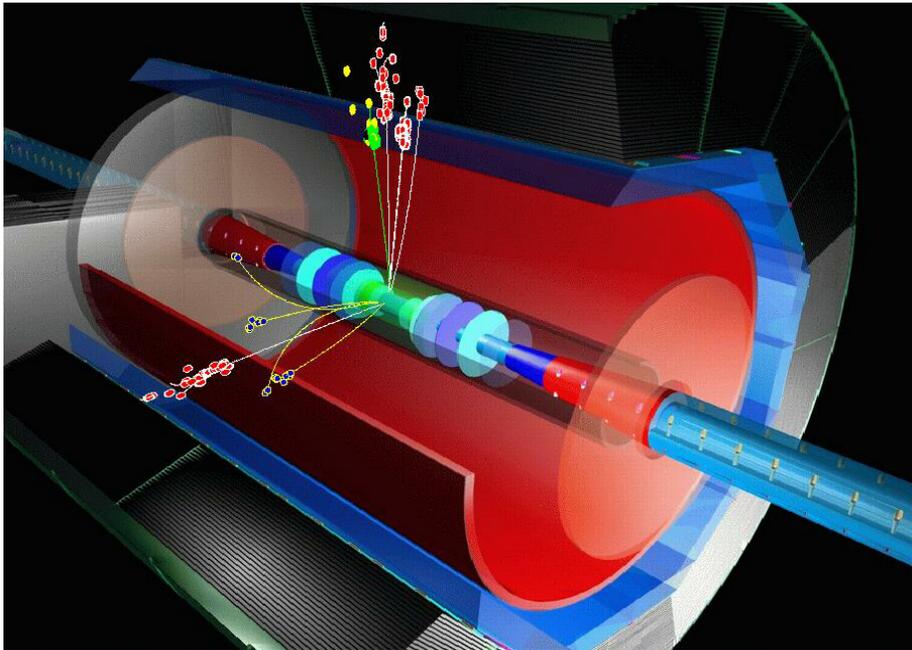


# Where are we now and what next ?

Mark Thomson  
University of Cambridge



## This Talk:

- ★ Why oh why ?
- ★ Frameworks/Tools
- ★ Software status
- ★ Organisation

# ① Why oh why ?

- ★ Working towards detector DCR by the end of 2006 !
- ★ Desire full simulation/full reconstruction detector performance studies
- ★ Simply using Tesla TDR studies would not look good

## Perhaps more importantly:

- ★ 3 out of 4 detector concepts choose high granularity calorimetry (i.e. high cost) for particle flow
- ★ NEED to be convinced that Particle Flow paradigm is correct
- ★ For Detector DCR must try to demonstrate the PFA can be made to work for current concepts
- ★ Only(?) evidence that it can be made to work are "old" TESLA studies (LC-PHSM-2003-001)
- ★ For DCR repeating/validating these studies with current detectors **must be a very high priority**

## But very little time:

- ★ Need to get more organised...

# So PFA Matters – what matters for PFA ?

**Everything !**

e.g. Perfect Particle Flow (see P. Krstonosic Vienna ECFA meeting)  
e.g.  $e^+e^- \rightarrow Z \rightarrow qq$  at 91.2 GeV

Effect	$\sigma$ [GeV] separate	$\sigma$ [GeV] not joined	$\sigma$ [GeV] total ( $\% / \sqrt{E}$ )	$\sigma$ % to total
$E_\nu > 0$	0.84	0.84	0.84 (8.80%)	12.28
$Cone < 5^\circ$	0.73	<b>FORWARD REGION TRACKING</b>		9.28
$P_t < 0.36$	1.36	<b>TRACKING</b>		32.20
$\sigma_{HCAL}$	1.40	<b>HCAL RESOLUTION</b>		34.12
$\sigma_{ECAL}$	0.57	1.51	2.32(24.27%)	5.66
$M_{neutral}$	0.53	1.60	2.38(24.90%)	4.89
$M_{charged}$	0.30	1.63	2.40(25.10%)	1.57

(assumed sub-detector resolutions: **ECAL 11%/√E**, **HCAL 50%/√E +4%**)

**+ all mistakes made in PFA algorithm**

**★ PFA is delicate - it needs realistic studies:  
simulation + tracking + clustering**

## 2 Software Frameworks/Tools

So where are we now ?

