Results from the OPAL Experiment

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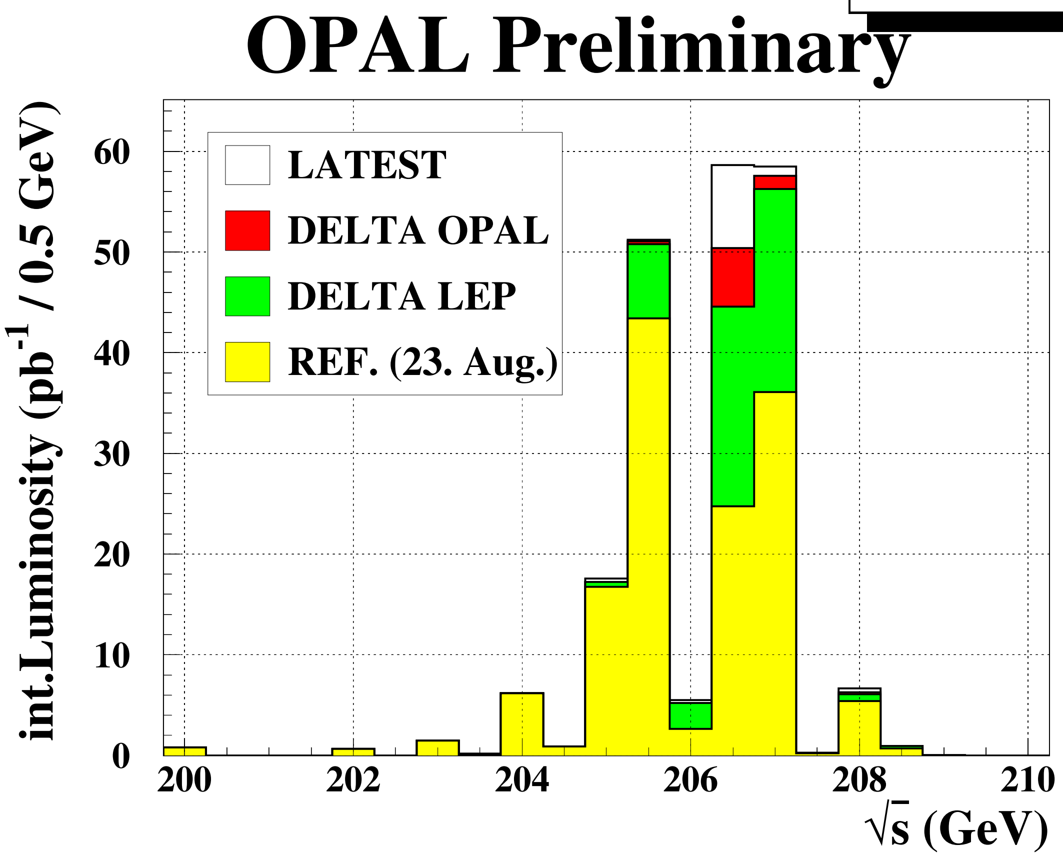
On behalf of the OPAL Collaboration

LEPC Seminar November 3, 2000

- **Data Sets**
- **LEP2 Results**
  - ▷ **SM Results**
  - ▷ **Searches Highlights**
  - ▷ **Higgs Searches**
- **Conclusion**

Data Sets



- The OPAL detector works very well
- Background conditions are good
  LEP delivered 237.814 pb^{-1}

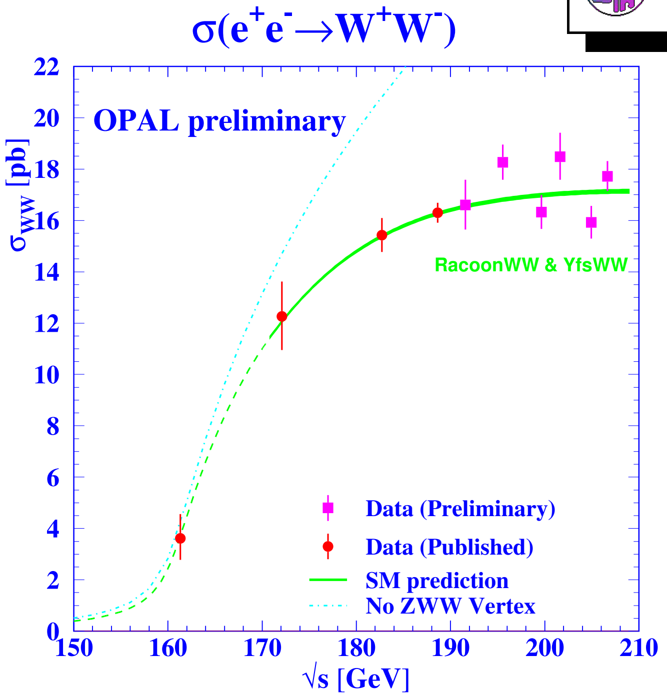
Many Thanks !!!

- OPAL recorded 218.963 pb^{-1}
  (Efficiency 92.1 %)
- All results are PRELIMINARY

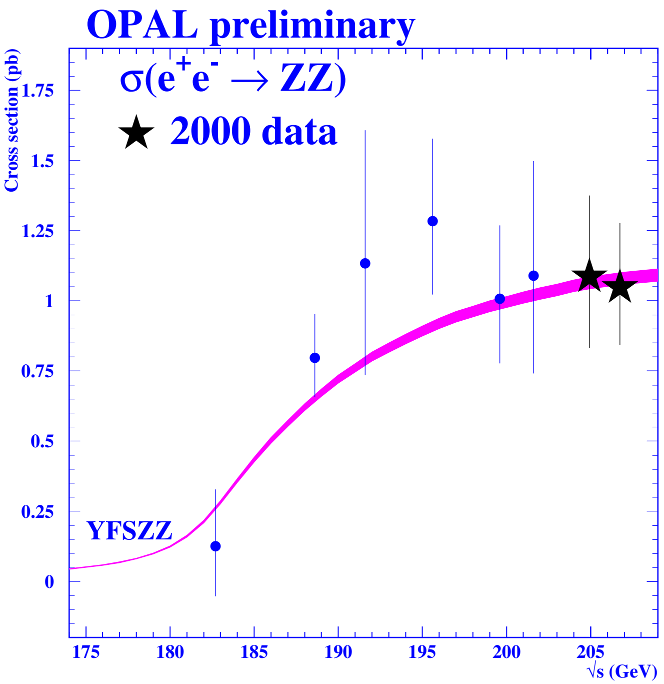
(not included)

LUMI (pb^{-1})	REF 23.Aug.	DELTA LEP: 18.Oct.	DELTA OPAL: 24.Oct.	TOTAL	Latest 2.Nov.
all $\sqrt{s}$	140	(51)	59	199	10.2
$\sqrt{s} > 206$ GeV	70	(43)	50	120	9.7

