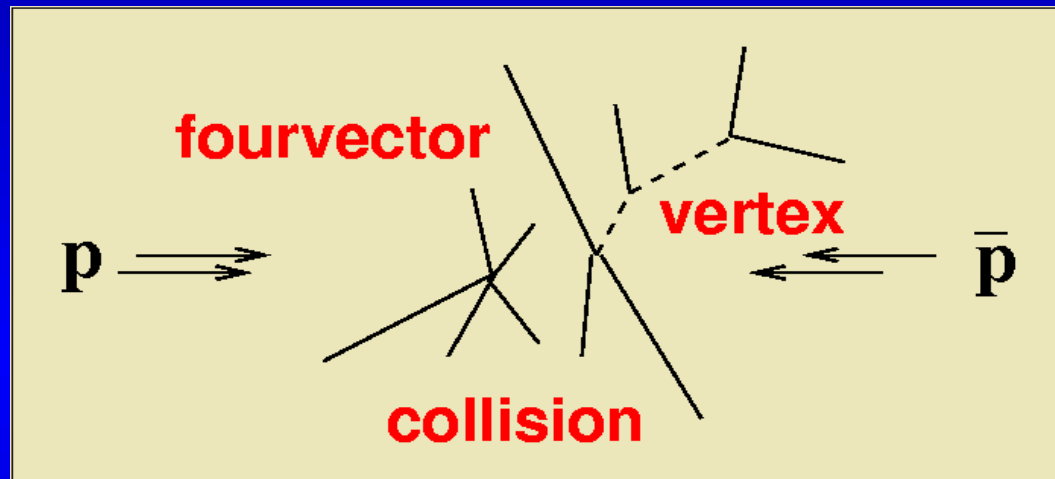


Physics Analysis Expert (PAX)

first applications



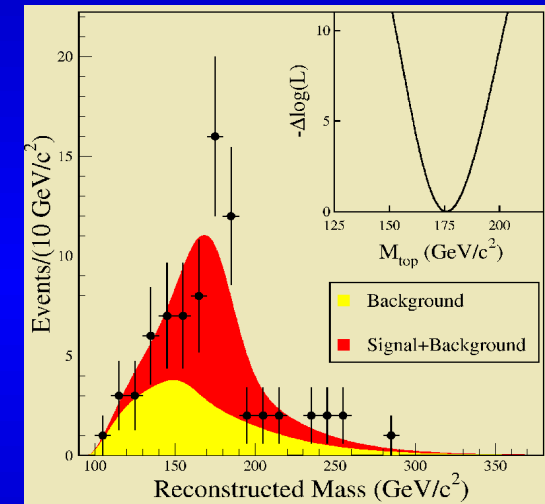
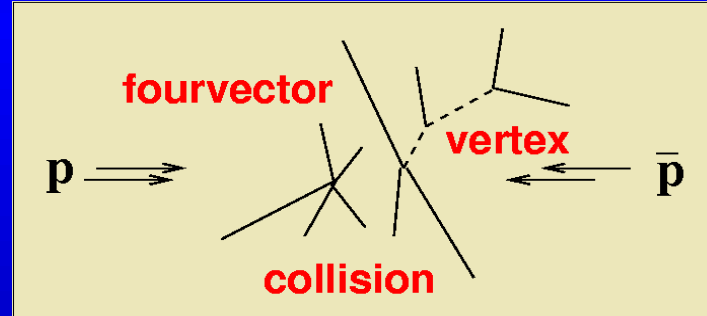
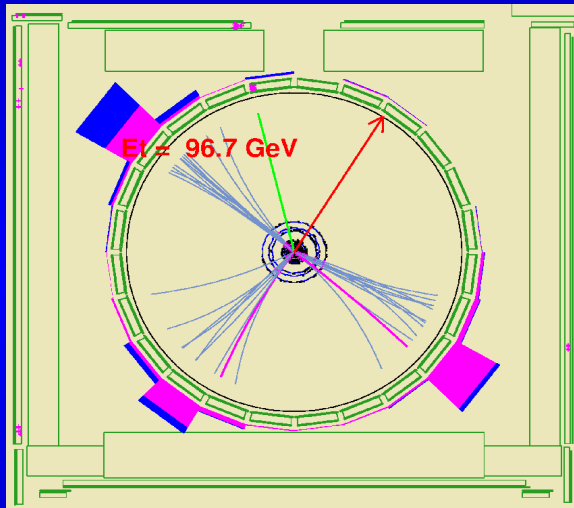
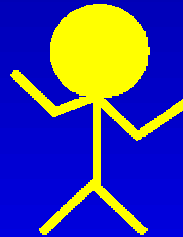
Martin Erdmann,
Hirschbuehl, Jung, Kappler, Kemp, Kirsch, Miksat,
Piasecki, Quast, Rabbertz, Schemitz, Schmidt, Walter



University Karlsruhe



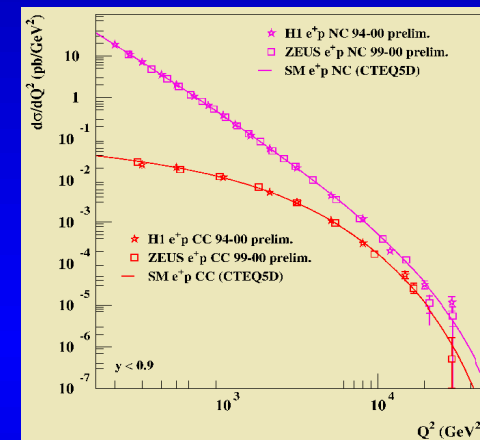
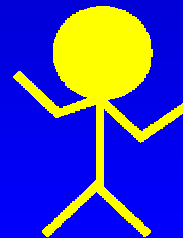
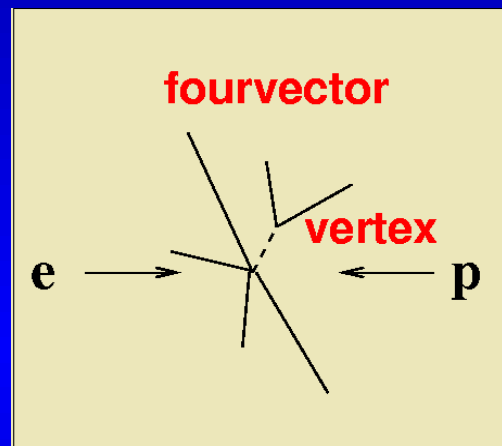
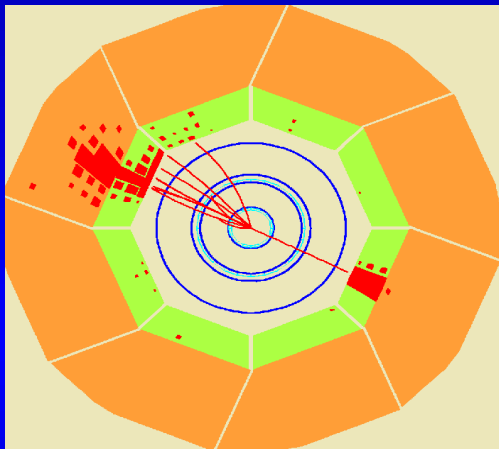
unified access to detector reconstruction
requires new level of abstraction



