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Application Note Number 14:
The Built-in Ion Gauge

Abstract: The Extorr XT Series ionizer has a Bayard / Alpert type ion gauge integrated into its design. The B / A ion gauge operates between 10^{-2} and $2x10^{-10}$ Torr. This note describes its operation.

Figure 1 below shows the Extorr XT Series ionizer and the built-in B / A type ion gauge. The dual thoria-coated iridium filaments to the right of the figure, produce an electron current that passes through the source grid with an energy of 70 eV. Since the probability that the electrons actually hit a molecule within the source grid is typically less that one in a thousand, most of the electrons

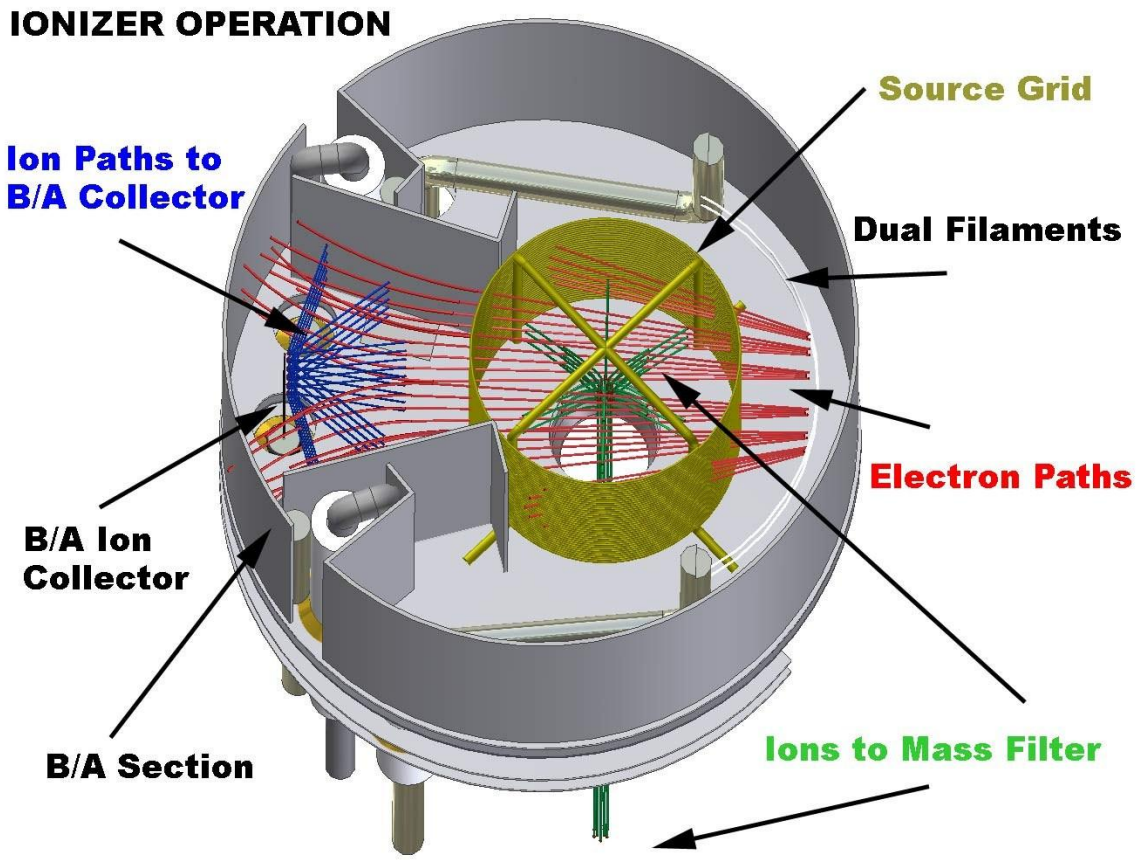

Figure 1 Extorr XT Series Ionizer

continue through the source grid into the B /A gauge section of the ionizer. Ions created by these "ion gauge electrons" travel to the very thin B / A ion collector wire.

The ion current produced is proportional to the electron current $\boldsymbol{I_e}$ and the pressure $\boldsymbol{p}$. The ion gauge sensitivity $\boldsymbol{k}$ is given by

$$k = \frac{I_{\text{ion}}}{I_{\text{e}}\, p}$$

The pressure measured will then be given by

$$p = \frac{1}{k\, I_{\text{e}}}\, I_{\text{ion}} = s\, I_{\text{ion}}$$

Typically $\boldsymbol{s}$ is set to one Torr per amp. The user can recalibrate this gauge on the Calibration Parameters tab of the VacuumPlus software by changing the "Total Sensitivity" value.

The B / A gauge's lower pressure limit (2×10^{-10} Torr) is due to emission of the soft X-ray radiation generated by primary electrons hitting the anode. These X-ray photons hit the ion collector electrode and release photoelectrons. The electron current due to photoemission is indistinguishable from the ion current of positive ions arriving at the collector electrode. Below 10^{-10} Torr the photoemission current becomes a large enough fraction of the ion current to distort the pressure reading.