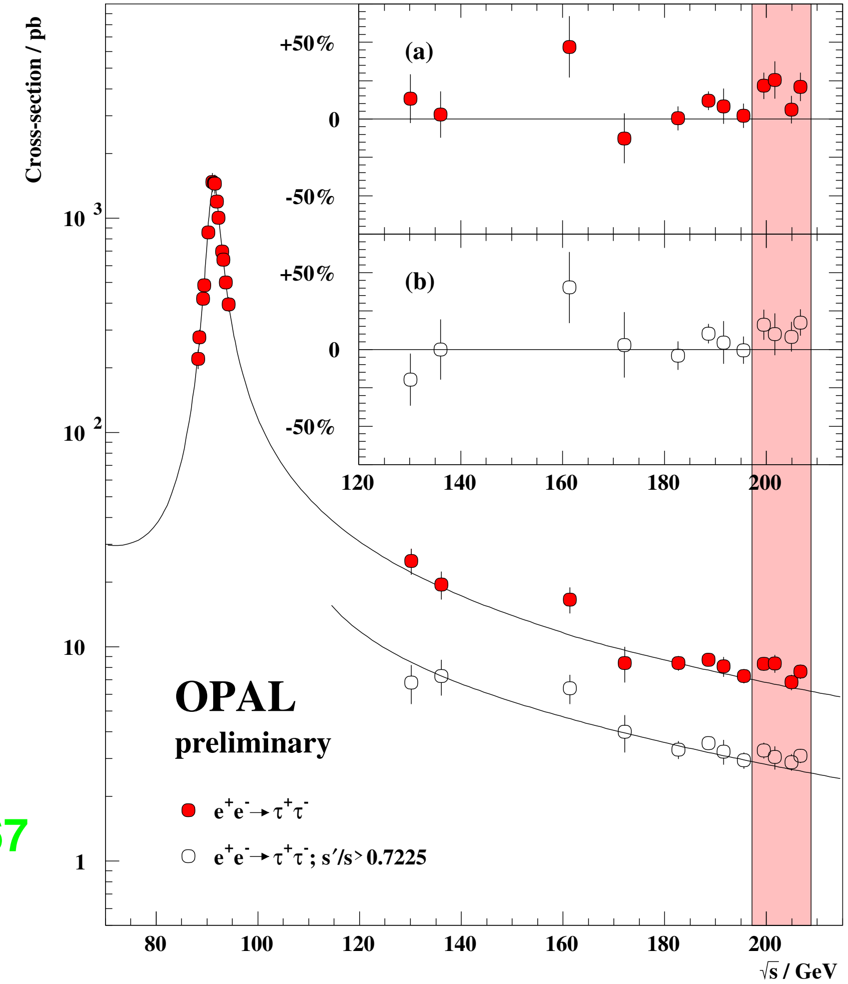
Standard Model Processes



▷ Good agreement of W-pair and Z-pair Xsecs with Standard Model



▷ More OPAL results on Standard Model in PN467



▷ 2-Fermion Xsecs agree generally well with SM

▷ 2.4 σ excess in $\tau^+\tau^-$ at highest $\sqrt{s}$

Searches Highlights

OPAL has searched for :

- Scalar quarks
- Anomalous production of leptonic events with missing energy
- Charginos
- Neutralinos
- Heavy long-lived charged particles
- Excited leptons
- Leptoquarks
- single top quark production
- $H^+ H^-$, $H \rightarrow \gamma\gamma$, hA production in MSSM

No significant excess observed, except for

search for charginos with

- $\Delta M_+ = m_{\tilde{\chi}_1^+} - m_{\tilde{\chi}^0} <$ 10 GeV
- nr. charged particles $\leq$ 4

	$\Delta M_+ <$ 5 GeV	5 GeV $< \Delta M_+ <$ 10 GeV
total bkg.	19.1 ± 3.9	20.7 ± 3.9
observed	26	33

Find more details in : PN466
PN468

SM Higgs Search: What's New ?

- **Almost 60 pb^{-1} of new data wrt. 5.September**

- **Si Reprocessing:**

  Since 30th June one ladder in Si-Vertex-Detector inefficient

  $\Rightarrow$ Reprocessing of data to improve in 4% of solid angle

  - **hit association**

- **Slight Modifications in 4jet analysis:**

  - **signal mass cocktail in likelihood reference changed from 99-114 GeV to 104-120 GeV**

  - **in likelihood inputs replace 5C-ZH fit probability by "equal-mass" fit probability $\longrightarrow$ suppress ZZ**

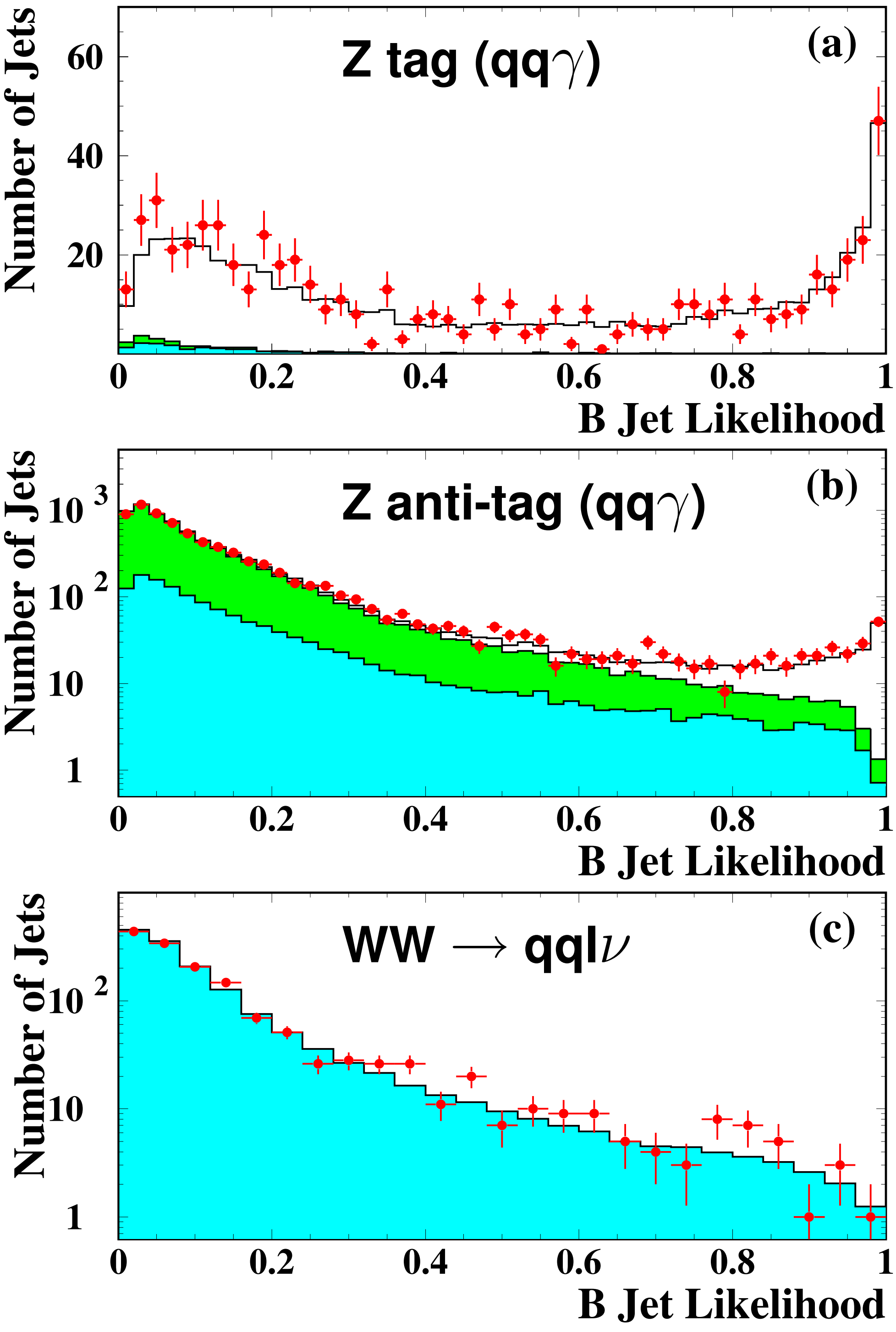
  - **in jet-pairing likelihood also consider pairings with low probability 5C-ZH fit $\longrightarrow$ suppress background**