Physics Analysis Expert (PAX)

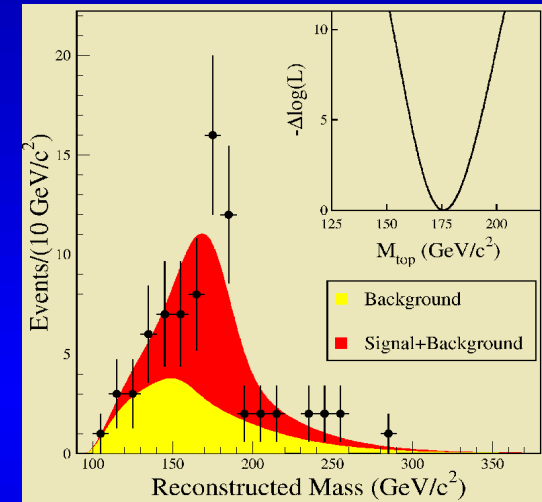
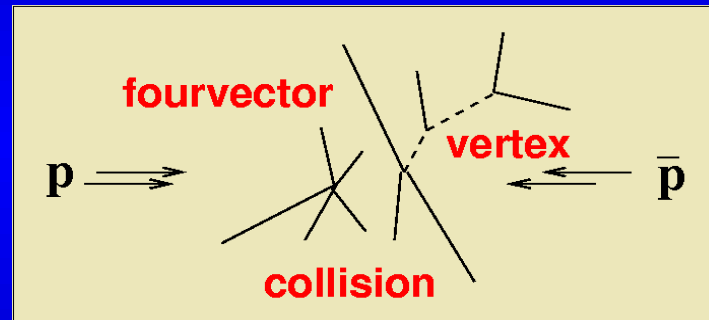
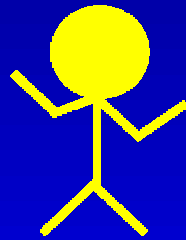
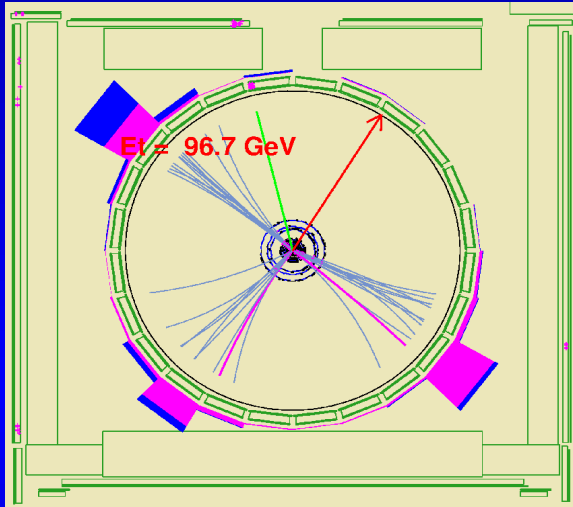
FORTRAN: H1PHAN, ALPHA

H1-, ALEPH-Experiments

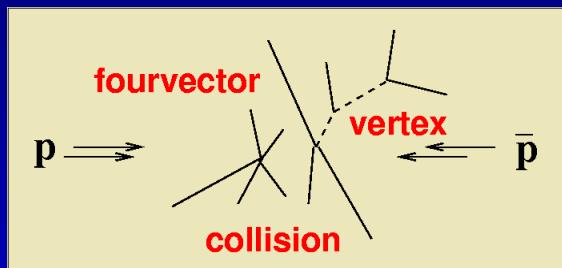


- **emphasis on unified access to reconstruction**
- **complete filling: user 'behind' H1PHAN**
- **designed for single collision events**
- **majority of H1-publications via H1PHAN**

Physics Analysis Expert (PAX)



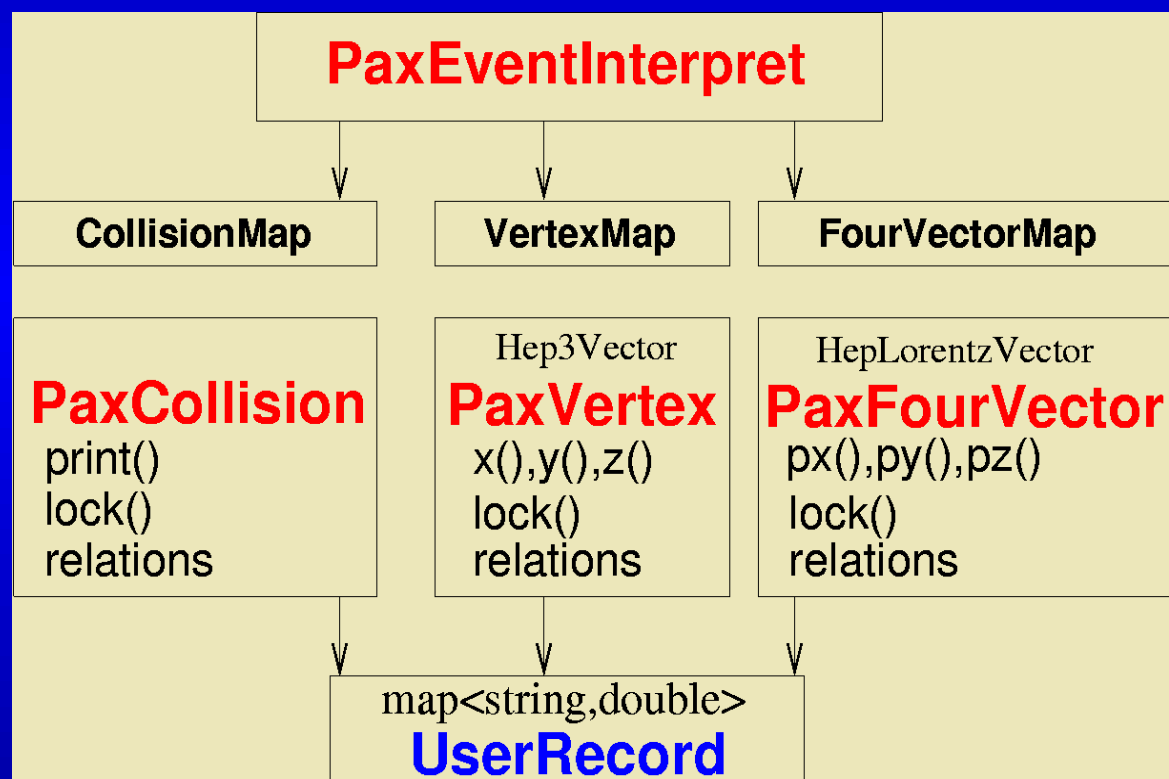
- **utility: full user control**
- **multiple collision events**
- **multiple event versions**



