

Update on tests with CVN in module-1 configuration

S.A.-M. and S.P , 12 nov. 2020

Update on what shown one month ago

Recall: views are removed from the Module-1 simulation, the network is trained and tested.

- The results, compared to 3-views ones (published) , showed a degradation of performance on ν_e purity, as main effect
- and little difference between 2-views and 1-view

Results (II)

	Overall Purity (CC ν_μ)	Overall Purity (CC ν_e)	Overall Efficiency (CC ν_μ)	Overall Efficiency (CC ν_e)
DUNE CVN (views 0, 1, and 2)	0.9727	0.8705	0.9389	0.9261
Collection plane (view 2)	0.9625	0.7915	0.8922	0.8846
Induction planes (views 0 and 1)	0.9631	0.7896	0.9129	0.8963
Induction plane, collection plane (views 1 and 2)	0.9633	0.7872	0.9106	0.8924

The training was done without changing the priorities used in the DUNE-FD-SP.

The absolute statistical uncertainty in the figures is about 0.01 (samples of some 20k events).

Effects of removing planes, compared to default 3D:

- Small reduction in ν_μ efficiency
- Somewhat larger reduction in ν_e efficiency
- Small reduction in ν_μ purity
- Most visible reduction (by 8% relative) in ν_e purity

The loss of performance is not large.

The loss on ν_e purity might be reduced (to the cost of reduced efficiency, most likely).

There is very little difference in performance among the three 1D/2D variations.

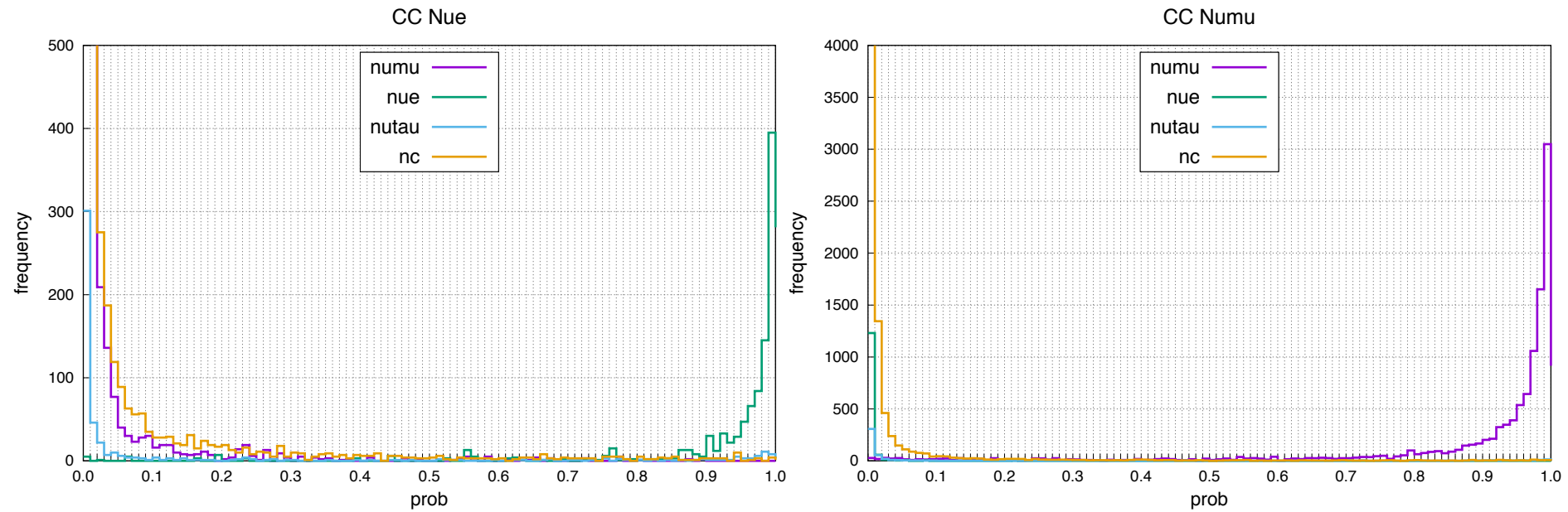
We do not have fully simulated data for the VD configuration, but the 1-view results can be taken as **lower-bound** on the performance of the VD detector (at least the view from the strip orthogonal to the detector axis is common the two design).