OPAL analyses stable,

unbiased search for SM Higgs

B-Tagging Performance

OPAL Preliminary



Signal Efficiency
$\Rightarrow$ **ok**

Signal & Backgrd Fakes
$\Rightarrow$ **ok**

Backgrd Efficiency
$\Rightarrow$ **ok**

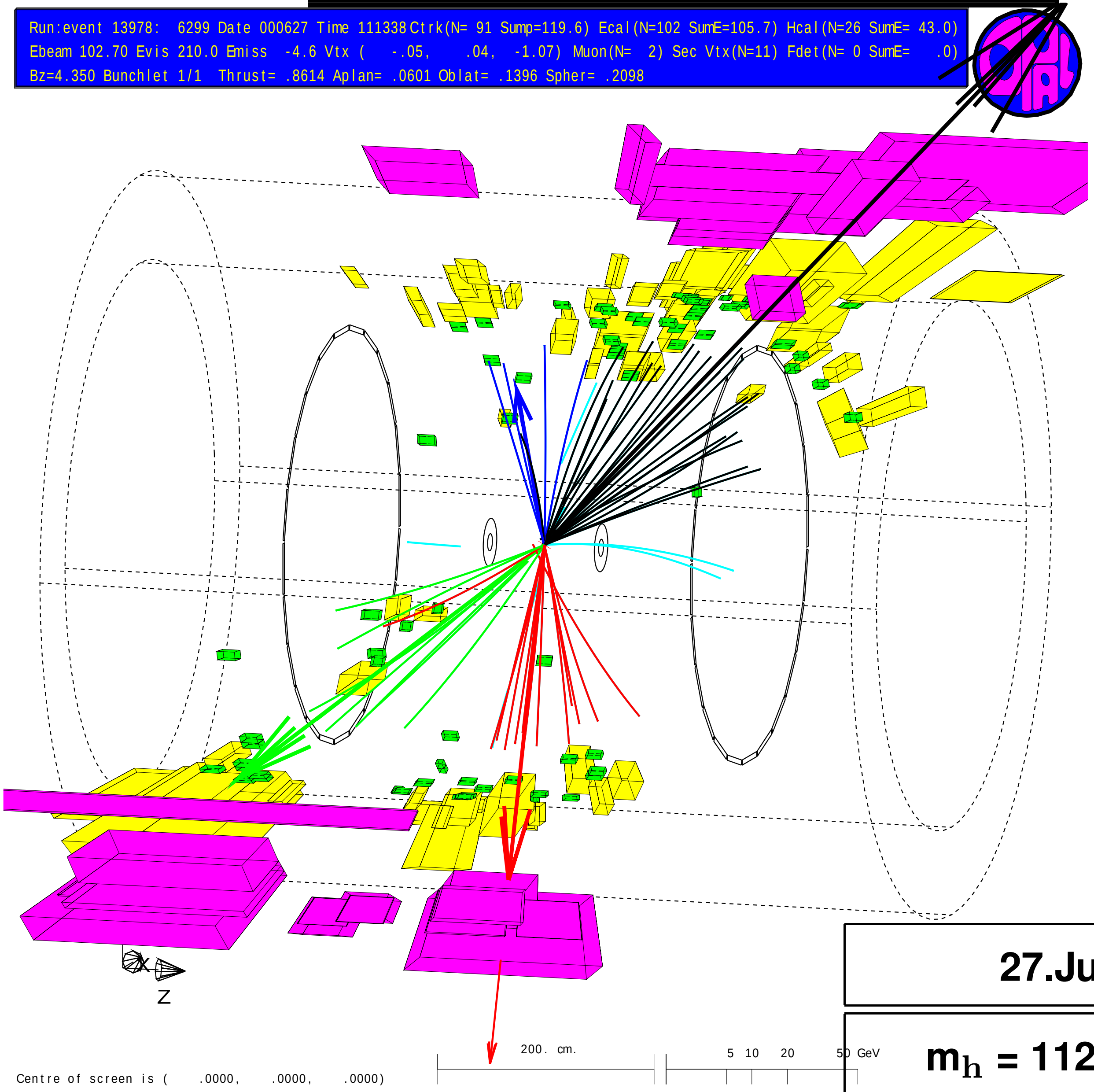
▷ **B-tag well described by MC and reliable !!!**

Event Overview

candidates observed at $m_{rec} \geq$ 105 GeV or s/b (115 GeV) $\geq$ 0.1 :

m_{rec} [GeV]	channel	$\sqrt{s}$ [GeV]	s/b (114 GeV)	since 5.Sept.
112.6	4jet	205.4	0.5234	
104.0	$\nu\nu$	205.4	0.3190	$\surd$
112.2	$\nu\nu$	206.4	0.2522	$\surd$
108.2	$\nu\nu$	206.8	0.2178	
100.6	4jet	206.8	0.2037	$\surd$
101.8	$\nu\nu$	206.6	0.1949	
109.8	4jet	205.4	0.1703	
112.7	$\nu\nu$	206.8	0.1565	$\surd$
107.2	4jet	206.6	0.1388	$\surd$
99.1	$\nu\nu$	206.6	0.1229	$\surd$
111.7	$\nu\nu$	206.8	0.0985	$\surd$
124.7	ee	205.4	0.0903	
105.3	$\tau\tau$	205.3	0.0672	$\surd$
112.3	$\nu\nu$	207.0	0.0616	
108.5	$\nu\nu$	206.6	0.0555	$\surd$
110.5	$\nu\nu$	205.4	0.0458	$\surd$
107.3	4jet	206.8	0.0426	$\surd$
108.4	$\nu\nu$	206.4	0.0393	$\surd$
109.9	$\nu\nu$	206.6	0.0234	
109.9	$\nu\nu$	206.6	0.0234	
105.0	4jet	206.4	0.0193	$\surd$
114.8	$\nu\nu$	206.6	0.0049	

