# Accelerator States

**Collider Operation**
The purpose of collider operations is to provide collisions of protons and antiprotons for the experiments. In preparation for collider operations the Tevatron takes 150 GeV protons and antiprotons and accelerates them to 980 GeV. During collider operations the Tevatron maintains the two particle beams while controlling the squeeze points for collisions. (The low beta quads control the squeeze.) This process continues as long as the luminosity remains at a useful level. TEVMOD1

**Proton Only**
Physicists use the proton only mode for studies. (In general, accelerator studies fall into two categories: first and primarily, they're used to increase machine efficiency in creating, transporting, and accelerating particles so that experimenters can better understand and make discoveries about the properties of matter; second, they help physicists understand particle accelerators.) TEVMOD2

**Dry Squeeze**
The purpose of a dry squeeze is to make sure the magnet fields will remain at consistent levels before loading the next store. To this end, the Tevatron magnet currents are all briefly ramped to their "collision" values with no beam in the machine. TEVMOD3

**Ramping**
The Tevatron power supply program repeatedly run through its cycle from 90 GeV to 150 GeV to 980 GeV to 150 GeV and then back to 90 GeV. (When you ramp a power supply you change its output current from one level to another. When you change the current you change the strength of the magnet's field.) TEVMOD4

**Recovery**
The purpose of Tevatron recovery is to reset all systems needed to turn on and operate the accelerator after a trip. The power supplies repeatedly ramp up and down in this state. TEVMOD5

**The Tevatron is now off**
When the Tevatron is off there is no beam in the accelerator. (Any beam left in the accelerator was aborted—intentionally routed to a beam dump.) TEVMOD6

**Shutdown**
The Debuncher and Accumulator rings are located in the same tunnel and are part of the Antiproton Source. These rings contain no circulating beam when shutdown. APSMOD1

**In Access Mode**
When a tunnel is in access mode it has been made ready for people to enter. The Debuncher and Accumulator rings contain no circulating beam during an access and beam cannot be sent to the area. APSMOD2

**Stacking Mode**

# Accelerator States

The Main Injector sends protons to a nickel target in the AP1 transfer line to create antiprotons. The Debuncher captures the antiprotons coming off of the target and prepares them for injection into the Accumulator. The Accumulator collects (stacks) and stores the antiprotons until needed. APSMOD7

**Shots to the Tevatron**
A shot is the injection of antiprotons from the Accumulator to the Main Injector and then from the Main Injector to the Tevatron. APSMOD9

**Shots to the Recycler**
A shot is the injection of antiprotons from the Accumulator to the Main Injector and then from the Main Injector to the Recycler. APSMOD12

**Antiproton Source is NOT ready to transfer**
The setup for the sequence of events that must happen to transfer particles from the Accumulator to the Main Injector has NOT been completed. PSHOOT1

**Ready to Transfer**
The setup for the sequence of events that must happen to transfer particles from the Accumulator to the Main Injector has been completed. PSHOOT2

**Unstacking Pbars**
The Accumulator manipulates the antiprotons out of the core (the densest part of the beam), forms separate RF buckets full of antiprotons (a bucket is a stable region in Longitudinal phase space), and then moves each bucket to the proper position for transfer into the Main Injector. PSHOOT3

**Ready for Main Injector Tune up**
The setup for the sequence of events that transfers particles from the Accumulator to the Main Injector has been completed. The transfer of antiprotons is waiting on the Main Injector tune up. PSHOOT4

**Pbar Shot Setup is Complete**
The setup for the sequence of events that transfers particles from the Accumulator to the Main Injector has been completed. PSHOOT5

**Beginning Reverse Proton Tune up**
The Antiproton Source uses protons injected in the opposite direction of the antiprotons, and since they have an opposite charge they can be used for tuning and calibration. Protons are cheaper to use than antiprotons. MSHOOT3

**Reverse Proton Tune up is Complete**
The Antiproton Source has completed its tune up using protons injected in the opposite direction of the antiprotons. MSHOOT4

