

Global Track Reconstruction

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MICE Collaboration Meeting 47

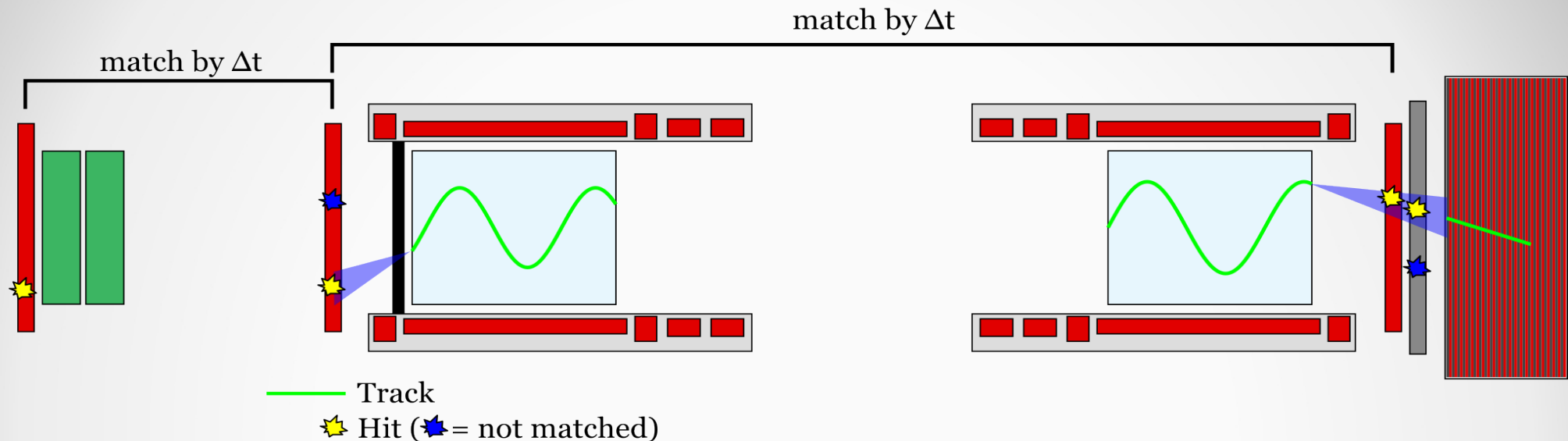
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Track Matching

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- Propagate track point between detectors
- Compare agreement between propagated and measured track point
- → Accept / Reject
- Different method (Δt based) for TOF0 and US/DS matching

Track Matching

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- Propagation requires mass and charge to be known, so track matching creates 3 or 6 tracks for each particle tagged with a PID hypothesis. Celeste's PID code then picks out the correct one