Event Discussion (4-jet)



27.June

$\mathbf{m_h}$ **= 112.6 GeV**

B-tag(1) = 0.345

B-tag(2) = 0.960

$\sqrt{s}$ **= 205.4 GeV**

$\mathcal{L}$ **= 0.999**

s/b(105 GeV) = 0.2844

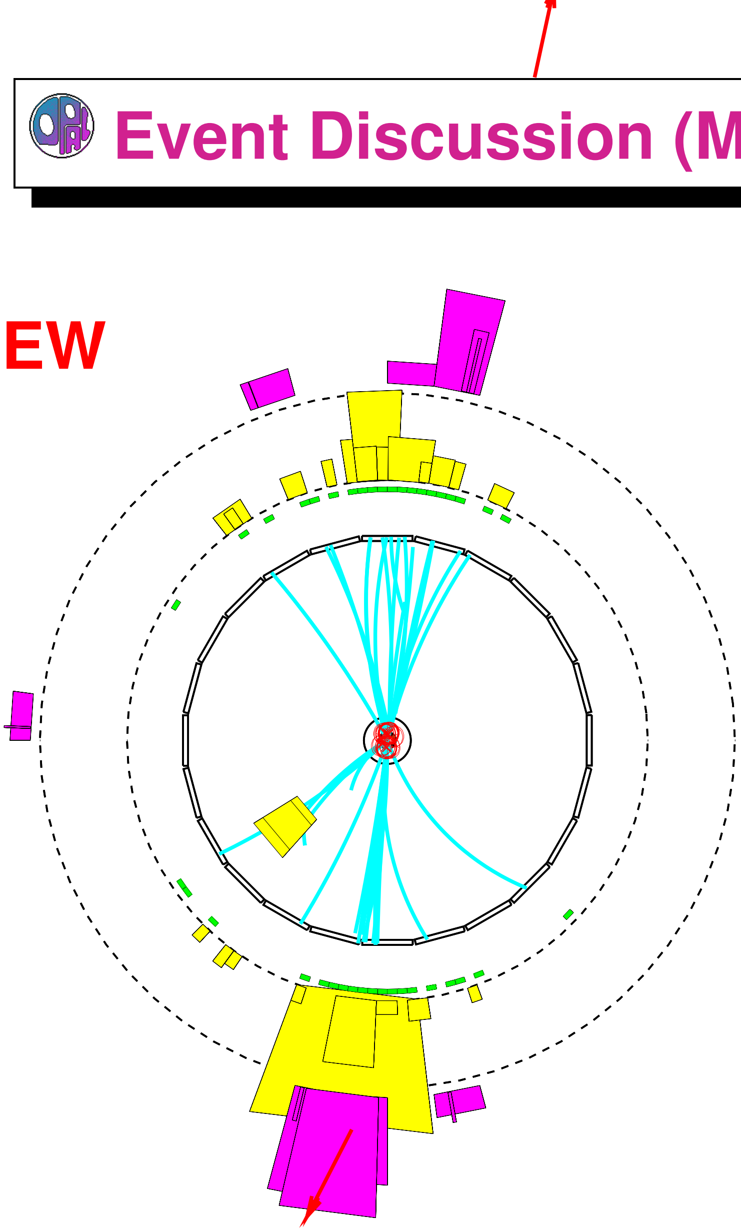
s/b(110 GeV) = 1.1355

s/b(115 GeV) = 0.5234

▷ **Highest weight OPAL candidate**

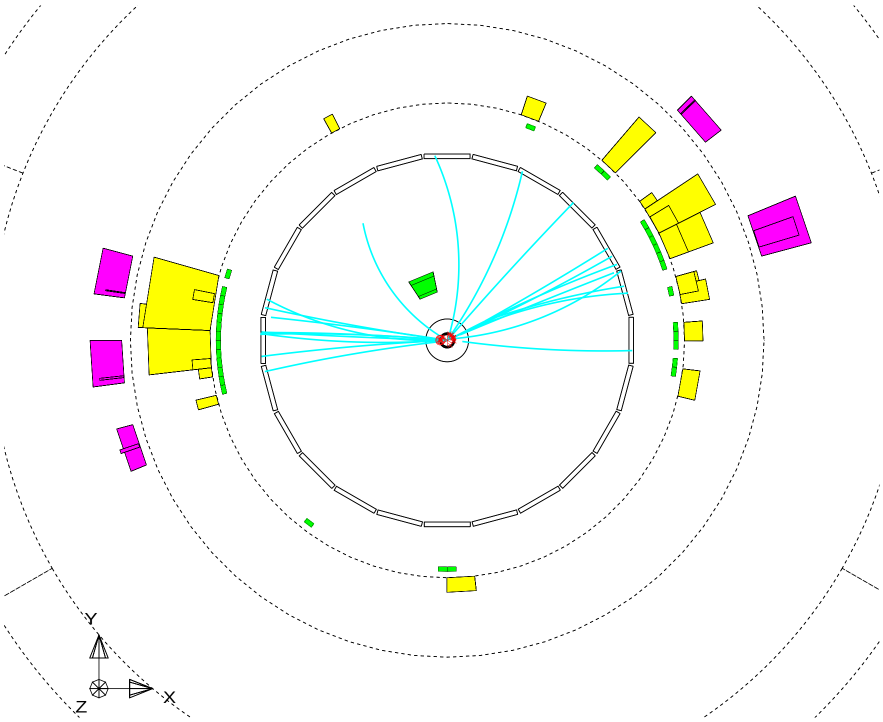
Event Discussion (Missing Energy)

