What's in the ATLAS data?

-electrons, muons, jets-

ATLAS offline software tutorial

- Uvod u ATLAS data

  -Triger i sistem za sakupljanje podataka DAQ (Data Acquisition System)

  -Offline Software

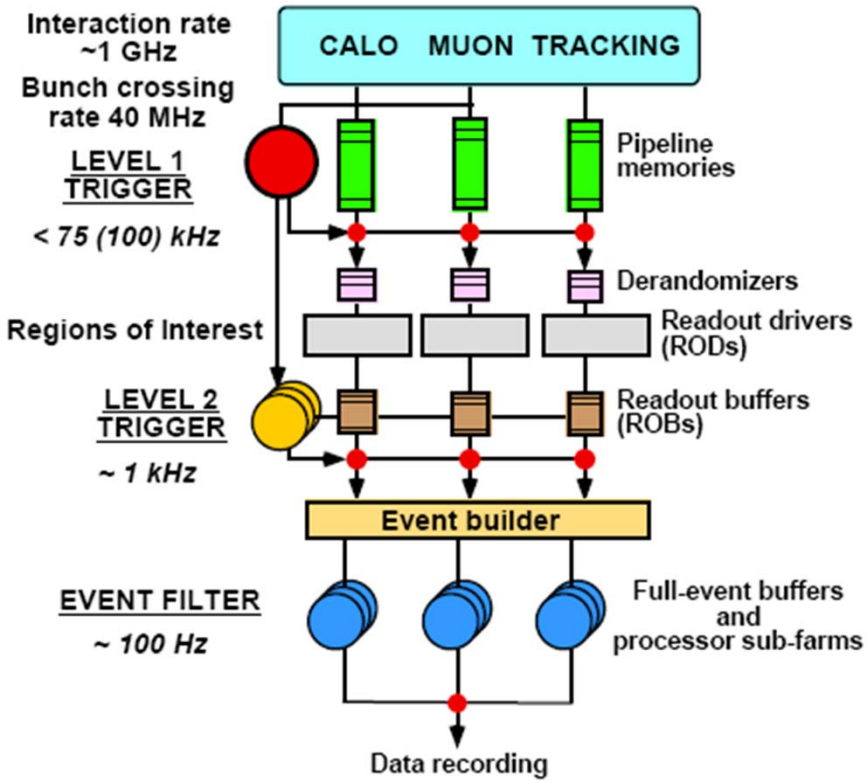
- Elektroni

- Mioni

- Jetovi

Triger i sistem za sakupljanje podataka DAQ (Data Acquisition System)

- zasnovan na online selekciji dogadjaja u tri nivoa LVL1, LVL2, EF(Level 1, Level 2 i Event Filter-poslednja dva cine HLT, High Level Trigger)
- LVL1-hardverski triger, t<2.5 μs, glavni kriterijum za triggerovanje dogadjaja je p_T prag
- LV2- t<10 ms, izolacija objekata
- EF-offline algoritmi za rekonstukciju prilagodjeni online okruzenju
- trigger menu-dogadjaj je zapamcen ako ispunjava skup uslova,



$$e25i,\ e15i,\ \gamma60i,\ 2\gamma20i,\ \mu20i,\ 2\mu10i,\ j360,\ 3j150,\ 4j110,\ \tau60i,$$
$$\mu10 + e15i,\ \tau35i + xE45,\ j70 + xE60,\ xE200,\ E1000,\ jE1000.$$

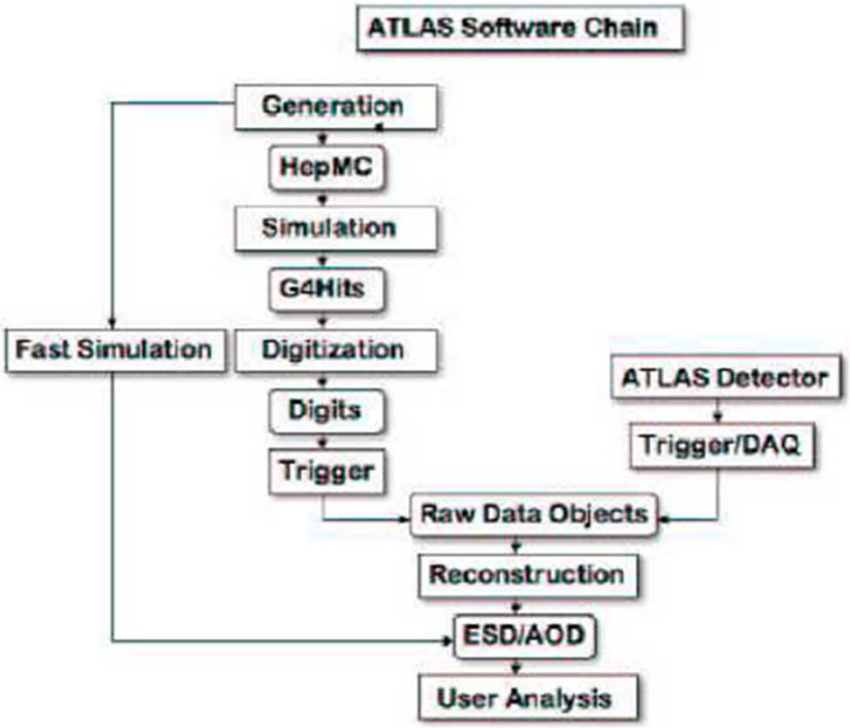
Offline Software

- procesuiranje dogadjaja sakupljenih DAQ sistemom, pristup i obrada podataka pomocu softverskih paketa
- Athena-ATLASovo offline softversko okruzenje, algoritmi za simuliranje, rekonstrukciju, fizicku analizu i obradu podataka

- MC generator

-fast simulacije, ALTfast:parametrizovan model za odgovor detektora (η-pokrivenost, granularnost kalorimetra i barrel/endcup prelaz u EMCalo) i rezoluciju objekata; izlaz paketa su rekonstruisani objekti leptoni, jetovi, fotoni, E_{Tmiss} i njihovi kinematicki parametri-cetvoroimpulsi

-full simulacije, GEANT4: u obzir uzeti detalji geometrije detektora i fizicki procesi, rezolucija i efikasnost detekcije, poravnanje i kalibraciju pojedinih detektorskih sistema; izlazni podaci:hit-ovi



