# Low temperature measurement on directional dependence of phonon-scintillation signals from a zinc tungstate crystal

JA Jeon[1], HL Kim[1], SR Kim[1], YH Kim[1,2] ,HJ Lee[1], H. Sekiya[3]

[1]Center for Underground Physics, Institute for Basic Science (IBS), Daejeon, South Korea
[2]Korea Research Institute of Standards and Science (KRISS), Daejeon 34113, Korea
[3]Kamioka Observatory, ICRR, The University of Tokyo, Hida, Gifu, Japan

LTD 18 — 22-26 JULY 2019 MILANO — LOW TEMPERATURE DETECTORS

Low Temperature Detector fabrication techniques and materials

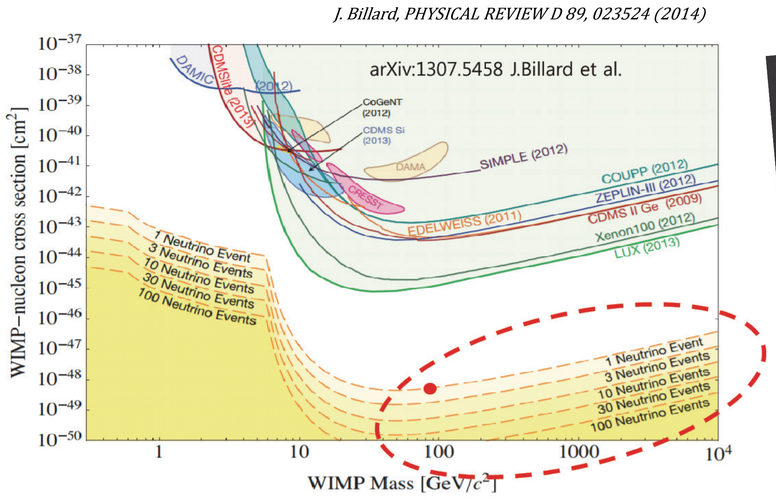
**#103**

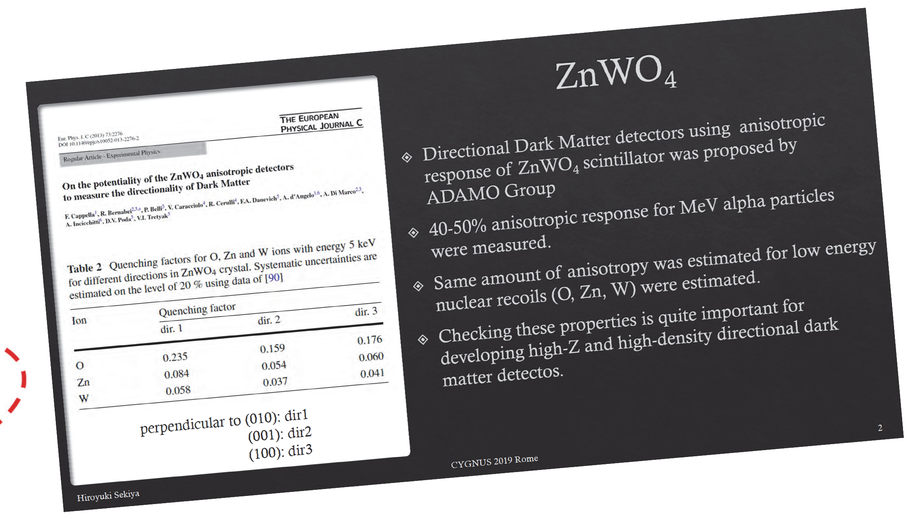
## Abstract

In dark matter direct-detection experiments, the detection limits of most detectors are confined with the backgrounds originating from coherent neutrino-nucleus scattering. One of the possible methods to break the neutrino background floor is a use of the directional dependence of detector response. We employed ZnWO4 crystals as an anisotropic target material for the simultaneous detection of phonon and scintillation signals based on MMC readouts. The crystal is known to have birefringence properties depending on its crystal axes. Its low-temperature properties are well suited for phonon-scintillation detection. Here we report on the recent progress in low-temperature measurement using a ZnWO4 crystal that demonstrated clear dependence of scintillation signals on different incident directions of alpha particles relative to the crystal axes. We found the signal amplitudes were differed by 13.2 % in the light channels. However, the high energy resolution in the heat channels showed no measureable difference within 0.077 %. We will discuss the crystal properties and features for the directional WIMP detection.

