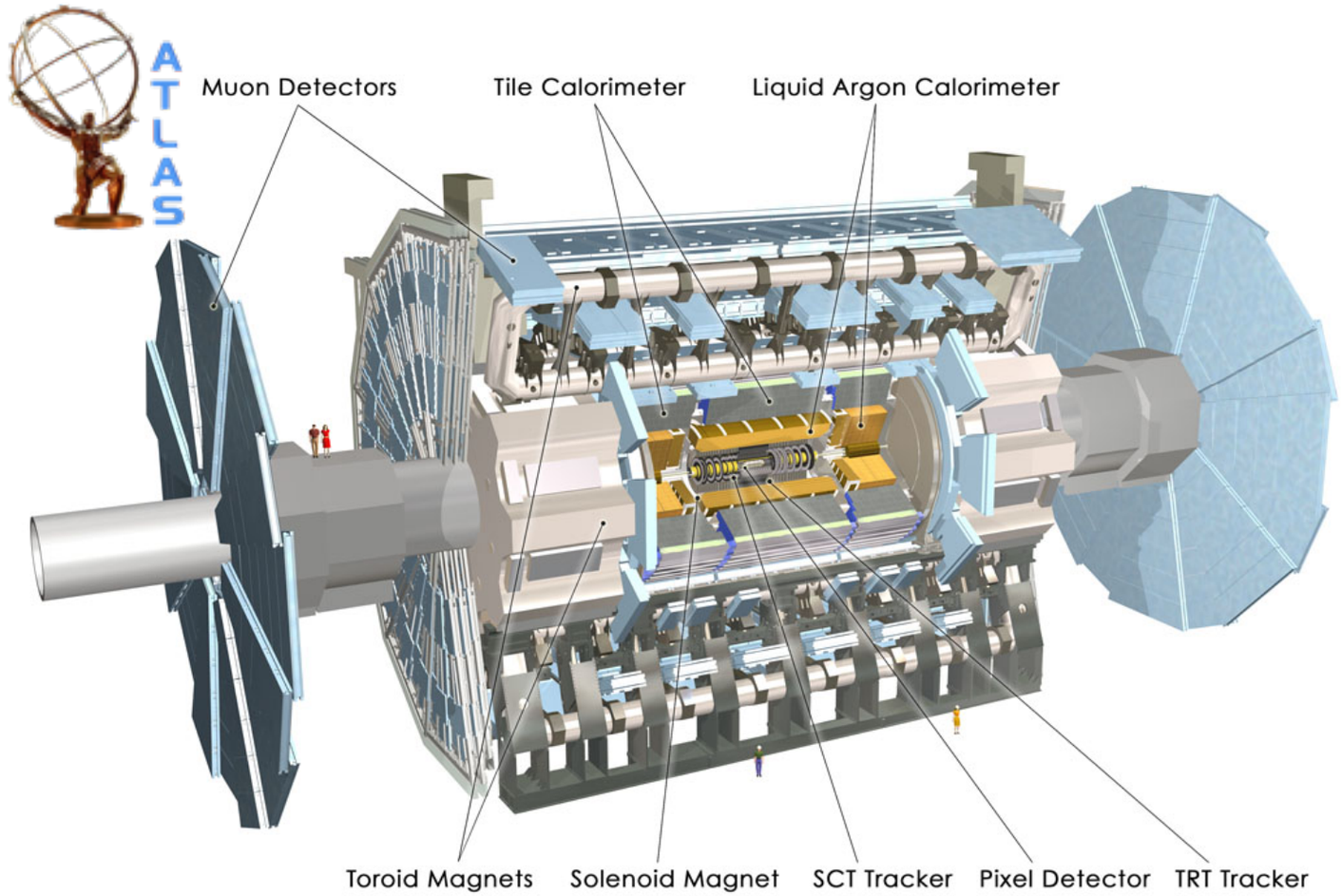
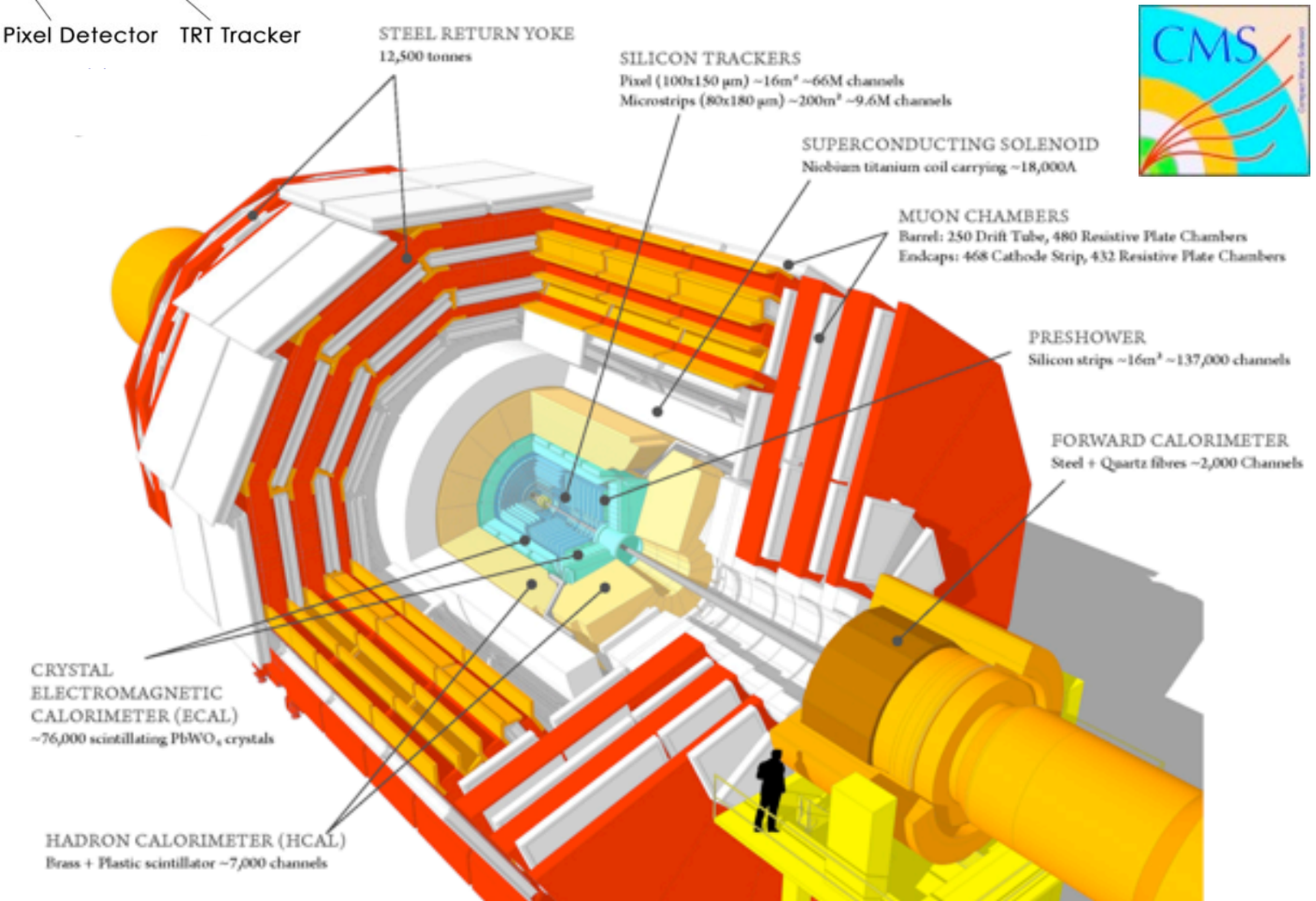


