

# Otkriće Higsovog bozona i merenje njegovih osobina

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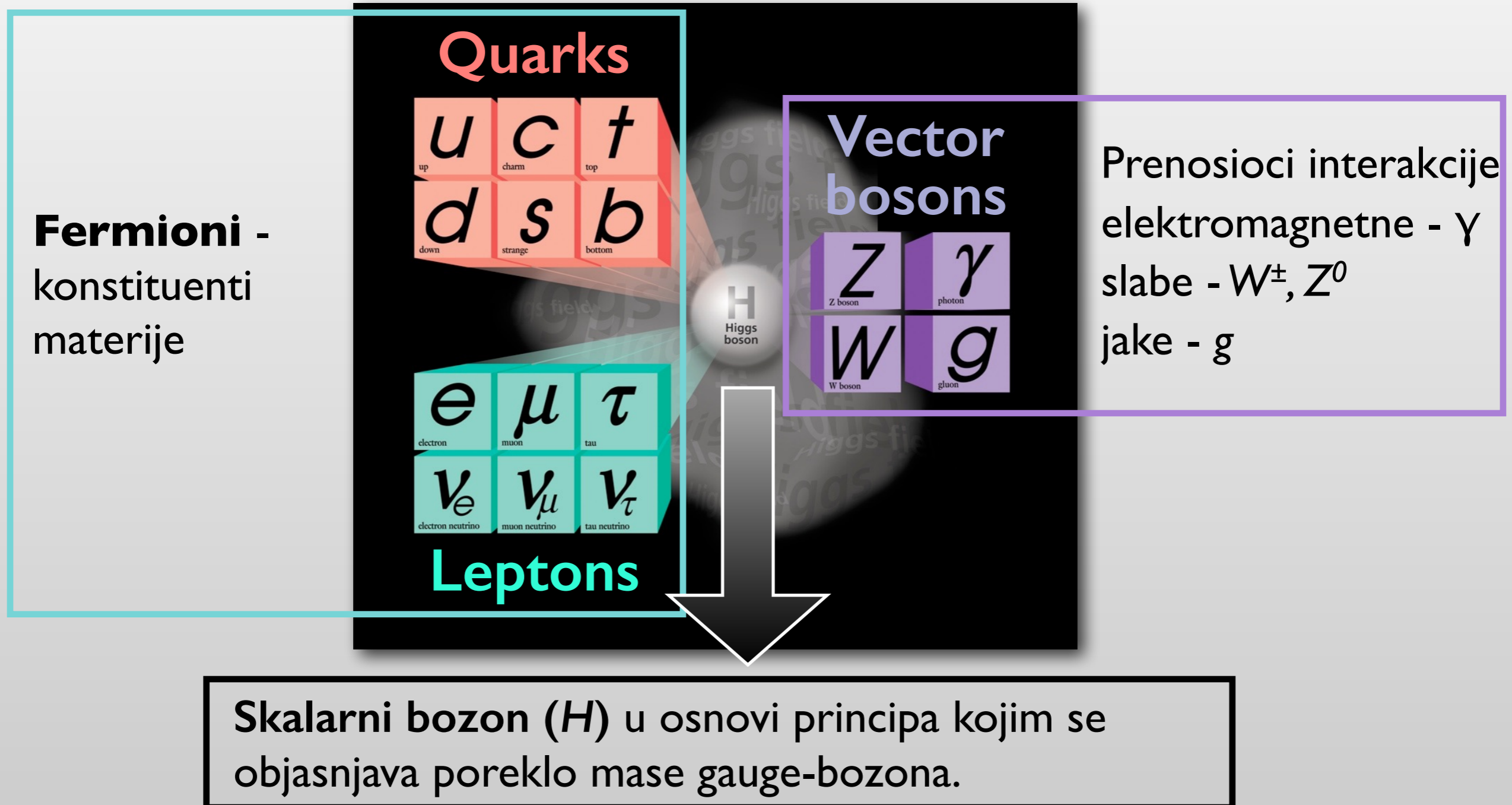
Jelena Jovićević  
*TRIUMF*



Serbian Teachers Program  
07 August, 2015

# Standardni Model

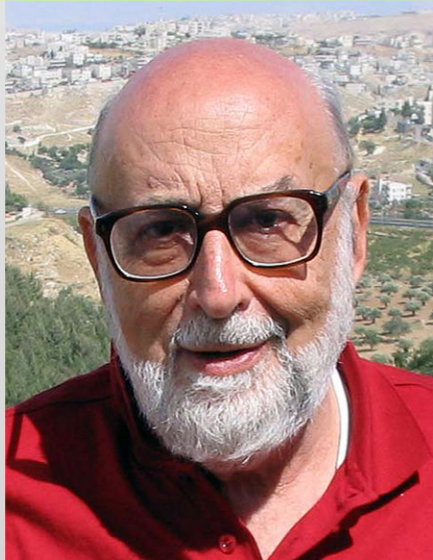
Teorija koja opisuje konstituente materije i sile među njima.  
Testirana sa visokom preciznošću poslednjih 50 godina...



# Ideja o Higsovom polju

$$\begin{aligned}\mathcal{L} = & -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} \\ & + i\bar{\psi}\not{\partial}\psi + h.c. \\ & + \bar{\psi}_i \gamma_{ij} \psi_j \phi + h.c. \\ & + |D_\mu \phi|^2 - V(\phi)\end{aligned}$$

