INFN
Istituto Nazionale di Fisica Nucleare

ROMA TRE
UNIVERSITÀ DEGLI STUDI

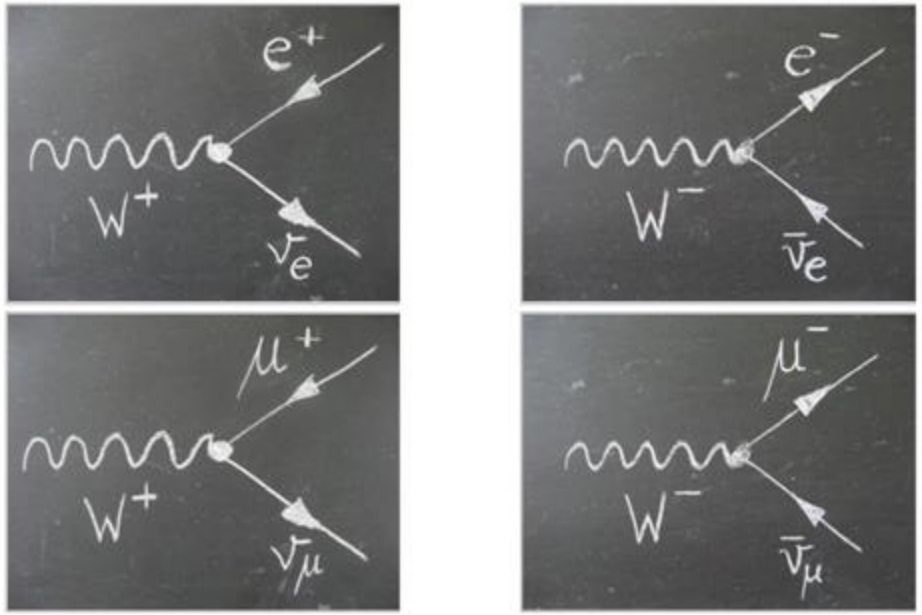
INTRODUZIONE ALL'ANALISI DEI DATI

Rita Antonietti

Università di Roma Tre &
INFN Roma Tre

QUALI EVENTI VOGLIAMO RICOSTRUIRE?

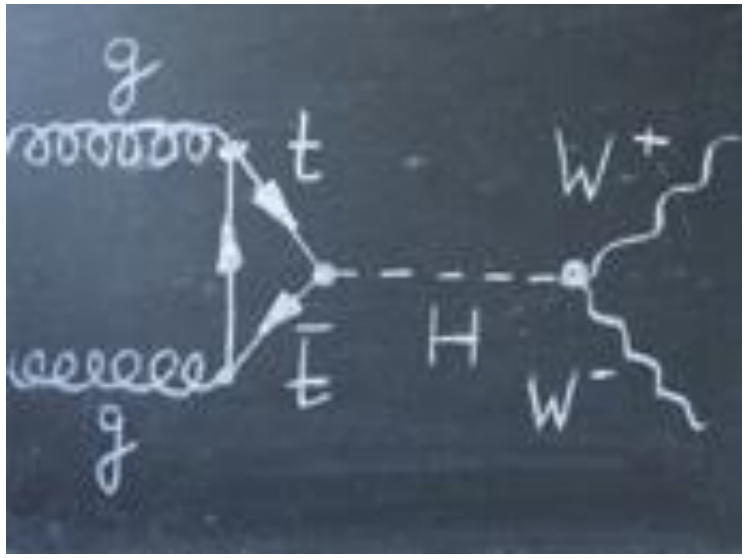
W^+ / W^-



nello stato finale rilevo:

- una particella carica
- energia trasversa mancante

H



nello stato finale rilevo:

-due particelle cariche

- energia trasversa mancante

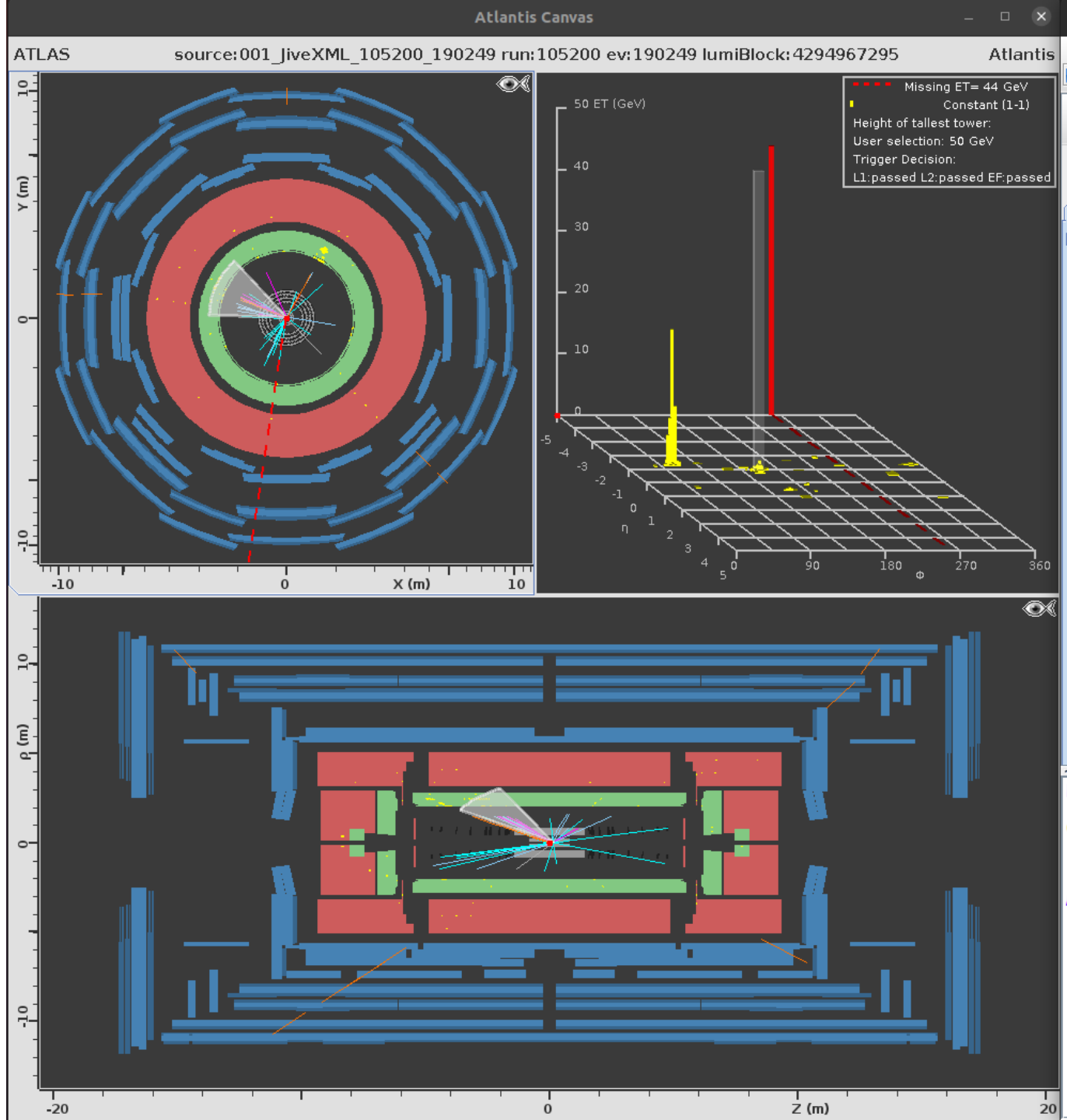
E ORA...MANO AL COMPUTER!

