L1 Trigger

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2nd open meeting for the proto-collaboration
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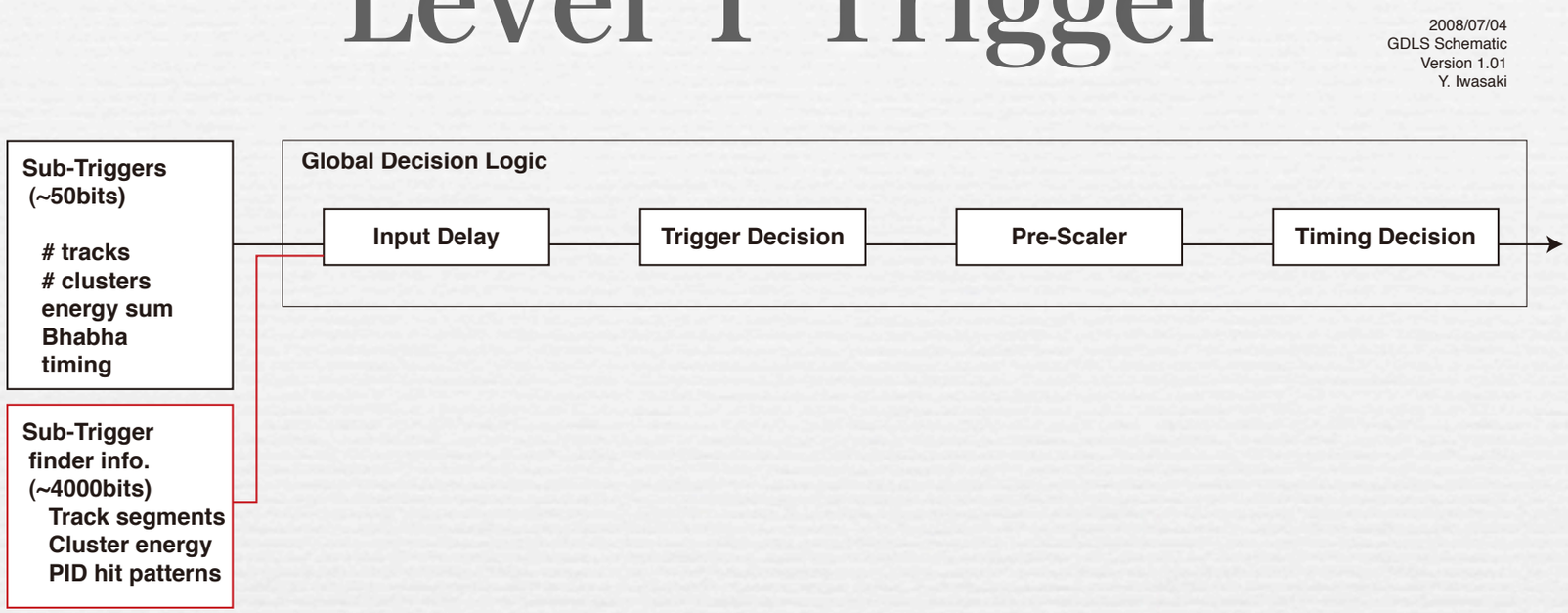
Physics Targets

Process	C.S. (nb)	R @ L=10^34 (Hz)	R @ L=10^35 (Hz)
Upsilon(4S)	1.2	12	120
Continuum	2.8	28	280
μμ	0.8	8	80
ττ	0.8	8	80
Bhabha	44	4.4	44
γ-γ	2.4	0.24	2.4
Two photon	15	35	350
Total	67	~100	~1000

- Cross-sections are calculated within the detector acceptance
- The rate with Bhabha and γ-γ are pre-scaled by factor 100
- Two-photon cross-section is obtained with Pt>0.3 GeV cut