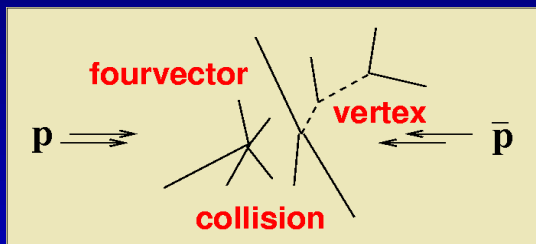
the basic unit in PAX: "event interpretation"

STL

CLHEP

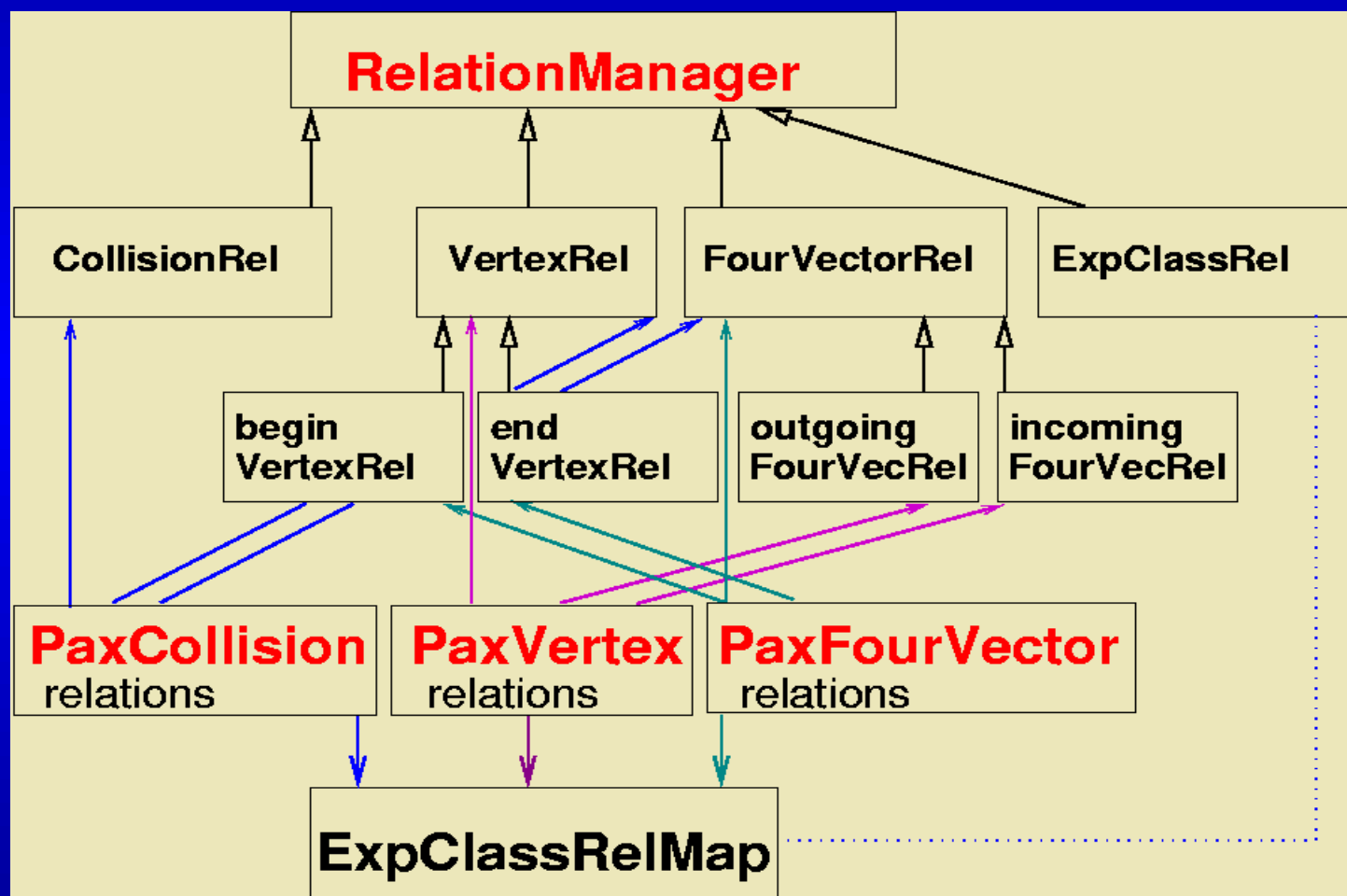


H1PHAN

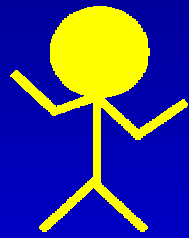


the heart of PAX: relation management

design
pattern:
mediator



CDF detector reconstruction → PAX



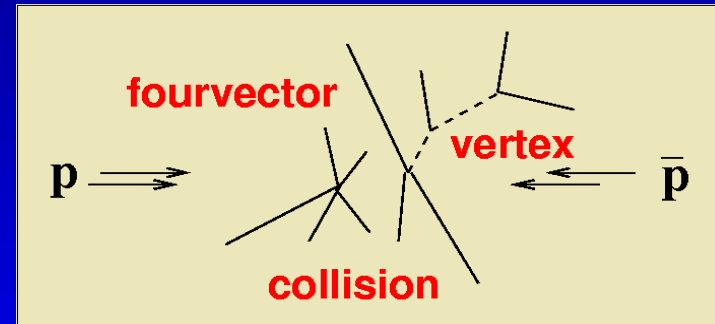
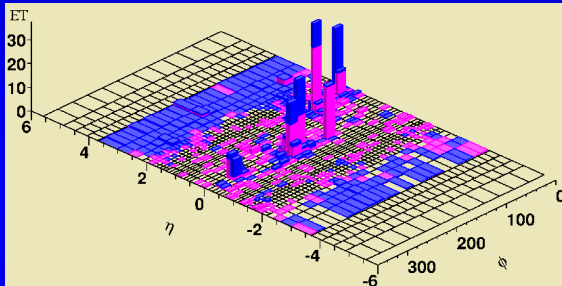
books

fills

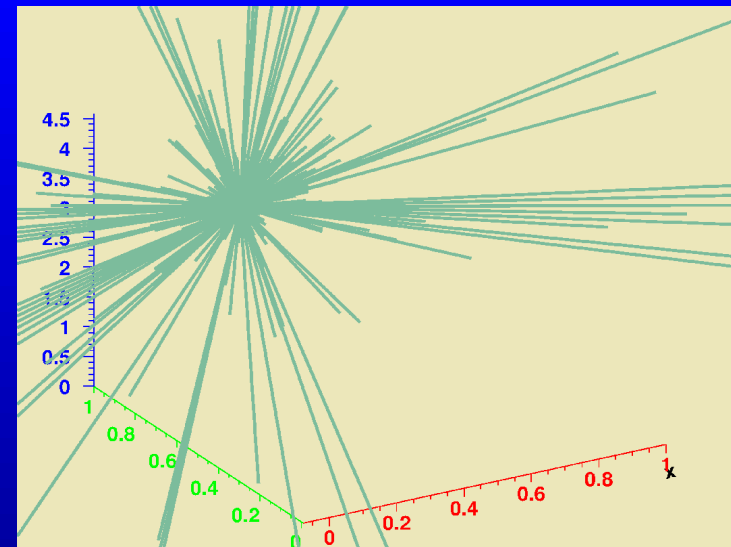


draws

deletes

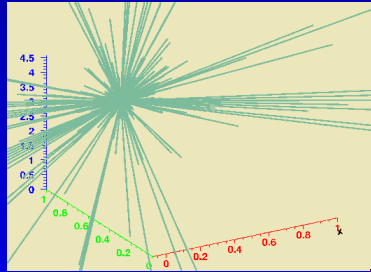


fillCalorimeter()