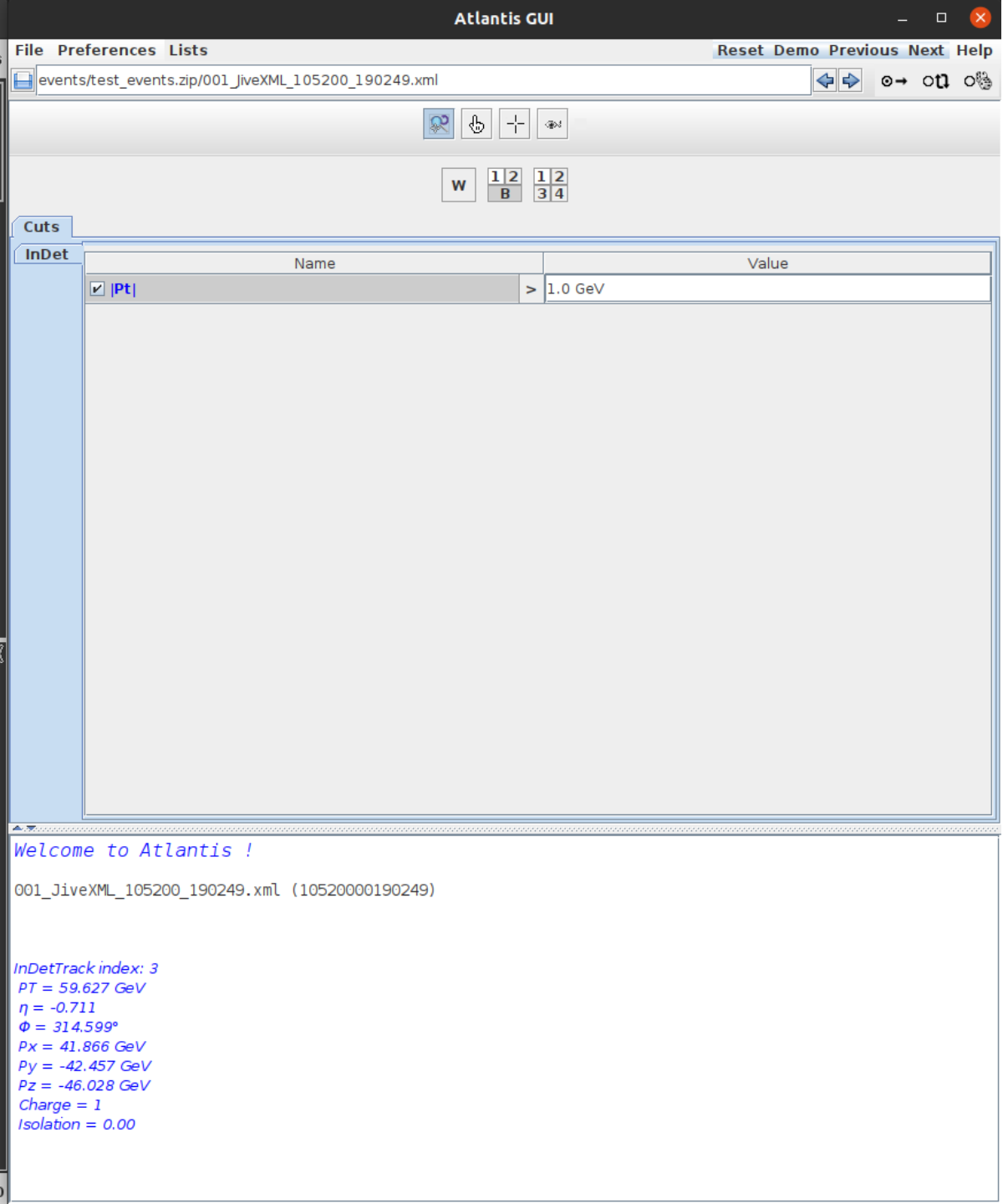
- Aprite Minerva

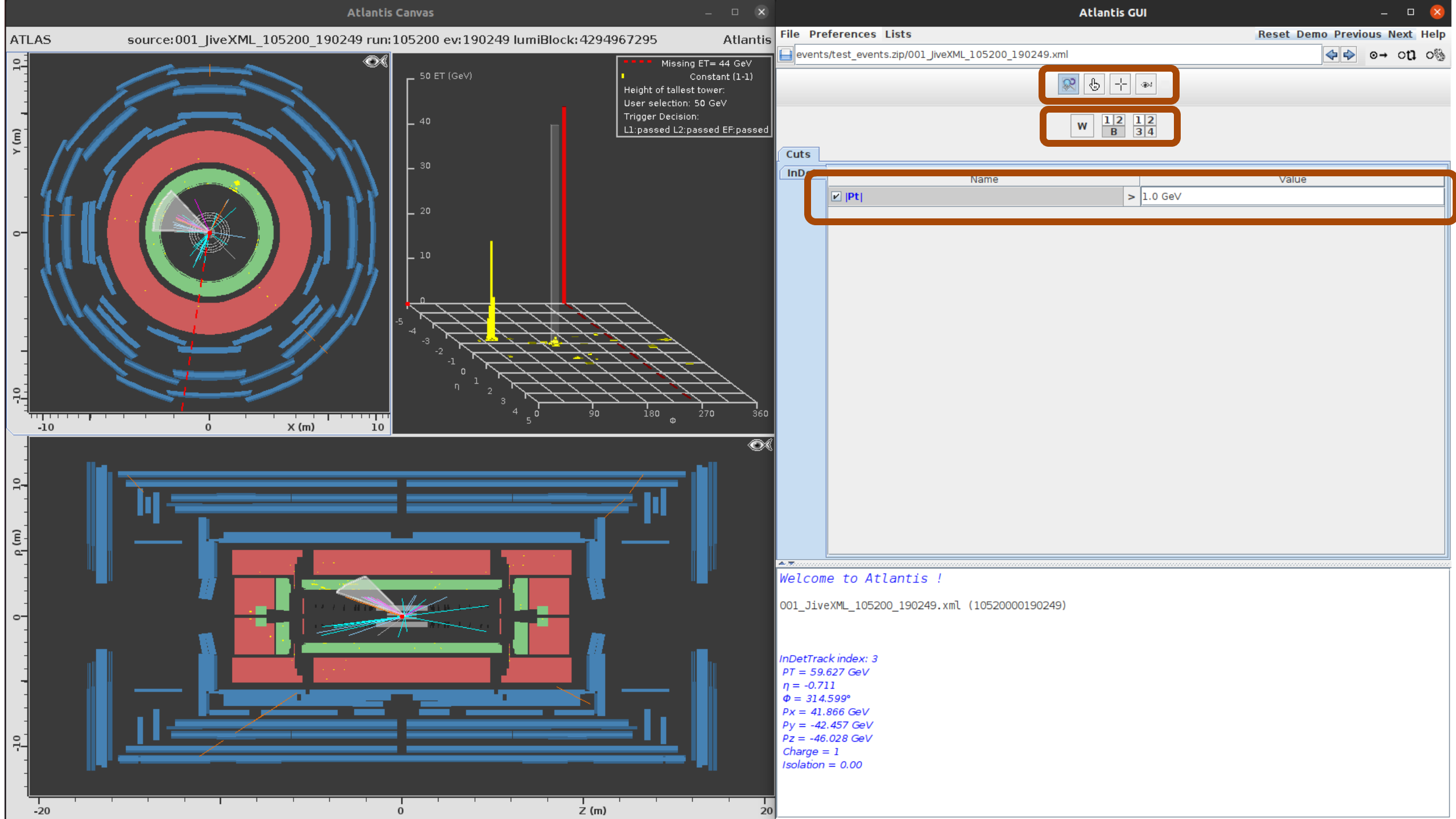
E ORA...MANO AL COMPUTER!

- Aprite Minerva

Gli strumenti di Minerva


Atlantis Canvas
ATLAS
source:001_JiveXML_105200_190249 run:105200 ev:190249 lumiBlock:4294967295
Atlantis
Missing ET= 44 GeV
Constant (1-1)
Height of tallest tower:
User selection: 50 GeV
Trigger Decision:
L1:passed L2:passed EF:passed
50 ET (GeV)
Y (m)
X (m)
η
Φ
ρ (m)
Z (m)


Atlantis GUI
File Preferences Lists
Reset Demo Previous Next Help
events/test_events.zip/001_JiveXML_105200_190249.xml
W
1 2 B
1 2 3 4
Cuts
InDet
Name
Value
|Pt|
>
1.0 GeV
Welcome to Atlantis !
001_JiveXML_105200_190249.xml (10520000190249)
InDetTrack index: 3
PT = 59.627 GeV
η = -0.711
Φ = 314.599°
Px = 41.866 GeV
Py = -42.457 GeV
Pz = -46.028 GeV
Charge = 1
Isolation = 0.00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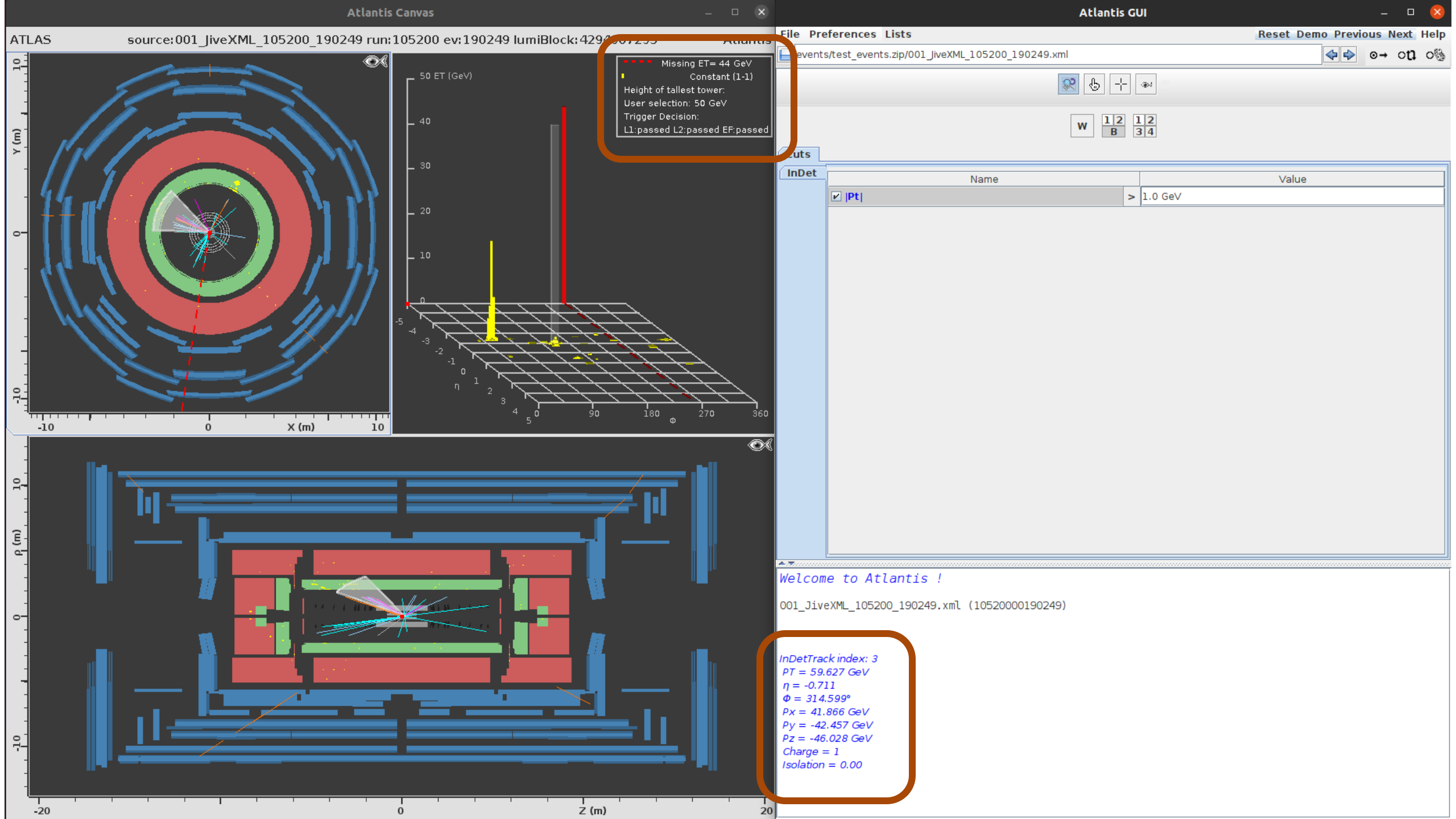
GLI STRUMENTI DI MINERVA

- Lente di ingrandimento per fare lo zoom nelle diverse schermate
- Puntatore a manina per selezionare le tracce e visualizzarne le proprietà

- Tasti per cambiare le varie proiezioni di ATLAS
- Taglio sul momento trasverso delle tracce

Name		Value
☑ |Pt|	>	1.0 GeV

- Impostate il taglio a 1 GeV per verificare la presenza di jets e per capire l'evento, poi impostate un taglio maggiore (9 GeV)


Atlantis Canvas
ATLAS
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Missing ET= 44 GeV
Constant (1-1)
Height of tallest tower:
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Trigger Decision:
L1:passed L2:passed EF:passed
50 ET (GeV)
Y (m)
X (m)
η
Φ
ρ (m)
Z (m)
Atlantis GUI
File Preferences Lists
Reset Demo Previous Next Help
events/test_events.zip/001_JiveXML_105200_190249.xml
InDet
Name
Value
|Pt|
1.0 GeV
Welcome to Atlantis !
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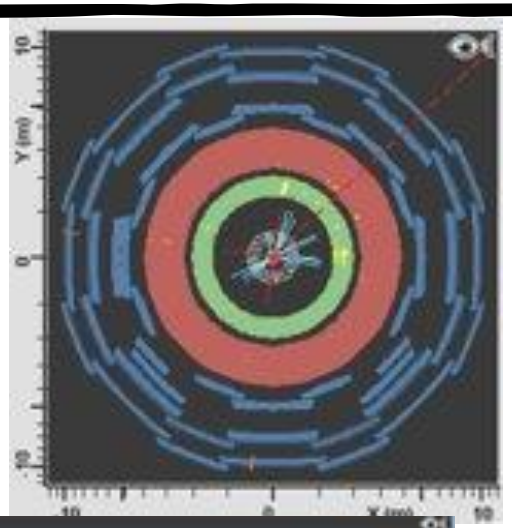
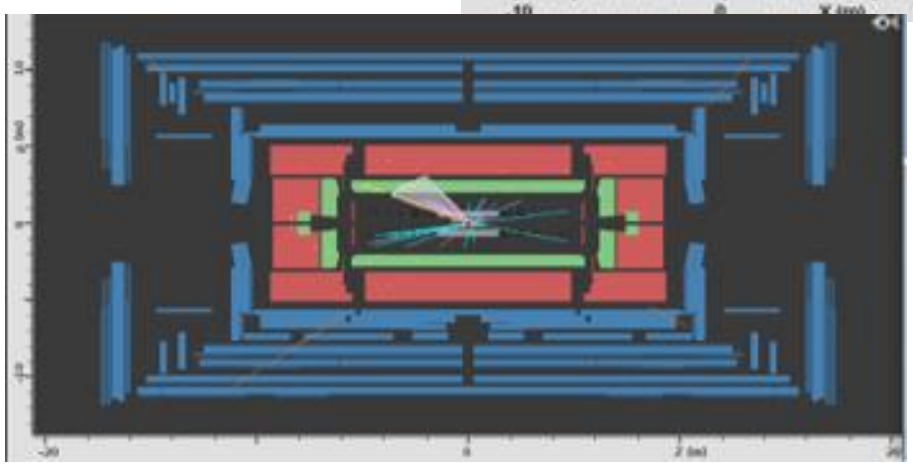
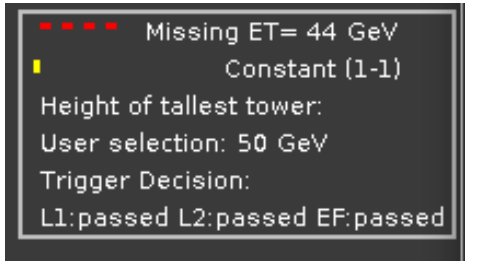
VISUALIZZAZIONE DELLE TRACCE

