PFA status in brief

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SiD PFA status

- Lots of changes to the PFA recently -- most importantly:
  - Short second pass to pick up cluster pieces missed in first pass. Currently using simple cone -- we can do better.
  - Smarter handling of shared hits (hit-by-hit, not en bloc).
  - Trying harder to find structure in hadronic showers
  - Addition to main clustering pass: as well as usual link types (MIP-MIP, MIP-clump, etc), link track seeds to clusters in tight cone downstream of showering point.
  - Share teeny clusters by cone from showering point as well as proximity.
  - Don't drop any hits.

Using our standard benchmark*, performance is now:

sid01 HCAL: Digital RPC	sid01_scint HCAL: Digital scintillator
$\text{mean}_{90} + \text{rms}_{90} = -0.93 \pm 4.15$ $dM/M = \text{rms}_{90}/(m_Z+\text{mean}_{90}) = 4.6\%$	$\text{mean}_{90} + \text{rms}_{90} = -1.06 \pm 3.76$ $dM/M = \text{rms}_{90}/(m_Z+\text{mean}_{90}) = 4.2\%$

* $e^+e^- \rightarrow Z(\nu\nu)\ Z(qq)$, $\sqrt{s}$=500 GeV, q=u/d/s, looking at dijet invariant mass residuals. Remember, rms90 is less than real resolution -- typically 70-80%.

Trying to compare with Pandora

dM/M=4.2% is a big improvement from before, but:

- Still short of what we want for physics performance -- we have more work to do!
- Still not as good as Pandora numbers.

But! Comparison with Pandora is not quite apples-to-apples:

- Pandora numbers use event energy resolution rather than mass of boosted jets -- don't need to measure direction.
- Pandora numbers quoted for mono-energetic jets.
- Pandora numbers made with a bigger, deeper detector.

Effect of 3x3 vs 1x1 HCAL segmentation?

Here is Marcel's Pandora comparison table from May:

	SiDish	SID	LDC00Sc	Comments
Starting point (200 GeV qq)	35%	46%	30%	from Pandora/ Memory
- RPC (3%)		43%		from Pandora
6 more layers in HCAL (2 %)		41%		guesstimated
+TPC Tracking tricks (2 %)		39%		guesstimated
+10 layers in ECAL (2 %)	33%	37%		from Pandora
+0.25 m radius (1 %)	32%	36%		from Pandora
+0.2 m radius – 1T B field (2 %)	30%	34%	30%	from Pandora

Trying to compare with Pandora

Let's look at qq events & try to compare like with like:

	Pandora					SiD PFA	
	LDC00SC	SiDish (scint)	SiDish (rpc)	SiD (scint)	SiD (rpc)	SiD (scint)	SiD (rpc)
qq91	25%	28%	32%	?	?	31%	36%
qq200	30%	35%	39%	43%	46%	41%	45%
qq500	57%						

Not bad! We're pretty much even with how we think Pandora would do on SiD for ~100 GeV jets.

(Aiming to do better, though -- Pandora isn't optimized for our detector.)

Trying to compare with Pandora

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	LDC00SC	SiDish (scint)	SiDish (rpc)	SiD (scint)	SiD (rpc)	SiD (scint)	SiD (rpc)
qq91	25%	28%	32%	?	?	31%	36%
qq200	30%	35%	39%	43%	46%	41%	45%
qq500	57%					97%	109%

... but performance tanks for higher energy jets.

Conclusions & thoughts

- PFA performance is improving
  - Brainstorming + big push over last month helped a lot. (Thanks!)
  - Still lots of ideas to try & known problems to fix
- There is still a long way to go
  - Performance still not where we'd like for physics (dM/M ~ 4-5%... we want <3% or better)
  - Things are especially bad for higher-energy jets.
- Starting to catch up with Pandora for E_{jet} ~ 100 GeV
  - Lots of caveats -- not good at high energy, assumptions about extrapolation from SiDish to SiD, HCAL segmentation, etc.
  - And we should really be doing BETTER than Pandora -- SiD is our own back yard & we should be optimized for it. Ideally, SiD-PFA on SiD should be competitive with Pandora on ILD.
  - But we can now start forming our own opinions on detector optimization.