The ATLAS Forward Physics Project (AFP)

Christophe Royon
IRFU-SPP, CEA Saclay

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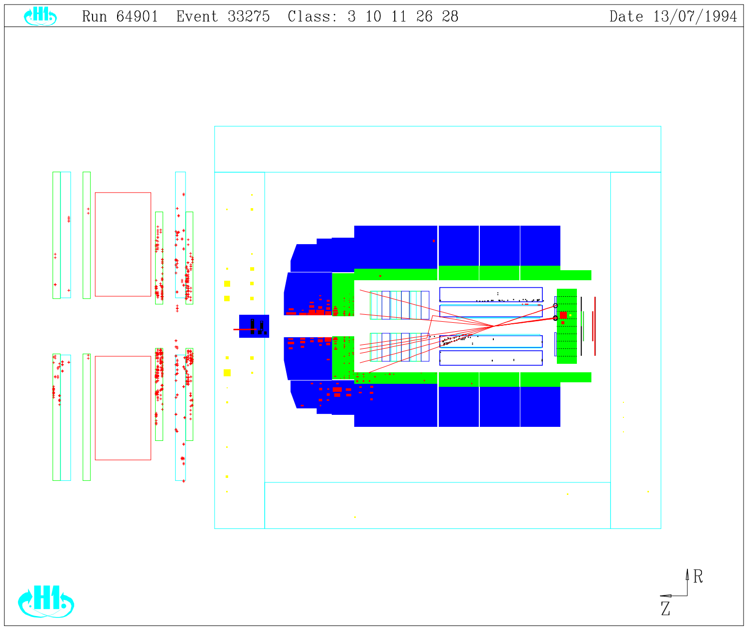
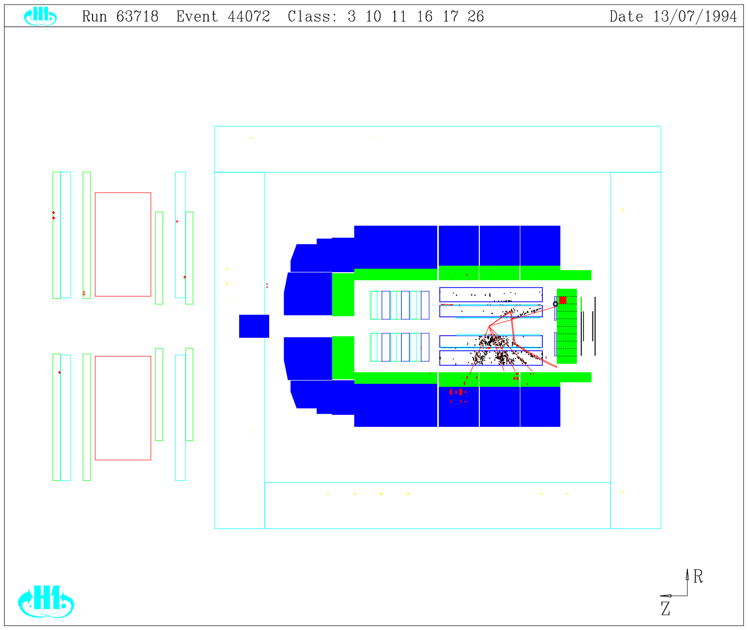
- ATLAS Forward Physics (AFP) project

Definition of diffraction: example of HERA

- Typical DIS event: part of proton remnants seen in detectors in forward region (calorimeter, forward muon...)
- HERA observation: in some events, no energy in forward region, or in other words no colour exchange between proton and jets produced in the hard interaction
- Leads to the first experimental method to detect diffractive events: rapidity gap in calorimeter: difficult to be used at the LHC because of pile up events
- Second method to find diffractive events: Tag the proton in the final state, method to be used at the LHC (example of AFP project)

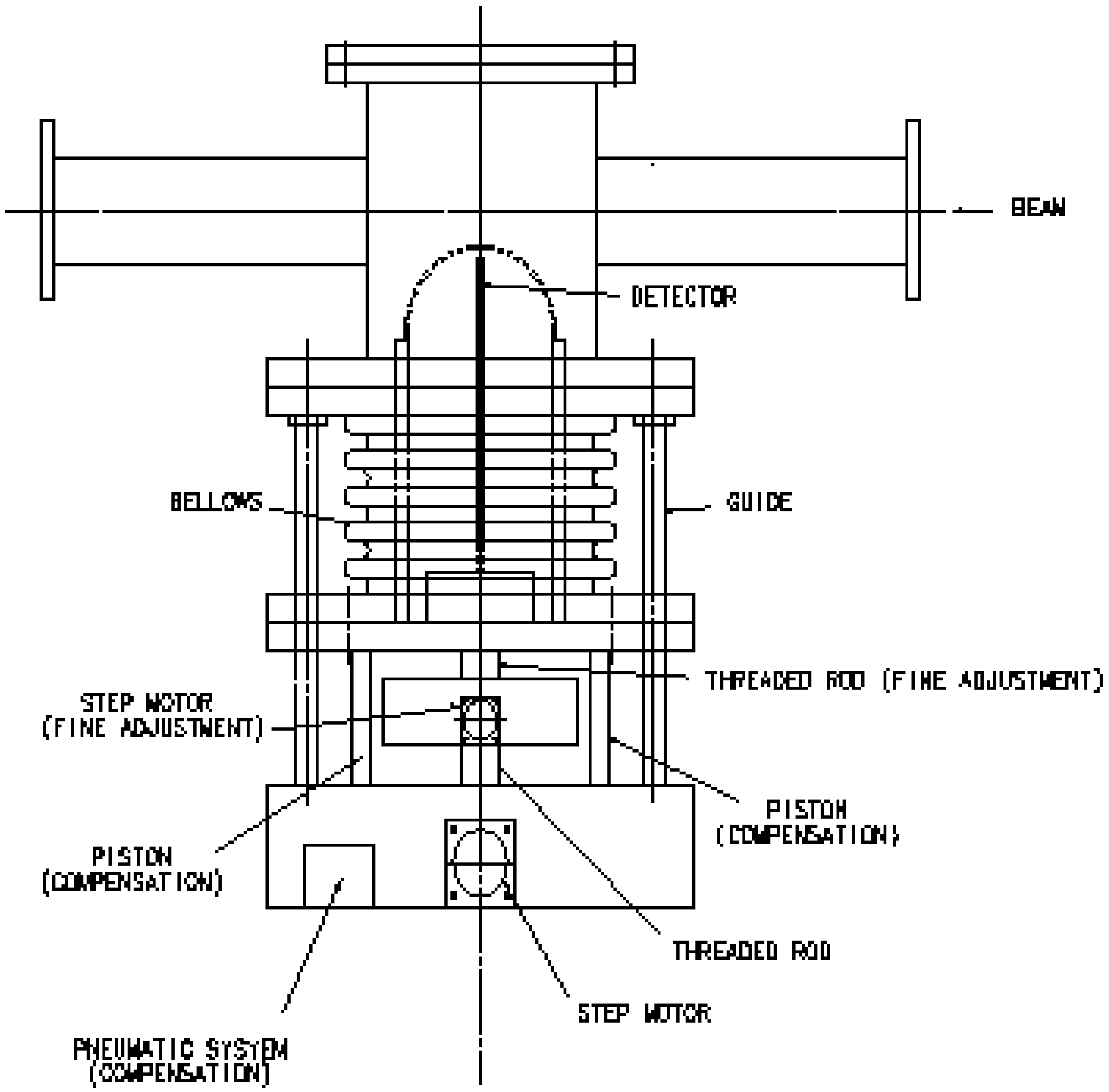
DIS and Diffractive event at HERA



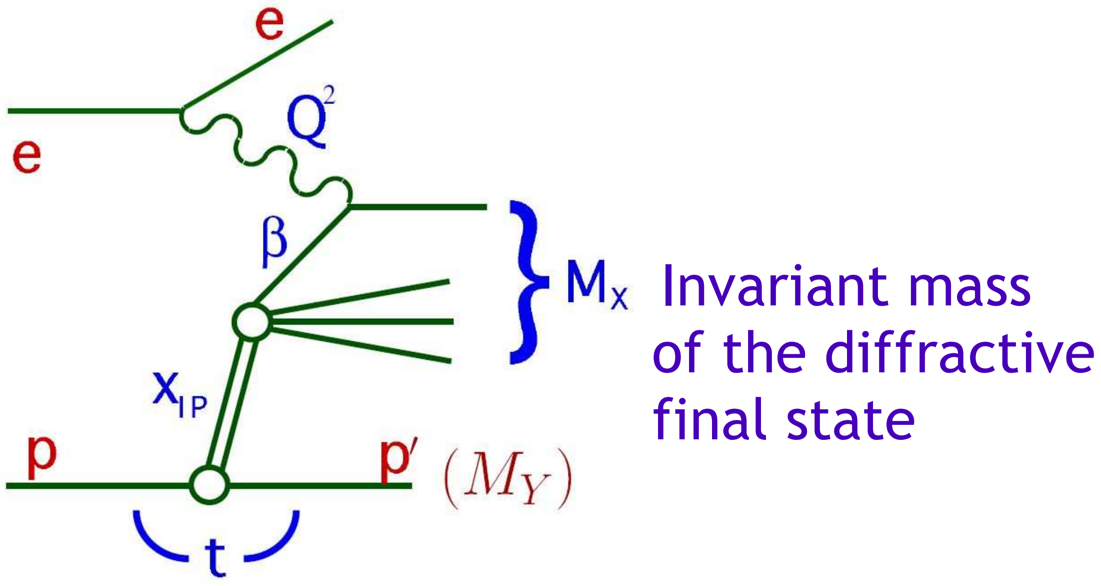


Scheme of a roman pot detector

Scheme of roman pot detector: traditionally used in diffraction



Diffractive kinematical variables



- Momentum fraction of the proton carried by the colourless object (pomeron): $x_p = \xi = \frac{Q^2+M_X^2}{Q^2+W^2}$
- Momentum fraction of the pomeron carried by the interacting parton if we assume the colourless object to be made of quarks and gluons: $\beta = \frac{Q^2}{Q^2+M_X^2} = \frac{x_{Bj}}{x_P}$
- 4-momentum squared transferred: $t = (p - p')^2$

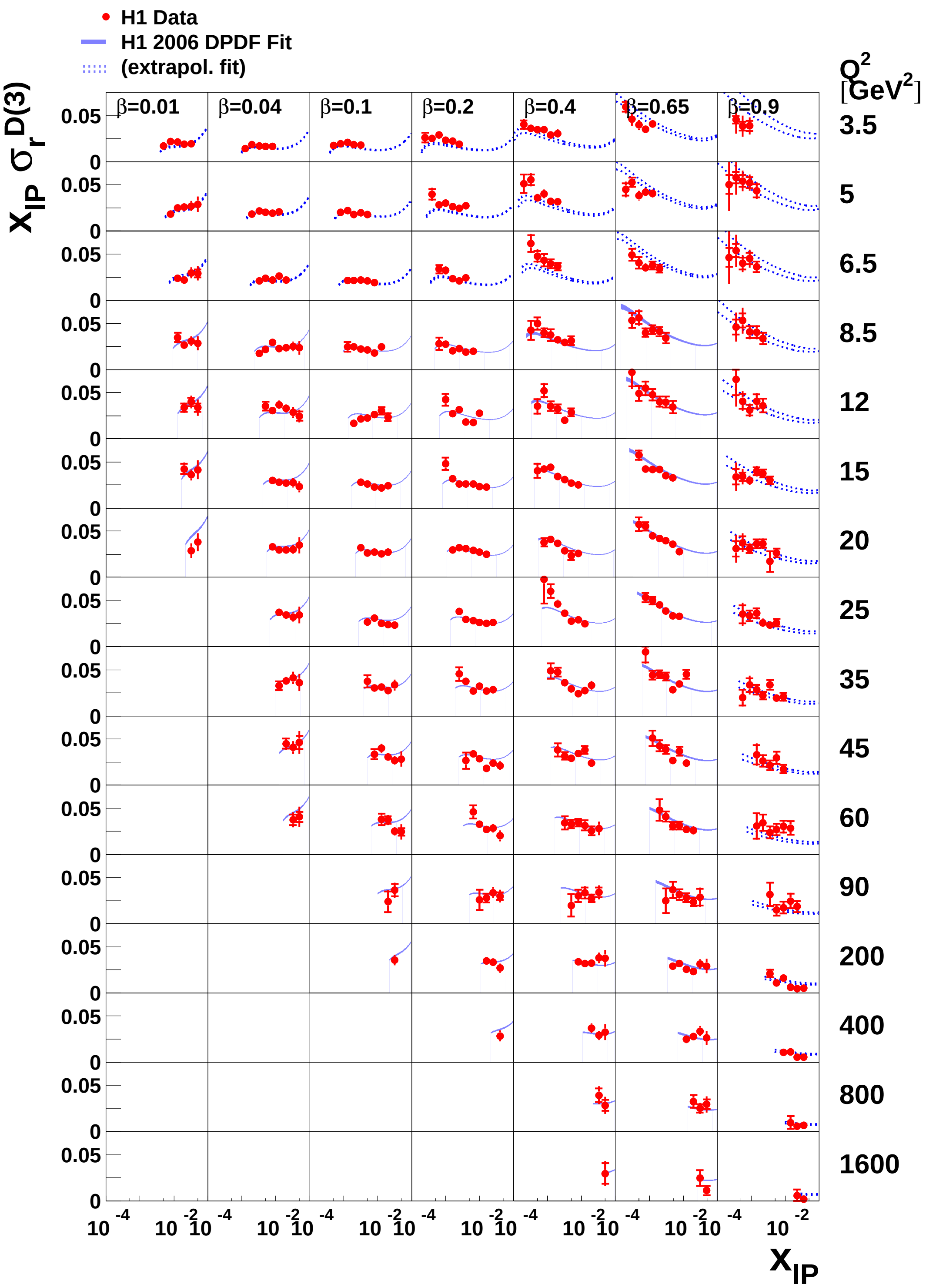
Measurement of the diffractive structure function F_2^D

- Measurement of the diffractive cross section using the rapidity gap selection over a wide kinematical domain in (x_P, β, Q^2) (same way as F_2 is measured, there are two additional variables for diffraction, t is not measured)
- Definition of the reduced cross section:

$$\frac{d^3\sigma^D}{dx_P dQ^2 d\beta} = \frac{2\pi\alpha_{em}^2}{\beta Q^4}\left(1 - y + \frac{y^2}{2}\right)\sigma_r^D(x_P, Q^2, \beta)$$

- As an example: H1 data
- Use these data to make QCD fits and determine the pomeron structure in quarks and gluons: $\rightarrow$ allows to predict inclusive diffraction at Tevatron/LHC introducing the concept of survival probability

Measurement of the diffractive structure function F_2^D



Extraction of the parton densities in the pomeron (H1)

- Assume pomeron made of quarks and gluons: perform QCD DGLAP fits as for the proton structure function starting from xG and xq distributions at a given Q_0^2, and evolve in Q^2 (the form of the distributions is MRS like)

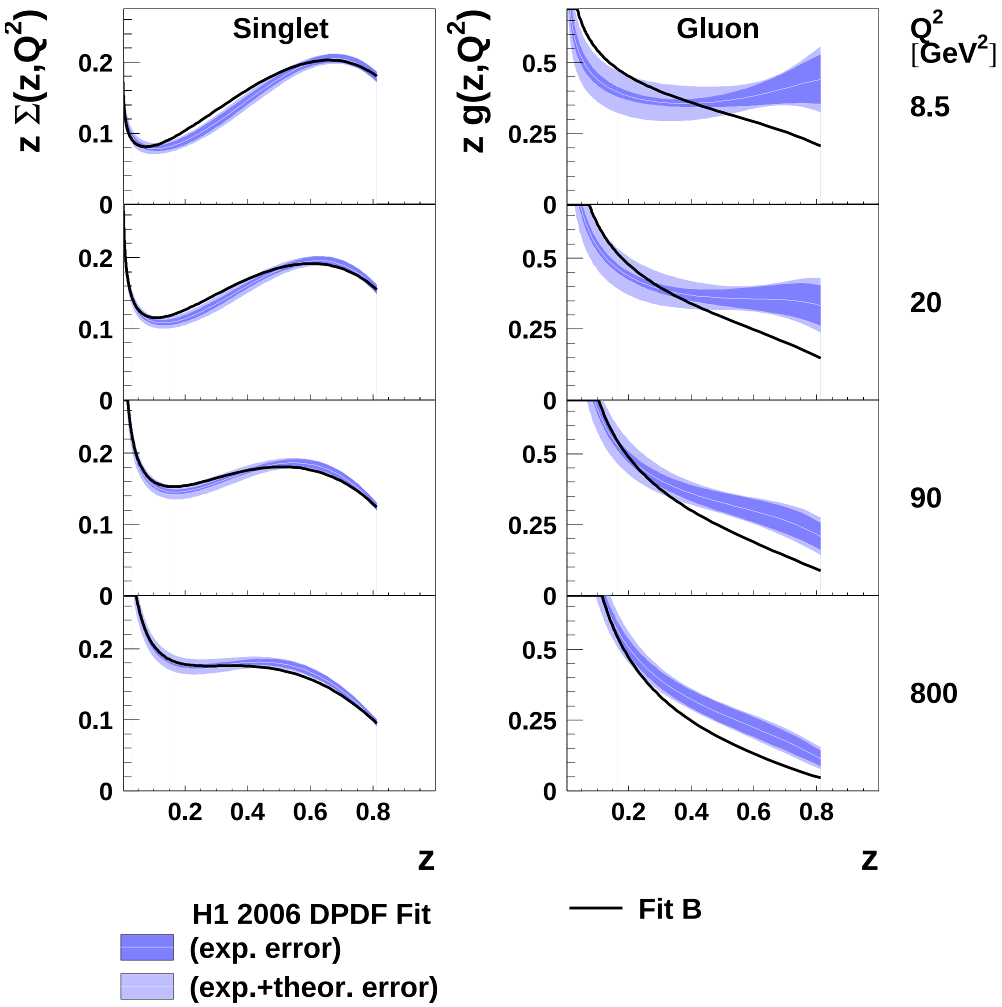
$$\begin{aligned} \beta q &= A_q \beta^{B_q} (1-\beta)^{C_q} \\ \beta G &= A_g (1-\beta)^{C_g} \end{aligned}$$

- At low β: evolution driven by $g \to q\bar{q}$, at high β, $q \to qg$ becomes important
- Take all data for $Q^2 > 8.5$ GeV^2, $\beta < 0.8$ to be in the perturbative QCD region and avoid the low mass region (vector meson resonances)

$$\frac{dF_2^D}{d\log Q^2} \sim \frac{\alpha_S}{2\pi} \left[P_{qg} \otimes g + P_{qq} \otimes \Sigma \right]$$

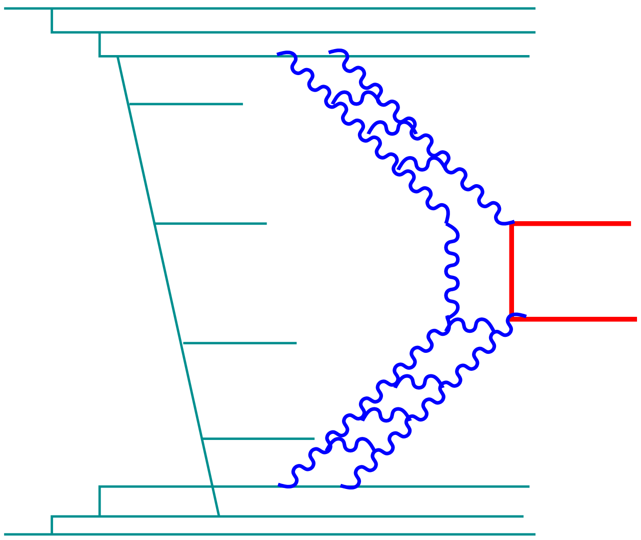
Parton densities in the pomeron (H1)

- Extraction of gluon and quarks densities in pomeron: gluon dominated
- Gluon density poorly constrained at high β (imposing $C_g = 0$ leads to a good fit as well, Fit B)
- Good description of final states

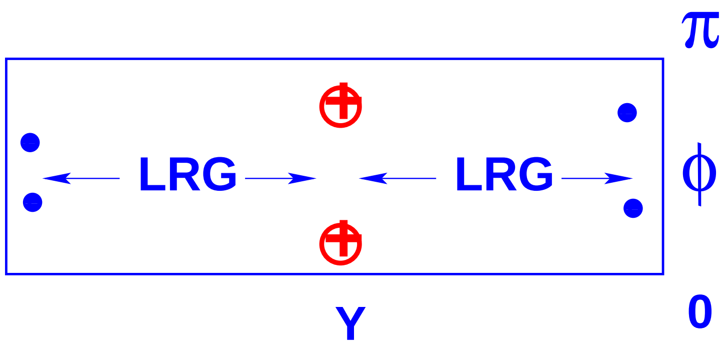


Factorisation at Tevatron/LHC?

