EMCal Trigger Simulation

EMCal Software Meeting

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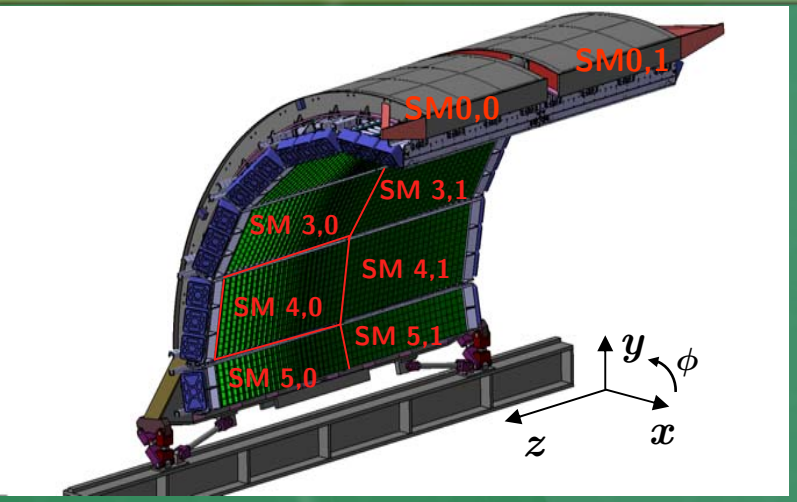
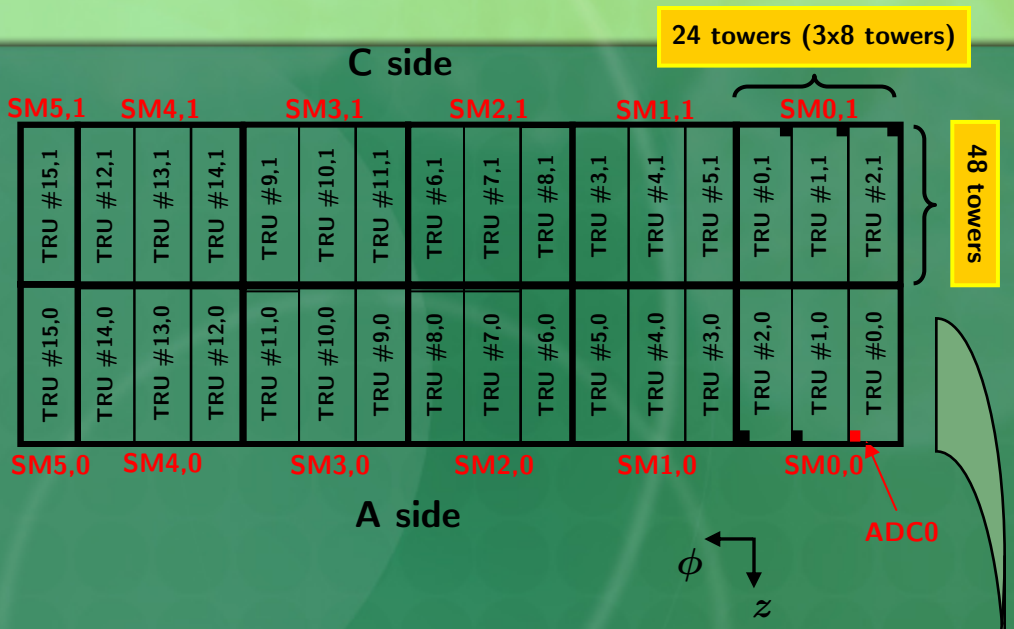
EMCal Layout

