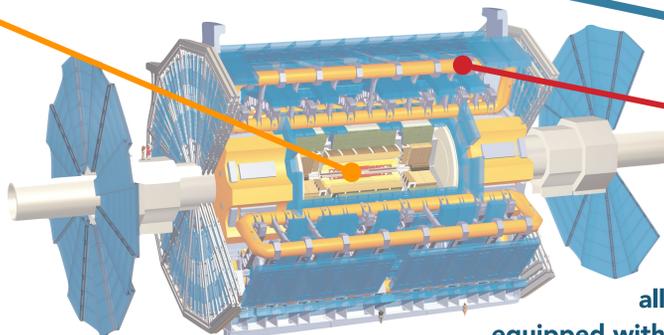


Inner Detector (ID)

The Inner Detector reconstructs the tracks associated to charged particles by combining high-resolution detectors at inner radii (Pixel detector and SemiConductor Tracker) with continuous tracking at outer radii (Transition Radiation Tracker). It is all contained in a solenoidal magnetic field of 2 T and its acceptance in pseudorapidity is $|\eta| < 2.5$.



Muon Spectrometer (MS)

The Muon Spectrometer is designed for muon detection within $|\eta| < 2.7$. Three large air core toroidal magnets with a mean magnetic field of 0.5 T allow for a precise measurement of muon momenta up to the TeV range. It is equipped with precision chambers (Monitored Drift Tubes and Cathode Strip Chambers) as well as trigger chambers (Resistive Plate Chambers and Thin Gap Chambers).

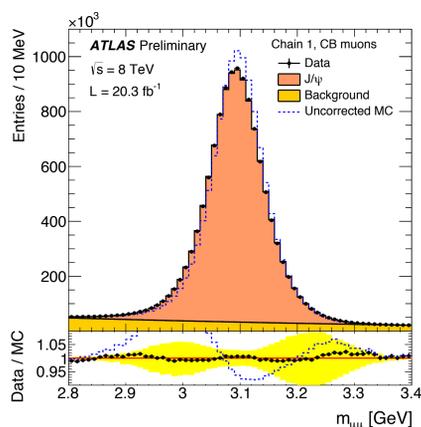
Corrections to the simulated muon momentum

The ATLAS simulation includes the best knowledge of the detector geometry, material budget and modelling of muon interactions at the time of its production and needs additional corrections in order to reproduce the muon momentum scale and resolution observed in data. We correct separately the ID and MS tracks of a single muon using this equation:

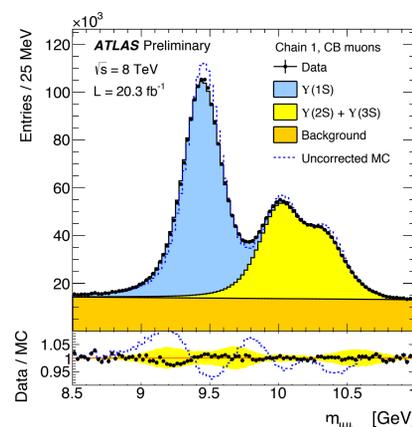
$$\left(\mathbf{p}_T^{\text{MC, det}}\right)' = \frac{\mathbf{p}_T^{\text{MC, det}} + \sum_{n=0}^{\infty} s_n^{\text{det}}(\eta, \phi) \cdot \left(\mathbf{p}_T^{\text{MC, det}}\right)^n}{1 + \sum_{m=0}^{\infty} \Delta r_m^{\text{det}}(\eta, \phi) \cdot \left(\mathbf{p}_T^{\text{MC, det}}\right)^{m-1}}$$

where det can be either ID or MS and $s_n, \Delta r_m$ are the correction parameters. These parameters are derived with a MC template maximum likelihood fit, with about 6M muon pairs from J/ψ and 9M muon pairs from Z decays.

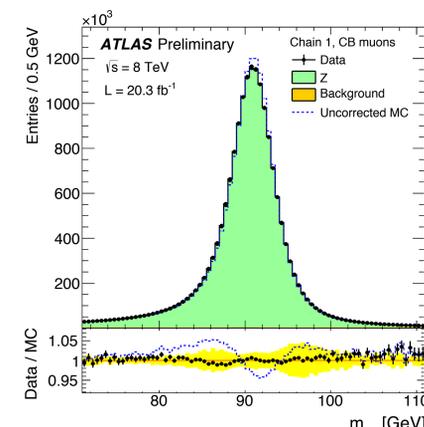
Region	Δr_1^{ID}	$\Delta r_2^{ID} [\text{TeV}^{-1}]$	s_1^{ID}
$ \eta < 1.05$	$0.0068^{+0.0010}$	$0.146^{+0.039}$	$-0.92^{+0.26}_{-0.22} \times 10^{-3}$
$1.05 \leq \eta < 2.0$	$0.0105^{+0.0018}$	$0.302^{+0.046}$	$-0.86^{+0.30}_{-0.35} \times 10^{-3}$
$ \eta \geq 2.0$	$0.0069^{+0.0121}$	$0.088^{+0.084}$	$-0.49^{+1.17}_{-1.63} \times 10^{-3}$