Visuale Trasversa





Visuale Longitudinale



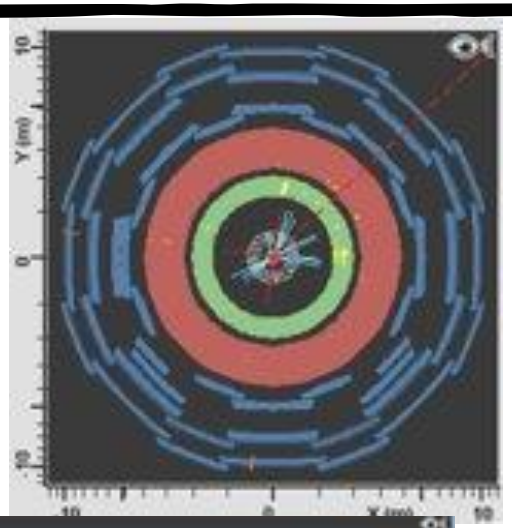
Energia trasversa mancante

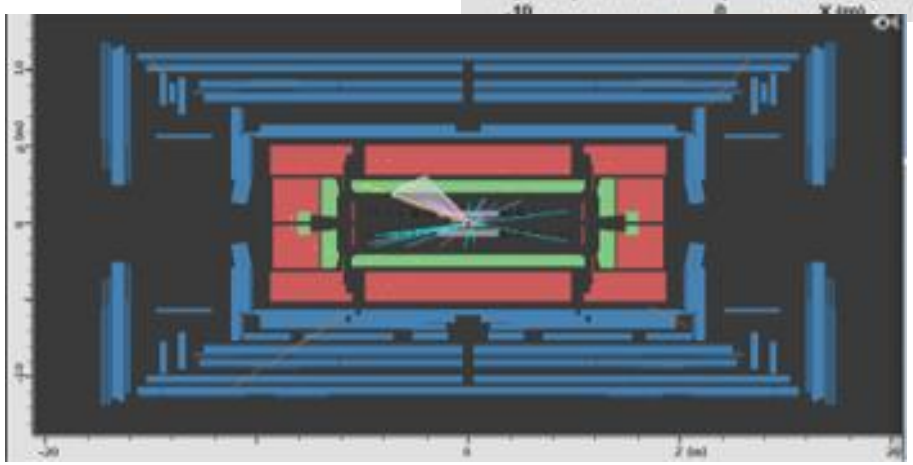
InDetTrack index: 3
PT = 59.627 GeV
η = -0.711
Φ = 314.599°
Px = 41.866 GeV
Py = -42.457 GeV
Pz = -46.028 GeV
Charge = 1
Isolation = 0.00

Informazioni della traccia selezionata

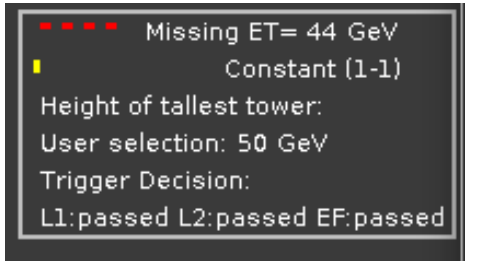
VISUALIZZAZIONE DELLE TRACCE

Visuale Trasversa





Visuale Longitudinale



Energia trasversa mancante

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Px = 41.866 GeV
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Charge = 1
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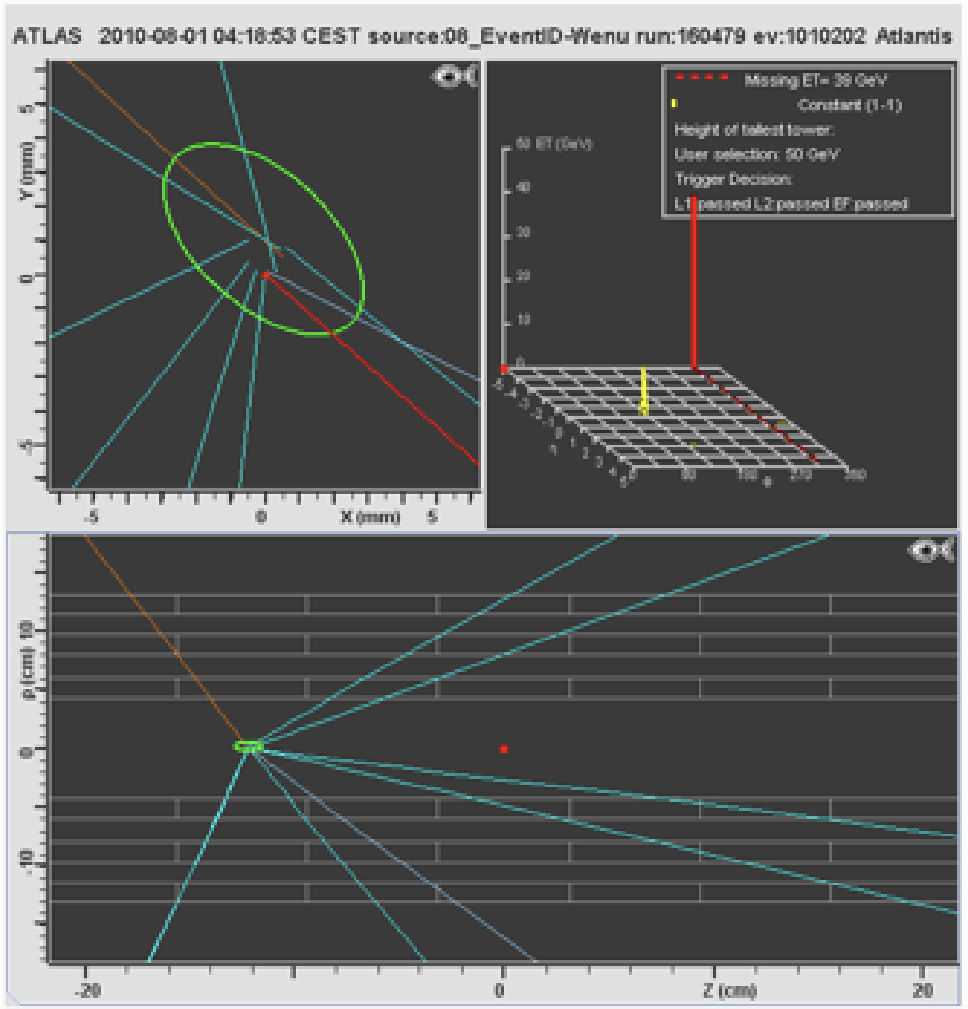
Informazioni della traccia selezionata

USATE LO ZOOM!

- Non dovete aspettarvi che da un vertice primario emerga una sola traccia
- Possono esserci anche tracce adroniche a basso p_T
- È importante che ci sia un solo leptone (o due se cerchiamo eventi che vengano dall'Higgs)



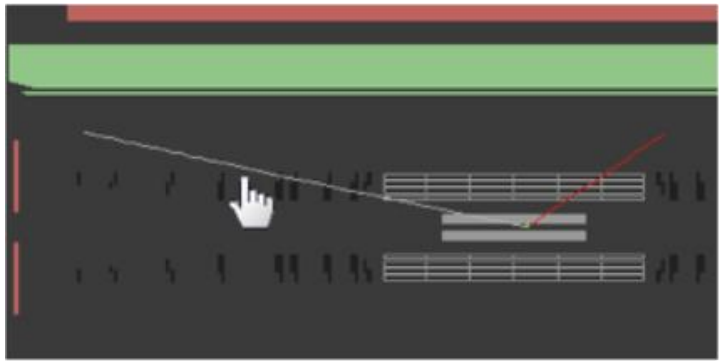
ISOLAMENTO DI UNA PARTICELLA

Un leptone è considerato isolato se è sufficientemente lontano da altre tracce dell'evento:

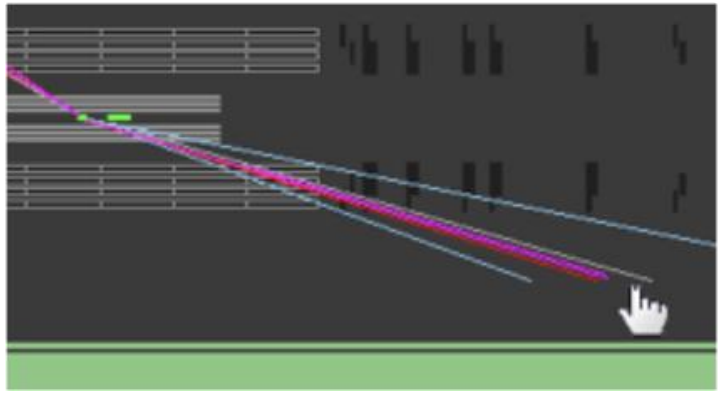
- Isolation > 0.2 leptone NON ISOLATO
- Isolation <0.2 leptone ISOLATO

ISOLAMENTO DI UNA PARTICELLA

Un leptone è considerato isolato se è sufficientemente lontano da altre tracce dell'evento



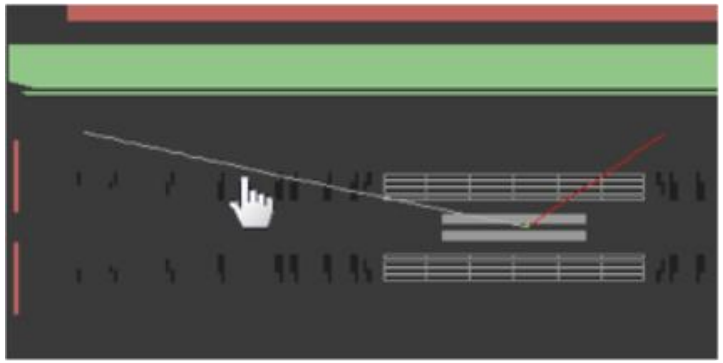
InDetTrack index: 0
PT = 1,376 GeV
η = -1,752
Φ = 37,127°
Px = 1,097 GeV
Py = 0,830 GeV
Pz = -3,846 GeV
Charge = -1
Isolation = 0,00



InDetTrack index: 20
PT = 2,414 GeV
η = 1,470
Φ = 286,991°
Px = 0,705 GeV
Py = -2,308 GeV
Pz = 4,972 GeV
Charge = -1
Isolation = 24,82

ISOLAMENTO DI UNA PARTICELLA

Un leptone è considerato isolato se è sufficientemente lontano da altre tracce dell'evento