Future measurements at ATLAS and CMS: Possibilities and limitations

Ilse Krätschmer* (HEPHY Vienna)
showing slides from
T. Madlener and B. Yabsley

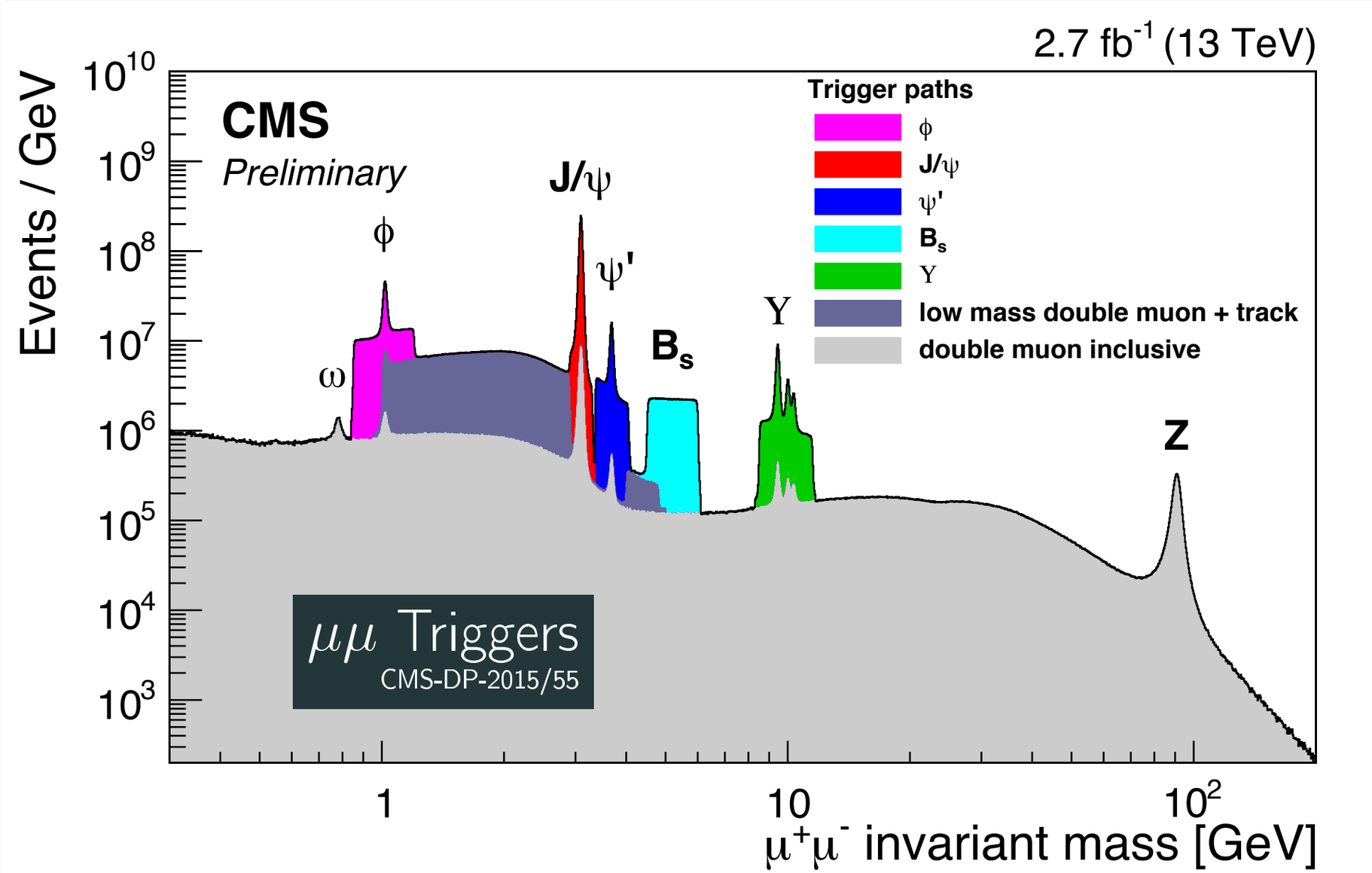
Round table discussion
QWG 2016
10 June 2016



HEPHY
INSTITUT FÜR HOCHENERGIEPHYSIK

* supported by Austrian Science Fund (FWF): P28411-N36

Dimuon spectrum and triggers at 13 TeV



T. Madlener
QWG 2016
6 June 2016

Colored: Dedicated triggers with (e.g.) opposite charge, p_T and invariant mass region requirements

