**To set backlash values (this section contributed by Jerry Pinter)**

Be sure to accurately (within an arcminute or less) determine the exact amount of backlash for each axis. Use a laser pointer attached to the scope, projecting a dot of light onto a wall. Start with both backlash settings (in config.dat) equal to 0. Using the handpad, microstep for awhile in one direction, enough to takeup any backlash, stop, then read the altaz coordinates from the screen. Then reverse the motor direction on the handpad and stop immediately when the scope starts moving. Read the new altaz coordinate to determine the amount of backlash (in degrees). Repeat this several times and use the average value for each axis. Convert this to arcminutes and enter into config.dat. If one does not have a laser pointer, one can focus a cross-hair eyepiece on a stationary object on the horizon (house, tree, etc) to determine when the scope starts to move. The encoders could also be used if their precision is high enough. After entering the correct backlash parameters into config.dat, repeat the backlash test using the laser or encoders. The scope should now "take up the slack" prior to microstepping, for example just quickly depress the handpad pushbutton for a split second and one should hear the motors spin, but the scope should not move much at all, and the altaz coordinates should not change much. This is the key to backlash compensation: even though the motors are spinning fast to take up the backlash, the scope is not moving and thus the altaz coordinates do not change in value. Without backlash compensation, prior to every change of direction for slewing, microstepping, and tracking, the motors will spin for awhile and the PC will think the scope is moving (and thus change the coordinates on the screen) however the scope is not moving yet. This creates errors in pointing accuracy. Backlash can cause serious slewing, finding and tracking errors, especially if the backlash is a significant portion of the field of view.

For example, my (Jerry Pinter's) Cookbook CCD f.o.v. is about 15 arcminutes on my scope, and my backlash is about 7 arcminutes. Thus if I think I have an object nearly centered, without backlash compensation it may actually be 7 arcminutes off-center (depending on which way the motors last spun) which could be off the edge of the chip! Another problem is when doing initializations or "resetting" off a nearby bright star, if backlash is not compensated, then the scope may be pointing in error by the amount of backlash. Also, when tracking an object for CCD imaging, if the backlash is not compensated, then the object will drift across the image before the backlash is taken up. With backlash properly compensated for (as described above), everything is taken care of automatically. The PC knows exactly where the scope is pointing during initialization, resets, and slews. When the scope slews to an object, the object will land on the CCD chip, and tracking will start immediately after the motors take out the slop, leaving the object in the same place within the field of view. It's important to have the scope balanced (alt axis) since any imbalance will tend to make the backlash appear only in one direction, which will screw up the backlash compensation.