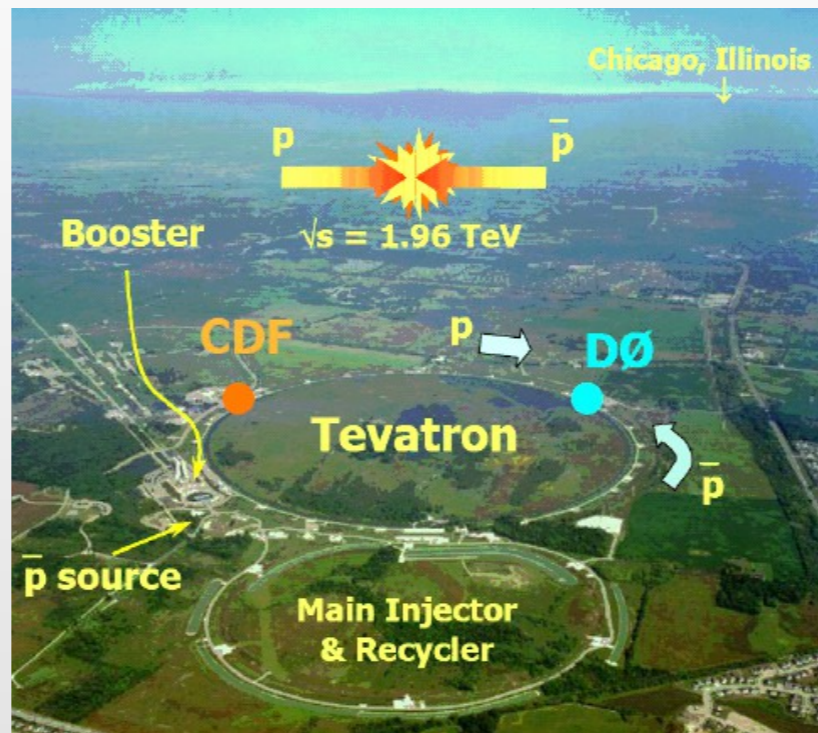
- Predviđeno dodatno skalarno polje u teoriji - Higsovo polje  
➡ Higsov bozon spina 0.
- Konstante sprezanja sa drugim poljima direktno povezane sa masama čestica.



1964

# Experimenti pre LHC-a

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\psi}\not{\partial}\psi + h.c. + \bar{\psi}i\not{\partial}\psi + h.c. + \frac{1}{2}\partial_\mu\phi\partial^\mu\phi - V(\phi)$$



Tevatron u Fermilab-u, SAD

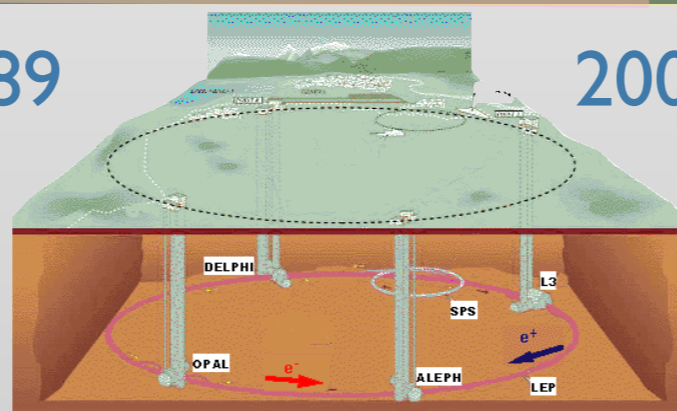


1967

'87 '89

2000

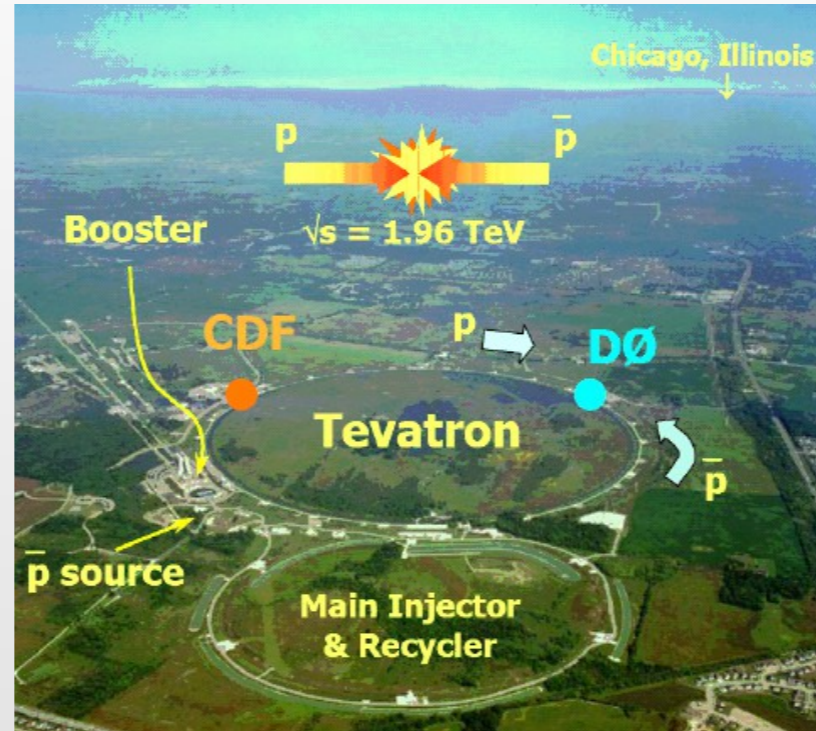
'11



LEP u CERN-u

# Experimenti pre LHC-a

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\psi}\not{\partial}\psi + h.c. + \bar{\psi}\gamma_5\not{\partial}\psi + h.c. + \frac{1}{2}\partial_\mu\phi\partial^\mu\phi - V(\phi)$$



