CLAIMS:

1. A method for measuring one or more variables of an incident radiation within intervals of an independent variable, where said one or more variables vary dependent on the independent variable, the method comprising the steps of:

collecting the incident radiation to be measured;

directing more than half of incident radiation in each interval into one of at least two distinct paths with a spatial modulator or a temporal modulator, said modulator undergoing a sequence of configurations such that each member of the sequence directs a different combination of incident radiation within intervals into each path;

wherein the sum of radiation intensity for all distinct paths is at least 60% of the total incident radiation;

measuring the total intensity of radiation in each path with a detector for each modulator configuration to provide a plurality of detector outputs;

analyzing the detector outputs statistically to obtain information relating to the dependent variables of the radiation to be measured.

2. The method according to claim 1 wherein said modulator cycles through a sequence of M configurations, in each configuration dividing incident radiation into N portions according to a position and a time that the radiation is incident on the modulator, and directing a majority of each portion of incident radiation into one of P distinct paths; wherein P is greater than or equal to two and less than N and wherein M is greater than or equal to N and the modulator configuration sequence includes at least two configurations for which a majority of each portion is directed into different paths.

3. The method according to claim 1 or 2 wherein the radiation is spatially separated by source location, wavelength, phase or polarization and directed into $N > 2$ different regions to be characterized into a measurement surface.

4. The method according to any preceding claim wherein the sequence of configurations of the modulator are chosen such that a matrix representation of the sequence of configurations

Z has the property that Z^TZ is non- singular; wherein Z has MP rows and N columns, and wherein each row of Z represents the measurement at one detector and each column of Z represents one range of independent parameter and the elements of Z represent the fraction of particle flux from each range for said row.

5. The method of claim 4 wherein at least one element of Z is non-integer.

6. The method according to claim 4 or 5 wherein with convolution applied to the matrix, the encoding pattern is neither binary nor orthogonal.

7. The method according to any preceding claim wherein each path has a plurality of detectors and wherein each detector measures radiation travelling along the path within a different energy range.

8. The method according to any preceding claim wherein each path has a plurality of detectors and each detector on a path measures radiation from a different region of origin.

9. The method according to any preceding claim wherein the spatial modulator is one of: refractive, reflective, diffractive.

10. The method according to claim 1 wherein the detector on each path produces an analog voltage and that analog voltage has a base voltage level subtracted prior to conversion to digital form.

11. The method according to any preceding claim wherein the modulator produces cyclic permutations of a base mask with at least two distinct regions.

12. The method according to claim 11 wherein the modulator causes each region of the base mask to direct substantially all of the radiation incident upon that region into a distinct direction.

13. The method according to claim 11 wherein the modulator produces a cyclic permutation of the base mask and at least a portion of the mask characteristics are determined by motion of the mask during a measurement period.

14. The method according to any preceding claim wherein at least one element of the modulator has at least two different configurations.

15. The method according to claim 11 wherein the modulator comprises dynamic Toeplitz masks and the resolution is varied by changing the sampling rate.

16. The method of any preceding claim wherein each detector output is normalized to the sum of the detector outputs.

17. The method of any preceding claim wherein the properties of the radiation to be measured are obtained by multivariate least squares analysis.

18. The method of any preceding claim wherein the information in the radiation to be measured is obtained by multivariate statistical analysis of the raw detector outputs or the normalized detector outputs.

19. The method of any preceding claim wherein the information in the radiation to be measured is obtained by correlation analysis of the raw detector outputs or the normalized detector outputs.

20. The method of any preceding claim wherein the radiation pattern with N regions is analyzed by statistical analysis to find a smaller number m of latent variables in a spectrum; making m measurements, and using statistical analysis to infer the value of each latent variable.

21. The method of any preceding claim wherein the total intensity of the radiation summed over all detectors varies for at least some of the spatial modulator configurations; and at each modulator configuration, a raw intensity value is generated at each detector; wherein the total intensity for the modulator configuration is C=SUM (detector intensities di) where the data vector is loaded with the values di' = di/C so that this normalization compensates for changes in the intensity.

22. The method according to any preceding claim wherein a bandpass filter limits the range of wavelengths propagating through the measurement system to establish boundary conditions for the analysis system.

23. The method according to claim 22 wherein the bandpass filter is used to optimize the instrument sensitivity for measurement in the measurement system of a particular analyte by weighting the transmission of different spectral bands in proportion to the significance of that spectral band to the measurement of the particular analyte.

24. The method according to any preceding claim wherein an intensity of the radiation varies for each of a plurality of samples, at each time sample, a raw intensity value is generated at a first detector A and at a second detector B, wherein the total intensity in the time step is C=A+B where the data vector is loaded with the values a'=A/C and b'=B/C so that this normalization compensates for changes in the intensity.

25. The method according to any preceding claim including dividing the incident radiation into N packets, each packet containing radiation with a different value of a first property; separating said radiation packets temporally or spatially using a temporal or spatial modulator and varying the modulator using a modulation sequence to direct at least N different combinations of incident radiation packets into at least two distinct paths; including the steps of estimating the time weighted contribution of each band to the total intensity received by each detector in each measurement and setting the coefficients of the Z matrix to explicitly model the time weighted contributions.

26. The method according to any preceding claim wherein the spatial modulator and associated optics and detectors are in relative motion with respect to the source of radiation to be measured and the relative motion produces the desired modulation.

27. The method according to any preceding claim wherein said modulator cycles through a sequence of M configurations, in each configuration dividing incident radiation into N portions according to a position the radiation is incident on the modulator, and directing a majority of each portion of incident radiation into one of P distinct paths; wherein P is greater than or equal to two and less than N and wherein M is greater than or equal to N and the

modulator configuration sequence includes at least two configurations for which a majority of each portion is directed into different paths.

28. The method according to any preceding claim wherein said modulator cycles through a sequence of M configurations, in each configuration dividing incident radiation into N portions according to a time the radiation is incident on the modulator, and directing a majority of each portion of incident radiation into one of P distinct paths; wherein P is greater than or equal to two and less than N and wherein M is greater than or equal to N and the modulator configuration sequence includes at least two configurations for which a majority of each portion is directed into different paths.

29. The method according to any preceding claim wherein the modulators are arranged with no gaps between regions providing a unity packing fraction.

30. The method according to any preceding claim wherein the spatial modulator is held in a fixed configuration for the duration of each measurement.

31. The method according to any preceding claim wherein the spatial modulator is in relative motion with respect to the spatially variable particle flux to be measured and the particle flux from each region is directed to different detectors according to the relative time weighted geometric cross sections of modulator regions for each detector during one measurement cycle.