- Is factorisation valid at Tevatron/LHC? Can we use the parton densities measured at HERA to use them at the Tevatron/LHC?
- Factorisation is not expected to hold: soft gluon exchanges in initial/final states
- Survival probability: Probability that there is no soft additional interaction, that the diffractive event is kept
- Value of survival probability assumed in these studies: 0.1 at Tevatron (measured), 0.03 at LHC (extrapolated)



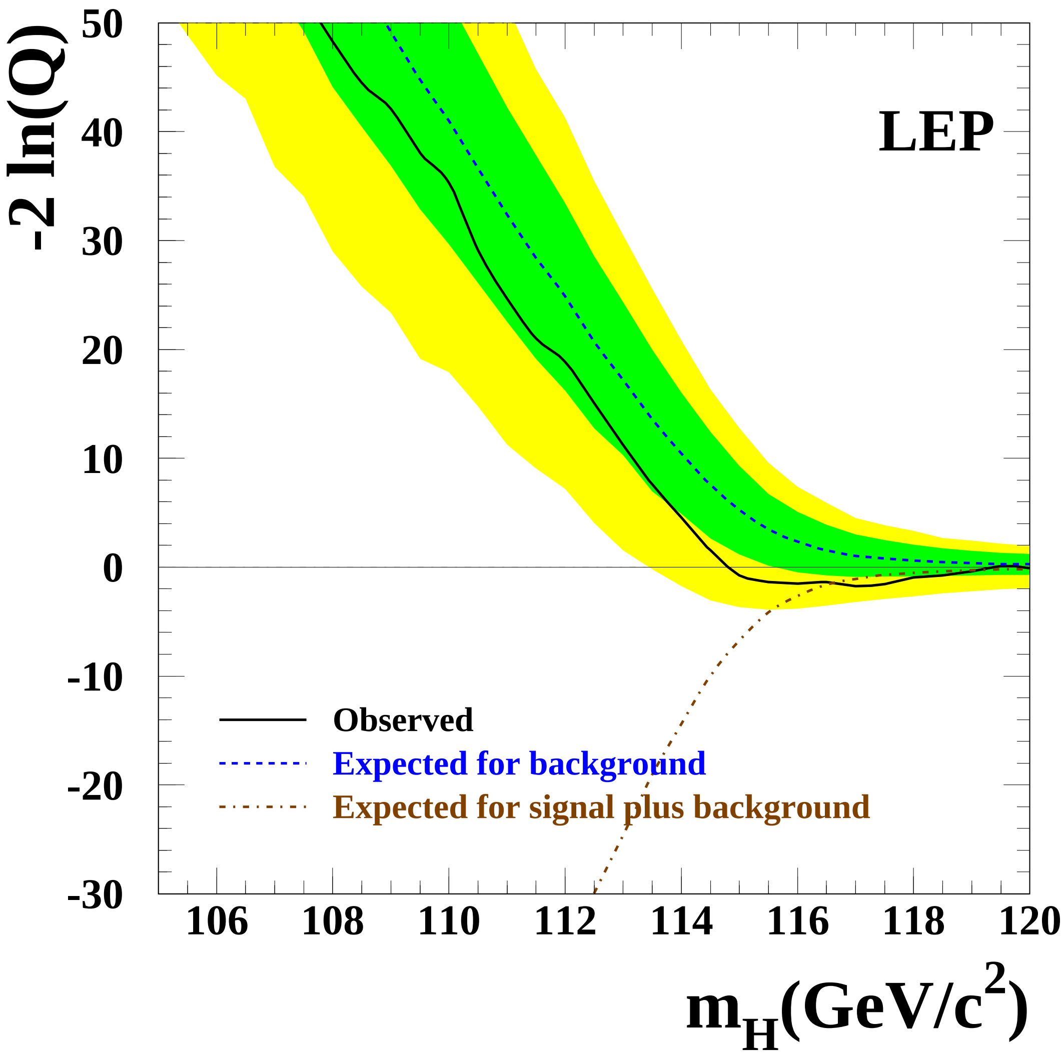
a)



b)

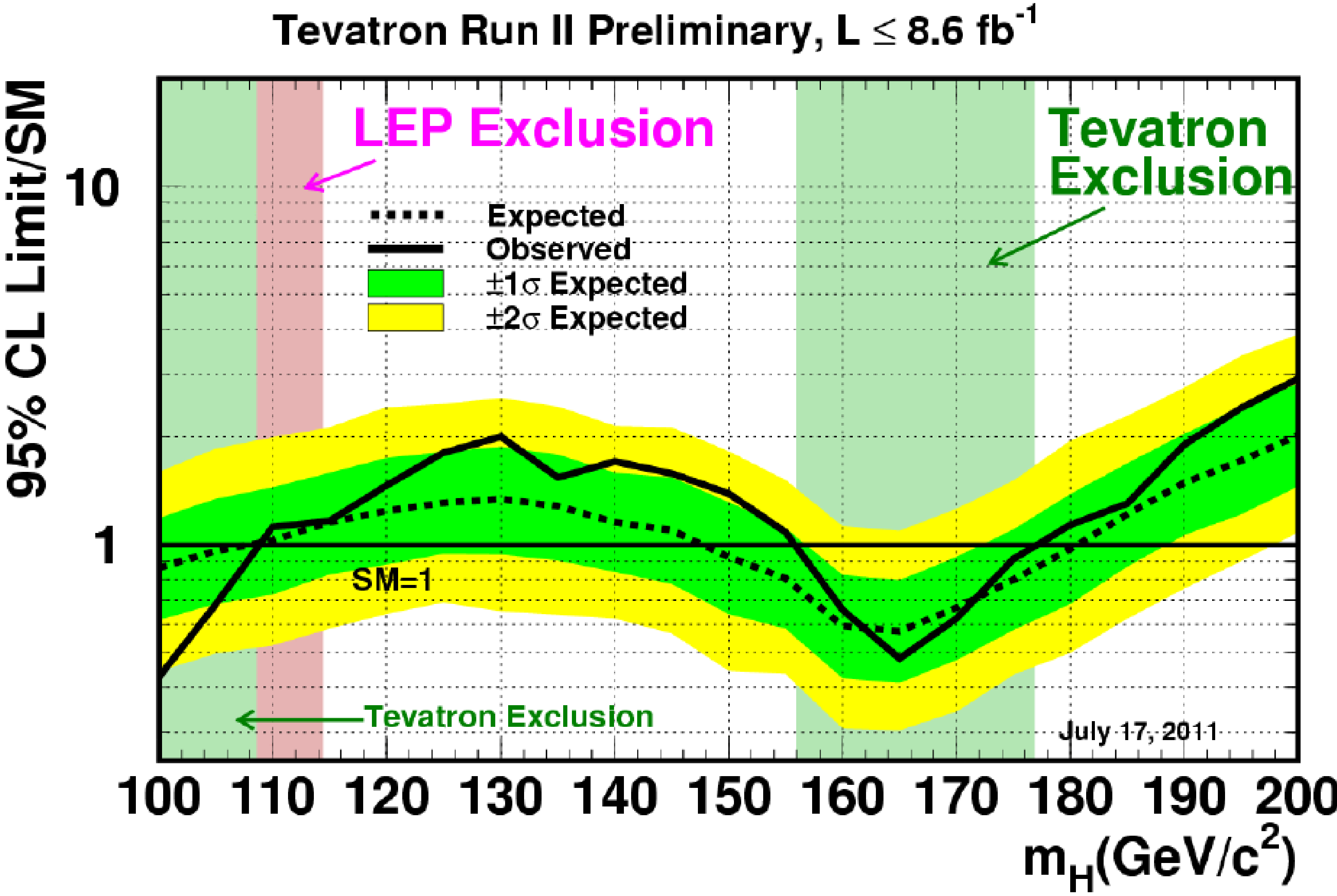
LEP experiments limits on Higgs mass

- Q: ratio of the probability to observe what has been seen if it is a Higgs signal by the probability to observe the same if it is only background
- Limit on Higgs mass: 114.4 GeV



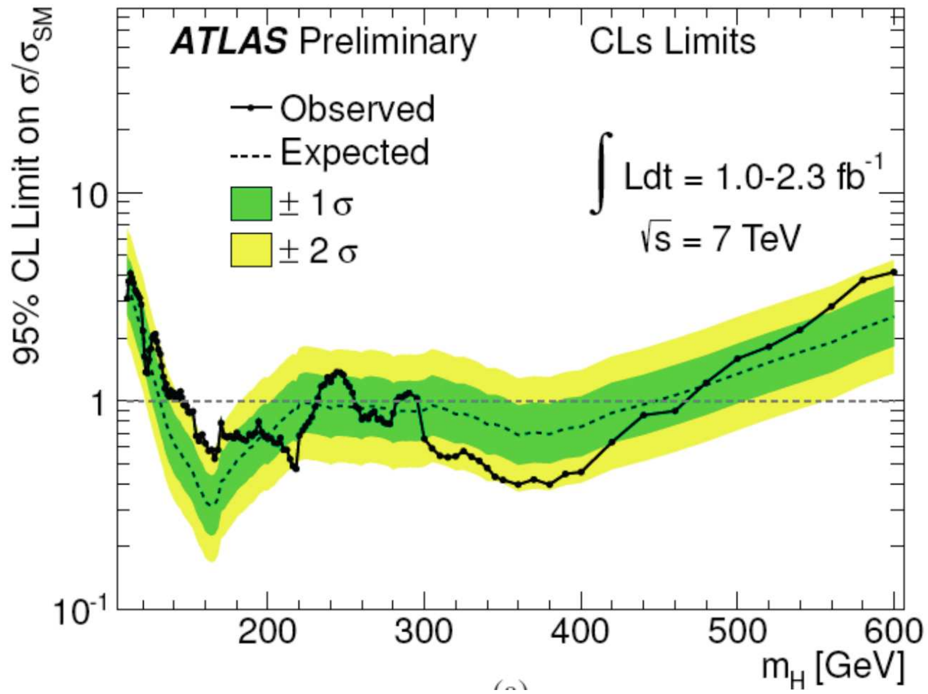
Tevatron limit on Higgs mass

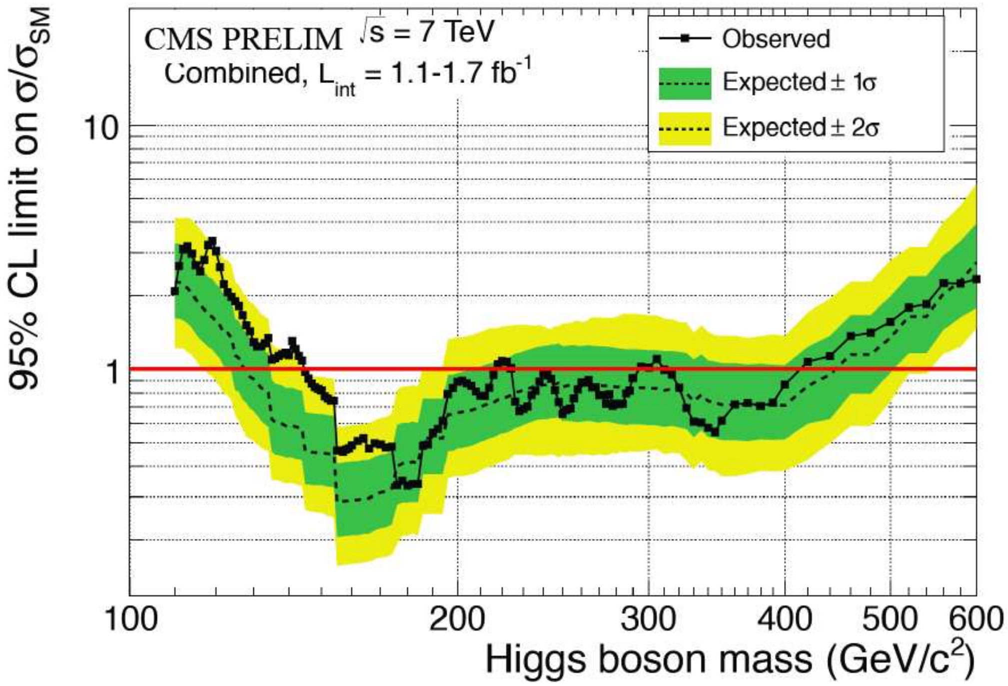
Best sensitivity around 165 GeV; new D0-CDF combination excludes region around 156-177 GeV



ATLAS/CMS limits on Higgs boson mass

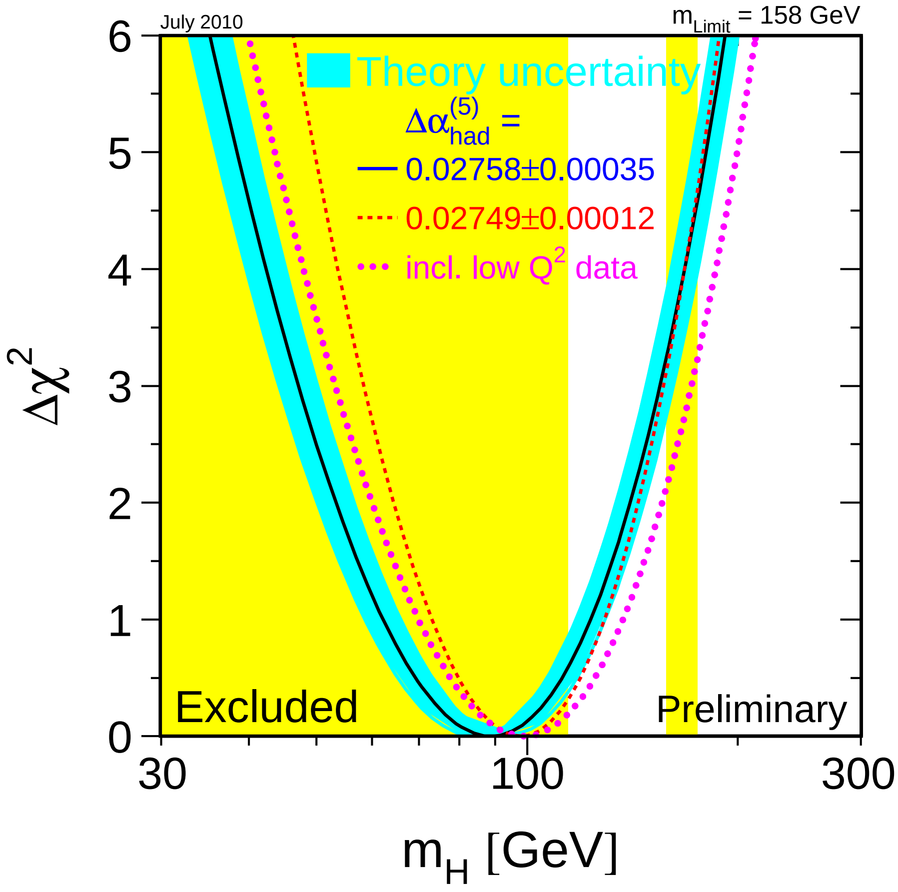
- LHC experiments competitive on Higgs searches
- ATLAS exclusion: 146-232, 256-282, 296-466 GeV
- CMS exclusion: 145-216, 226-288, 310-400 GeV