Tevatron u Fermilab-u, SAD

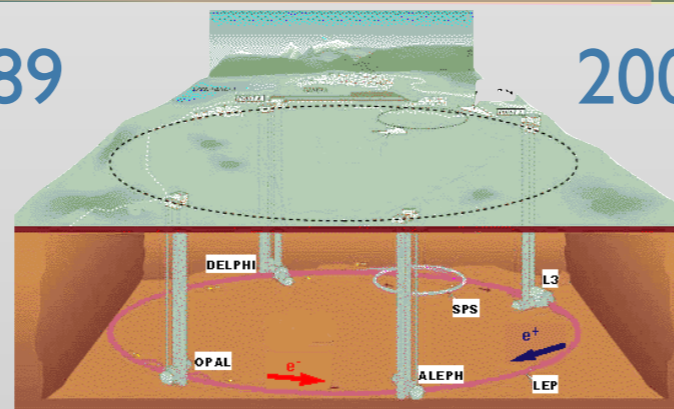


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LEP u CERN-u

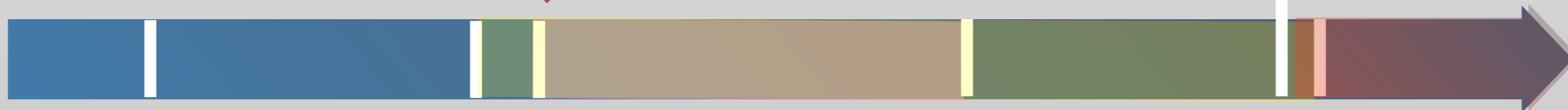
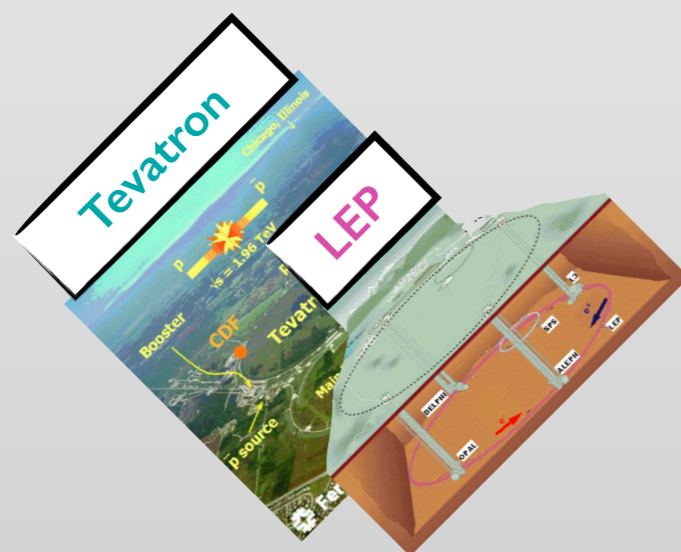
LEP+Tevatron:  
Ograničenje na masu Higsovog bozona:  
 $m_H < 114.4 \text{ GeV}$   
 $158 < m_H < 177 \text{ GeV}$

# LHC (Veliki hadronski sudarač)



**ATLAS i CMS**  
Potraga za Higsom  
kao primarni cilj!

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \bar{\psi} i \not{D} \psi + \text{h.c.} + \frac{1}{2} (D_{\mu} \phi)^{\dagger} (D^{\mu} \phi) + \text{h.c.} + \Delta \phi^{\dagger} \phi - V(\phi)$$



1967

'87 '89

2000

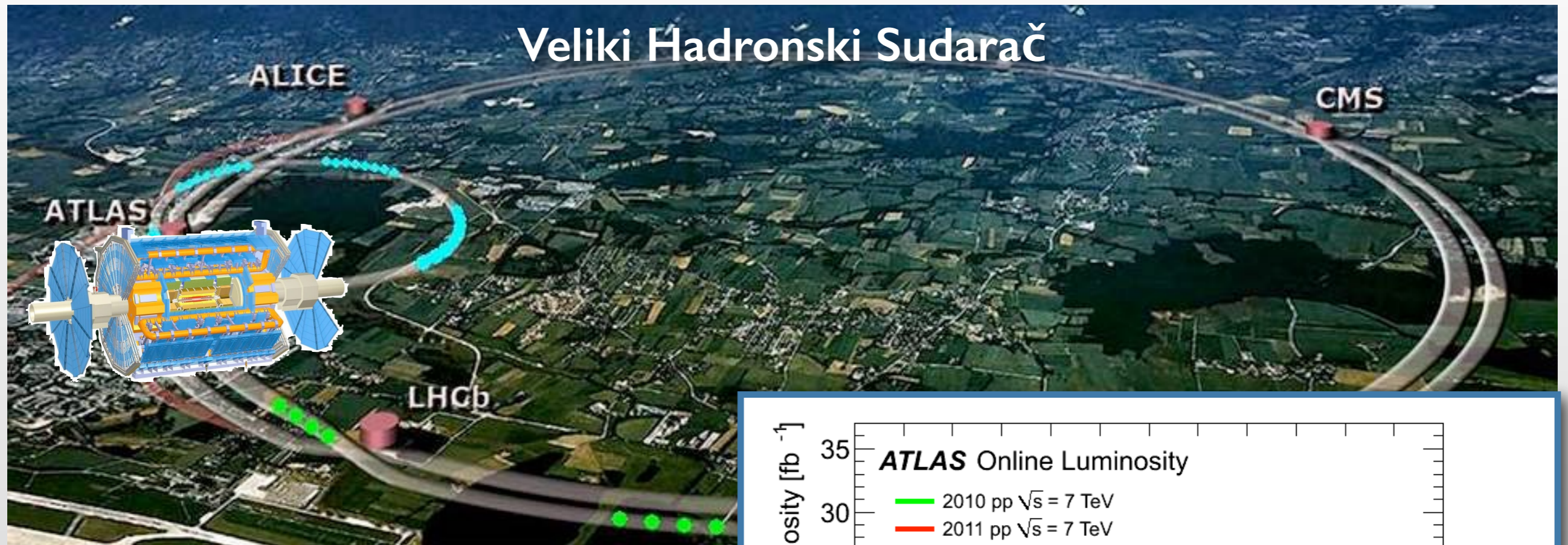
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## Primarni ciljevi:

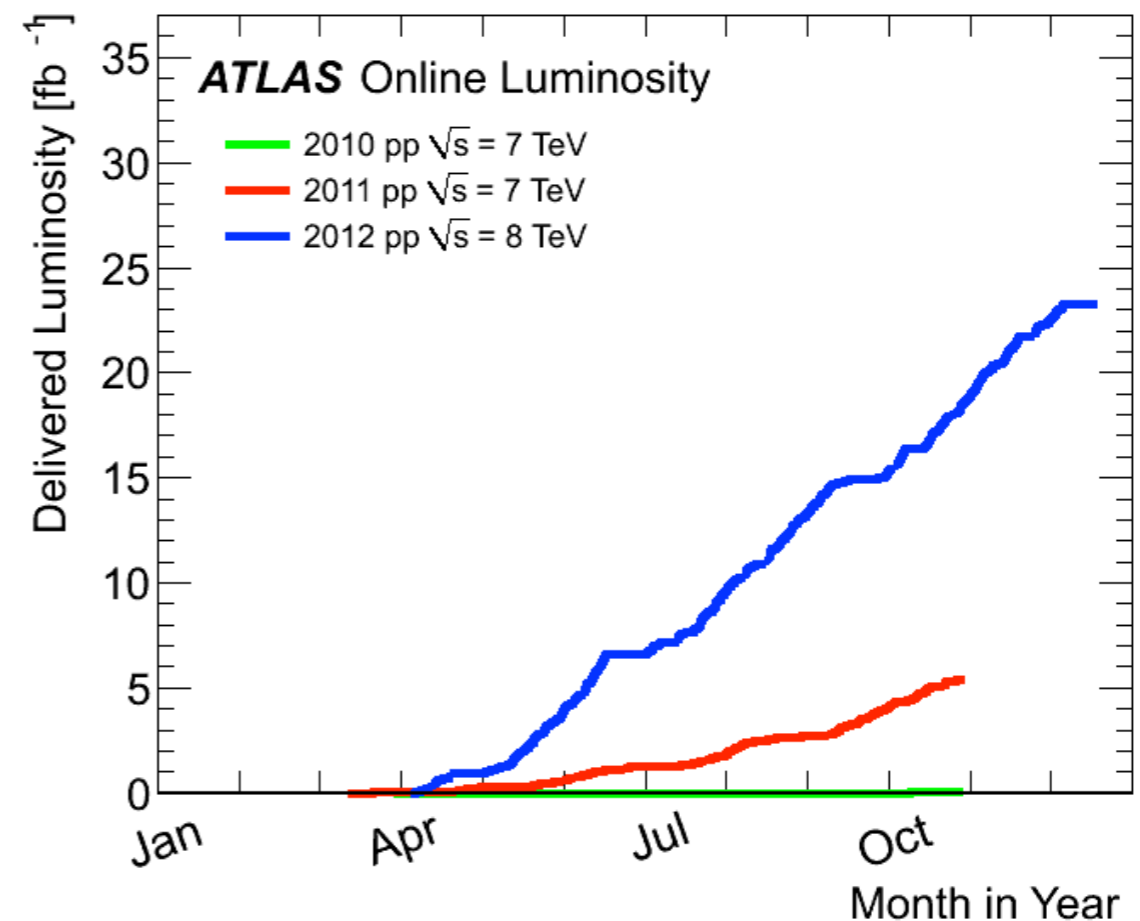
- Precizno merenje SM procesa
- Potruga za Higsovim bozonom
- Potruga za fizikom izvan SM

# LHC i ATLAS



## Primarni ciljevi:

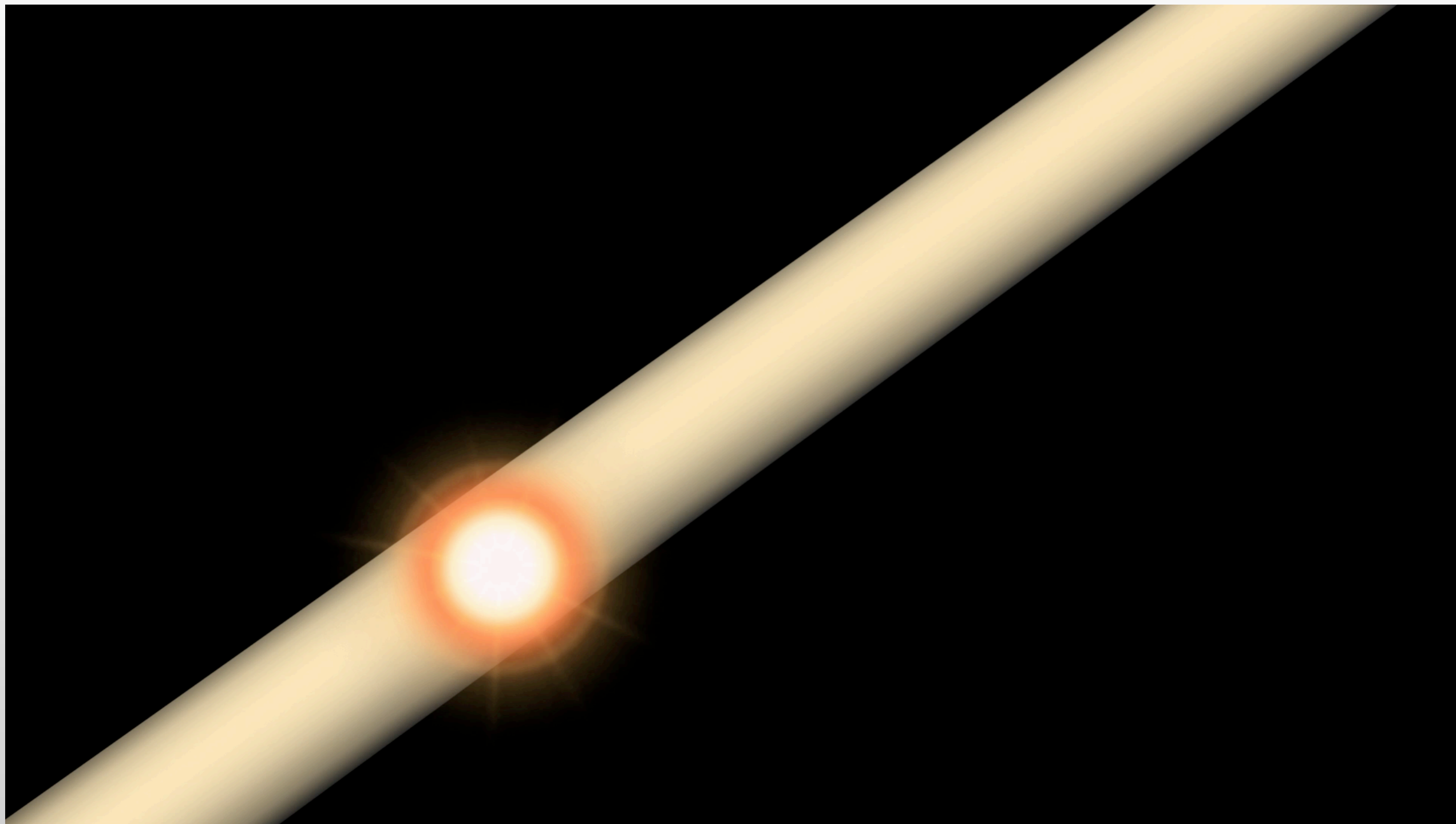
Precizno merenje SM procesa  
Potraga za Higsovim bozonom  
Potraga za fizikom izvan SM