NEW



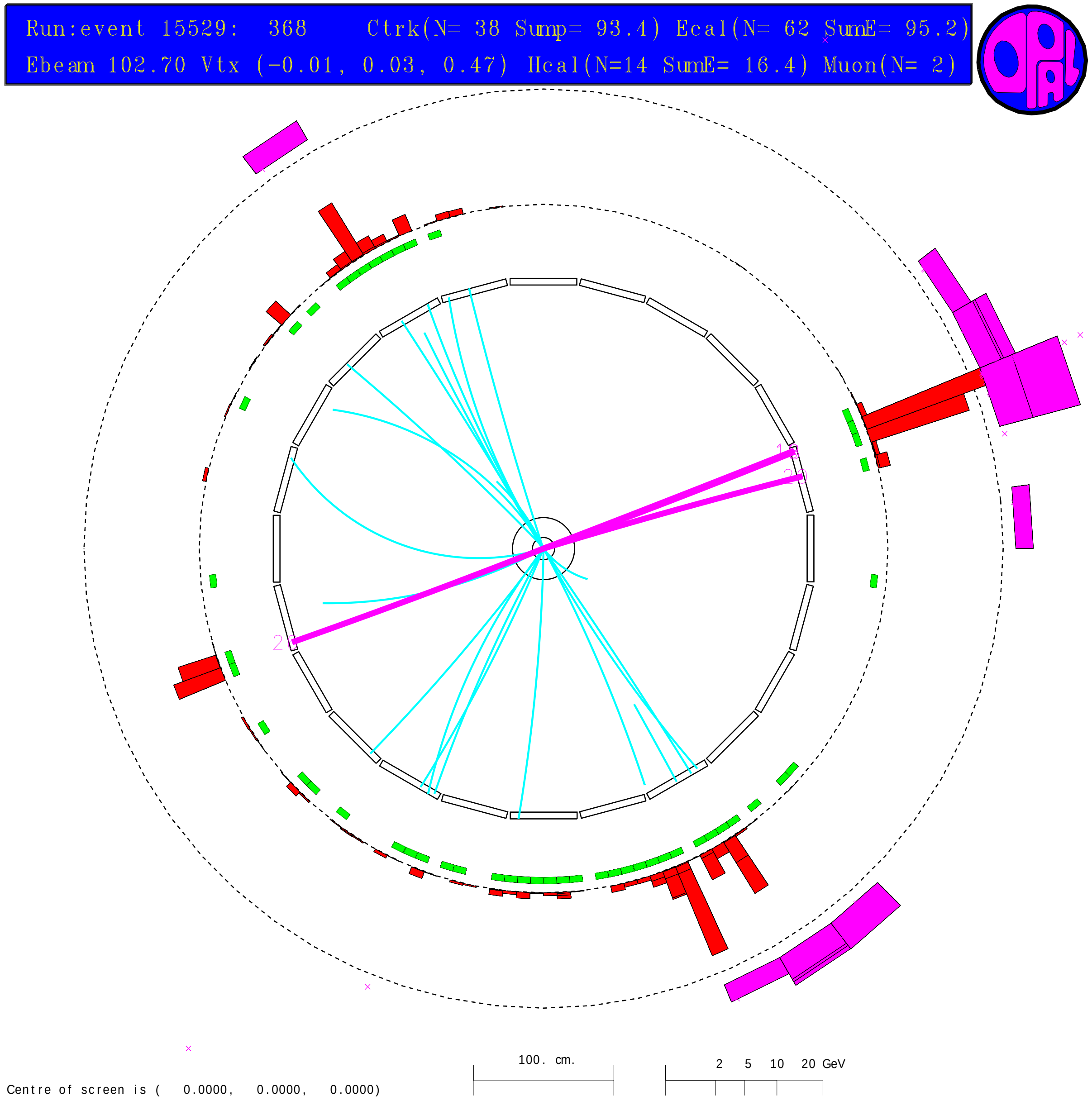
11.October
m_h = 112.2 GeV
B-tag(1) = 0.702
B-tag(2) = 0.460
$\sqrt{s}$ = 206.4 GeV
$\mathcal{L}$ = 0.853
s/b(105 GeV) = 0.1836
s/b(110 GeV) = 0.4659
s/b(115 GeV) = 0.2522

NEW



26.August
m_h = 104.0 GeV
B-tag(1) = 0.936
B-tag(2) = 0.973
$\sqrt{s}$ = 205.4 GeV
$\mathcal{L}$ = 0.9994
s/b(105 GeV) = 4.8461
s/b(110 GeV) = 1.0708
s/b(115 GeV) = 0.3190

Event Discussion ($\tau\tau$)