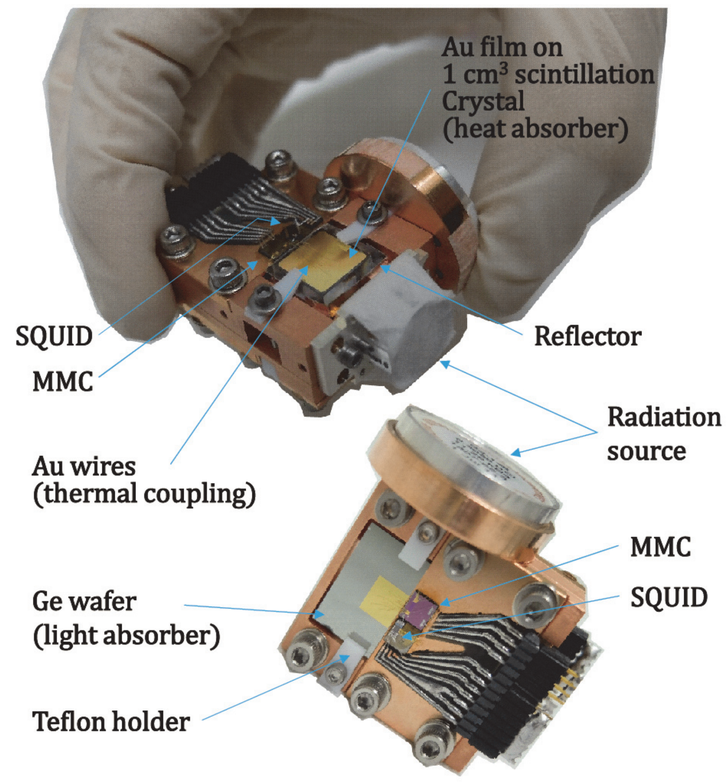
## || Background and motivation

*J. Billard, PHYSICAL REVIEW D 89, 023524 (2014)*



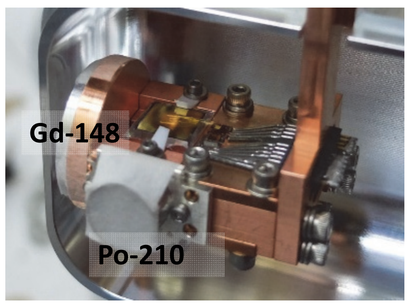



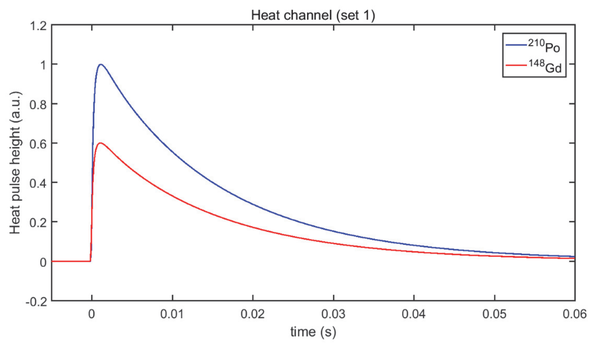

**WIMP discovery limit :**
The dominant neutrino components for different WIMP mass regions are labeled.
Progress beyond this line, require a better knowledge of **the neutrino background**, **annual modulation**, and/or **directional detection**.