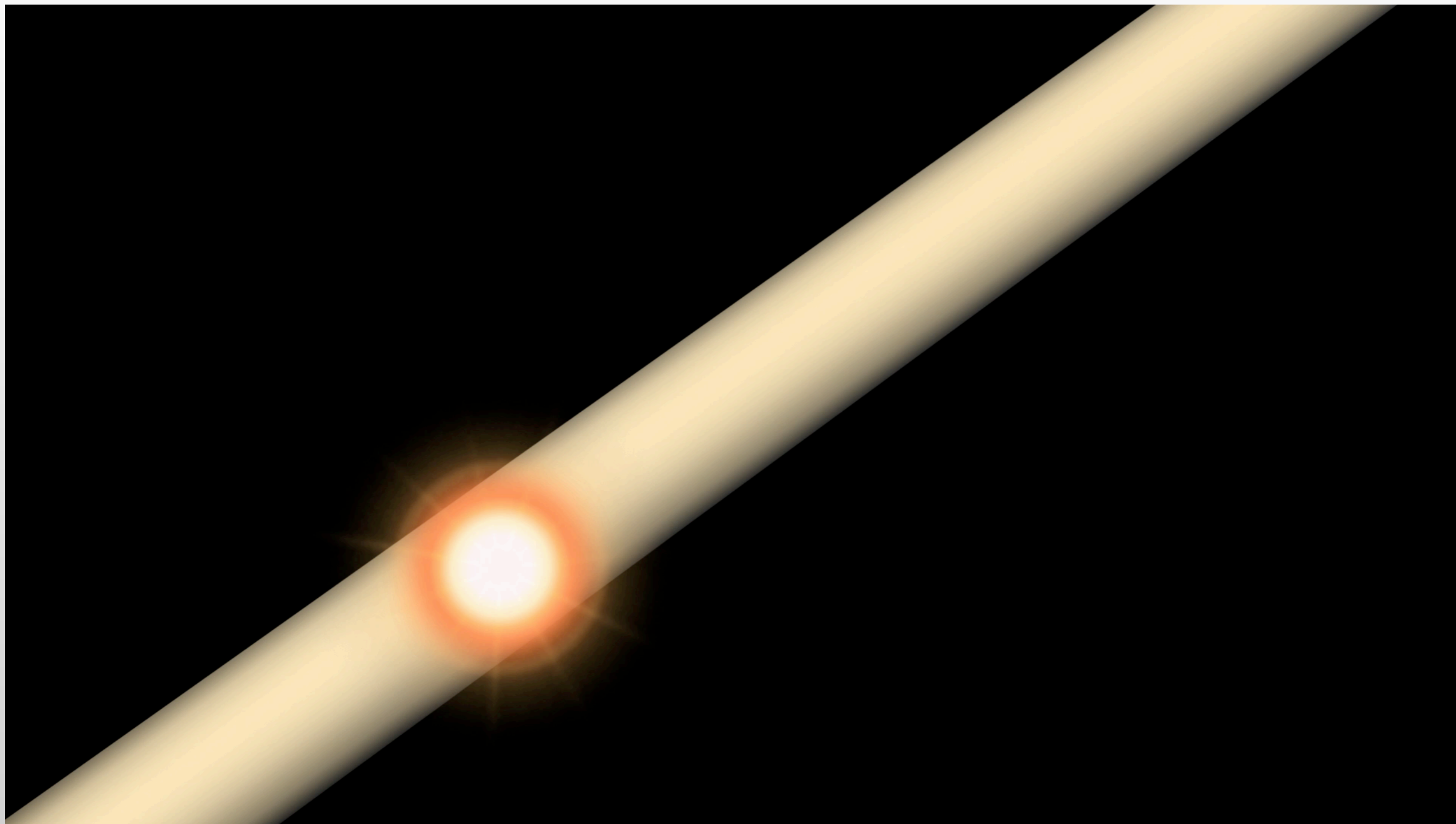
# LHC i ATLAS

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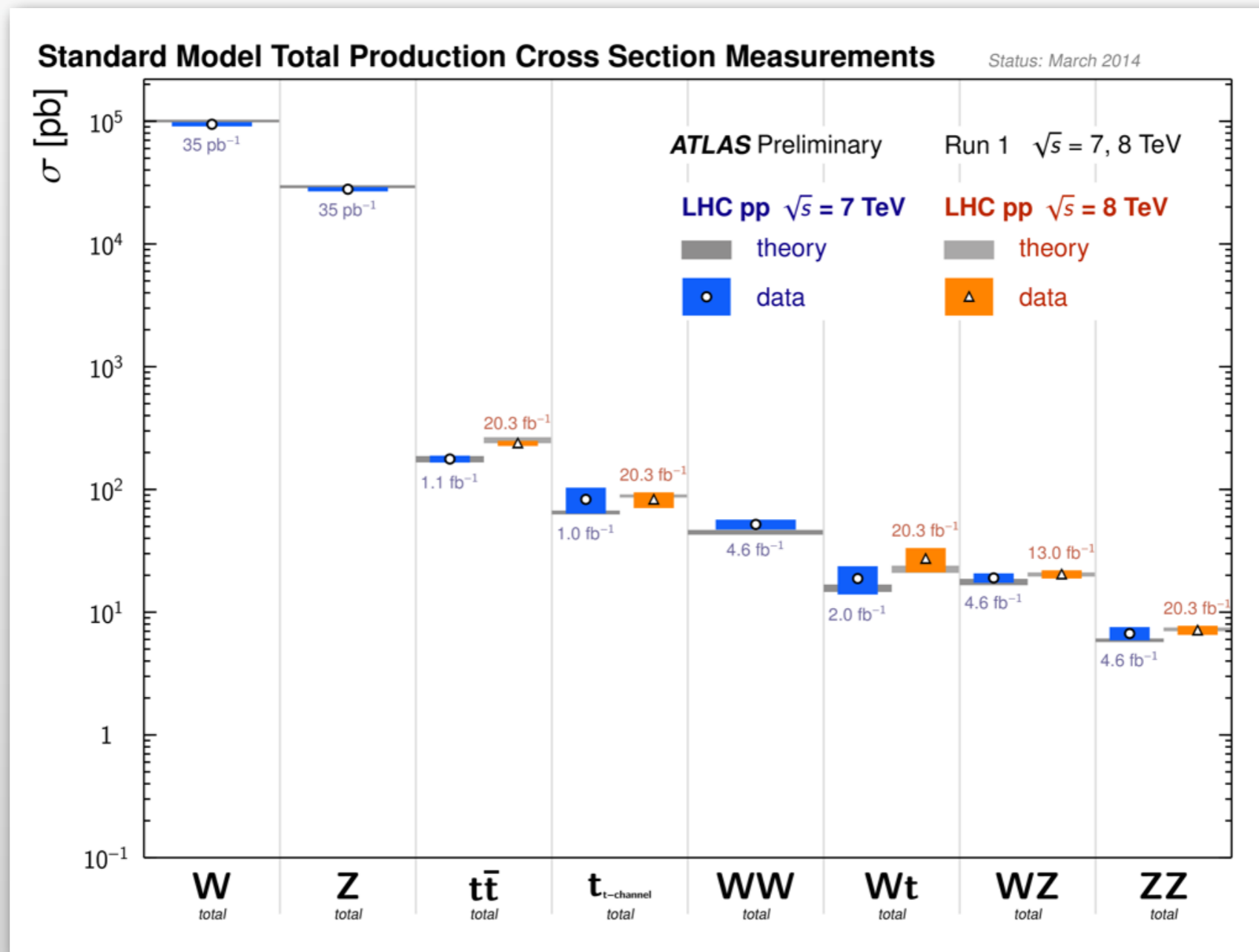


# LHC i ATLAS

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# Precizna merenja na LHC-u

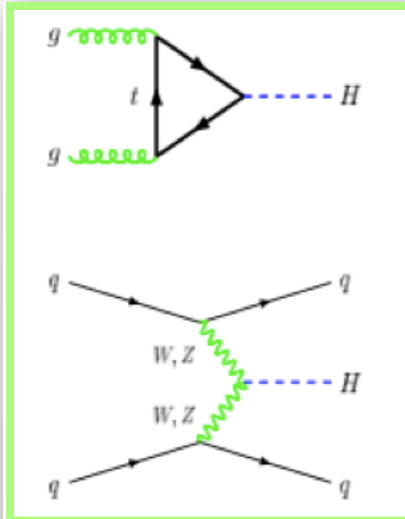


Procesi Standardnog modela izmereni sa visokom preciznošću!!  
Potrebno za razumevanje fonskih procesa za signal Higsovog bozona.

