

Conceptual specs for helicity decoder board
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The idea behind the helicity decoder board is to continuously receive the signals from the helicity board in order to determine the seed needed to reconstruct the reported pattern helicity and relative polarity of the event within the pattern. This information can then be provided to triggered events to allow reconstruction of the true helicity of the beam for all events.

This board should not reconstruct the true helicity or the seed value which would include the true helicity.

In the following discussion, I make the assumption that the helicity delay will always be an integer multiple of the pattern size, so that the seed can be determined by looking at the reported helicity at the first event of the pattern. Allowing non-multiple pattern delays will require some modification, and would likely require a configuration step.

The board should support the range of trigger latencies and event depths typical for current and proposed JLab instrumentation systems.

1 Input signals

This board should take the “T_stable”, “reported_helicity”, and “pattern_sync” signals as produced by the helicity board. It may be useful for it to also receive the 20 MHz clock from the helicity board, and the “pair_sync”.

The board should take an event trigger signal. Again, the board should support the range of trigger latencies and event depths typical for current and proposed JLab instrumentation systems.

2 Processing at start of T_stable

When the T_stable signal begins, the reported_helicity and pattern_sync should be latched.

If pattern_sync is true, the reported_helicity should be used to update the seed value. The pattern_phase counter (event number within a pattern) should be cleared. The reported_pattern_helicity should be recorded.

If pattern_sync is not true: the pattern_phase counter should be incremented, the event_polarity would be the XOR of the reported_pattern_helicity and the reported_helicity.

There should probably be various counters, such as:

1. Number of “start of T_stable” edges
2. Number of “end of T_stable” edges
3. Number of pattern starts
4. Number of pair_sync starts (?)

3 Event records

The following are the key data elements this board should make available for each event trigger.

1. Reported helicity seed for the current pattern—Would be used in analyzers to predict the true helicity for the first event in the pattern
2. Polarity of the current event with respect to the pattern polarity—By taking the XOR of this with the true pattern helicity, would recover the true helicity for the event
3. Counter of “start of T_stable”
4. Counter of “end of T_stable”
5. Counter of patterns

6. Counter of events within a pattern
7. Status of the T_stable at time of trigger—Was this trigger during a stable helicity period
8. Latched reported helicity for this event (?)
9. Latched pattern_sync for this event (?)

Other possible data elements per trigger:

10. Time of trigger since last “start of T_stable”
11. Time of trigger since last “end of T_stable”
12. Duration of the previous complete T_stable interval (?)
13. Duration of the previous complete inverse(T_stable) interval (?)
14. Event polarities of the previous complete pattern as a bit register (?)
15. Some sort of history of event helicities and pattern_syncs to serve as a cross-check that the pattern transitions line up with the pattern_sync (?)