

# Helicity Decoder Update

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# Update

- Bug fix:
  - Take the one bit delay of the helicity signal in the scaler into consider when decoding
  - Mark the unused helicity window in the ring buffer as error 0x0080
  - An alignment issue when inserting helicity info back into the rootfile
- Improvement:
  - Add variables to help making cuts

# Decoder

- The package will provide these command line tools:
  - `extract`: decode the helicity info
  - `ring`: predict ring buffer helicity for scaler
  - `tir`: predict TIR (trigger interface register) helicity
  - `align`: assign gated scaler info (BCM, T1, T3, ...) to data stream
  - `gen`: insert the helicity and gated scaler info to the tree
  - `helicity.sh`

# Decoder

- Usage:
  - The command will display a usage help if not used correctly
  - An example in g2p/chao/replay dir
- Output:
  - variables labeled as "hel.\*" in the "T" tree
  - "hel\_ring" tree
  - "hel\_happ" tree

# Decoder

- Variables in "T" tree:
  - hel\_rep: raw helicity state
  - hel\_act: predicted helicity state
  - qrt, mps, pairsync: 3 other helicity raw signal
  - timestamp: TIR timestamp for each event
  - seed: 30bits pseudo-random helicity seed
  - error: error level of the decoding
  - numring, numhappex: ring buffer event amount recoded in this event
  - bcmup, bcmdown, time, L1A, T1, T2 ... : helicity gated information calculated from ring buffer

# Decoder

- Structure of "hel\_ring" and "hel\_happ" tree:
  - evnum: event number which contains this ring buffer event in raw data
  - hel\_rep: raw helicity state
  - hel\_act: predicted helicity state
  - qrt: helicity pattern info
  - seed: 30bits pseudo-random helicity seed
  - error: error level of the decoding
  - bcmup, bcmdown, time, L1A, T1, T2 ... : helicity gated info recorded by the ring buffer

# Decoder

- Definition of the values of the error variable:
  - 0x0001 : prediction error in TIR helicity info
  - 0x0002 : events used to generate seed
  - 0x0008 : T8 event
  - 0x0010 : prediction error in scaler helicity info
  - 0x0020 : events used to generate seed
  - 0x0080 : unused event in ring buffer
  - 0x0100 : prediction error in happex helicity info
  - 0x1000 : unable to find corresponded scaler info
  - 0x2000 : unable to find corresponded happex info

