L1Cal Trigger Terms

- **L1Cal sends up to 64 And-Or Terms to TFW**
  - **Pseudo-Terms: can be used in ORs ⇒ matching**
  - **Non-Pseudo-Terms: only ANDs possible**

- **Def's for these Terms can Change in Run IIb**
  - **TT-based → Cluster-based EM, JET & TAU**
  - **more processing available**
  - **explicit Cal-Track match at L1**

- **Constraints on New Terms from System Architecture**
  - **mainly from large amount of data to small number of boards**

⇒ Have to Think this through Carefully – Now !!! ⇐

http://www.nevis.columbia.edu/~evans/l1cal/hardware/trig_terms/trig_terms.html

Run IIa Trigger Term Distribution

And-Or No.	Used By
0 – 15	Calorimeter
16 – 31	Calorimeter
32 – 47	Forward Pre-Shower
48 – 63	Tracking: CFT+CPS
64 – 79	Tracking: CFT+CPS
80 – 95	Muon
96 – 111	Forward Pre-Shower
112 – 127	Forward Proton Detector
128 – 143	Calorimeter
144 – 159	Calorimeter
160 – 175	Tracking: CFT+CPS
176 – 191	Tracking: CFT+CPS
192 – 207	Muon
208 – 223	Luminosity / Level-0
224 – 239	Cal: Timing & Control
240 – 255	Framework Generated

can be used in pseudo-terms

Total L1Cal Terms 64

can not be used in pseudo-terms

Anticipated Run IIa L1Cal Terms

Name	*n* (obj's)	No. Thr's	Regions	No. Terms
CEQ(n,ϕ)	1,2	1	ϕ: 4 qdrnt's	8
CJQ(n ,ϕ)	1	1	ϕ: 4 qdrnt's	4
CER(n,t,η)	1,2	1 or 2	η: S,C,N	9
CJR(n,t,η)	1,2	1	η: S,C,N	6
CET	1	1	1	1
CME(t)	1	4	1	4
CEM(n,t) *	1,2	4	1	8
CJT(n,t) *	1,2,3,4	4	1	16
CTI(n,t,η)	1,2	1 or 2	2	8

