

# Using JetWeb to tune Monte Carlo for hadronic backgrounds from $\gamma\gamma$ events at a linear collider.

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for the Cedar collaboration

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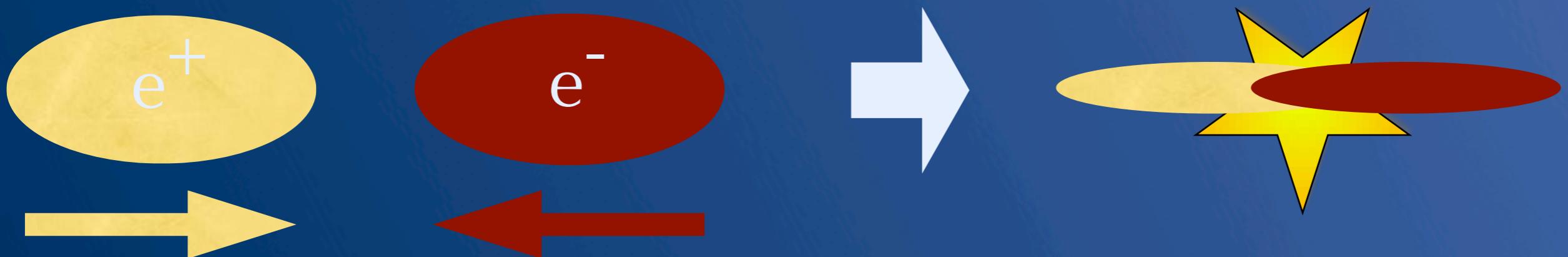
- Brief explanation of hadronic background from gamma-gamma collisions.
- Description and demonstration of JetWeb
- Early comparisons to HERA data

Lepton collider != zero hadronic background

Photons can also be a bag of partons

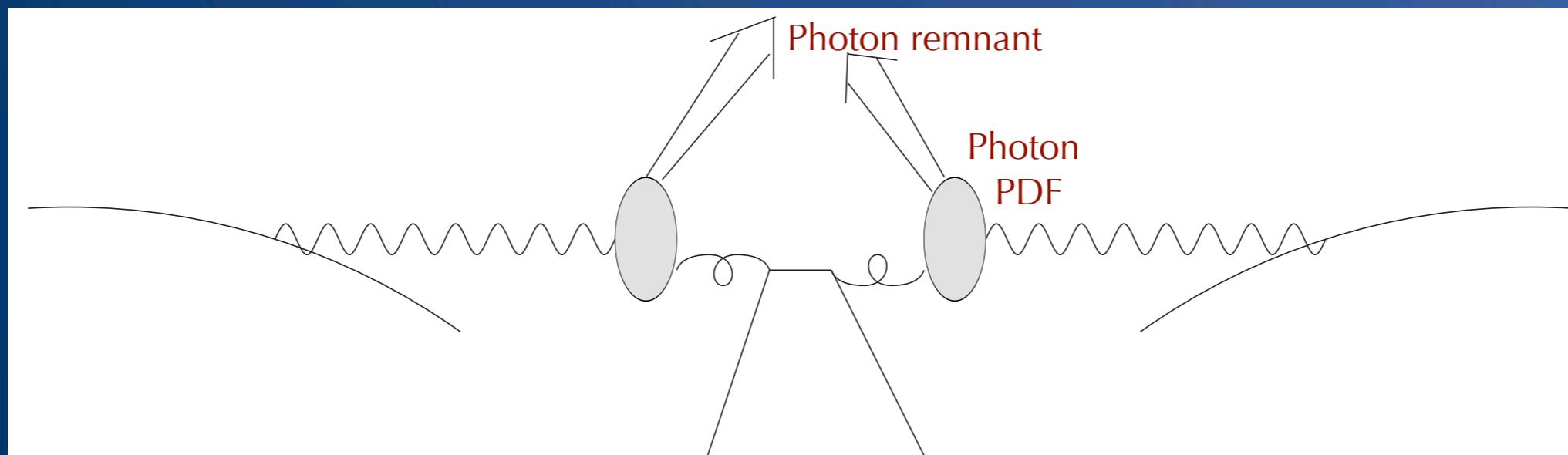
Plenty of photons at a linear collider...