NEW

17.September

m_h = 105.3 GeV

$m_{\tau\tau}$ = 90.7 GeV

B-tag(1) = 0.9776

B-tag(2) = 0.7492

$\sqrt{s}$ = 205.3 GeV

$\mathcal{L}_{bb\tau\tau}$ = 0.993

$\mathcal{L}_{\tau\tau qq}$ = 0.602

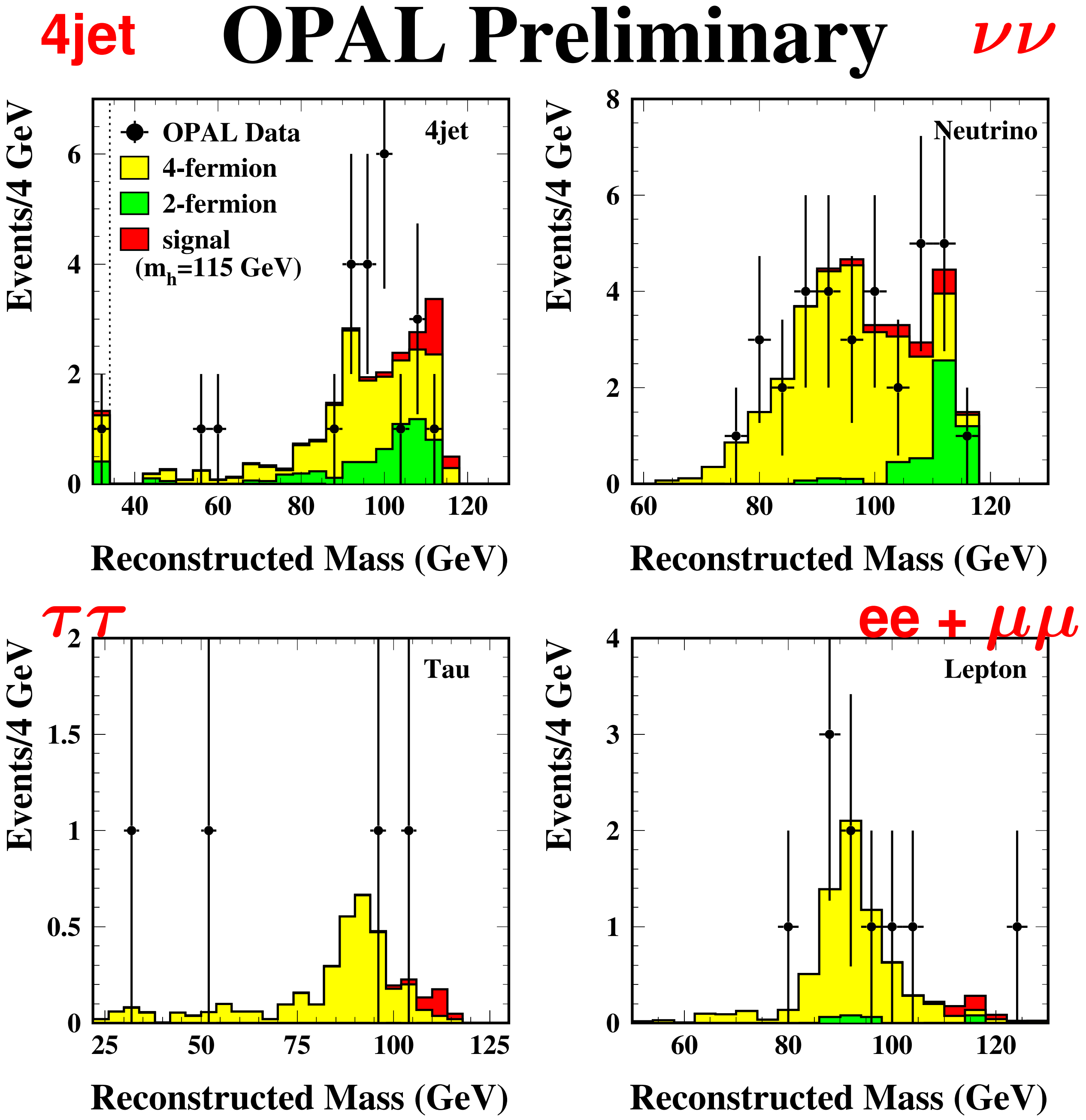
s/b(105 GeV) = 5.3773

s/b(110 GeV) = 0.6132

s/b(115 GeV) = 0.0672

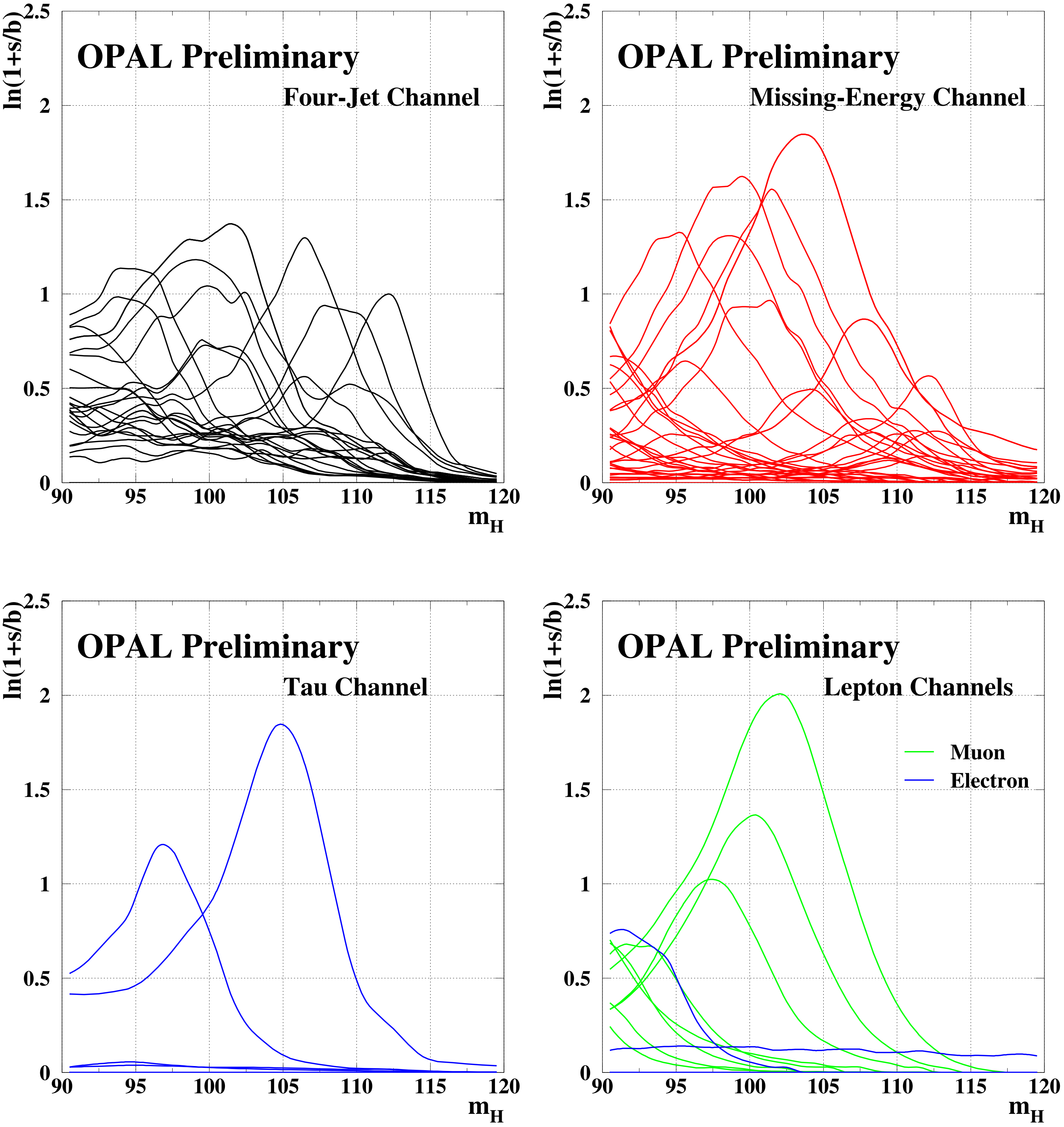
(also in MSSM selection)

Massplots



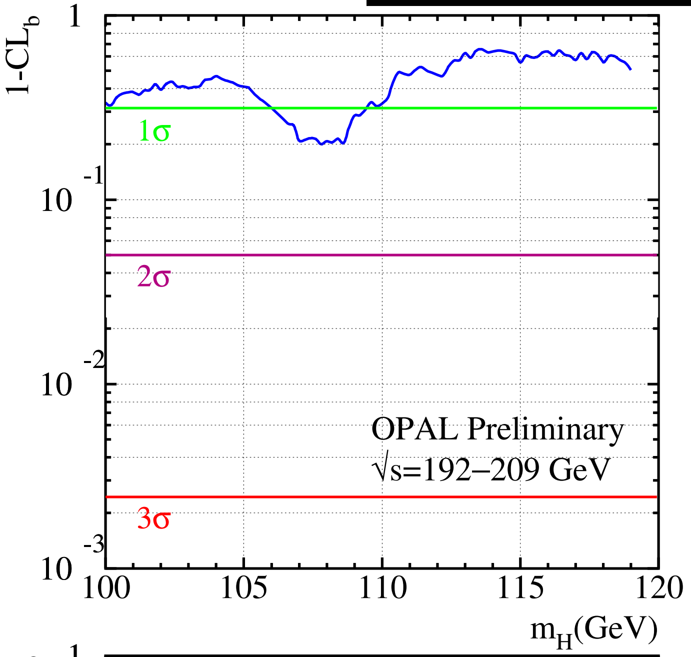
Channel	Data	Bkg.	Efficiency & (signal events)	
			m_h = 110 GeV	m_h = 115 GeV
4-jet	23	20.2 $\pm$ 2.5	44.5 (7.21)	45.2 (1.83)
$\nu\nu$	34	31.9 $\pm$ 3.3	53.4 (3.87)	45.7 (1.25)
$\tau\tau$	4	3.5 $\pm$ 0.5	29.5 (0.79)	24.1 (0.20)
ee	2	3.6 $\pm$ 0.5	54.2 (0.54)	52.2 (0.15)
$\mu\mu$	8	3.3 $\pm$ 0.6	59.4 (0.64)	60.5 (0.18)