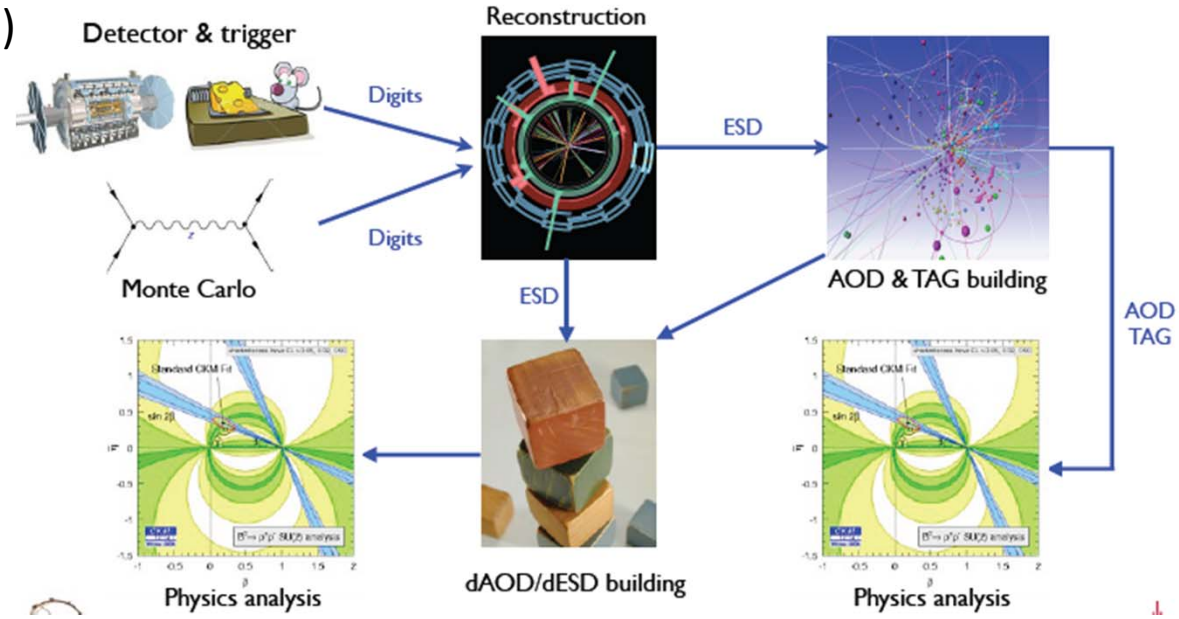
- Digitalizacija - prevodjenje hit-ova u izlaz koji ce postojati u realnim eksperimentalnim uslovima → RDO
- Algoritmi za rekonstrukciju objekata u Athena okruzenju, podaci smesteni u Container-ima:

→ESD (Event Summary Data): kompletne informacije iz rekonstrukcije i MC o svakom generisanom dogadjaju

→AOD (Analysis Object Data): redukovane informacije o rekonstruisanim objektima, oko 5 puta manji fajlovi od ESD

- Pri analizi je potrebno otkloniti preklapanje
- Obrada dogadjaja softverskim paketima, koji se smestaju u ntupl-e koji se analiziraju dalje van Athene pomocu objektno-orijentisanog okruzenja ROOT, dESD, dAOD (Data derived from ESD or AOD)

The data processing chain



Elektroni

- Kanali fizickih procesa od primarnog interesa na LHC-u, ocekuje se da ce produkovati elektrone sa p_T izmedju nekolikoGeV i 5 TeV.
- **Detektori koji ucestvuju u detekciji**

inner detektor : rekonstrukcija tragova, id-cestice u TRT-u;

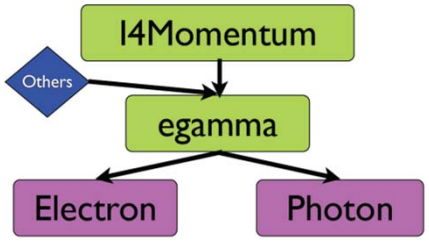
LAr EM kalorimetar : celije, klasteri + oblici pljuskova za id –cestice;

hadronski kalorimetar : u slucaju pojave “curenja” i izolacije

- fake-rate za detektovanje fotona i elektrona <10%,

Ovi objekti su rekonstrusani istim paketom (egammaRec),

(the same barcode, but different version numbers)



- Cluster + Track = Electron
- Cluster + no Track = Photon

- I4Moment elektrona(E,px,py,pz) : Energija se dobija iz kalorimetra; a (φ,η)iz traga

- problem kod rekonstrukcije elektrona je hadronska aktivnost koja proizvodi slican signal, potreban je faktor potiskvanja QCD jetova 10^5

egamma algoritmi

- **Velicina kluster-a** za elektrone : 3×7 (in barrel), 5×5 (in end-caps)

- **Tri algoritma za rekonstruciju (**Reconstruction/egamma/egammaRec**)**

1.standardni egamma algoritam – cluster-based for|η|<2.5

{seeded by clusters reconstructed in LAr EM by a sliding window (SW) algorithm

match a track to cluster procedure

match a –conversion vertex to cluster procedure}

(python/egammaGetter.py, src/egammaBuilder.cxx)

2.“softe” - track-based inputs, for | η |<2.5 , essentially useful for E_T<5 GeV

(python/softeGetter.py, src/softeBuilder.cxx)

3.forward electrons for | η |>2.5 – uses topo clusters, no inner detector information

(python/forwardGetter.py, src/forwardBuilder.cxx)

- **Nekoliko algoritama za analizu (**Reconstruction/egamma/egammaAnalysis**)**

Glavni algoritmi za analizu sadrze kalibracije, scaling faktore, korekcije na izolaciju

(Reconstruction/egamma/egammaAnalysis/egammaAnalysisUtils)

-can also run on D3PDs

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/EgammaSoftwareDoxygen

egamma object

- **Author** – odredjuje koji algorimatm je iskoriscen
- **Four-momentum**, with errors (E-p combined and uncombined)

eg->get4Mom(egamma::Combined) , eg->get4Mom(egamma::Uncombined)

- **CaloCluster,** informacije o kalorimetarskim klasterima
- **Link to TrackParticles (if any)**

-tracking information for when interpreted as an electron

-trackParticles are sorted so that those with silicon hits are before those without, and within the category, in deltaR/deltaϕ.

-the “best” trackParticle should be the first

- **Link to VxCandidates (if any)**

-conversion vertex information for when interpreting as converted photons

-vertices are sorted so that those with two tracks are before those with one track, and within the categories, by conversion radius.

- **egDetail,** dodatne informacije o rekonstrukciji
- **PID,** particle identification **and Object Quality**

EgammaAOD (ElectronAODCollection)

- 4-vektor: Release 15.5 i kasniji: kombinovanje odgovarajucih energija i uglova iz EM kalorimetra i inner detektora
- author() : da bi se pronasao autor nekog objekta treba pogledati u egammaEvent/egammaParamDefs.h gde su dati svi moguci autori. Takodje treba pogledati definicije za elektrone i fotone.

na primer: electron->author(egammaParameters::AuthorElectron) vraca true ako je objekat pronadjen putem egamma standardne rekonstrukcije.

