

# CRESST (Data Analysis)

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MPP

September 7, 2018

# Goal of this talk

Very brief overview over the CRESST Experiment.

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Please try to spot things relevant for you and ask us about the details later.

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- Cryogenic detectors → 10-20mK
- Detection by energy/heat deposition measured by a special thermometer



1 Detector Working Principle

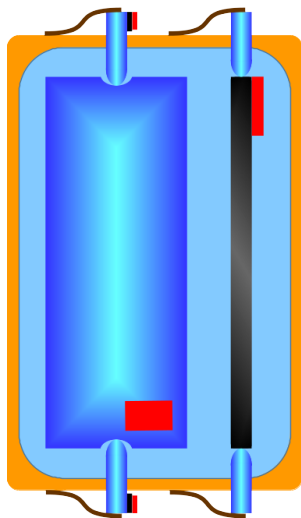
2 Data Acquisition

3 Data Analysis

4 Results

# CRESST Detectors - Modules

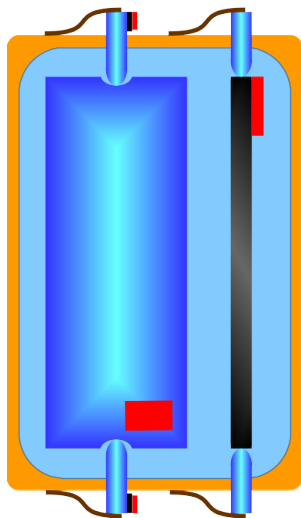
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## Module components

-  TES
-  CaWO<sub>4</sub>
-  Light Detector
-  Reflective Foil
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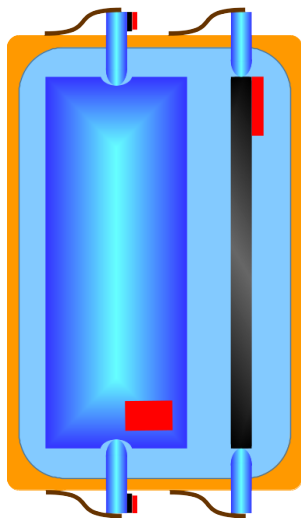


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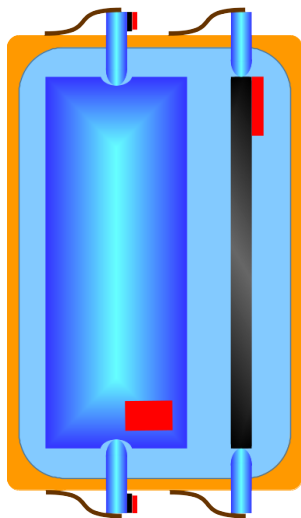


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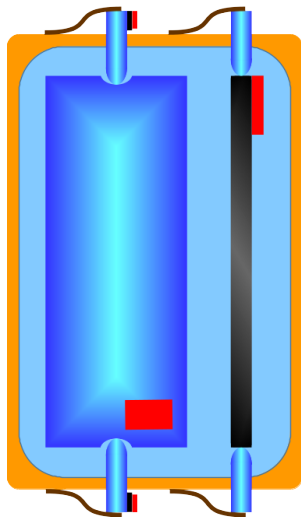


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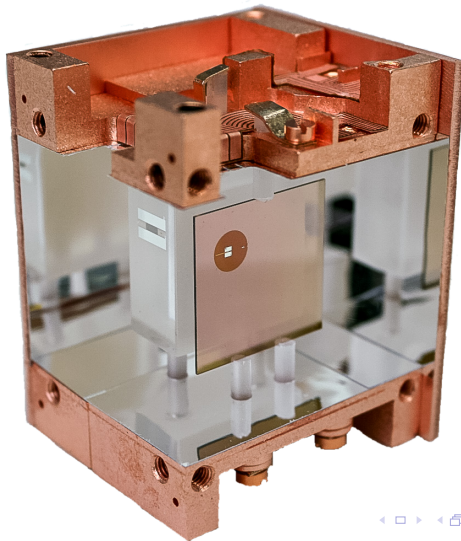