Pinch effect - leads to bending of  $e^\pm$  trajectory



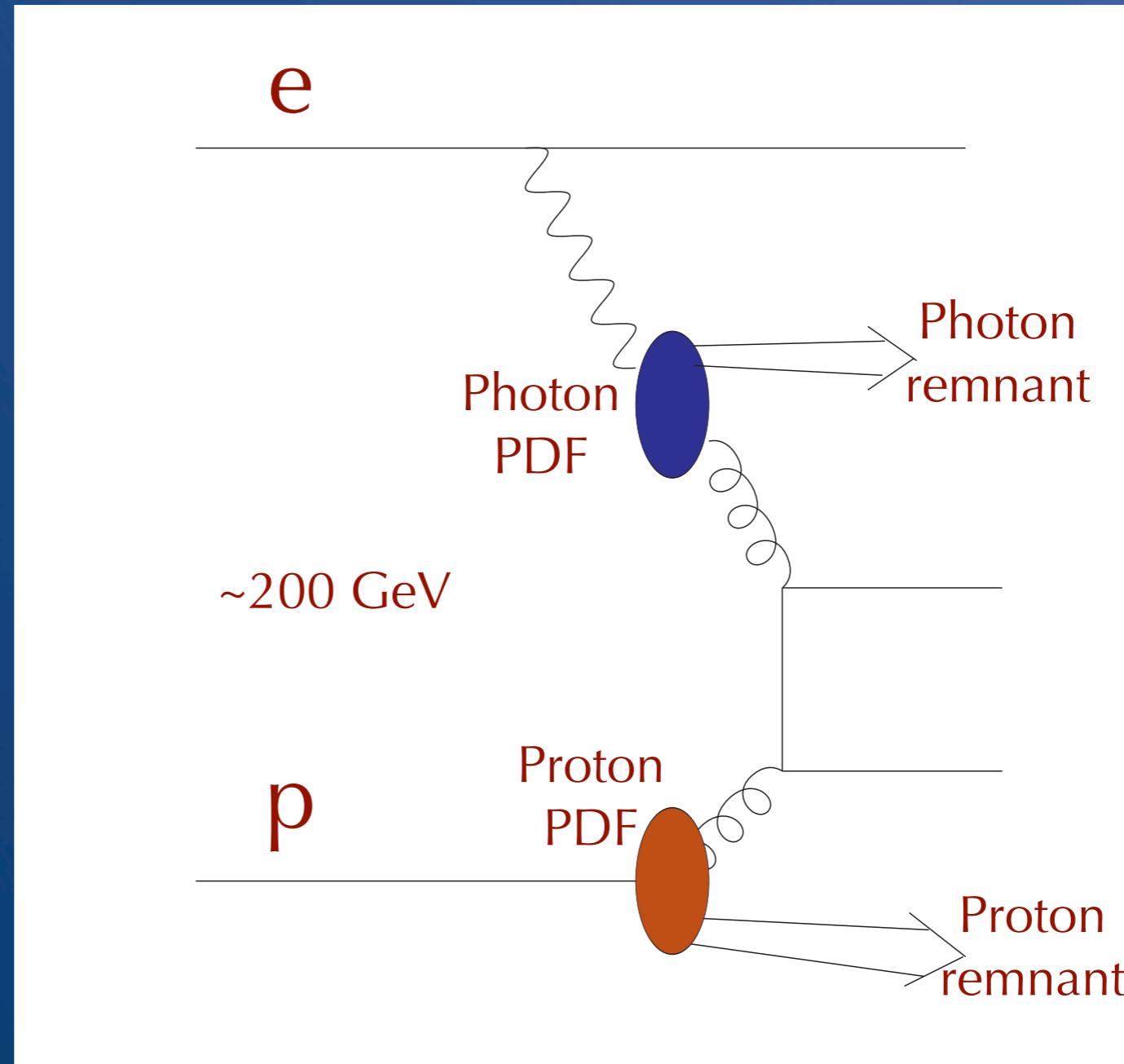
Increases luminosity but smears beam energy...