Therefore it is worth to look at the interplay between purity and efficiency for nu_e events, to see whether the drop in purity (87% to 79%) can be recovered, and at what cost.

Changing the way the network is trained has not produced remarkable results so far, so today we discuss the effect of changing the threshold for acceptance.

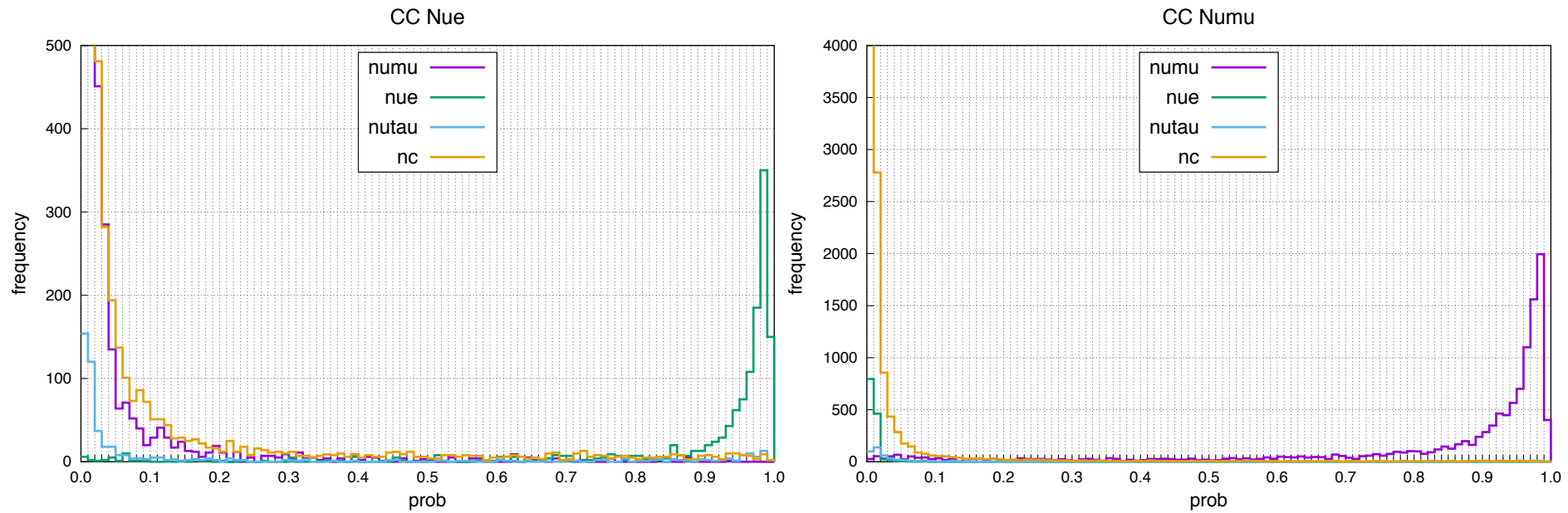
Event distributions (0)

- Original DUNE CVN (views 0, 1, and 2).