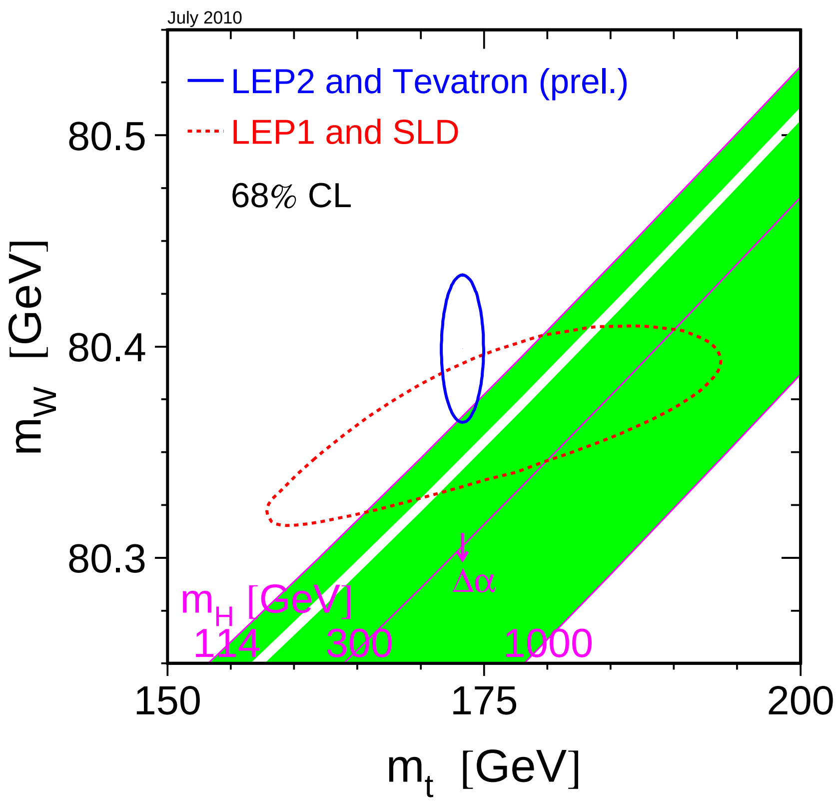




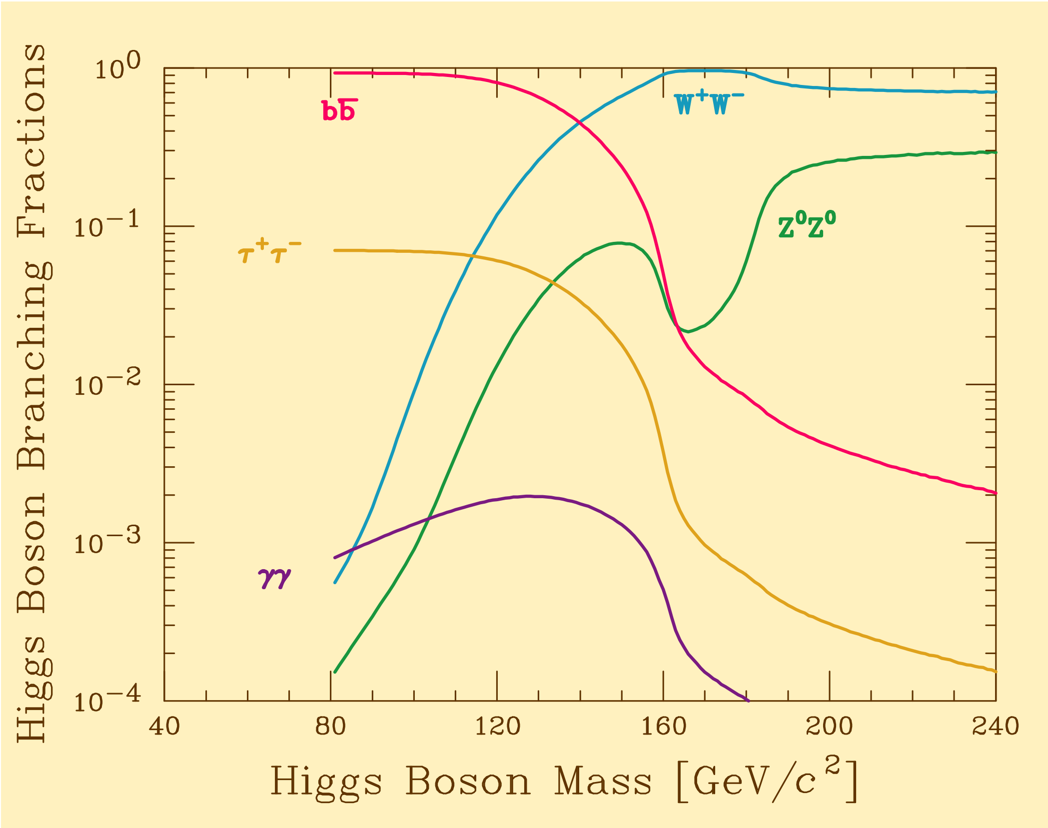
Electroweak fits and mass of Higgs boson

- Use new M_{top}, width of W boson from Tevatron and LEP, and mass of W from LEP and Tevatron
- $M_{Higgs} = 89 + 35 - 26$ GeV (68% CL), and $<$ 158 GeV at 95% CL





SM Higgs decay

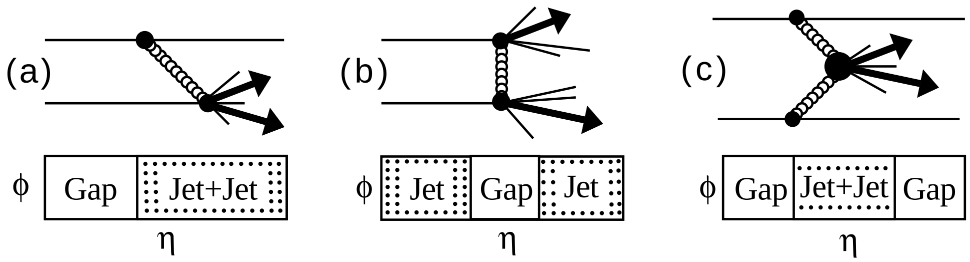


Low masses: $b\bar{b}$ and $\tau\tau$ dominate
High masses: WW dominates

LHC sensitivity on Higgs boson

ATLAS + CMS ≈ 2 x CMS	95% CL exclusion	3σ sensitivity	5σ sensitivity
1 fb^{-1}	120 - 530	135 - 475	152 - 175
2 fb^{-1}	114 - 585	120 - 545	140 - 200
5 fb^{-1}	114 - 600	114 - 600	128 - 482
10 fb^{-1}	114 - 600	114 - 600	117 - 535

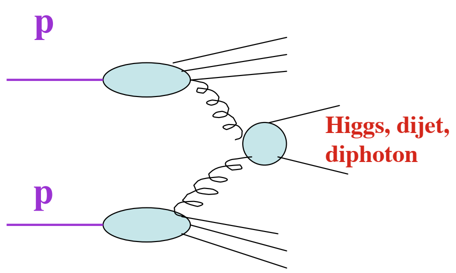
Diffraction at Tevatron/LHC



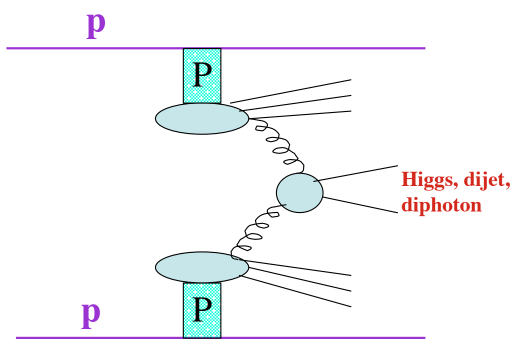
Kinematic variables

- t: 4-momentum transfer squared
- ξ_1, ξ_2: proton fractional momentum loss (momentum fraction of the proton carried by the pomeron)
- $\beta_{1,2} = x_{Bj,1,2}/\xi_{1,2}$: Bjorken-x of parton inside the pomeron
- $M^2 = s\xi_1\xi_2$: diffractive mass produced
- $\Delta y_{1,2} \sim \Delta\eta \sim \log 1/\xi_{1,2}$: rapidity gap

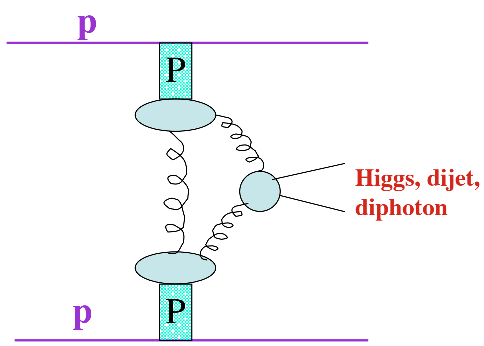
“Exclusive models” in diffraction



Inclusive non diffractive (1)



Inclusive Diffractive (2)

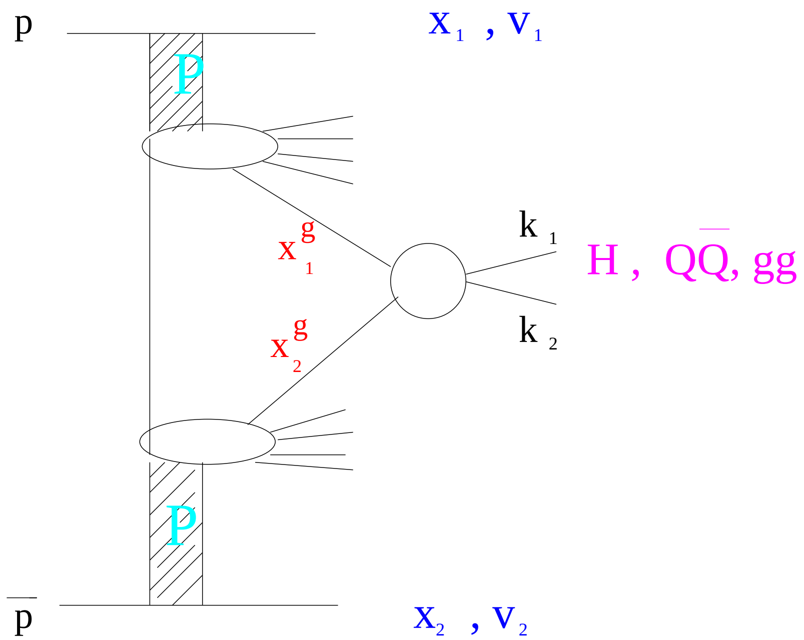


Exclusive Diffractive (3)

- All the energy is used to produce the Higgs (or the dijets), namely $xG \sim \delta$
- Possibility to reconstruct the Higgs boson properties from the tagged proton: system completely constrained
- See papers by Khoze, Martin, Ryskin; Boonekamp, Peschanski, Royon...

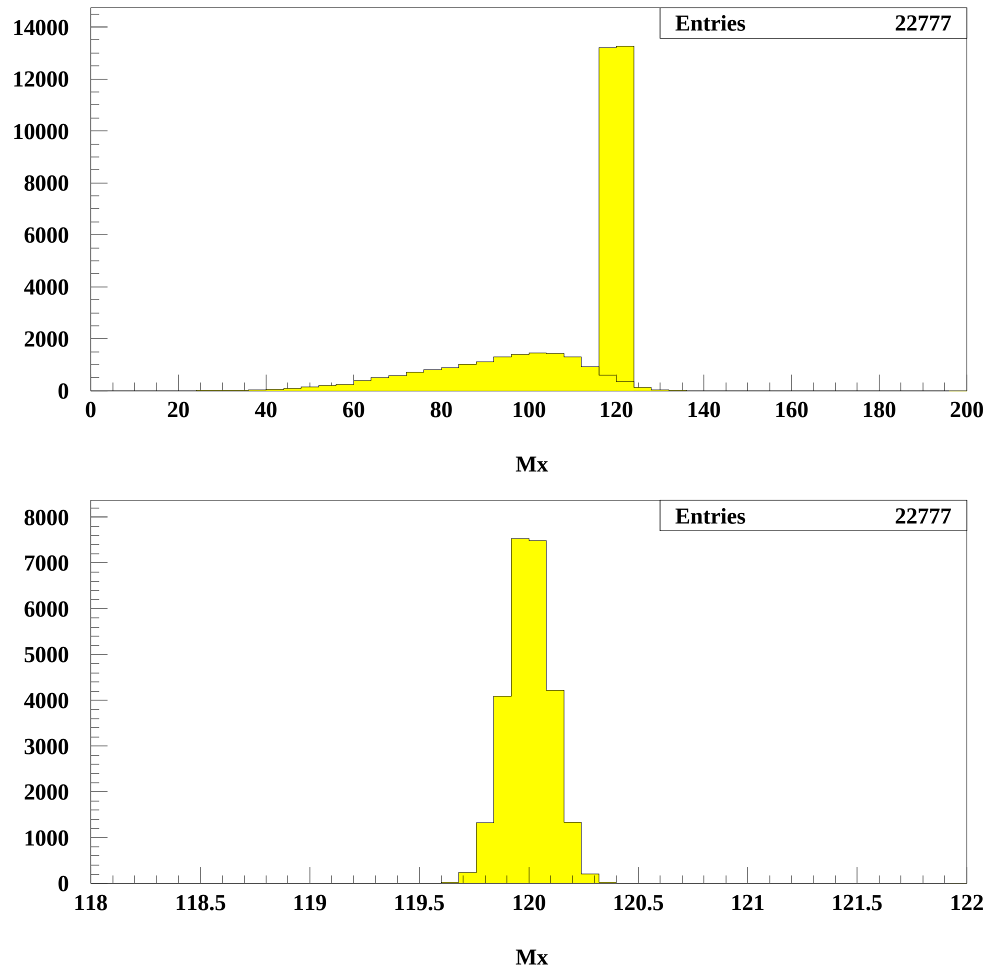
“Inclusive” models

- “Inclusive” models: Take the hard matrix element convoluted with the parton distributions in the pomeron
- Take shape of H1 measurement of gluon/quark density in pomeron
- Survival probability introduced for normalisation
- Inclusive cross sections need to be known in detail since it is a direct background to search for exclusive events



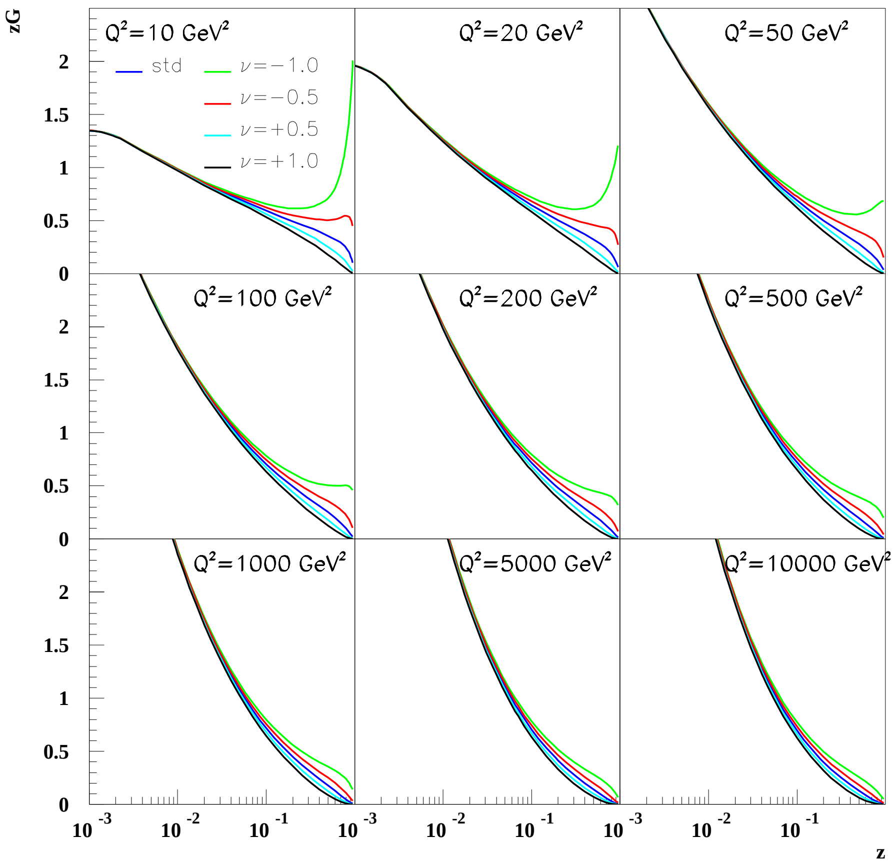
Advantage of exclusive Higgs production?