**Global Collimator Abort**

# Accelerator States

All the Tevatron collimators stop moving. TEVCOL1

**User Defined Test State**
This is an arbitrarily defined test state for accelerator studies. TEVCOL2

**Going to Initial Positions for Halo Removal**
All the Tevatron collimators move quickly to a position 1/2 the distance to the beam within a prescribed amount of time. This position is expected to be just outside of the halo. TEVCOL3

**Begin Halo Removal Scraping**
One at a time, each Tevatron collimator moves slowly into the beam halo. The collimator motion is controlled by loss monitor feedback and continues until a loss monitor reaches a preset loss value. (This state follows the "Intermediate halo removal" state.) TEVCOL4

**Retracting Proton Collimators**
All the Tevatron collimators pull out forty mils or 1 millimeter. At this position they will reduce the halo, but not interfere with the protons. TEVCOL5

**Scraping During Store**
The Tevatron collimators exclusively remove the proton halo during a proton only store. (The definition of this state does not match its intended purpose.) TEVCOL6

**Going to Initial Positions for Proton Removal**
When this state is used, three E0 collimators will move quickly to a position close to the protons. (The two states TEVCOL7 and TEVCOL8 are designed to be an integral part of Run IIB Collider. These two steps will remove protons from the Tevatron and begin the process of recycling antiprotons from the Tevatron to the Recycler.) TEVCOL7

**Beginning Proton Removal Scraping**
When it is used, three E0 collimators will remove protons from the Tevatron. (The two states TEVCOL7 and TEVCOL8 are designed to be an integral part of Run IIB Collider. These two steps will remove protons from the Tevatron and begin the process of recycling antiprotons from the Tevatron to the Recycler.) TEVCOL8

**Going to Safe Position**
All the Tevatron collimators move simultaneously to the "safe" position, which is the farthest out of the beam position. TEVCOL9

**Intermediate Halo Removal**
Sets of Tevatron collimators move in until the beam halo is found by using loss monitor feedback. Once one collimator discovers the halo the entire group of collimators stop moving. (This step speeds up the halo removal process.) TEVCOL10

**Retracting P-bar Collimators**

# Accelerator States

All the antiproton collimators retract approximately one millimeter (40 mils). TEVCOL11

**Accumulator Lattice Set to Stacking Mode**
The quadrupole power supply currents are ramped to a different level than that of shots to make for better stacking. APSLAT1

**Accumulator Lattice Set to Shots Mode**
The quadrupole power supply currents are ramped to a different level than that of stacking to optimize shot emittances. APSLAT2

**Collimators are at Injection Positions**
The collimator injection position is the "safe" position, which is the farthest open position. TSCRAP1

**Halo Removal in Progress**
The Tevatron collimators have begun moving into the halo. The collimators follow a specific pattern of TEVCOL# states. TSCRAP2

**Halo Removal is Complete**
The Tevatron collimators are pulled back to the "safe" position (which is the farthest open position) just before the start of a store. TSCRAP3

**Proton Removal in Progress**
The Tevatron collimators are moved into the proton beam according to a special pattern of TEVCOL# states. TSCRAP4

**Proton Removal Complete**
The Tevatron collimators are moved out of the proton beam according to a special pattern of TEVCOL# states. TSCRAP5

**Proton Injection Front Porch**
The Tevatron power supplies first have their currents lowered to 90 GeV levels, to rid the magnets of any remnant fields, and then raised to 150 GeV for proton injection from the Main Injector. During a proton injection front porch, the Tevatron is held at its 150 GeV injection energy to allow the injection tune-up to proceed. CLDRST1

**Proton Injection Tune Up**
The Main Injector sends 150 GeV protons through the P1 transfer line and into the Tevatron. A program called Injection Closure uses the protons to make suggested P1 line magnet adjustments to the particles' incoming angle so that they match with the Tevatron. An operator looks at the suggestions and chooses to accept them or not. CLDRST2

