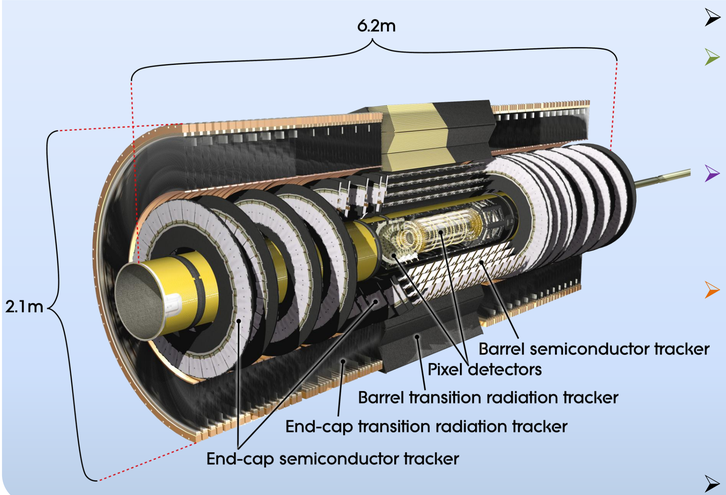
Reconstruction of known particle decays in proton-proton collisions at energies of 900 GeV and 7 TeV with the ATLAS Inner Detector

ICHEP2010 – 35th International Conference on High Energy Physics
July 22-28 2010 Paris, France

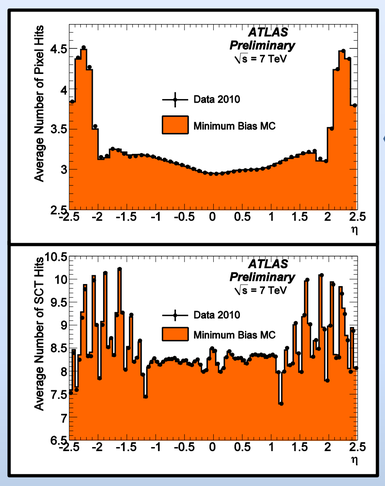
Roberto Di Nardo on behalf of ATLAS collaboration

University of Roma Tor Vergata & INFN

The ATLAS Inner Detector

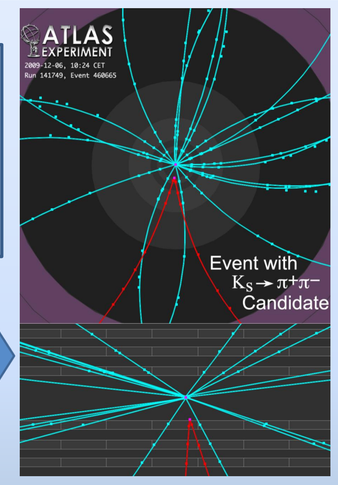


- Covers $|\eta|<2.5$ with 3 subdetectors
- Pixel detector (silicon pixel)
  - 1744 modules, ~80 M channels
  - Resolutions: ~10 μm (rφ) – ~115 μm (rz)
- SCT detector (silicon strip)
  - 4088 modules, ~6.3 M channels
  - Resolutions ~ 17 μm (rφ) – ~580 μm (rz)
- TRT detector (straw drift tubes, $|\eta|<2$)
  - 73(160) straw planes in barrel(endcap)
  - ~0.4 M channels
  - Intrinsic tube resolution ~130 μm (rφ)
  - $e^{+/-}$PID by detection of transition radiation γ
- Data collected with a Minimum Bias Trigger



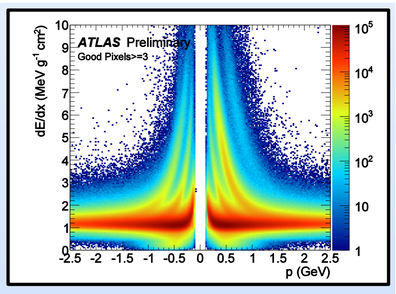
- Number of silicon hits as a function of pseudorapidity in data and simulation at $\sqrt{s}$=7 TeV for Pixel (top) and SCT (bottom).
- All details (including missing modules) are included.
- Excellent agreement between Data and MC

