CLAIMS

What is claimed is:

1. A method for generating and maintaining a magnetic field with a field reversed configuration (FRC) comprising the steps of:

forming a mirror plasma within a confinement chamber,

injecting beams of fast neutral atoms from a plurality of neutral beam injectors into the mirror plasma at an angle towards the mid-plane of the confinement chamber to transition the mirror plasma to a FRC plasma, and

maintaining the FRC plasma at or about a constant value without decay by injecting beams of fast neutral atoms from the plurality of neutral beam injectors into the FRC plasma at an angle towards the mid-plane of the confinement chamber.

2. The method of claim 1 wherein the step of the forming the mirror plasma comprises applying a magnetic field to the confinement chamber and injecting a gas into the confinement chamber.

3. The method of claim 2 wherein the step of the forming the mirror plasma further comprises applying end-on edge-biasing systems from first and second divertors interconnected to opposing ends of the confinement chamber, optionally wherein the end-on edge-biasing systems include a plasma gun and concentric electrodes.

4. The method of claim 3 wherein first and second formation sections interpose the confinement chamber and the first and second divertors.

5. The method of claims 1 through 4 wherein the step of injecting beams of fast neutral atoms includes one of the step of tuning the beam energies of the plurality of neutral beams injectors between a first beam energy and a second beam energy, wherein the second beam energy differs from the first beam energy, or the step of tuning the beam energies of the plurality of neutral beam injectors between a first beam energy and a second beam energy, wherein the second beam energy differs from the first beam energy, and wherein the plurality of neutral beam injectors switch between the first and second beam energies during the duration of an injection shot.

6. The method of claims 1 through 5 further comprising generating a magnetic field within the chamber with quasi-dc coils extending about the chamber.

7. The method of claim 6 further comprising the step of guiding magnetic flux surfaces of the FRC into divertors coupled to the ends of the confinement chamber, further optionally further comprising the step of generating a magnetic field within the first and second divertors with quasi-dc coils extending about the first and second divertors and further optionally further comprising the step of generating a mirror magnetic field within opposing ends of the chamber with quasi-dc mirror coils extending about the opposing ends of the chamber.

8. The method of claim 6 or claim 7 further comprising the step of generating one of a magnetic dipole field and a magnetic quadrupole field within the chamber with saddle coils coupled to the chamber.

9. The method of claim 7 or claim 8 further comprising the step of conditioning the internal surfaces of the chamber and divertors with a gettering system, optionally wherein the gettering system includes one of a Titanium deposition system and a Lithium deposition system.

10. The method of claims 1 through 9 further comprising the step of controlling the radial electric field profile in an edge layer of the FRC plasma, optionally wherein the step of controlling the radial electric field profile in an edge layer of the FRC includes applying a distribution of electric potential to a group of open flux surfaces of the FRC with biasing electrodes.

11. The method of claims 1 through 10 wherein the step of maintaining the FRC plasma at or about a constant value without decay includes maintaining the FRC plasma at or about a constant value without decay in excess of 30 ms.

12. The method of claims 1 through 11 wherein the step of maintaining the FRC plasma at or about a constant value without decay includes maintaining the electron temperature of the FRC plasma at or about 600 eV.

13. The method of claims 1 through 12 wherein the step of maintaining the FRC plasma at or about a constant value without decay includes reaching a total temperature for the FRC plasma in excess of 4.4 keV or 50 million degrees Celcius.

14. A system for generating and maintaining a magnetic field with a field reversed configuration (FRC) comprising

a confinement chamber,

first and second divertors coupled to the confinement chamber,

a plurality of biasing electrodes and first and second mirror plugs, one or more biasing electrodes of the plurality of biasing electrodes being positioned within one or more of the confinement chamber and the first and second divertors, and the first and second mirror plugs being positioned between the confinement chamber and the first and second divertors,

a gettering system coupled to the confinement chamber and the first and second divertors,

a plurality of neutral atom beam injectors coupled to the confinement chamber and oriented at an angle towards the mid-plane of the confinement chamber, and

a magnetic system comprising a plurality of quasi-dc coils positioned around the confinement chamber and the first and second divertors, first and second sets of quasi-dc mirror coils positioned between the confinement chamber and the first and second divertors,

wherein the system is configured to form a mirror plasma within the confinement chamber and inject beams of fast neutral atoms from the plurality of neutral beam injectors into the mirror plasma at an angle towards the mid-plane of the confinement chamber to transition the mirror plasma to a FRC plasma and maintain the FRC plasma without decay while the neutral beams are injected into the FRC plasma.

15. The system of claim 14 wherein the plurality of neutral beams are adjustable between a first beam energy and a second beam energy, wherein the second beam energy differs from the first beam energy, and wherein the beam energies of the plurality of neutral beams are switchable between the first and second beam energies during the duration of an injection shot.

16. The system of claims 14 or 15 further comprising first and second diametrically opposed reversed-field-theta-pinch formation sections interposing the first and second divertors and the confinement chamber.

17. The system of claim 16 further comprising third and fourth divertors interposing the first and second diametrically opposed reversed-field-theta-pinch formation sections and the confinement chamber.