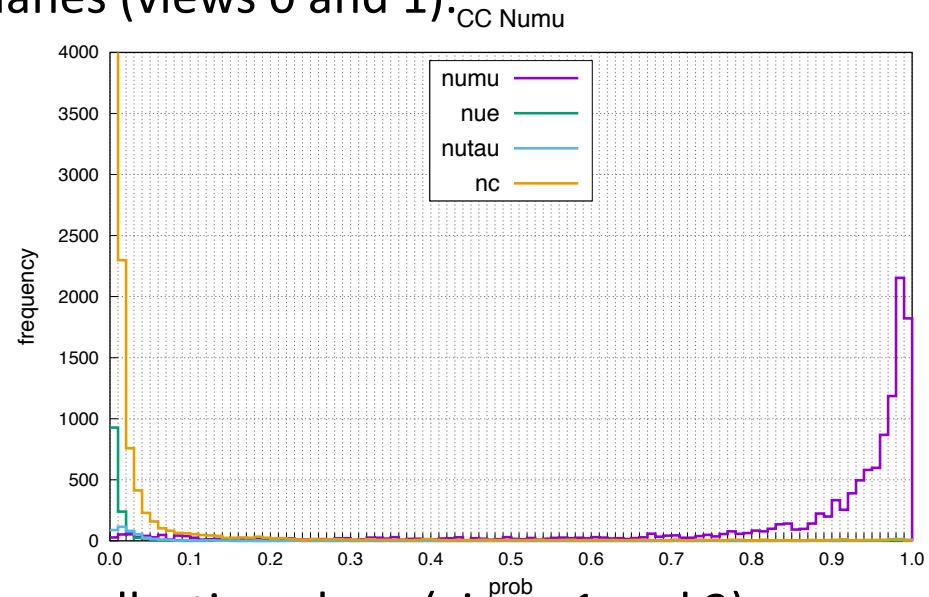
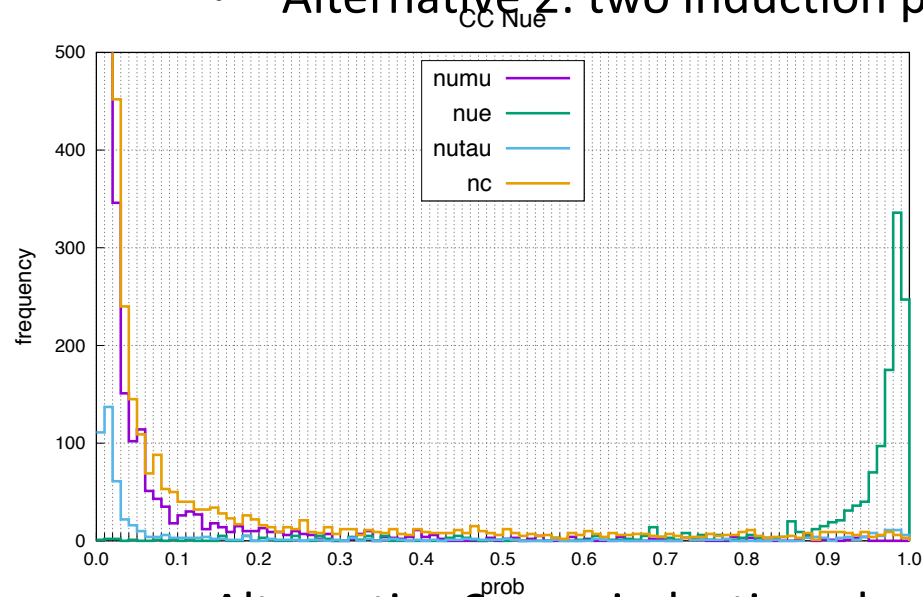
Event distributions (1)

- Alternative 1: only collection plane (view 2).