ALICE official coordinate system see ALICE-INT-2003-038

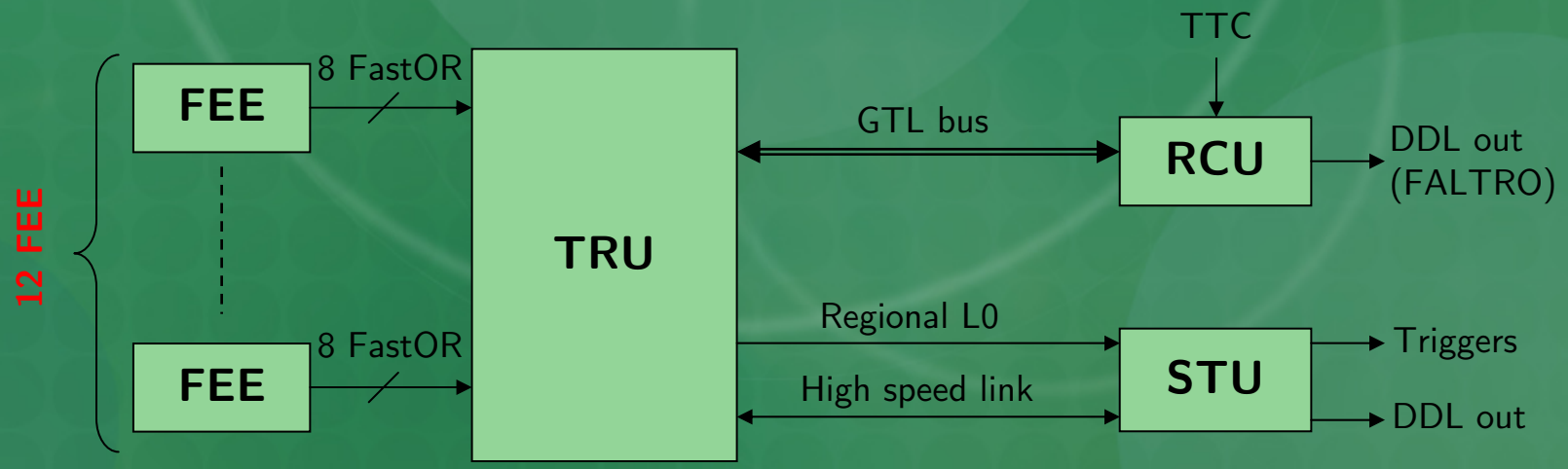




TRU ADC Mapping

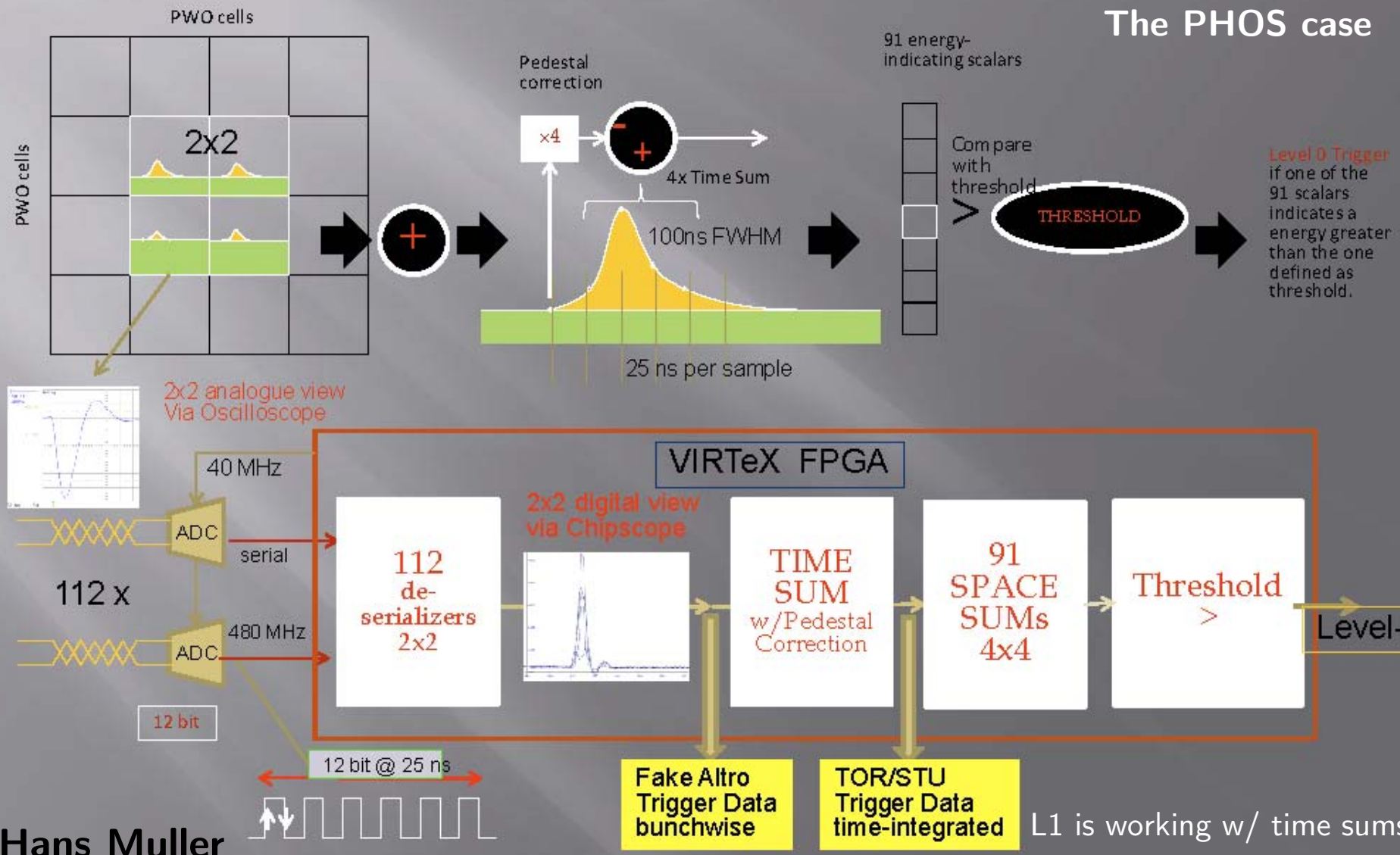
EMCal Trigger in a Nutshell

- **L0 (1.2 μs after interaction)**
  - Energy summed over sliding window of 4×4 towers (2×2 FastOR) and compared to a threshold above noise
- **L1-γ (6.5 μs after interaction)**
  - Energy summed over sliding window of 4×4 towers (2×2 FastOR) and compared to a multiplicity dependent threshold (from V0)
- **L1-j**
  - Energy summed over a sliding window of n×n subregions and compared to a multiplicity corrected threshold (a subregion is defined as 8×8 towers)



Level-o threshold trigger

The PHOS case



L1 is working w/ time sums

Hans Muller

L1-γ processing

- Patch size is similar to the L0 one
- But EMCal is scanned over its whole surface (no TRU border limit as in the L0 case)