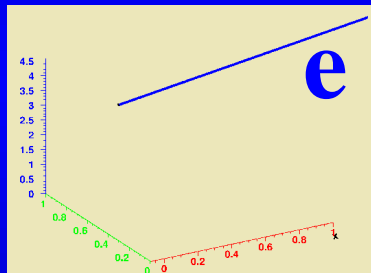


combine detector reconstruction

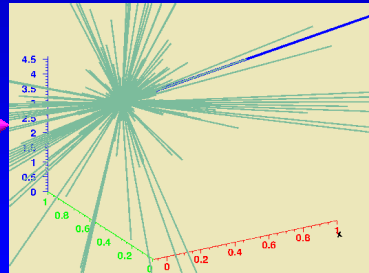
calorimeter



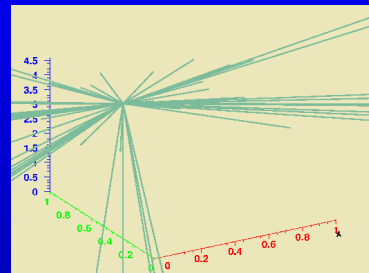
electrons



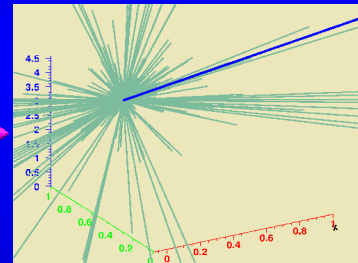
combined



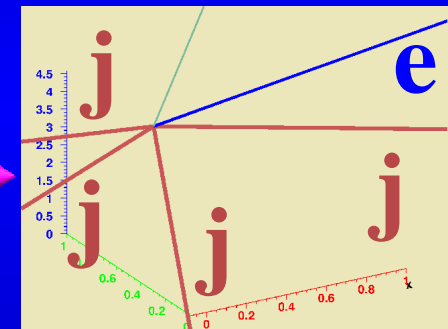
tracker



combined

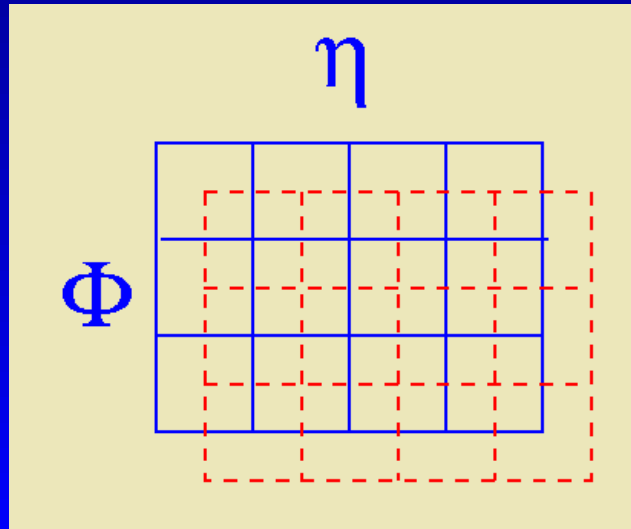


electron
jets
others

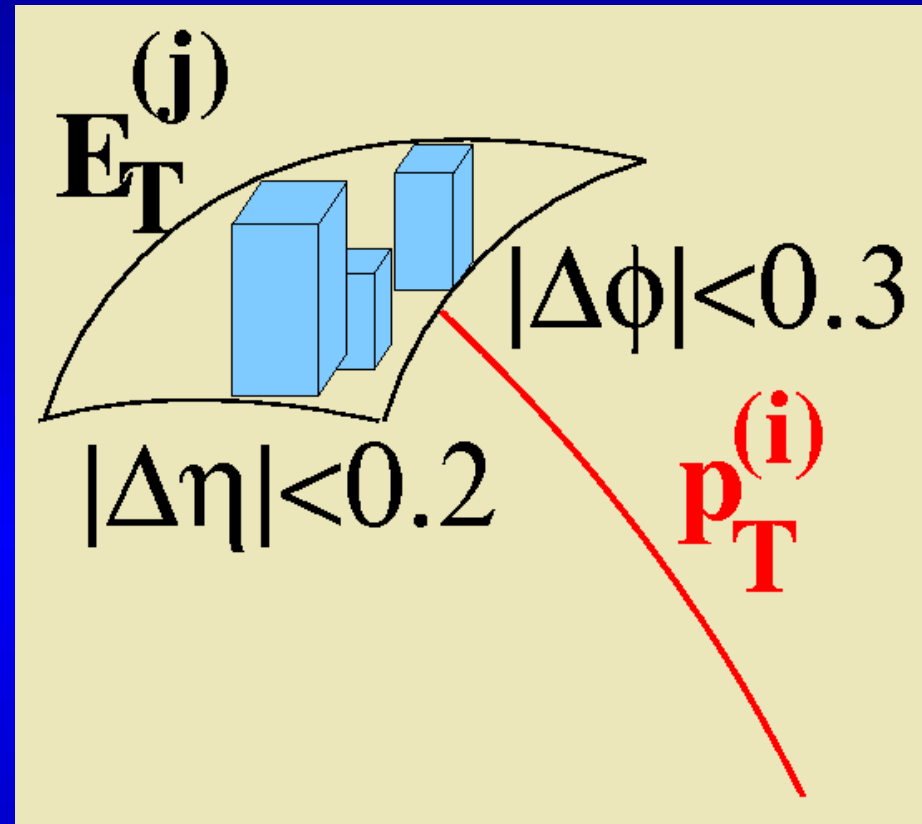


algorithm

combine calorimeter and tracks



define regions
of interest

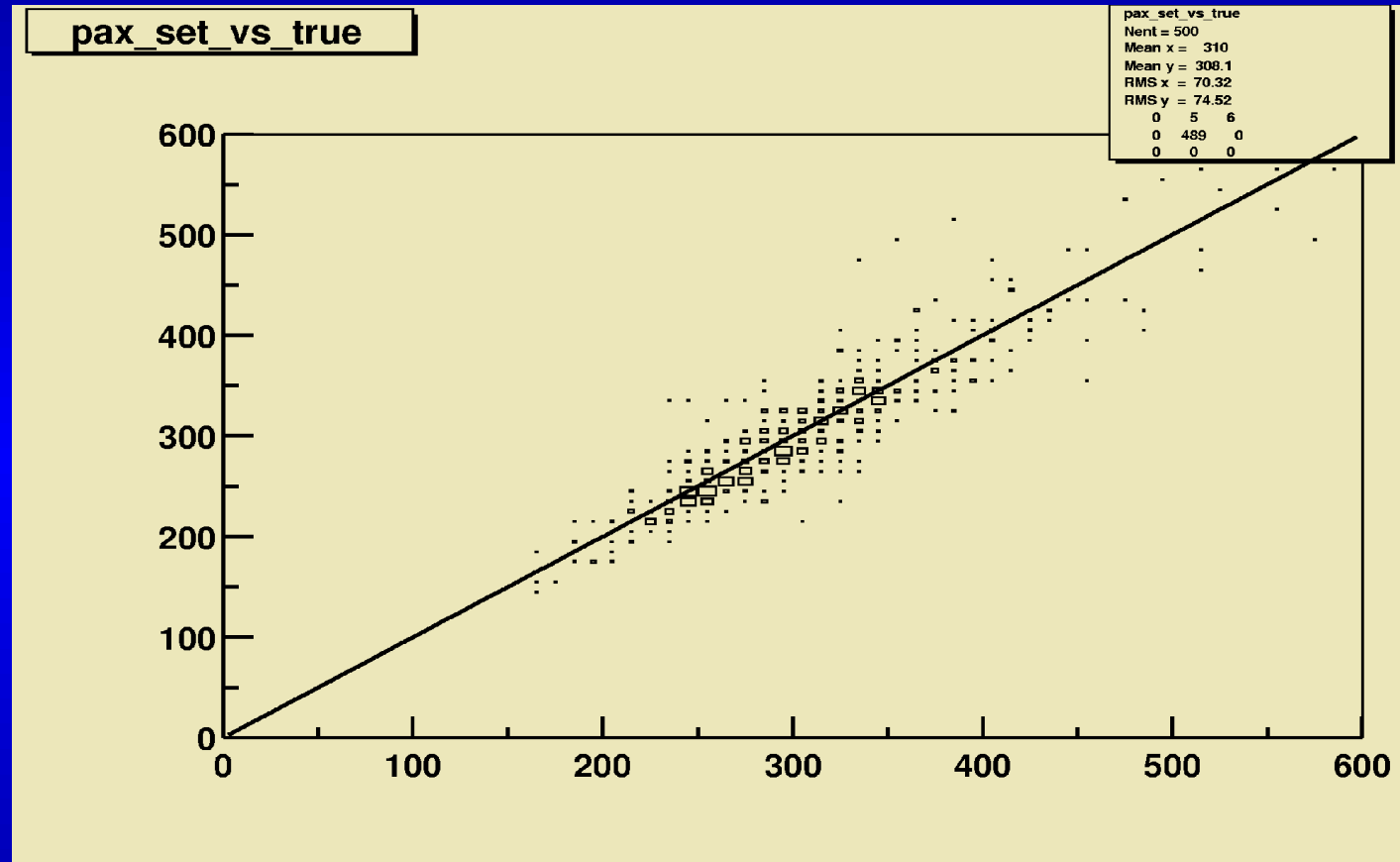


associate according
to best $E_T \leftrightarrow P_T$ match

combined measurement: quality