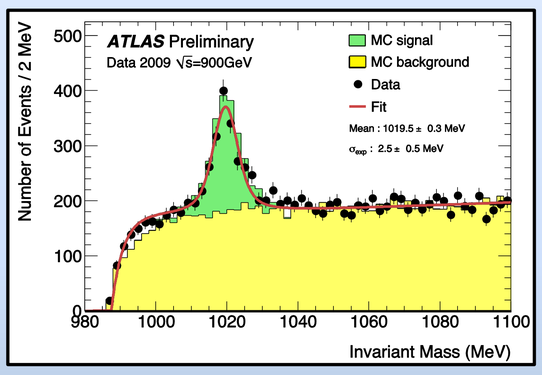
- Event display of a K_s decaying in two pions in 900 GeV centre-of-mass energy collision data



$\Phi \to K^+K^-$ at 900GeV

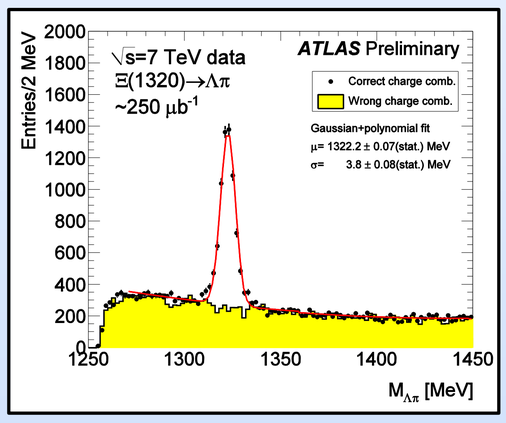
- Used Time-over-threshold measurements from the Pixel detector
  - kaon identification through dE/dx up to momenta ~800MeV

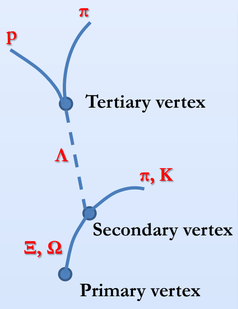


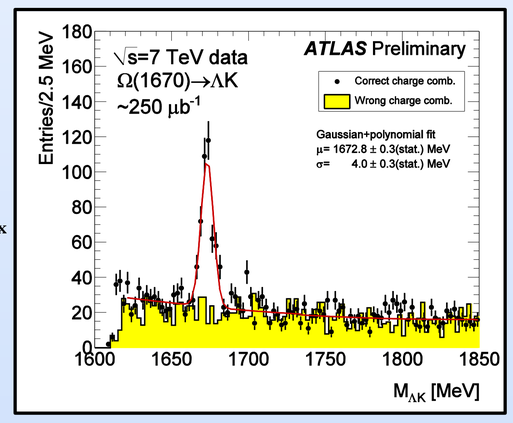


- Reconstruction:
  - 2 opposite charged tracks from primary vertex
  - at least 2 Pixel hits and 2 SCT hits on track
  - 100 MeV < p_T < 800 MeV
  - M_{PDG}=1019.46 MeV M_{Fit}=1019.5 MeV

$\Xi \to \Lambda(p\pi)\pi$ and $\Omega \to \Lambda(p\pi)K$







- Reconstruction:
  - Ξ flight distance > 4mm
  - Secondary vertex χ^2 <7
  - Cuts on bachelor π track :
    - p_T> 150 and transverse IP>0.5 mm
  - at least 2 Pixel hits and 2 SCT hits on track

M_{PDG}=1321.7 MeV M_{Fit}=1322.2 MeV

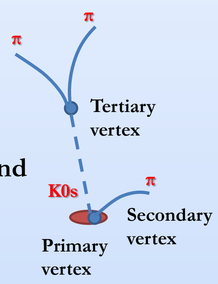
- Pre-selection: $|M_{p\pi}-M_{\Lambda}|$<8 MeV