Level 1 Trigger



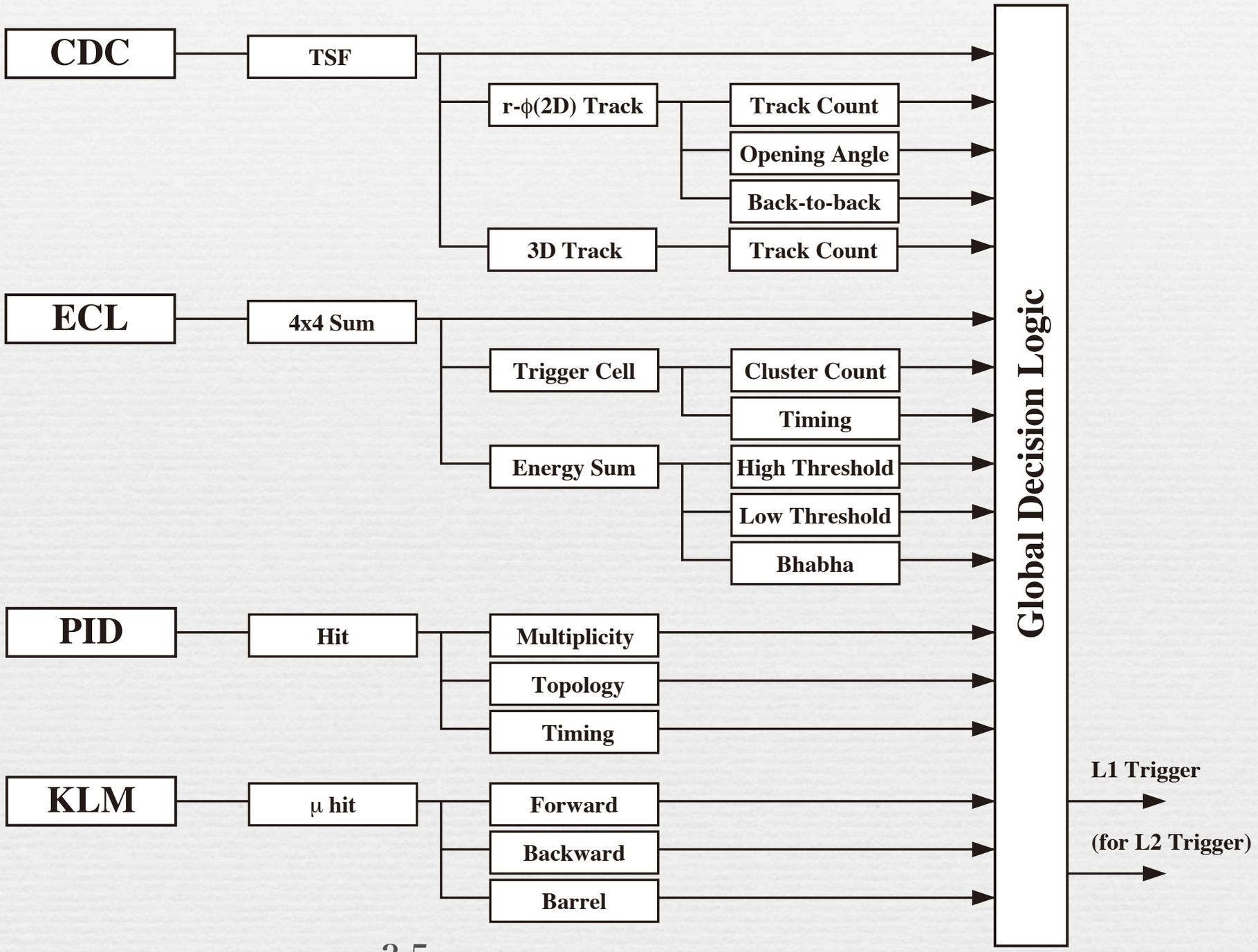
- Keep Belle triggering scheme
  - Present L1TRG works very fine
  - If no-one comes with better idea ...
  - In hardware level, new technology should be used to be more flexible and redundant for backgrounds and new targets
- Requirements
  - Fast decision : latency 3～3.5 μ sec
  - Tight but efficient logic : S/N >> 0.1, $\varepsilon(\Upsilon) \sim 1$
  - Redundant for any background conditions
  - Output rate @ $L=10^{35}$
    Average L1 rate ～ 10 kHz, Maximum ～ 30 kHz