KL Cell Merge

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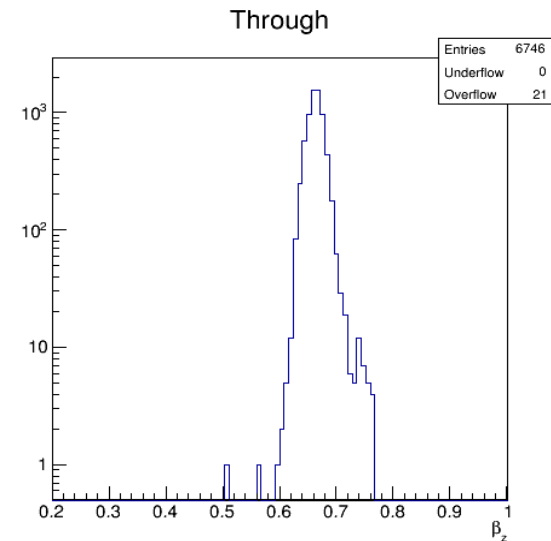
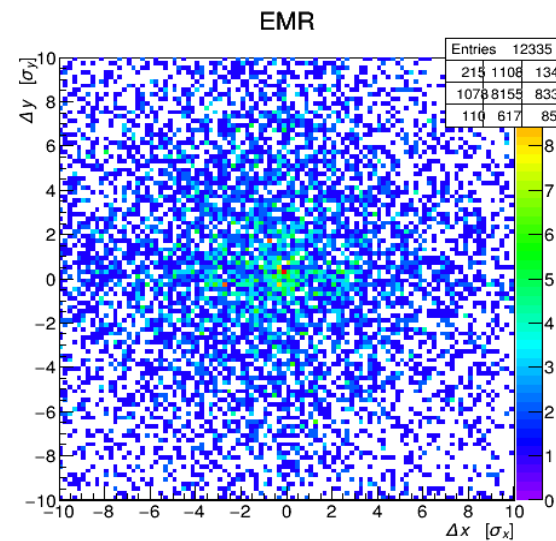
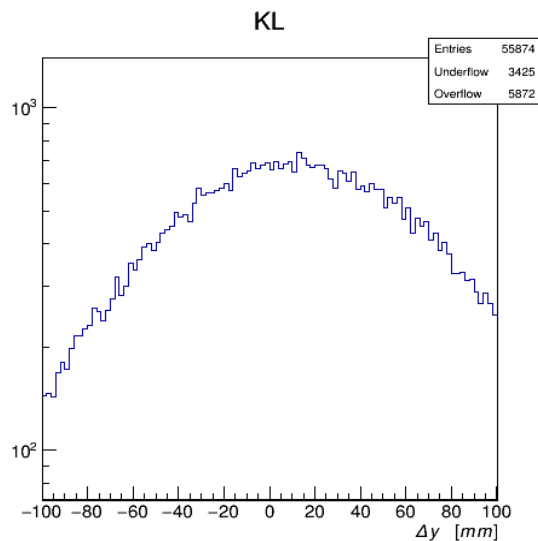
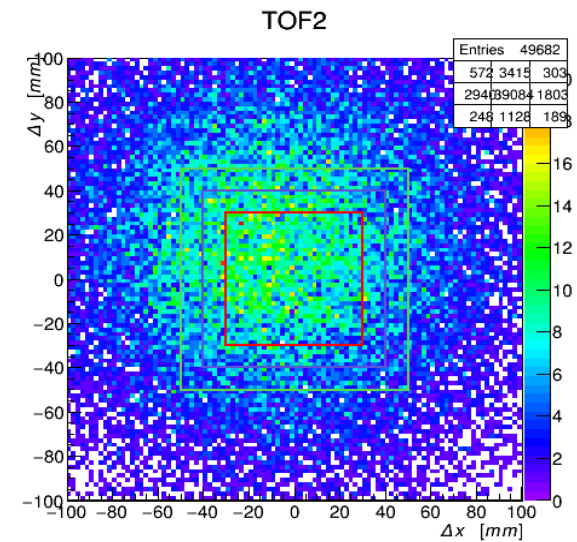
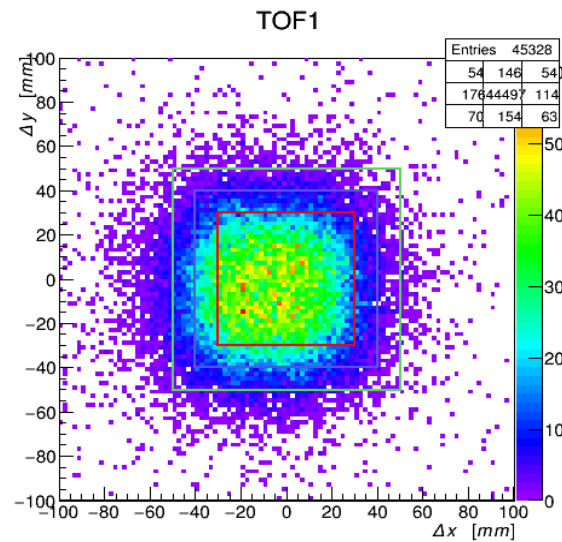
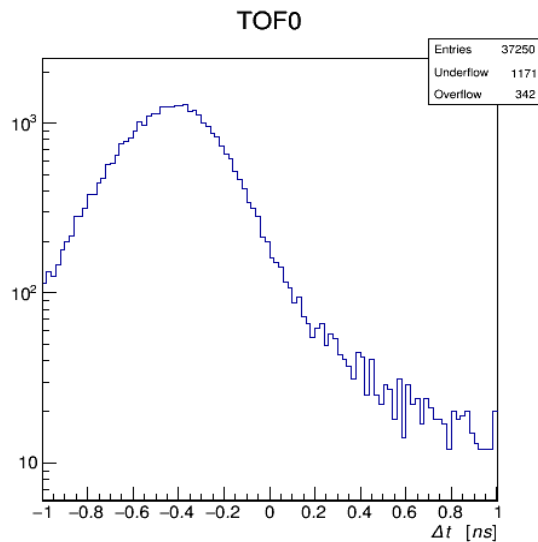
- KL local reconstruction produces one spacepoint per cell hit, i.e. particles passing through multiple cells will create multiple spacepoints
- Modified the import into the global datastructure to merge adjacent cell hits, with averaged position weighted by charge deposit (y error calculated appropriately)