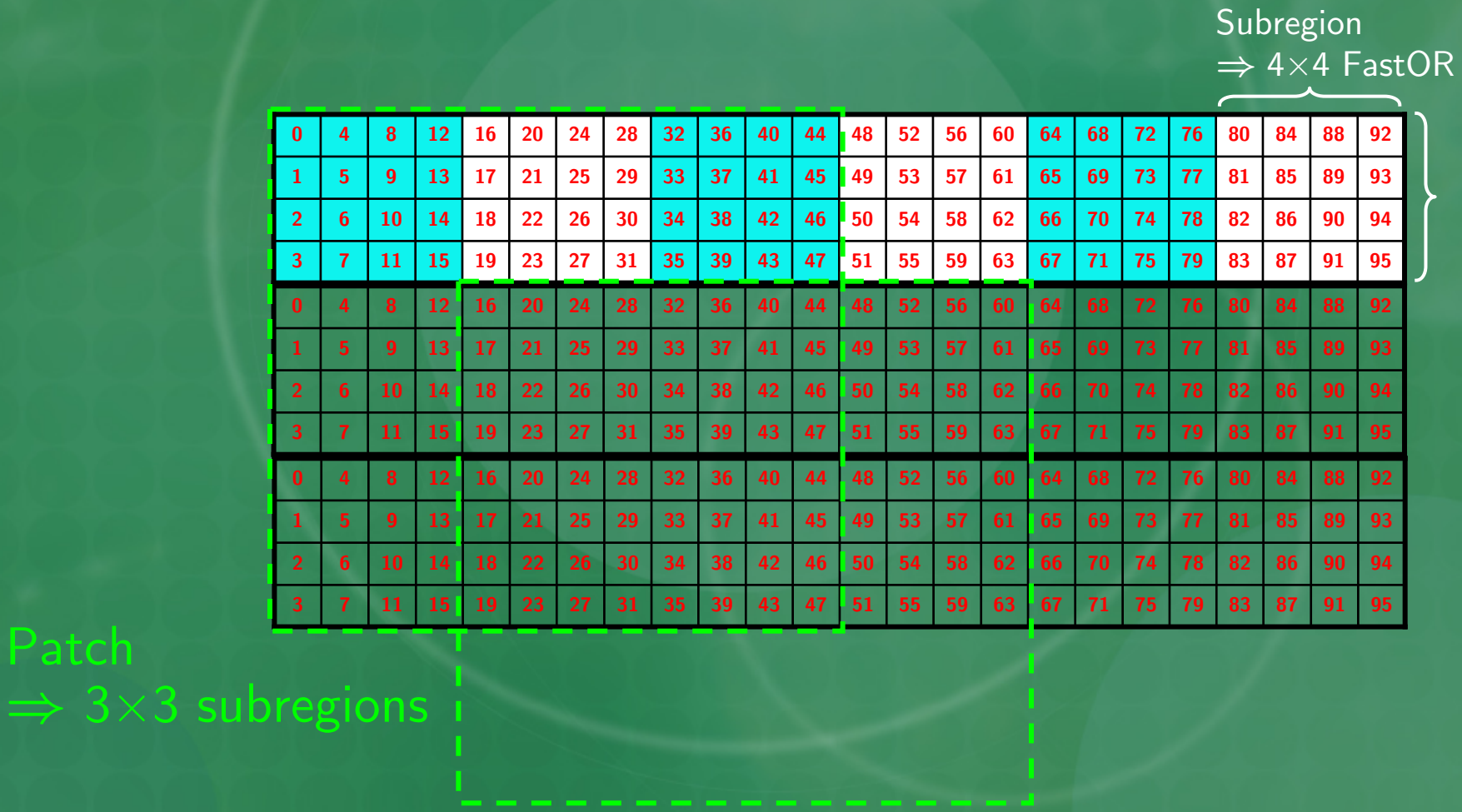
TRU# n

0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	81	85	89	93
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71	75	79	83	87	91	95

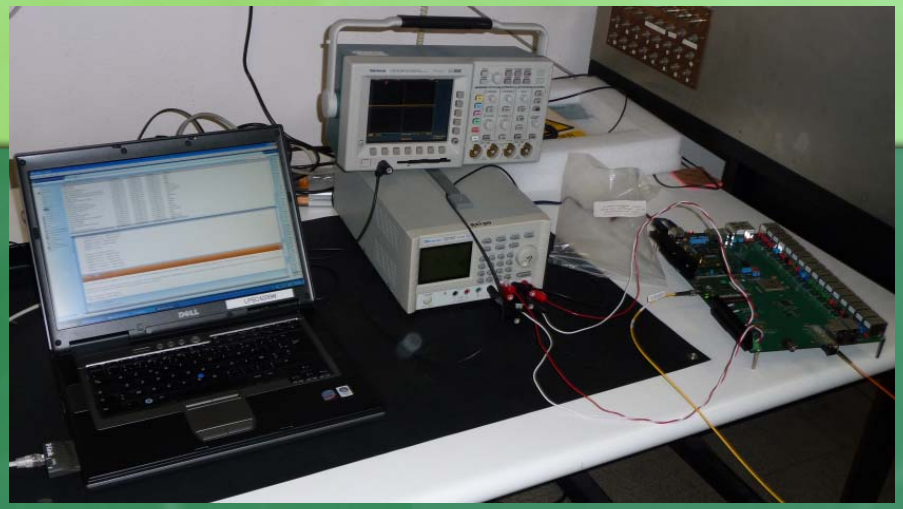