Finer Info. from Sub-triggers

- GDL gather finer info. from sub-triggers
  - To make combination triggers in GDL level.
    - To be more flexible and redundant for backgrounds,
    - To catch up new physics targets
  - To send finer info. to Level 2 trigger (if necessary)
- CDC sub-trigger
  - Charged track (θ , ϕ , pt, pz) ... order 2000 bits
- ECL sub-trigger
  - Energy cluster (θ , ϕ , E) ... order 2000 bits
- PID (& KLM) sub-trigger
  - Hit position (θ , ϕ) ... order 100 bits x2

- To receive such info., we need new hardwares

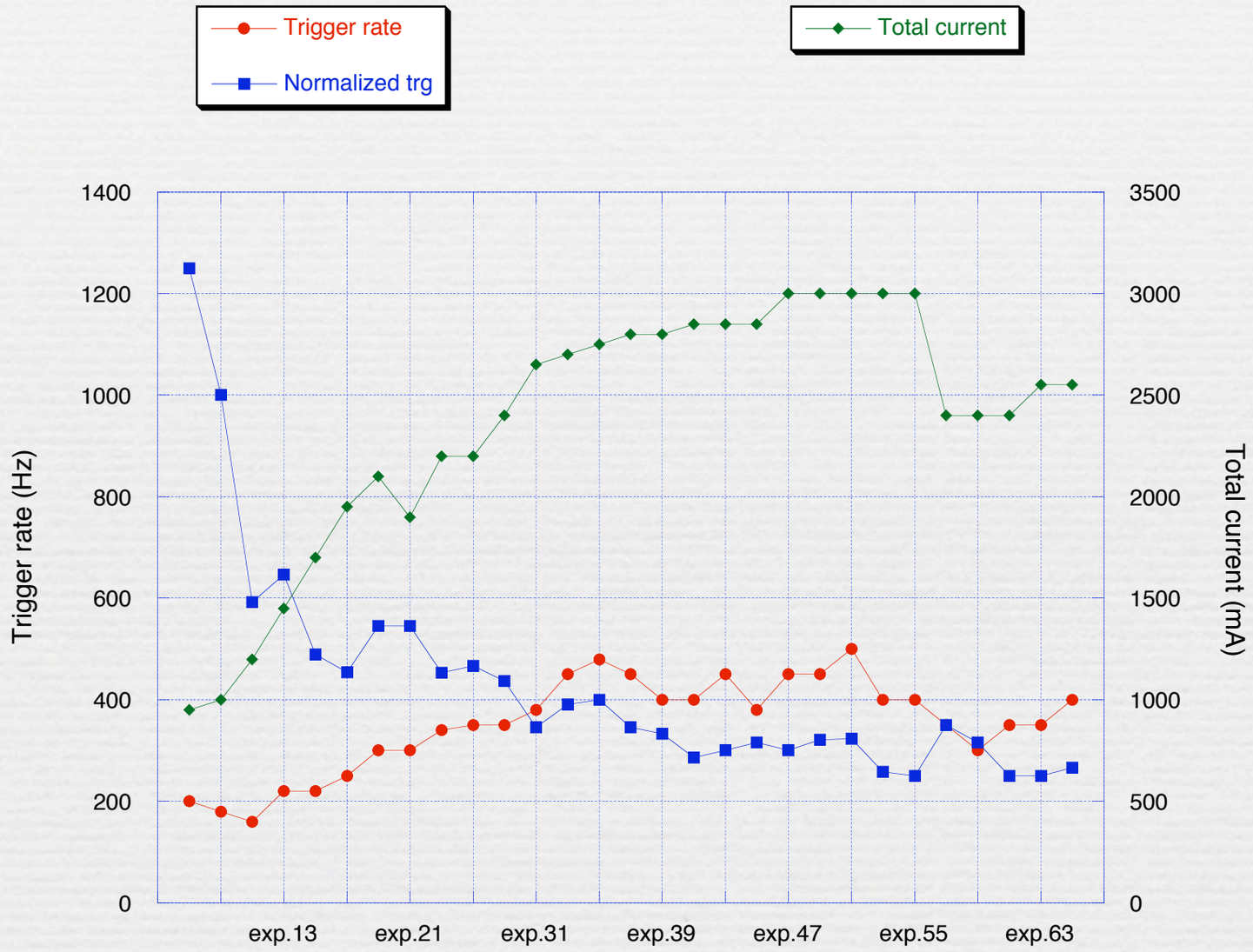