- Reconstruction:
  - Ω flight distance > 6mm
  - Secondary vertex χ^2 <7 , $p_T(\Omega)$>1.5 GeV
  - Cuts on bachelor K track :
    - p_T> 400 and transverse IP>1 mm
  - $|M_{\Lambda\pi}-M_{\Xi}|$>8 MeV to reject Ξ reflections

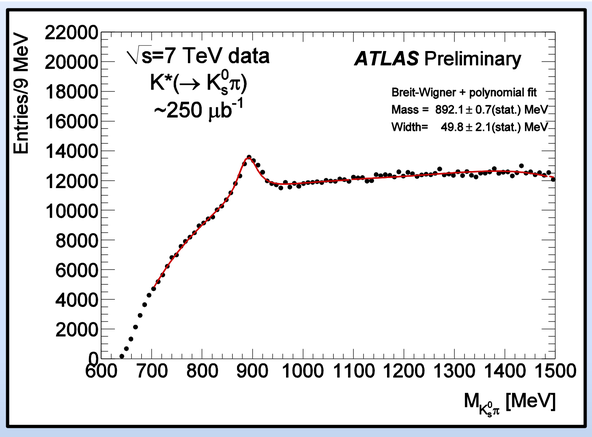
M_{PDG}=1672.4 M_{Fit}=1672.8

$K^*(892) \to K^0_s \pi$

- K* decays hadronically
  - lifetime cannot be directly measured
  - SV on top of PV
  - Large combinatorial background



- Preselection: $|M_{\pi\pi}-M_K|$<25 MeV
- Reconstruction:
  - K* flight distance < 0.8 mm
  - χ^2 of KS vertex < 4
  - p_T K* > 1 GeV



M_{PDG}=891.66 MeV M_{Fit}=1672.8 MeV Γ_{PDG}= 50.8 MeV Γ_{Fit}= 49.8 MeV

$K^0_s, \Lambda\ \bar{\Lambda}$ at $\sqrt{s}$ = 7TeV

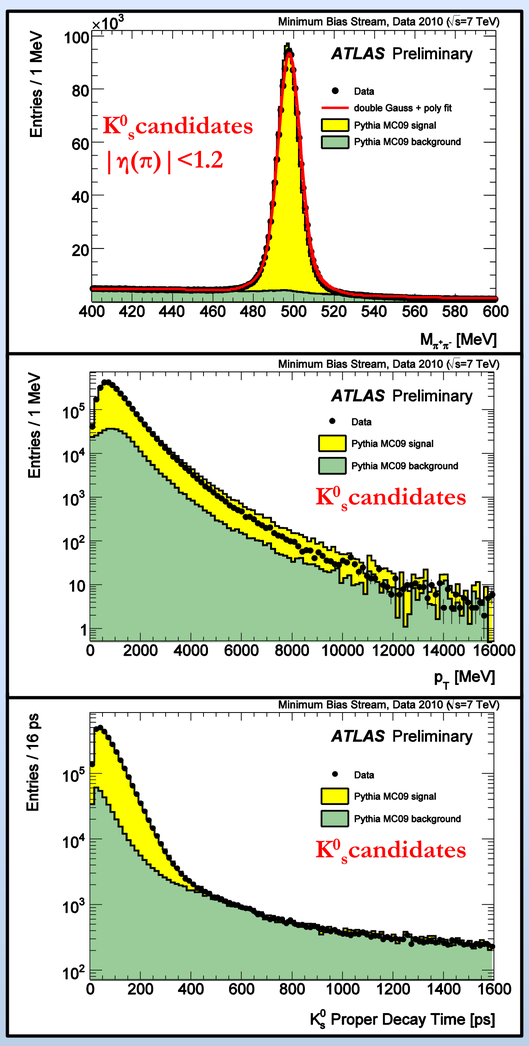
- Used ~190 μb^{-1} of 7 TeV minimum-bias collision data and compared with non-diffractive minimum bias simulation (Pythia ATLAS MC09 tune)
- MC signal and background adjusted separately to match signal/background ratio in data
- Pre-selection: tracks with opposite charge, p_T>100MeV , at least 2 silicon hit (Pixel +SCT)