	Description	Detector	Language	IO-Format	Region
<b>Simdet</b>	fast Monte Carlo	TeslaTDR	Fortran	StdHep/LCIO	EU
<b>SGV</b>	fast Monte Carlo	simple Geometry, flexible	Fortran	None (LCIO)	EU
<b>Lelaps</b>	fast Monte Carlo	SiD, flexible	C++	SIO, LCIO	US
<b>Mokka</b>	full simulation – Geant4	TeslaTDR, LDC, flexible	C++	ASCI, LCIO	EU
<b>Brahms-Sim</b>	Geant3 – full simulation	TeslaTDR	Fortran	LCIO	EU
<b>SLIC</b>	full simulation – Geant4	SiD, flexible	C++	LCIO	US
<b>LCDG4</b>	full simulation – Geant4	SiD, flexible	C++	SIO, LCIO	US
<b>Jupiter</b>	full simulation – Geant4	JLD (GDL)	C++	Root (LCIO)	AS
<b>Brahms-Reco</b>	reconstruction framework (most complete)	TeslaTDR	Fortran	LCIO	EU
<b>Marlin</b>	reconstruction and analysis application framework	Flexible	C++	LCIO	EU
<b>hep.lcd</b>	reconstruction framework	SiD (flexible)	Java	SIO	US
<b>org.lcsim</b>	reconstruction framework (under development)	SiD (flexible)	Java	LCIO	US
<b>Jupiter-Satellite</b>	reanalysis	JLD (GDL)	C++	Root	AS
<b>LCCD</b>	Conditions Data Toolkit	All	C++	MySQL, LCIO	EU
<b>GEAR</b>	Geometry description	Flexible	C++ (Java?)	XML	EU
<b>LCIO</b>	Persistency and datamodel	All	Java, C++, Fortran	-	AS,EU,US
<b>JAS3/WIRED</b>	Analysis Tool / Event Display	All	Java	xml,stdhep, heprep,LCIO,	US,EU

