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Impact and Mitigation of Naturally Occurring ^{32}Si

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The recent observation by the DAMIC experiment of ~80 events/day/kg, associated with trace levels of ^{32}Si in their CCDs, is a concern for future Si-based dark matter detectors. These data suggest a ^{32}Si concentration of ~1 in 10^{18} Si atoms. With a half-life of order 153 years, any geologically aged silicon source should be nearly devoid of ^{32}Si. Yet the DAMIC silicon is only two orders of magnitude lower in ^{32}Si concentration than seawater silica (1 in 10^{16}), which is expected to be in equilibrium with atmospherically produced ^{32}Si. This surprisingly high ^{32}Si concentration in ultra-high resistivity silicon may reflect two disparate factors: first, the silicon production is focused on chemical purity and primarily on elements that impact electrical properties; second, silicon metal comes from mining operations that use large quantities of water to move material and reduce dust. Silica gels can form in the early stages of mining and ore processing that could capture atmospheric ^{32}Si and introduce it into the metallurgical supply. We have examined the issues related to detecting and mitigating ^{32}Si in high-resistivity silicon. Radiation counting appears to be the most reliable detection method at concentrations this low but requires us to work with gaseous phases such as SiF_4. We have a plan to detect ^{32}Si in commodity silicon that may lead to a method to reduce its concentration in our crystal supply chain. An alternative mitigation plan is to obtain depleted SiF_4 developed for the Avogadro Project. We will discuss prospects for a sensitive detection method and mitigation strategies to ensure that precursor materials for future detectors will be greatly reduced in ^{32}Si.

Summary

^{32}Si is a radioactive isotope with low natural abundance. It is created in the upper atmosphere and has been measured in rain and ocean waters. It is a source of unwanted background radiation in the DAMIC experiment. We are in the process of developing methods to detect and mitigate ^{32}Si in commodity silicon.

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