TRU# n+1

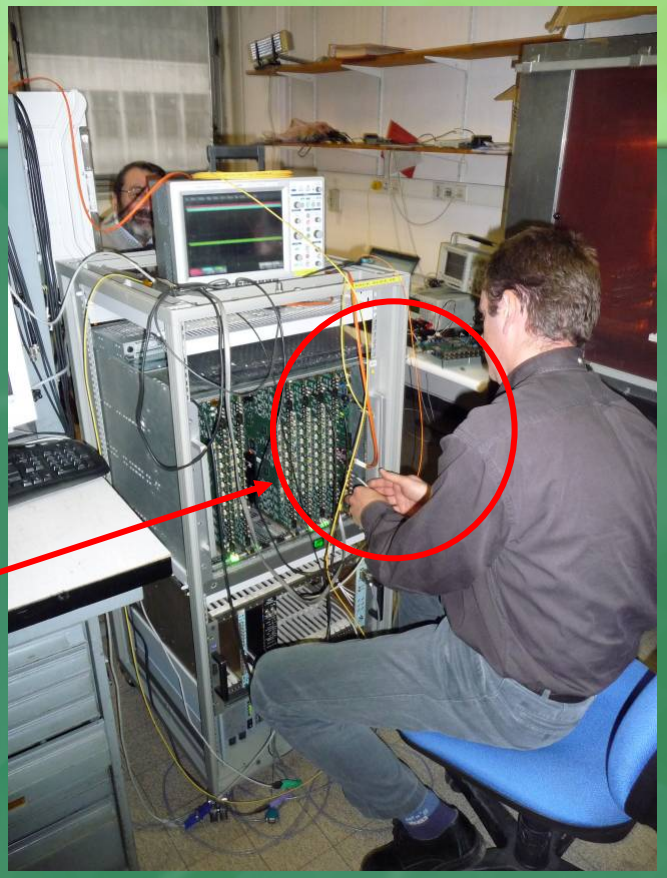
0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	81	85	89	93
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71	75	79	83	87	91	95