- **Tri container-a dostupna u StoreGate-u**

ElectronAODCollection

PhotonAODCollection

egDetailsAOD

- **Linkovi ka drugim container-ima**

TrackParticle, CaloCluster, VxCandidate..

information is sufficient for the user to be able to redo some basic PID

- **Documentation**

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/EgammaAOD

- Default metod koriscen pri identifikaciji elektrona

- **A basic series of cuts based on:**

-shower shape properties in different compartments of the calorimeter

-combination of ID and Calo

-test using, for example, eg->isElectron(egammaPID::ElectronMedium), which returns a bool

- **Loose - Calorimeter only information**

-hadronic Leakage, Shower Shape (middle layers only of EM cal)

-excellent ID efficiency, low BG rejection

- **Medium - Adds tracking information**

-basic Track quality cuts

-more detailed Calorimeter Cuts

-increased jet rejection efficiency by a factor 3-4 while reducing ID efficiency by 10%

- **Tight - Using all information available**

-b-layer hit requirement,TRT High Threshold hit information

-strongest background rejection but lowest ID efficiency

-ISO - For isolated electrons provides tighter calorimeter cuts

-TRT - For non-isolated electrons (from heavy quark decay) tighter TRT PID

Multivariate techniques are available (eg. Log Likelihood, Boosted Decision Trees, H-matrix, Neural Nets, …) and will be commissioned after the cut-based electron id has been validated with early data.

Definicije varijabli koriscene u cut-ovima prilikom identifikacije loose, medium i tight elektrona u centralnom regionu detektora za |η| < 2.47.

Type	Description	Name
Loose selection		
Acceptance	$\|\eta\| < 2.47$	
Hadronic leakage	Ratio of E_T in the first layer of the hadronic calorimeter to E_T of the EM cluster (used over the range $\|\eta\| < 0.8$ and $\|\eta\| > 1.37$)	R_{had1}
	Ratio of E_T in the hadronic calorimeter to E_T of the EM cluster (used over the range $\|\eta\| > 0.8$ and $\|\eta\| < 1.37$)	R_{had}
Middle layer of EM calorimeter	Ratio of the energy in 3×7 cells over the energy in 7×7 cells centred at the electron cluster position	R_η
	Lateral width of the shower	$w_{\eta 2}$
Medium selection (includes loose)		
Strip layer of EM calorimeter	Total shower width	w_{stot}
	Ratio of the energy difference between the largest and second largest energy deposits in the cluster over the sum of these energies	E_{ratio}
Track quality	Number of hits in the pixel detector (≥ 1)	n_{pixel}
	Number of total hits in the pixel and SCT detectors (≥ 7)	n_{Si}
	Transverse impact parameter ($\|d_0\|$ <5 mm)	d_0
Track–cluster matching	$\Delta\eta$ between the cluster position in the strip layer and the extrapolated track ($\|\Delta\eta\| < 0.01$)	$\Delta\eta$
Tight selection (includes medium)		
Track–cluster matching	$\Delta\phi$ between the cluster position in the middle layer and the extrapolated track ($\|\Delta\phi\| < 0.02$)	$\Delta\phi$
	Ratio of the cluster energy to the track momentum	E/p
	Tighter $\Delta\eta$ requirement ($\|\Delta\eta\| < 0.005$)	$\Delta\eta$
Track quality	Tighter transverse impact parameter requirement ($\|d_0\|$ <1 mm)	d_0
TRT	Total number of hits in the TRT	n_{TRT}
	Ratio of the number of high-threshold hits to the total number of hits in the TRT	f_{HT}
Conversions	Number of hits in the b-layer (≥ 1)	n_{BL}
	Veto electron candidates matched to reconstructed photon conversions	

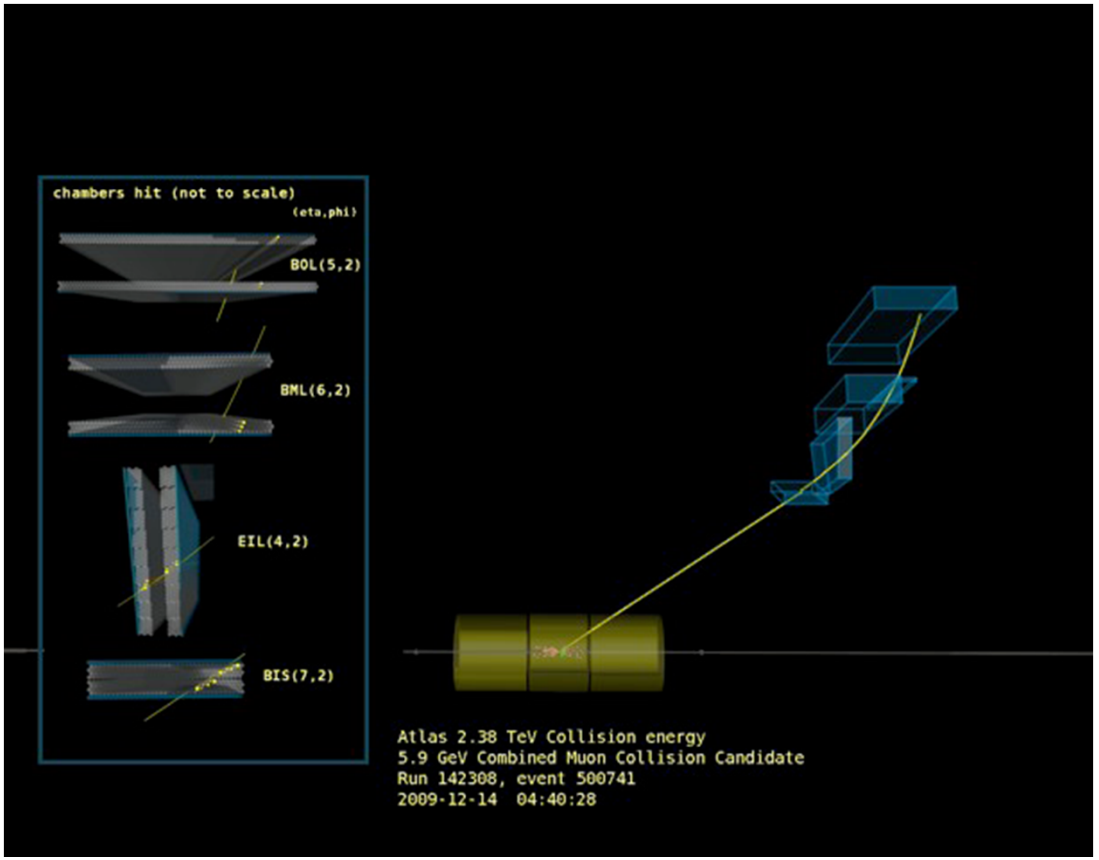
Linkovi

- https://twiki.cern.ch/twiki/bin/view/AtlasProtected/ElectronGamma
- https://twiki.cern.ch/twiki/bin/view/AtlasProtected/EgammaNotes
- https://twiki.cern.ch/twiki/bin/view/AtlasProtected/EgammaAOD
- Doxygen Documenation http://tinyurl.com/6h2o23
- https://hypernews.cern.ch/HyperNews/Atlas/get/EGammaWG.html

Rekonstrukcija miona na ATLAS detektoru –algoritmi i analiza-

- identifikacija tragova hit-ova u mionskim komorama (kombinacijom hitova u segmente, segmenata u trag) ; rekonstrukcija kroz ceo detektor do perigeja (najblize tacke liniji sudara) radi racunanja parametara tragova

