What is claimed is:

1. A mask apparatus for use in compressed sensing of incoming radiation, comprising:

one or more coded masks, each of the masks having a body being formed of a material that modulates the intensity of the incoming radiation;

wherein each of the one or more masks has a plurality of mask aperture regions that allow a higher transmission of the radiation relative to other portions of the one or more coded masks, the relative transmission being sufficient to allow reconstruction of the compressed sensing measurements;

wherein one or more of the coded masks are configured to rotate; and

in the case where the apparatus comprises more than one coded mask, at least one of said coded masks is configured to rotate relative to another of said coded masks.

2. The mask apparatus of claim 1, wherein: the
one or more masks are cylindrical.

3. The mask apparatus of claim 1, wherein:

each of the one or more masks has a top and a bottom, and the mask apparatus further comprises a radiation shield that modulates the intensity of the incoming radiation and that covers the top and bottom of the masks.

4. The mask apparatus of claim 1, wherein:

the one or more masks are hemispherical, segments of spheres, ~~or~~ spherical, arcuate, ellipsoid, rectangular, circular or flat.

5. The mask apparatus of claim 1, wherein:

the plurality of mask aperture regions of each of the one or more masks are equal in number to a power of two.

6. The mask apparatus of any one of claim 1, wherein:

each of the one or more masks is formed from a material selected from the group consisting of: tungsten, lead, gold, tantalum, hafnium and their alloys.

7. The mask apparatus of claim 1, wherein each of the one or more masks is

formed:

i) from a material that modulates incoming gamma-ray radiation;
ii) from a material that modulates incoming optical or infrared radiation;
iii) formed from a material that modulates incoming neutron radiation; or
iv) from a material that modulates both incoming gamma-ray radiation and neutrons.

8. The mask apparatus of claim 7, wherein:

some of the mask aperture regions are modulating regions for gamma-rays and some of the mask aperture regions are modulating regions for neutrons.

9. The mask apparatus of any one of claim 1, comprising a plurality of masks, wherein:

the plurality of masks are concentric.

10. The mask apparatus of claim 1, wherein the mask apparatus has two coded masks.

~~11. The mask apparatus of claim 10, wherein the masks are configured to be rotated relative to one another.~~

~~12.~~11. The mask apparatus of claim 2, wherein the mask apparatus has a horizontal field of view of 360^0 .

~~13.~~12. The mask apparatus of claim 1, wherein the one or more masks are hemispherical and the mask apparatus has a field of view of 2π or the one or more masks are spherical and the mask apparatus has a field of view of nearly 4π.

~~14.~~13. The mask apparatus of claim 1, further comprising a radiation shield formed of a material that modulates the intensity of the incoming radiation and that surrounds the one or more masks;

wherein the radiation shield has an opening that limits a field of view of a radiation sensor located within the one or more coded masks.

~~15.~~14. The mask apparatus as claimed in claim ~~14~~13, wherein the radiation shield is cylindrical.

~~16.~~15. The mask apparatus as claimed in claim ~~15~~14, wherein the radiation shield has an arcuate opening that limits the field of view of the radiation sensor to an arc defined by the opening.

~~17.~~16. The mask apparatus of claim ~~14~~13, wherein each of the one or more masks has a top and a bottom, and the mask apparatus further comprises a further radiation shield that modulates the intensity of the incoming radiation and that covers the top and bottom of the masks.

~~18.~~17. A radiation detection method, comprising:

making compressed sensing measurements with a radiation sensor and a mask apparatus as claimed in any one of claims 1 to ~~17~~16.

18. The method as claimed in claim 17, further comprising generating radiation image data from the compressed sensing measurements using a compressed sensing reconstruction algorithm comprising:

- a gradient projection method,
- an iterative shrinkage/thresholding method,
- a matching pursuit method, or
- a Gradient Projection for Sparse Reconstruction (GPSR) algorithm.

19. A method of decommissioning, decontamination, environmental monitoring, medical imaging, astronomy or security, comprising a radiation detection method as claimed in either claim 18 or 19.

20. A compressed sensing radiation imager, comprising:

a mask apparatus as claimed in any one of claims 1 to ~~17~~16; and

at least one radiation sensor located within the mask apparatus;

wherein the imager is configured to make compressed sensing measurements and to generate radiation image data from the compressed sensing measurements.

21. A radiation imager as claimed in claim 20, wherein the at least one radiation sensor comprises:

i) at least one gamma-ray radiation sensor, such that the radiation imager constitutes a gamma-ray radiation imager;

ii) at least one neutron sensor, such that the radiation imager constitutes a neutron radiation imager;

iii) at least one gamma-ray radiation sensor and at least one neutron radiation sensor, such that the radiation imager constitutes a gamma-ray radiation and neutron radiation imager; or

iv) at least one dual modality sensor; or

v) at least one dual modality sensor senses both gamma-rays and neutrons.

22. A radiation imager as claimed in claim 20, further configured to capture an optical, infrared or other wavelength image and to output image data.

23. A radiation imager as claimed in claim 20, wherein the imager is configured to overlay the radiation image data and an optical or infrared image corresponding to a common field of view.