Run 8681 Data Residuals

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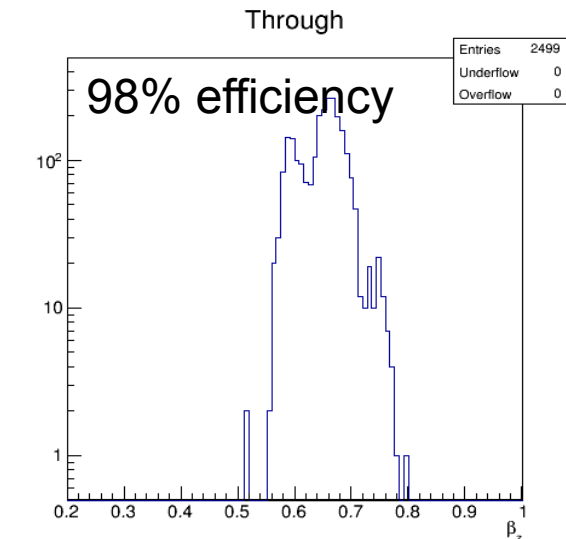
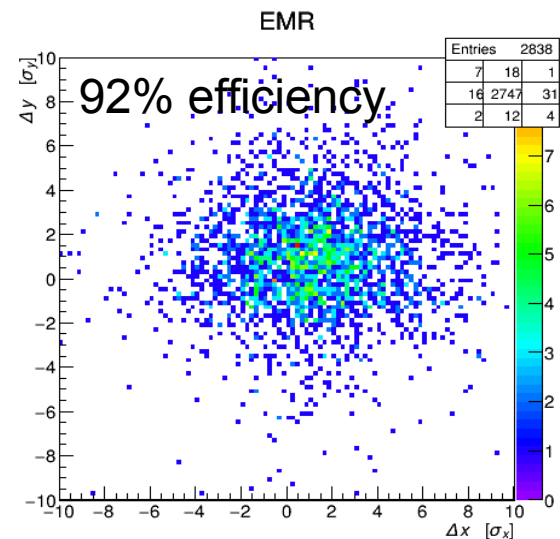
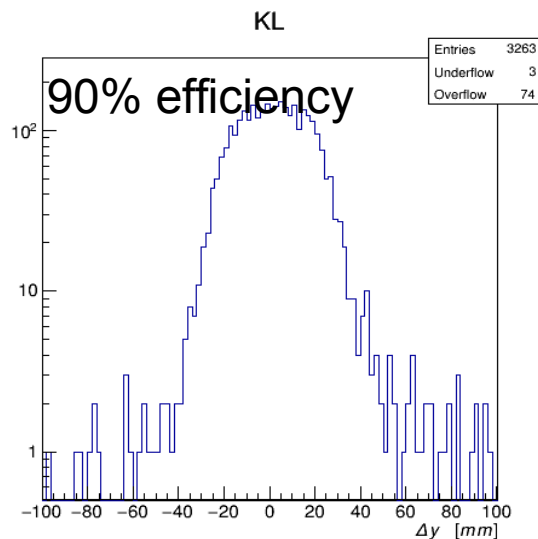
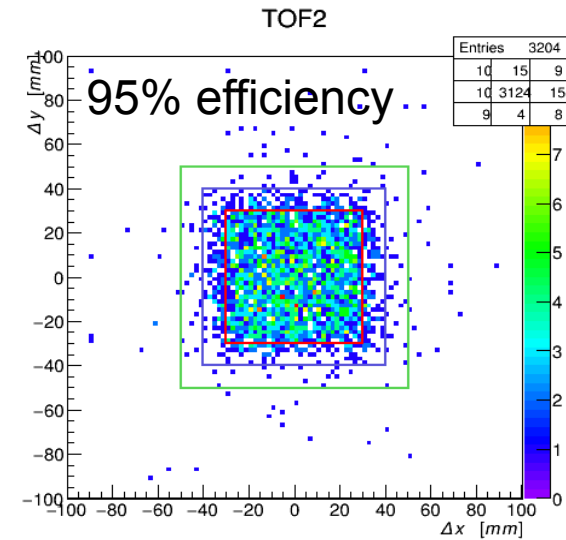
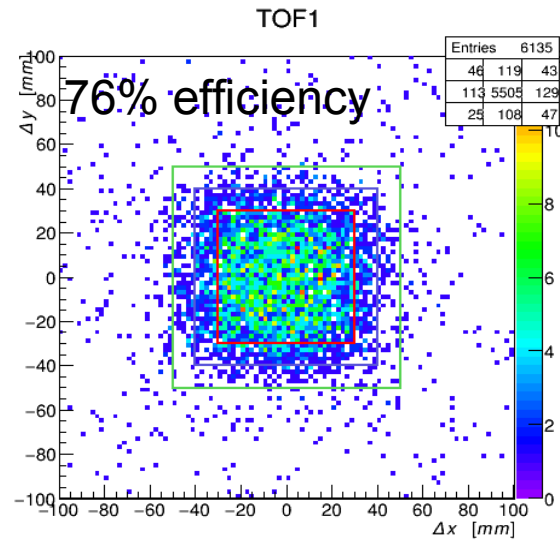
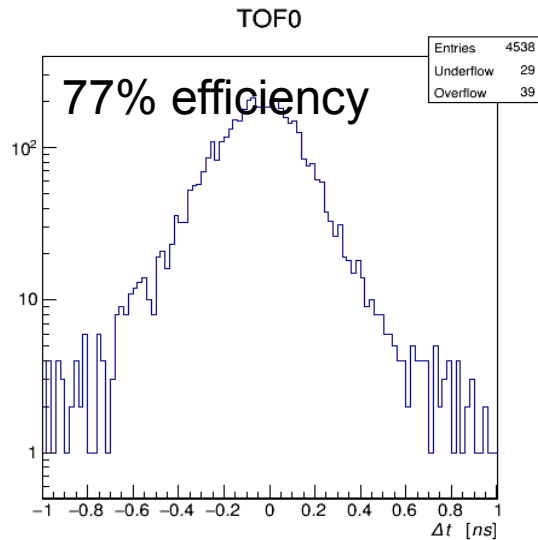


