

Proposed GELATO (physics chain) Operating Point

- Our original proposal was for 1 kHz unique rate at GELATO L1
 - It was found that the GELATO HLT would use $\sim 1\%$ of the CPU farm

To combat this, we propose the following thresholds and rates:

	Unique Rate	Total Rate	ATHENA Threshold
GELATO L1	500 Hz	~ 8 kHz	1516309
GELATO HLT	10 Hz	~ 144 Hz	7.083

We justify this choice in the following slides.

Threshold Tuning Studies

In order to see if lowering the L1AD rate was possible we compared four options of unique rates:

- L1AD = 1 kHz $\rightarrow$ HLTAD = 10 Hz (original scheme)
- L1AD = 500 Hz $\rightarrow$ HLTAD = 10 Hz (lower L1AD rate for less resource usage at HLT)
- L1AD = 250 Hz $\rightarrow$ HLTAD = 10 Hz (very tight L1AD rate, unlikely to be optimal)
- L1AD = 20 Hz $\rightarrow$ HLTAD = 10 Hz (for internal studies only, not feasible working point)

Note: there was a small bug in the initial round of these studies in which the L1AD rate was not being changed correctly. This was fixed for the current results

Threshold Tuning Studies

- We calculated performance over our full set of MC signals
- As a metric, we calculated efficiency gain (over the current menu without GELATO)

We obtained the following summary statistics:

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Summary - Number of signals for which each scheme is best:
1000 Hz: 12 signals (28.6%)
500 Hz: 21 signals (50.0%)
250 Hz: 4 signals (9.5%)
20 Hz: 5 signals (11.9%)

Total signals analyzed: 42
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Accordingly, going down to 500 Hz at L1AD is totally feasible on the physics side :)

Threshold Tuning Studies

Why don't we lose performance with a tighter GELATO L1 working point?

To understand this, we can imagine the two **single network** extreme cases:

- 40 MHz → GELATO L1 → 10 Hz unique
- 40 MHz → GELATO HLT → 10 Hz unique (not technically feasible, but is useful to study for conceptual understanding)

In these two schemes, the (software) thresholds and rates were calculated to be

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L1AD threshold: 19.186201095581055, L1AD pure rate: 9.909572868960359, L1AD total rate: 284.15913707260796  
HLTAD threshold: 16.984447479248047, HLTAD pure rate: 8.82980580555196, HLTAD total rate: 33.084711168364045
```

- As can be seen, the total rate in the L1AD-only scheme is much higher than that in the HLTAD-only scheme
- In other words, GELATO L1 is **more correlated to the current menu**

Threshold Tuning Studies

Why don't we lose performance with a tighter GELATO L1 working point?

- By tightening the GELATO L1 threshold, fewer events are seen in GELATO HLT
- Accordingly, we get to loosen the GELATO HLT threshold to maintain 10 Hz unique rate
- GELATO HLT is more decoupled from the current menu, so:
 - A lower threshold results in more unique events
 - Lower incoming rate yields worse performance

These two effects work against each other, and performance can remain strong at different working points. Effects vary for different signals, but we want to avoid optimizing on any individual signatures.

Accordingly, we propose that 500 Hz at GELATO L1 will help reduce the resource usage at HLT while maintaining a strong physics performance