Herwig $t\bar{t}$

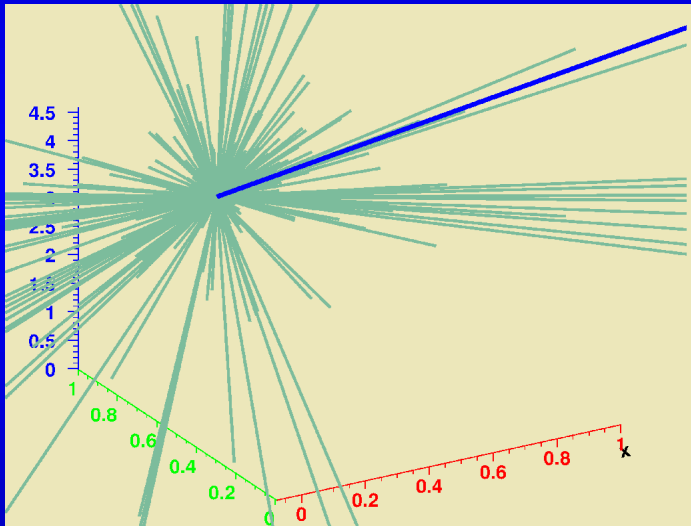
rec.
 ΣE_T



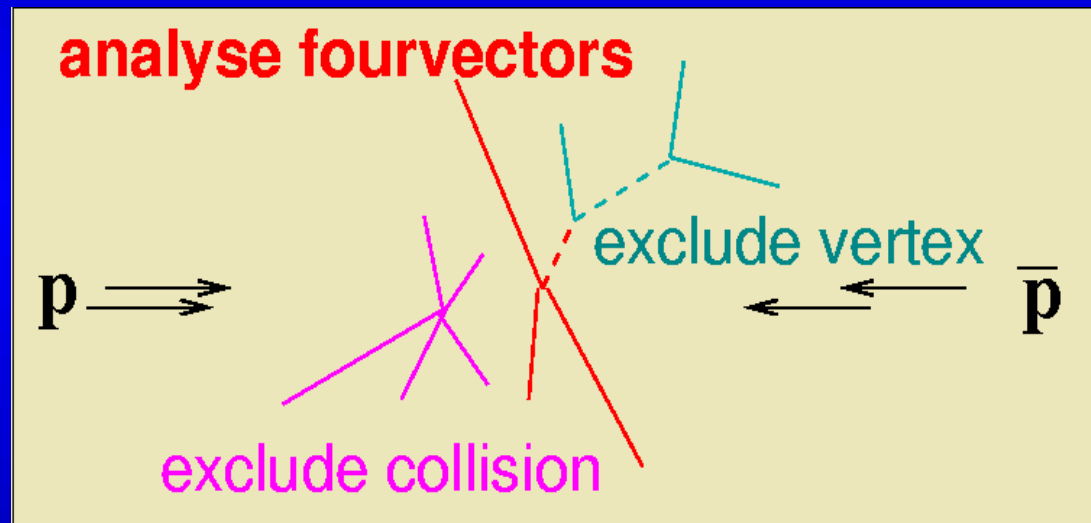
true ΣE_T

exclude part of event from analysis

simple: lock electron
during jet finding



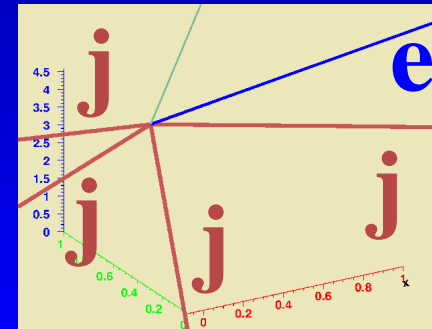
sophisticated lock mechanism



lock collision, vertex, fourvector
→ exclude following decay tree

PAX: access to original instance of experiment specific class

example: b-tagging in jets



PAX class `Experiment< >` allows, e.g.,
`Experiment < TStnTrack > ()`
to be registered with its `PaxFourVector`
access original member function \rightarrow `NSvxHits()`