**See talk of F.Gaede**

Fast Simulation

Full GEANT Simulation

Reconstruction Framework

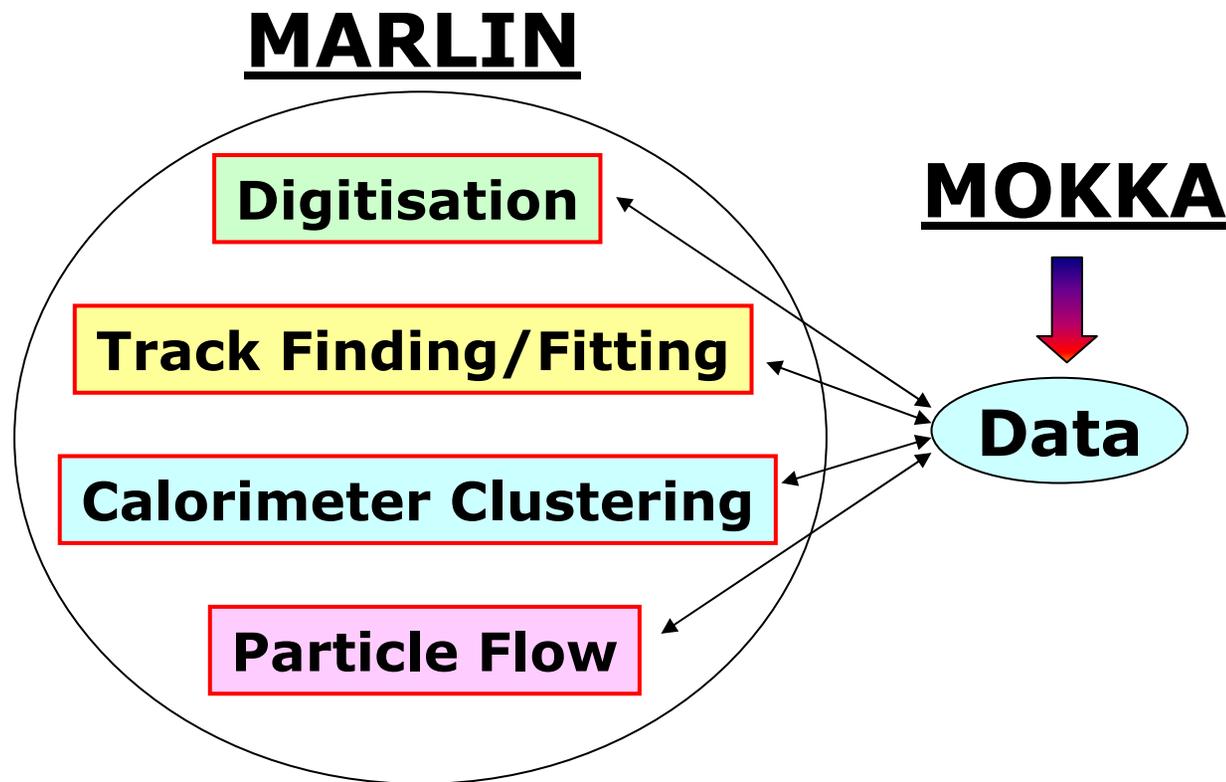
Geometry/Data Format+..

+reconstruction...

- ⬆ **Much duplication of work**
- ⬆ **Currently Software highly tied to concepts/region**
- ⬆ **Given the lack of resources, this is an unfortunate position**
- ⬆ **Difficult to see this change in short-term**

# Euro-centric View

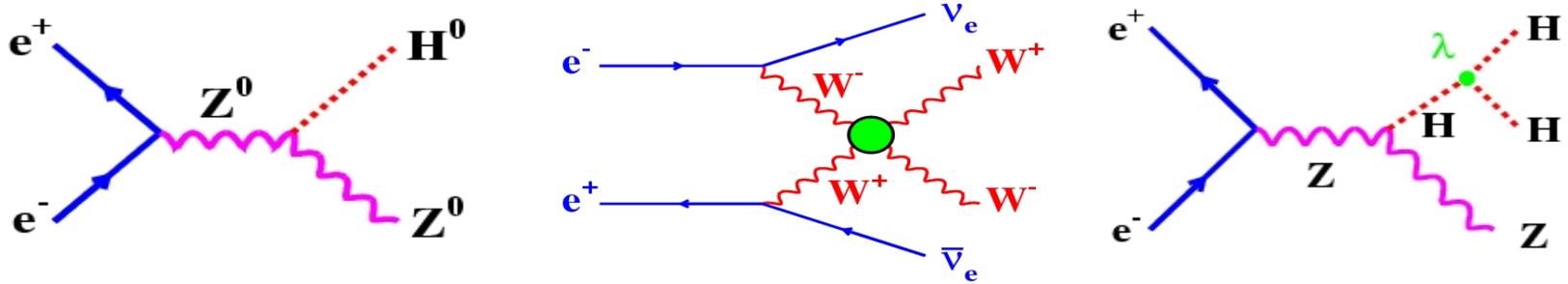
HERE: Euro-centric = Marlin-centric = LDC-centric view



- ★ A lot of code already exists – **complete** (but imperfect) reconstruction chain
- ★ Large data samples available – easy to access via Grid tools
- ★ Marlin is easy to use
- ★ People can start to develop analyses (e.g. see today's talks)