Dark gray: Low mass non-resonant double muons plus track

Light gray: Inclusive double muon triggers

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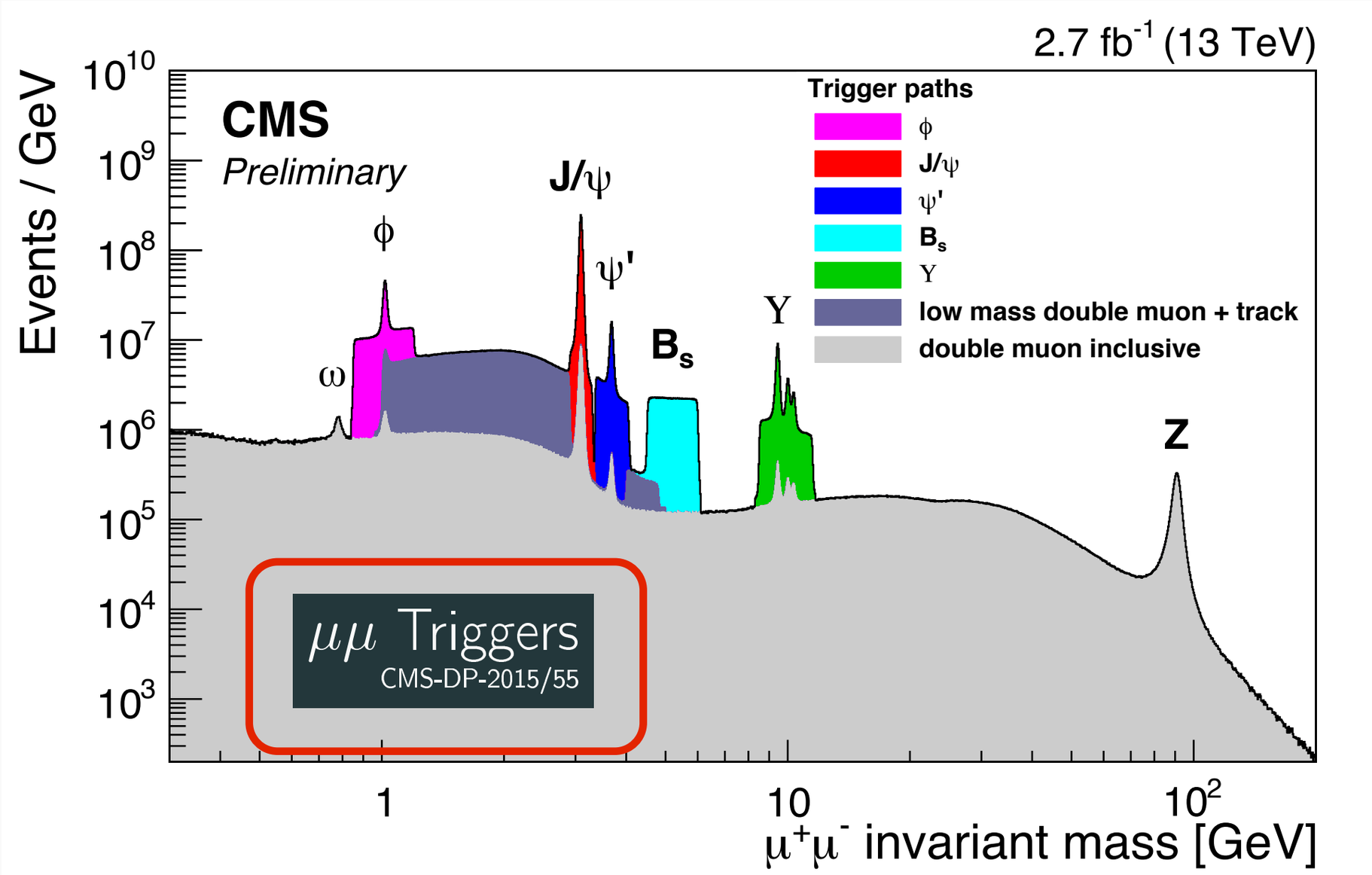

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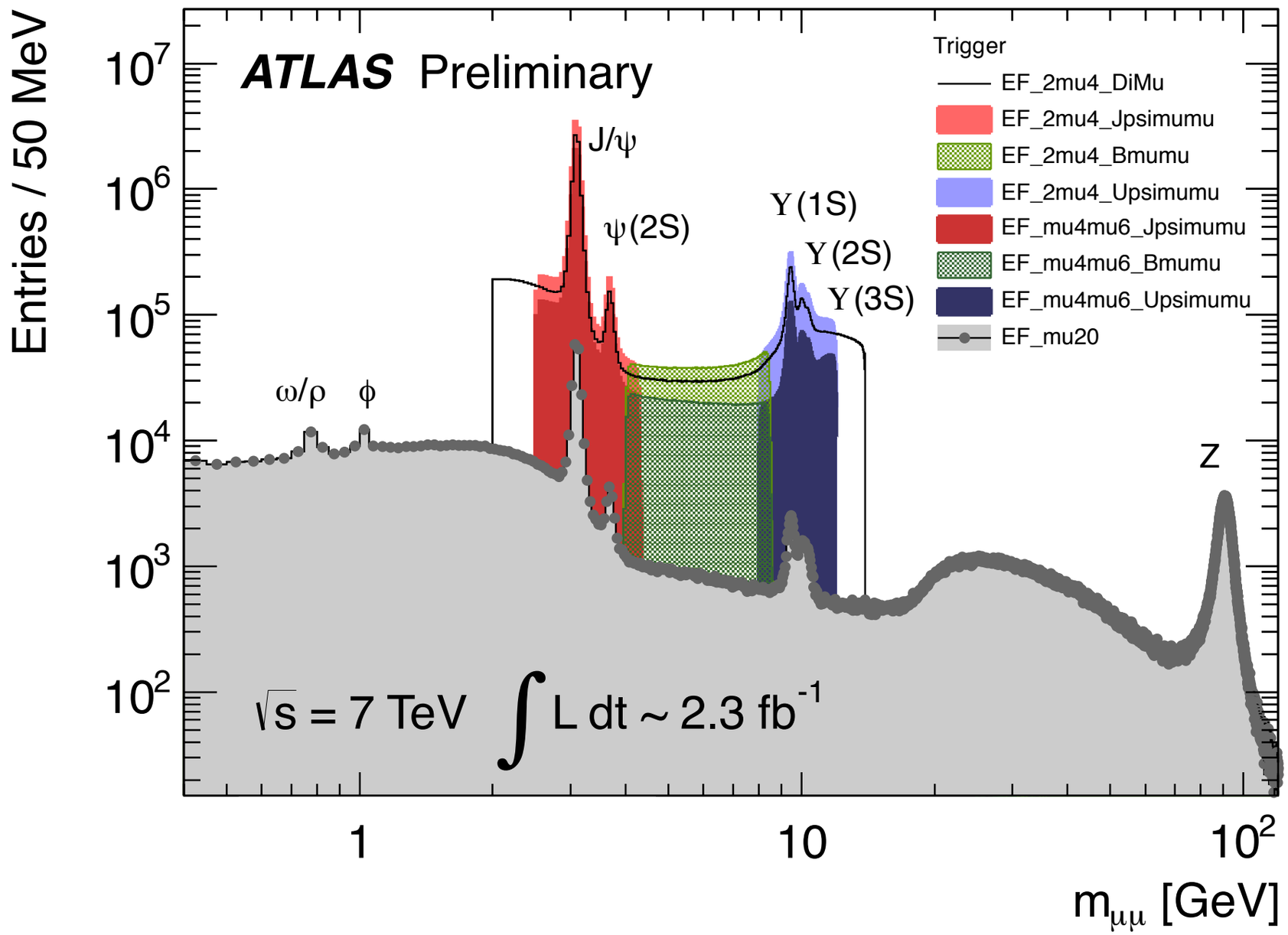
ATLAS: (1) detector and trigger

- rate limited by trigger bandwidth, especially at Level 1 (hardware)
- for quarkonia: high-p_T μ & $M(\mu\mu)$-restricted-dimuon triggers
- increasing $\mathcal{L} \longrightarrow$ higher-p_T triggers, prescaling, ...