Run 8681 MC Residuals (140 MeV)

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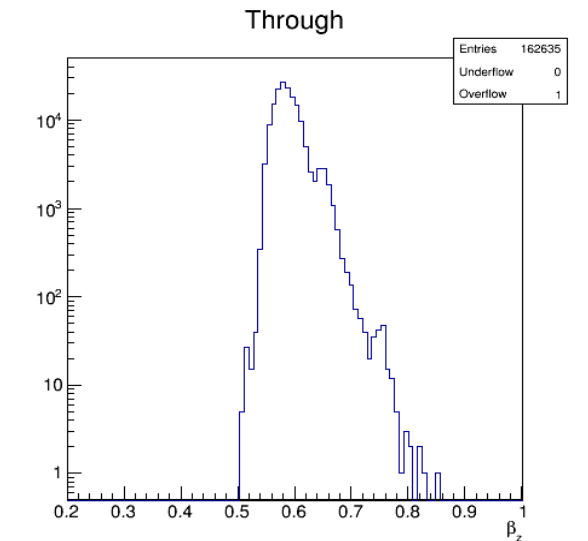
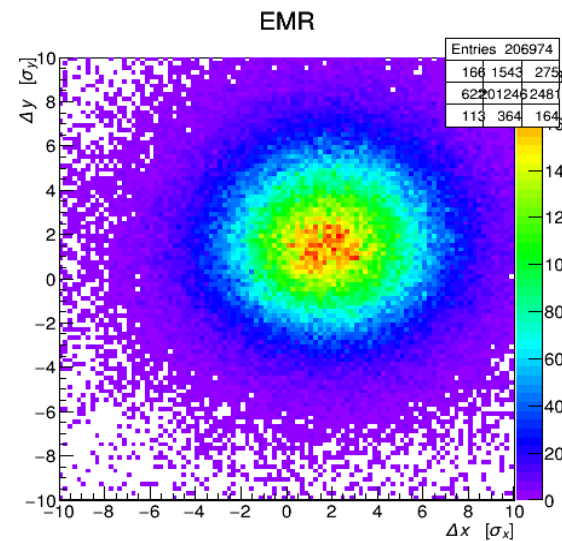
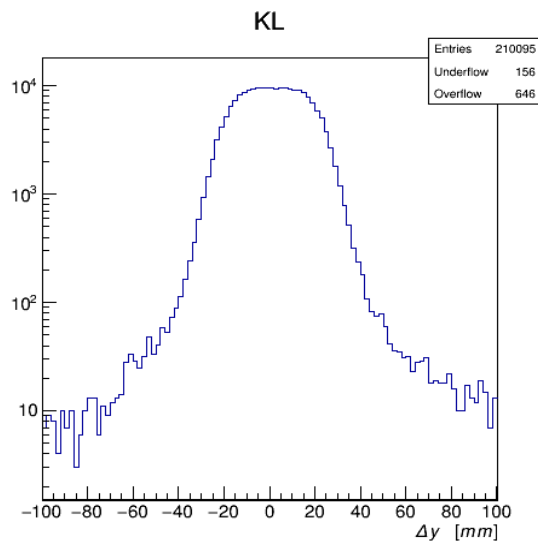
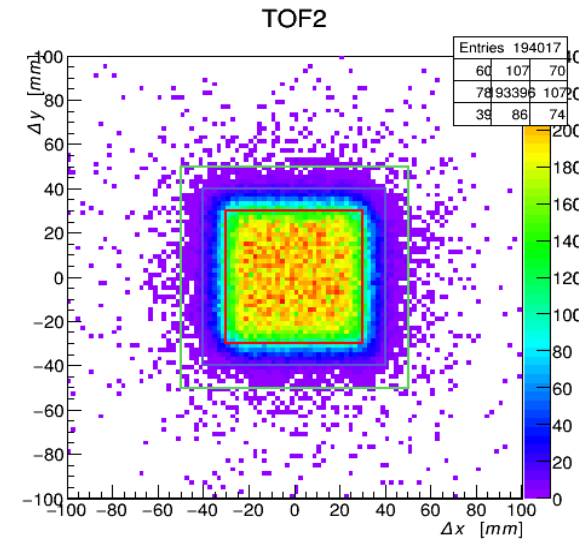
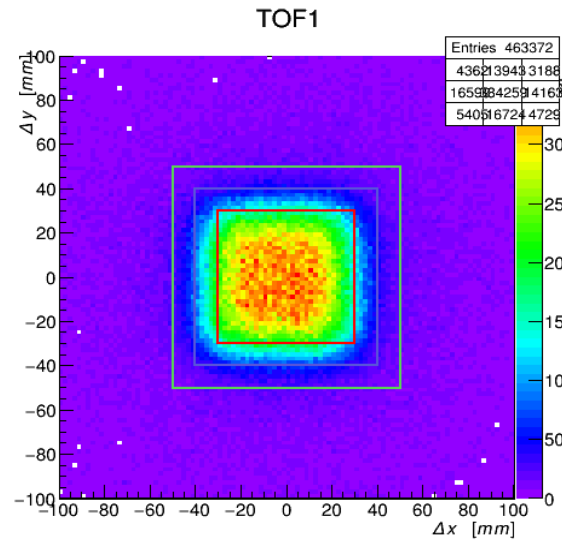
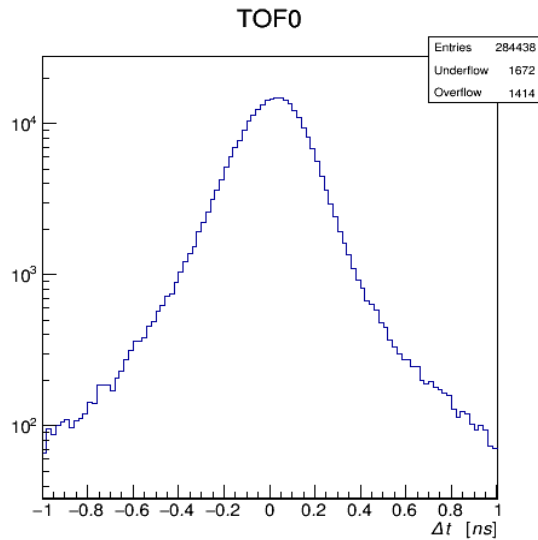


