CLAIMS

1. An optical system for a flow cytometer, the optical system comprising:

a flow cell including a particle interrogation zone;

a first optical subunit comprising:

(i) a first light source configured to produce a first light beam, and

(ii) a first converging element configured to convert the first light beam into a first converging light beam;

a second optical subunit comprising:

(i) a second light source configured to produce a second light beam, and

(ii) a second converging element configured to convert the second light beam into a second converging light beam; and

an optical train comprising a dichroic element, wherein the optical train is configured to direct the first converging light beam and the second converging light beam to the particle interrogation zone, and wherein the dichroic element is configured to introduce little or no aberrations into the first converging light beam and the second converging light beam.

2. The optical system of claim 1, wherein the dichroic element is configured to receive the first converging light beam through an entry face, and wherein the entry face is configured to be at least near perpendicular to the first converging light beam.

3. The optical system of claim 1, wherein the dichroic element is configured to transmit the first converging light beam as a first transmitted converging light beam through an exit face, and wherein the exit face is configured to be at least near perpendicular to the first transmitted converging light beam.

4. The optical system of claim 3, wherein the dichroic element is configured to receive the second converging light beam through a second entry face, and wherein the second entry face is configured to be at least near perpendicular to the second converging light beam.

5. The optical system of claim 4, wherein the dichroic element is configured to transmit the second converging light beam as a second transmitted converging light beam through the exit face, and wherein the exit face is configured to be at least near perpendicular to the second transmitted converging light beam.

6. The optical system of claim 2, wherein the entry face is configured to allow all parts of the first converging light beam to simultaneously enter the dichroic element.

7. The optical system of claim 1, wherein the dichroic element comprises prisms.

8. The optical system of claim 7, wherein the dichroic element comprises two prisms arranged to form a cube.

9. The optical system of claim 8, wherein the dichroic element includes a wavelength selective coating located between the two prisms.

10. The optical system of claim 9, wherein the optical train additionally comprises a second dichroic element, wherein the second dichroic element is configured to receive the third converging light beam through an entry face, and wherein the entry face is configured to be at least near perpendicular to the third converging light beam.

11. The optical system of claim 1, additionally comprising: a third optical subunit comprising:

(i) a third light source configured to produce a third light beam, and

(ii) a third converging element configured to convert the third light beam into a third converging light beam, wherein the optical train is configured to direct the third converging light beam to the particle interrogation zone and introduce little or no aberrations into the third converging light beam.

12. The optical system of claim 1, wherein the first converging light beam and the second converging light beam maintain a flat top profile or a Gaussian profile as each are directed to the particle interrogation zone.

13. The optical system of claim 1, wherein the aberrations include spherical aberrations, astigmatisms, linear comas, and cubic comas.

14. The optical system of claim 1, wherein the first converging element is a convex lens.

15. The optical system of claim 1, wherein the dichroic element is a long pass filter or a short pass filter.

16. The optical system of claim 1, wherein the optical train does not include a plate dichroic element.

17. The optical system of claim 1, wherein the first light beam and the second light beam are not collimated.

18. The optical system of claim 1, wherein the first optical subunit and the second optical subunit are each affixed to an opto-mechanical mount, and wherein the opto-mechanical mounts are configured for independent adjustment on an x, y, and z coordinate system.

19. A method to incorporate light beams in a flow cytometer, the method comprising:

providing a first light beam and a second light beam;

passing the first light beam through a first converging element and the second light beam through a second converging element to produce a first converging light beam and a second converging light beam; and

directing, with an optical train, the first converging light beam and the second converging light beam to an interrogation zone within a flow cell, wherein the optical train comprises a dichroic element, wherein the dichroic element is configured to introduce little or no aberrations into the first converging light beam and the second converging light beam, and wherein the first converging light beam and the second converging light beam are spatially separated upon entering the interrogation zone.

20. A flow cytometer optical alignment method, the method comprising:

producing a first converging light beam by passing a first light beam produced by a first light source through a first converging element, wherein first light source and the first converging element are affixed to a first opto-mechanical mount;

producing a second converging light beam by passing a second light beam produced by a second light source through a second converging element, wherein the second light source and the second converging element are affixed to a second opto-mechanical mount;

directing, with an optical train, the first converging light beam and the second converging light beam to a flow cell in a first set of positions, wherein the optical train comprises a dichroic element, and wherein the dichroic element is configured to introduce little or no aberrations into the first converging light beam and the second converging light beam;

repositioning the first opto-mechanical mount or the second opto-mechanical mount;

and directing, with the optical train, the first converging light beam and the second converging light beam to the flow cell in a second set of positions, wherein the second set of positions is different than the first set of positions.