# What next

## ★ GOAL : Full Simulation Physics Studies



Requires work in three areas



- ★ Need to attack all three areas in **parallel** (for DCR)
- ★ To achieve this need clear commitment from people/groups
- ★ Developing Physics analysis → strong feedback into reco/framework

### 3 Reconstruction Software Holes

**DIGITISATION**

- ★ Code available
- ★ Define LDC defaults

**VERTEX RECO**

- ★ Sophisticated code under development – **real progress**
- ★ Vital for many physics studies
- ★ High priority to get this in Marlin
- ★ **Promised by Summer**

**TRACKING**

- ★ Code available – but not ideal
- ★ Plenty of people working
- ★ Not much coordination !
- ★ **High priority (finding/fitting)**

**FORWARD**

- ★ In the LDC, LCAL is “extension” of ECAL
- ★ Need Mokka sim. + Marlin reconstruction

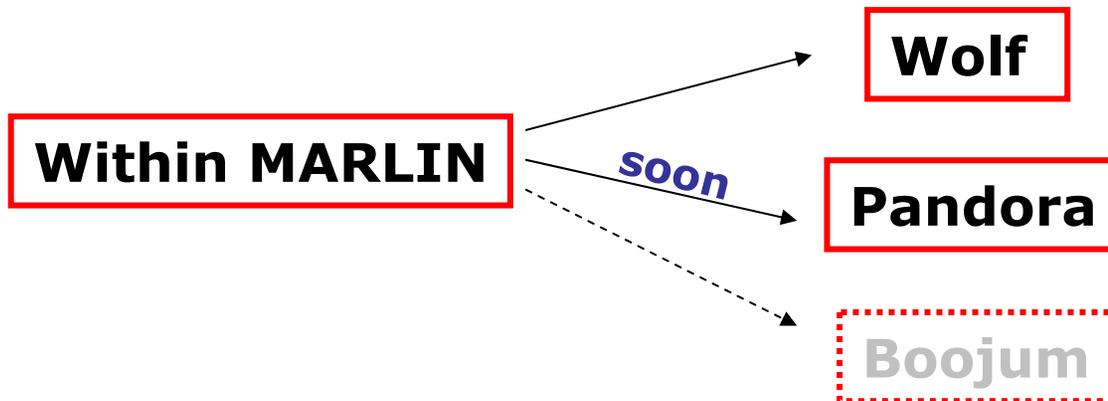
**PFA**

- ★ Lots of **INDEPENDENT** work
- ★ Coordinate more ?
- ★ **VITAL** to have decent PFA performance soon...
- ★ Very high priority
- ★ Progressing.....