- Good Higgs mass reconstruction: fully constrained system, Higgs mass reconstructed using both tagged protons in the final state ($pp \to pHp$)
- No energy loss in pomeron "remnants"
- Mass resolution of the order of 2-3% after detector simulation



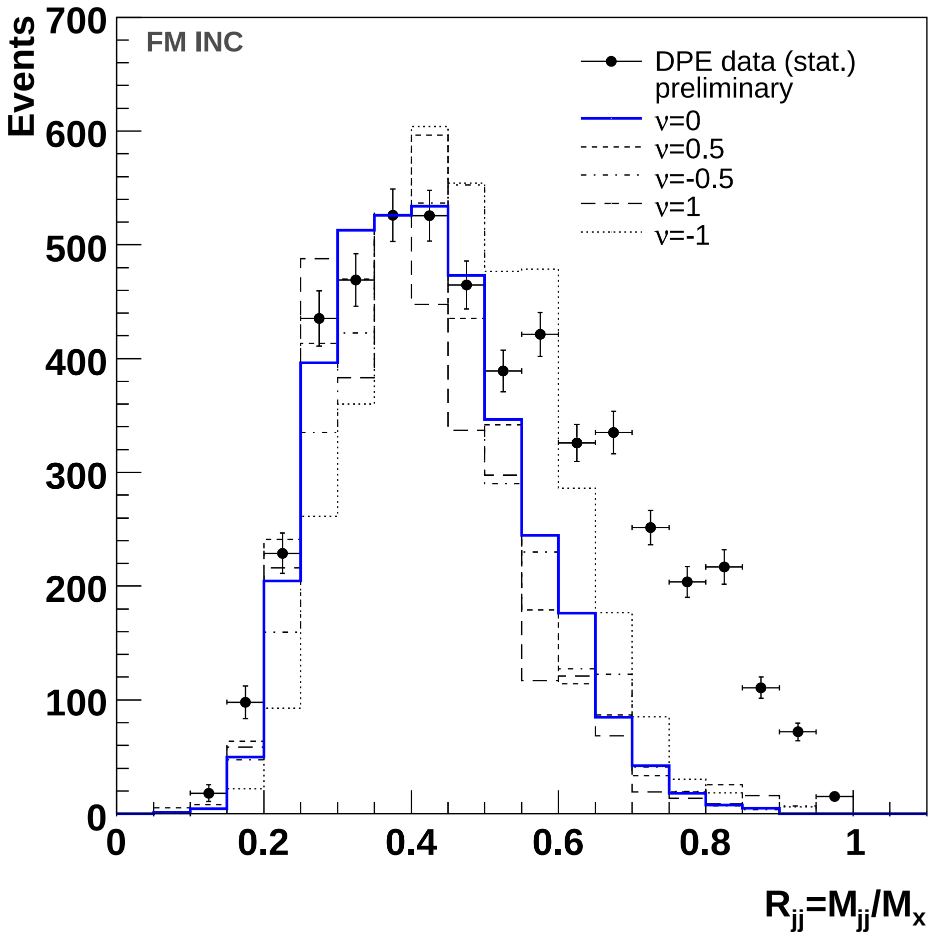
Looking for exclusive events: uncertainty on high β gluon

- Important to know the high β gluon since it is a contamination to exclusive events
- Experimentally, quasi-exclusive events indistinguishable from purely exclusive ones
- Uncertainty on gluon density at high β: multiply the gluon density by $(1-\beta)^{\nu}$ (fit: $\nu = 0.0 \pm 0.6$)



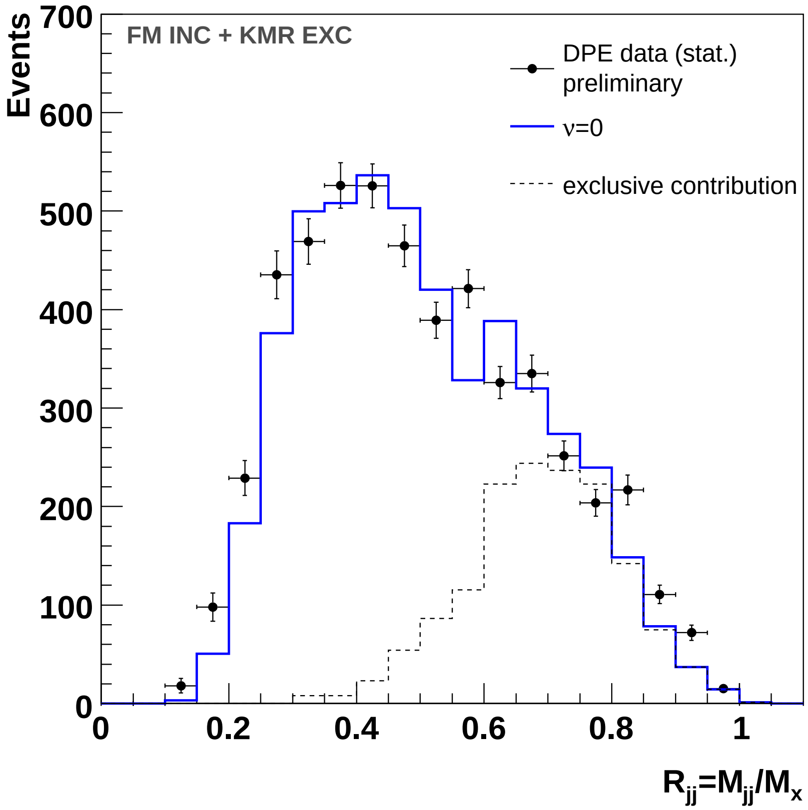
Dijet mass fraction measurement in CDF

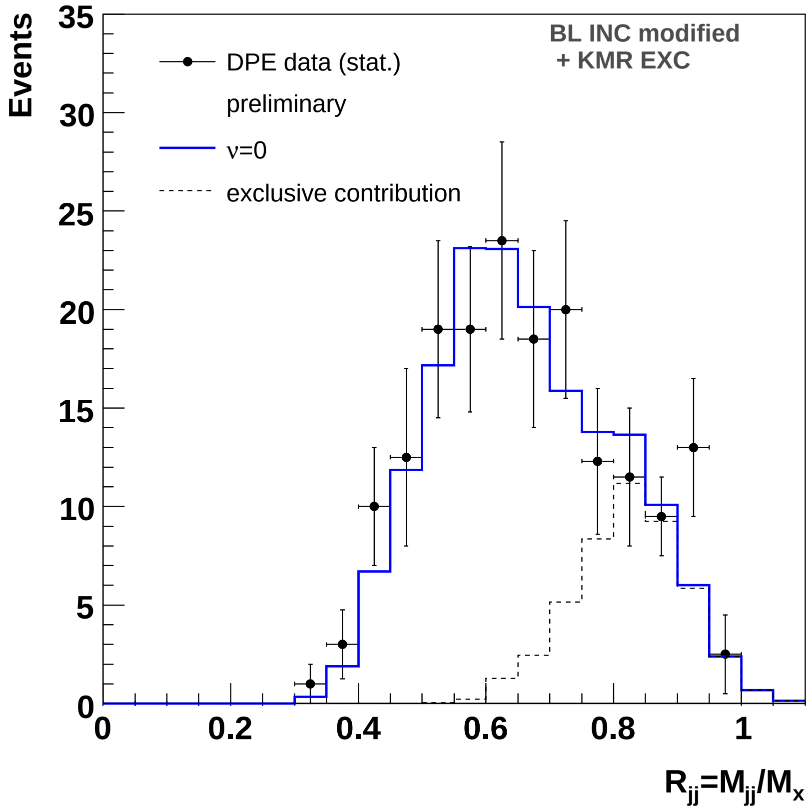
- Look for exclusive events (events where there is no pomeron remnants or when the full energy available is used to produce diffractively the high mass object)
- Select events with two jets only, one proton tagged in roman pot detector and a rapidity gap on the other side
- Predictions from inclusive diffraction models for Jet $p_T > 10$ GeV



Prediction from inclusive and exclusive diffraction

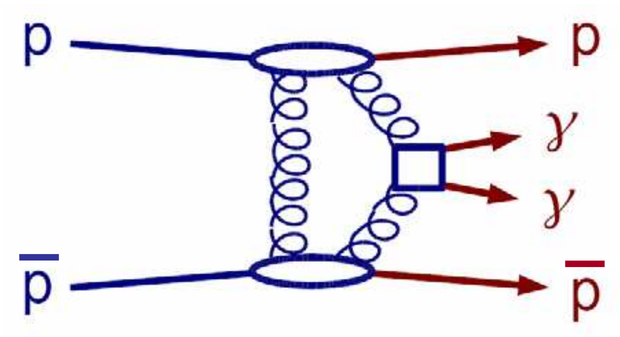
- Add the exclusive contribution (free relative normalisation between inclusive and exclusive contribution)
- Good agreement between measurement and predictions
- As an example: exclusive and inclusive models for $p_T > 10$ GeV and for $p_T > 25$ GeV
- See CDF papers; O. Kepka, C. Royon, Phys.Rev.D76 (2007) 034012; arXiv0706.1798



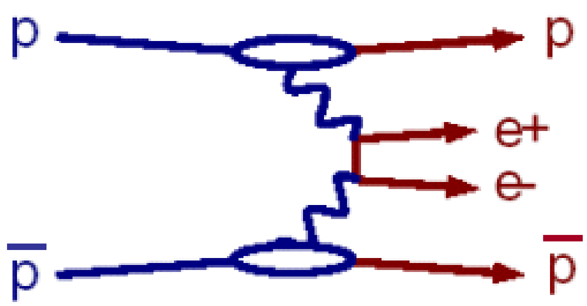


Search for exclusive diphotons (CDF)

- Look for diphoton events: very clean events (2 photons and nothing else), but low cross section (nothing means experimentally nothing above threshold..., quasi-exclusive events contamination)
- Look for dilepton events: produced only by QED processes, cross-check to exclusive $\gamma\gamma$ production



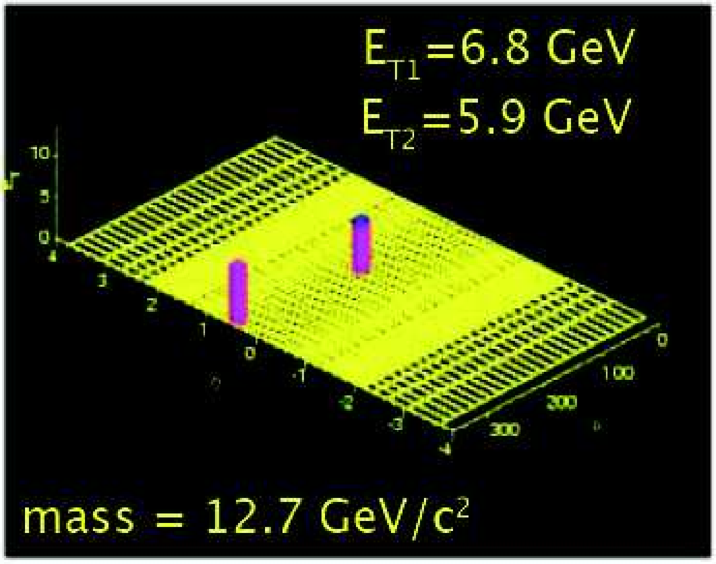
$$p\overline{p} \rightarrow p + \gamma\gamma + \overline{p}$$

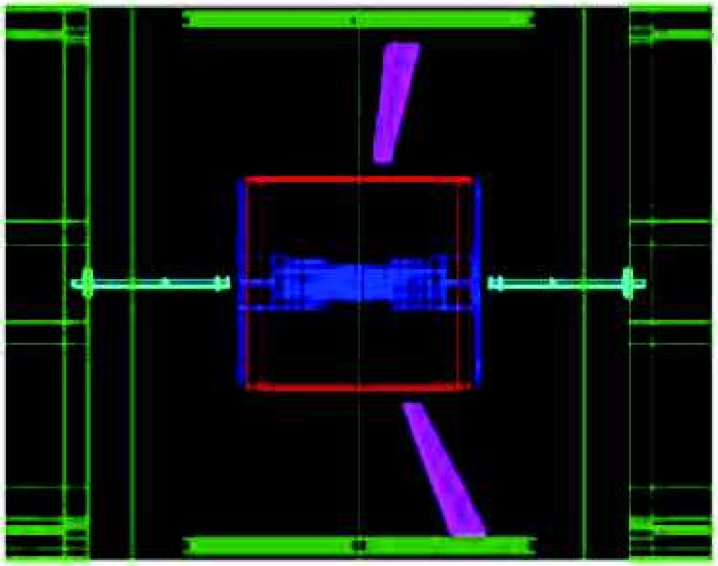


QED process: cross-check to exclusive $\gamma\gamma$

Search for exclusive diphotons (CDF)

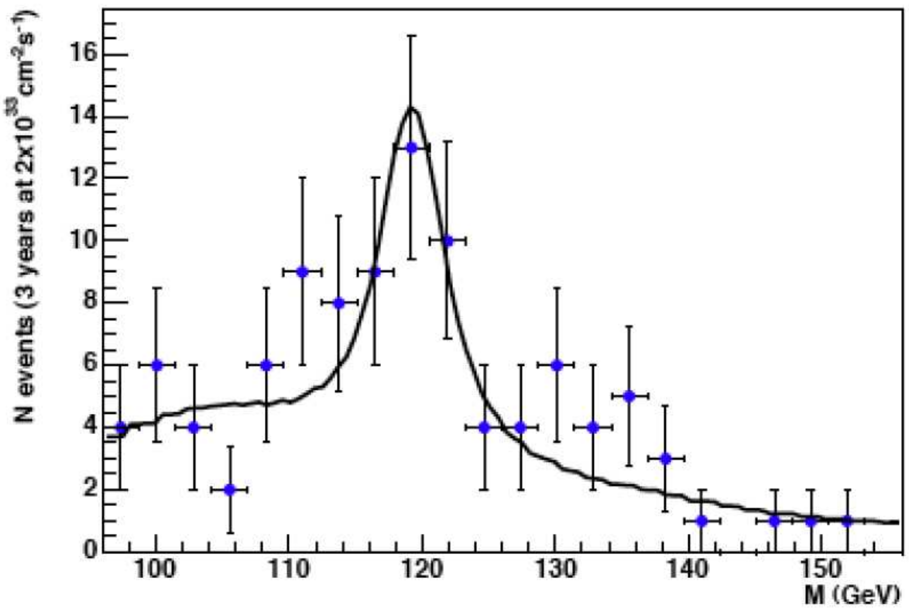
- Look for exclusive diphoton or dilepton production, dominated by QED events (photon exchanges) and not from pomeron exchanges
- Cross section for e^+e^- exclusive production: $N_{candidates} = 16^{+5.1}_{-3.2}$, $N_{background} = 2.1^{+0.7}_{-0.3}$ (mainly dissociation events) in 46 pb^{-1} $\sigma = 1.6^{+0.5}_{-0.3}(stat) \pm 0.3(syst)$ pb
- Cross section for $\gamma\gamma-$ exclusive production: $N_{candidates} = 3^{+2.9}_{-0.9}$, $N_{background} = 0^{+0.2}_{-0.0}$ (mainly dissociation events) in 46 pb^{-1} $\sigma = 0.14^{+0.14}_{-0.04}(stat) \pm 0.03(syst)$ pb

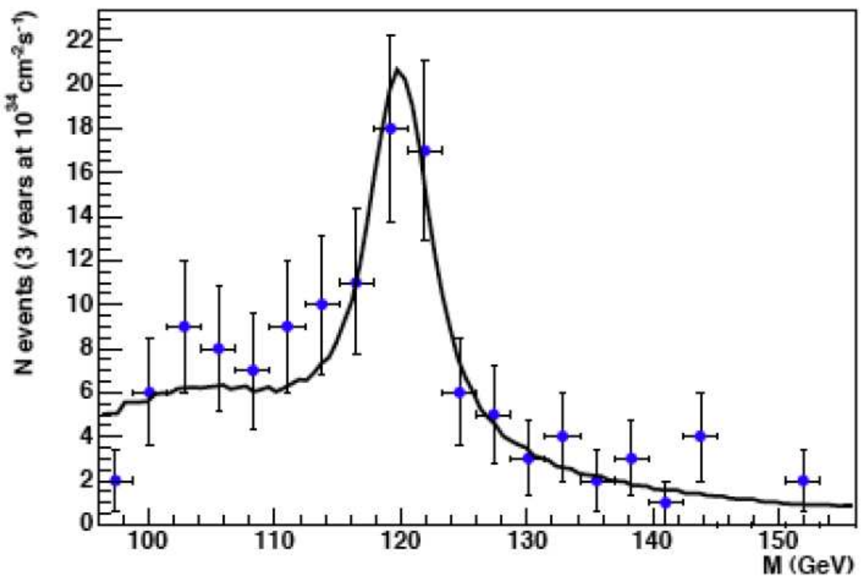




SUSY Signal significance

- Signal and background full simulation, pile up effects taken into account: see B. Cox, F. Loebinger, A. Pilkington, JHEP 0710 (2007) 090 for h production at $\tan\beta \sim 40$, 8 times higher cross section than SM
- Significance $> 3.5\sigma$ for 60 fb^{-1} after detector acceptance
- Significance $> 5\sigma$ in 3 years at 10^{34} with timing detectors
- Diffractive Higgs boson production complementary to the standard search

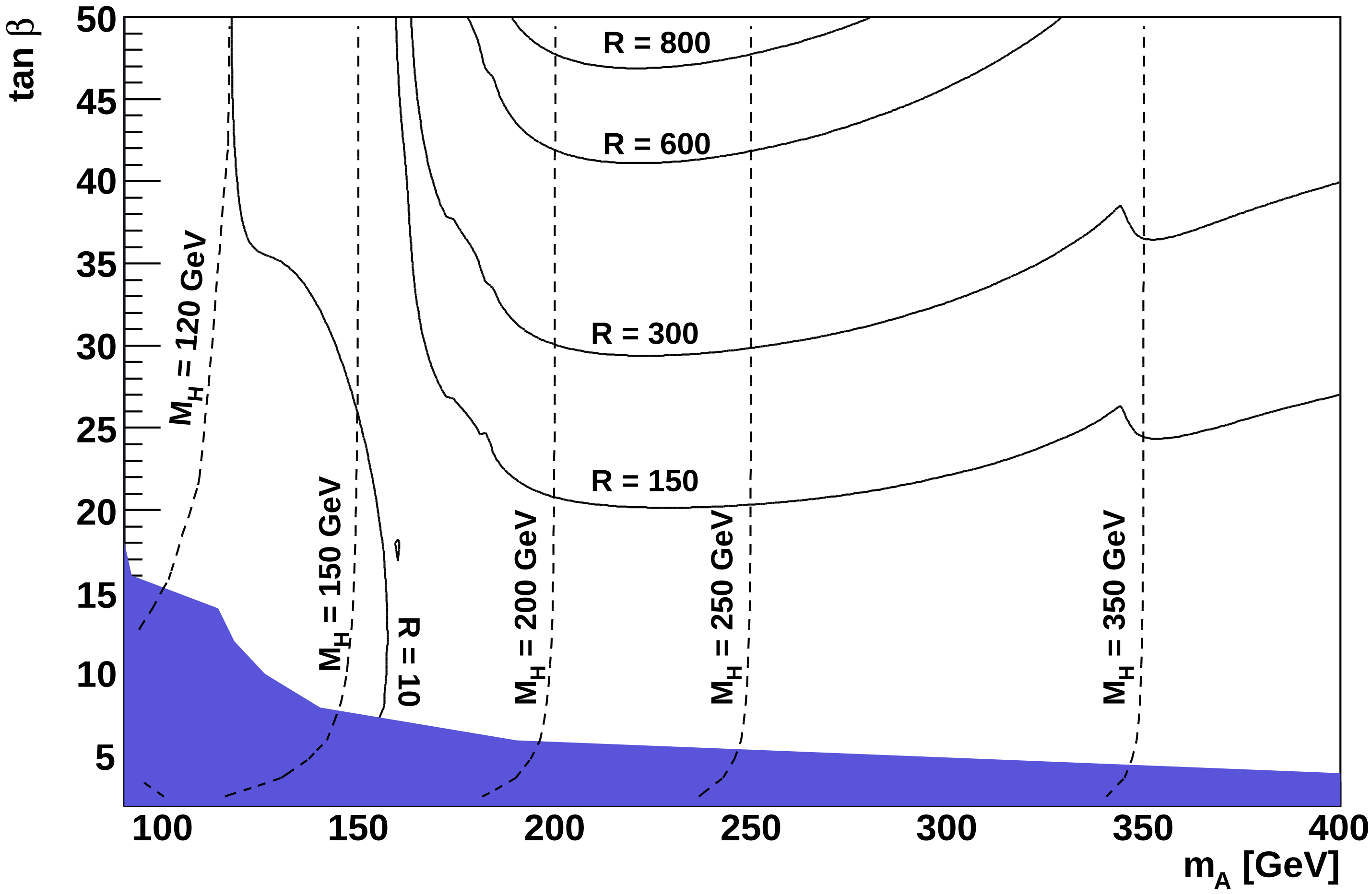




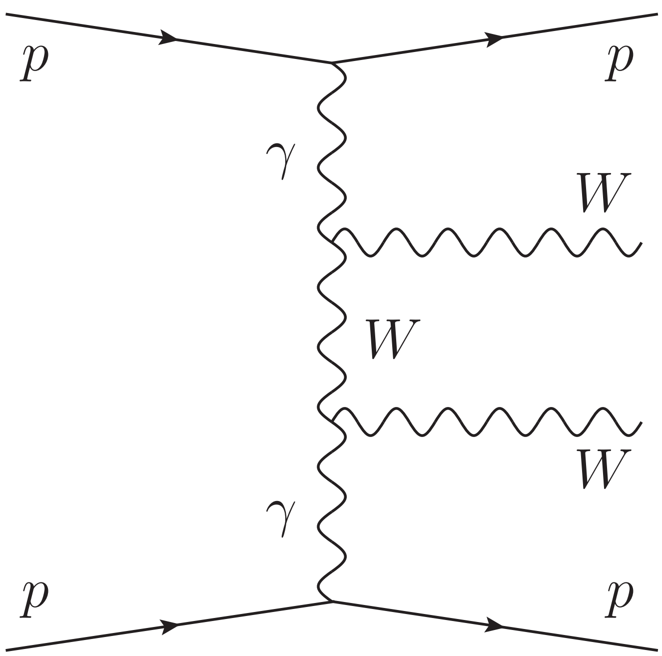
Diffractive SUSY Higgs production

Contour for the ratio of signal events in the MSSM and SM scenarios for $H \to b\bar{b}$ for heavy CP-even Higgs bosons