InDetTrack index: 0
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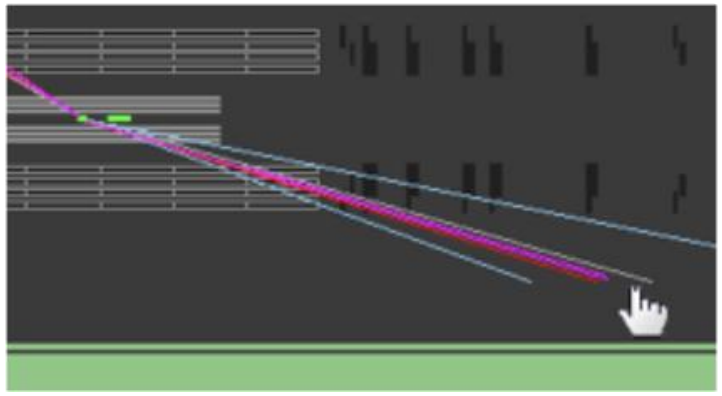
η = -1,752
Φ = 37,127°
Px = 1,097 GeV
Py = 0,830 GeV
Pz = -3,846 GeV
Charge = -1
Isolation = 0,00

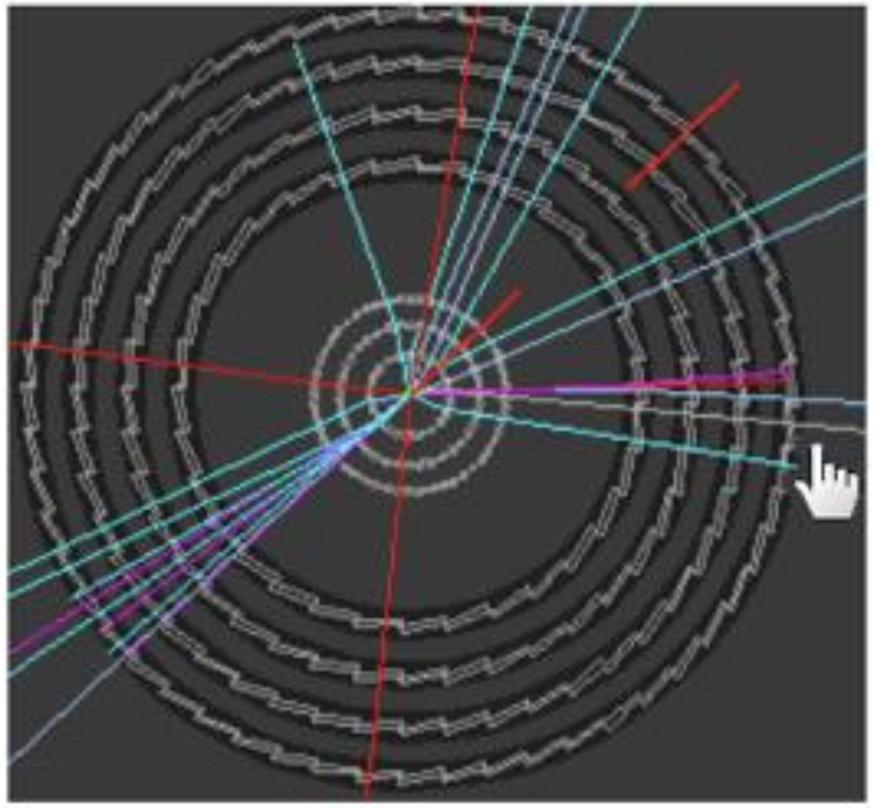
QUESTA TRACCIA È ISOLATA



InDetTrack index: 20
PT = 2,414 GeV
η = 1,470
Φ = 286,991°
Px = 0,705 GeV
Py = -2,308 GeV
Pz = 4,972 GeV
Charge = -1
Isolation = 24,82

QUESTA TRACCIA NON È ISOLATA

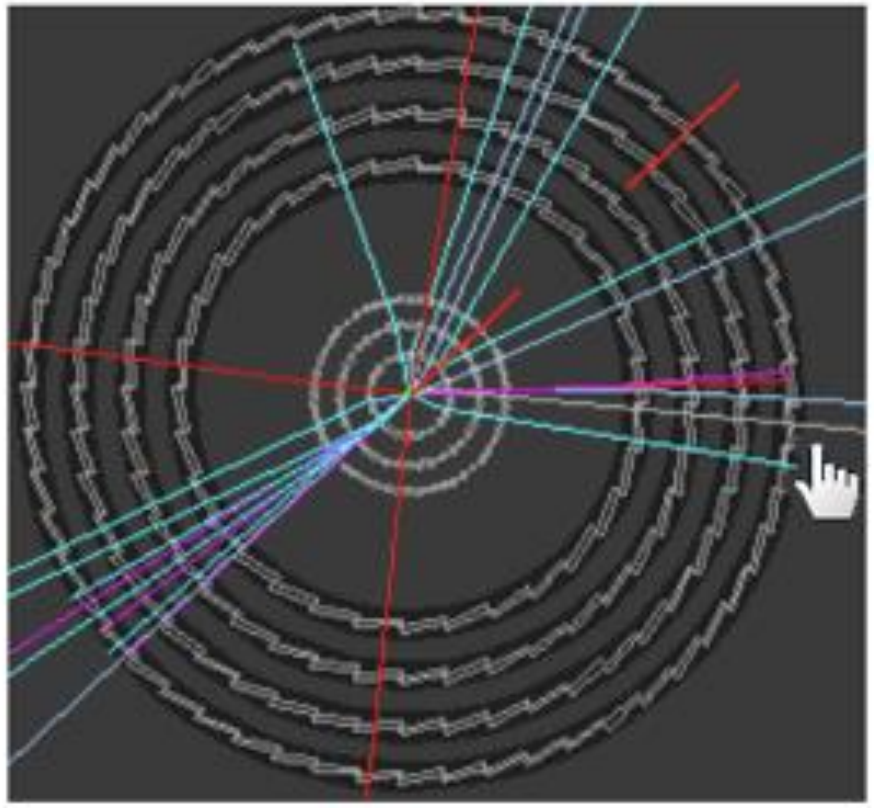
MA...L'OCCHIO INGANNA



Come vi sembra questa traccia?

- Isolata
- Non Isolata

MA...L'OCCHIO INGANNA



Come vi sembra questa traccia?

- [x] Isolata
- [ ] Non Isolata

InDetTrack index: 45
PT = 1,553 GeV
η = 0,604
Φ = 6,877°
Px = 1,542 GeV
Py = 0,186 GeV
Pz = 0,997 GeV
Charge = 1
Isolation = 0,00

Due tracce possono sembrare molto vicine (e quindi non isolate) se viste in una particolare proiezione, ma in realtà...
Controllate sempre la variabile ISOLATION per valutare l'isolamento di una traccia

RIASSUMIAMO

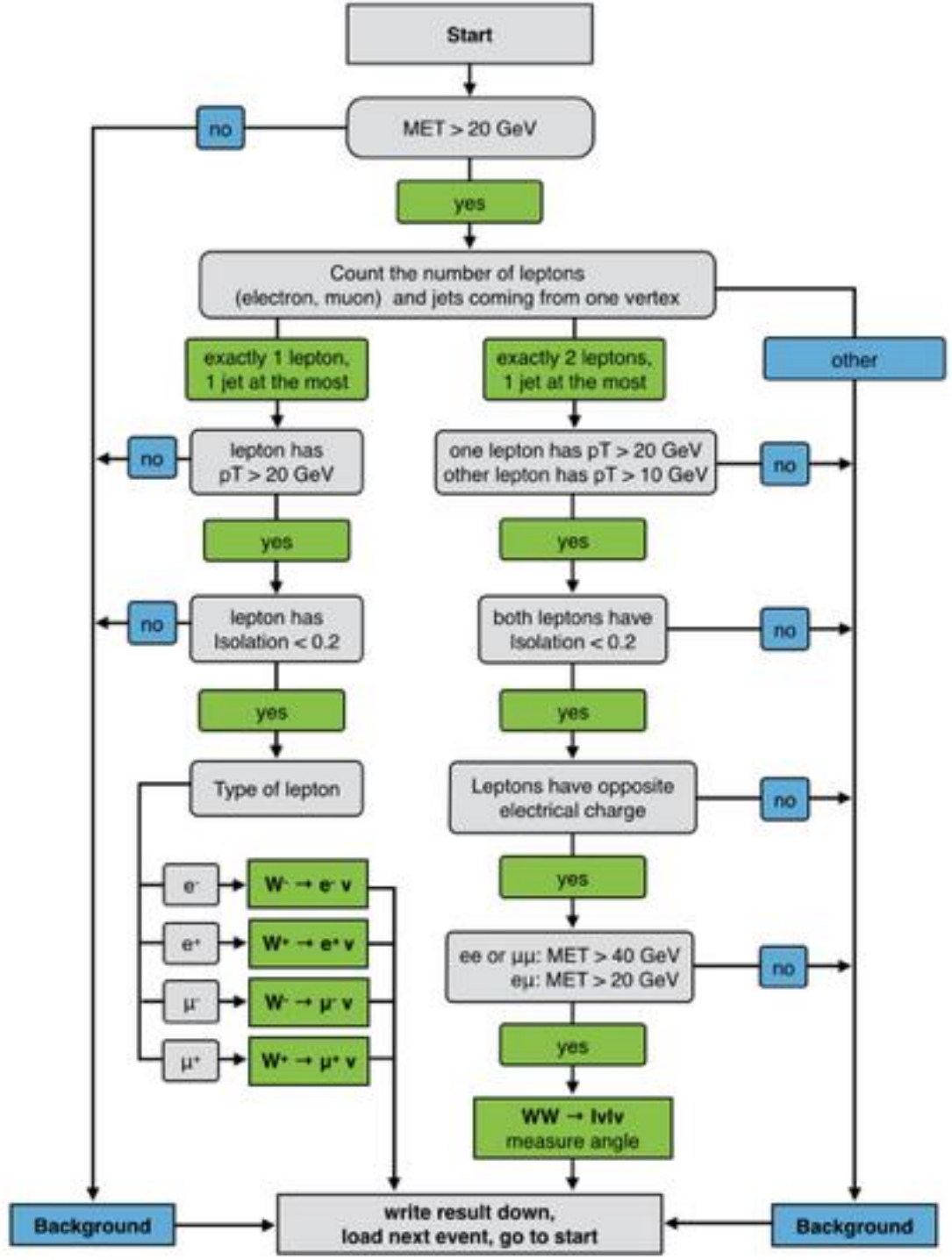
- 1 bosone W -> un leptone carico e MET 20 GeV
- 2 bosoni W -> due leptoni di carica opposta provenienti dallo stesso vertice + MET > 20 (o 40) GeV
- I leptoni devono avere un alto impulso trasverso (p_T)
- I leptoni devono essere isolati (isolation < 0.2)