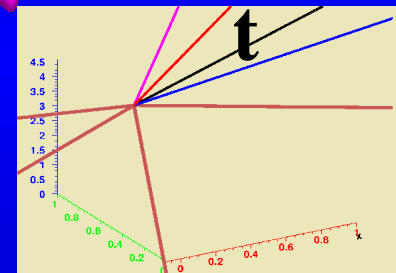
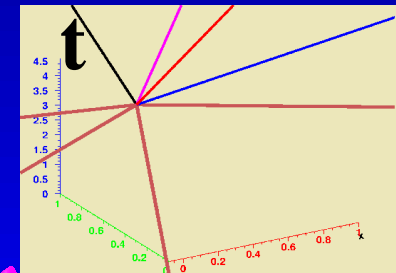
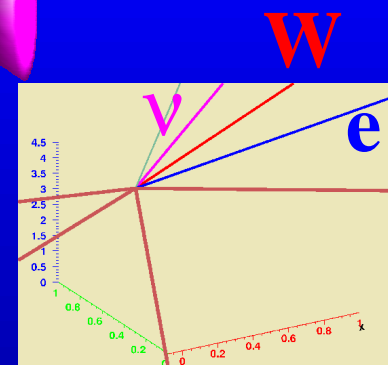
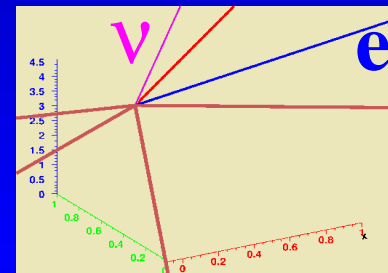
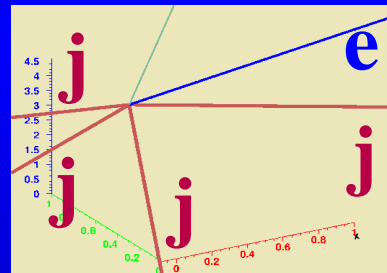
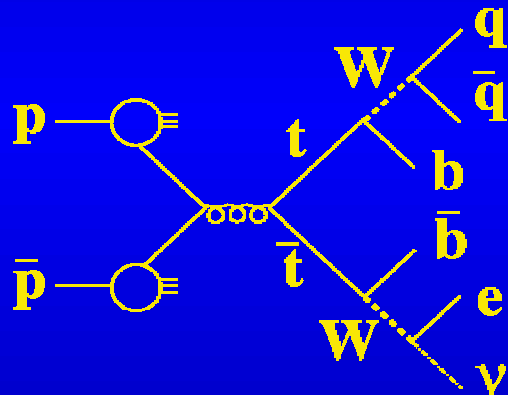
PAX: top quark analysis

algorithm

$t \rightarrow b W \rightarrow b e \nu$

$W \rightarrow e \nu$

electron
jets
others

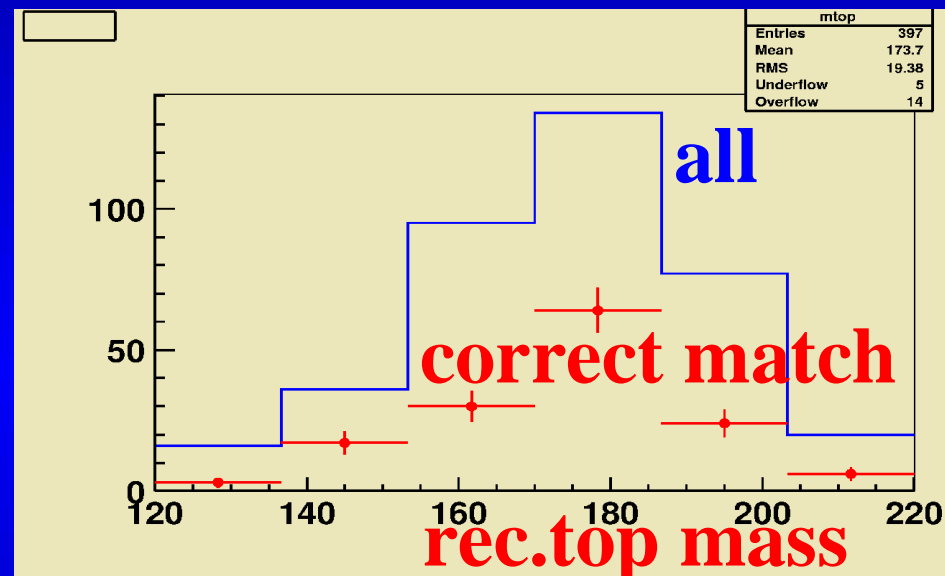
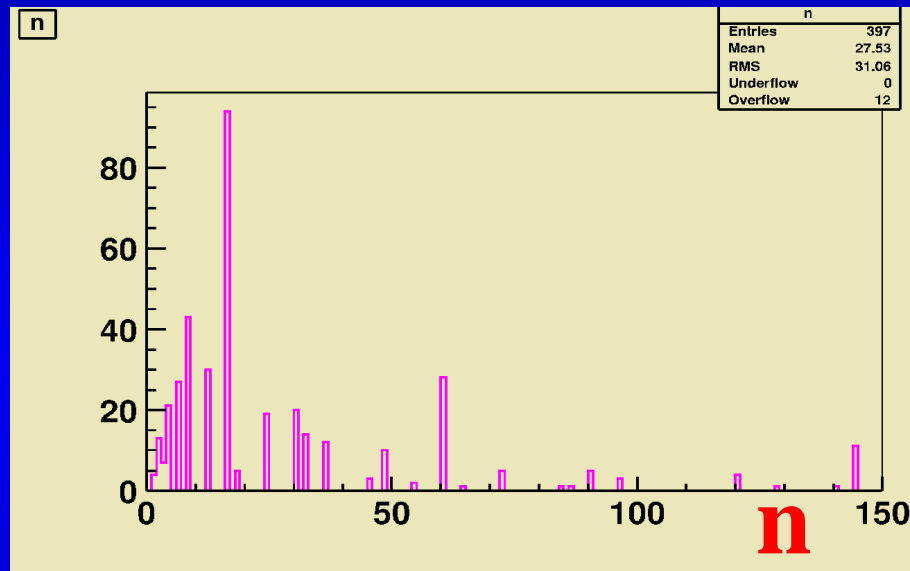


...