$m_{\mu\mu} (J/\psi)$



$m_{\mu\mu} (Y)^*$



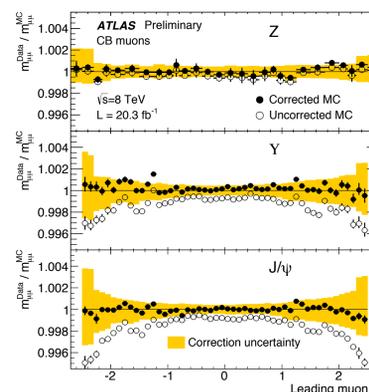
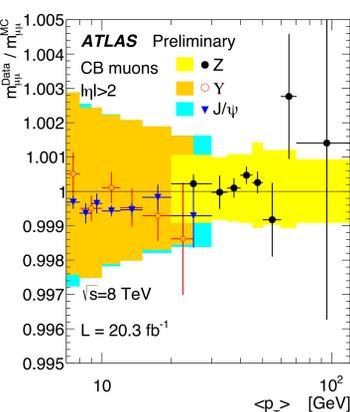
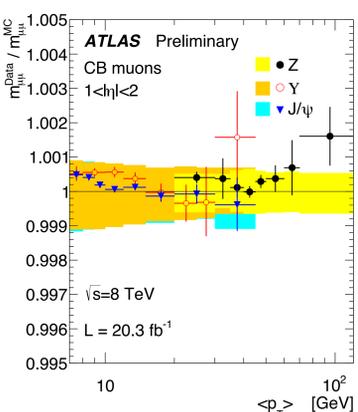
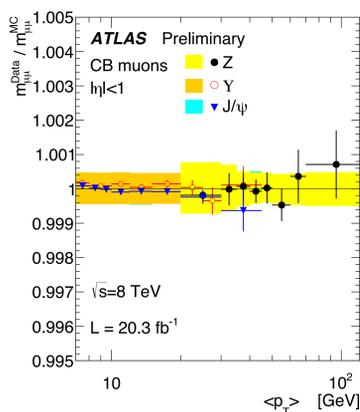
$m_{\mu\mu} (Z)$

* (only used for validating the corrections)

Region	$\Delta r_0^{MS} [\text{GeV}]$	Δr_1^{MS}	$\Delta r_2^{MS} [\text{TeV}^{-1}]$	$s_0^{MS} [\text{GeV}]$	s_1^{MS}
$ \eta < 1.05$ (small)	$0.115^{+0.083}$	$0.0030^{+0.0079}$	$0^{+0.212}$	$-0.035^{+0.017}_{-0.011}$	$+3.57^{+0.38}_{-0.60} \times 10^{-3}$
$ \eta < 1.05$ (large)	$0.101^{+0.090}$	$0.0034^{+0.0081}$	$0^{+0.111}$	$-0.022^{+0.007}_{-0.014}$	$-0.22^{+0.37}_{-0.24} \times 10^{-3}$
$1.05 \leq \eta < 2.0$ (small)	$0^{+0.080}$	$0.0171^{+0.0059}$	$0^{+0.206}$	$-0.032^{+0.017}_{-0.016}$	$-1.07^{+0.77}_{-0.93} \times 10^{-3}$
$1.05 \leq \eta < 2.0$ (large)	$0^{+0.080}$	$0.0190^{+0.0047}$	$0^{+0.173}$	$-0.026^{+0.009}_{-0.017}$	$-1.46^{+0.45}_{-0.57} \times 10^{-3}$
$ \eta \geq 2.0$ (small)	$0^{+0.080}$	$0.0022^{+0.0075}$	$0^{+0.061}$	$-0.031^{+0.029}_{-0.031}$	$-0.91^{+1.63}_{-1.22} \times 10^{-3}$
$ \eta \geq 2.0$ (large)	$0^{+0.080}$	$0.0171^{+0.0052}$	$0^{+0.291}$	$-0.057^{+0.019}_{-0.021}$	$+0.40^{+1.91}_{-0.50} \times 10^{-3}$

Corrections are derived separately for different detector regions with uniform scale and resolution and the parameters take into account different physical effects:

- s_0 \blacktriangleright energy loss in the calorimeters and in other materials ($s_0^{ID}=0$ since energy loss between IP and ID is negligible)
- s_1 \blacktriangleright magnetic field integral and radial distortions of the detector
- Δr_0 \blacktriangleright energy loss fluctuations in the material (again $\Delta r_0^{ID}=0$ since energy loss negligible)
- Δr_1 \blacktriangleright multiple scattering, local radial distortions and local distortion of magnetic field
- Δr_2 \blacktriangleright intrinsic resolution and additional misalignments



Mass scale measurement

The momentum scale is derived by comparing the position of the mass peak in data and in the simulation. This is shown here as a function of the average p_T (for different detector regions) or as a function of the leading muon η .

Dimuon resolution measurement

The mass resolution has been measured on the collected J/ψ , Y and Z samples using a functional fit of the invariant mass peaks. Results are shown for $\sigma(m_{\mu\mu})/m_{\mu\mu}$ as a function of the average p_T of the muon pair in different detector regions, for all resonances.