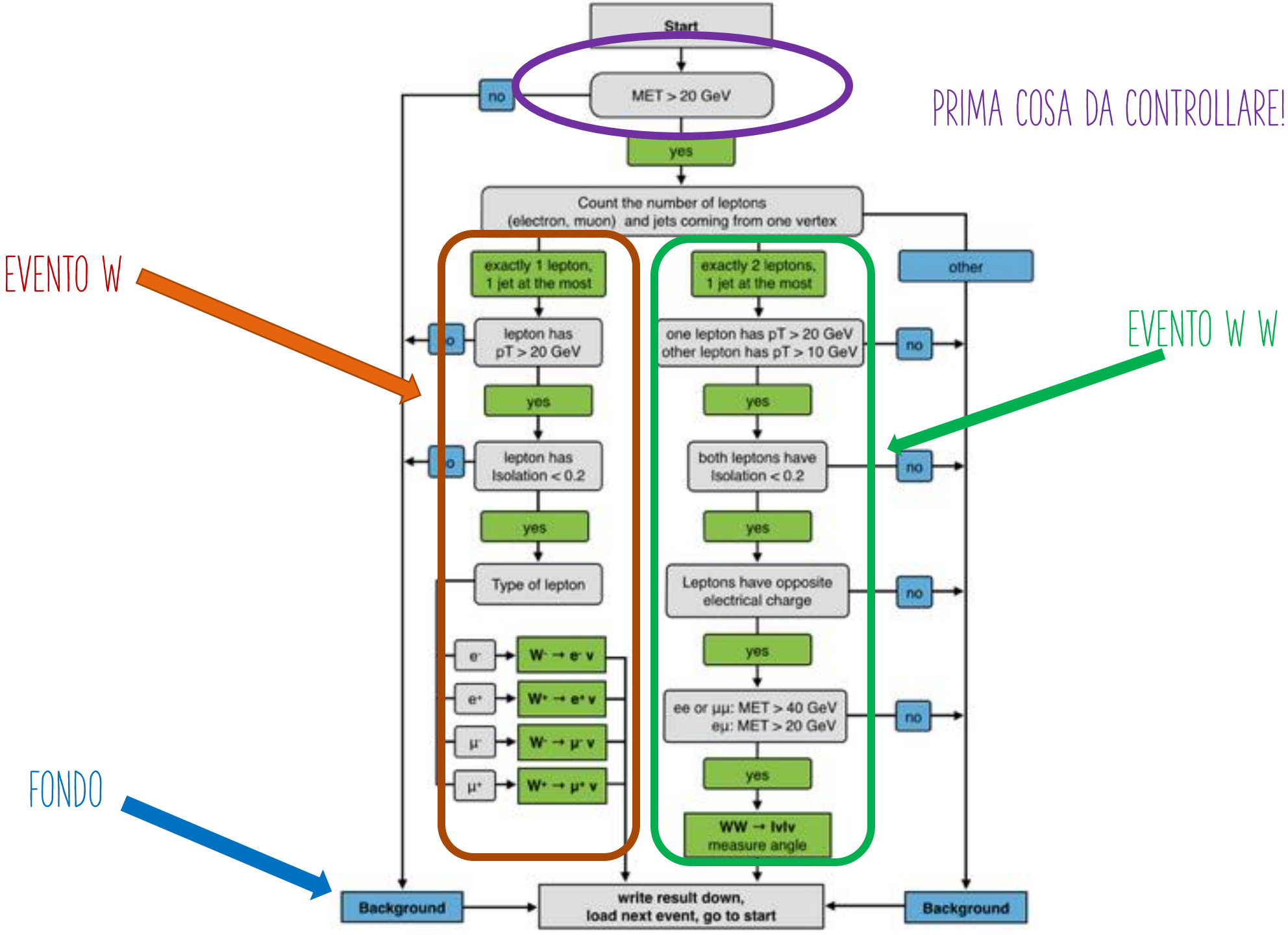
IDENTIFICAZIONE DEGLI EVENTI

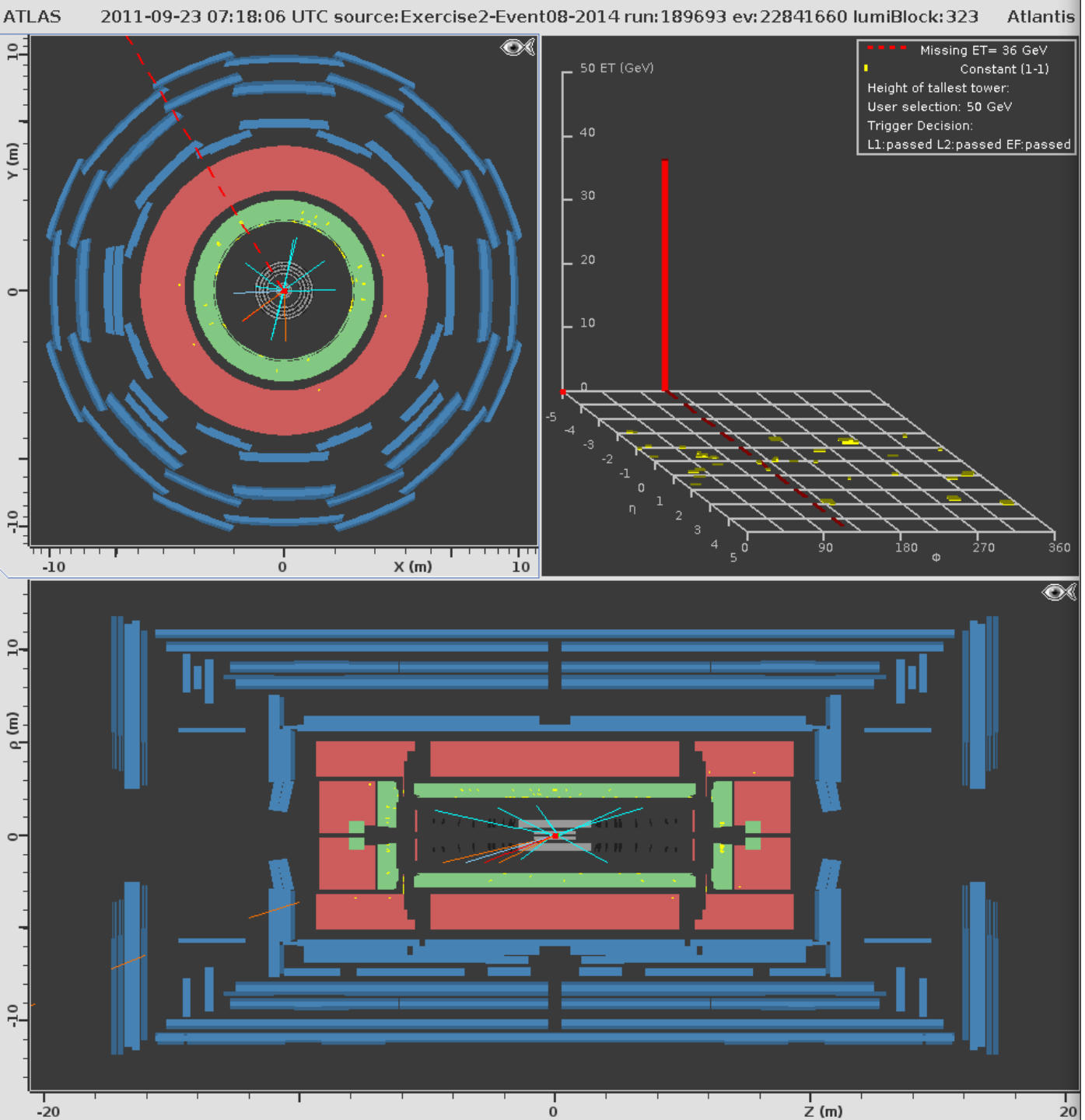
- Abbiamo 10 eventi da visualizzare ed identificare con il programma Minverva
- Utilizzate tutte le informazioni che ci vengono fornite e tutte le viste del rivelatore ATLAS

1. Aprite Minerva
2. ATLANTIS GUI (schermata di destra)
3. File-> Read Event Locally-> exercise2-2014.zip

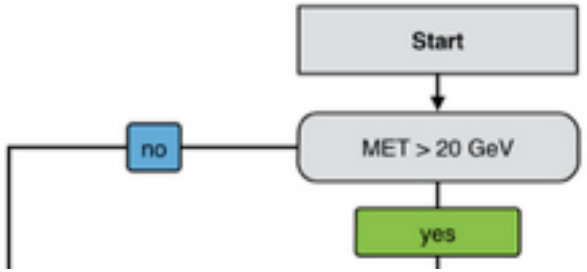
Evento	$W^+ \to e^+ \nu_e$	$W^- \to e^- \bar{\nu}_e$	$W^+ \to \mu^+ \nu_\mu$	$W^- \to \mu^- \bar{\nu}_\mu$	$WW^- \to l^- \bar{\nu} l^+ \nu_l$	Fondo	
01							Check
02							Check
03							Check
04							Check
05							Check
06							Check
07							Check
08							Check
09							Check
10							Check

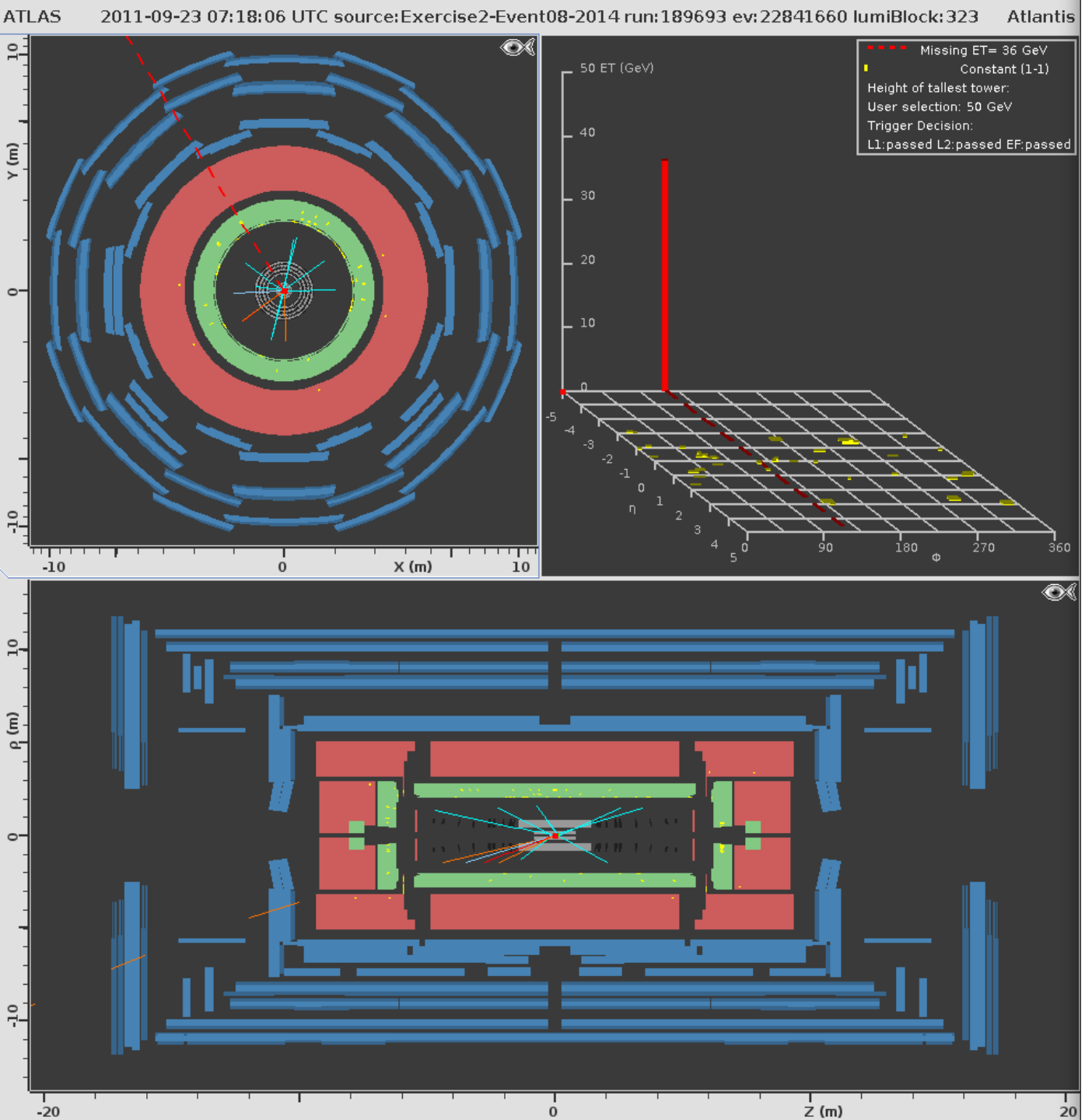

Start
MET > 20 GeV
no
yes
Count the number of leptons (electron, muon) and jets coming from one vertex
exactly 1 lepton, 1 jet at the most
exactly 2 leptons, 1 jet at the most
other
lepton has pT > 20 GeV
no
yes
one lepton has pT > 20 GeV other lepton has pT > 10 GeV
no
yes
lepton has Isolation < 0.2
no
yes
both leptons have Isolation < 0.2
no
yes
Type of lepton
Leptons have opposite electrical charge
no
yes
e⁻
e⁺
μ⁻
μ⁺
W⁻ → e⁻ ν
W⁺ → e⁺ ν
W⁻ → μ⁻ ν
W⁺ → μ⁺ ν
ee or μμ: MET > 40 GeV
eμ: MET > 20 GeV
no
yes
WW → lνlν
measure angle
Background
write result down, load next event, go to start
Background