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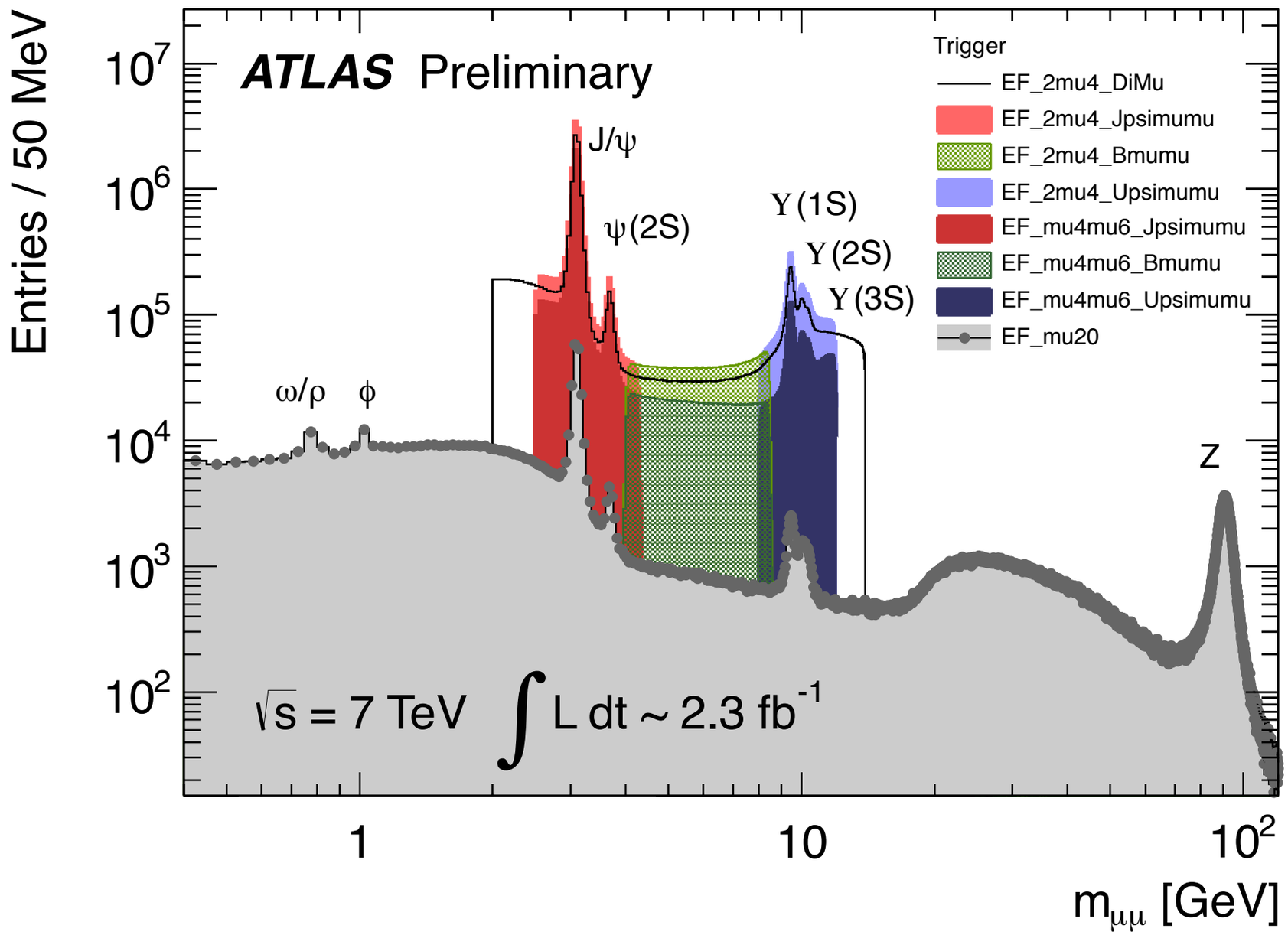
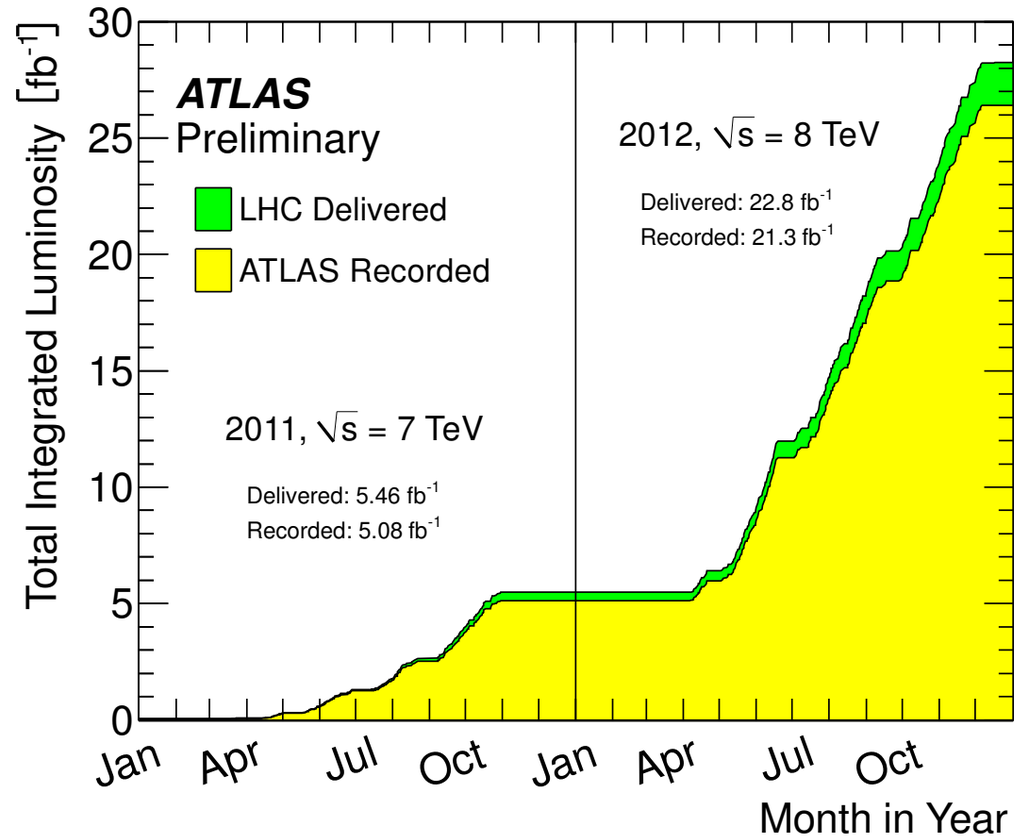
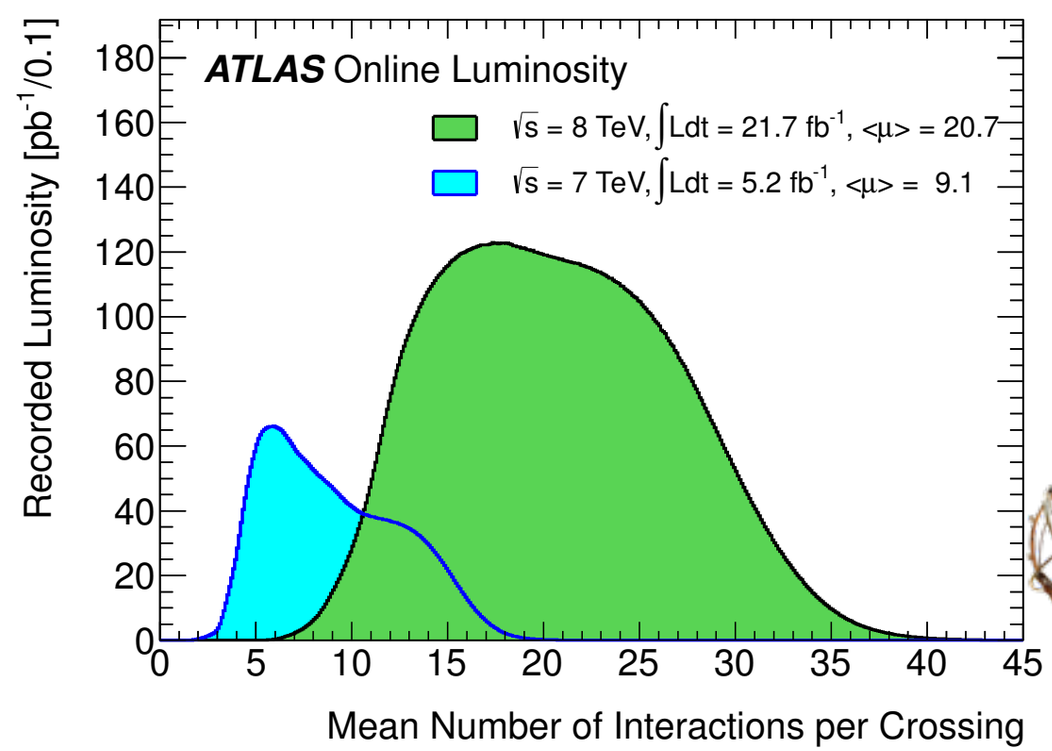


