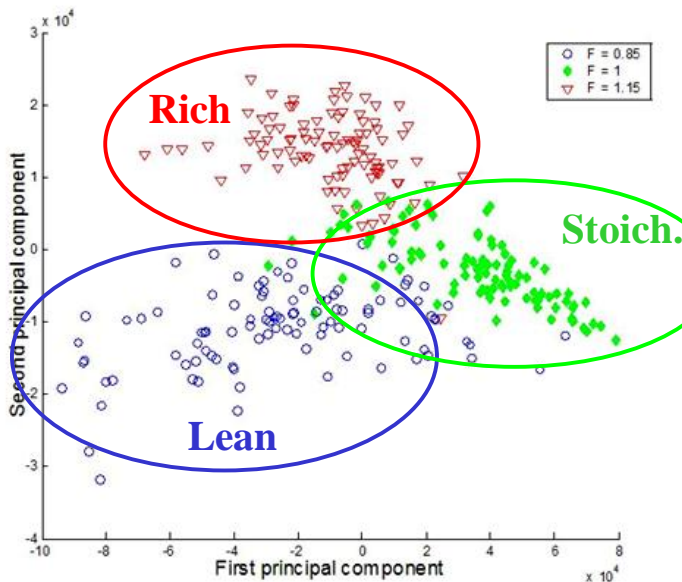
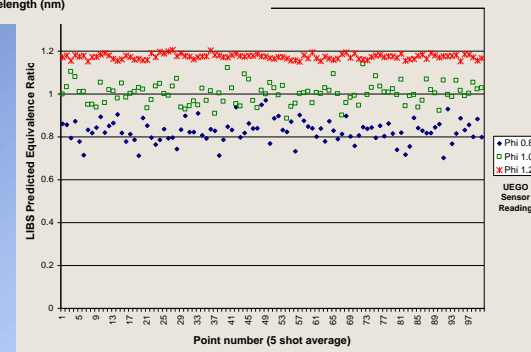
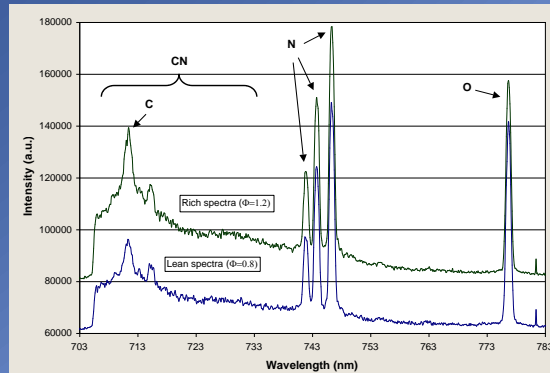


## Laser Induced Breakdown Spectroscopy (LIBS)

A short, high-power laser pulse, when focused, will ablate and ionize material from a solid surface, or form a dielectric gas breakdown, in either case creating a plasma. Excited atoms and small molecules in the plasma emit light, which is collected to classify and quantify the measured material.

### Photon Machines' LIBS Systems

Photon Machines' customizable LIBS systems are perfect for applications involving fuel-air mixtures and/or chemical discrimination in mixtures or among samples of unknown chemical composition. For example, broadband spectra reveal elemental peaks such as C, H, O, and N. Ratios of these elements can be used to determine equivalence ratio or chemical stoichiometry. Figures at right show data taken in the exhaust of a spark-ignited engine running at specified equivalence ratios. The prediction was based on the ratio of the C elemental line to the O and N lines. Data from **Ferioli, Puzinauskas, and Buckley**, *Applied Spectroscopy*, 57 (9), 2003.



### Powerful Chemometrics make analysis easy

The two-dimensional projection into principal components makes the separation of various engine operating conditions clear. With a three-dimensional projection these operating modes completely separate, allowing identification of aberrant mixtures, which are a problem for catalytic converters in spark-ignited engines and also particularly difficult for homogenous charge compression-ignition (HCCI) engines. Similar chemometric analyses can be used to identify chemical composition or particular chemical ratios in mixtures, when the components of the mixture are known. Data from **Ferioli, Buckley, and Puzinauskas**, *International Journal of Engine Research* 7 (6) 2006.