Sub-Triggers



Trigger Logics

- Main triggers for hadronic events
  - Two-track
  - Total energy
  - Isolated cluster
- Radiative events
  - Combination of ECL and CDC
- Low multiplicity events
  - High efficiency required ?
- Bhabha events
  - High efficiency, high purity
- Cosmic events
  - Not so important with high luminosity ?
- Veto triggers
  - Bhabha
  - Cosmic

Trigger Rate



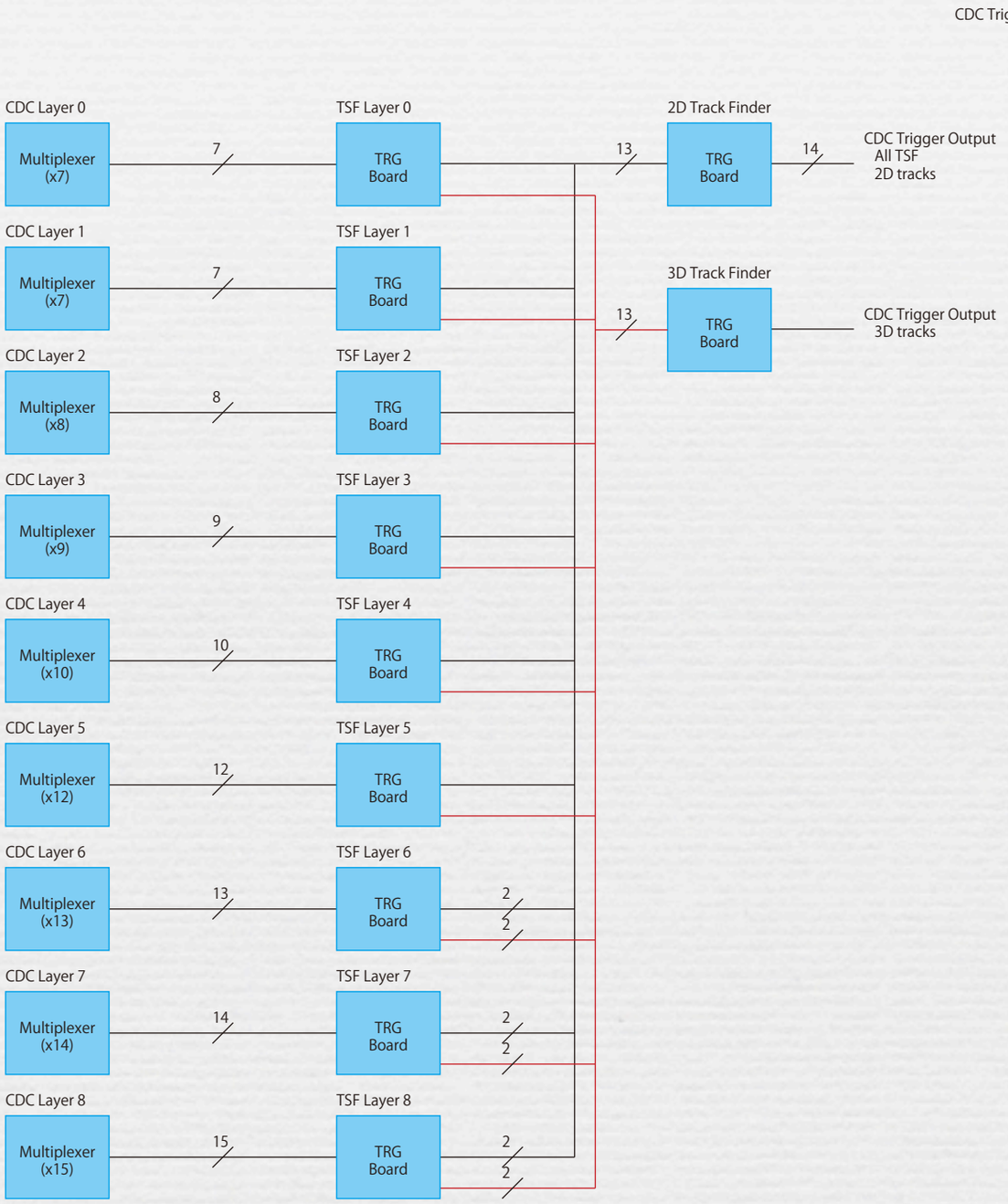
- Normalized trg
  = Rate @ $L=1\times10^{34}$
- Improvements seen in Norm. trg is due to the vacuum
- Simple extrapolation