ATLAS: (2) dataset and research program

- **Run 1 dataset:**
  $5\,\mathrm{fb}^{-1}$ at $7\ \mathrm{TeV}$ (2011)
  $21\,\mathrm{fb}^{-1}$ at $8\ \mathrm{TeV}$ (2012)
- analyses presented here use large subsets, depending on trigger availability & prescaling
- conditions change over the run, esp. the rate of *in-time pileup*: additional pp interactions in the same bunch-crossing
- less $\int \mathcal{L}\,\mathrm{d}t$ at $7\ \mathrm{TeV}$; harsher conditions at $8\ \mathrm{TeV}$
- affects track multiplicity, combinatorial background, and (via bkgd suppression) efficiency

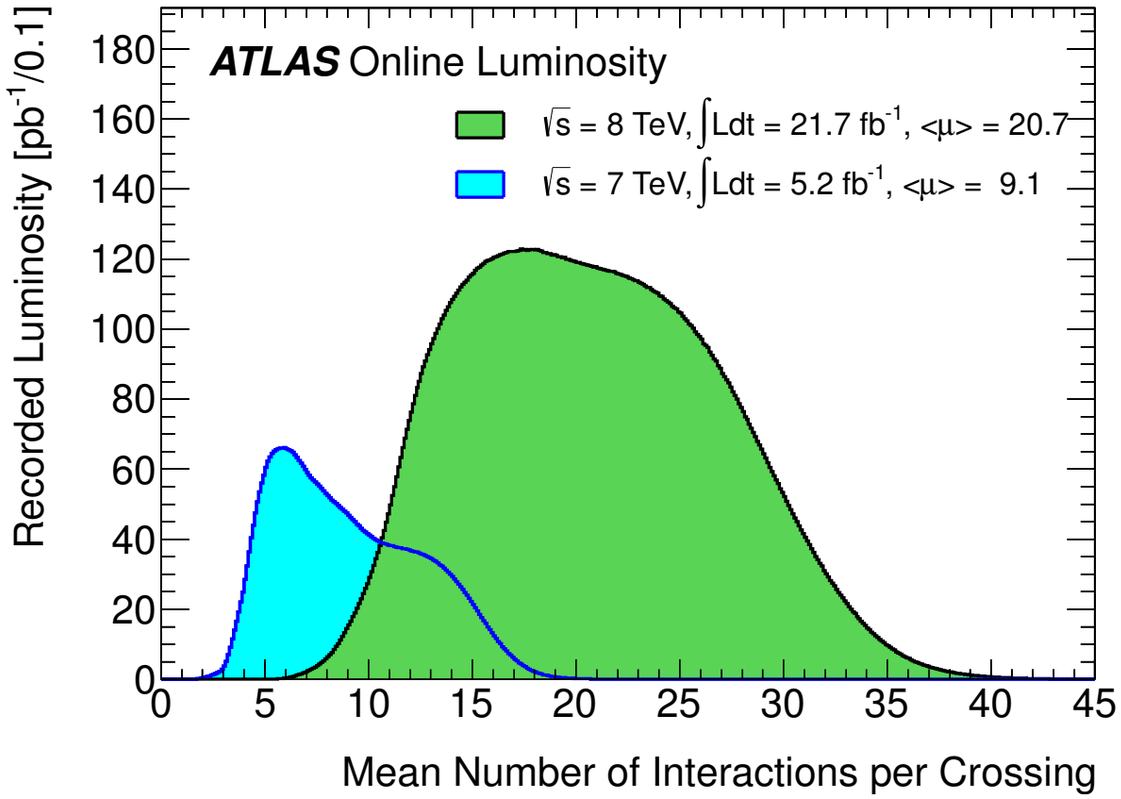




ATLAS: (2) dataset and research program

harsher conditions at 8 TeV

- affects track multiplicity, combinatorial background, and (via bkgd suppression) efficiency