**Reverse Injection**

# Accelerator States

The Tevatron sends 150 GeV protons through the A1 transfer line and into the Main Injector. A program called Injection Closure uses the protons to make suggested A1 line magnet adjustments to the particles' incoming angle so that they match with the Main Injector. An operator looks at the suggestions and chooses to accept them or not. (Protons are used for this tune up because they are cheaper to use than antiprotons.) CLDRST3

**Inject Protons**
The Main Injector sends one bunch of 150 GeV protons at a time through the P1 Line to the Tevatron in preparation of a store. CLDRST4

**Pbar Injection Front Porch**
The Tevatron power supplies first have their currents lowered to 90 GeV levels, to rid the magnets of any remnant fields, and then raised to 150 GeV for antiproton injection from the Main Injector. This state is used during the rare occasions when antiprotons are the only particles being injected into the Tevatron. CLDRST5

**Inject Pbars**
The Antiproton Source sends 8 GeV antiprotons from the Accumulator to the Main Injector. The Main Injector accelerates the antiprotons to 150 GeV and then sends them four bunches at a time through the A1 line to the Tevatron in preparation of a store. CLDRST6

**Cogging**
This state is not used. (The term refers to the process of spacing the protons and antiprotons properly so they collide at the correct places around the Tevatron.) CLDRST7

**Preparing to Ramp**
This state presets power supply ramp values before the protons and antiprotons get accelerated to their next energy level. CLDRST8

**Acceleration**
The Tevatron accelerates the particles to the flattop energy of 980 GeV. CLDRST9

**Flat Top**
The power supply currents are held at their 980 GeV level. CLDRST10

**Squeeze**
The low beta quadrupole magnet fields tightly focus the proton and antiproton beams at the interaction points around the Tevatron ring. CLDRST11

**Initiate Collisions**
The electrostatic separators near each interaction point change their voltages. This causes the spiral orbits of the proton and antiproton (which normally are keep away from each other) to come together within the detectors and produce collisions. CLDRST12

# Accelerator States

**Remove Halo**
Tevatron collimators remove the proton and antiproton halo per the TEVCOL# states control process. CLDRST13

**High Energy Physics**
Shot data is saved for later analysis. As soon as this is completed, operators inform the experiments that the store is ready. CLDRST14

**Pause High Energy Physics**
During a pause, Tevatron experts may conduct studies or Operations may scrape the beam. CLDRST15

**Proton Removal**
This state is for Recycler operations. The Tevatron will use this state to remove protons before injecting (recycling) the remaining antiprotons back into the Recycler. CLDRST16

**Unsqueeze**
The low beta quadrupole currents and separator voltages return to their normal 980 GeV values in preparation for ramping down and beginning the next shot setup. CLDRST17

**Secondary Flat Top**
The secondary flattop refers to the portion of the 980 GeV ramp that occurs after the "Unsqueeze." CLDRST18

**Deceleration**
This state is for Recycler operations. The Tevatron RF system reduces the antiprotons' energy from 980 GeV to 150 GeV. CLDRST19

**Extraction Porch**
The power supplies have ramped down to 150 GeV current levels. This is also called the "Back Porch." CLDRST20

**Extract Pbars**
This state is for Recycler operations. The Tevatron will recycle antiprotons to the Recycler. CLDRST21

**Reset**
The Tevatron power supplies have their currents lowered to 90 GeV levels to rid the magnets of any remnant fields. This is sometimes referred to as the "dip." CLDRST22

**Recovery**
When the Tevatron trips off due to a problem, such as a quench, the power supply current is bypassed, or "dumped," but the supply's ramp command gets held at whatever GeV level the collider state was asking for. It's necessary to free the ramp before turning the power supplies back on. To do this the supercycle is allowed to play out, that is the ramp

commands continually run through all the ramps from 90 GeV to 150 GeV to 980 GeV to 150 GeV and back to 90 GeV. CLDRST23

**Ramping**
The power supplies' current levels repeatedly play out their ramps from 90 GeV to 150 GeV to 980 GeV to 150 GeV and back to 90 GeV. CLDRST24