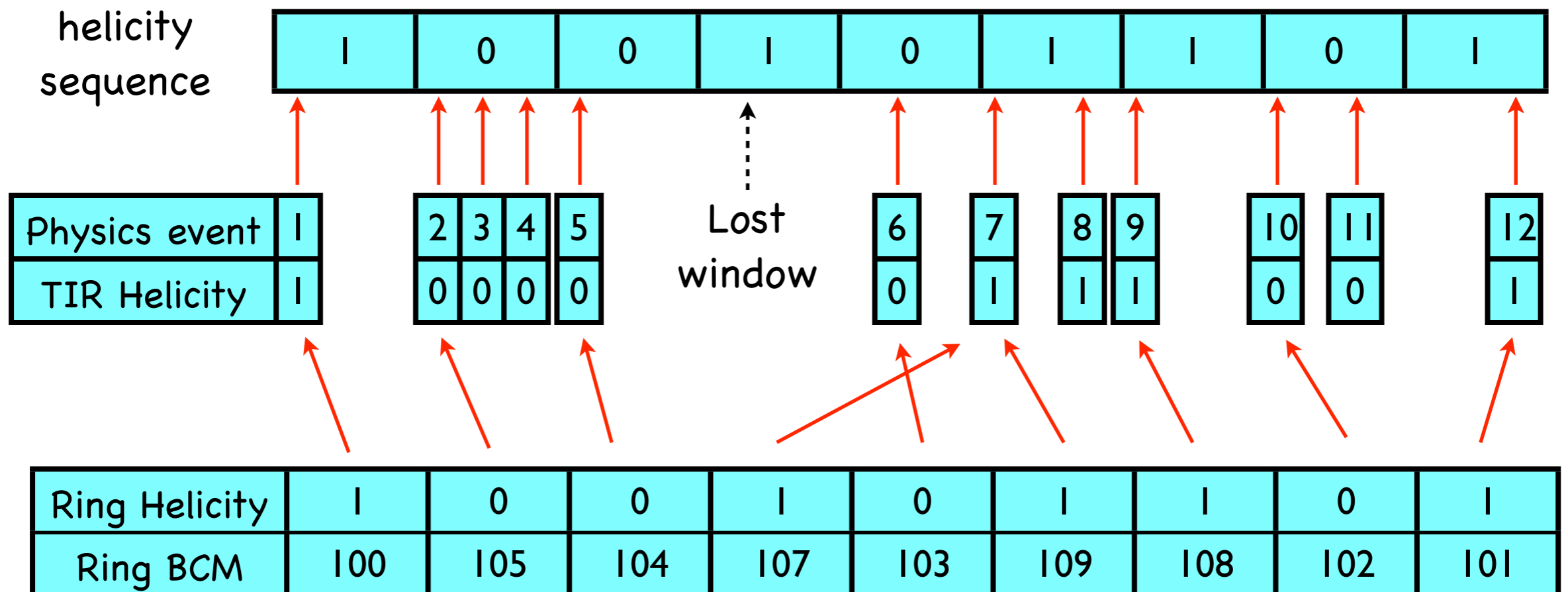
# Usage

- Usage:
  - "hel\_act" is the actually helicity which should be used to calculate asymmetry
  - "error" is an important variable, all the events with error $\neq$ 0 should be cut off
- Cuts for low beam current
  - Should cut in the unit of helicity patterns
  - Add time info to help make this cut
    - typical fast clock counts in one window is  $\sim 108$
    - do not make cut on the event with a counts much lower or larger than this number

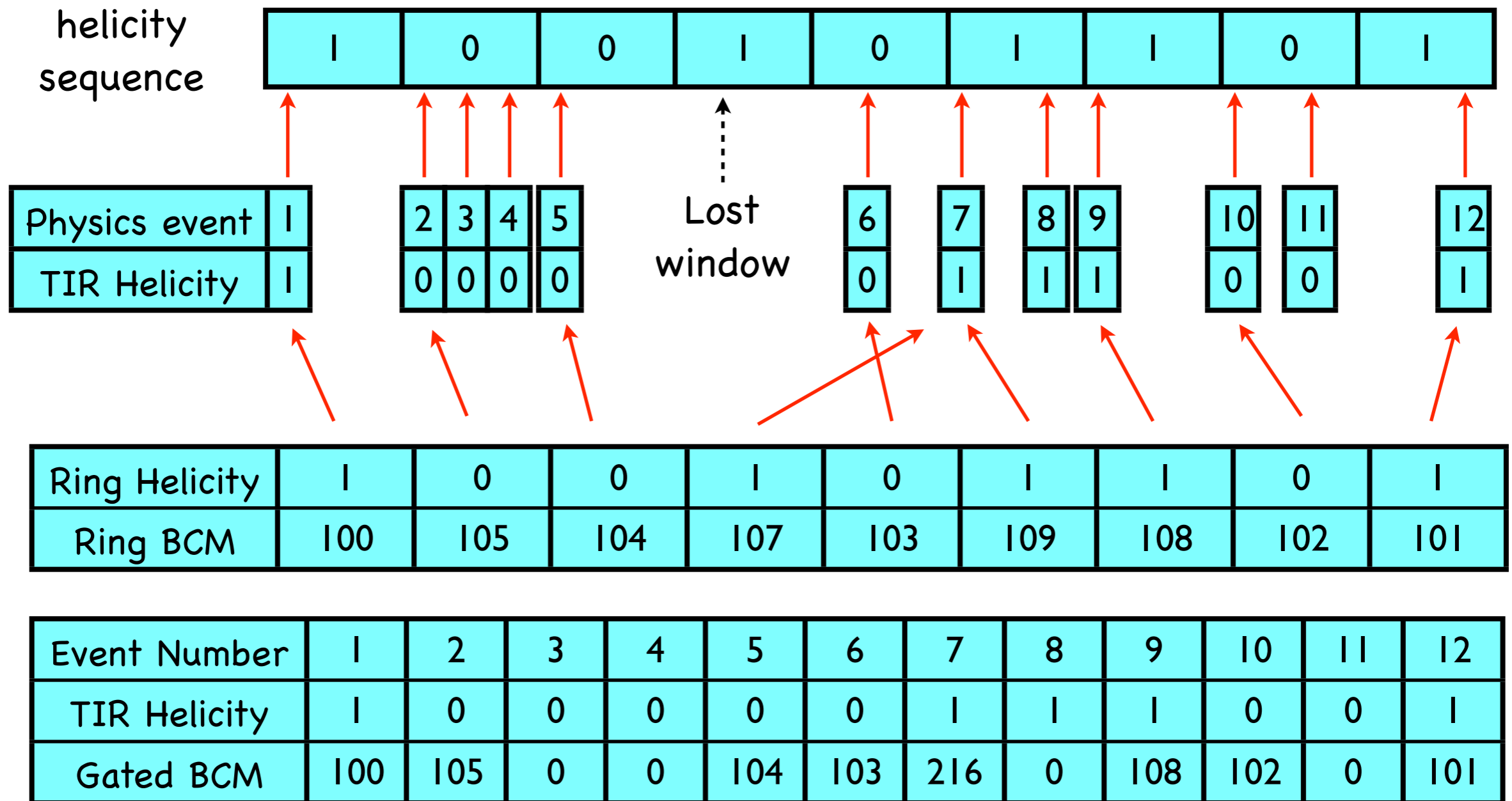


# Decoder: Align TIR and Ring

- Use seed of random generator as fingerprint to align TIR and Ring helicity
- For those helicity windows which lost in TIR, we will assign their BCM information to the closest physics event with the same helicity state



# Decoder: Align TIR and Ring



final event sequence with helicity gated BCM information