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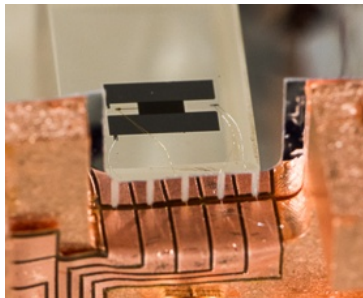
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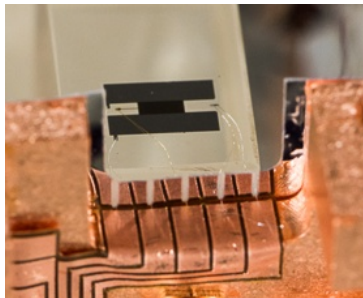


# CRESST Detectors - Thermometers



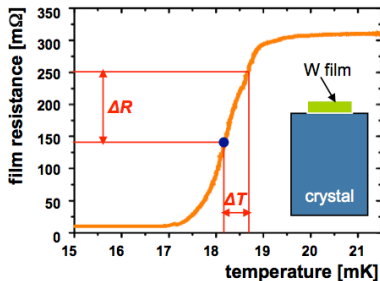
# CRESST Detectors - Thermometers

- Superconductor stabilised within its phase transition

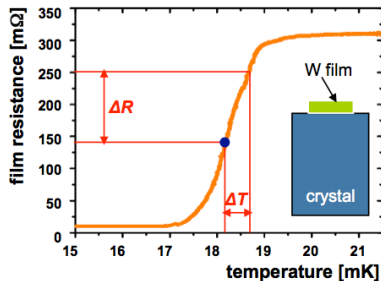


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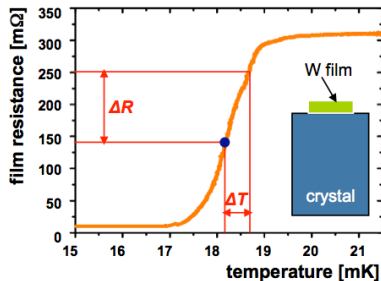


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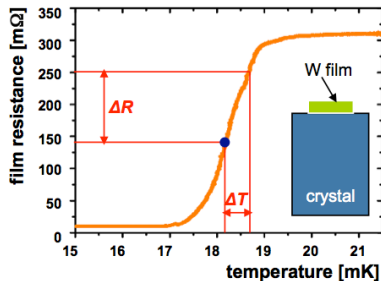
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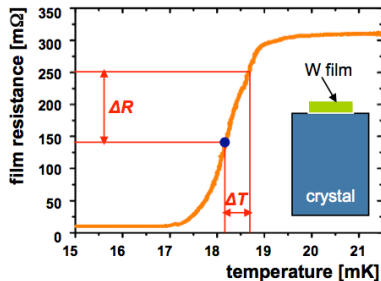
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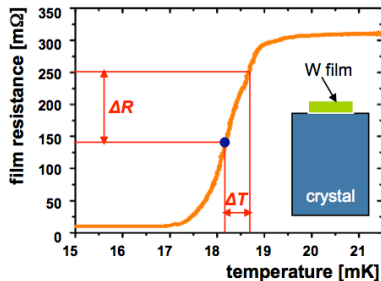
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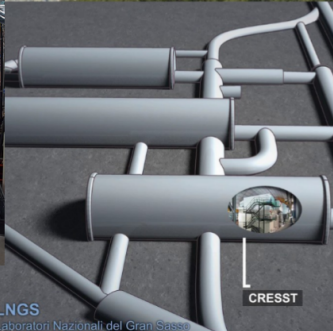
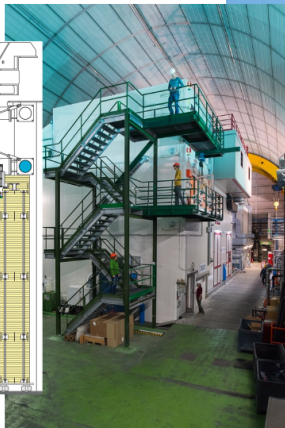
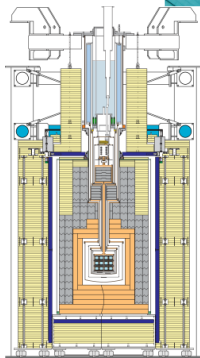
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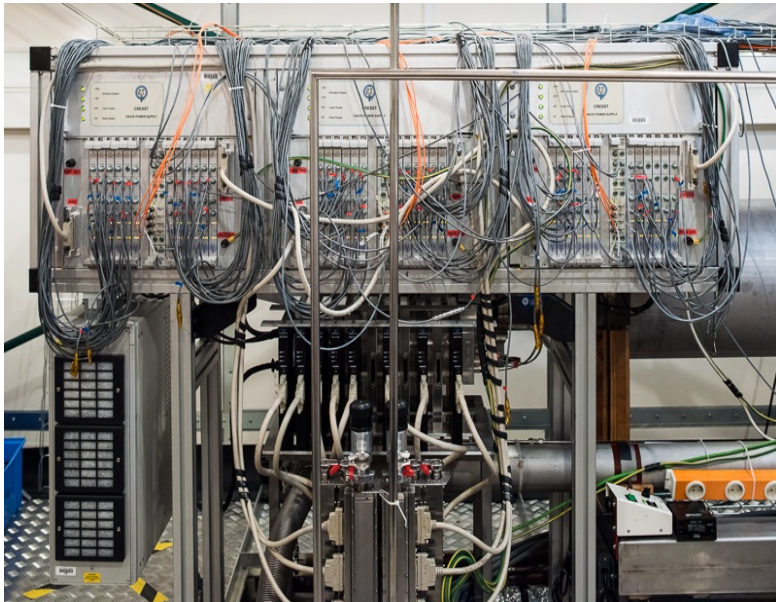
- Superconductor stabilised within its phase transition
- Small temperature changes lead to big resistance changes
- Read out with a SQUID system
- Very sensitive (Detector threshold in the end  $\approx 100$  eV)
- Requires a temperature stabilization
- Limited linear and dynamic range