L1-j processing



V0 Interface





- Physical layer OK
- Protocol agreed
  - 2×11 bit word transfer: A plate and C plate charge
  - Transfer initiated by CTP confirmed L0
  - V0 can provide charge values at the L0/L1a rate
  - EMCal doesn't need to implement specific test mode for timing adjustment
- V0 DCS will made the HV setting available for STU DCS
  - Optimal threshold equation parameter can be computed before each run by DCS

EMCal present trigger simulation in AliRoot

- The 'all-in-one' `AliEMCALTrigger` class
  - No more in line w/ real Hw design
    FastOR shaping is wrong! (use the FEE one, H/L gain?)
  - Trigger definitions are outdated
    `_GammaHPt_L1`, `_GammaMPt_L1`, `_GammaLPt_L1`
    Thresholds are fixed...
      one L0, N≥5 (?) hardcoded for L1-j, 2 (H/G gain) for L1-γ
    ...but the patch energy is corrected from V0 multiplicity (retreived from ESD)
  - Some 'unknown' legacy code possibly not feasible from the Hw point of view
    Method `IsPatchIsolated()`

New implementation from scratch

- Constrain
  - Ability to recompute off/on-line the trigger response from Fake-ALTRO data for trigger monitoring
- EMCal trigger package
  - Set of 8 new classes

    `class AliEMCALTrigger`

    `class AliEMCALTriggerBoard`

    `class AliEMCALTriggerTRU : AliEMCALTriggerBoard`

    `class AliEMCALTriggerSTU : AliEMCALTriggerBoard`

    `class AliEMCALTriggerPatch` (x, y, sum)

