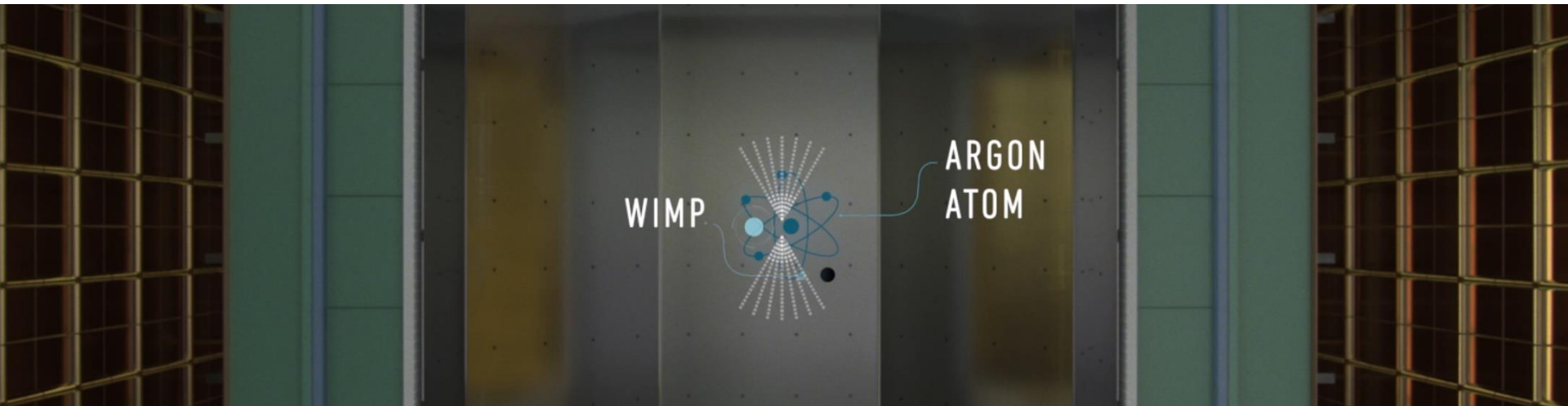




DarkSide Masterclass

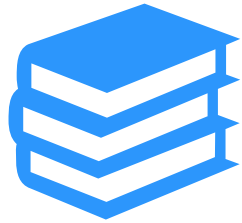


Results – Group 3

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Liceo Galvani, Bologna/ 6/11/20





Theory Overview

- **What is the Dark Matter?**

Dark Matter is a non-luminous unknown particle that is postulated to exist in space and could take several forms including weakly interacting particles (WIMPs, cold dark matter) or high-energy randomly moving particles (SIMPs, hot dark matter).

- **How can we detect WIMPs?**

WIMPs can be detected by analysing the interaction with known matter in a protected environment in order to avoid the exposure to background particles.

- **How can we reduce the background?**

The background can be reduced by operating underground and using radio-pure materials such as Argon (Ar) as a target for WIMPs and for the structure.



**Results: exercise on
reconstruct position
and cut**

We analysed 3 events: number 4, 19383 and 474
We used the “Position Cut sheet” to ensure that the events detected could be potential WIMPs respecting the Fiducial Volume definition

Fiducial Volume definition
$0\text{ cm} < r < 15\text{ cm}$
$4,4\text{ cm} \leq z \leq 31,9\text{ cm}$

event 4

r (cm)	8,05742
Drift Distance (cm)	23,564
z (cm)	12,036

X_Mean (cm)	-7,172
Y_Mean (cm)	4,106

Event 4 and 19383
 can be considered
 as potential WIMPs

Event 19383

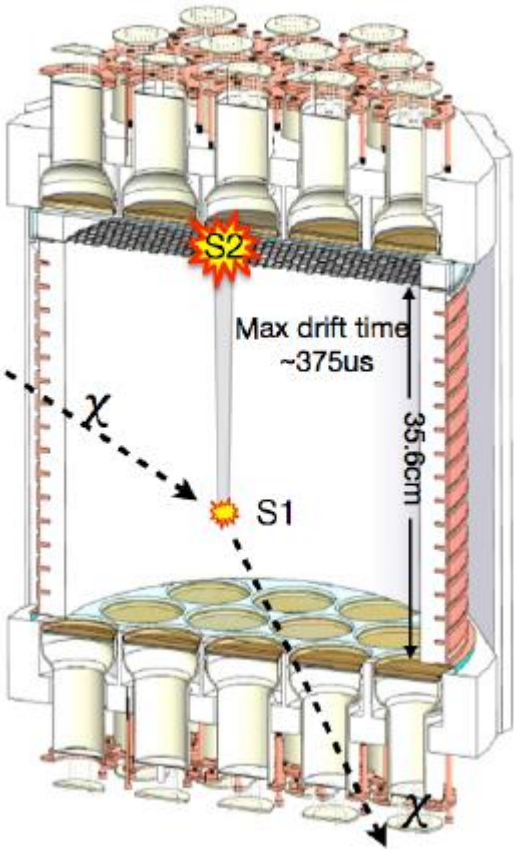
r (cm)	8,138
Drift Distance (cm)	12,070
z (cm)	23,530