32 pseudo-terms

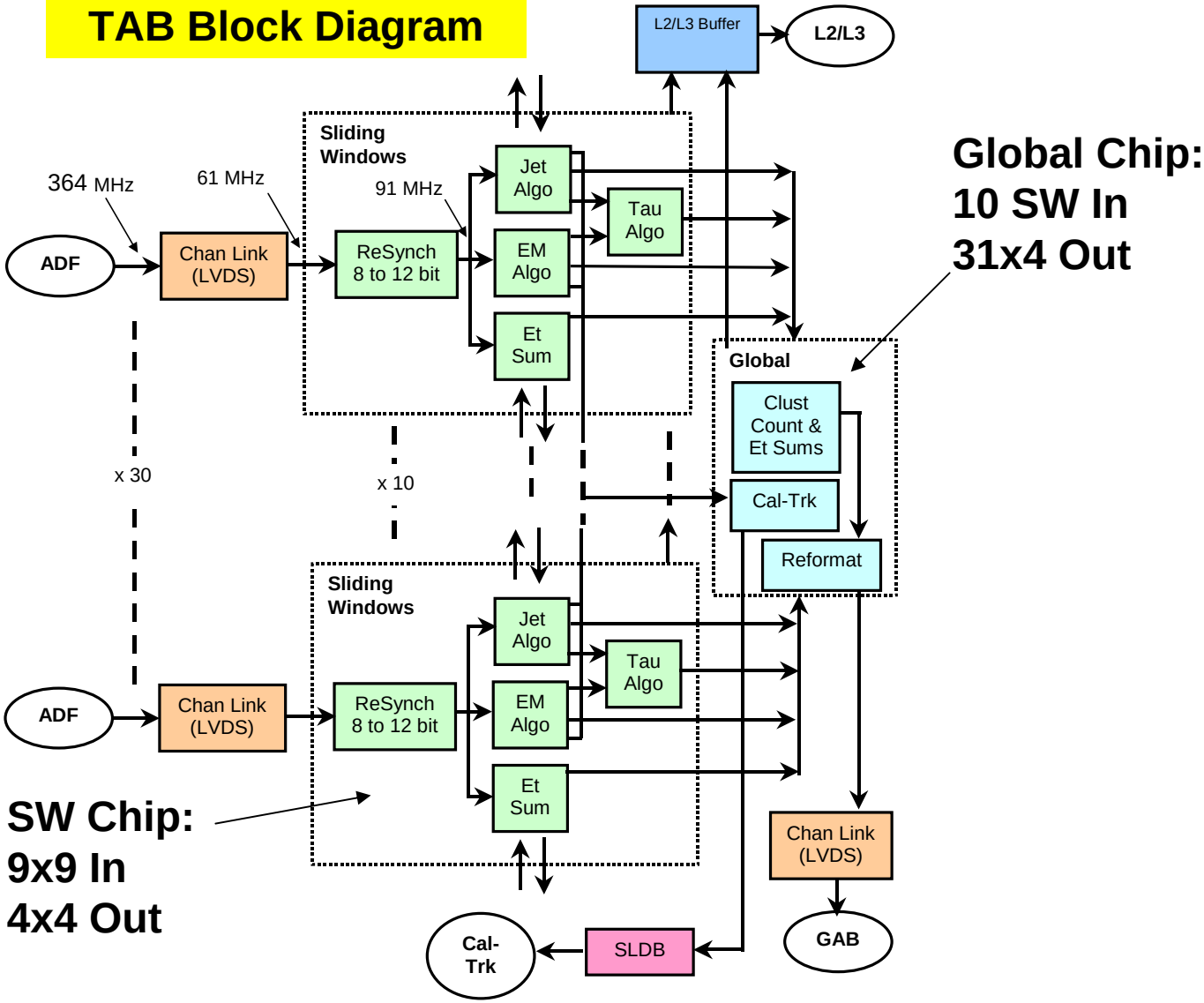
32 non-pseudo

- CEQ/CER/CEM — EM Obj's per ϕ/η/all region
- CJQ/CJR/CJT — JET Obj's per ϕ/η/all region
- CET/CME — Total Et / Missing Et
- CTI — Large Tile

*** currently implemented (partially)**

TAB Architecture Matters

TAB Block Diagram



Data Transfer in Run IIb L1Cal

Inside the TAB

- SW Chip Output: 25 lines
  - each line: 12-bits/BC
- Outputs
  - Clusters 12 lines
    - 16-EM + 16-H+ 16-TAU
    - each clust = 3-bits (highest of 7 thr's pass)
  - Sum(EM+H Et) 4 lines
    - sum over η for each ϕ
  - Data for L2/L3 2 lines
  - Stat/BX/Frame 3 lines
  - Spare 4 lines

TAB to GAB

- Serial Xmit via LVDS
  - 6 data pairs + clk - 8:1mux
  - Data = 12 bit words
- Outputs
  - Sum(EM+H) 3 words
    - Et, Ex, Ey
  - EM Counts 12 words
    - 6 thr's – 2 bit counts
    - S,C,N regions
  - H Counts 12 words
  - TAU Counts 12 words
  - Error/Parity 2 words
  - Clk/Frame 2 words
  - Spare 6 words

http://www.nevis.columbia.edu/~evans/l1cal/hardware/tab/sw_to_global.html

http://www.nevis.columbia.edu/~evans/l1cal/hardware/tab/tab_to_gab.html

Run IIb L1Cal – Trigger Terms

Name	*n* (obj's)	No. Thr's	Regions	No. Terms
CEQ(n,ϕ)	1,2	1	ϕ: 4 qdrnt's	8
CJQ(n ,ϕ)	1	1	ϕ: 4 qdrnt's	4
CER(n,t,η)	1,2	1	η: S,C,N	6
CJR(n,t,η)	1,2	1	η: S,C,N	6
CET	1	1	1	1
CME(t)	1	4	1	4
CTO(n)	—	—	—	3
CEM(n,t)	1,2	4	1	8
CJT(n,t)	1,2,3,4	4	1	16
CTA(n,t)	1,2	2	1	4
CTO(n)	—	—	—	4

32 pseudo-terms

32 non-pseudo

- CTO Topological
- CTA Tau
- CEQ,CER pre-shower match
- CJQ,CJR not needed ???

Intended to Start Discussion
Input Needed !!!

New for IIb: L1Cal Topological

- **Largely replaces L1Cal Pseudo-Terms**
  - **except for pre-shower match**
- **Constructed in GAB**
  - **large Stratix chip required to accommodate large number of inputs**
- **Simple Examples**
  - **Jet-Free Region (2D)** **$ZH \rightarrow \nu\nu bb$**
    - **{ !ϕ(i) AND !ϕ(i+1) …AND !ϕ(i+n) } (OR x32)**
    - **ϕ(i) = count of JET clusters over thr. at ϕ=i**
    - **use in conjunction w/ dijet trigger**
  - **Acolinear Jet/EM/Tau** **$ZH \rightarrow \nu\nu bb$, Z+jets**
    - **!{ ϕ(i) AND [ϕ(i+15) OR ϕ(i+16) OR ϕ(i+17)] } (AND x15)**
    - **use in conjunction w/ dijet trigger**
- **Quite Complicated Topologies Possible**
  - **(in principle)**
  - **lots of room in Stratix on GAB**

Conclusions

- **Flexible Choice of Trigger Terms in Run IIb**
  - **(but not infinitely so !!!)**
  - **New Topological and Tau terms**
- **Limitations on Creativity from Data Transfer Architecture**
  - **main constraint from no. of physical lines used in SW chips to Global chip transfer on TAB**
- **Workable List of Trigger Terms Created**
  - **see L1Cal Hardware web page**
- **New Ideas for the List Requested**
  - **these will be harder to fit in as time goes along**
  - **need to be supported by simulation studies**