A microwave induced plasma is another atomic emission source. Typically, a 2.45 GHz microwave generator (magnetron) produces a wave that travels through a cable and is focused via a tuning system where a torch sits in the center of a cavity. This torch has a carrier gas flowing through the outer portion of the torch (sometimes tangentially, other times not) and the plasma is started (or ignited) via a Tesla coil or a piece of copper wire. The carrier gas continues to flow through the torch and the plasma is self-sustaining. Remember the plasma has a high electron density. Analyte is introduced into the center or inner portion of the plasma typically via a nebulizer or ETV system.

There are several different MIPs torches developed, which include the Beennakker cavity, and microwave plasma torch, and the capacitively coupled microwave plasma.

### Carrier Gas

Air, nitrogen, helium and argon can be used as a carrier gas. Helium and argon are easily ionized in the MIP:

\[
\ce{He + e^- \rightarrow He^+}\]

with \(E_1 = 24.6 \, \text{eV}\)

and

\[
\ce{Ar + e^- \rightarrow Ar^+}\]

with \(E_1 = 15.8 \, \text{eV}\)

In particular, helium discharges can excite non-metals and produce emission lines the visible (and UV) spectral region:

CI match is great (479 nm) and S, F, Br, C, and O are good in NIR

Exercise

Why is this the emission source of choice for GC interfacing? [Click here for the answer!](#)

Overall, MIP is not used readily since the limits of detection are generally worse than ICP systems. This is due to the fact that ICP has a much higher energy density, which leads to a higher vaporization of the analyte. Most of the portable atomic emission systems manufactured utilize MIPs since the generator is small and relatively low power is helpful. [MIP references are here](#).