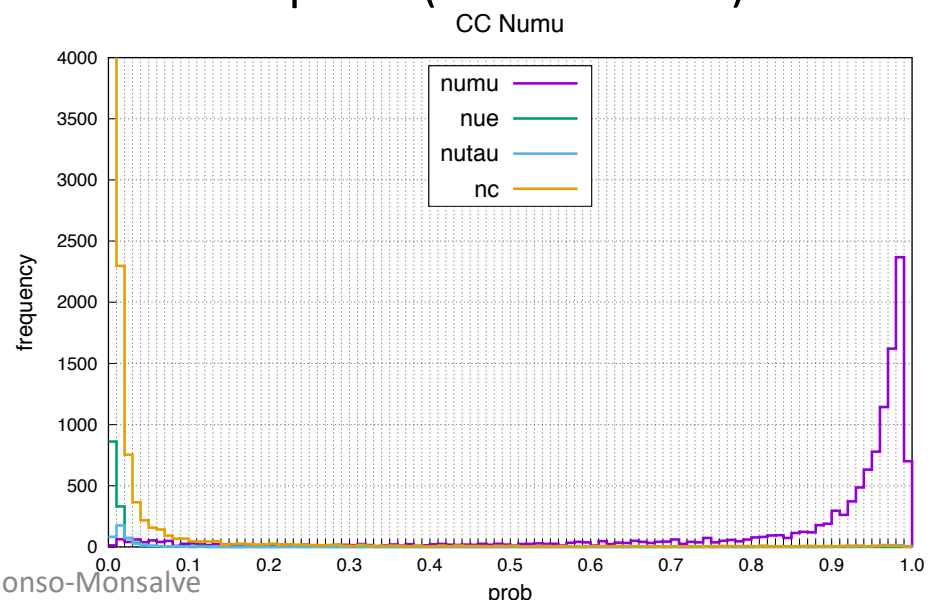
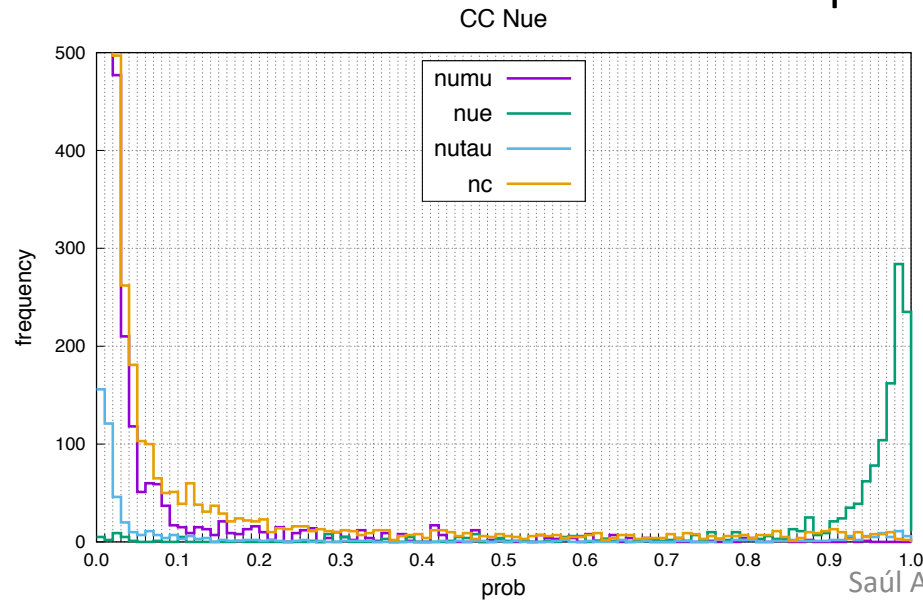


Event distributions (2) and (3)

- Alternative 2: two induction planes (views 0 and 1).



- Alternative 3: one induction plane + collection plane (views 1 and 2).



Trying different CC ve cut values

Due to network parameter initialisation, the results have a \pm error of ~ 0.005

Cut value:	Overall CC ve purity			Overall CC ve efficiency		
	0.80	0.85	0.90	0.80	0.85	0.90
DUNE CVN (views 0, 1, and 2)	0.9040	0.9219	0.9360	0.9008	0.8896	0.8486
Collection plane (view 2)	0.8526	0.8749	0.8998	0.8422	0.8086	0.7565
Induction planes (views 0 and 1)	0.8355	0.8532	0.8867	0.8673	0.8452	0.7992
Induction plane, collection plane (views 1 and 2)	0.8277	0.8551	0.8835	0.8575	0.8385	0.7823

results (II)

Overall Purity (CC ν_e)	Overall Efficiency (CC ν_e)
Cut: 0.70	
0.8705	0.9261
0.7915	0.8846
0.7896	0.8963
0.7872	0.8924

87% purity is recovered at a cost of a drop from 93% to 81% in efficiency.

- Not clear yet what would be the optimal trade-off between efficiency and purity
- Adding the x-view should improve the performance
- The fact that, in this test, 2-views are not better than 1-view suggests that the network may not be optimal/robust, but this requires further studies (and the subject is probably not central for the case of VD)