

The DarkSide masterclass is a set of lectures and exercises addressed to High School students.

You can find two directories: **Level 1** and **Level 2**, corresponding to two slightly different levels of complexity.

The two directories include the files described below.

### ***First Part***

**Lecture\_Masterclass\_Part1.pptx** is a set of slides about Dark Matter and WIMPs

**Lecture\_Masterclass\_Part2.pptx** is a set of slides about how to detect WIMPs and a description of the experiment

Please note that:

a few videos are included in the slides;

a few comments, as a guide for the speaker, are included in the slides.

The duration of the lectures is around 30 minutes each (questions included).

Watching the DS-20k promotional video is also foreseen during the masterclass. The video can be either watched in between the two lectures or be sent to the participants before the masterclass.

You can find the video here:

<http://darkside.lngs.infn.it/promotional-video-2/>

### ***Second Part***

The second part of the masterclass includes two exercises, by using a set of data from DS50.

#### **First exercise**

study of the position cuts by analyzing 3 particular events: the students have to compute the  $z$  and  $xy$  coordinates by using S1 and S2 signals; they have to state whether that event is accepted or not (fiducial volume).

*Files:*

**Instruction\_PartA.pptx**

**Masterclass\_PartA\_Position\_cut.xlsx**

The xlsx file can be downloaded and used either with Excel or with a Google Sheet.

The pptx should be downloaded since it contains some videos (not visible by Google tools).

### **Second exercise**

analysis of 20k events to obtain the f90\_vs\_S1 plot and look for candidate WIMP events: the students are required to apply sequential cuts, draw the plot and check if events are in the nuclear recoil/WIMP region.

Please note that a fake WIMP event is included in the data.

*Files:*

**Instruction\_PartB.pptx**

**MasterClass\_PartB\_f90S1.xlsx**

**MasterClass\_PartB\_f90S1\_5000.xlsx**

The xlsx file can be downloaded and used either with Excel or with a Google Sheet.

Please note that MasterClass\_PartB\_f90S1.xlsx contains 20k events, while MasterClass\_PartB\_f90S1\_5000.xlsx contains a subset of 5k events.

The smaller set was prepared in order to avoid possible issues with CPU.

A final discussion of the results is foreseen at the end of the Masterclass.

The file **student\_results.pptx** is a template that can be filled by each group of students and used to summarize their results.

In case there is no time left at the end of the Masterclass this file should be sent, once ready (in a few days), to the organizers.

### ***Difference between Level 1 and 2***

The lectures are the same, but in Level 2 a few more slides showing more details on S1 and S2 signals and the exclusion plot are included.

Level 1 foresees that the exercises are performed by using Excel or Google Sheet. The cuts are applied by using the filter option and the formulas to be used are included.

Level 2 foresees the exercises are performed by using Excel or Google Sheet and in this case the students have to write formulas by themselves.

A procedure with “root” instead of Excel/Google sheet is explained; so, in Level 2 additional files are provided:

**TTreeMaker.c** to create a root Tree including needed variables;  
**data\_master.txt** is the set of data that the students have to read by using the root macro or by uploading the txt file in a Excel/Google sheet file;  
**Student\_report\_guide.pptx** if the corresponding template file for Level 2.

Level 2 also makes use of 2 level cut VETO, both from the LSV and WT (while in Level 1 only one VETO cut is reported). A PSD simplified cut for educational purpose is also added.