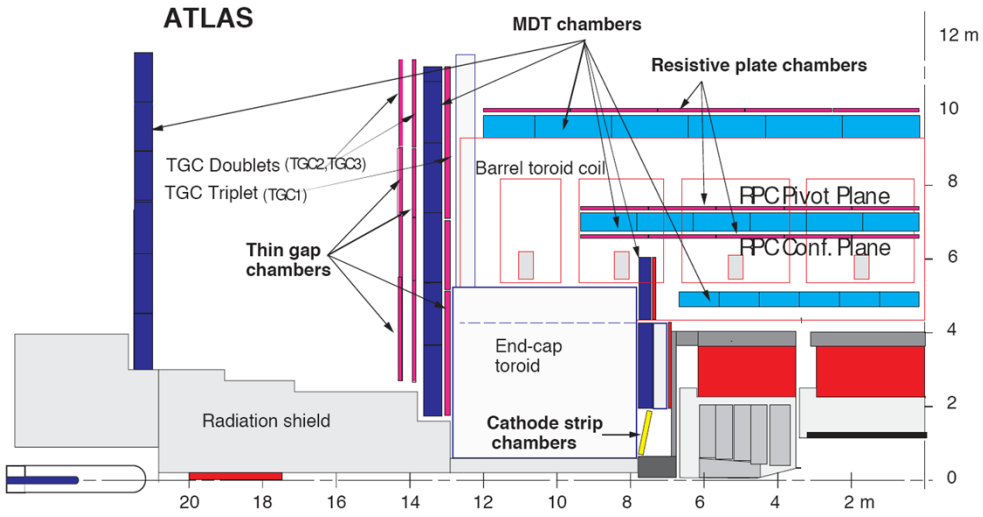
Identifikacija i rekonstrukcija na osnovu kombinacije trajektorija i informacija o energetskim gubicima u nekim ili svim detektorskim sistemima

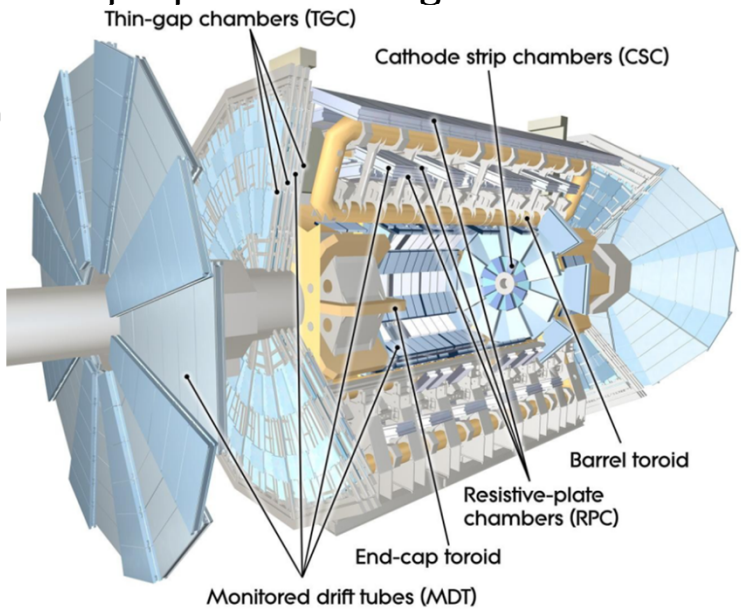


Mionski Spektrometar

- Toroidal magnetic field of 0.5 T by 8 barrel coils + 2 x 8 end-cap coils
- 2 fast trigger chamber technologies: RPC- Resistive Plate Chamber (barrel), TGC - Thin-Gap Chambers (end-caps)
- 2 precision tracking technologies: MDT- Monitored Drift Tubes CSC -Cathode Strip Chambers (high occupancy)
- coverage $|\eta| < 2.7$
- može da meri impulse miona potpuno nezavisno od unutrašnjeg detektora jer ima svoje magnetno polje koje generišu *air-core* superprovodni magneti.

$$\sigma_{p_T}/p_T = 10\% \text{ at } p_T = 1 \text{ TeV}$$

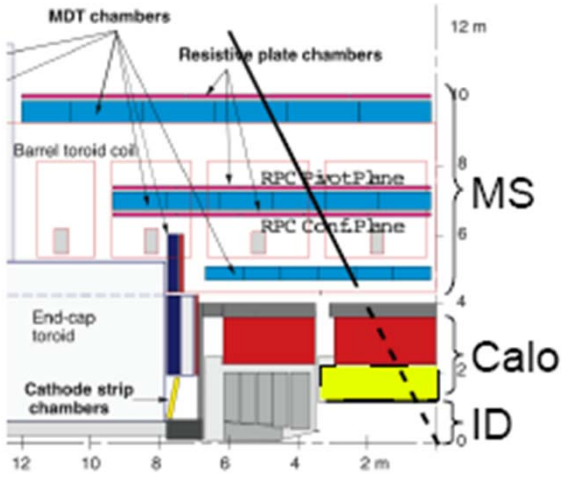




Algoritmi za rekonstrukciju miona

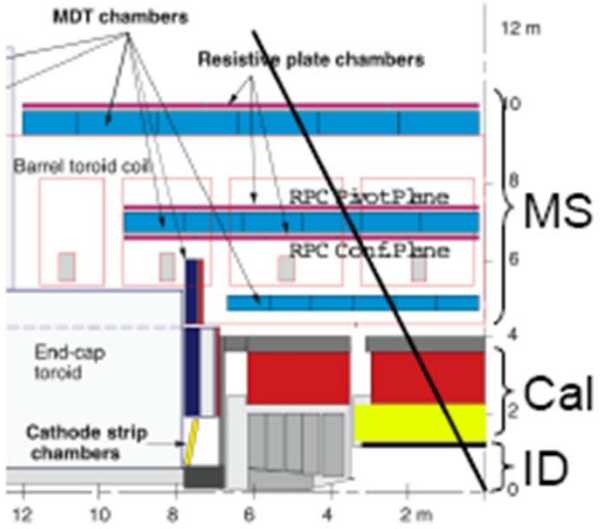
- **Standalone Muon**

-trag u MS extrapoliran u IP,
korigovan za Calo E-loss
-pokrivenost do |η|<2.7
-koristi se u regionu sa visokim η,
u proucavanju MS performance



- **Combined Muon**

-trag u MS combinovan sa tragom u ID,
uzima se u obzir Calo E-loss
-pokrivenost do |η|<2.5
-najbolja rezolucija pri merenju impulsa



Algoritmi za rekonstrukciju miona

- **Segment Tagged Muon, Inside-Out Reconstruction**

-trag u ID μ je taggovan ako se poklapaju signali u segmentima u MSu

-pokrivenost do $|\eta|<2.5$

-koriste se u slucaju miona sa niskim impulsom koji ne prodju kroz sve slojeve MSa i za regione $\eta\sim1.2$