Run 8681 MC Residuals (200 MeV)

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PID (M Uchida)

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- Combines information from detectors into a set of PID variables—quantities that can be used to distinguish between possible PIDs.
- Produces probability density functions (PDFs) of these variables from MC data, for each possible PID.
- Calculates the value of each variable for a track matched data track.
- Compares these values to the corresponding PDFs for each PID, obtaining a likelihood for the track to have been made by a particle with that PID.
- The likelihoods (as log-likelihoods) are combined and the confidence level of the track having each PID is calculated. If one confidence level is sufficiently higher than the others (can be user defined) then the track is assigned that PID

PID Efficiency & Purity (M Uchida)

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Efficiency:

$$\epsilon_{PID} = \frac{N_C}{N_{ID} + N_F} = \frac{N_C}{N_C + N_W + N_F}$$

Purity:

$$\rho = \frac{N_C}{N_{ID}} = \frac{N_C}{N_C + N_W}$$

where N_C is the number of correctly identified tracks, N_{ID} is the total number of identified tracks, N_W is the number of incorrectly identified tracks, and N_F is the number of tracks for which the PID failed to identify the track, despite it being suitable

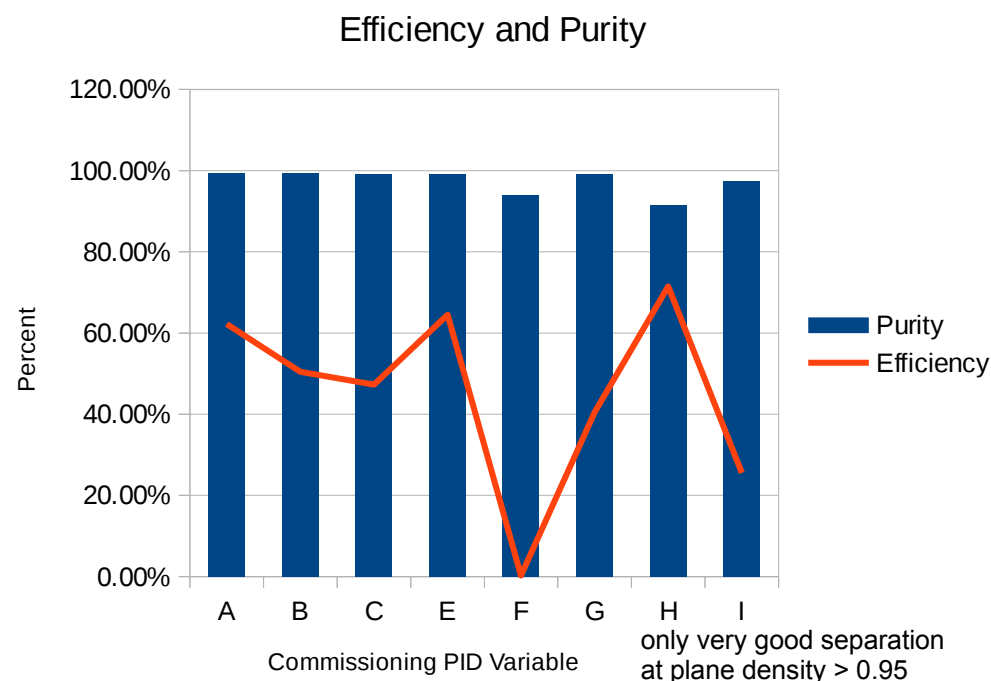
PID Efficiency & Purity (M Uchida)

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Variable	Purity	Efficiency
A	99.3%	62.2%
B	99.3%	50.4%
C	99.2%	47.3%
E	99.2%	64.5%
F	93.9%	0.189%
G	99.2%	40.4%
H	91.5%	71.5%
I	97.5%	25.5%
Overall	99.9%	96%



Variables are used in combination and tuned for purity on individual particle species therefore efficiency takes a hit (by variable) but purity is maintained and overall PID (combined) efficiency is good.

