We claim:

1. An ion focusing device, comprising:

a first surface extending along a first axis and a second surface extending along a second axis and defining a space therebetween dimensioned to receive ions, the first axis arranged at a first angle with respect to an ion propagation axis and the second axis arranged at a second angle with respect to the ion propagation axis, the first surface includes a first plurality of inner electrodes comprising:

a first plurality of electrodes extending along the first axis, the first plurality of electrodes comprising a first electrode configured to receive a first radiofrequency (RF) voltage and a second electrode configured to receive a second RF voltage, the second electrode adjacent to the first electrode; and

a second plurality of segmented electrodes arranged along the first axis between or adjacent to the first plurality of electrodes, the second plurality of segmented electrodes configured to receive a first plurality of voltages and generate a first traveling wave configured to travel along the first axis.

2. The ion focusing device of claim 1, wherein the second surface includes a second plurality of inner electrodes comprising:

a third plurality of electrodes extending along the second axis, the third plurality of electrodes comprising a third electrode configured to receive a third radiofrequency (RF) voltage and a fourth electrode configured to receive a fourth RF voltage, the third electrode adjacent to the fourth electrode; and

a fourth plurality of segmented electrodes arranged along the first axis between or adjacent to the third plurality of electrodes, the fourth plurality of segmented electrodes configured to receive a second plurality of voltages and generate a second traveling wave configured to travel along the second axis.

3. The ion focusing device of claim 1, further comprising first and second outer electrode sets positioned on opposing lateral sides of the first surface, each outer electrode set including:

at least one non-rectangular RF electrode; and

at least one non-rectangular traveling wave electrode.

4. The ion focusing device of claim 1, wherein the first and second axis are arranged at an angle of zero degrees with respect to the ion propagation axis.

5. The ion focusing device of claim 1, wherein the first and the second surfaces extend from an input end on the ion propagation axis to an output end on the ion propagation axis, the first and the second surfaces separated by an input distance at the input end and an output distance at the output end.

6. The ion focusing device of claim 5, wherein the input distance is greater than the output distance.

7. The ion focusing device of claim 5, wherein the first electrode extends from the input end to the output end along the first axis, wherein the first electrode has a first width at the input end and a second width at the output end, the first width greater than the second width.

8. The ion focusing device of claim 5, wherein the first surface is operatively coupled to an ion source at the input end and an ion transfer channel at the output end.

9. The ion focusing device of claim 8, wherein the first traveling wave is configured to direct ions from the ion source to the ion transfer channel along the ion propagation axis.

10. The ion focusing device of claim 1, wherein the first surface comprises a first guard electrode located at a first outer end and a second guard electrode located at a second outer end of the first plurality of inner electrodes, wherein the first guard electrode and the second guard electrode are configured to generate a guard electric field that constrains ion motion along a lateral direction transverse to the ion propagation axis.

11. The ion focusing device of claim 10, wherein at least one of the first guard electrode and the second guard electrode is configured to receive a DC voltage.

12. The ion focusing device of claim 1, wherein the first surface comprises a first plurality of guard electrodes located at a first outer end of the first plurality of inner electrodes, wherein the first plurality of guard is electrodes configured to generate a first transverse traveling wave along a lateral direction transverse to the ion propagation axis.

13. The ion focusing device of claim 12, wherein a first set of guard electrodes of the first plurality of guard electrodes configured to receive a plurality of guard RF voltages and generate a pseudopotential that inhibits ions from approaching the first plurality of guard electrodes.

14. The ion focusing device of claim 12, wherein a second set of guard electrodes of the first plurality of guard electrodes configured to receive a third plurality of voltages and generate the first transverse traveling wave.

15. The ion focusing device of claim 12, wherein the first surface comprises a second plurality of guard electrodes located at a second outer end of the first plurality of inner electrodes, wherein the second plurality of guard electrodes configured to generate a second transverse traveling wave along the lateral direction transverse to the ion propagation axis.

16. The ion focusing device of claim 1, wherein the first RF voltage and the second RF voltage are phase-shifted with respect to one another.

17. A method comprising:

injecting ions within a space defined between a first surface extending along a first axis and a second surface extending along a second axis, the first axis arranged at a first angle with respect to an ion propagation axis and the second axis arranged at a second angle with respect to the ion propagation axis, the first surface includes a first plurality of inner electrodes comprising:

a first plurality of electrodes extending along the first axis, the first plurality of electrodes comprising a first electrode and a second electrode adjacent to the first electrode; and

a second plurality of segmented electrodes arranged along the first axis between or adjacent to the first plurality of electrodes;

applying a first RF voltage to the first electrode of the first plurality of electrodes, and a second RF voltage to the second electrode of the first plurality of electrodes; and

applying a first plurality of voltages to the second plurality of segmented electrodes and generating a first traveling wave configured to travel along the first axis.

18. The method of claim 17, wherein the first electrode and the second electrode are configured to generate a pseudopotential that inhibits ions from approaching the first surface.

19. The method of claim 17, wherein the second surface includes a second plurality of inner electrodes comprising:

a third plurality of electrodes extending along the second axis, the third plurality of electrodes comprising a third electrode configured to receive a third radiofrequency (RF) voltage and a fourth electrode configured to receive a fourth RF voltage, the third electrode adjacent to

the fourth electrode; and

a fourth plurality of segmented electrodes arranged along the first axis between or adjacent to the third plurality of electrodes, the fourth plurality of segmented electrodes configured to receive a second plurality of voltages and generate a second traveling wave configured to travel along the second axis.

20. The method of claim 17, wherein the first surface further comprises first and second outer electrode sets positioned on opposing lateral sides of the first surface, each outer electrode set including:

at least one non-rectangular RF electrode; and

at least one non-rectangular traveling wave electrode.

21. The method of claim 17, wherein the first and second axis are arranged at an angle of zero degrees with respect to the ion propagation axis.

22. The method of claim 17, wherein the first and the second surfaces extend from an input end on the ion propagation axis to an output end on the ion propagation axis, the first and the second surfaces separated by an input distance at the input end and an output distance at the output end.

23. The method of claim 22, wherein the first electrode extends from the input end to the output end along the first axis, wherein the first electrode has a first width at the input end and a second width at the output end, the first width greater than the second width.

24. The method of claim 22, further comprising operatively coupling the first surface to an ion source at the input end and an ion transfer channel at the output end.