→ collect relevant information before making decisions

select event interpretation

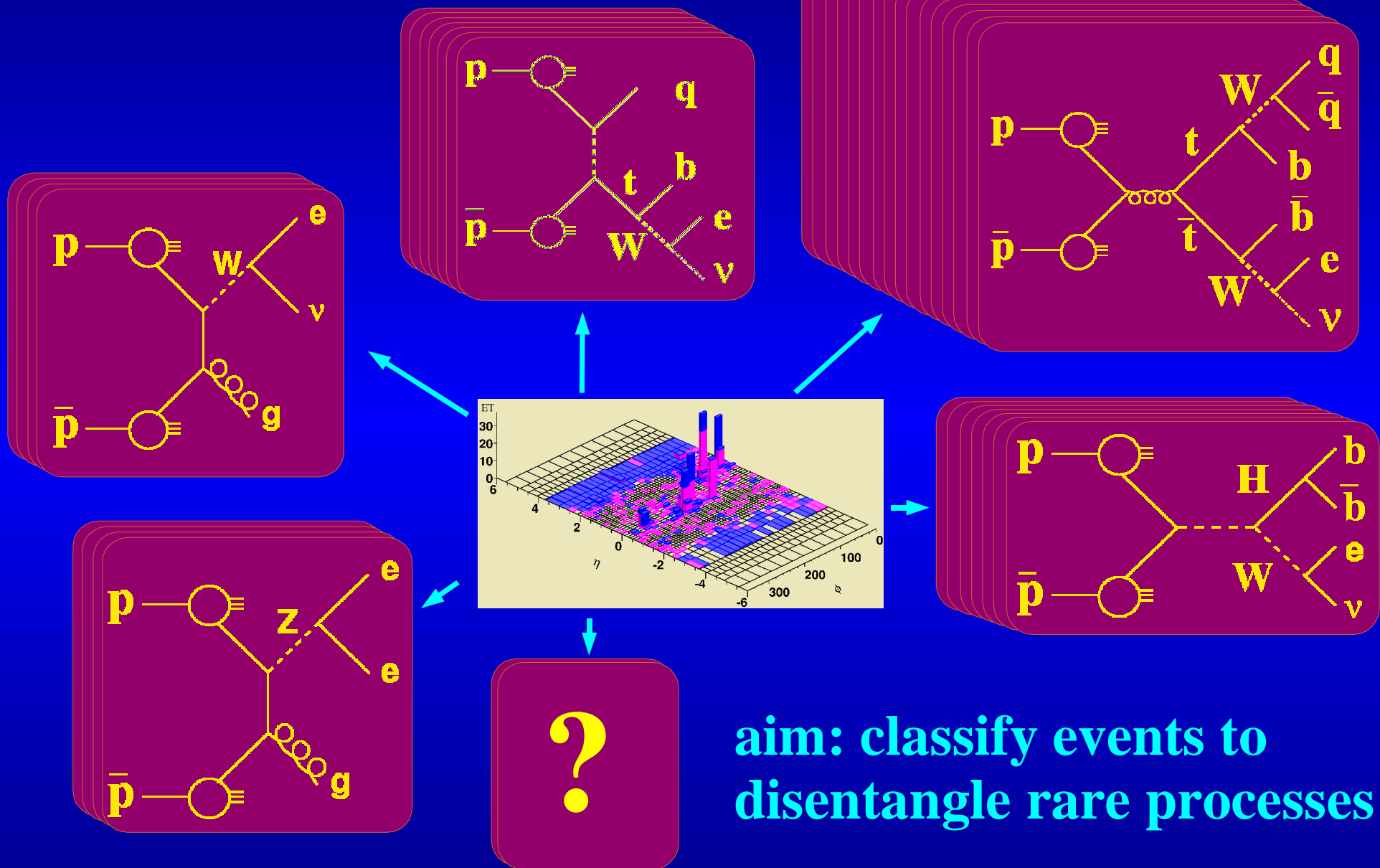
Herwig $t\bar{t}$ events: χ^2 test for top & W masses



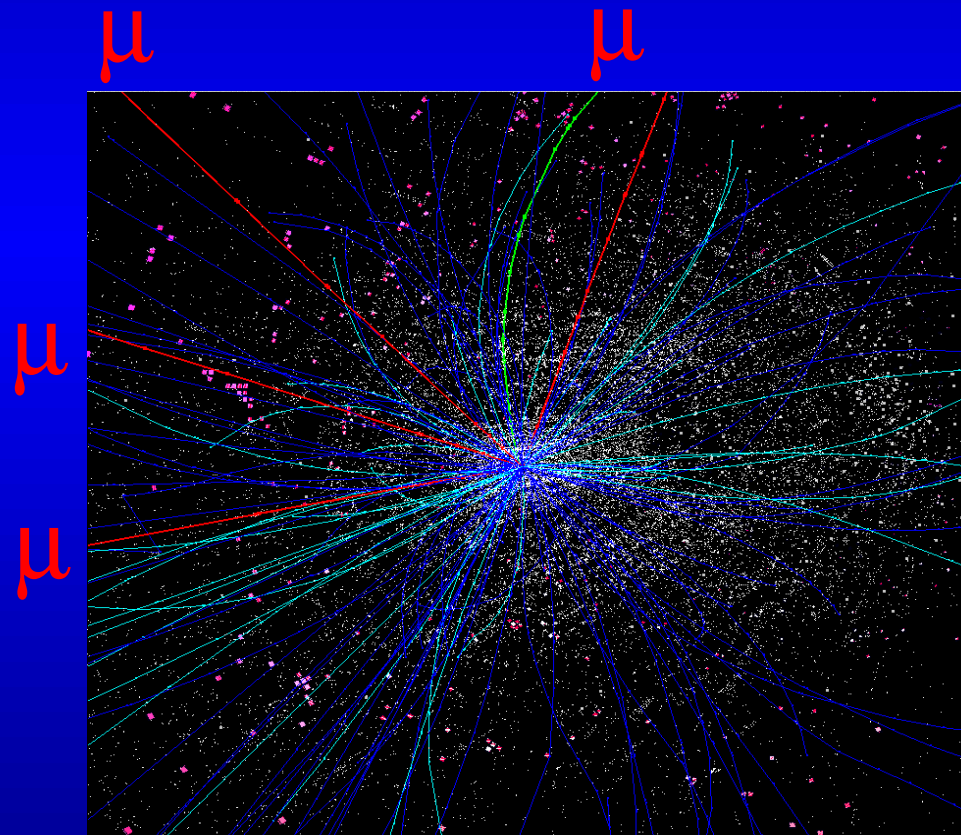
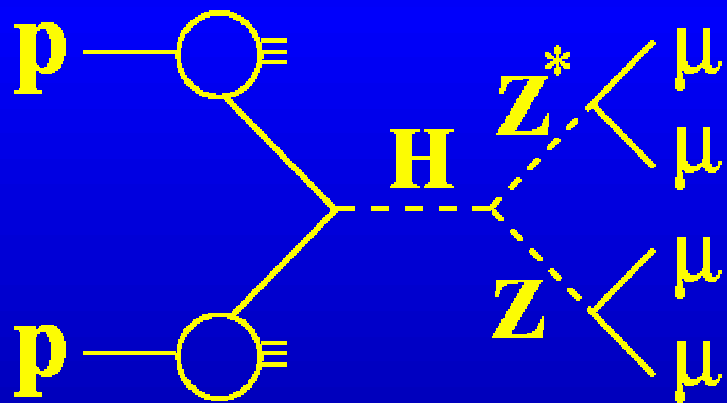
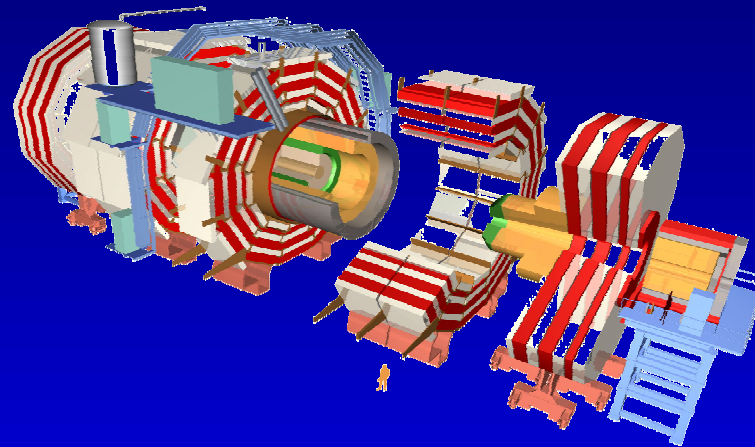
number of $t\bar{t}$ event
interpretations
(incl. simple b-tag)