# CRESST Detectors - Shielding and Location

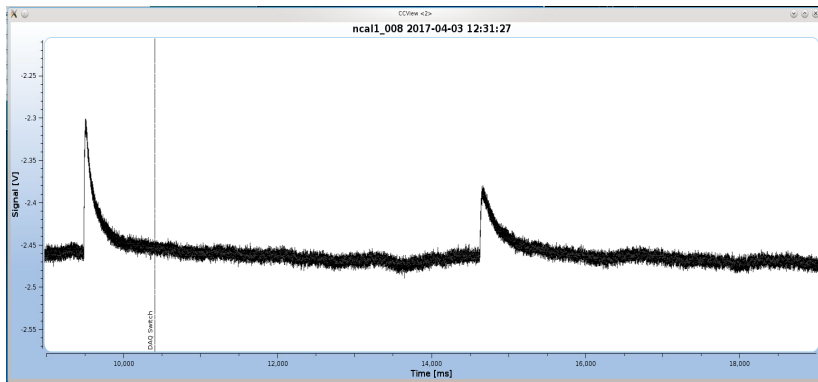


# Continuous Data Acquisition



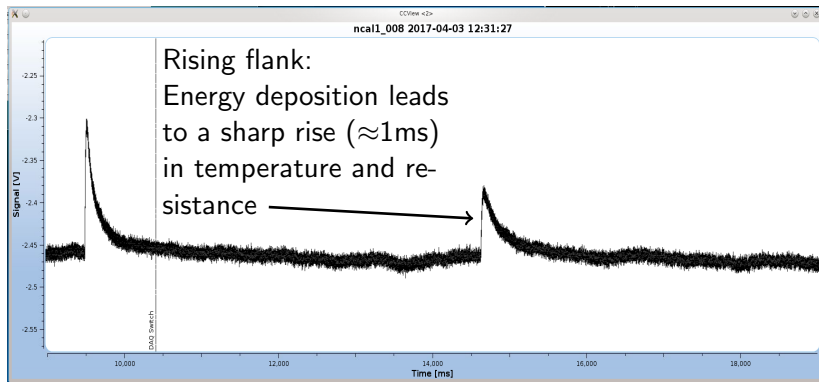
# Continuous Data Acquisition

The analog voltage output from the detector side is continuously sampled, digitized and written to disc:



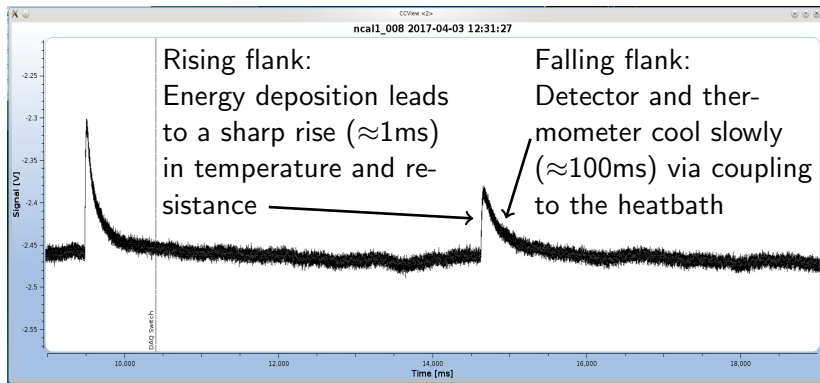
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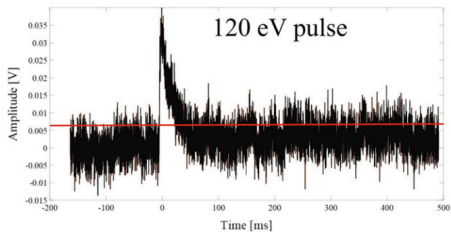
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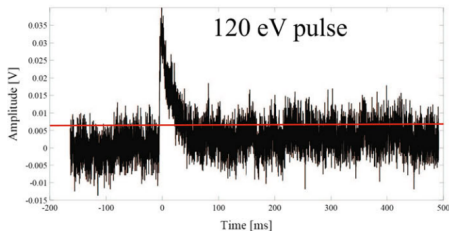
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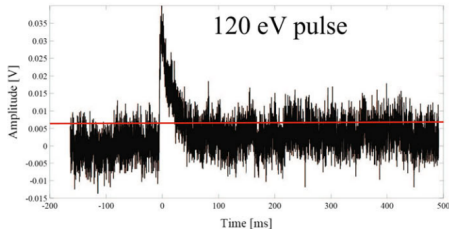
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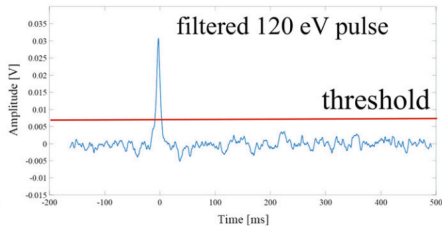
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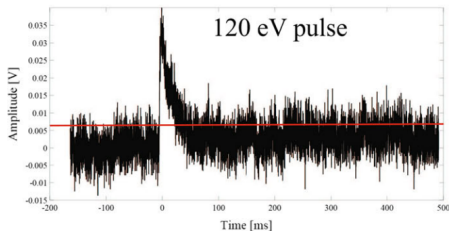
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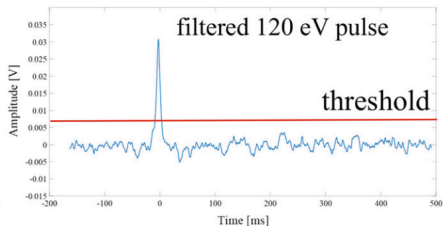
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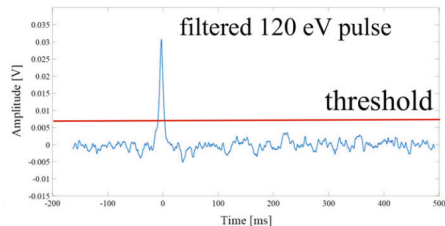
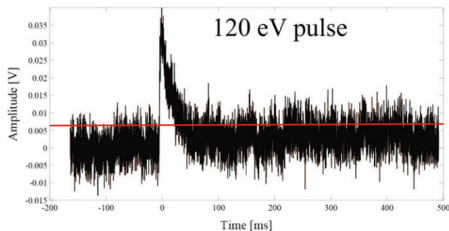
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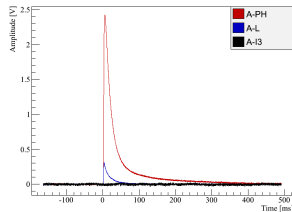


