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SnowBall Chamber: Supercooled Water for Low-Mass Dark Matter

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We have all heard of the cloud and bubble chambers of course, and the latter in the context of direct WIMP dark matter detection even. However, no one has explored a third phase transition, into solid, until now that is. This talk will introduce the snowball chamber, which utilizes a supercooled liquid, just purified water in the prototype. An incoming particle triggers nucleation in the liquid, forming a solid. We will present the world's first definitive evidence that radiation can trigger freezing in metastable cold water, an effect never before observed, and in particular share AmBe neutron source calibration data, wherein multiple nucleation sites could be observed during the neutron source runs, another world first, making our device act just like a reverse bubble chamber. Because the reaction is exothermic not endothermic as in a bubble chamber however the energy threshold should be lower, perfect for sub-GeV dark matter searches, for which we will show the measured gamma discrimination, high as in a bubble chamber, and the projected sensitivity, showing our new technology reaching the neutrino floor, with a smaller, more cost-effective detector than many of the competing new technologies. The crystallization may even have directionality which we will show preliminary evidence for: this would mean higher-density directional detectors than in gas, capable of not just reaching the neutrino floor but punching through it, at masses less than 10 GeV/cˆ2 at least.

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