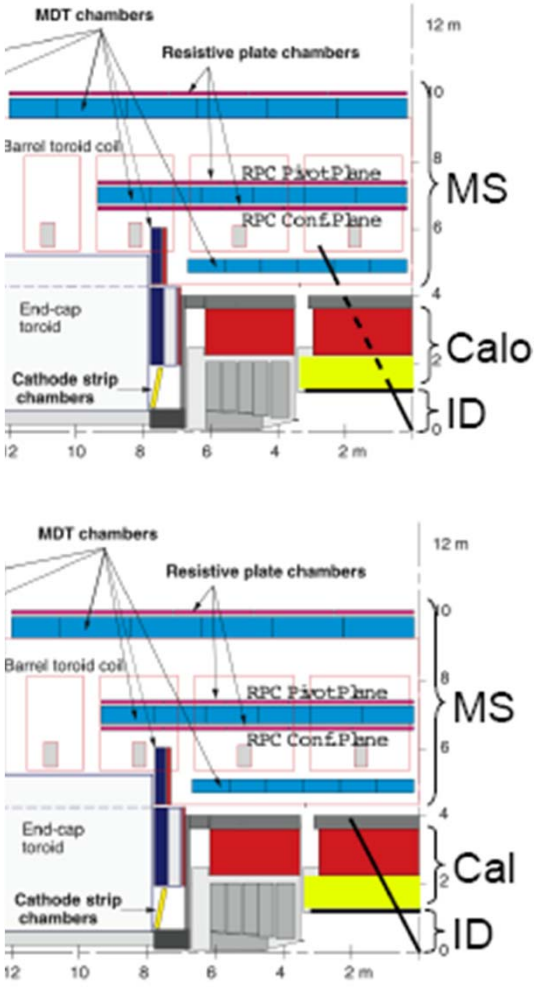
-najuniformnija pokrivenost η i p_T

- **Calo Tagged Muon**

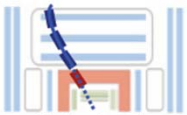
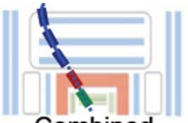
-trag u ID, μ je taggovan ako su signali u kalorimetru oko ekstrapoliranog traga konzistentni sa M.I.P.

-pokrivenost do $|\eta|<2.5$

-koriste se u slucaju miona sa niskim impulsom koji ne prodju kroz sve slojeve MSa i za regione $\eta\sim0$



Algoritmi za rekonstrukciju miona

	MS Reconstruction	Calorimeter Correction	Combined Reconstruction
STACO Stream	Muonboy	Muonboy Extrap.	STACO
Muid Stream	MOORE	Muid Standalone	Muid Combined

+ **Segment Taggers**

MuTag: Dopuna STACO familiji (ovde su pronadjeni samo oni mioni koje STACO nije vec pronasao). Koristi samo jedan ili dva sloja u MS-u

MuTagIMO: Zasnovan na algoritmu MuTag, ali koristi sve slojeve MS-a. Uglavnom koristan za commissioning

+ **Segment Tagger/Inside-Out Reconstruction**

MuGirl: Algoritam nezavisan od familijeuglavnom se koristi sa mionima Muid Stream (mada mioni iz MuGirl bi takodje mogli biti rekonstruisani preko Muid-a, sto treba prveriti u author-u)

+ **Calorimeter Taggers**

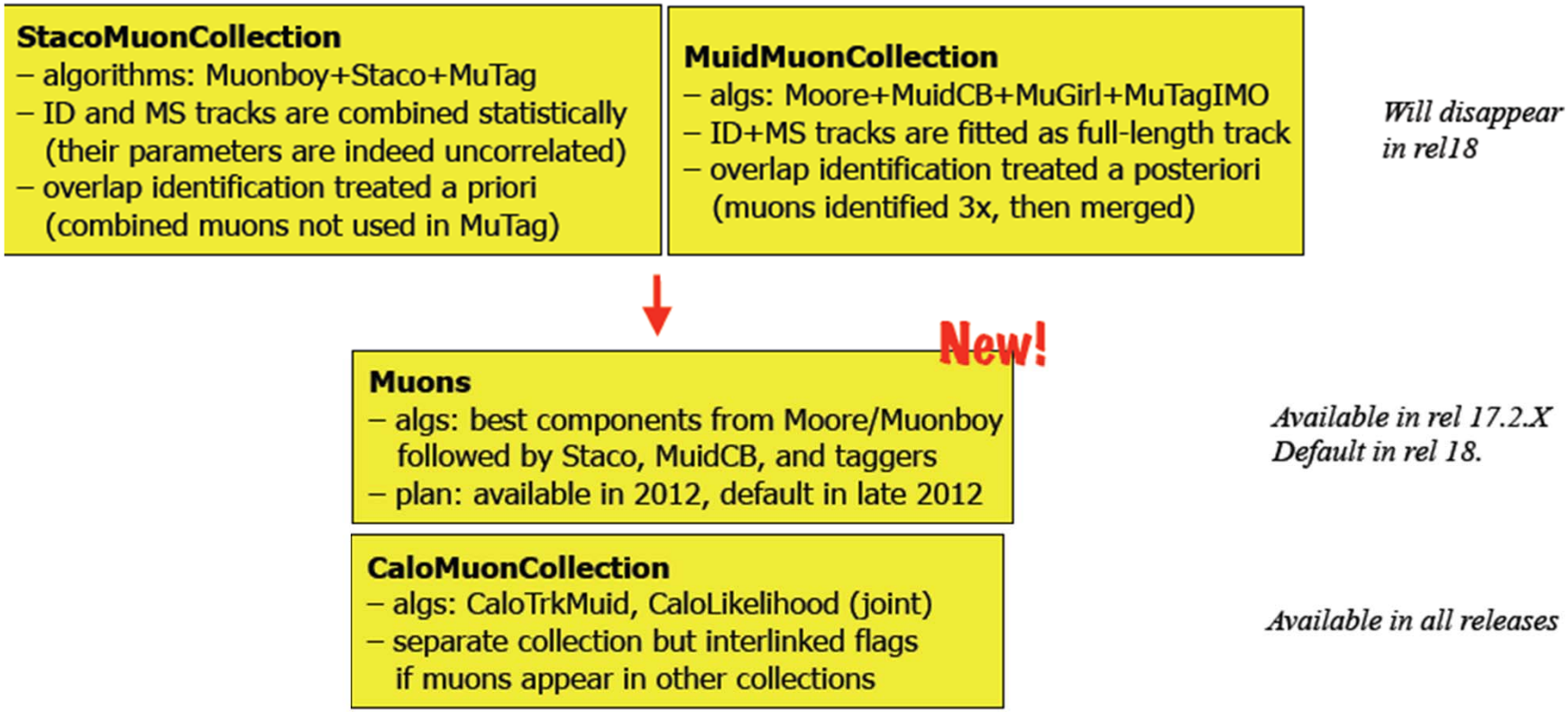
Razvijeni nezavisno od STACO ili Muid streams

Dva razlicita pristupa (algoritma):

- **CaloTag**: Jednostavni cut-ovi na osnovu deponovane energije
- **CaloLikelihood**: Funkcija Likelihood-a izvedena iz Monte Carlo