PID (M Uchida)

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- No major changes to PID
- Some bug fixes improving speed and efficiency
- PID now being consistently tested over data and PDFs are being produced (hampered by Melissa's MOM shifts)

Data Structure

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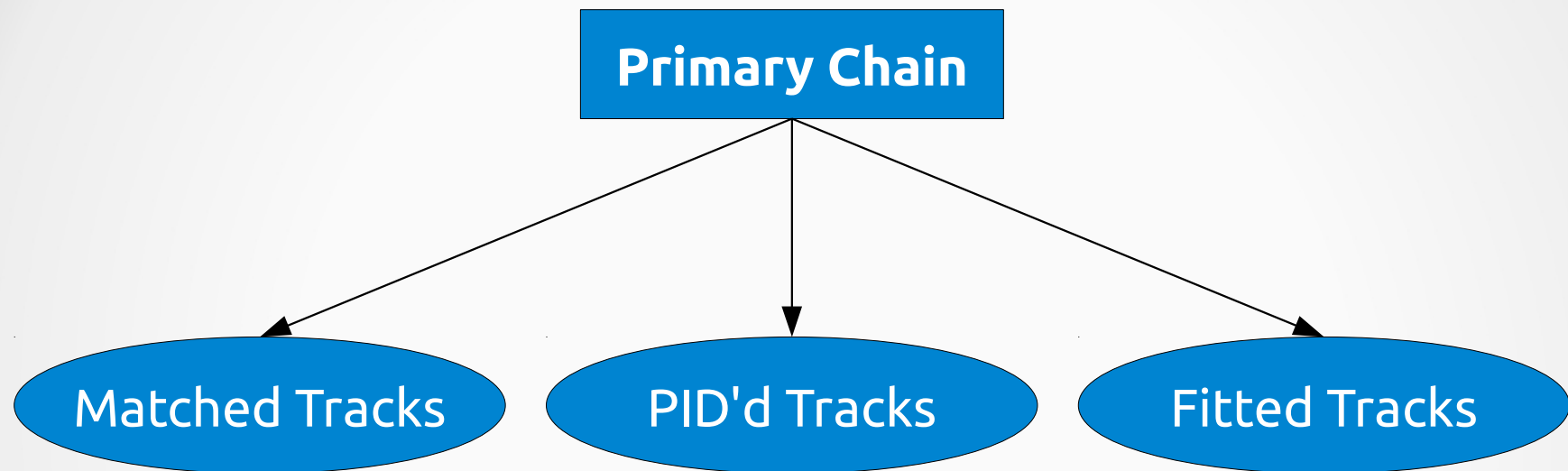
- Clear structure required for storing and accessing tracks and trackpoints from every step of Globals (Matching, PID, Fitting)
- Rewrote PrimaryChain object (original version from 2013 unfit for purpose)