$m_t \rightarrow bW \rightarrow \text{bev}$

analysis factory

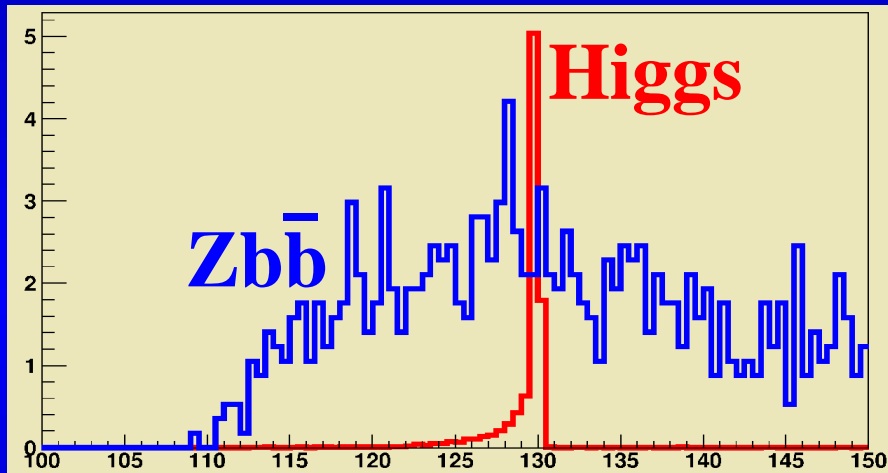


PAX: Higgs analysis in CMS Experiment

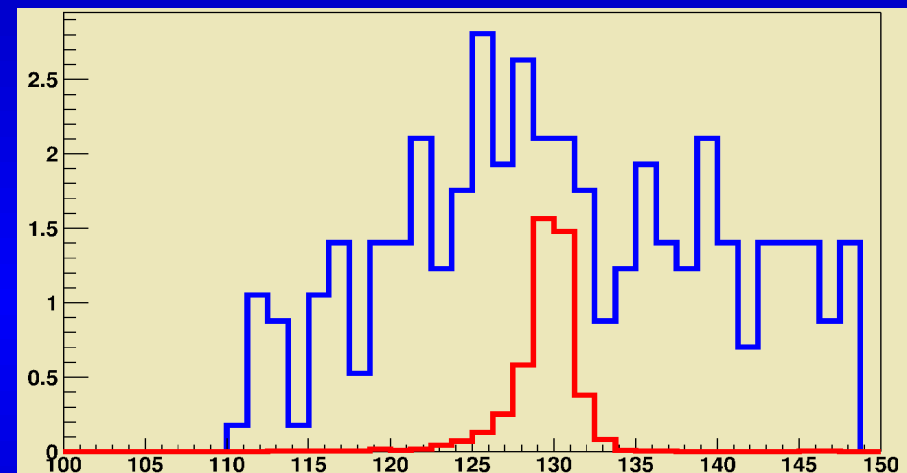


PAX at CMS: Higgs $\rightarrow 4\mu$

generator level (Pythia) reconstruction level



m_{higgs}



m_{higgs}

identical analysis code with different input

PAX user guide

www-ekp.physik.uni-karlsruhe.de/~erdmann

Netscape: paxguide

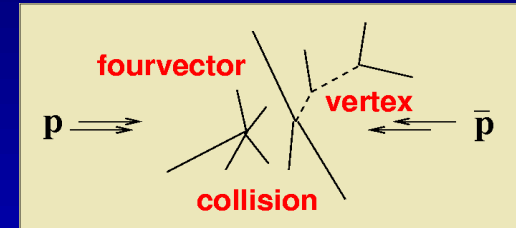
File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Physics Analysis eXpert **CDF Version 1.0, March 2003**

mission	manual (ps)	license	authors: Martin Erdmann , Yves Kemp , Dominic Hirschbuehl , Patrick Schemitz , Thorsten Walter			
examples, user hooks, Stntuple		fill, print Pax-EventInterpret	loop over fourvectors, histogram pt	loop over vertices and their related fourvectors	access Experiment Class	make jets
PaxEventInterpret		members	fill collisions, vertices, fourvectors	access collisions, vertices, fourvectors	relations to generated particles	user records
PaxCollision		members	fill	access	lock	user records
PaxVertex		members	fill	access	lock	user records
PaxFourVector		members	fill	access	lock	user records
ExperimentClass		members	fill	access		
Fill experiment		calorimeter	electrons, muons, photons	generated event	jets	tracks
algorithms		missing-Et	sum-Et	makeJet	makeW,Z,top	combine Pax-FourVectors
class diagrams, technical details		container	iterator	relations	key	print level

Martin Erdmann 2002-09-27



PAX assists physicists: from detector reconstruction → to physics interpretation of event

- utility: full user control
- covered: typical use cases in physics analysis
- interface: event interpretation
- experience: STL, CLHEP, inspired by H1PHAN
- applications: demonstrated in two HEP experiments
- documentation: manual and web navigator
- user programming: intuitive standards
- development status: beta