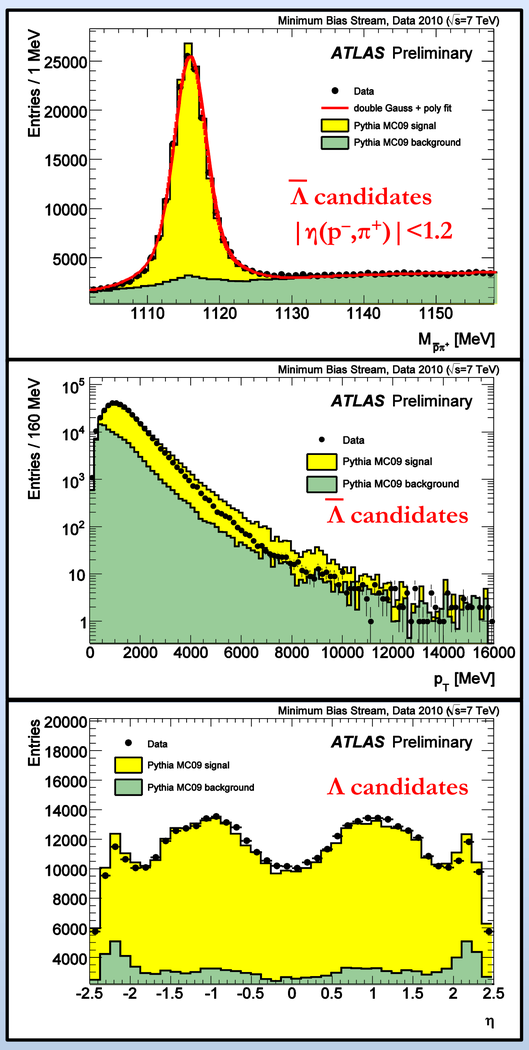
$K^0_s \to \pi^+\pi^-$

- Reconstruction:
  - transverse flight distance > 4mm
  - angle between flight and momentum direction cos (θ_K) > 0.999
- Kinematic distributions for $|M(K_s)-M(K_{PDG})|$<20 MeV

$\Lambda \to p^+\pi^-$ and $\bar{\Lambda} \to p^-\pi^+$

- Reconstruction:
  - flight distance > 30mm
  - angle between flight and momentum direction cos (θ_Λ) > 0.9998
- Kinematic distributions for $|M(\Lambda)-M(\Lambda_{PDG})|$<7 MeV





$D^* \to D^0(K\pi)\pi$, $D^+ \to K\pi\pi$ and $D_s \to \Phi(KK)\pi$

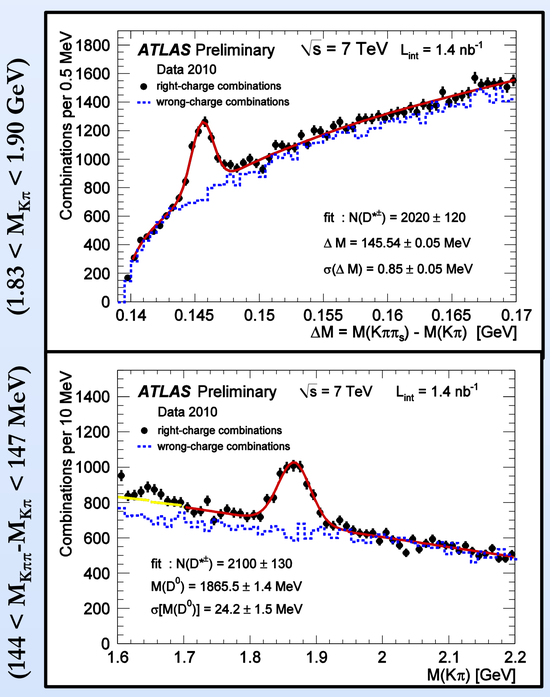
- Pre-selection cuts for $D^{*\pm}$, $D^{\pm}$ and $D^{\pm}_s$
  - at least 1 Pixel hit and at least 4 SCT hits
  - $p_T(D^{(*)})$ >3.5 GeV $|\eta(D^{(*)})|$< 2.1
  - p_T ($D^{*\pm}$,$D^{\pm}$)/E_T > 0.02, p_T ($D^{\pm}_s$)/E_T > 0.04