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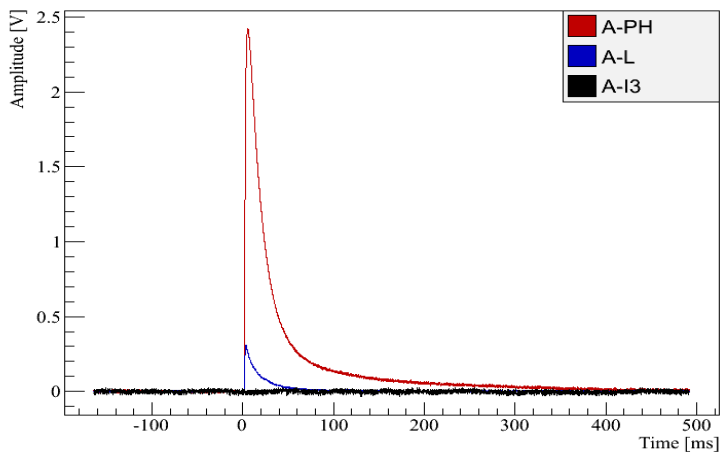
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Event 45622 -- Thu 3-Nov-2016 04:44:43.920 (CET)



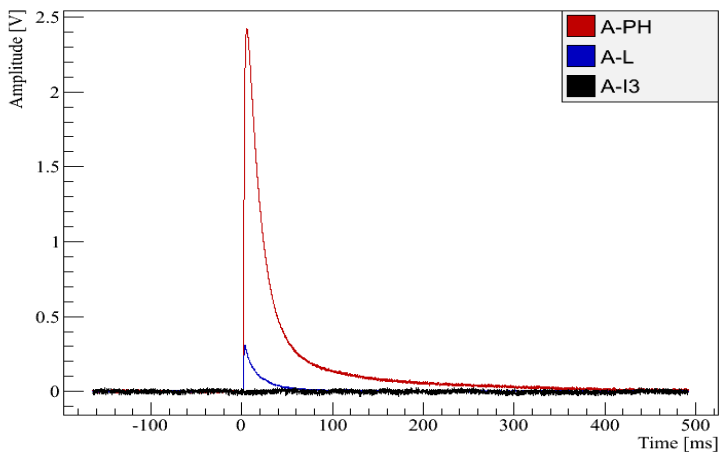
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This is where my work usually starts.

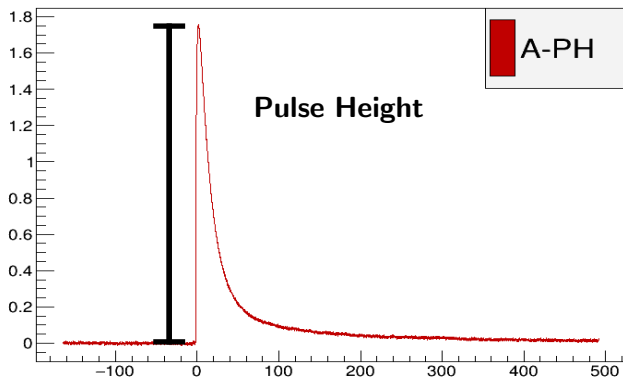
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Parameters derived from the events to better classify them and reject bad events that cannot be analyzed properly e.g.:

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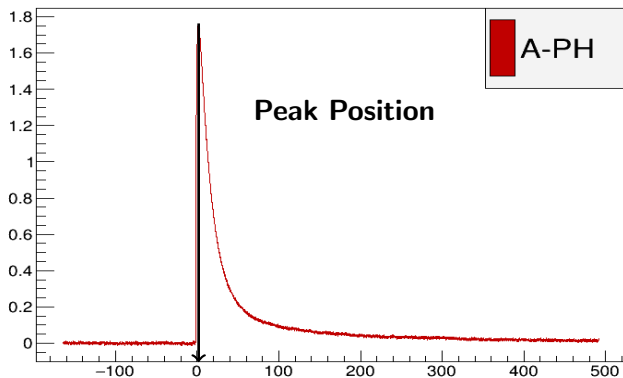
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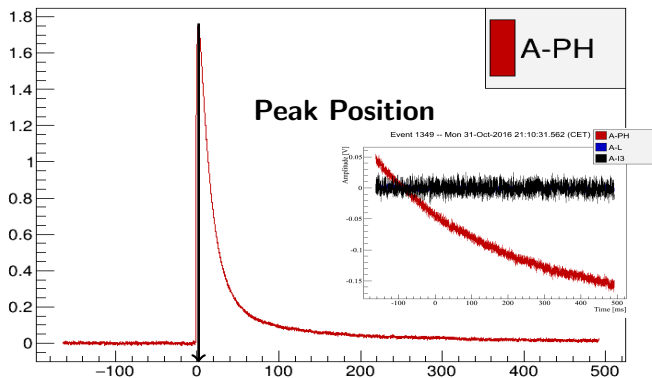
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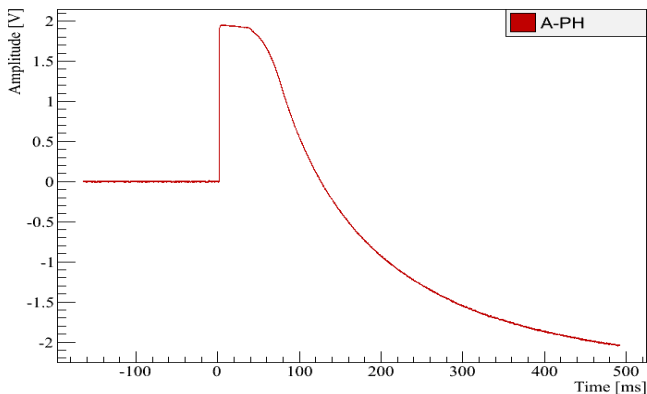
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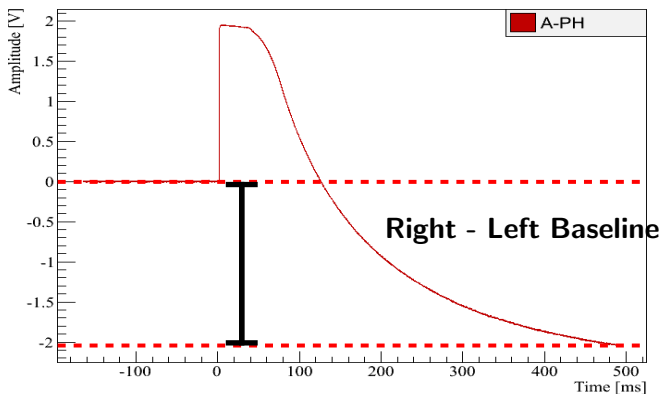
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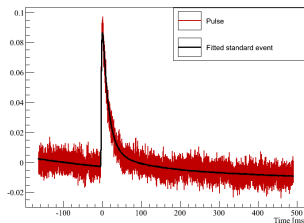
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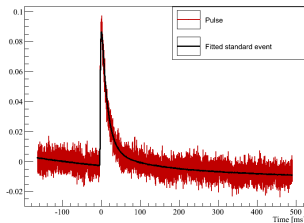


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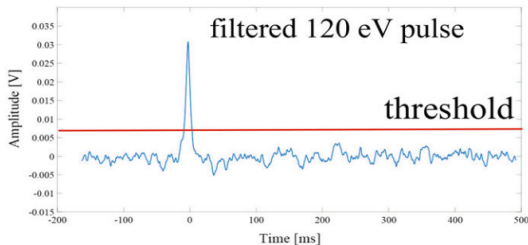
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## Optimum filter