S. Heinemeyer et al., Eur.Phys.J.C53:231-256,2008



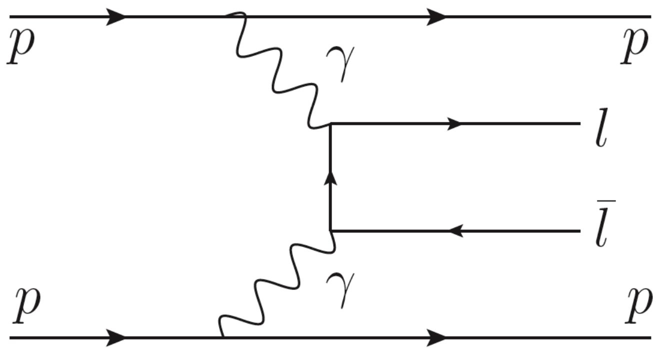
WW production at the LHC



- Study of the process: $pp \to ppWW$
- Clean process: W in central detector and nothing else, intact protons in final state which can be detected far away from interaction point
- Exclusive production of W pairs via photon exchange: QED process, cross section perfectly known
- Two steps: SM observation of WW events, anomalous coupling study
- $\sigma_{WW} = 95.6$ fb, $\sigma_{WW}(W > 1TeV) = 5.9$ fb
- Rich $\gamma\gamma$ physics at LHC: see E. Chapon, O. Kepka, C. Royon, Phys. Rev. D78 (2008) 073005; Phys. Rev. D81 (2010) 074003; T J. De Favereau et al., arXiv:0908.2020; Nicolas Schul, Trento 2010, http://diff2010-lhc.physi.uni-heidelberg.de/Talks/, and arXiv:0910.0202

WW production at the LHC

- Signal: We focus on leptonic signals decays of WW and ZZ, the protons are tagged in the forward proton detectors; fast simulation of the ATLAS detector (ATLFast$++$)
- Backgrounds considered:
  - Non diffractive WW production: large energy flow in forward region, removed by requesting tagged protons
  - Two photon dileptons: back-to-back leptons, small cross section for high p_T leptons



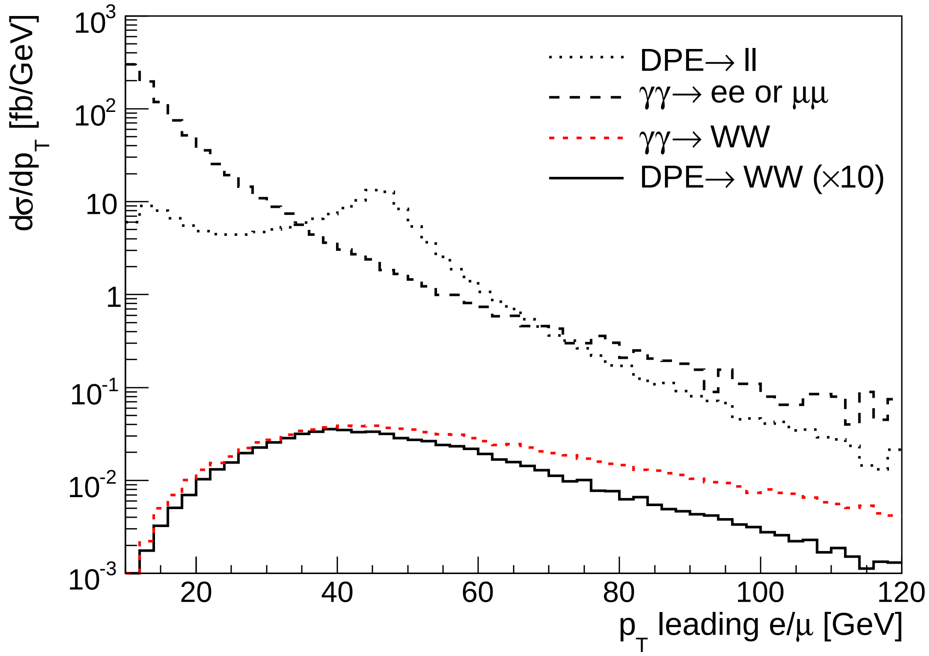
  - Lepton production via double pomeron exchange: activity in the forward region due to pomeron remnants, removed by $\not{E}_T$ cut
  - WW via double pomeron exchange: removed by cut on high diffractive mass

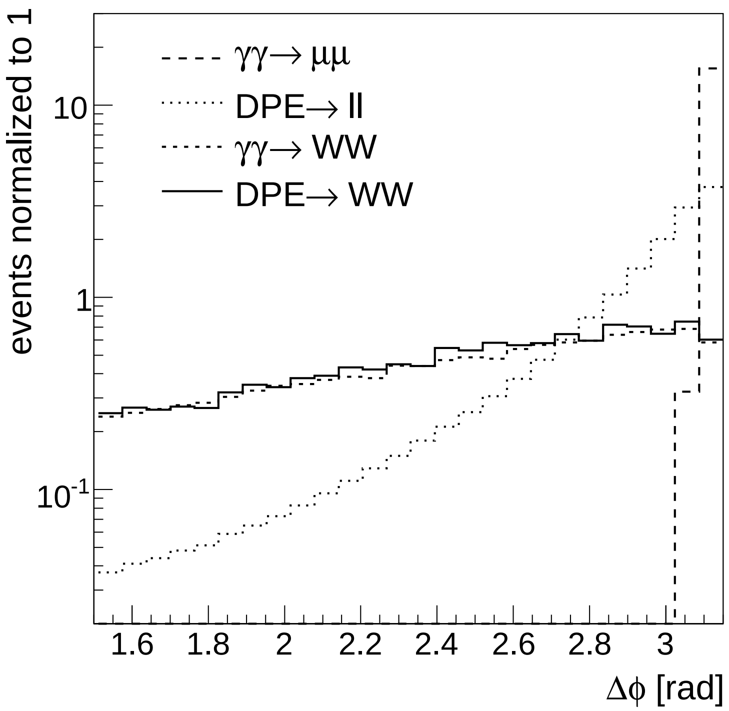
Forward Physics Monte Carlo (FPMC)

- FPMC (Forward Physics Monte Carlo): implementation of all diffractive/photon induced processes
- List of processes
  - two-photon exchange
  - single diffraction
  - double pomeron exchange
  - central exclusive production
- Inclusive diffraction: Use of diffractive PDFs measured at HERA, with a survival probability of 0.03 applied for LHC
- Survival probability for photon exchange events: 0.9
- Central exclusive production: Higgs, jets... for Khoze Martin Ryskin and Dechambre Cudell models
- FPMC manual (see M. Boonekamp, A. Dechambre, O. Kepka, V. Juranek, C. Royon, R. Staszewski, M. Rangel, ArXiv:1102.2531)
- Output of FPMC generator interfaced with the fast simulation of the ATLAS detector in the standalone ATLFast++ package

Strategy to measure the $\gamma\gamma \to WW$ SM cross section

- Require both Ws to decay leptonically (as a starting point to avoid jet background) with p_T of leading (2nd leading) lepton above 25, 10 GeV
- Require both protons in the ATLAS Forward Proton (AFP) detector
- $\not{E}_T > 20$ GeV, natural for W decays (get rid of dilepton background produced by photon exchange)
- $\Delta\Phi$ between leading leptons allows to remove dilepton background



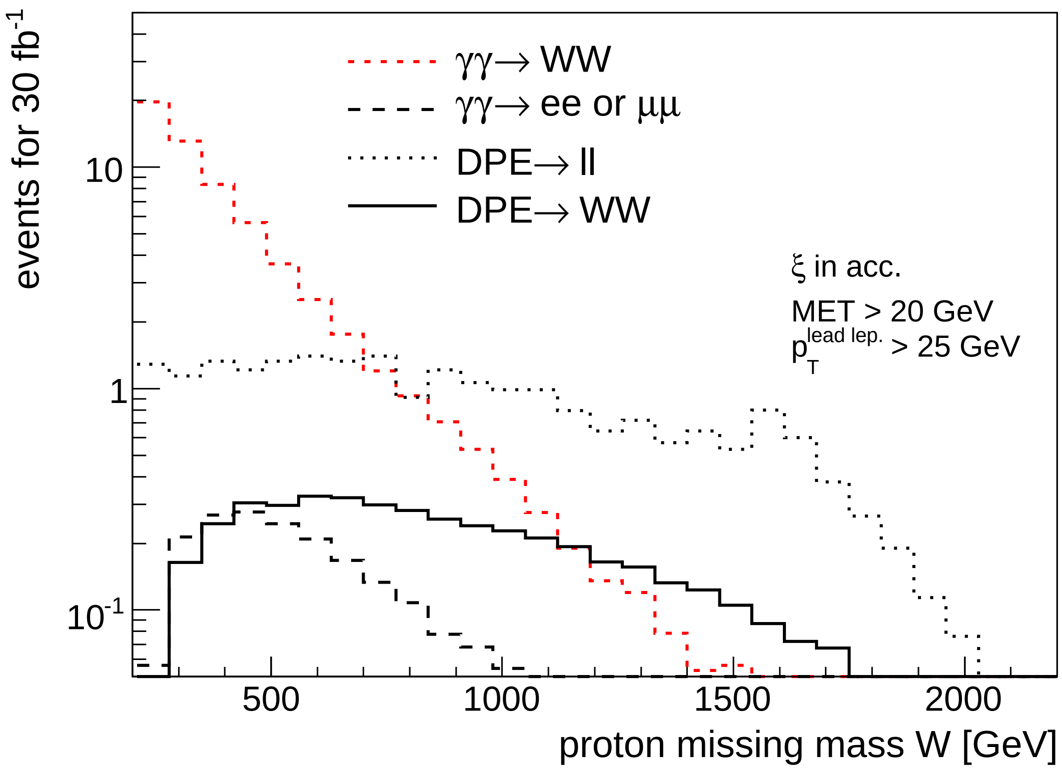


Measuring the $\gamma\gamma \to WW$ SM cross section

Number of events for 30 fb^{-1} after successive cuts

cut / process	$\gamma\gamma \to ll$	DPE$\to ll$	DPE$\to WW$	$\gamma\gamma \to WW$
$p_T^{lep1,2} > 10$ GeV	50620	17931	8.8	95
$0.0015 < \xi < 0.15$	21059	11487	5.9	89
$\not{E}_T > 20$ GeV	14.9	33	4.7	78
$W > 160$ GeV	9.2	33	4.7	78
$\Delta\phi < 2.7$	0	14	3.8	61
$p_T^{lep} > 25$ GeV	0	7.5	3.5	58
$W < 500$	0	1.0	0.67	51

5 σ discovery possible after 5 fb^{-1} (pure leptonic decays of Ws)



Measuring the $\gamma\gamma \rightarrow WW$ SM cross section: semi-leptonic decays

- Consider both leptonic and semileptonic decays of Ws
- Fast generator level study: For a luminosity of 200 pb^{-1}, observation of 5.6 W pair events for a background less than 0.4, which leads to a signal of 8 σ

ξ_{max}	signal (fb)	background (fb)
0.05	13.8	0.16
0.10	24.0	1.0
0.15	28.3	2.2

- Study needs to be redone considering the simulation of all backgrounds: especially when one of the quarks radiates a W boson, which is being implemented in FPMC

Quartic anomalous gauge couplings

- Quartic gauge anomalous $WW\gamma\gamma$ and $ZZ\gamma\gamma$ couplings parametrised by a_0^W, a_0^Z, a_C^W, a_C^Z

$$\mathcal{L}_6^0 \sim \frac{-e^2}{8}\frac{a_0^W}{\Lambda^2}F_{\mu\nu}F^{\mu\nu}W^{+\alpha}W_\alpha^- - \frac{e^2}{16\cos^2(\theta_W)}\frac{a_0^Z}{\Lambda^2}F_{\mu\nu}F^{\mu\nu}Z^\alpha Z_\alpha$$

$$\mathcal{L}_6^C \sim \frac{-e^2}{16}\frac{a_C^W}{\Lambda^2}F_{\mu\alpha}F^{\mu\beta}(W^{+\alpha}W_\beta^- + W^{-\alpha}W_\beta^+) - \frac{e^2}{16\cos^2(\theta_W)}\frac{a_C^Z}{\Lambda^2}F_{\mu\alpha}F^{\mu\beta}Z^\alpha Z_\beta$$

- Anomalous parameters equal to 0 for SM
- Best limits from LEP, OPAL (Phys. Rev. D 70 (2004) 032005) of the order of 0.02-0.04, for instance $-0.02 < a_0^W < 0.02$ GeV^{-2}
- Dimension 6 operators $\rightarrow$ violation of unitarity at high energies

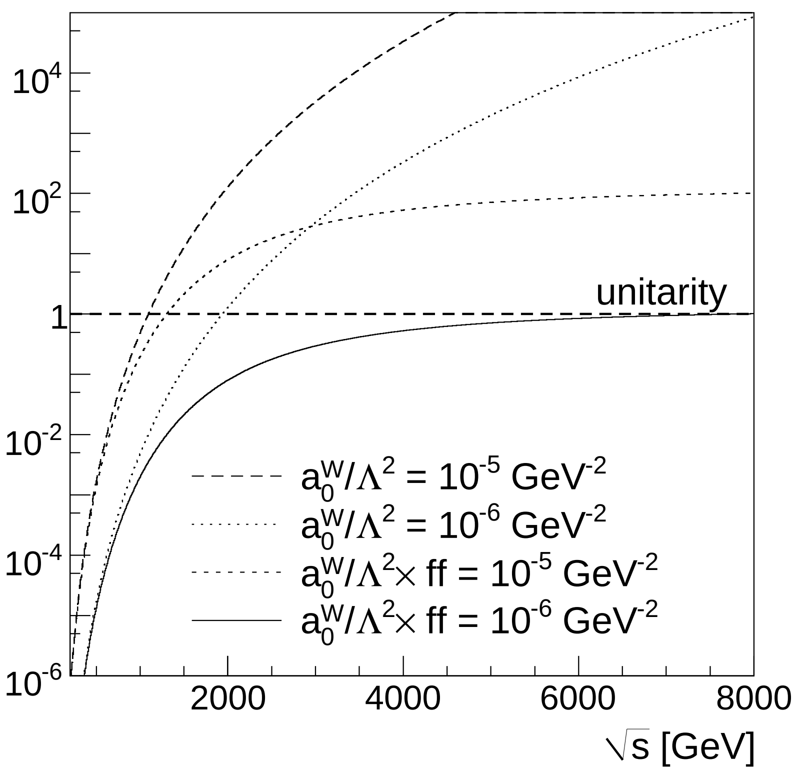
Quartic anomalous gauge couplings: form factors

- Unitarity bounds can be computed (Eboli, Gonzales-Garcia, Lietti, Novaes):

$$4\left(\frac{\alpha a s}{16}\right)^2\left(1-\frac{4M_W^2}{s}\right)^{1/2}\left(3-\frac{s}{M_W^2}+\frac{s^2}{4M_W^4}\right)\leq 1$$