... and leads to photon-photon background



Similar to  $\gamma p$  events at HERA

# Photoproduction



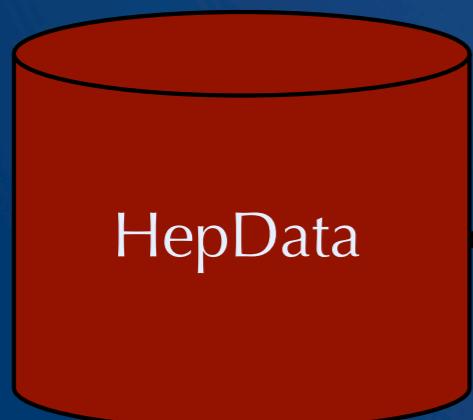
Also  $\gamma\gamma$  events from LEP, even in future from LHC with tagged protons

Want to tune generators so they fit the HERA and LEP photon data and then extrapolate to future linear collider energies.

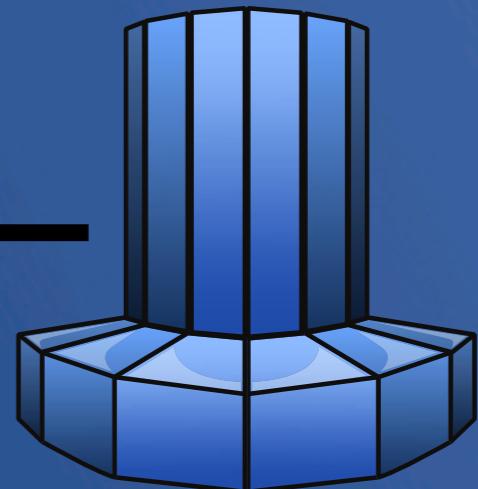
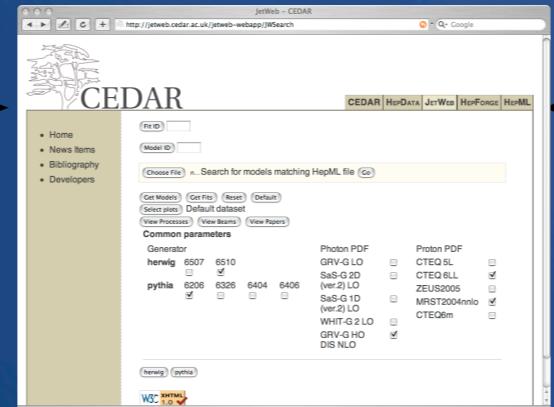
First need to develop the tools to do this...

# Cedar

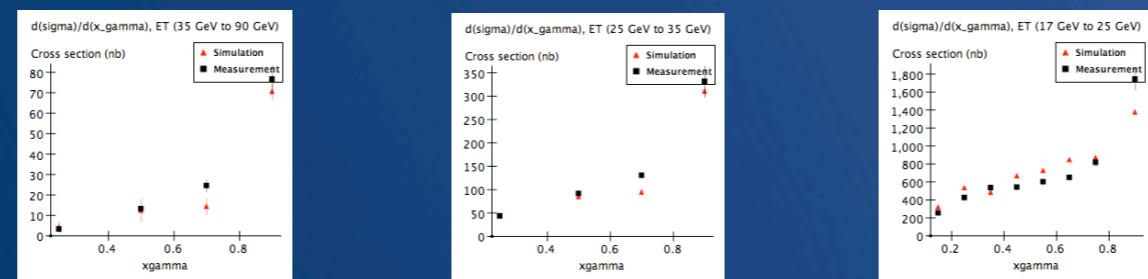
JetWeb  
(web interface, database of models)



(results going back to the '70s)



