. 3)The very interesting possibility to count neutron's interactions and to subtract this background (the interaction length of a neutron is of the order of 6 cm in our liquid) and so the double or triple interactions in the same frame can help statistically to evaluate the number of events with a single interaction due to neutrons. Clearly a WIMP has at maximum only one interaction. 4)The possibility to distinguish the spin dependent interaction of WIMP from spin independent by changing the composition of the liquid used. The property (1) mentioned before is already tested (Rejection at the level 10**11 of mip particles (see COUPP work)) Two cameras were seeing in a continuous way (50 frames per second (fps)) the volume in the freon vessel. Some pixels undergo a change of luminosity when a bubble is generated. At this point a trigger was launched and a stream of pictures was

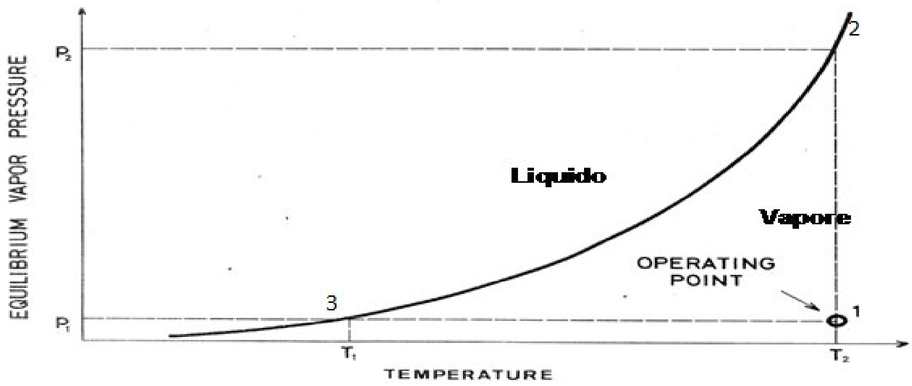

Figure 1. Ideal Geyser Cycle

registered (for Instance between -50 and + 50 frames starting from the trigger). The evolution of a bubble observed in the prototype detector is shown in Fig.2.

After that, the stream of data was stored and visually scanned to check the validity of the bubbles. The vessel (quartz or glass) was immersed in a water bath and it was surrounded by Cu coils with an internal circulating water at two fixed temperatures. The temperature of the regions of water were kept fixed by two thermostats with a precision of 0.1 degrees. Everything was surrounded by a cylindrical vessel of plexiglass (thickness 1,5 cm). The freon was illuminated by diffuse light, coming from LED. Now a better and bigger Detector is ready in Milano and it will be transported to the LNGS. The following Fig. 2 shows the evolution of a bubble in the Geyser: the sequence starts from the fourth line (Right to Left), continues in the third line (always from Right to Left); in the second line the bubble reaches the top of the freon and there we can see a small protuberance like in a natural Geyser; in the first line the bubble goes up and arrives in the vapour region.