Event Weight Distribution



▷ **Low mass candidates contribute to hypothesis of m_h = 115 GeV**

Combined Results



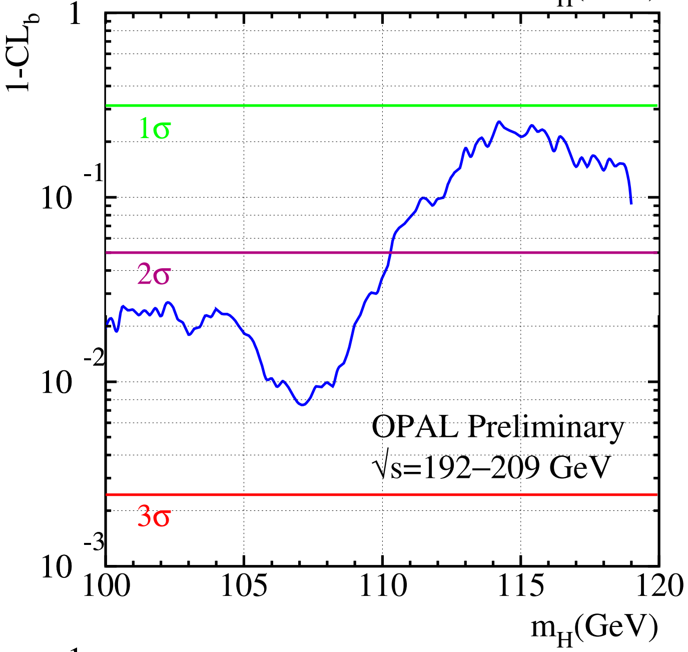
REF (5.Sept.)

$1\text{-}CL_b$ @ 115 GeV

0.6 σ

Min. of $1\text{-}CL_b$ @ $\sim$ 107 GeV

$\sim$ 1.2 σ



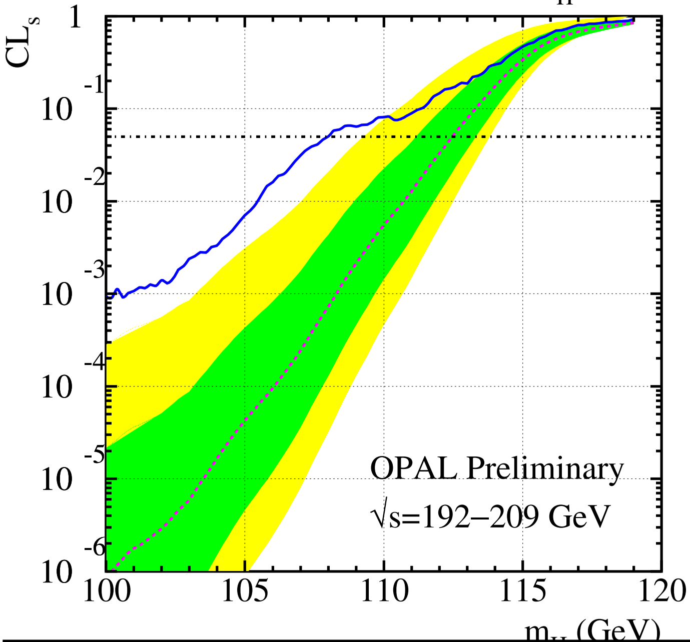
TOTAL (3.Nov.)

$1\text{-}CL_b$ @ 115 GeV

$\sim$ 1.2 σ

Min. of $1\text{-}CL_b$ @ $\sim$ 107 GeV

2.6 σ



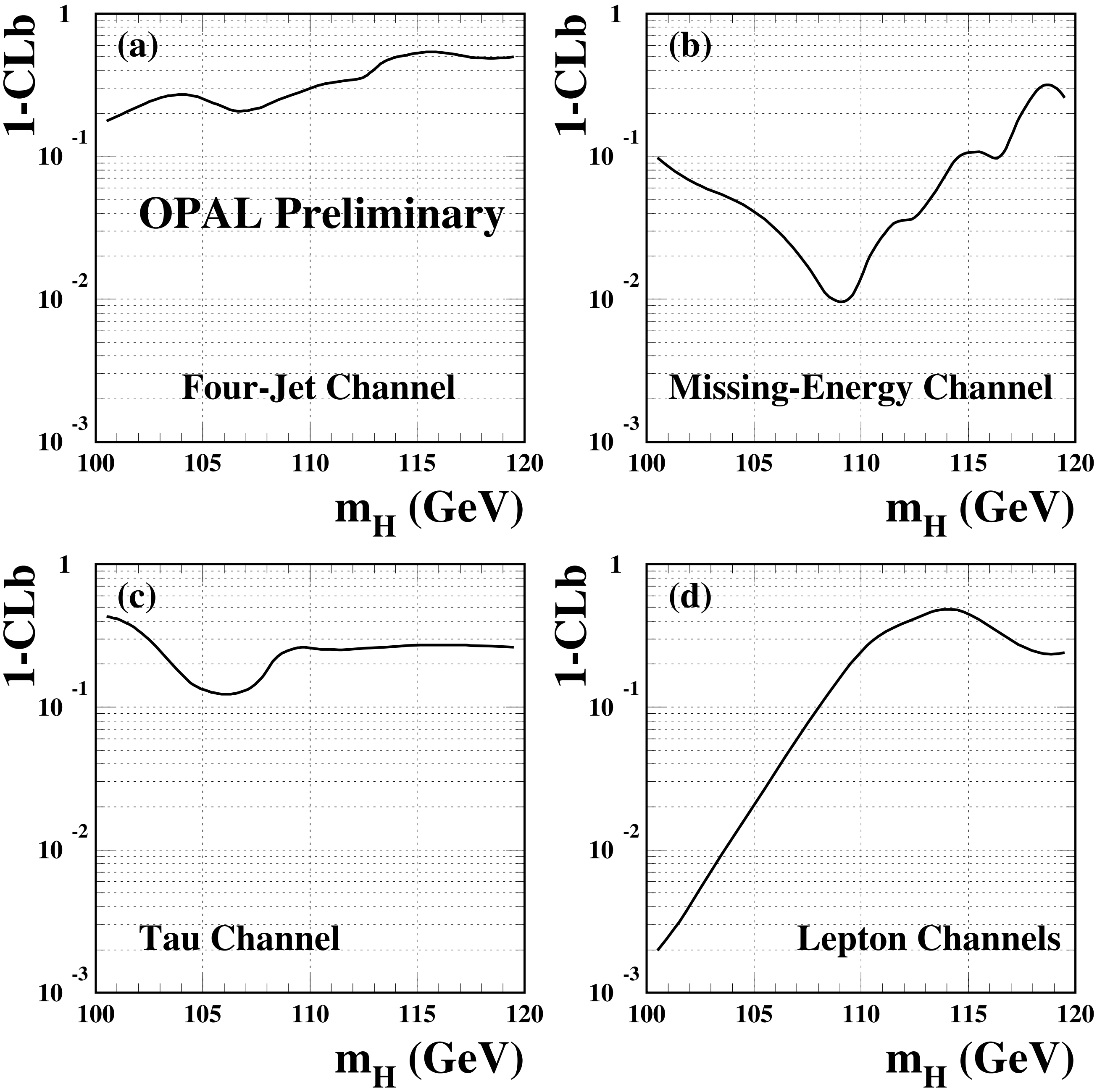
TOTAL (3.Nov.)

