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### INSTRUMENT DUTY CYCLE DEFINED

The duty cycle of a Q-Tof mass spectrometer describes the percentage of available ions that are extracted orthogonally into the oa-TOF analyzer. For acquisitions over a given  $m/z$  range, the duty cycle is dependent upon the  $m/z$  of the ion in question; the average value being approximately 15%. This is significantly higher than the equivalent duty cycle of a triple quadrupole mass spectrometer, for example, when operating in full scan MS or MS/MS mode. This explains the excellent sensitivity characteristics of the Waters® Micromass® Q-Tof Premier™ Mass Spectrometer when acquiring data over a wide  $m/z$  range.

### ENHANCEMENT OF INSTRUMENT DUTY CYCLE PROVIDES SIGNIFICANT INCREASES IN SENSITIVITY FOR TARGETED $m/z$ VALUES

Utilizing the traveling wave (T-Wave<sup>TM</sup>)<sup>1</sup> collision cell of the Q-Tof Premier, it is possible to increase the instrument duty cycle to levels approaching 100% when monitoring for selected ions. This is achieved by shaping the continuous ion beam that enters the T-Wave collision cell into 'packets' of ions of differing  $m/z$  values. The packets travel through the collision cell and are released at defined intervals. As these packets progress towards the oa-TOF extraction region, they separate according to their  $m/z$  values. The activation of the oa-TOF pusher is then synchronized for the arrival of the ion of interest into the extraction region, thus maximizing the duty cycle for that particular ion. The process is repeated, commencing with the timed release of the next packet of ions from the T-Wave cell.

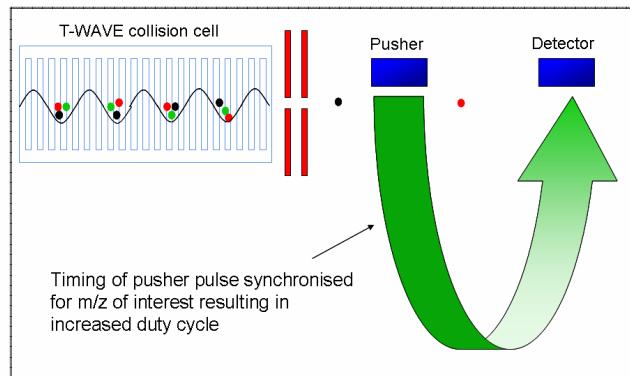
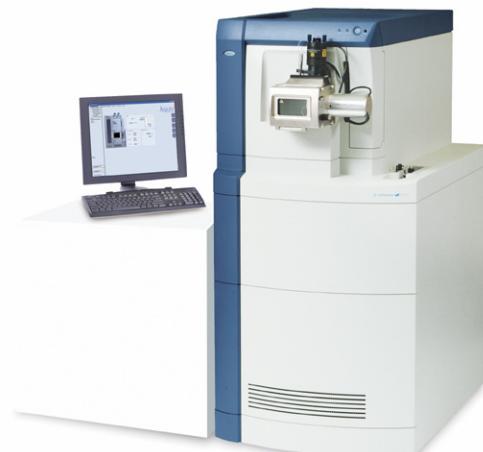


Figure 1. Schematic depicting 'shaping' of continuous ion beam in the T-Wave collision cell and synchronized operation of oa-TOF pusher for ion of interest when operating in EDC mode.

The increases in sensitivity offered by T-Wave-enabled EDC (Enhanced Duty Cycle) are dependent on the  $m/z$  of the ion under analysis. Increases of an order of magnitude are achievable for ions below  $m/z=250$ , as illustrated in Figure 2, whereas at  $m/z=800$  and above, increases of 3- to 4-fold are typical. Ions centered around the ion of interest which fall outside of a defined window are not pushed into the oa-TOF and are not acquired. The width of the window is also dependent upon the  $m/z$  of the ion of interest; this becomes wider at higher  $m/z$  values.



<sup>1</sup>The traveling wave device described here is similar to that described by Kirchner in US Patent 5,206,506 (1993).

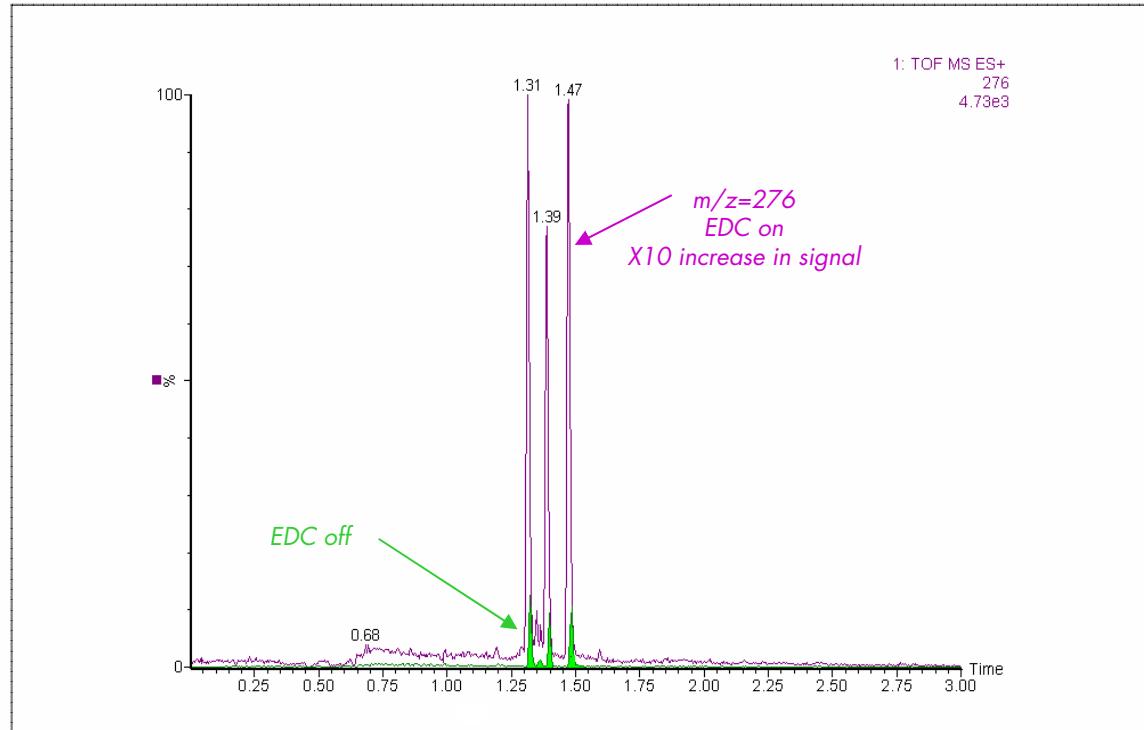


Figure 2. UPLC/MS data illustrating a 10-fold increase in signal for an injection of 2.5  $\mu\text{M}$  Propanolol when utilizing EDC. Data was acquired using the Waters<sup>®</sup> ACQUITY UPLC<sup>™</sup> System with the Q-ToF Premier MS.

## CONCLUSION

Complementing superior Ultra Performance LC<sup>™</sup> separations, the Waters Micromass Q-Tof Premier, with its T-Wave technology and enhanced duty cycle (EDC) mode enables unparalleled sensitivity, thus maximizing the amount of information that can be obtained from a single injection of a complex sample.

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