CLAIMS

1. An electron beam apparatus comprising:

an electron source configured to generate a primary electron beam along a primary optical axis;

a compound objective lens comprising a magnetic lens and an electrostatic lens, the magnetic lens comprising a cavity configured to allow the primary electron beam to pass through; and

a first electron detector configured to detect a first portion of a plurality of signal electrons generated from a sample,

wherein the first electron detector is located immediately upstream from a polepiece of the magnetic lens with respect to a path of the primary electron beam along the primary optical axis and inside the cavity of the magnetic lens.

2. The apparatus of claim 1, wherein the first electron detector is positioned such that a central axis of an opening of the first electron detector is aligned with the primary optical axis.

3. The apparatus of claim 2, wherein the opening of the first electron detector is smaller than the first opening of the polepiece of the magnetic lens.

4. The apparatus of claim 1, further comprising a second electron detector configured to detect a second portion of the plurality of signal electrons, and disposed upstream from the first electron detector along the primary optical axis.

5. The apparatus of claim 4, wherein the opening of the first detector is configured to allow the second portion of the plurality of signal electrons to pass through.

6. The apparatus of claim 4, wherein the second electron detector comprises an opening configured to allow a portion of the primary electron beam to pass through.

7. The apparatus of claim 6, wherein the second electron detector comprises an in-lens

detector positioned such that the opening of the second electron detector is aligned with the primary optical axis.

8. The apparatus of claim 4, further comprising a beam manipulator configured to deflect the primary electron beam onto a surface of the sample and located between the first and the second electron detector.

9. The apparatus of claim 8, wherein the beam manipulator comprises a plurality of beam deflectors aligned with the primary optical axis and located inside the cavity of the magnetic lens.

10. The apparatus of claim 4, further comprising a third electron detector configured to detect a third portion of the plurality of signal electrons, and disposed downstream from the first electron detector along the primary optical axis.

11. The apparatus of claim 10, wherein the third electron detector is disposed immediately downstream from the polepiece of the magnetic lens.

12. The apparatus of claim 10, wherein the third electron detector is disposed along the primary optical axis between the polepiece of the magnetic lens and the sample.

13. The apparatus of claim 10, wherein a size of an opening of the third electron detector is determined based on a field-of-view and a distribution of the plurality of signal electrons.

14. The apparatus of claims 1 and 10, wherein the first, the second, and the third electron detectors are configured to detect substantially all of the plurality of signal electrons generated from the sample.

15. A non-transitory computer readable medium storing a set of instructions that is executable by one or more processors of an electron beam apparatus to cause the electron beam apparatus to perform a method of observing a sample, the method comprising:

focusing a primary electron beam onto the sample using a compound objective lens

comprising a magnetic lens and an electrostatic lens, the magnetic lens comprising a cavity that allows the primary electron beam to pass through;

generating a plurality of signal electrons from the sample after interaction with the primary electron beam; and

detecting a first portion of the plurality of signal electrons using a first electron detector located immediately upstream from a polepiece of the magnetic lens with respect to a path of the primary electron beam along a primary optical axis and inside the cavity of the magnetic lens.

16. The non-transitory computer readable medium of claim 15, wherein the set of instructions that is executable by one or more processors of the electron beam apparatus causes the electron beam apparatus to further perform detecting, using a second electron detector, a second portion of the plurality of signal electrons.

17. The non-transitory computer readable medium of claim 15, wherein the set of instructions that is executable by one or more processors of the electron beam apparatus causes the electron beam apparatus to further perform influencing, using a control electrode, an electrostatic field near the sample by adjusting a voltage applied to the control electrode,

wherein adjusting the voltage applied to the control electrode causes a change in a trajectory of the first portion of the plurality of signal electrons.

18. The non-transitory computer readable medium of claim 15 and 17, wherein the set of instructions that is executable by one or more processors of the electron beam apparatus causes the electron beam apparatus to further perform adjusting a position of a plane of the sample along the primary optical axis, wherein adjusting the position of the plane of the sample causes a change in a signal electron detection distribution across the first and the second electron detectors.

19. A method performed by an electron beam apparatus for observing a sample, the method comprising:

focusing a primary electron beam onto the sample using a compound objective lens comprising a magnetic lens and an electrostatic lens, the magnetic lens comprising a cavity

that allows the primary electron beam to pass through;

generating a plurality of signal electrons from the sample after interaction with the primary electron beam; and

detecting a first portion of the plurality of signal electrons using a first electron detector located immediately upstream from a polepiece of the magnetic lens with respect to a path of the primary electron beam along a primary optical axis and inside the cavity of the magnetic lens.

20. The method of claim 19, further comprising detecting, using a second electron detector, a second portion of the plurality of signal electrons.