95% CL exclusion limit :

obs.: $m_h > 108.0$ GeV

exp.: $m_h > 112.5$ GeV

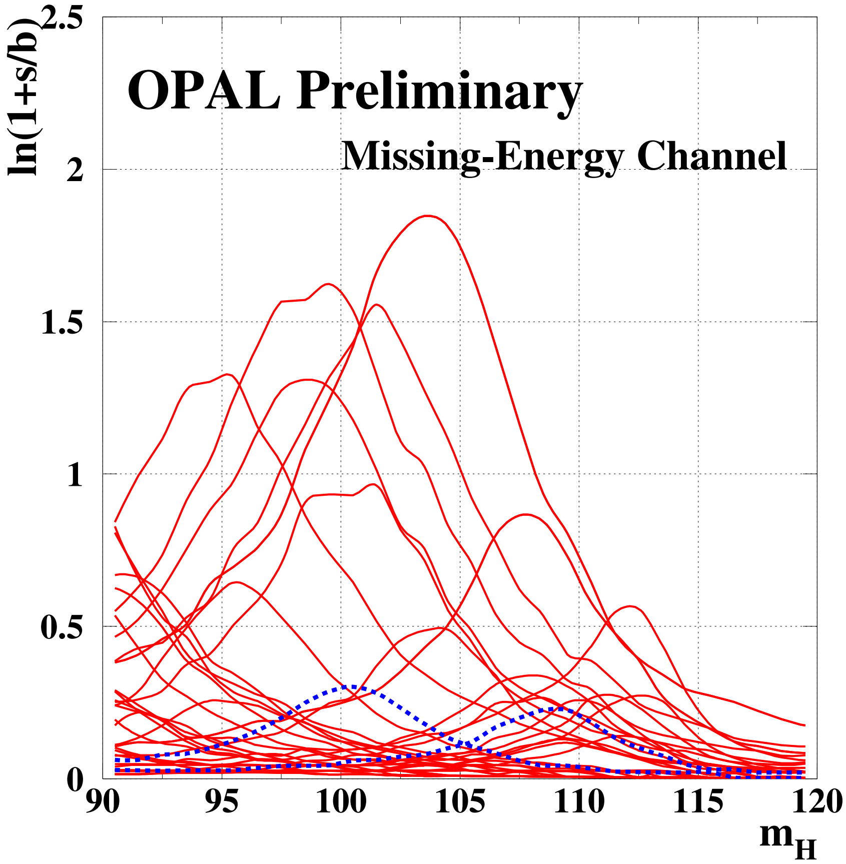
1-CL_b by Channel (Nov.3)



▷ **Several channels contribute**

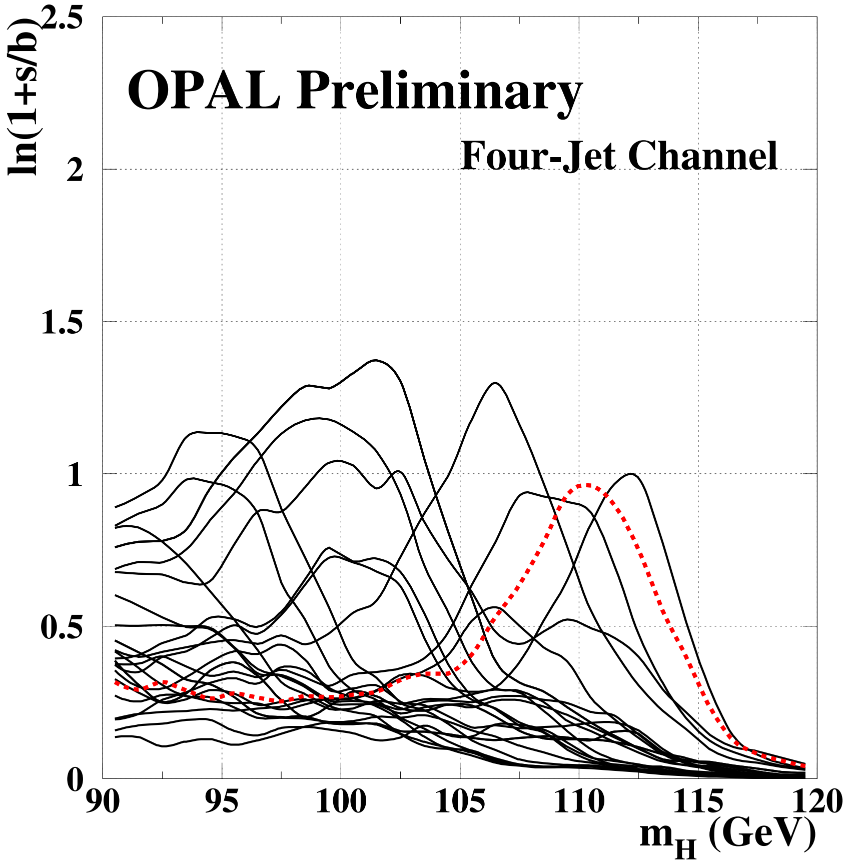
Latest Event Weight Evolution

candidates observed at $m_{rec} \geq 100$ GeV after 24.October :



missing energy
m_{rec} = 109.2 GeV
B-tag(1) = 0.440
B-tag(2) = 0.161
$\mathcal{L}$ = 0.4120

m_{rec} = 100.8 GeV
B-tag(1) = 0.678
B-tag(2) = 0.998
$\mathcal{L}$ = 0.450



4-jet
m_{rec} = 110.5 GeV
B-tag(1) = 0.937
B-tag(2) = 0.409
$\mathcal{L}$ = 0.9947

Summary

- OPAL observes good Higgs candidates
  - ▷ mainly in missing energy channel
  - ▷ other channels contribute as well
- On expectation for 'signal (m_{h} = 115 GeV) + background' hypothesis
- But still consistent with 'background-only' hypothesis
- Exclusion limits : 112.5 GeV exp.
  108.0 GeV obs. at 95% CL
- A 5 σ discovery of a SM Higgs of 115 GeV is within reach, if LEP runs at $\sqrt{s} \approx$ 208 GeV

OPAL strongly supports the request to run in 2001