Start
MET > 20 GeV
no
yes
Count the number of leptons (electron, muon) and jets coming from one vertex
exactly 1 lepton, 1 jet at the most
lepton has pT > 20 GeV
yes
lepton has Isolation < 0.2
yes
Type of lepton
e⁻
e⁺
μ⁻
μ⁺
W⁻ → e⁻ ν
W⁺ → e⁺ ν
W⁻ → μ⁻ ν
W⁺ → μ⁺ ν
exactly 2 leptons, 1 jet at the most
one lepton has pT > 20 GeV other lepton has pT > 10 GeV
yes
both leptons have Isolation < 0.2
yes
Leptons have opposite electrical charge
yes
ee or μμ: MET > 40 GeV eμ: MET > 20 GeV
yes
WW → lνlν measure angle
other
no
Background
write result down, load next event, go to start
Background
PRIMA COSA DA CONTROLLARE!
EVENTO W
EVENTO W W
FONDO



Missing ET = 36 GeV





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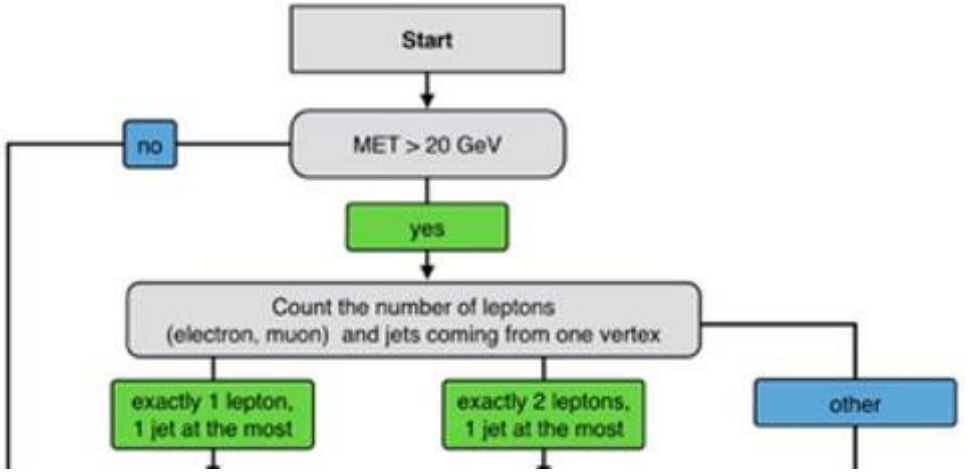
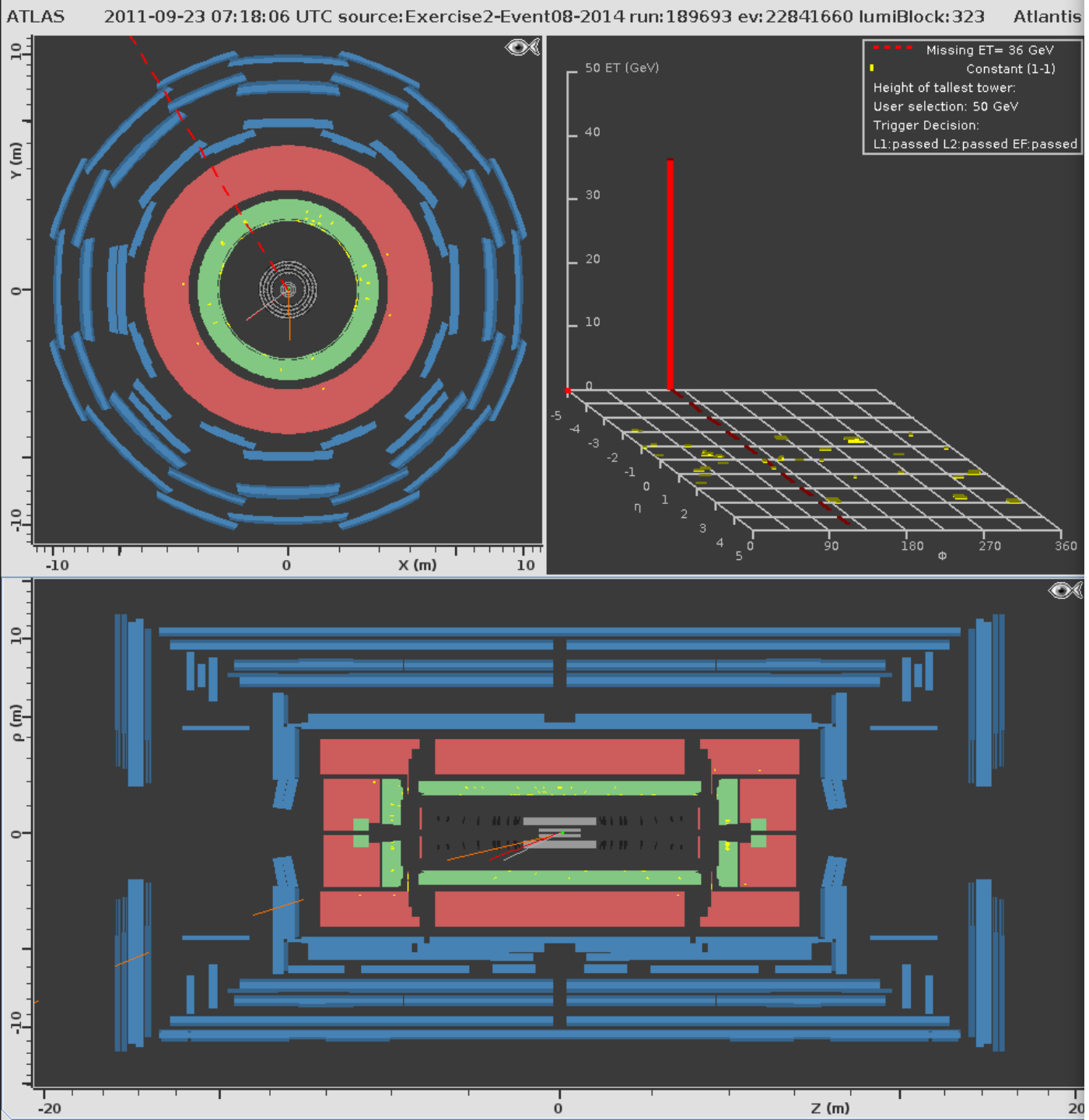


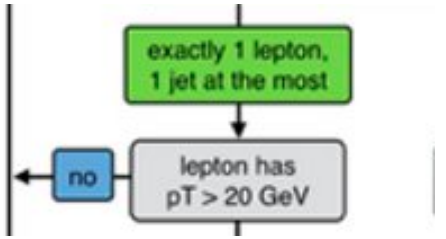
1 SOLO LEPTONE



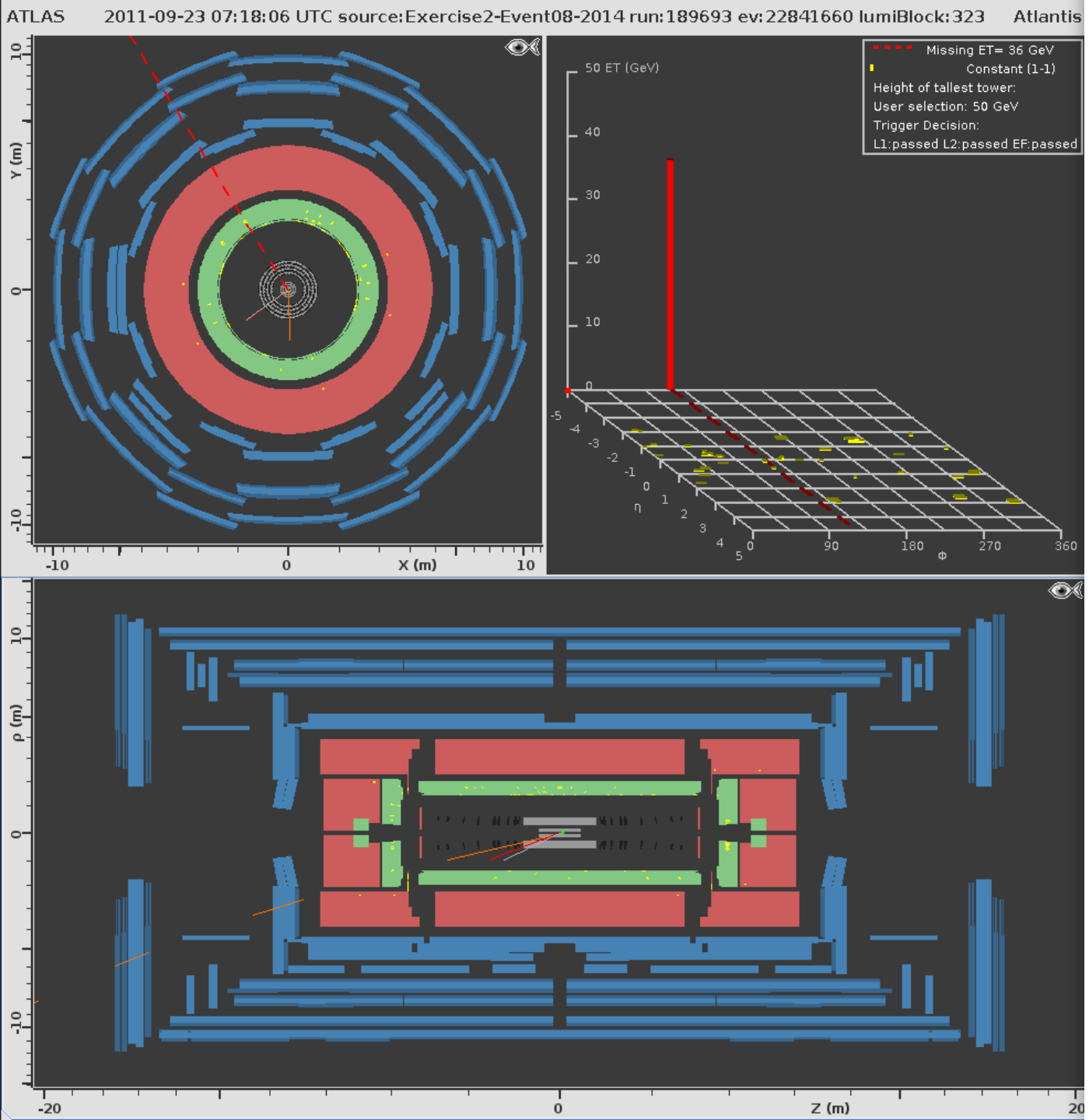
Missing ET = 36 GeV

1 LEPTONE

PT > 9 GeV



InDetTrack index: 1
PT = 29.672 GeV
η = -1.687
Φ = 272.910°
Px = 1.507 GeV
Py = -29.634 GeV
Pz = -77.409 GeV
Charge = 1
Isolation = 0.00

