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Application Note:
Helium Nanodroplet Spectroscopy

Professor Wolfgang Jaeger and his research group at the University of Alberta (Edmonton, Alberta, Canada) are using an Aculight® Argos™ continuous wave (CW) optical parametric oscillator (OPO) for helium nanodroplet research. Superfluid helium nanodroplets provide an ultra-cold environment to study novel chemical species. The helium droplet instrument (figure 1) measures microwave and infrared spectra of embedded molecules.

Helium droplets that consist of several thousand helium atoms (^{4}He) are formed in a supersonic expansion. These droplets have a temperature of 0.4K and are superfluid. They can be doped with one or several atoms or molecules and spectroscopically characterized. The resultant rotational or ro-vibrational spectra contain information about the dopant molecule and about its interaction with the ultra-cold superfluid helium droplet environment. For infrared measurements, the bolometer detector can be raised. This allows coaxial counter-propagation of the laser beam with the helium droplet beam and detection with the mass spectrometer.

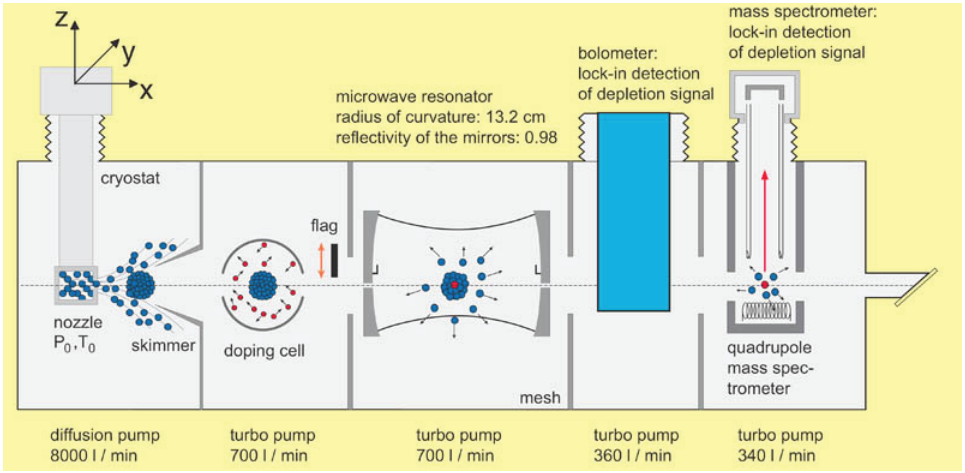

Figure 1: Schematic of the helium nanodroplet experiment at University of Alberta.

Dr. Paul Ratson and Dr. Rudi Lehnig, current and former postdoctoral researchers with Prof. Jaeger, have used the Aculight Argos' high power output at 3006 nm to measure cyano-acetylene spectra (figure 2). To do so they applied stepwise voltage changes to the piezo-transducer on the distributed feedback (DFB) fiber laser that seeds the OPO's pump laser. This produces simultaneous monotonic tuning of both the pump laser and OPO idler frequencies, such that depletion spectra of ~1cm^{-1} range are measured in the vicinity of 3300 cm^{-1}.

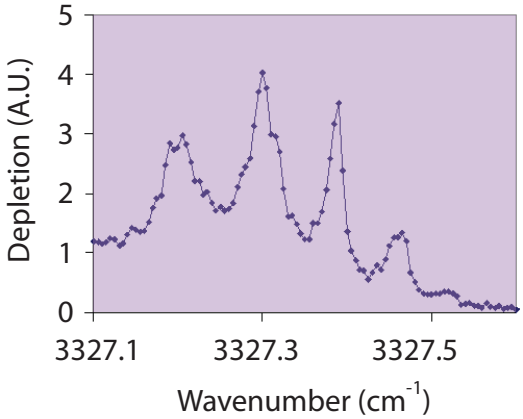

Figure 2: Infrared depletion spectrum of cyano-acetylene recorded using idler output of CW OPO.

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