# PFA where art thou ?

★ PFA paradigm central to GLD, LDC, SiD, concepts

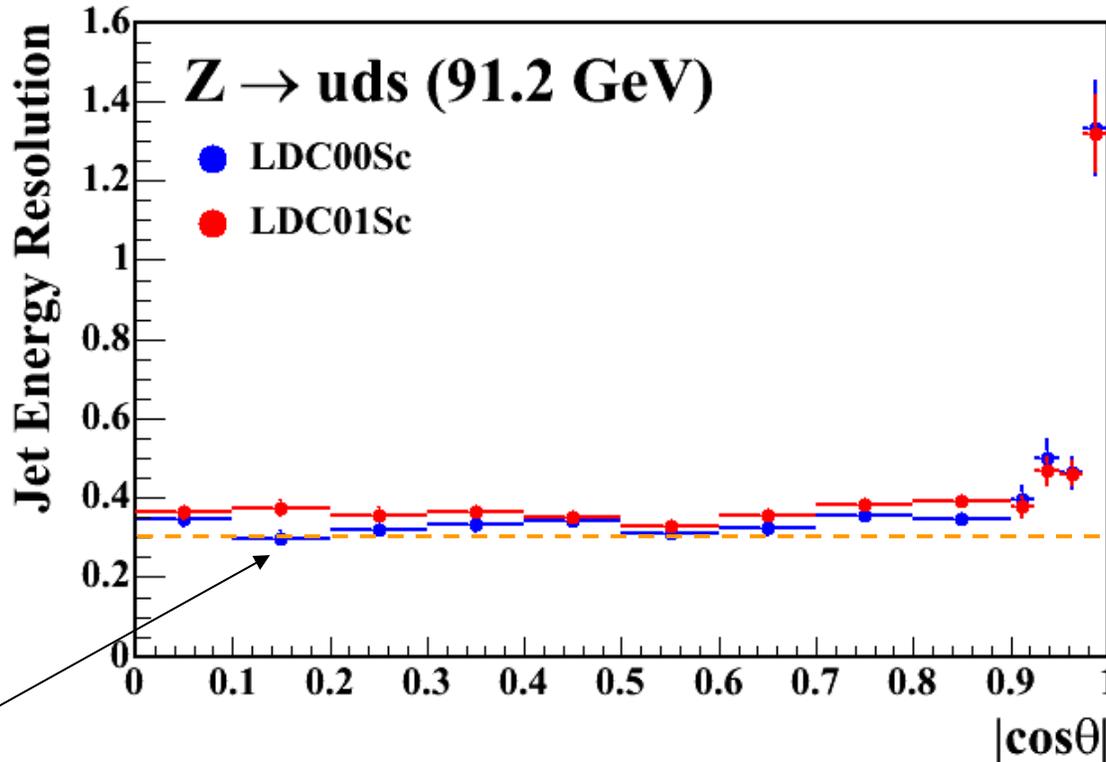
- **NOT THERE YET !**
- **BUT:** Real progress being made with PFA :  
63.63 % of talks in **LCWS06** software session related to **PFA**  
**+ Many talks at this meeting**
- **Progress**, but some way to go.... 6 months ? 1 year ? Longer ?



**Current Status.....**

# Results : Z uds events Angular dependence

★ Plot resolution vs generated polar angle of qq system



★ In barrel : 32-34 %/  $\sqrt{E(\text{GeV})}$

**BUT doesn't yet work well  
for higher energies**

**PERSONAL OPINION:** On timescale of Summer 2006 will have a PFA with **reasonable** performance

## ④ Organisation (for discussion)

★ **Opinion:** within Europe (Marlin) we need to work in a more coordinated manner (e.g. GLD and SiD have regular meetings)

### 2.5 steps to DCR Heaven?:

#### 1/2) Coordination?

- ★ Lots of good work – but duplication/lack of communication
- ★ We need to coordinate our efforts better to achieve goals
- ★ Hard to do outside a formal “collaboration”
- ★ Not sure how best to do this....
- ★ At least should maintain a list of people working on Marlin-based software

#### 1) Propose regular phone meetings:

- ★ Every 2(?) weeks (Marlin-centric but open to all)
- ★ Each meeting could have a special focus:  
PFA, Tracking, Framework, Physics studies...
- ★ Would immediately improve communication
- ★ Will set this up – EXACT FORMAT ?

## 2) Improve involvement

- ★ **Desperately** need more people working on physics studies
  - ★ The code is easy to use
  - ★ Opportunities e.g. WW/ZZ
  - ★ Get started with imperfect tools now ! + feedback
- ★ Need people to make concrete commitments to work on physics/reconstruction tools within common framework

### A few last random points:

- ★ How best to utilise the excellent work in US/Asia e.g. N. Graf's tracking
- ★ Meetings: in my opinion meetings such as this are useful (more focussed than larger regional meetings)  
**How frequent - format ?**
- ★ Many people at this meeting Cambridge, some relatively new to the ILC framework, if someone starts working on a new topic can make a big impact ! MARLIN is VERY easy to use

**Finally: Looking back 1 year – there has been an impressive amount of progress need to ensure this continues.**