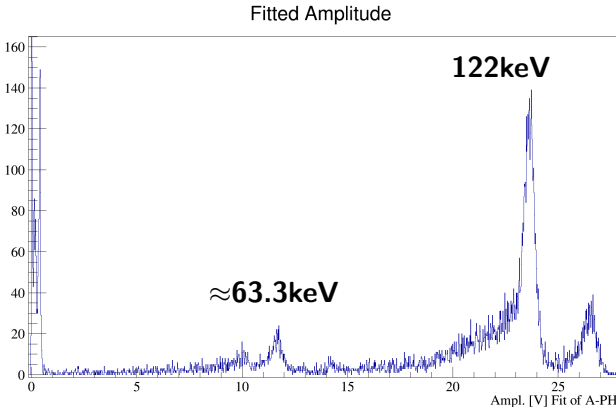
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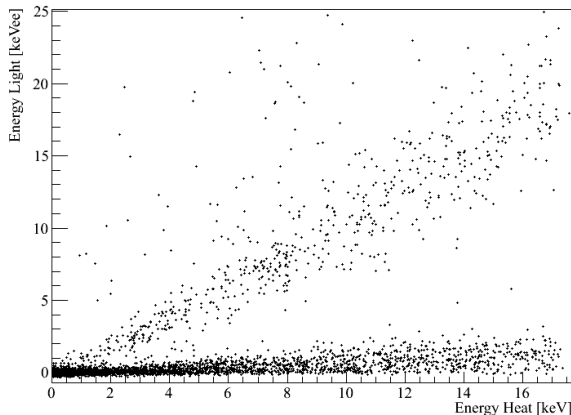
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# Event selection

Rare event search experiments require not only an ultra low background environment but also a way to reject dominating backgrounds. In CRESST this is done with the help of the light channel:

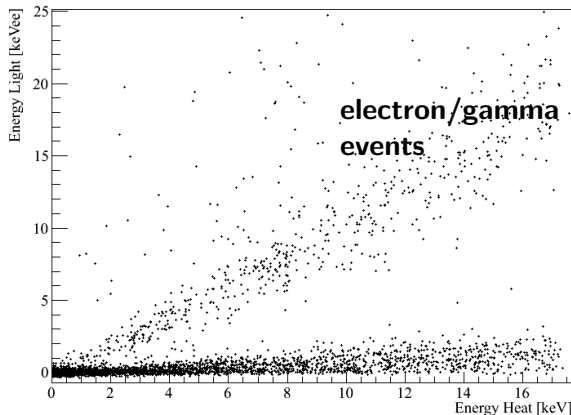
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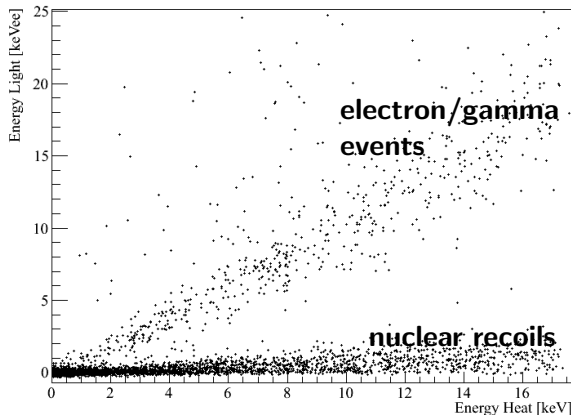
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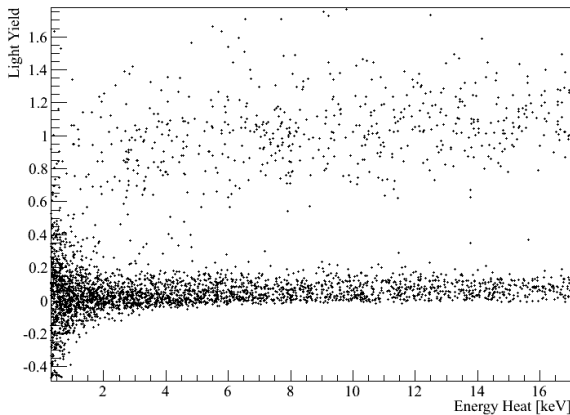