Muon Collections

-standardna klasa u kojoj su smesteni rezultati: **Analysis::Muon**
-Tri glavna MuonContainer-a u kojoj su smesteni podaci (AOD):



https://twiki.cern.ch/twiki/bin/view/AtlasProtected/StacoMuonCollection
https://twiki.cern.ch/twiki/bin/view/AtlasProtected/MuidMuonCollection
https://twiki.cern.ch/twiki/bin/view/Atlas/CaloMuonContainer

Analysis::Muon object

- Kinematika

-Analysis::Muon is an I4Momentum

pt(),e(),et(),px(),py(),pz(),eta(),phi(),m(),cosPhi(),sinTh()…

-Velicine su izrazena na perigeju(najbliza tacka liniji sudara)

- Osnovnim svojstvima je lako pristupati, za pristup drugim potrebno je poznavati druge delove softvera (TrackParticles)

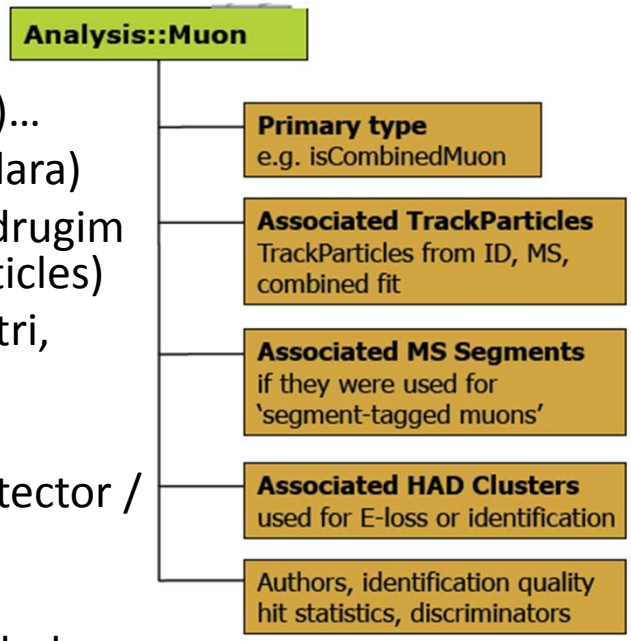
-Linkovi ka *Tracks / TrackParticles* (trajektorije, parametri, greske*)*

-track(): Kombinovani trag cestice ukoliko je dostupan

-Takodje, Muon Spectrometer extrapolated / Inner Detector / MS only

-Metodi koji proveravaju da li postoje takvi tragovi

- Sazetak rekonstrukcije -Author, number of hits and holes in each technology, chi-square...



Most analyses will depend on knowing the performance of the muon selection, i.e. the efficiency, fake rate and resolution (including tails) as function of kinematics (eta, pT, etc.) and time.

DOXYGEN: http://atlas-computing.web.cern.ch/atlas-computing/links/buildDirectory/AtlasOffline/15.1.0/InstallArea/doc/muonEvent/html/classAnalysis_1_1Muon.html

SVN: https://svnweb.cern.ch/trac/atlasoff/browser/Reconstruction/MuonIdentification/muonEvent/trunk

- How do I get / loop over the muons?

```
const Analysis::MuonContainer* muons;
m_storeGate->retrieve(muons, "StacoMuonCollection");
MuonContainer::const_iterator muon, muonE = muons->end();
for (muon = muons->begin(); muon != muonE; muon++){
//do stuff
}
```

- What if I want a particular type of muon?

```
for (muon = muons->begin(); muon != muonE; muon++){
 //do stuff
 if (!muon->isAuthor(MuonParameters::STACO)) continue;
}
```

(remember to include muonEvent/MuonParamDefs.h)

Quality (“tightness”), dressing information...

1. nacin: muon->isLoose(), isMedium(), isTight() ; loose: max efficiency, acceptable fake rate
2. nacin: koristeci MuonQualityTool::calcBits(muon) - the most up to date tight/medium/loose definition

	Loose	Medium	Tight
STACO container	Tagged with 1 segment in end-cap and no tgc hits	MS extrapolated |η|<2.5 (no ID match), tagged and not tight or loose	combined |η|<2.5, MS extrapolated |η|>2.5, tagged with 2 segments or 4 tgc hits
Muid container	Tagged with simple tagger (MuTagIMO) or neural-network (MuGirl)	MS extrapolated |η|<2.5 (no ID match)	combined |η|<2.5, MS extrapolated |η|>2.5, reco by inside-out reconstruction

- Analysis::Muons , za koje se kaze da su“dressed” nakon rekonstrukcije informacijom koja bi mogla biti upotrebljiva pri analizi:

− Kalorimetarska Izolacija : Energija u kalorimetru unutar nekog konusa oko miona, korisna pri utvrdjvanju porekla miona

double Muon::parameter(MuonParameters::etcone20)

− Tracking Izolacija : Broj tragova i njima odgovarajucih vrednosti p_T

double Muon::parameter(MuonParameters::nucone10), double Muon::parameter(MuonParameters::ptcone10)

− Associated Vertex : moze nekada biti koristan pri fitovanju

Trk::RecVertex* Muon::origin()

D3PD Content

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/D3PDContentMuon

Kinematics

mu_n	number of muons (size of container)
mu_E	Energy
mu_pt	Transverse momentum in MeV
mu_m	mass
mu_eta	Event
mu_phi	Event
mu_px	x momentum in MeV
mu_py	y momentum in MeV
mu_pz	z momentum in MeV
mu_charge	charge
mu_beta	v/c from low pt algorithms (in case of

Component tracks

Parameters are also stored for the different track types in the muon: D

mu_xx_qoverp	Charge divided by magnitude of momentum
mu_xx_theta	theta
mu_xx_phi	Azimuthal angle
mu_xx_d0	Transverse impact parameter
mu_xx_z0	Longitudinal impact parameter

At perigee (0,0,0)

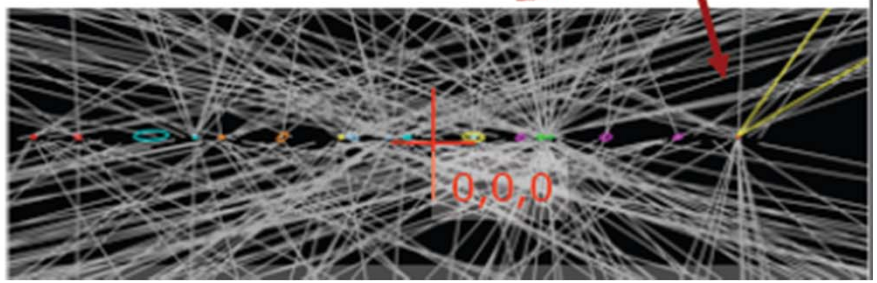
xx = id, ms, me, ie

Primary vertex:

mu_xx_qoverp_exPV	Charge divided by magnitude of momentum
mu_xx_theta_exPV	theta
mu_xx_phi_exPV	Azimuthal angle
mu_xx_d0_exPV	Transverse impact parameter
mu_xx_z0_exPV	Longitudinal impact parameter