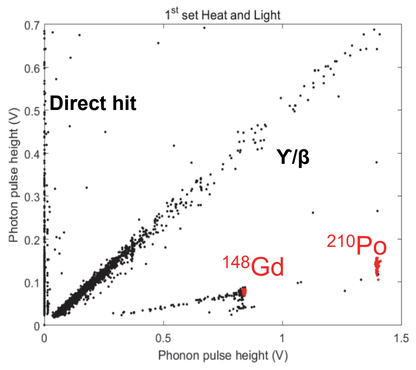


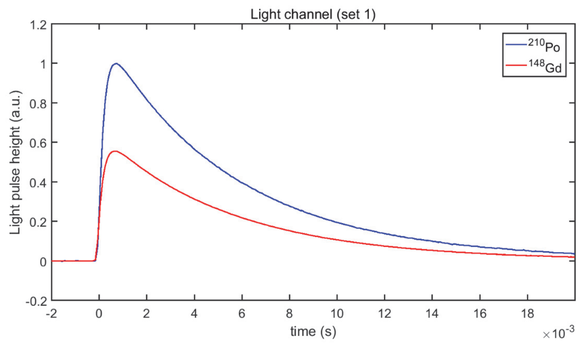

## || Directional dependence of alpha : measurement result

**Set 1** Po210 @ Direction 2, Gd148 @ Direction 1

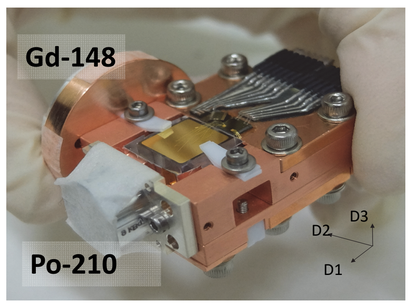


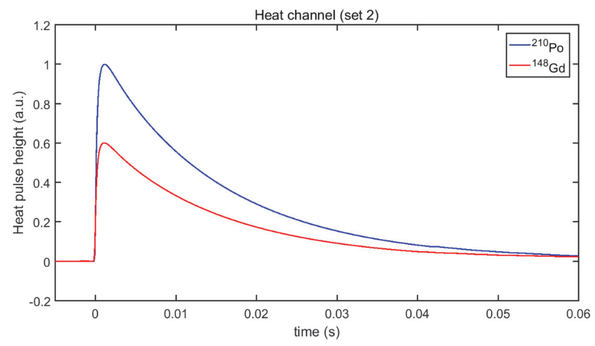



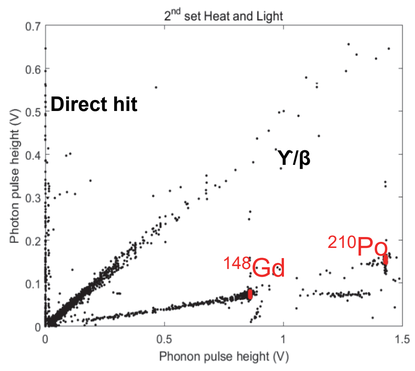



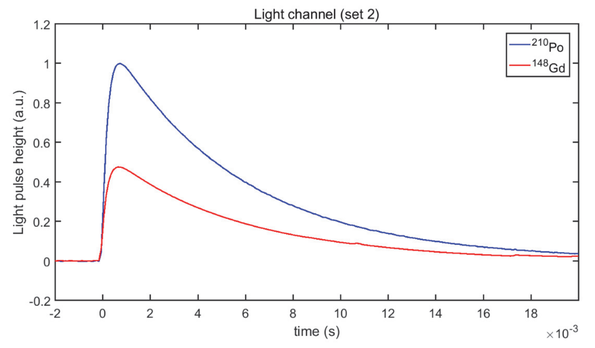




**Set 2** Po210 @ Direction 1, Gd148 @ Direction 2

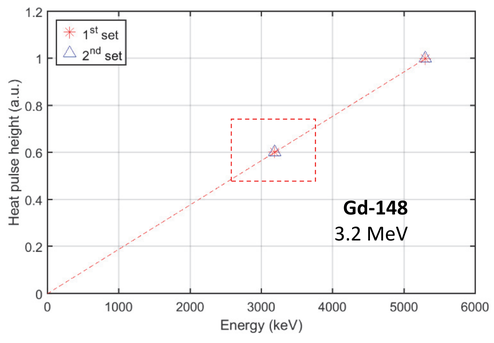


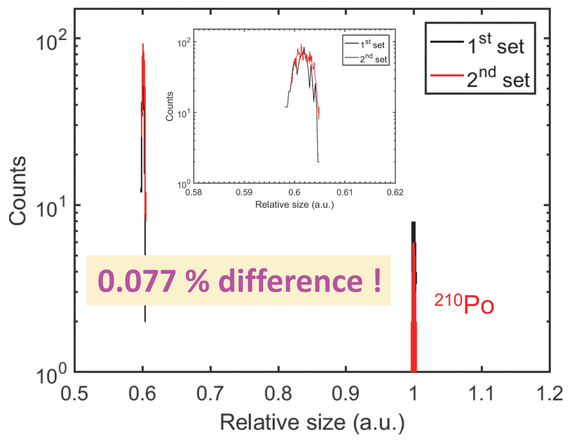



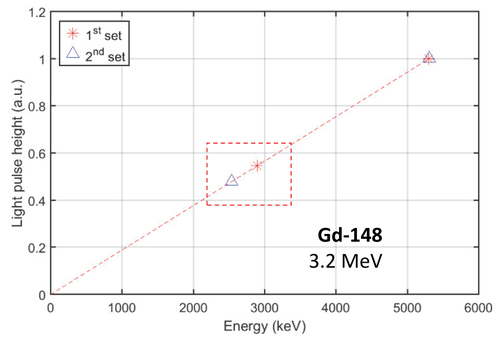



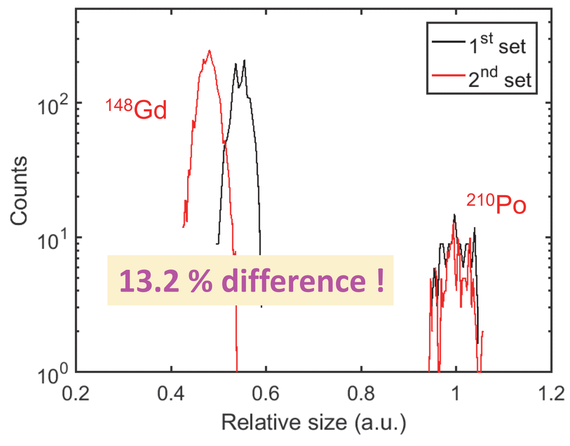

### Directional dependence of heat signal




### Directional dependence of scintillation light signal




## ||| Discussion

40mK measurement on directional dependence of heat and light signals from ZnWO4 crystal is measured. With alpha source, Gd148 (3182.7 keV ) scintillation showed 13.2 % different light signals in direction1 and direction2. In this case, heat (phonon) channels expect to have only 0.077% difference. We also measure gamma source, Co57 (122keV/136keV) in direction1, direction2 and direction3. No measureable difference was found in heat and light signals. We will repeat the difference measurement in other choice of directions. Other ZnWO4 crystals are to be tested in the setup. Lower temperature (10 mK) measurement can be made for confirmation.

CENTER FOR UNDERGROUND PHYSICS