

## WeO-2

### ICP-MS WITH QUADRUPOLES OPERATED IN HIGHER STABILITY ZONES

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Quadrupole mass filters separate ions on the basis of path stability. Ion trajectories are classified as stable if the amplitude of ion motion remains less than the field radius,  $r_0$ , (the distance from the centre to a rod) and “unstable” if the amplitude increases until an ion strikes an electrode. The stability is described in

terms of the Mathieu parameters  $a$  and  $q$  given by  $a = \frac{8eU}{m^2 r_0^2}$  and  $q = \frac{4eV}{m^2 r_0^2}$  where  $e$  is the ion

charge,  $U$  and  $V$  the dc and rf voltages between poles,  $\omega$  the angular rf frequency and  $m$  the ion mass. For a given ion mass to charge ratio, a given quadrupole size ( $r_0$ ) and given frequency,  $a$  is a measure of the dc voltage applied to the rods and  $q$  a measure of the rf voltage. Combinations of  $a$  and  $q$  that give stable motion form regions shown on a stability diagram. There is an infinite number of stability regions. Almost all commercial quadrupoles operate in the first stability region near  $(a,q)=(0.24,0.7)$ . With quadrupole operation in the stability region near  $(a,q)=(3,3)$  it is possible to achieve remarkably high abundance sensitivity,  $>10^7$  or more, 0.2 m/e from a peak maximum. It is also possible to reach a resolution of 4000 with 3 eV  $\text{Co}^+$  ions. The region near  $(a,q)=(0.03,7.55)$  allows achieving a resolution of 9000 (FWHM) with 20 eV  $\text{Co}^+$  ions and unit resolution on ions of at least 1000 eV. First results from the region near  $(a,q)=(0, 21.3)$  show that a resolution of 4000 can be obtained with 1000 eV  $^{39}\text{K}^+$  ions. Extrapolation of these data for the  $(0, 21.3)$  region suggests that unit resolution will be possible for 40,000 eV  $\text{K}^+$  ions. The implications of these results for ICP-MS will be described.