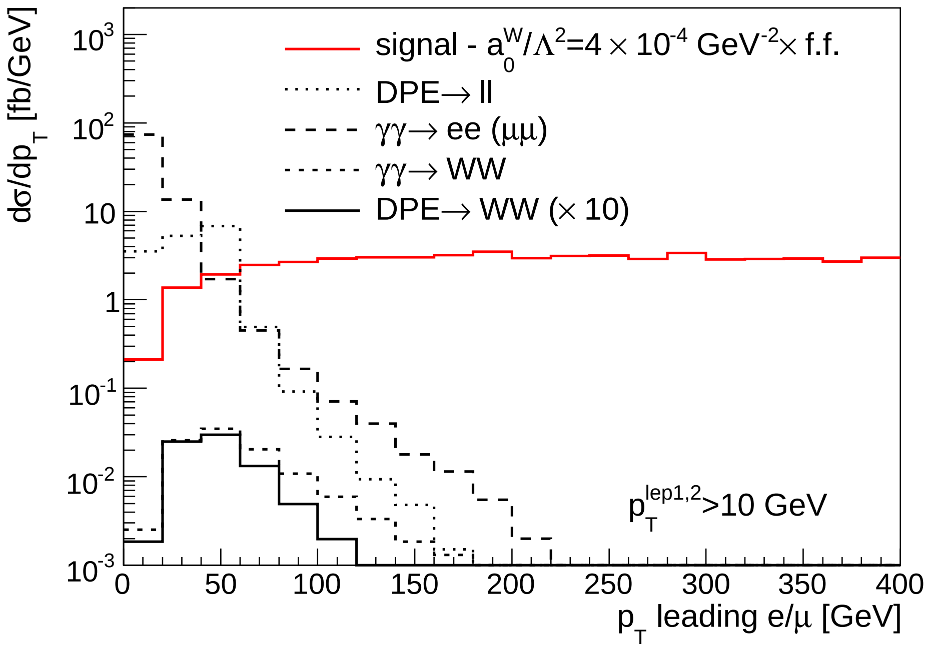
where $a = a_0/\Lambda^2$

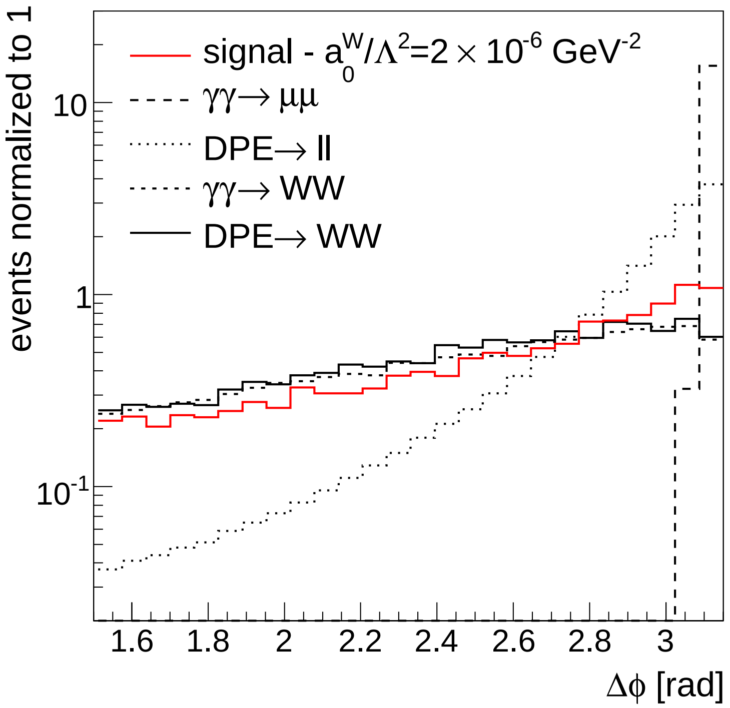
- Introducing form factors to avoid quadratical divergences of scattering amplitudes due to anomalous couplings in conventional way: $a_0^W/\Lambda^2 \to \frac{a_0^W/\Lambda^2}{(1+W\gamma\gamma/\Lambda_{cutoff})^2}$ with $\Lambda_{cutoff} \sim 2$ TeV, scale of new physics
- For $a_0^W \sim 10^{-6}$ GeV^{-2}, no violation of unitarity



Strategy to select quartic anomalous gauge couplings events

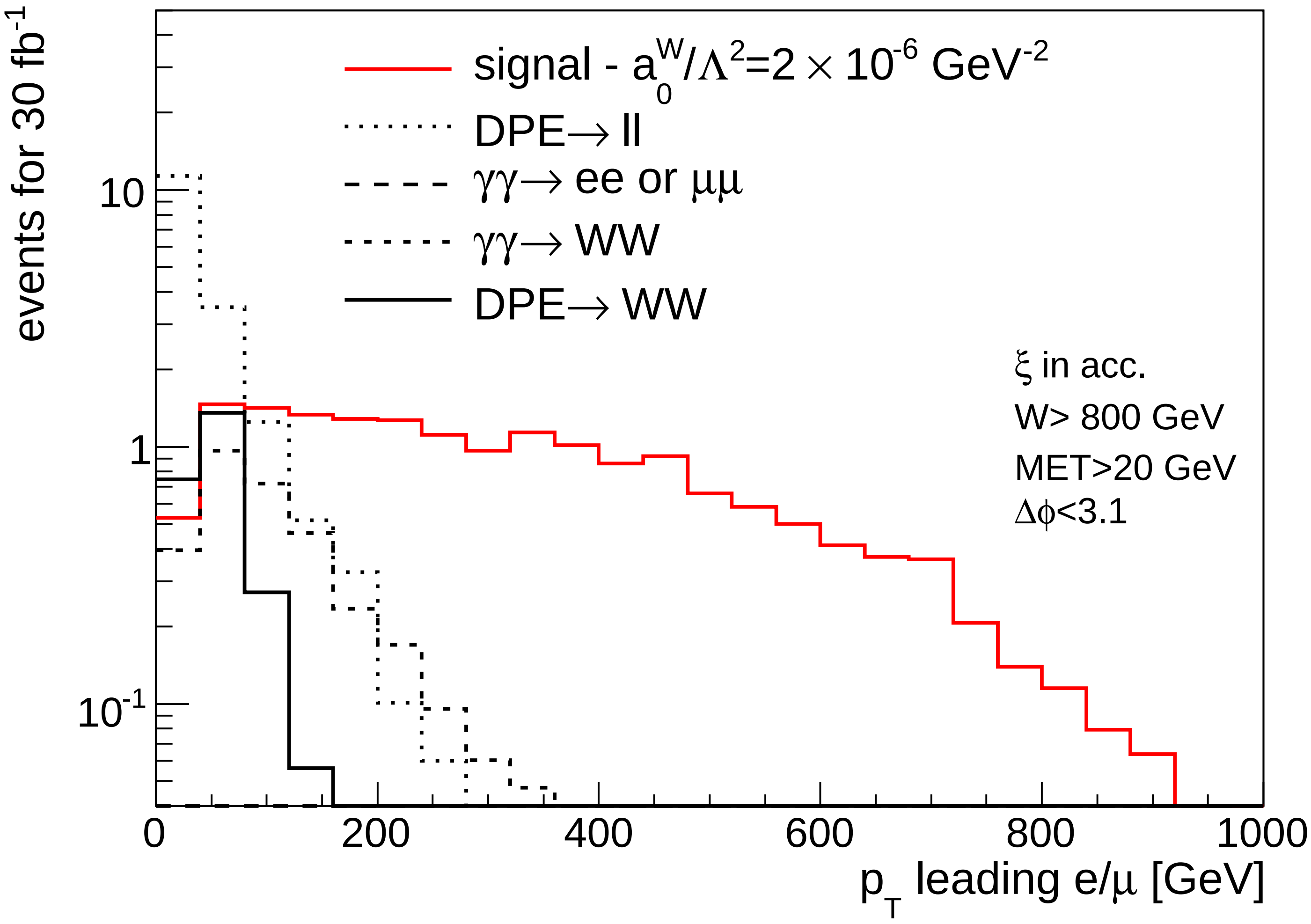
- p_T of the leading lepton: request high p_T lepton to remove background
- Missing E_T distribution: natural to be requested for W pair production
- Diffractive mass computed using the forward proton detectors $\sqrt{\xi_1 \xi_2 S}$: request high mass objects to be produced
- $\Delta\Phi$ between both leptons: avoid back-to-back leptons





Quartic anomalous gauge couplings

Distribution of the leading lepton p_T after all cuts (proton tagged, $\not{E}_T$, diffractive mass, $\Delta\Phi$) except the cut on leading lepton p_T



Quartic anomalous gauge couplings

Background events for 30 fb^{-1}

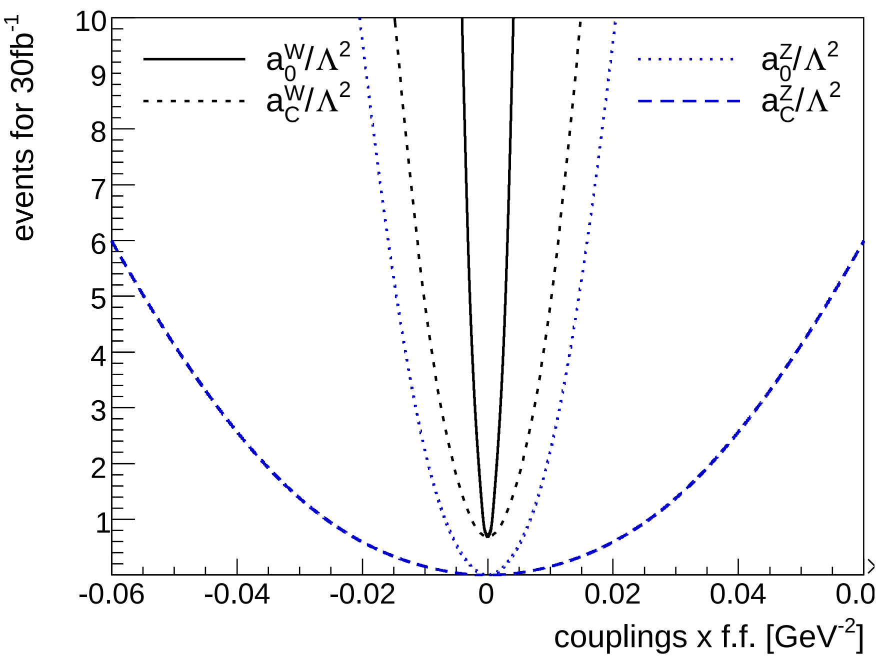
cut / process	$\gamma\gamma \to ll$	$\gamma\gamma \to WW$	DPE$\to ll$	DPE$\to WW$
$p_T^{lep1,2} > 10$ GeV	50619	99	18464	8.8
$0.0015 < \xi < 0.15$	21058	89	11712	6.0
$\not{E}_T > 20$ GeV	14.9	77	36	4.7
$W > 800$ GeV	0.42	3.2	16	2.5
$M_{ll} \notin < 80, 100 >$	0.42	3.2	13	2.5
$\Delta\phi < 3.13$	0.10	3.2	12	2.5
$p_T^{lep1} > 160$ GeV	0	0.69	0.20	0.024

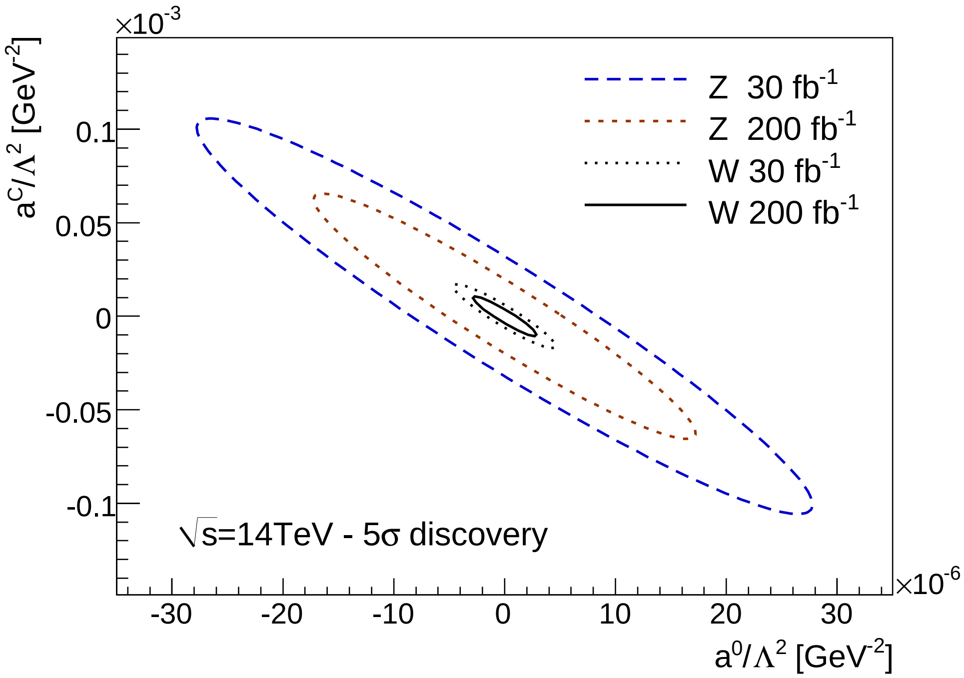
Signal events for 30 fb^{-1}

cut / couplings (with f.f.)	$a_0^W/\Lambda^2 = 5.4 \cdot 10^{-6}$	$a_C^W/\Lambda^2 = 20 \cdot 10^{-6}$
$p_T^{lep1,2} > 10$ GeV	202	200
$0.0015 < \xi < 0.15$	116	119
$\not{E}_T > 20$ GeV	104	107
$W > 800$ GeV	24	23
$M_{ll} \notin < 80, 100 >$	24	23
$\Delta\phi < 3.13$	24	22
$p_T^{lep1} > 160$ GeV	17	16

Quartic anomalous gauge couplings

- Strategy for ZZ events similar: Request either three leptons or two leptons of the same sign, protons tagged in forward detectors, p_T of leading leptons greater than 160 GeV
- Number of events for 30 fb^{-1} for the different couplings
- 5σ discovery countours for two different luminosities 30 and 200 fb^{-1}
- Present LEP limits can be improved by up to four orders of magnitude





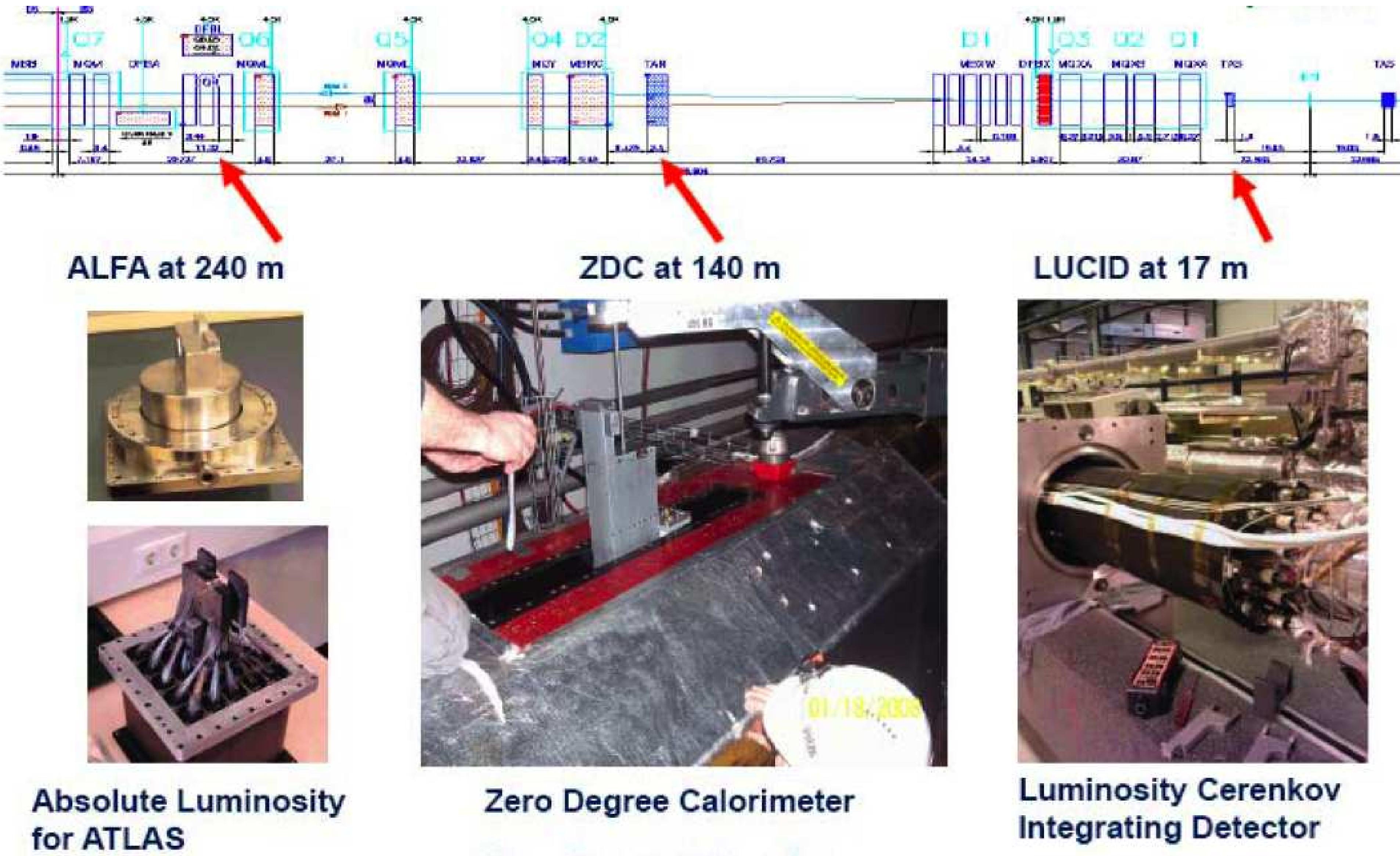
Reach at LHC

Reach at high luminosity on quartic anomalous coupling

Couplings	OPAL limits $[\mathrm{GeV}^{-2}]$	Sensitivity @ $\mathcal{L} = 30$ (200) fb^{-1} 5σ	95% CL
a_0^W/Λ^2	[-0.020, 0.020]	$5.4\ 10^{-6}$ $(2.7\ 10^{-6})$	$2.6\ 10^{-6}$ $(1.4\ 10^{-6})$
a_C^W/Λ^2	[-0.052, 0.037]	$2.0\ 10^{-5}$ $(9.6\ 10^{-6})$	$9.4\ 10^{-6}$ $(5.2\ 10^{-6})$
a_0^Z/Λ^2	[-0.007, 0.023]	$1.4\ 10^{-5}$ $(5.5\ 10^{-6})$	$6.4\ 10^{-6}$ $(2.5\ 10^{-6})$
a_C^Z/Λ^2	[-0.029, 0.029]	$5.2\ 10^{-5}$ $(2.0\ 10^{-5})$	$2.4\ 10^{-5}$ $(9.2\ 10^{-6})$

- Improvement of LEP sensitivity by more than 4 orders of magnitude with 30/200 fb^{-1} at LHC!!!
- Reaches the values predicted by Higgsless/extradimension models