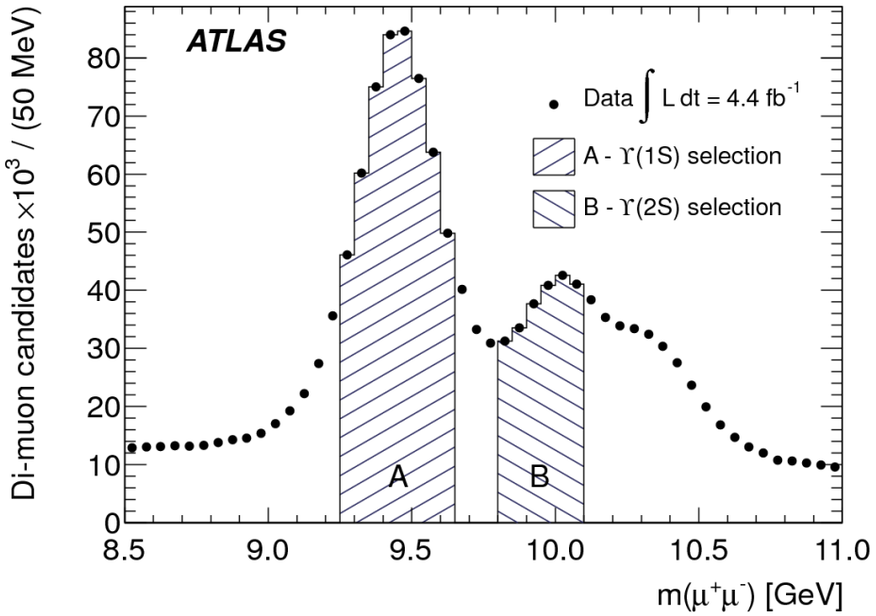


Observation of the $\chi_b(3P)$: (1) selection

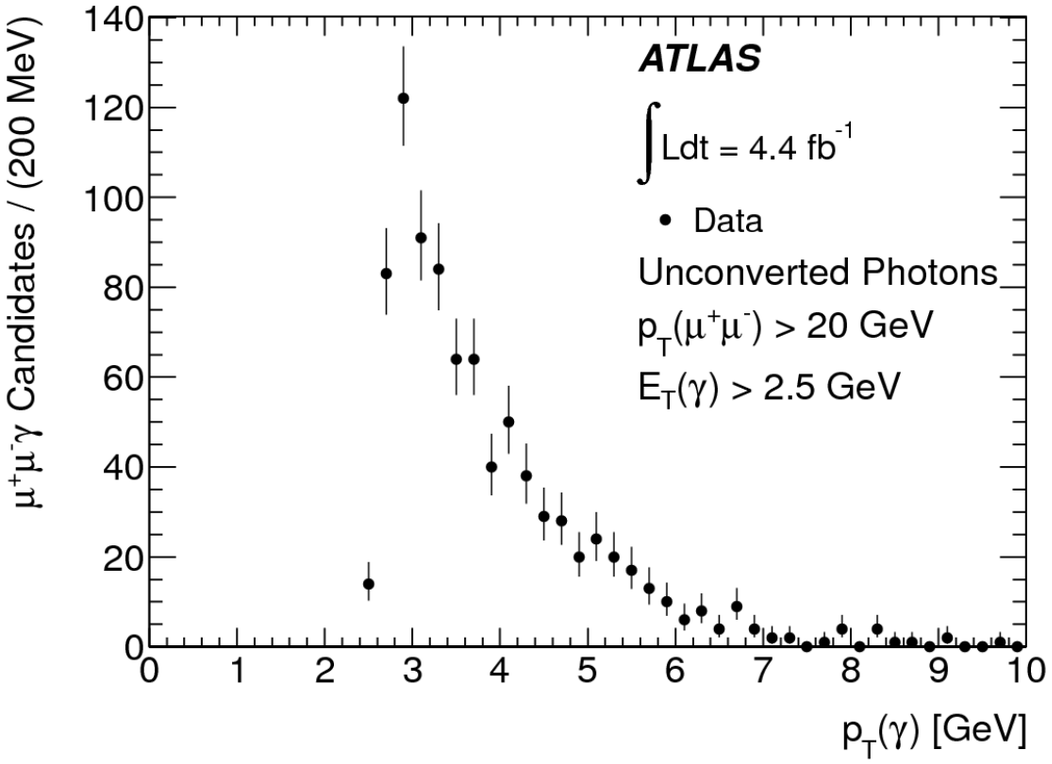
ATLAS Collaboration, Physical Review Letters 108, 152001 (2012)

$\mu^+\mu^-\gamma$ recon in 4.4 fb^{-1} (7 TeV):

- "combined" μ tracks, $p_T > 4\,\mathrm{GeV}$, $|\eta| < 2.3$
- well-vertexed $\mu^+\mu^-$, $p_T > 12\,\mathrm{GeV}$, $|y| < 2.0$
- selected $\Upsilon(1S)$ and $\Upsilon(2S) \to \mu^+\mu^-$:
- combine with a photon:



unconverted



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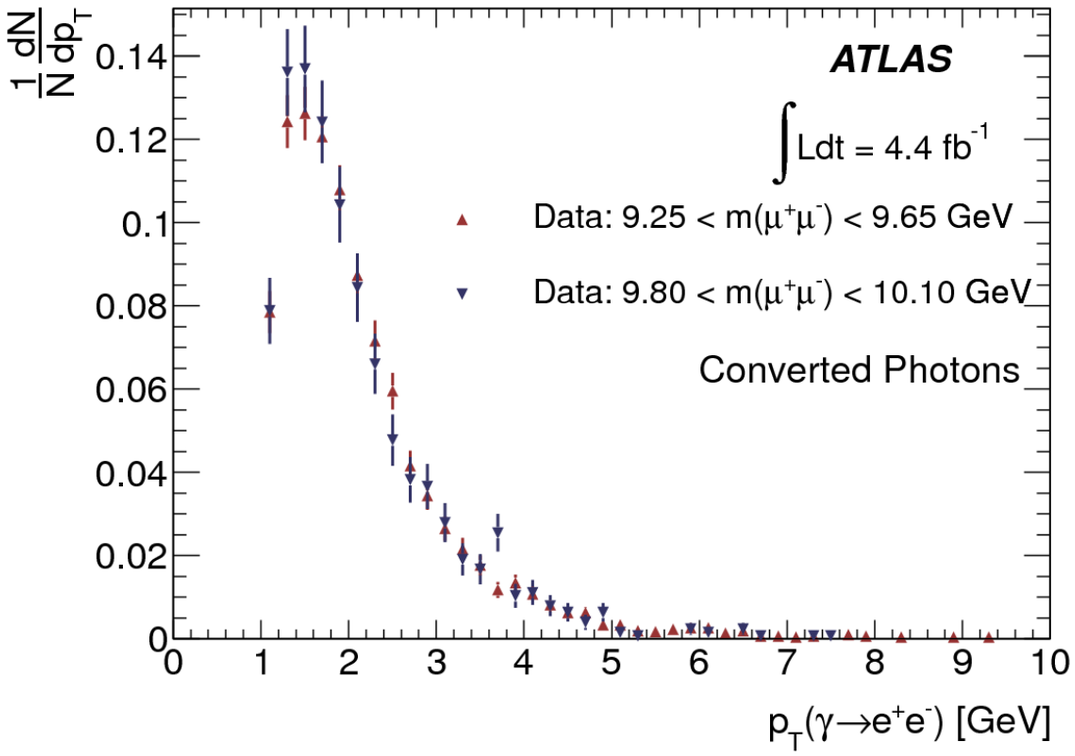

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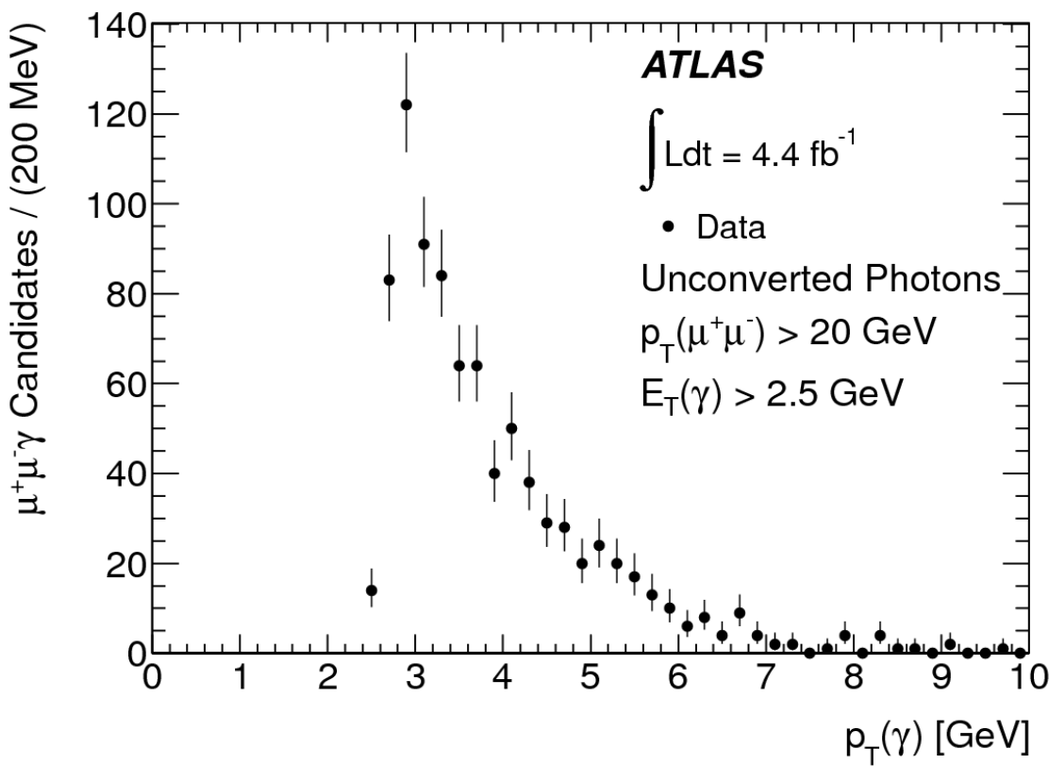

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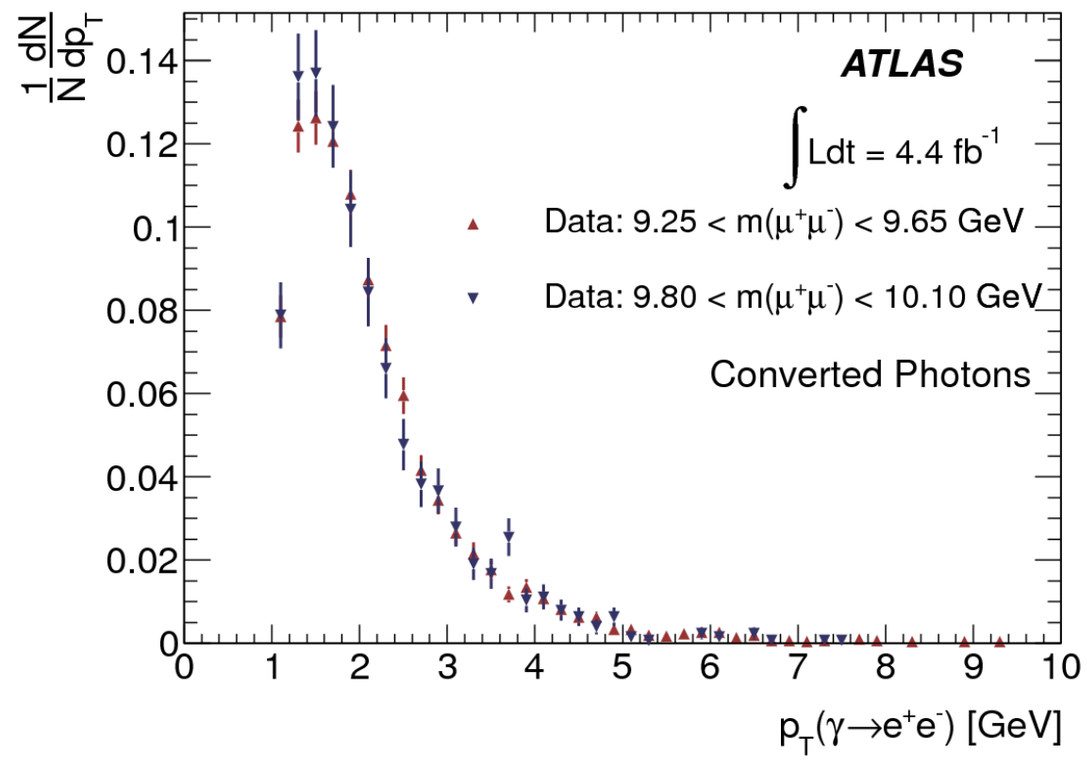