	best	worst
$L=1\times10^{35}$	2.5 kHz	13 kHz
$L=2\times10^{35}$	5.0 kHz	26 kHz
$L=8\times10^{35}$	20 kHz	100 kHz

- Worries
  - Vacuum@IR in sKEKB
  - Radiative Bhabha entering endcaps
  - Max. luminosity

Do we need Level 2 TRG?

CDC Trigger



- Track Segment Finder (TSF) are formed in all super layers for 3D track identification
- All TSF info. is sent to two track finders (TF)
  - 2D track
  - 3D track
- 3D track is very powerful for background reduction
  - See E. Won's talk
- TSF and TF use Universal Trigger Board 2 (UT2)

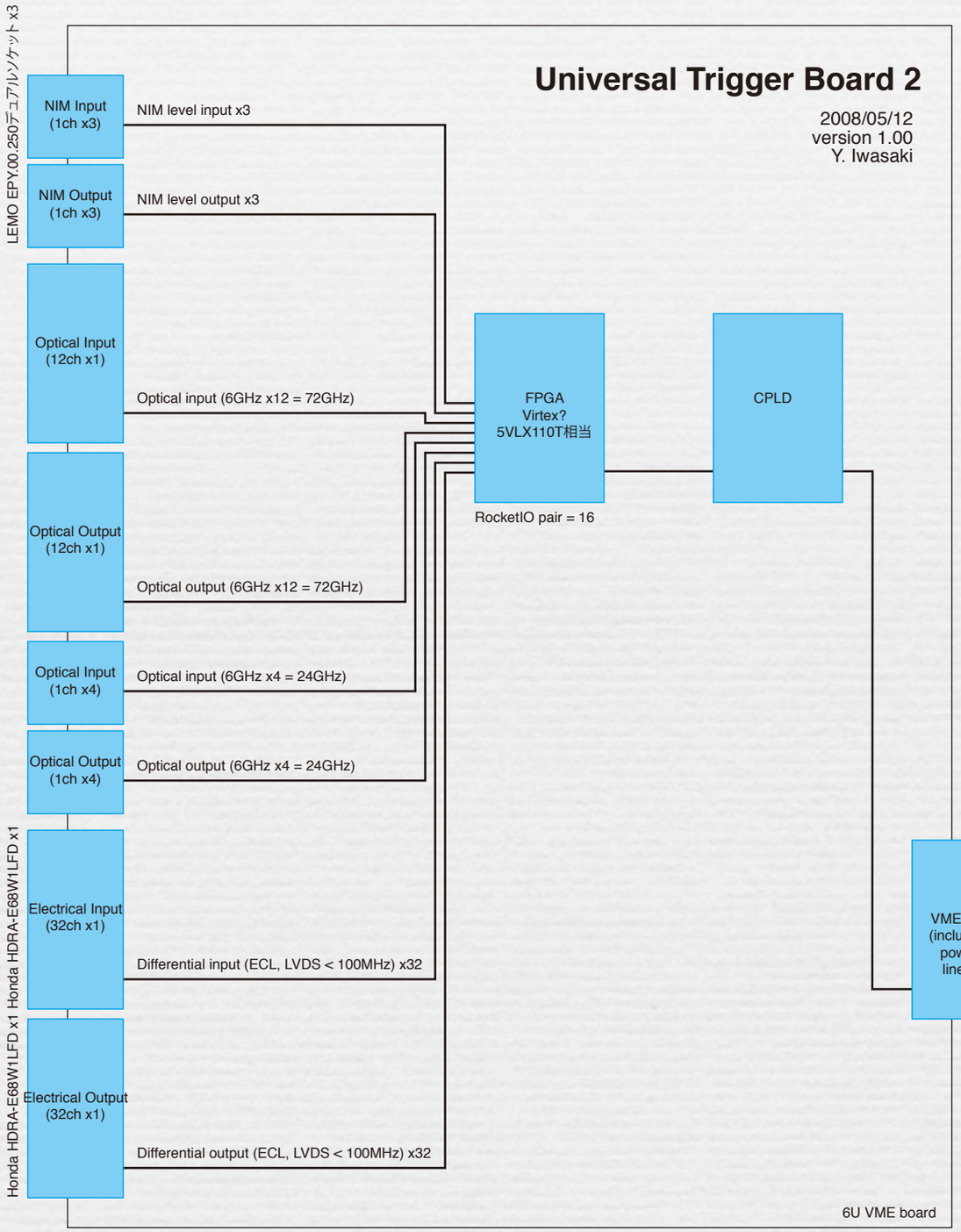
ECL trigger

- See B.G. Cheon's talk

PID (& KLM) triggers

- No discussion yet (except for PID timing)
- PID timing
  - See G. Varner's talk

Universal Trigger Board 2



- for CDC and GDL
- 6U VME board
- FPGA Core is Virtex5
- NIM x 3 I/O pairs
- Optical RocketIO
  - 6GHz x 16 I/O pairs
    ... 6000 channels in 16MHz
    ... 2400 channels in 40MHz
- Differential I/O x 32 pairs
- Design of proto-type is on going
  - Delivered in this fiscal year
  - 3GHz x 16 I/O pairs

tsim

- Purposes
  - To design trigger logics
    - Trigger efficiency estimation
    - Background reduction power
  - To check hardwares
    - Compare hardware and “tsim” response to pin down problems
- It’s time to start trigger design with realistic simulation
  - 1st version of G4 simulation is avilable
    - Give us enough information to simulate the trigger response
  - We reuse present “tsim” codes as much as possible
    - G4 can output Panther banks, which can be accepted by “tsim” with minimum modifications on present “tsim”
- “tsim” coordinator
  - E. Won (Korea U.)

Present Man Power

- Charged Track Triggers
  - 3D trigger : use axial and stereo wires
    - E. Won, B.G. Ko, B.Y. Han (Korea U.)
  - 2D trigger : use Hough algorithm
    - Y. Iwasaki (KEK)
- Energy Sum, Isolated Clusters, and Timing
  - B.G. Cheon, Y. Unno, S.G. Kim, I.S. Lee (Hanyang U.)
  - M.J. Lee, S. Ryu, S.K. Kim (SUN)
  - Y. Usov (BINP)
  - S.R. Kim (Notice Co.)
- Timing Trigger from PID device
  - G.S. Varner (U. Hawaii)
- Global Decision Logic
  - Y. Iwasaki (KEK)