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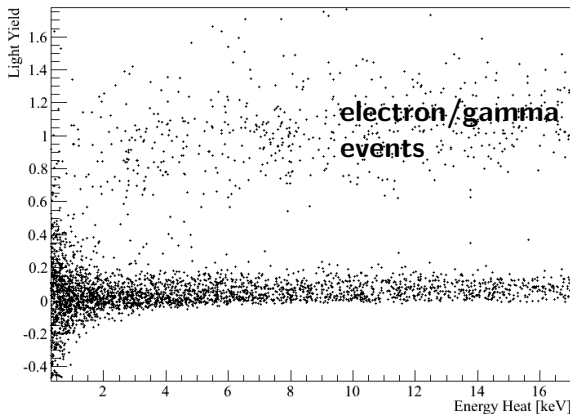
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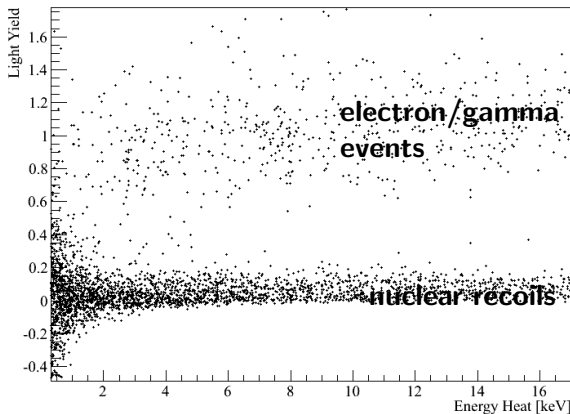
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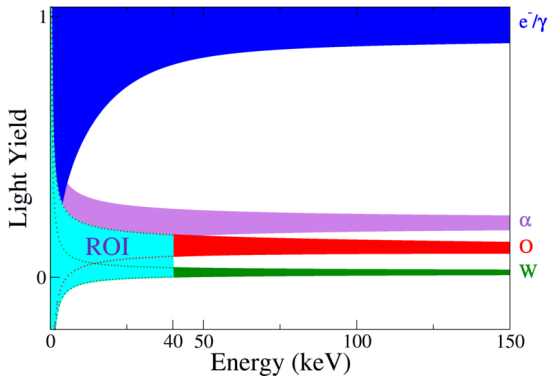
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## Limits (or discoveries)

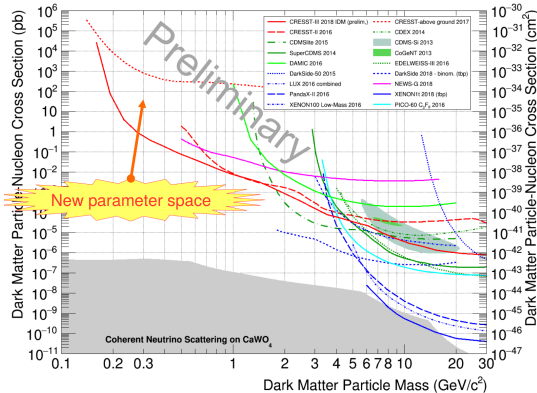


Figure 10: Direct dark matter detection exclusion plot with the new limit from a down to trigger threshold analysis of the CRESST-II Phase 1 data. At low energies the limit is dominated by an unexpected exponential background.

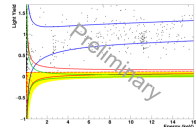


Figure 8: Light Yield (Light to photon ratio) plot for the blind data of the best performing detector of CRESST-II Phase 1. Blue: expected band (90%) for electron and gamma events. Red/Green: Oxygen/Tungsten nuclear recoil bands. Yellow: Region of interest for the dark matter search (50% Oxygen, 50% Tungsten). Due to the small exposure the band structure is not visible in the event distribution. At very low recoil energies ( $<200$  eV) the exponential background is visible.

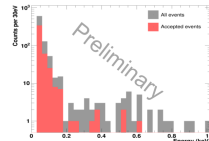


Figure 9: Measured energy spectrum of all events surviving the data selection (blue) and those that additionally fall into the region of interest for dark matter search (red). An exponentially rising background appears below 100 eV.

Thank you for your Attention!