Primary Chain

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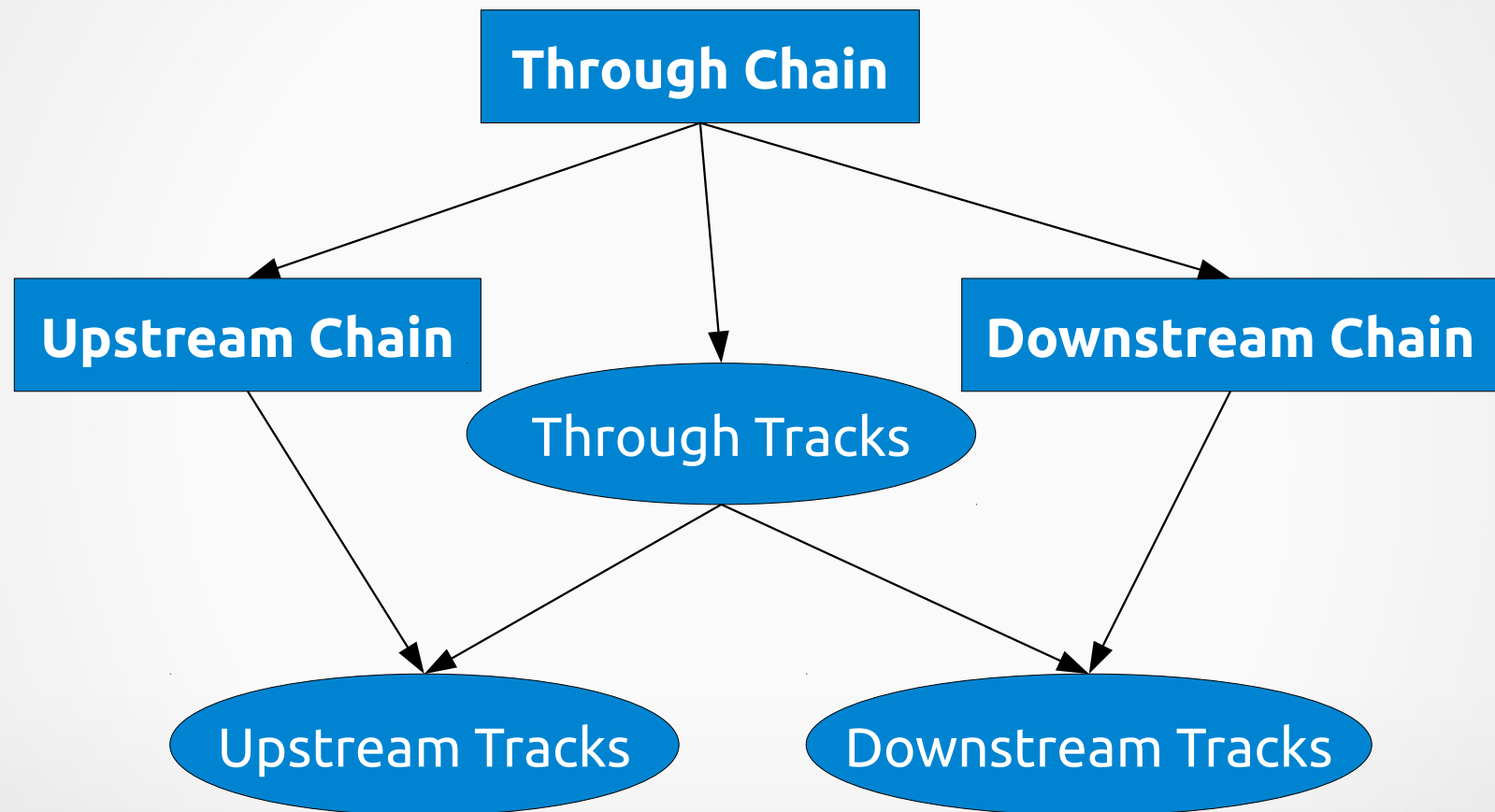


Primary Chain

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Primary Chain

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- Clear and structured interface for global reconstruction output
- Allows easy access to tracks at all stages of reconstruction, i.e. analyst can check what led to the formation of a final track and use this information (e.g. for cuts)
- $\pi \rightarrow \mu$ decay candidates can be identified
- Changes and detailed description for using Primary Chains in the MAUS User Guide will be in MAUS **very** soon (pending a the fixing of an issue with the testing framework)
- Getters and Setters exist to be integrated with Track Fitting (Rogers)

Conclusion

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- Pending minor fixes (primarily issue with testing framework), Track Matching and PID are ready to be used by the collaboration
- PID PDF generation is ongoing, will receive significant boost when Melissa is no longer MOM
- A clear datastructure exists for accessing the global tracks, back through all stages of global reconstruction
- Fitting to be inserted into Globals framework by Rogers
- **Clear and detailed documentation exists now**

PID Variable Consistency

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A	B	C	D	E	F	G	H	I
A	99.5%	99.1%	26.9%	99.6%	100%	99.2%	100%	99.3%
	B	99.2%	27.1%	99.1%	100%	98.4%	100%	99.2%
		C	30.4%	98.9%	100%	98.7%	100%	99.4%
			D	27.2%	81.2%	45.7%	57.5%	25.2%
				E	100%	98.9%	95.1%	98.3%
					F	93.3%	100%	100%
						G	90.6%	95.2%
							H	83.3%

A	B	C	D	E	F	G	H	I
A	99.0%	98.6%	34.0%	78.2%	92.6%	98.2%	86.1%	81.9%
	B	97.8%	31.5%	78.8%	88.9%	97.0%	85.5%	81.3%
		C	34.2%	71.9%	100%	95.6%	89.5%	82.0%
			D	32.8%	93.6%	34.2%	36.5%	37.0%
				E	30.8%	71.5%	64.4%	64.0%
					F	65.8%	98.1%	83.7%
						G	81.0%	82.6%
							H	74.1%

Table 3.5: Consistency between ComPIDVars on data.