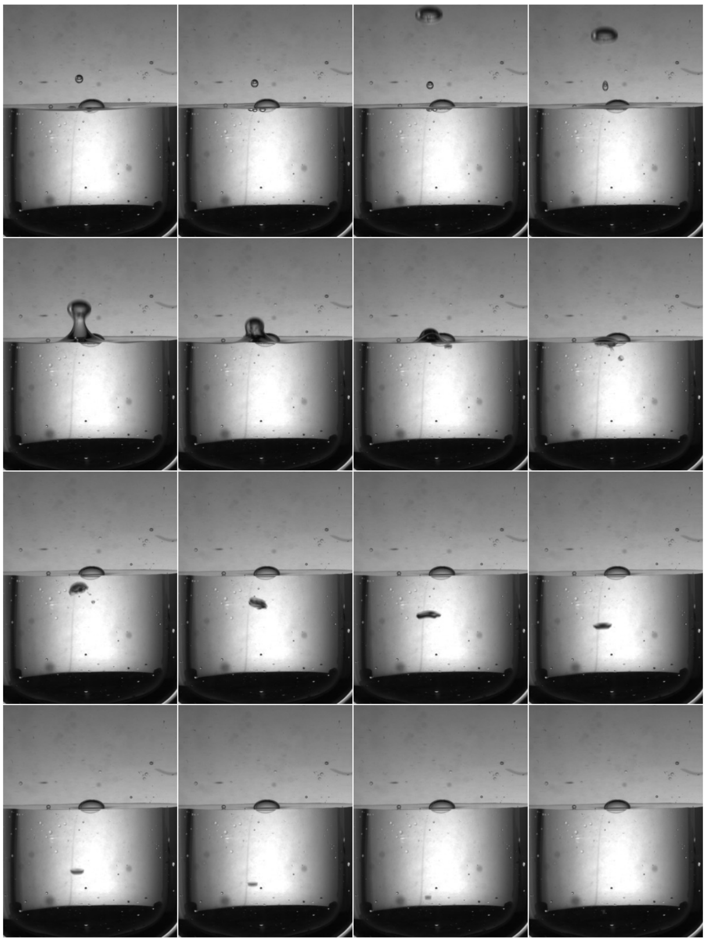

Figure 2. Evolution of a bubble

In the Fig.3 the sketch of the new Detector that can contain 40 kg of freon is reported. In this figure are reported two freon vessels (for 2 L and for 40 L); they can be used(clearly separately); but the mechanical and thermal supports are able to include both. The thermostats are shown in the figure(Lauda); to see inside the vessels two port-holes of glass are shown and to see the bubbles three holes are performed in the bottom (they can be used for a neutron source and for the light). During 2016 this detector will be transported to the LNGS and it will start to take data.

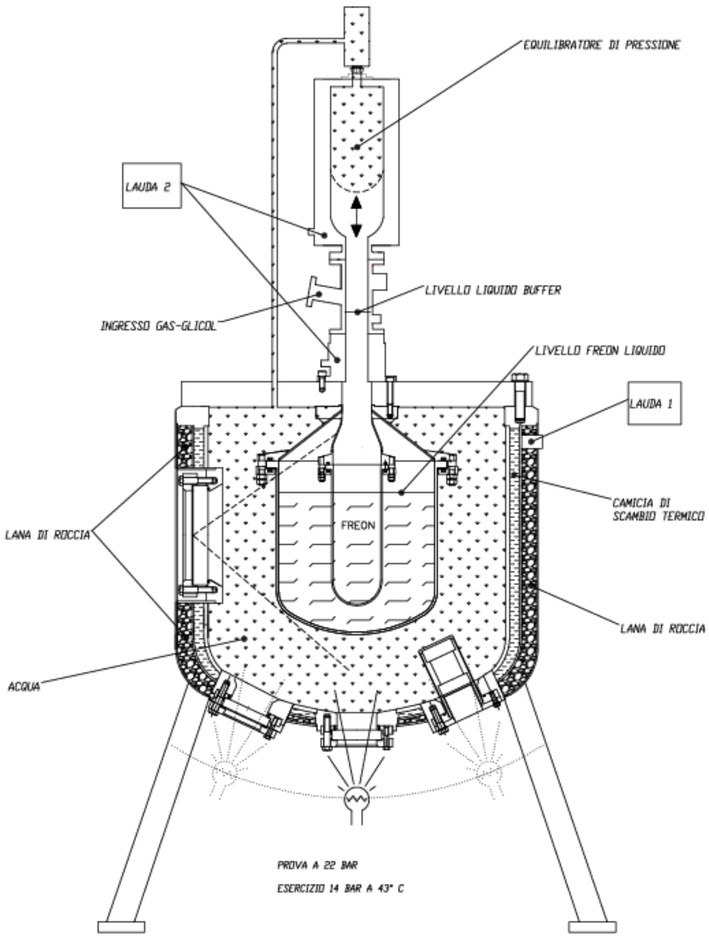

Figure 3. Sketch of the 40 Kg detector