HZTool/Rivet  
generated on grid



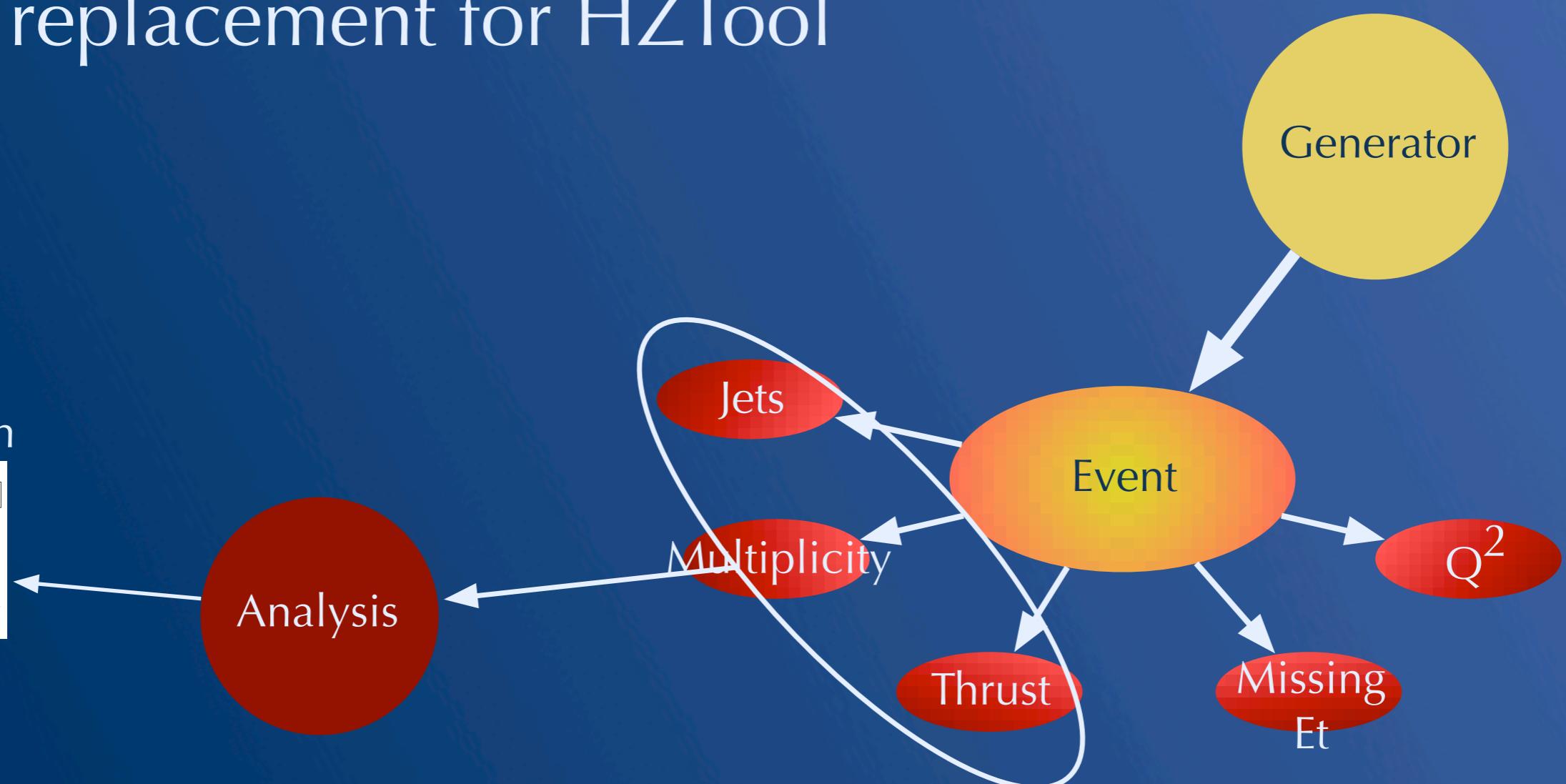
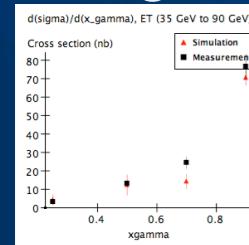
Comparison plots between experimental measurement and  
Monte Carlo for any set of Monte Carlo parameters