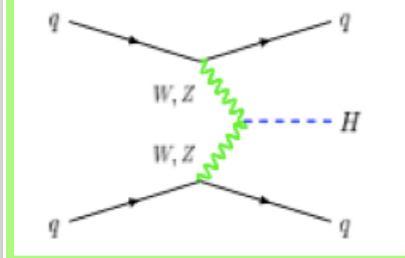
# Produckija Higsovog bozona na LHC-iju

## Production mechanisms

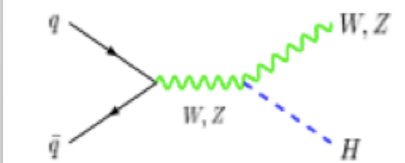
ggF



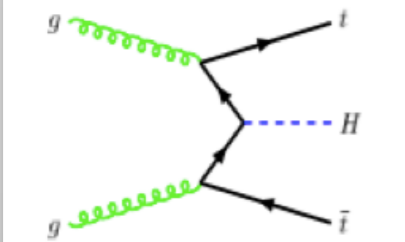
VBF



VH



ttH

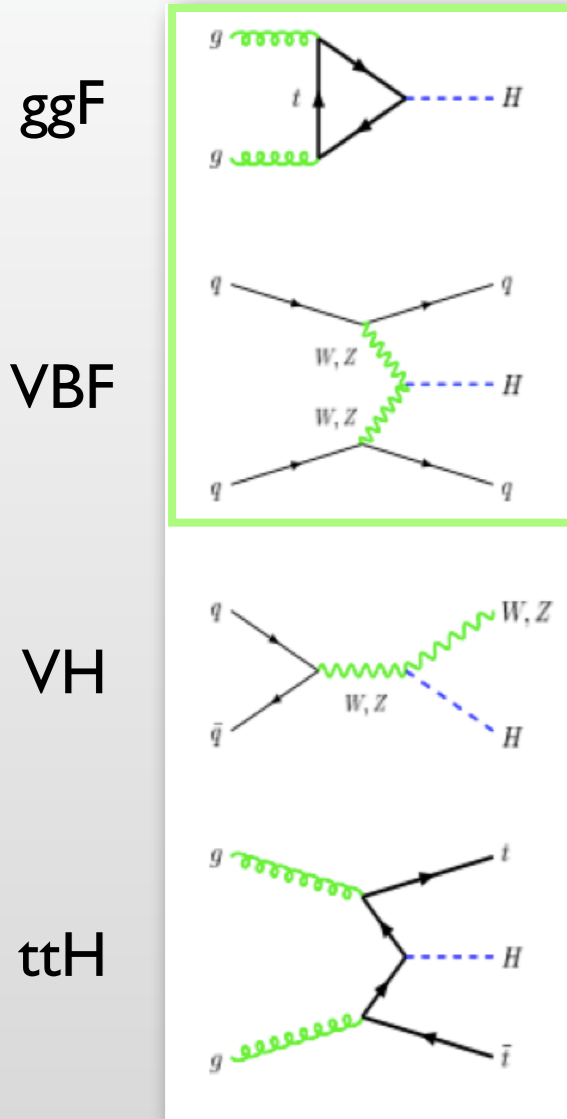


Predominant

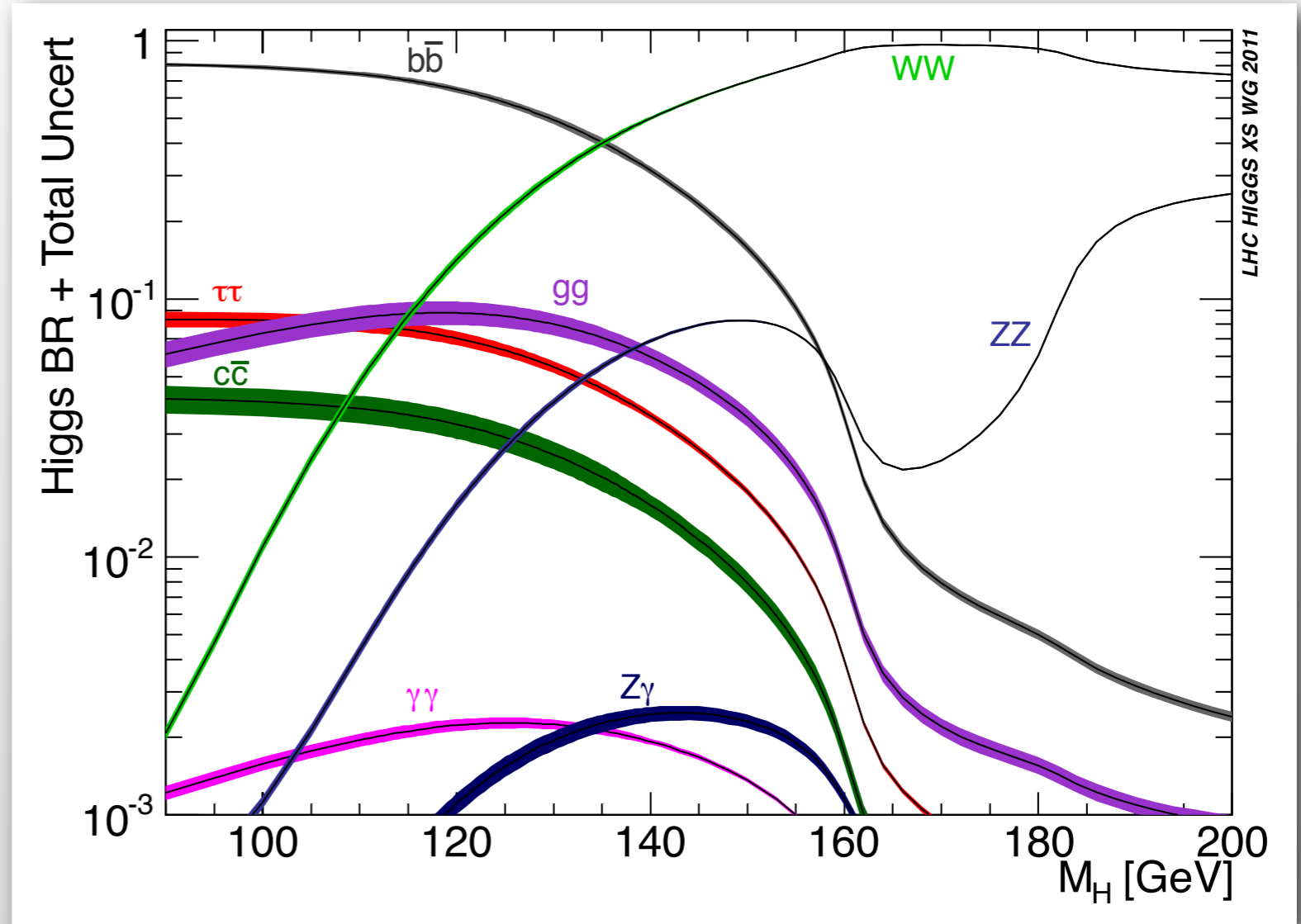
# Produckija i raspadi Higsovog bozona

Production mechanisms

SM Higgs boson decay modes



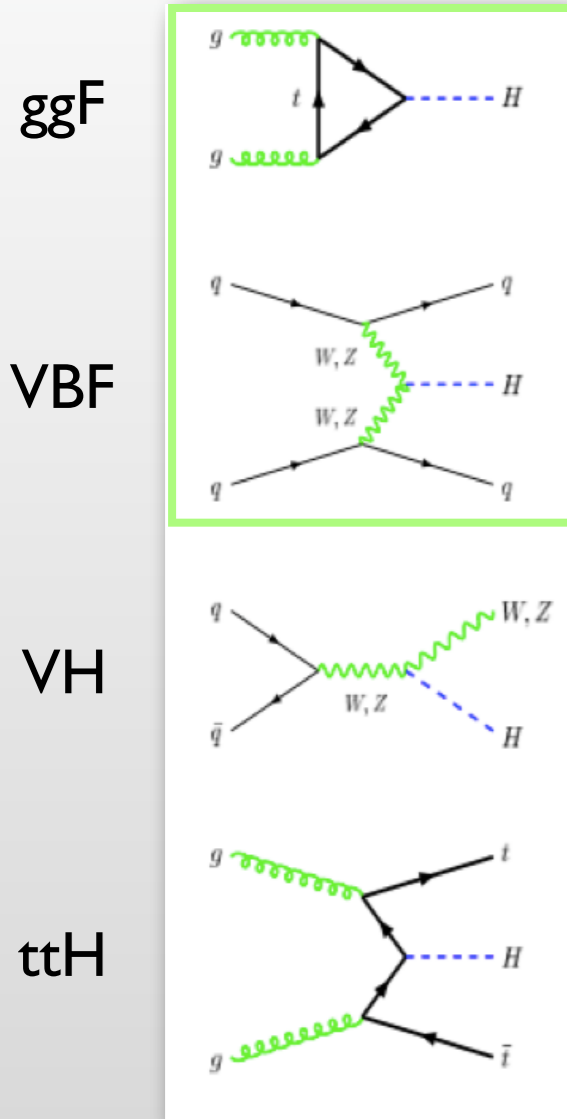
Predominant