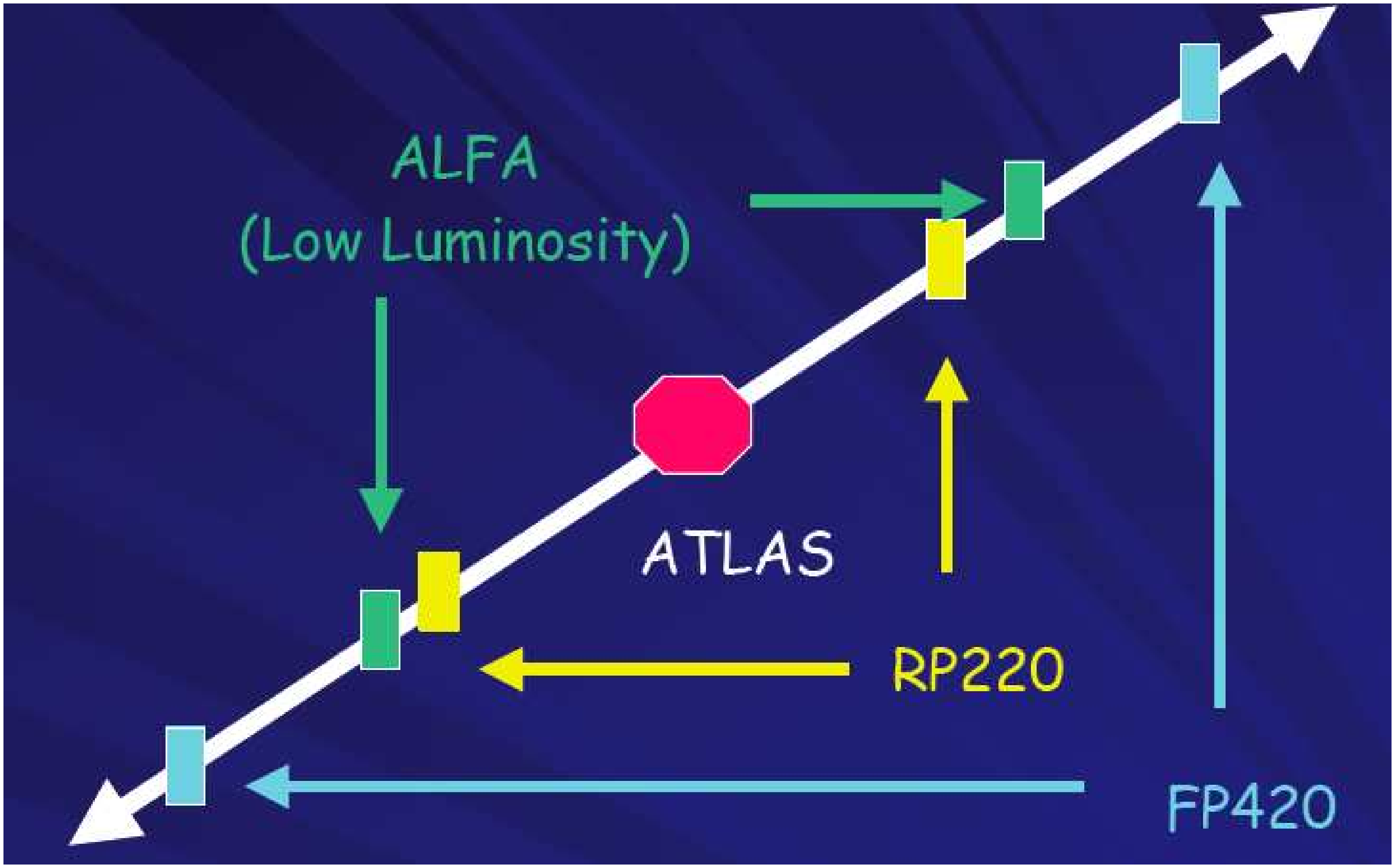
Forward detectors in ATLAS



- ALFA: TDR submitted, CERN/LHCC/2008-004, roman pots installed
- ZDC: Detector installed
- LUCID

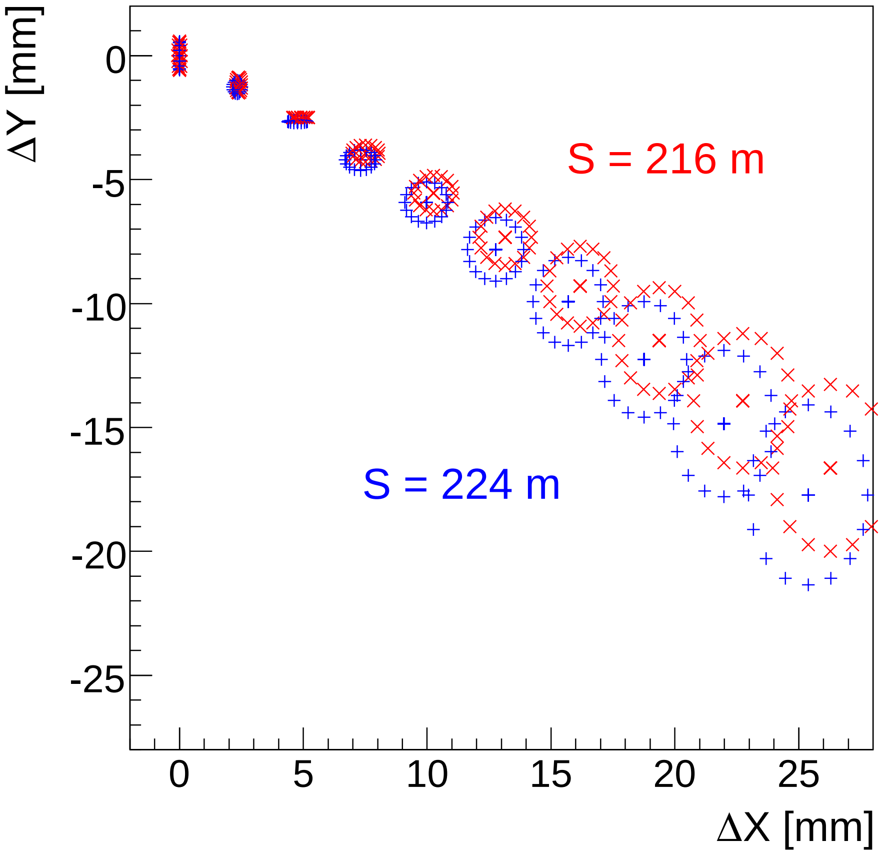
Detector location

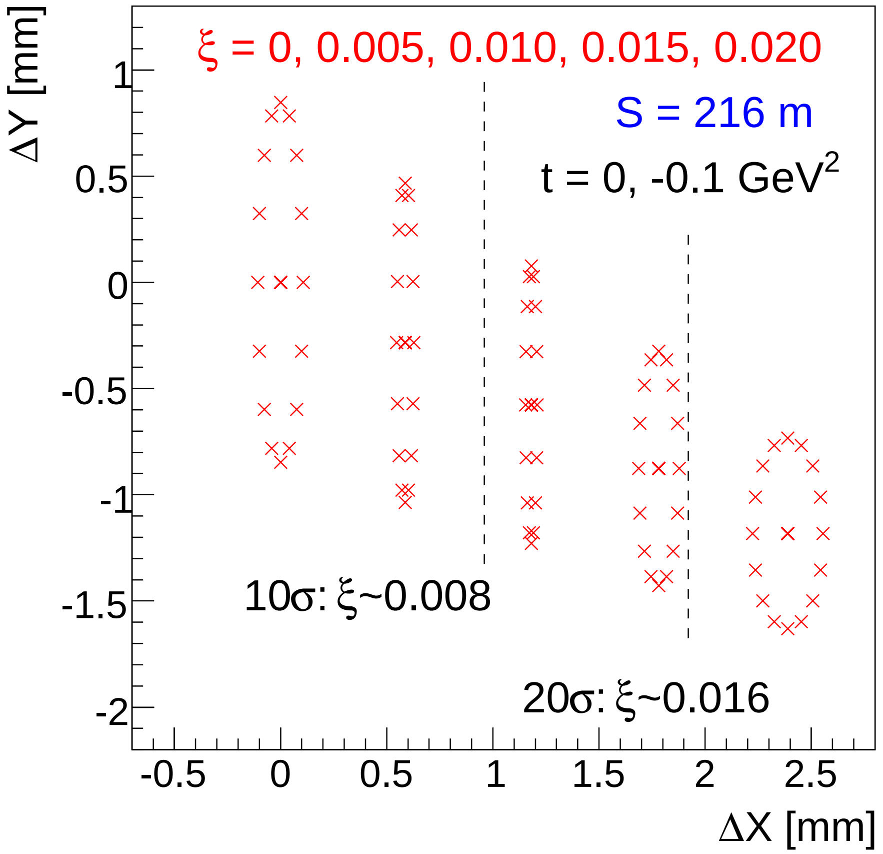
- what is needed? Good position and good timing measurements
- 220 m: movable beam pipes - for phase 1, only 220 m forward detectors
- 420 m: movable beam pipe (roman pots impossible because of lack of space available and cold region of LHC) - phase 2 of project



Example: Acceptance for 220 m detectors

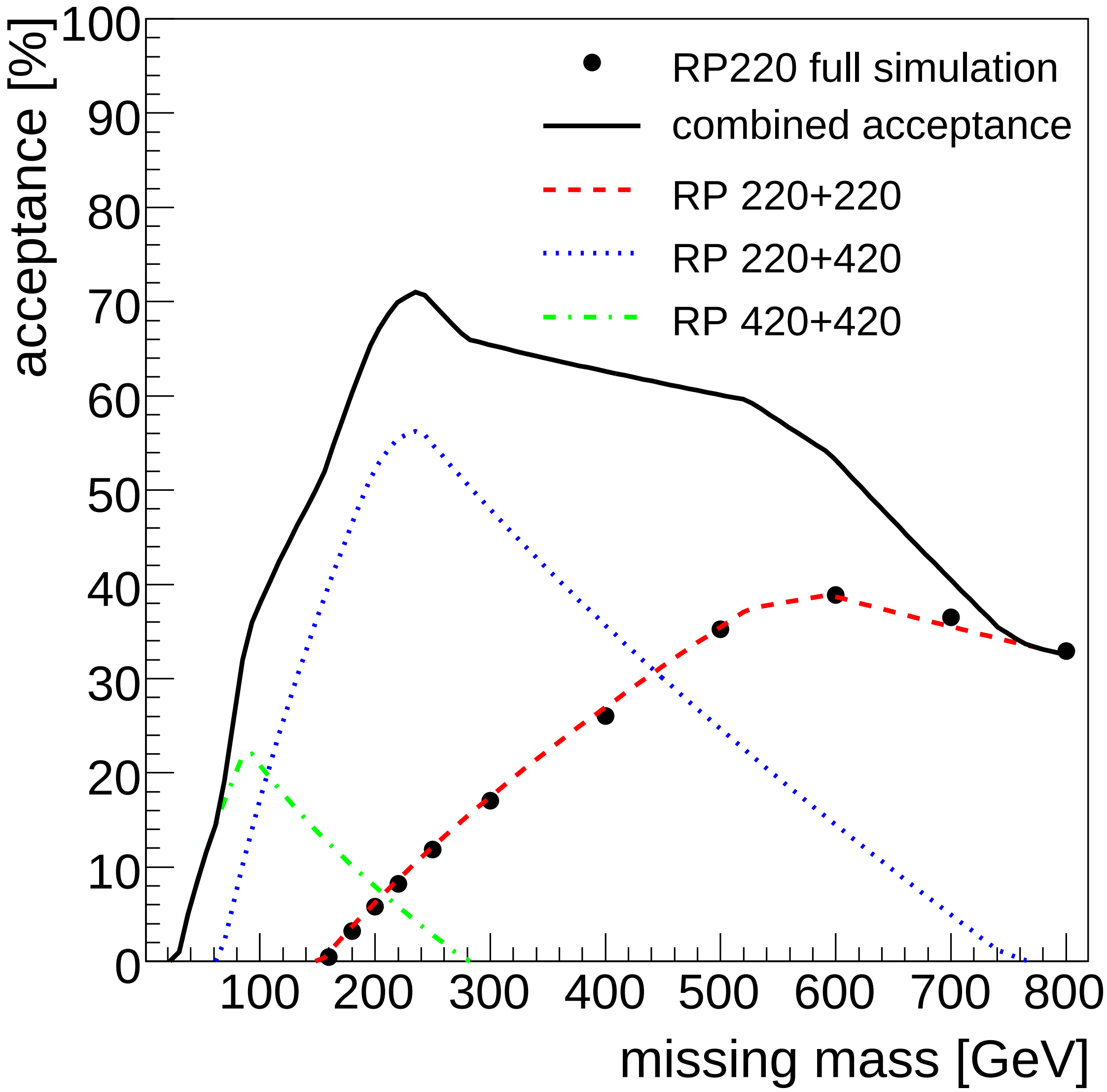
- Steps in ξ: 0.02 (left), 0.005 (right), $|t|$=0 or 0.05 GeV^2
- Detector of 2 cm $\times$ 2 cm will have an acceptance up to $\xi \sim 0.16$, down to 0.008 at 10 σ, 0.016 at 20 σ
- Estimate: possibility to insert the detectors up to $\sim 15\sigma$ from the beam routinely
- Detector coverage of 2 cm $\times$ 2 cm needed





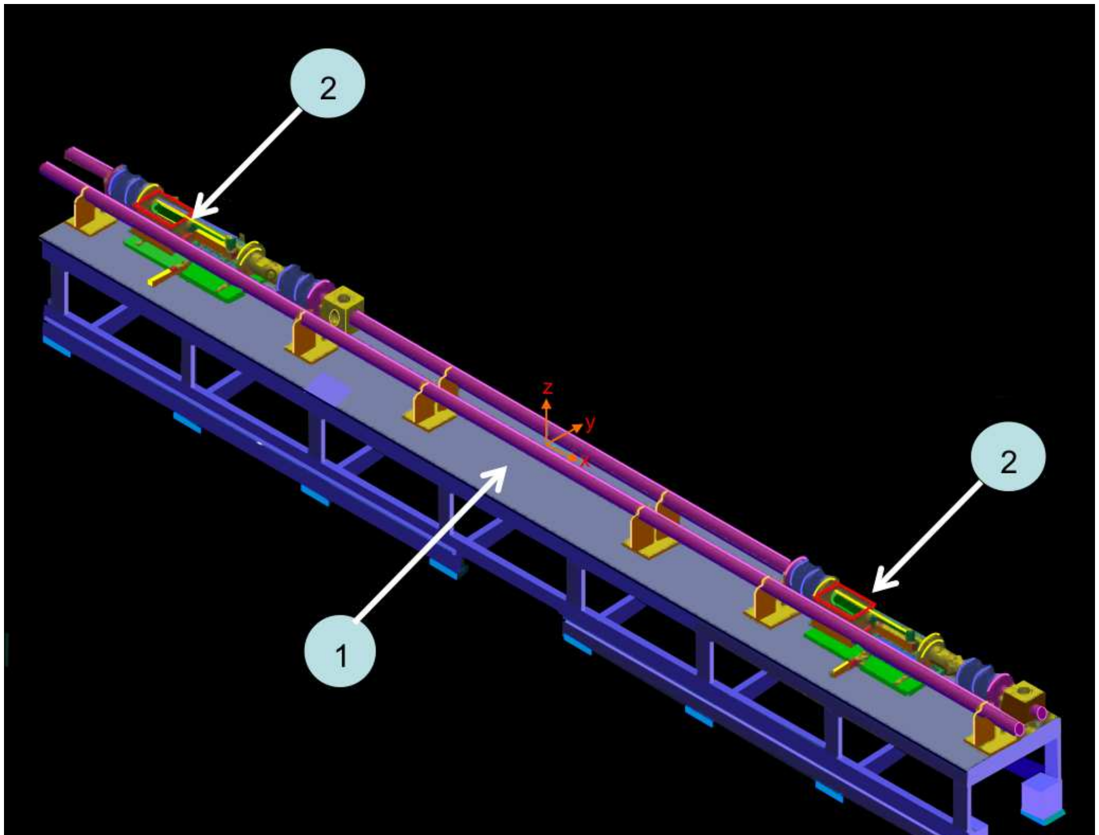
ATLAS Forward Physics detector acceptance

Both detectors at 420 and 220 m needed to have a good coverage of acceptance (NB: acceptance slightly smaller in CMS than in ATLAS)



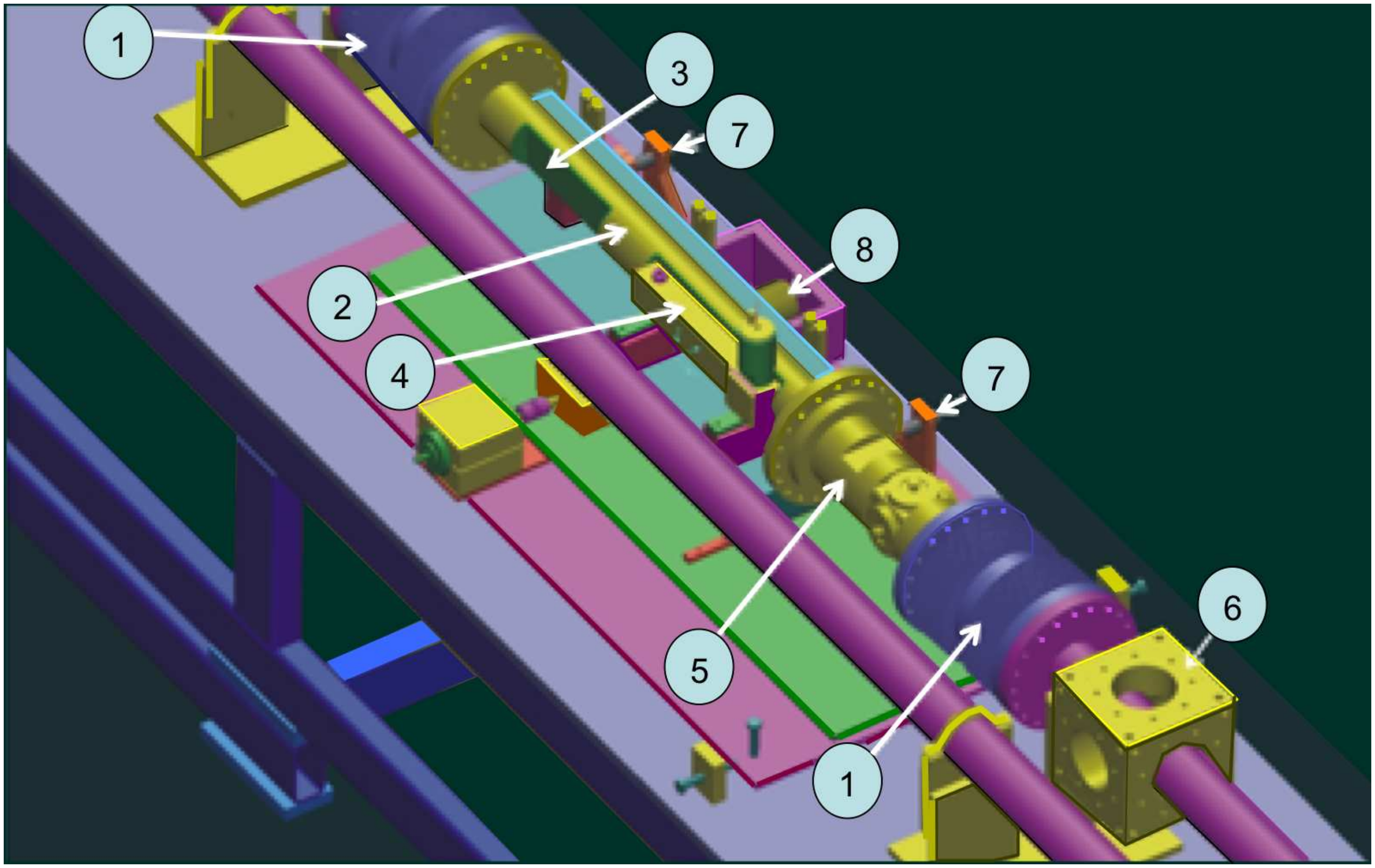
Movable beam pipes

- allow precise and repeatable movement of detectors close to the beam by $\sim$ 25 mm (HERA, Louvain)
- minimum deformation, thin vacuum window (detector a few mm from the beam), small RF impact
- use standard LHC components (bellows...)
- Choose movable beam pipe technique: less mechanical stress than roman pots since a fixed vacuum volume is maintained (studied in detail in FP420 document)
- The movable beam pipe is treated as an instrumented collimator from the LHC point of view which does not go as close to the beam as the collimator, uses same motors