At primary vertex

xx = cb, id, ms, me, ie



Linkovi

- https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/MuonCombinedEventDataModel
- https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/MuonSelection
- https://twiki.cern.ch/twiki/bin/view/AtlasProtected/MuonPerformance
- tutorijali: https://twiki.cern.ch/twiki/bin/viewauth/Atlas/MuonSoftwareTutorials

Jets in Athena

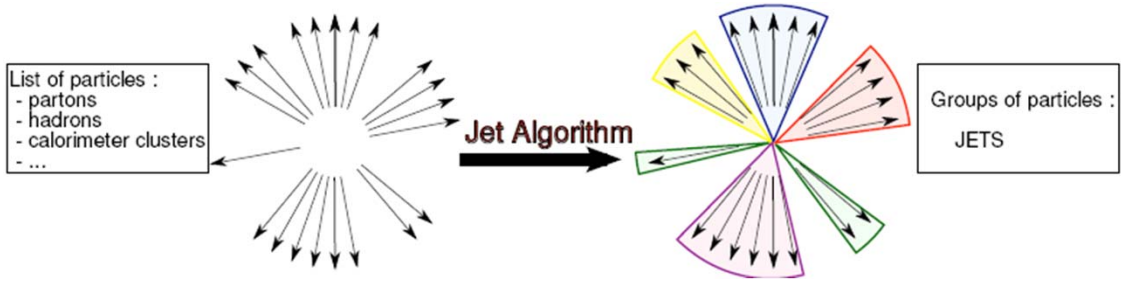
• Izborom cestica (cetvoro-impulsa) uvodi se restrikcija na definisanje rekonstruisanih jet objekta, Jet Software je dizajniran da bude sto fleksibilniji; Jet-ovi su IParticle sa daodatnim karakteristikama (constituents, moments, calib states)

-Bilo koji tip input-a (Truth, tracks, clusters, towers,...)

- Bilo koji tip jet algoritma

- Bilo koji kalibracioni metod

-Voditi racuna o konstituentima



• korisniku se dopusta da izabere jet-ove za svoju analizu, dok su obezbedjene neke referentne jet collections

• Dva glavna tipa jet algoritama:

- Kt aggregative algoritam (Default “AntiKt”, varijante: “standard”, “Cambridge”)

- konusni (Cone) algoritam (istorijska Atlas implementacija : “iterativni konus”, ima nekih teorijskih nedostataka, redje se koristi. Takodje postoji i “SISCone”)

-Neki drugi algoritmi su dostupni za testiranje i ne koriste se u standardnoj rekonstrukciji: Mid-point cone, Optimal Jet Finder

- k_T algoritam polazi od *i*-tog tower-a sa min energijom u kalorimetru, i racuna

$$d_{ij} = \min(p_{T_i}^2, p_{Tj}^2)(\Delta\eta_{ij}^2 + \Delta\phi_{ij}^2) \Big/ D^2$$

Ako $d_{ij} > \min(p_{T_i}^2, p_{Tj}^2)$, algoritam spaja tower-e *i* i *j* u novi i ponavlja proceduru.

Parametri su p_T prag i parametar D, koji kontrolise kraj procedure spajanja tower-a i odredjuje pribliznu velicinu rekonstruisanog jeta.

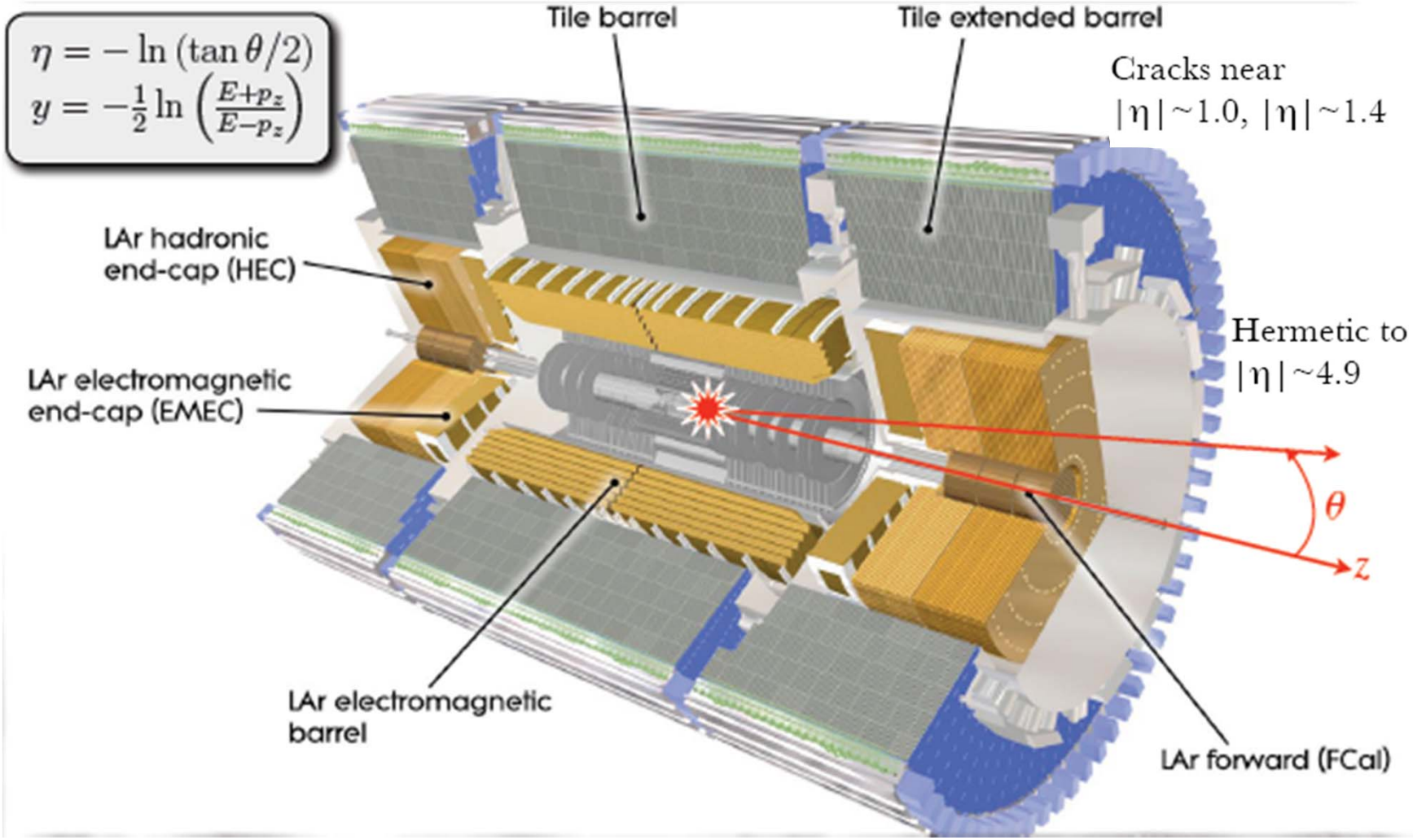
- Osnovni parametri konusnog algoritma su prag za "seme" jeta, poluprecnik konusa i p_T prag jeta. Ovaj algoritam polazi od "semena"-kalorimetarskog towera sa max deponovanom energijom u kalorimetru, koje odredjuje osnovni pravac konusa. Ako je deponovana energija u toweru > praga za seme jeta, izracunava se energija obuhvacenih towera u ΔR, i ako je p_T>praga jeta, objekat se prihvata kao jet. Centar jeta (η,ϕ)se ponovo racuna unutar ΔR.

