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Development of multiple- ion counting to measure isotope ratios at the picogram level.

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The use of secondary electron multipliers and ion counting Daly detectors to measure extremely small ion signals below the noise level of Faraday collectors, has been established for several decades now. To obtain accurate and high precision data does require stable ion signals as beam interpolation is necessary to eliminate errors produced by ion signal instability. For very small samples where total evaporation is necessary on TIMS, or in ICP-MC-MS where ion beams are inherently unstable this is not always an option. Furthermore, the peak jumping method, reduces the duty cycle (time spent on one isotope). As in Faraday measurement the only solution is to use an array of ion counters to simultaneously measure all the isotopes. We describe the development of a multiple ion counting array detector that can simultaneously measure up to 12 isotopes. These detectors have a dark noise of <0.5 counts per minute and so are ideal for measurement of ion signals at the few counts per second which would be the case for sub picogram sized samples. Of critical importance is the stability of gain between the detectors, dead time and linearity. Since the detectors can be moved to different mass dispersions, they are suitable for other isotope systems as well as the actinides. Their use, however, will be limited by analytical blank, but in applications where blank is not a limiting factor they could be of benefit.