$D^{*\pm} \to D^0(K^{\mp}\pi^{\pm})\pi^{\pm}$

- Reconstruction:
  - two track with p_T >1.0 GeV to reconstruct D^0
  - D^0 vertex χ^2 <5, l_{xy}>0
  - D^0 transverse IP < 0.2mm, longitudinal IP < 0.5 mm
  - Additional track added with opposite charge wrt K
    - p_T>0.25GeV, transverse IP < 0.8 mm, longitudinal IP < 1.5 mm
- $\Delta M(M_{K\pi\pi} - M_{K\pi})$ used as discriminating variables

~2000 $D^{*\pm}$ candidates in the Δm peak

$M_{PDG}(D^0)$ = 1864.84 MeV M_{Fit} (D^0) = 1865.5 MeV



$D^{\pm} \to K^{\mp}\pi^{\pm}\pi^{\pm}$

- Reconstruction:
  - Similar to D^* cuts
  - Tighter cut on $D^{\pm}$ transverse flight distance l_{xy}>1.3 mm
  - Veto D^* and $D_s \to \Phi(K^+K^-)\pi$ decays

~ 1700 $D^{\pm}$ candidates in the peak

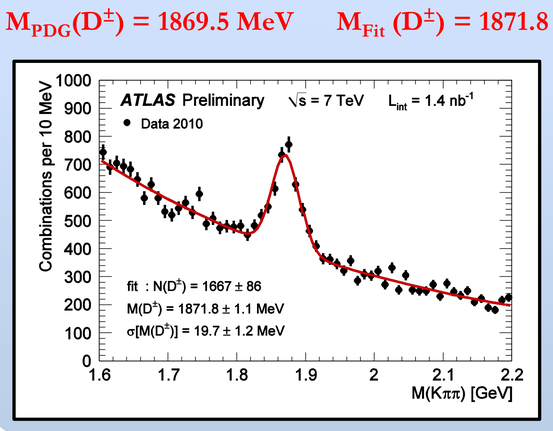
$M_{PDG}(D^{\pm})$ = 1869.5 MeV M_{Fit} ($D^{\pm}$) = 1871.8 MeV

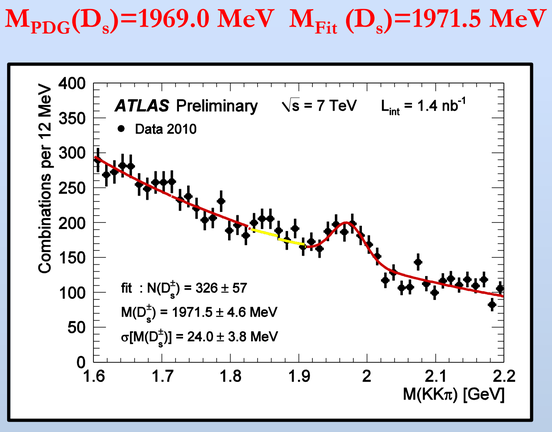
$D^{\pm}_s \to \Phi(K^{\mp}K^{\pm})\pi^{\pm}$

- Reconstruction:
  - Φ selection using decay angles
  - $|M(K^+K^-) - M(\Phi)_{PDG}|$ < 6 MeV
  - p_T >0.8 for the additional track

~ 300 D_s candidates in the peak

$M_{PDG}(D_s)$=1969.0 MeV M_{Fit} (D_s)=1971.5 MeV





References

1. "Φ(1020)-meson production in $\sqrt{s}$ = 900GeV collision data", ATLAS-CONF-2010-023
2. "Observation of Ξ, Ω baryons and K*(890) meson production at $\sqrt{s}$=7 TeV", ATLAS-CONF-2010-032
3. "Kinematic Distributions of Kshort and Lambda decays in collision data at $\sqrt{s}$=7 TeV", ATLAS-CONF-2010-033
4. "D(*) mesons reconstruction in pp collisions at $\sqrt{s}$=7 TeV", ATLAS-CONF-2010-034