    `class AliEMCALTriggerData`

    `class AliEMCALTriggerParam`

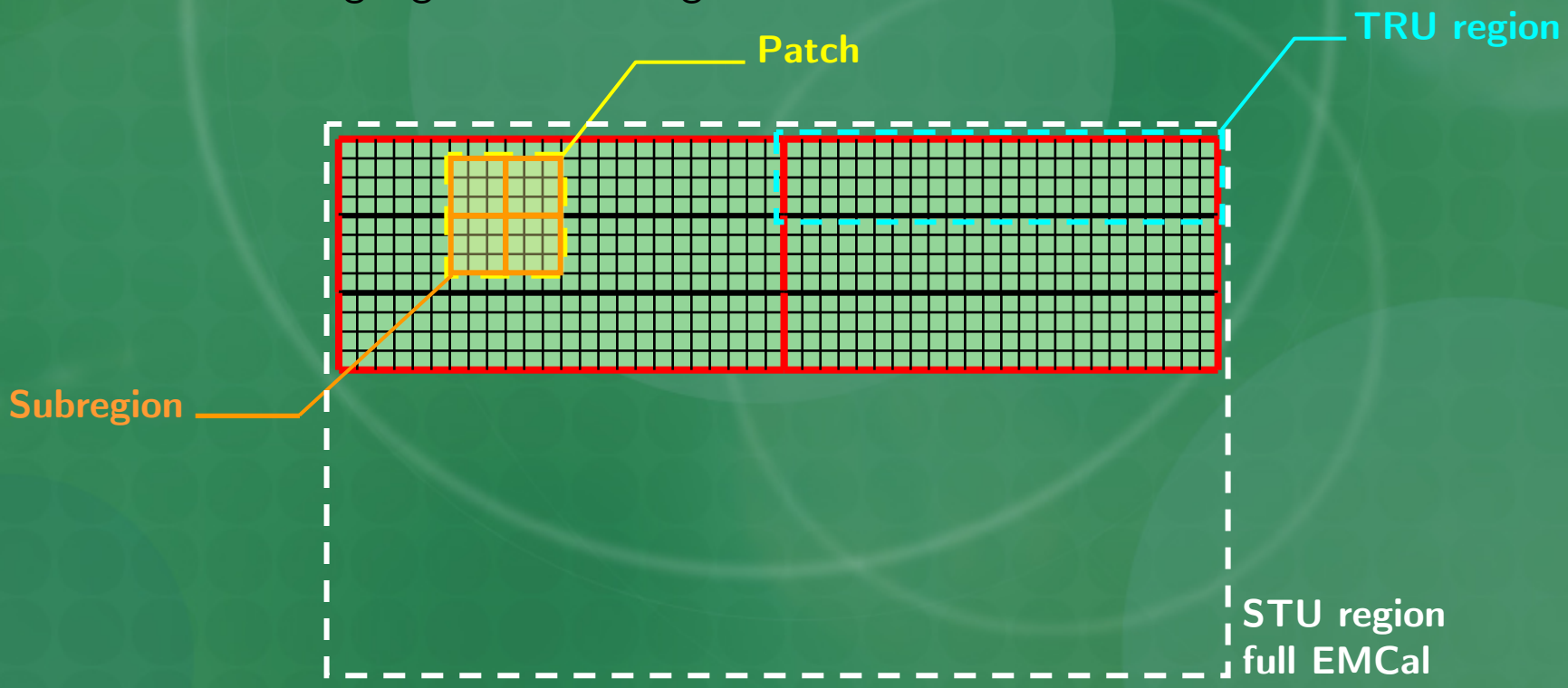
AliEMCALTrigger

- Replaces the old `AliEMCALTrigger` class but acts now as manager class only
  - Creates `AliEMCALTriggerTRU` objects (32)
  - Creates `AliEMCALTriggerSTU` object
  - Reads tower digits and sends them to the TRUs

    TRU index is computed from tower id using `AliEMCALGeometry::GetCellIndex()` and `AliEMCALGeometry::GetModulePhiEtaIndexInSModule()`
  - Issue L0 calculations and if one L0 is found issue L1 calculation
  - Fill L0/L1 data in digit tree

AliEMCALTriggerBoard

- Trigger boards base class
  - Region (made of FastOR) instantiation (array of int)
  - Subregion, patch size setters
  - Windowing algorithm running for both L0 & L1



AliEMCALTriggerTRU : AliEMCALTriggerBoard

- Analog FastOR recipe
  - Start from tower energy deposit
    from module digits summing `fDEprimary`
  - Light yield (from EMCal TDR) 125 photo-e^-/MeV at M=30
  - CSP response (from EMCal TDR) 0.136 μV/e^-
  - FastOR shaper transfer function
    computed from FEE circuitery
  - Phase shift due to ToF + cable length towards FEE crate

Digits of amplitude below a given threshold are removed

- Digital FastOR
  - Sampling frequency 40MHz
  - ADC FSR 0-1V
  - ADC resolution 11 bits
  - Noise can be generated according to a multivariate Gaussian if samples are correlated

To be checked from pedestal data

- L0 algorithm
  - For each time window
    Sliding patch of 2×2 FastOR
    Trigger is issued if patch energy is above threshold and patch energy has reached a maximum ('2-up/1-down' condition)

AliEMCALTriggerSTU : AliEMCALTriggerBoard

- Fill its internal data (full EMCal region) from TRU FastOR (time sums) on L0 issuing
- Read V0 digits & OCDB to estimate V0 A&C multiplicities
- Compute V0 threshold = f(V0A,V0C)
- Sliding window
  - L1-γ 2×2 subregions (subregion is 1×1 FastOR)
  - L1-j 3×3 subregions (subregion is 4×4 FastOR)

AliEMCALTriggerData

- Contain the triggering data to be stored in digit tree for post-processing
- Make a trigger branch and write
  - List of L0 patches
  - List of L1-γ patches
  - List of L1-j patches
  - EMCal region FastOR built from TRU inputs
  - V0 A&C multiplicity estimates

Still have some problem to update digit tree

AliEMCALTriggerParam

- Contains parameters for trigger calculation having in mind Hw limitations (not all Sw parameters can be Hw parameters)*
  - Subregion, patch sizes*
  - FastOR response (rise time, ADC FSR...)
  - Time window width...
- Could move pieces from `AliEMCALGeometry` regarding trigger mapping to be independent of pure geometry parameters (G3)

What's next?

- Simulate TRU data to be injected in the STU firmware
  - Generate DDL data packets decoded back in simulation (use `class AliEMCALSTURawStream`) and check consistency
- Define trigger calibration data and R/W from/to OCDB
  - L0 thresholds
  - L1 thresholds parameters f(V0)
  - dead/noisy channel masks...
- Clarify the use of `AliCentralTrigger` class
- Need for HIJING events