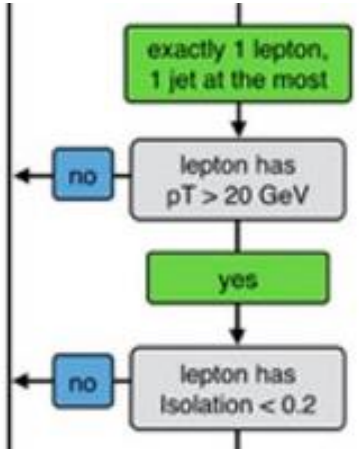


Missing ET = 36 GeV

1 LEPTONE

PT > 20 GeV

Isolation < 0.2



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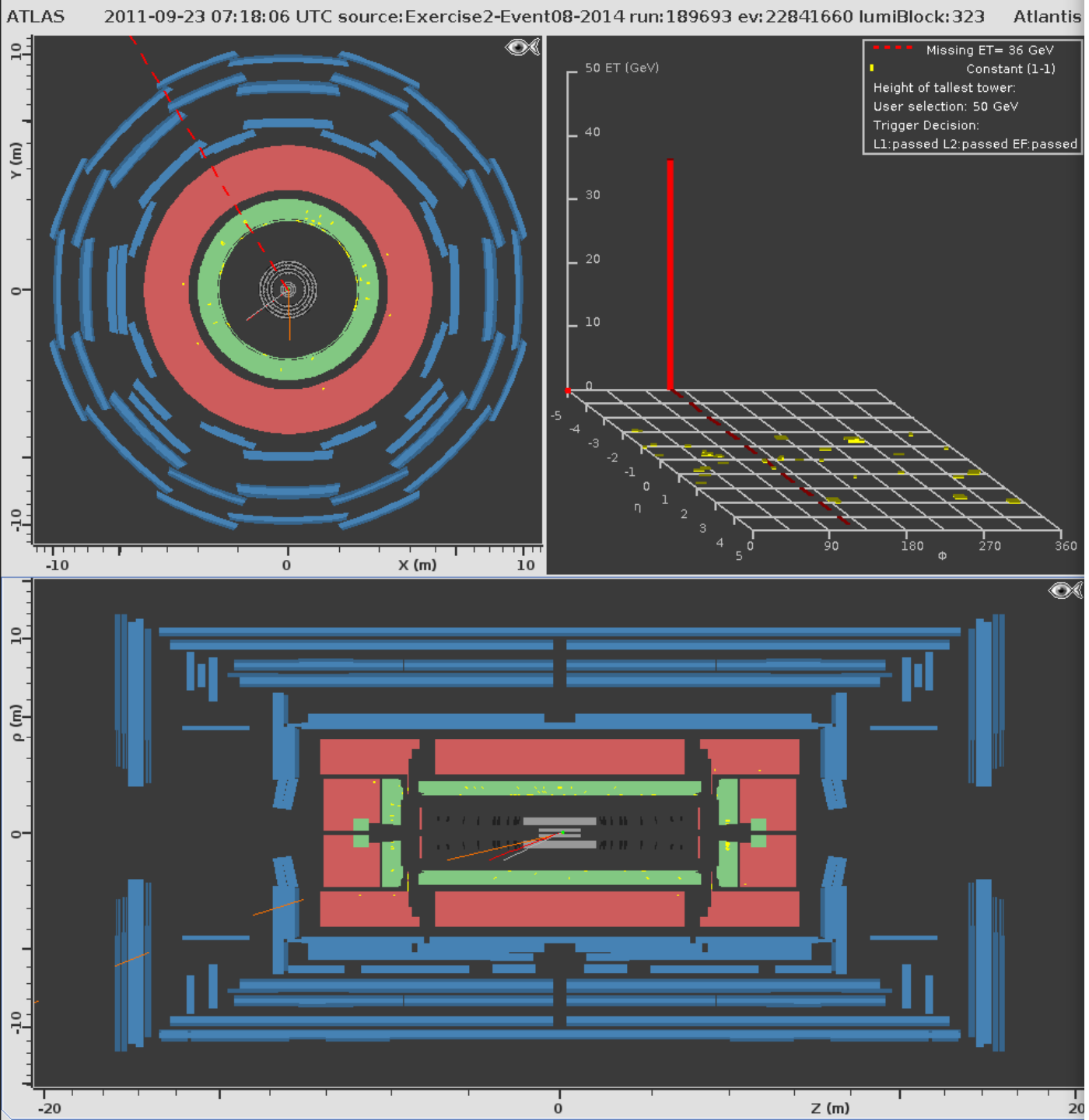

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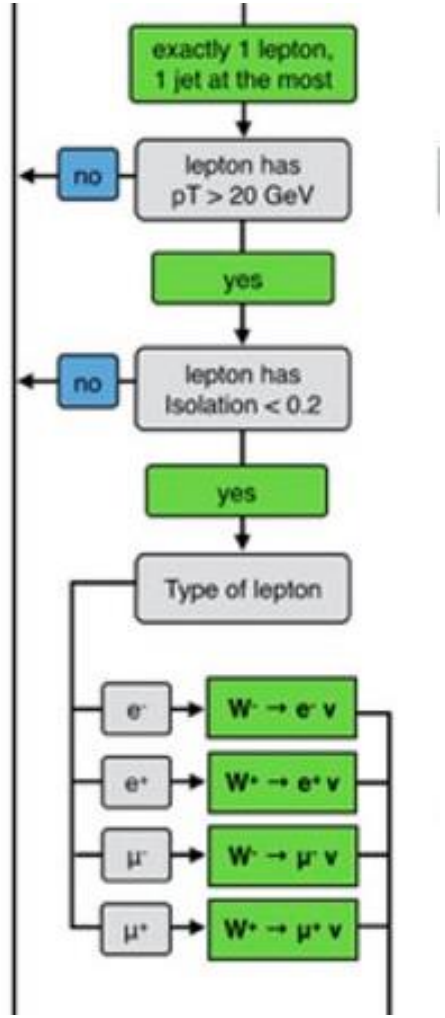
PT > 20 GeV

Isolation < 0.2



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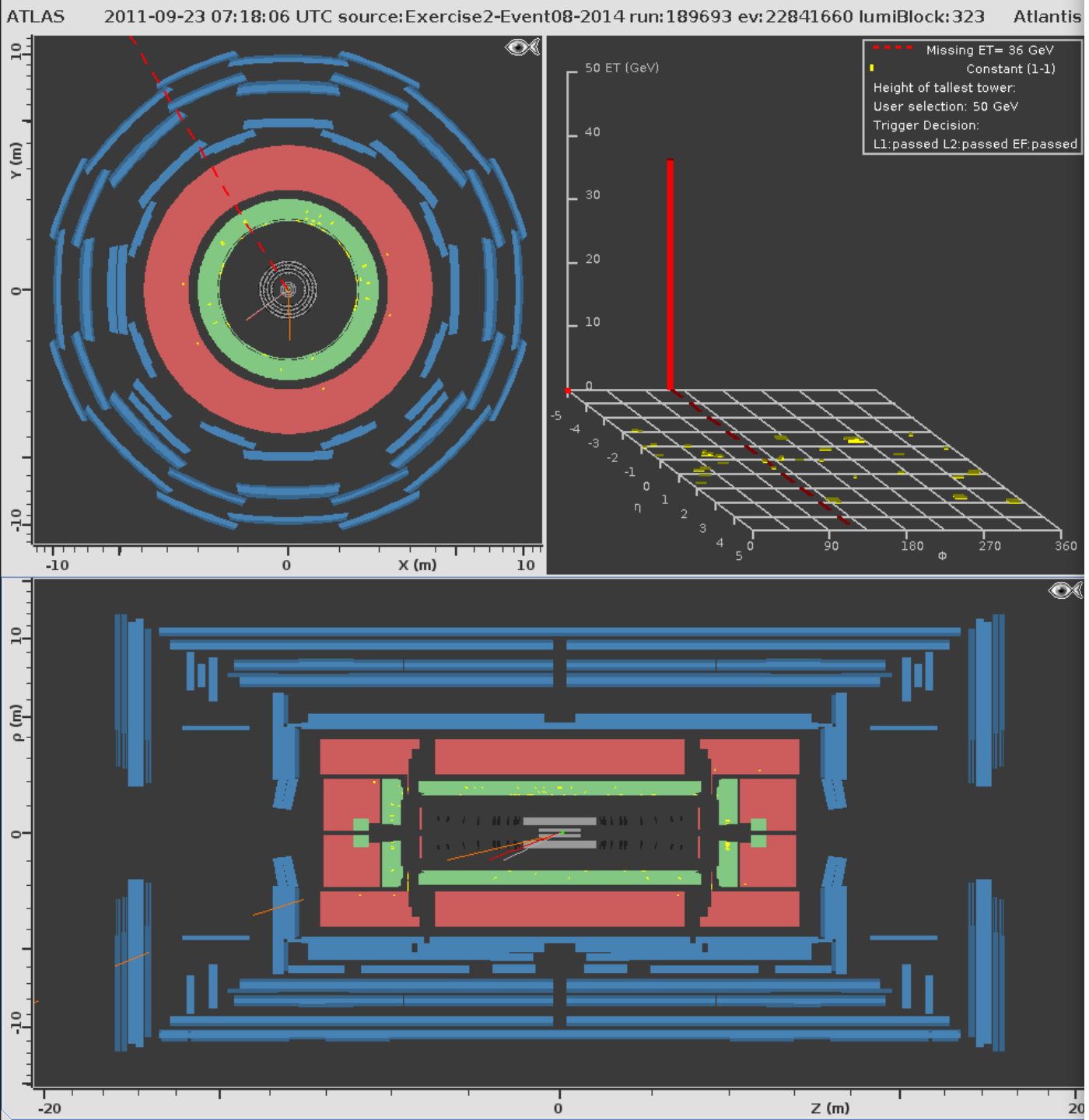