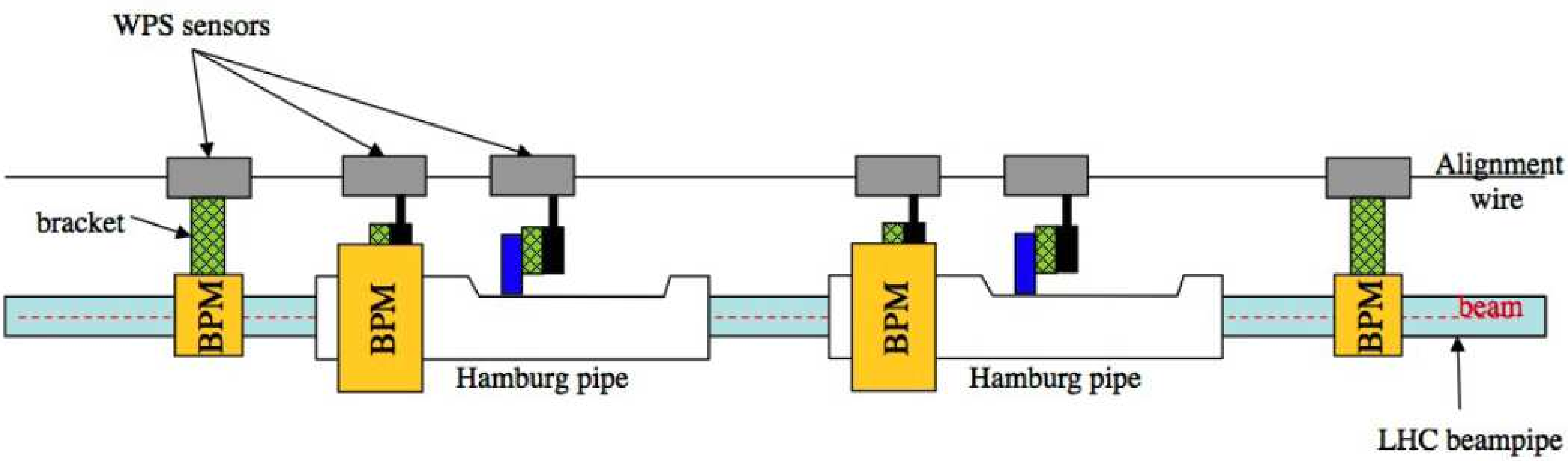


Movable beam pipes

- Different elements of movable beam pipes: (1) bellows, (2) movable beam pipe, (3) Si pocket, (4) timing detector pocket, (5) moving beam position monitors (BPM), (6) fixed BPM, (7) LVDT
- For 2013-14 shutdown: restrict to 220 m detectors
- 2 pockets for Si/timing detector 216 m: Si, GASTOF; 224 m: Si, QUARTIC



Beam position monitors

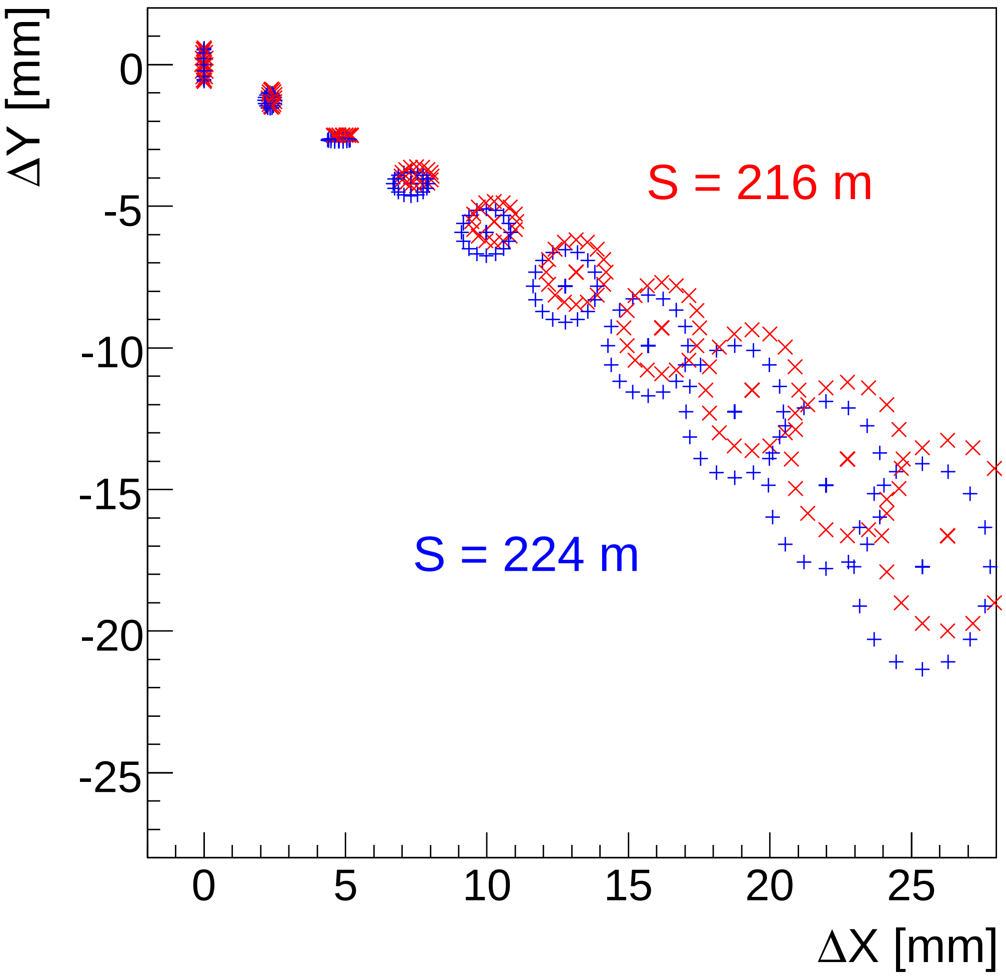


- Fixed BPMs on LHC beampipe and Wire Positioning Sensors
  - BPM and WPS: beam 's distance from alignment wire
  - LVDT and WPS: silicon's distance from wire
  - beam to silicon: difference between both
- Moving BPMs
- BPMs and WPS are standard LHC elements: readout electronics to be modified to get desired precision (in progress by LHC beam division)

Si tracking detector

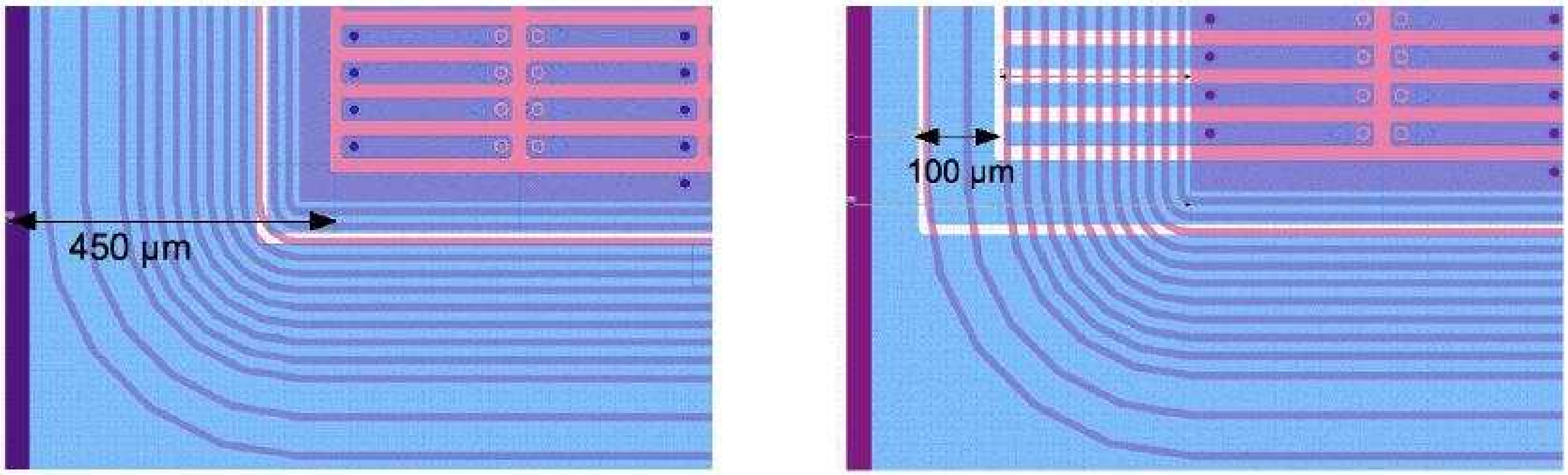
Key requirements for the Si detector

- Spatial resolution of 10 (30) μm in x (y) direction
- Angular resolution of about 1 μrad
- High efficiency over 20 mm $\times$ 20 mm
- minimal dead space at the edge
- Sufficient radiation hardness



Si detector: sensors

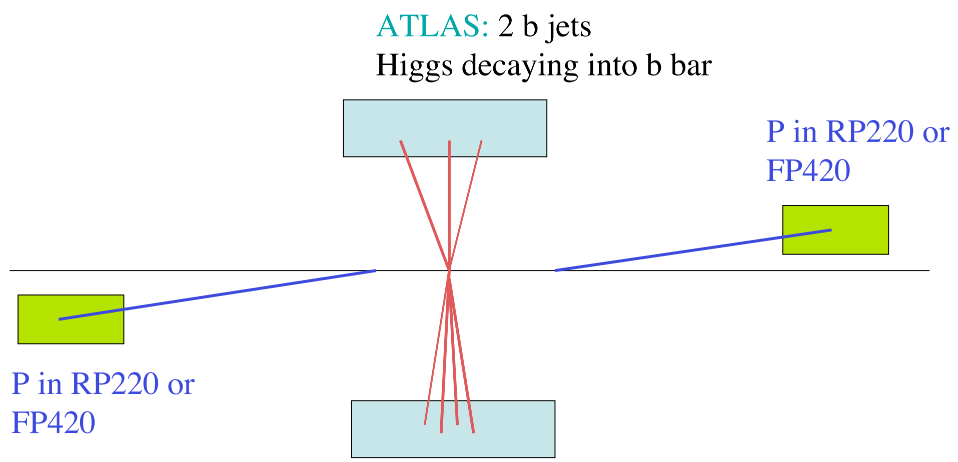
- Different options prossible for Si sensors (we benefit and follow the ATLAS IBL project)
  - 3D sensors: Double sided 3D sensors, single sided full 3D with active edges
  - Planar sensors: n-on-n
- Readout chip: FEI4, 1 chip needed per silicon layer, The new FEI4 chip solves the lifetime issue
- Cooling: under study, thermosiphon or vortex-based dry air cooling (local station enough to cool down Si, only compressed air needed)

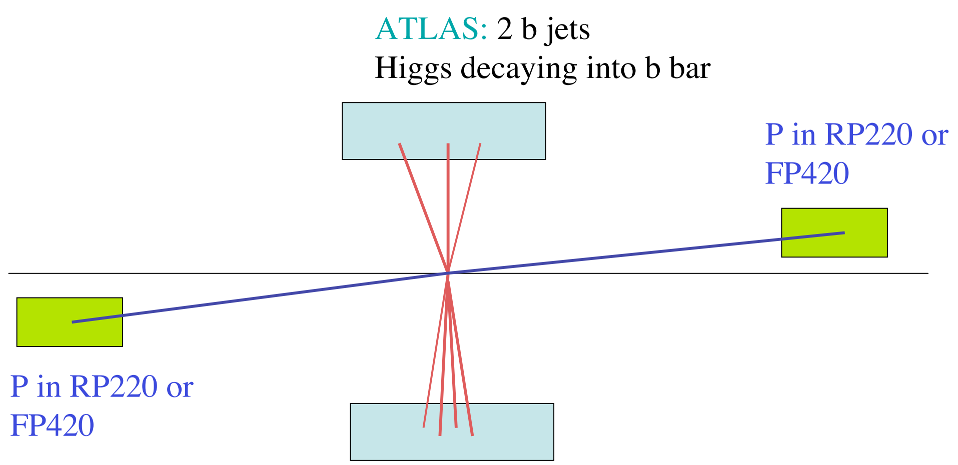


(a) (b)

Why do we need timing detectors?

We want to find the events where the protons are related to Higgs production and not to another soft event (up to 35 events occuring at the same time at the LHC!!!!)



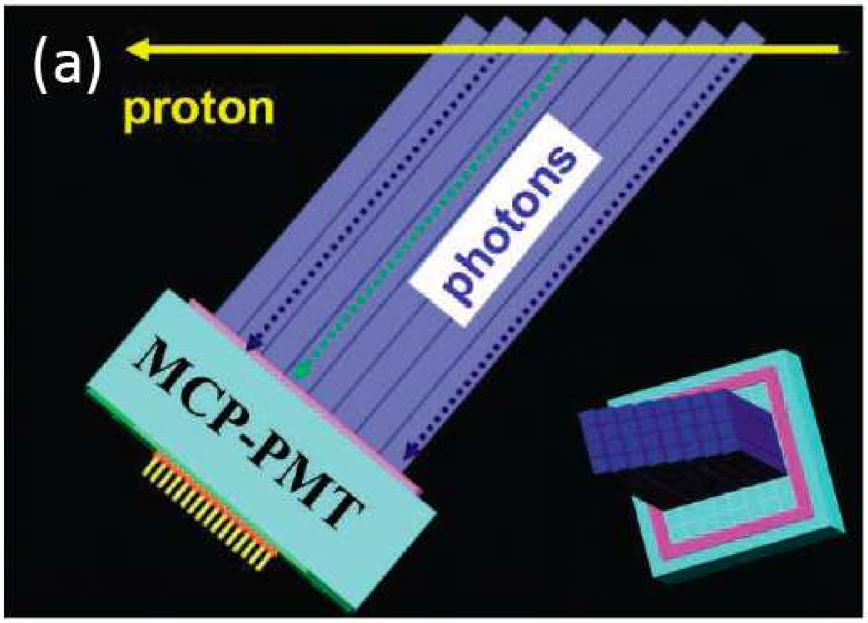


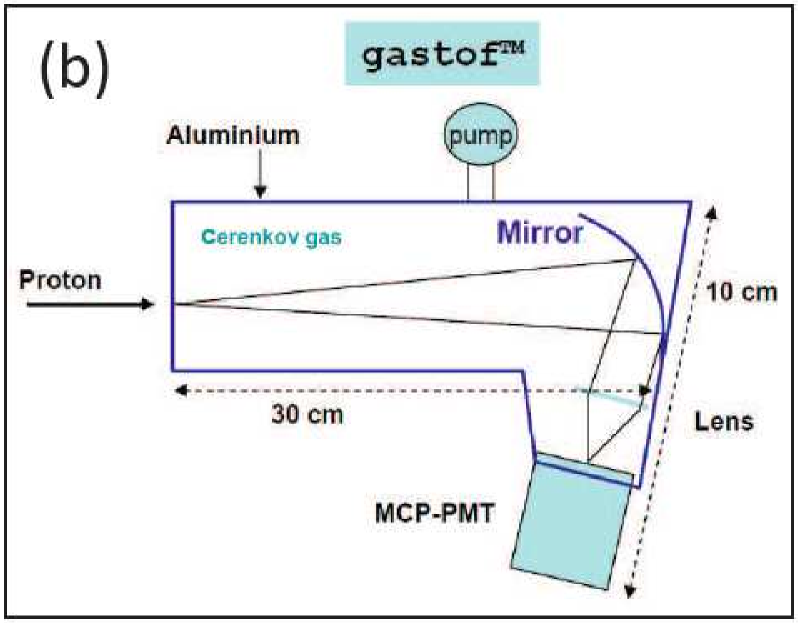
QUARTIC and GASTOF timing detectors

Requirements for timing detectors

- 10 ps final precision (20-30 ps for phase 0) (GASTOF in Louvain, QUARTIC in UTA, Fermilab, Alberta)
- acceptance that fully cover the tracking detectos, efficiency close to 100%
- high rate capability
- segmentation for multi-proton timing (not critical for phase 0)
- level 1 trigger capability (not critical for phase 0)

Micro-channel plate PMT lifetime issue: critical at highest lumi (new developments in progress by Hamamatsu, common developments between UTA and Burle/Photonis)





Conclusion and timescale

- Diffractive physics at the LHC: QCD, Higgs, WW, anomalous coupling...
- AFP project: movable beam pipes needed at 220/420 m - 2 phases: 220 m detectors only to be installed in 2013, 420 m additional detectors to be installed if physics motivates it later
- Position detectors to be used: 3D or pixel Silicon
- Timing detectors: High precision needed especially for high luminosity at the LHC ($\sim$ 5-10 picoseconds)
- Timescale: physics project approved by ATLAS, technical proposal submitted to ATLAS in February for phase 1; many groups involved: France (Saclay), Poland (Cracow), Czech Republic (Prague), USA (Texas Arlington, Stony Brook), Canada (Alberta), Germany (Giessen)
- Management structure in progress: Christophe Royon, ATLAS Forward Physics Project Coordinator
- Many developments performed/in progress for the project and extremly useful for the future in particle physics or medical applications: 3D Si, timing detectors