X_Mean (cm)	7,035
Y_Mean (cm)	-4,229

Event 474

r (cm)	17,392
Drift Distance (cm)	30,847
z (cm)	4,753

We didn't consider this
 event because it was out of
 the fiducial volume



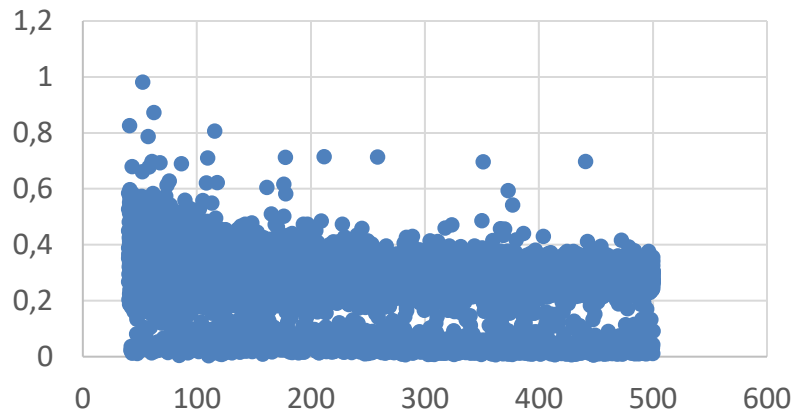
DS-50 TPC principle of operation from D'angelo, Davide "DS-50 TPC principle of operation" in *Proceedings of the 20th International Conference on Particles and Nuclei (PANIC 14)* 24-29 August 2014. Hamburg, Germany. DOI: <http://dx.doi.org/10.3204/DESY-PROC-2014-04/315>



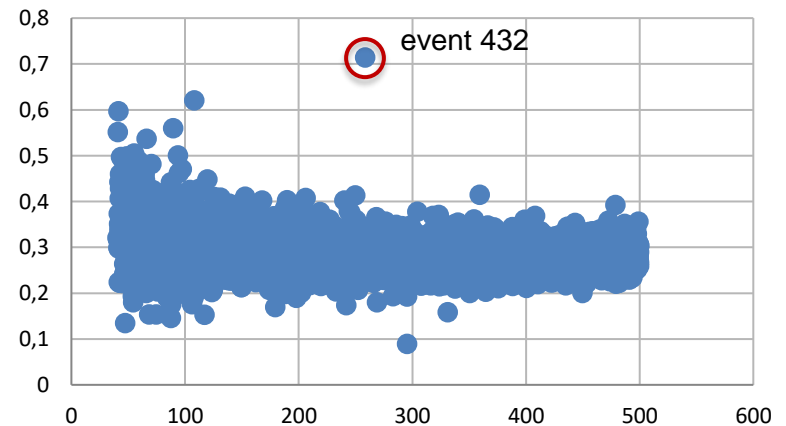
**Results: exercise on
 f_{90} vs $S1$**

We analysed a set of data from the existing DS-50 experiment in terms of f_{90} vs S_1 : f_{90} is expected to be roughly $>0,6$ for DM interaction.
To remove the background we applied filters to the radius ($r(\text{cm}) < 15\text{cm}$), Z ($4,352\text{cm} < Z(\text{cm}) < 31,88\text{cm}$) and to the VETO ($\text{VETO} < 6\text{pe}$)

Before



After



- **Entries under $f_{90}=0,1$ were excluded**
- **Most events in the region of potential WIMPs were cut out**

Conclusions



- **Why do we look for WIMPs?**

Dark Matter makes up the 85% of the known universe. Therefore, the discovery of these particles would give us a better grasp on the nature of the universe.

- **How did we work?**

We analysed a set of data collected by a two-phase liquid argon time projection chambers (LAr TPCs) as part of project DarkSide-50. Using Excel we verified that the events fit the parameters of an expected WIMP event

Conclusions



- **Did you find a WIMP signal?**

Observing the filtered plot graph, we found one potential WIMP signal

- **At which event number?**

Event number 432 (258, 7,1)

- **Why do you think that it is a WIMP event?**

The event is isolated from other ones and respects all the filtering parameters applied: Fiducial Volume, VETO quantity of light emitted, f90 vs S1 values which determine the DM area on the graph.