-Tower- skup celija u datom η-ϕ pravougaoniku, tipicno je Δη × Δϕ=0.1×0.1

Two technologies:
Liquid Argon: >98.5% channels good
Scintillating Tile: 97.3% channels good

Detector giving good data:
Liquid Argon: >95%
Scintillating Tile: 100%

$$\eta = -\ln(\tan\theta/2)$$
$$y = -\frac{1}{2}\ln\left(\frac{E+p_z}{E-p_z}\right)$$



- **Input** to jet finders : Softver je dizajniran tako da prihvata bilo koju kolekciju 4-vektora impulsa(INavigable4Momentum):

-Truth : generise interagujuce cestice (naravno, ne mione)

-Towers : calorimeter towers. Sve kalorimetarske celije (uz odredjenu selekciju) koje se nalaze u kvadratu 0.1x0.1 ravni (eta,phi)

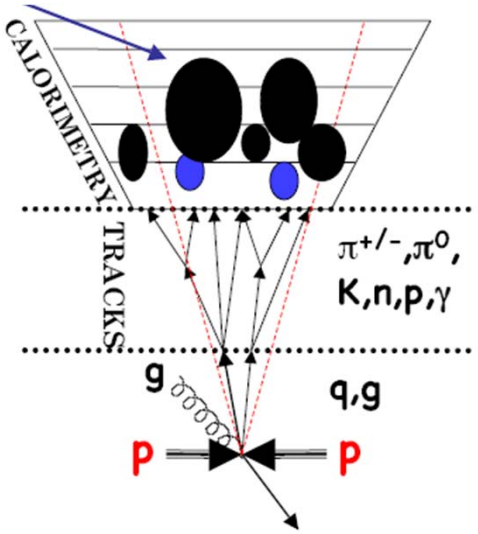
-Topo clusters : 3D topoloski energetski klasteri . Formiranje klastera je prema 4/2/0 algoritmu :

Pocinje se sa celijom $|E|>4\sigma$

Rekurzivno se skupljaju svi susedi sa $|E|>2\sigma$

Zatim se dodaju svi preostali susedi $|E|>0$

gde je *σ electronic+pile-up noise of the cells*



Apply same jet definition
to objects on different levels:

1. Partons
2. **Particles**
   →Truth Jets
   (only particles from the hard scattering)
   →Pileup Truth Jets
   (all particles, including secondary vertices)
3. **Calorimeter objects**
   (Towers, Topoclusters)
   → Reconstructed Jets
4. **Tracks**
   → Track Jets

• *na kraju dobijamo nekompenzovani EM kalorimetar, deo energije nece biti zabelezen u klasteru, potrebno je dodatno primeniti weighting (2 kalibracije)*

- 2 strategije za MC kalibraciju rekonstruisanih kalorimetarskih jetova

+ jet-level energy scale corrections (vise opcija koje se trenutno razmatraju)

- **Globalna kalibracija** (GCW : Global Cell Weighting) (Collection “H1Topo/TowerJets”)

H1 style calibration : jet se pronadje i onda se tezinski faktori primene: svaka kalorimetarska celija ima kalibracionu tezinu, koja zavisi od gustine energije, pozicije, energije. Tezine su MC fitovane , porede se truth particles jets sa reconstructed jets

- **Lokalna kalibracija** (LCW : Local Cell Weighting) (Collection “LCTopoJets”)

prvo se input u jet algoritam weightuje: pocinje se sa topoloskim klasterima; primeni se hadronska kalibracija nad klasterima (u skladu sa varijablama klastera, velicinom, oblikom, longitudinalnom dubinom kalorimetra), i izvrsava se run jet finding iz kalibrisanih klastera

Jet Objekat ima 4 karakteristike :

- 4-impuls (IParticle) : kinematicke funkcije(e(), mass(), rapidity(), etc...)
- lista konstituenata (pre kalib : $P_{Jet} = \sum P_{constituents}$) kojoj se moze pristupiti iz jeta
- Some attached “moments” and “associations” (to other particles)
  - B-tagging information
  - Energy per calorimeter sampling
  - jet width, ...
- “Calibration states”. Jets also hold different momentums user can switch on/off
  - EMSCALE (raw calorimetar energy scale) , CONSTITUENTSCALE (scale of LC clusters), FINALSCALE(default, fully calibrated scale)

→Jet information propagated to D3PDs (at ntuples) in various levels of detail

- Jet-ovi su smesteni u JetCollection object u StoreGate-u
- Ogranicen broj JetCollection-a se nalazi u ESD/AOD:

"AntiKt4TruthJets", "AntiKt4H1TowerJets", "AntiKt4H1TopoJets“

AntiKtX = AntiKt algoritam, Size paramter = 0.X (ili bi moglo biti “Cone4” za konusni algoritam) (distance parameter, radijus konusa)

- Samo su globalno kalibrisani jetovi u ESD/AOD, LC jetovi mogu naknadno da se smeste u pomenute fajlove
- Da bi se dobio dodatni prostor, ESD/AOD imaju ogranicenu kolicinu jet kolekcija, ali ovi fajlovi sadrze Calibrated topological clusters

→*korisnici mogu izvrsiti re-run-ovanje pronalazenja jeta iz klastera*

- Jednostavna konfiguracija u jobOption-u, pocetak vaseg algoritma:

```
from JetRec . JetGetters import *
make_StandardJetGetter ( 'Kt' , 0 . 6 , 'LCTopo ' )
```

ce kreirati standardnu Kt6LCTopoJets collection u StoreGate-u. Svi sledeci algoritmi joj imaju pristup.

- *Tehnicki problemi prilikom koriscenja AOD:*

-Towers : nisu smesteni u AOD, samo u ESD, nemoguce je vrsiti re-run iz AOD-a.

-Truth particles : u postojecim truth jet-ovima nije moguce pristupiti konstituentima

- Kalorimetarski Jetovi su izgradjeni iz CELOG kalorimetra

-u slucaju dogadjaja sa razlicitim objektima, e, mu, ... oni se zaista preklapaju sa ostalim kalorimetarskim objektima, fizicar je duzan da otkloni preklapanja

Linkovi

- Main Jet page :

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/JetEtMiss

- Very useful introduction :

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/IntroductionToHadronicCalibration

- Details on input to jet finding

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/JetInputs

- Frequently Asked Questions

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/JetSoftwareFAQ

- Reruning/configuring jets

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/JetConfigurableJobOD

- Btagging information :

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/FlavourTagging

- Accessing jet moment/shape :

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/JetAnalysis

- Jet Code :

http://alxr.usatlas.bnl.gov/lxr/source/atlas/Reconstruction/Jet/