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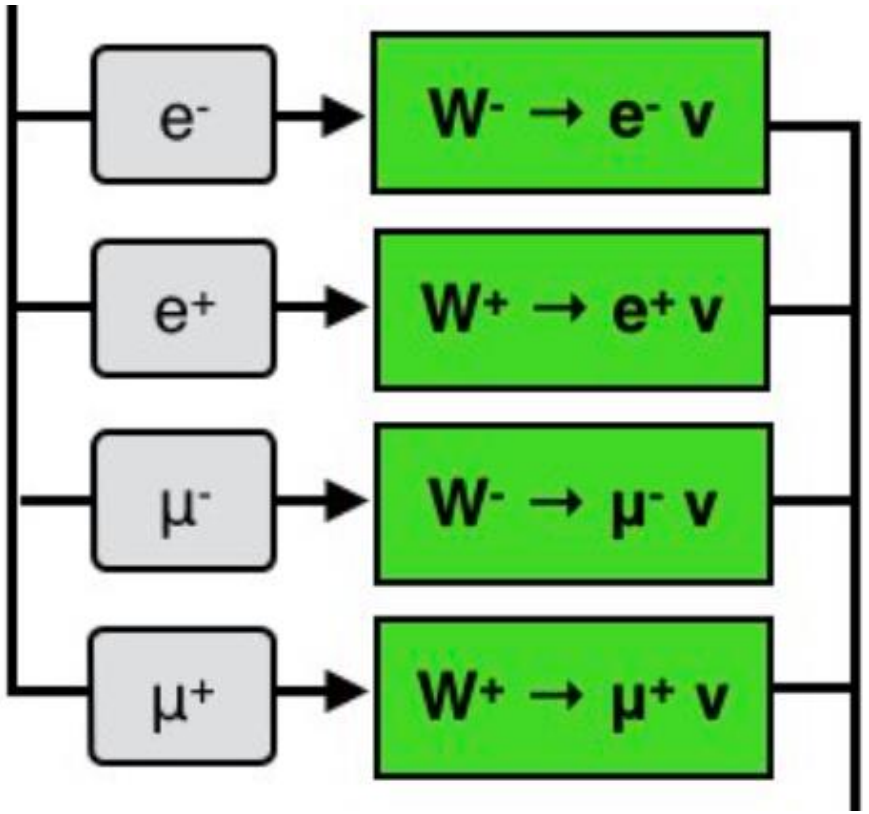
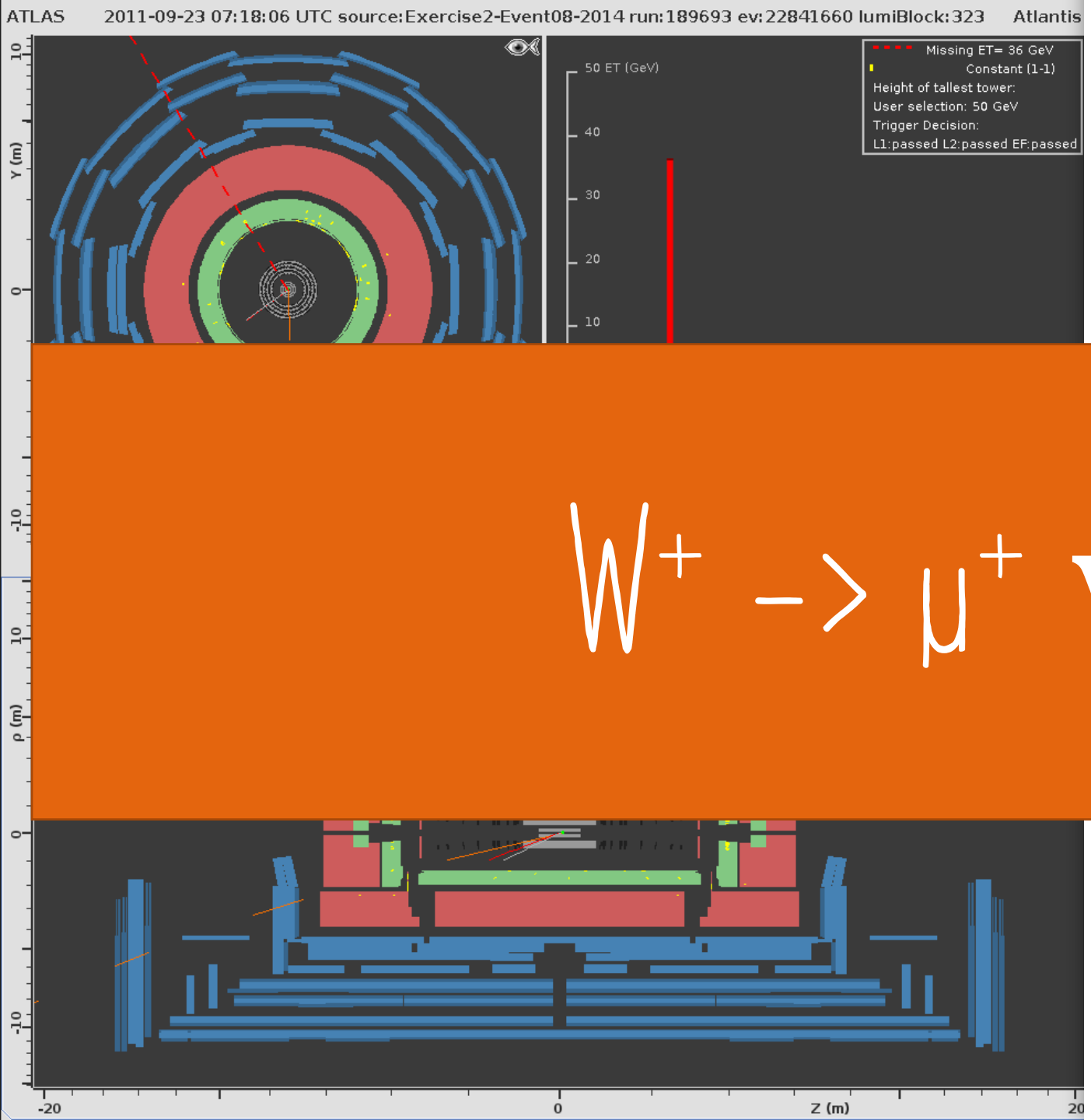
PT > 20 GeV

Isolation < 0.2

Charge = 1





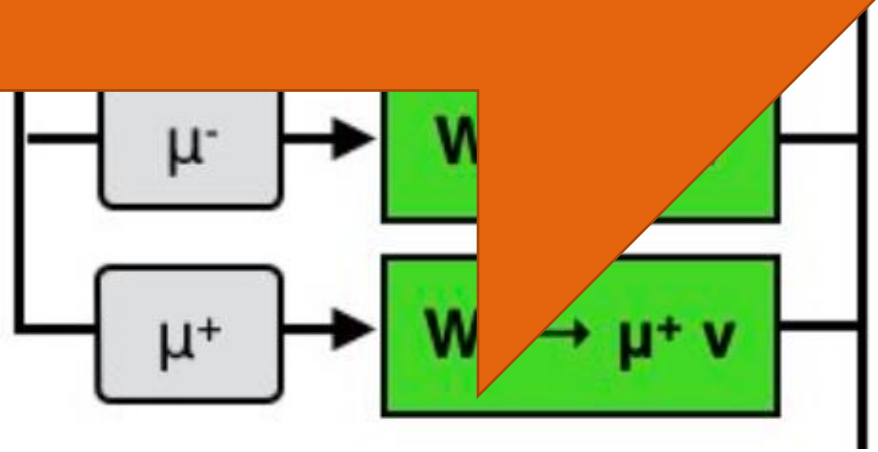
Missing ET = 36 GeV

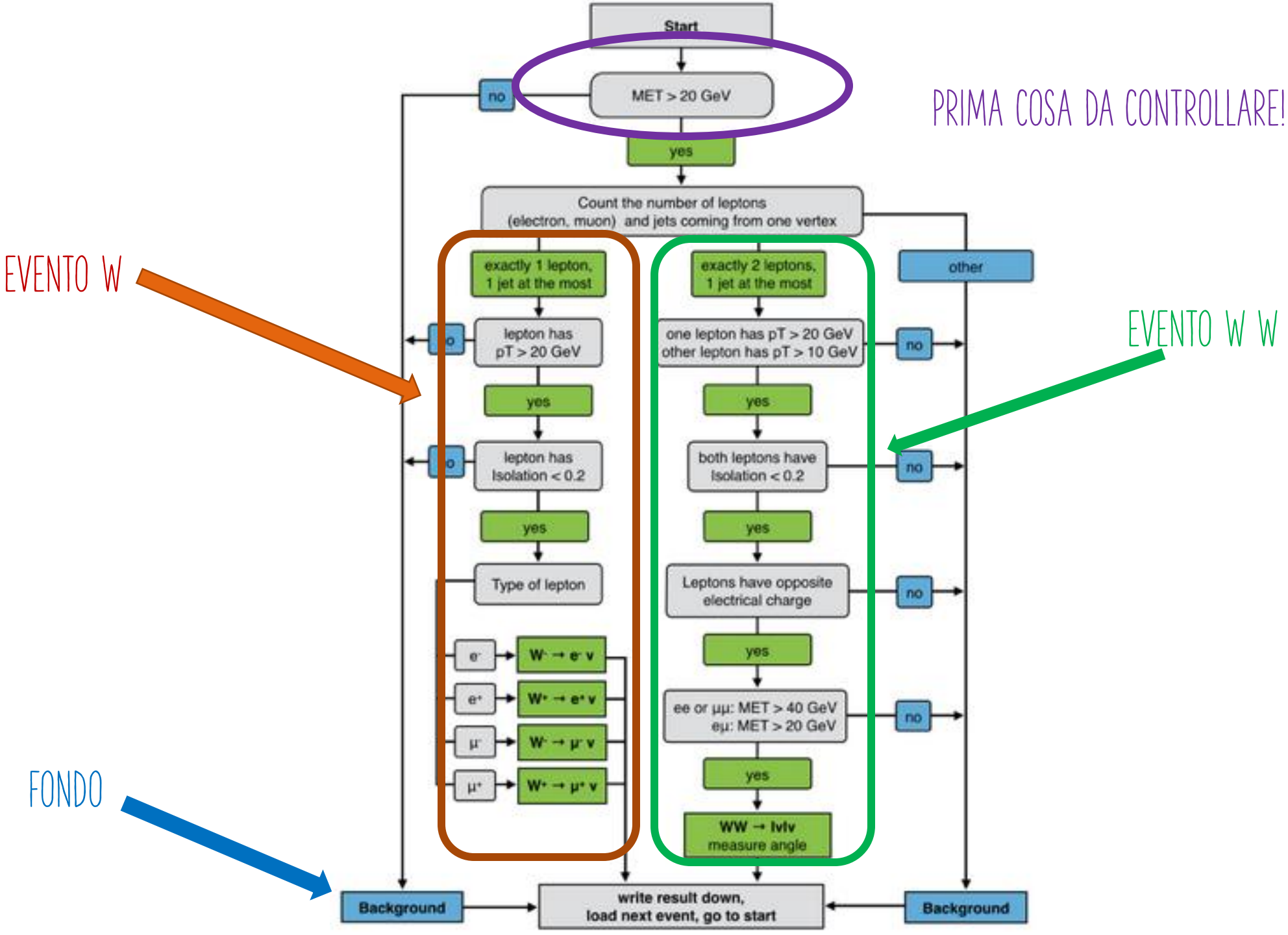
1 LEPTONE

PT > 20 GeV

Isolation < 0.2

$W^+ \rightarrow \mu^+ \nu_\mu$




Start
MET > 20 GeV
no
yes
Count the number of leptons (electron, muon) and jets coming from one vertex
exactly 1 lepton, 1 jet at the most
lepton has pT > 20 GeV
yes
lepton has Isolation < 0.2
yes
Type of lepton
e⁻
e⁺
μ⁻
μ⁺
W⁻ → e⁻ ν
W⁺ → e⁺ ν
W⁻ → μ⁻ ν
W⁺ → μ⁺ ν
exactly 2 leptons, 1 jet at the most
one lepton has pT > 20 GeV other lepton has pT > 10 GeV
yes
both leptons have Isolation < 0.2
yes
Leptons have opposite electrical charge
yes
ee or μμ: MET > 40 GeV eμ: MET > 20 GeV
yes
WW → lνlν measure angle
other
no
Background
write result down, load next event, go to start
Background
PRIMA COSA DA CONTROLLARE!
EVENTO W
EVENTO W W
FONDO

EVENTI CON 2 BOSONI W

- Il campione che analizzerete contiene eventi con 1 bosone W o con una coppia W^+W^-
- Misurate l'angolo fra i 2 leptoni (che vengono dai 2 W) nel piano trasverso
- Ricordate che i due leptoni devono avere carica opposta!

!!!IMPORTANTE!!!

Se avete identificato 2 leptoni in un evento WW potete calcolare l'angolo tra essi tenendo premuto il tasto "p" e cliccando sulle due tracce individuate

RIPORTATE L'ANGOLO TRA I LEPTONI SUL FOGLIO CHE AVETE A DISPOSIZIONE

E ORA TOCCA A VOI!

- Aprite MINERVA
- ATLANTIS GUI (schermata di destra)
- File -> Read Event Locally -> X.zip

IN BOCCA AL LUPO E BUON DIVERTIMENTO!