Search for an X_b: (5) reassessing the motivation

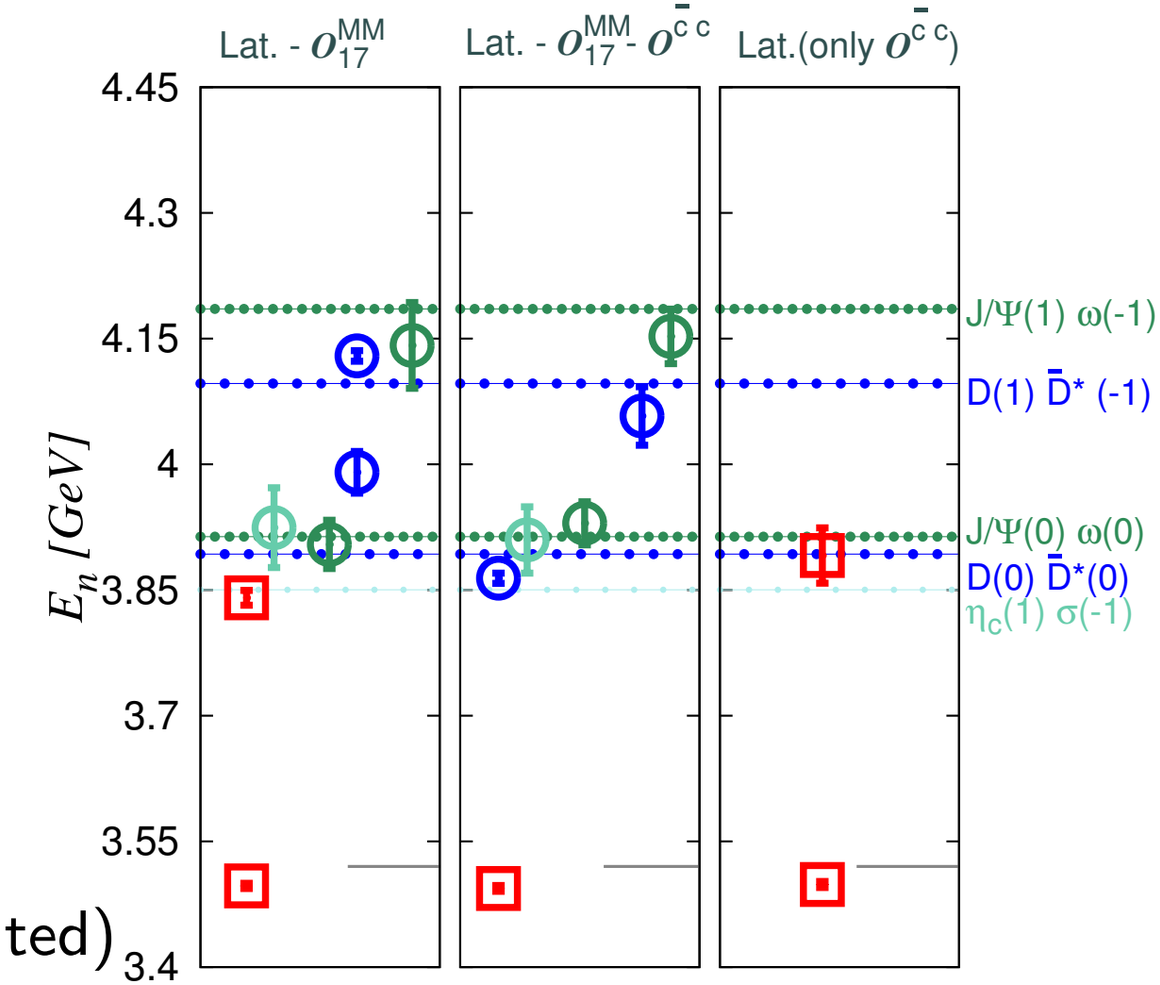
Padmanath, Lang, Prelovsek, PRD 92, 034501 (2015), & others in backup

some of us have taken the likely existence of an X_b for granted:

- naïvely, heavier constituents $\longrightarrow$ more deeply bound system; $m_b > m_c$, "so $X(3872)$ should have a hidden-beauty analogue"
- very well for vanilla molecule or tetraquark; *not necessarily* for models with accidental $\chi_{c1}(2P)$-threshold overlap, or attraction of resonance to threshold

cf. lattice state-of-the-art:

- $N_f = 2$; many interpolating fields
- $I = 0$, 1^{++} (actually T_1^{++}) case $\rightarrow$
- finds expected levels corresponding to meson pairs $D\overline{D}^*$, $\eta_c\sigma$, $\psi\omega$, and extra states $\simeq \chi_{c1}(1P)$, $X(3872)$
- $c\overline{c}$ omitted: the X *disappears*
  $c\overline{c}$ only: the X *remains*



future analysis priority? (personpower-limited)
$X_b \rightarrow \pi\pi\chi_{b1}$? $\chi_{bJ}(3P)$? associated $X(3872)$ prod^n? other?

Search for an X_b: (5) reassessing the motivation

Padmanath, Lang, Prelovsek, PRD 92, 034501 (2015), & others in backup

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$X_b \to \pi\pi\chi_{b1}$? $\chi_{bJ}(3P)$? associated $X(3872)$ prod^n? other?

Summary

- Data selection with dimuon and for certain analyses single muon triggers
- Higher p_T thresholds with increasing energy and luminosity
- Harsher environment at higher $\sqrt{s}$ affects track multiplicity, particle reconstruction, efficiencies, combinatorial background, …
- Many possibilities for future measurements, but…
- Measurements are personpower-limited

➡ Priorities of our future analyses?