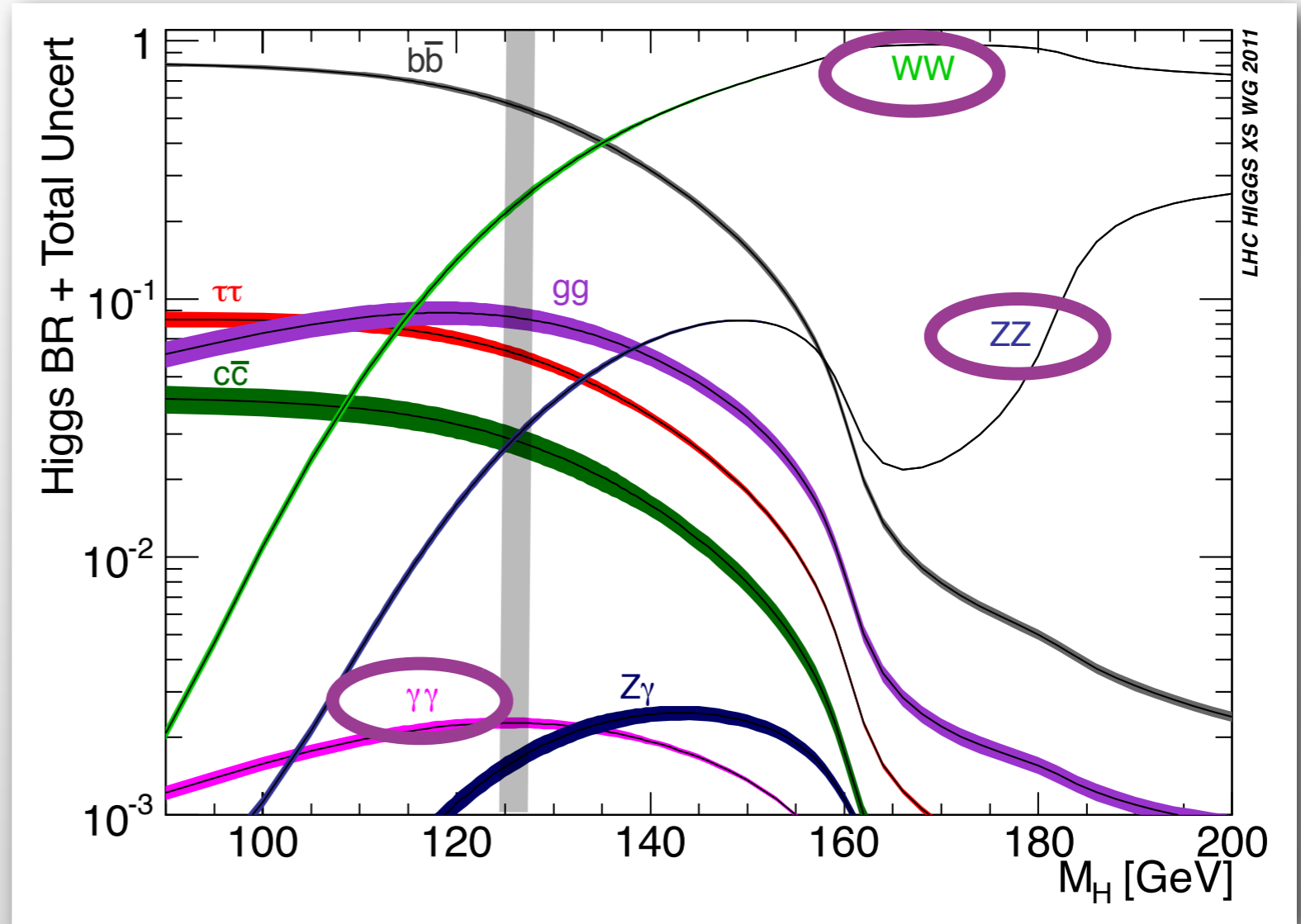
# Produckija i raspadi Higsovog bozona

Production mechanisms

SM Higgs boson decay modes



Predominant



**Kanali za detekciju Higgs-a:**

**Bozonski:**  $H \rightarrow WW$ ,  $H \rightarrow ZZ$ ,  $H \rightarrow \gamma\gamma$ ,  $H \rightarrow Z\gamma$ ;

**Fermionski:**  $H \rightarrow b\bar{b}$ ,  $H \rightarrow \tau\tau$ ,  $H \rightarrow \mu\mu$ .

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*H* → WW proces