How hot is the Glow Discharge?

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In the current European project GLADNET (www.gladnet.eu) one aspect investigated has been the gas temperature in glow discharge (GD) and its measurement. Gas temperature affects the electrical parameters of the discharge and therefore may affect analytical results. GD plasmas are not in local thermal equilibrium, so mathematical equations for temperature estimation used for other plasma types cannot be applied here. Therefore the estimation of the GD gas temperature is made via measurement of the Doppler broadening of some emission lines or via rotational temperature measured using molecular bands of nitrogen, introduced into the discharge for this purpose. Spectra measured with the high resolution Fourier Transform Optical Emission Spectrometer at Imperial College in London allowed the application of both approaches at the same time. Rotational temperatures measured exceeded the Doppler temperatures by about 1000 K. Furthermore the rotational temperatures from the first negative and second positive systems differ dramatically. Significantly lower rotational temperatures were found in neon GD in comparison to argon GD. Doppler temperature results on the other hand revealed similar temperatures for both argon and neon plasmas. Additional experiments with plane and hollow cathode geometries under various pressures also gave conflicting results – rotational temperatures were found to be higher for higher pressures, whilst the opposite was the case for Doppler temperatures. At the conclusion the rotational temperature was found to give a false estimation of the gas temperature in GD. Further detailed investigations of GD temperatures are in progress using Doppler width of carefully chosen spectral lines measured with a special built instrumentation including a monochromator and a pressure scanning Fabry-Perot interferometer. Investigations on the temperatures measured in direct current and pulsed GD modes are continuing.