# A quick slide about Rivet

(Robust Independent Verification  
of Experiment against Theory)

C++ replacement for HZTool

Aida or  
root  
histogram



Only need do each projection once per event

## Search for models/tunes

JetWeb – CEDAR

<http://jetweb.cedar.ac.uk/jetweb-webapp/JWSearch>

CEDAR HEPDATA JETWEB HEPFORGE HEPML

Choose File ... Search for models matching HepML file (Go)

Get Models Get Fits Reset Default Select plots Default dataset View Processes View Beams View Papers

Common parameters

Generator Photon PDF Proton PDF

herwig 6507 6510 GRV-G LO CTEQ 5L

pythia 6206 6326 6404 6406 Sas-G 2D CTEQ 6LL

(ver.2) LO ZEUS2005

Sas-G 1D MRST2004nlo

(ver.2) LO CTEQ6m

WHT-G 2 LO

GRV-G HO

DIS NLO

herwig pythia

W3C XHTML 1.0

list of matching models

JetWeb – CEDAR

<http://jetweb.cedar.ac.uk/jetweb-webapp/JWSearch>

CEDAR HEPDATA JETWEB HEPFORGE HEPML

Model ID: 10 Generator: herwig-6510; Photon PDF: Sas-G 2D (ver.2) LO; Proton PDF: MRST2004nlo  
Model description: PTJIM=4 GeV [full details]

Model ID: 9 Generator: herwig-6510; Photon PDF: Sas-G 1D (ver.2) LO; Proton PDF: MRST2004nlo  
Model description: PTJIM=2 GeV [full details]

Model ID: 12 Generator: herwig-6510; Photon PDF: Sas-G 1D (ver.2) LO; Proton PDF: CTEQ 6LL  
Model description: Atlas tune (Sas photon) [full details]

Model ID: 11 Generator: herwig-6510; Photon PDF: Sas-G 1D (ver.2) LO; Proton PDF: MRST2004nlo  
Model description: PHRAD=0.19 [full details]

Model ID: 5 Generator: herwig-6510; Photon PDF: GRV-G HO DIS NLO; Proton PDF: CTEQ 6LL  
Model description: Atlas tune [full details]

model details

JetWeb – CEDAR

<http://jetweb.cedar.ac.uk/jetweb-webapp/JWSearch>

CEDAR HEPDATA JETWEB HEPFORGE HEPML

A model defines a generator and its parameter settings.  
Model ID: 5 Generator: herwig-6510; Photon PDF: GRV-G HO DIS NLO; Proton PDF: CTEQ 6LL  
Model description: Atlas tune

Available fits using this model

More data Similar data Non-default parameters

Compare to another model : (Go)

Generator: herwig-6510 Parameters:  
NFLAV ISPAC IFLMAX IOPREM JIMMY  
6 0 5 1 1  
PTJIM PDFPOWCLMAX PRSOF PSPLT1 PRRAD  
4.91E0 0E0 3.35E0 0E0 1E0 1.8E0  
VGCUPTPRMS PHRAD VCUT BTCLM PSPLT2  
1E-1 0E0 4.7E-1 4.8E-1 1E0 1E0  
PHAD PDFX0 QCDLAM CLPLOW QSPAC VPCUT  
3E2 0E0 1.8E-1 1.2E0 2.5E0 4E-1

Minimum Bias 820 0p\_27.5e+ data  
Nothing generated for this process type.

JetWeb – CEDAR

<http://jetweb.cedar.ac.uk/jetweb-webapp/JWSearch>

CEDAR HEPDATA JETWEB HEPFORGE HEPML

In sufficient data currently exist in the database matching the parameters you specified.  
Submit the form below to request generation of this data.

Minimum PT (GeV) for generated events : (Submit the request) Reset

Common parameters

Generator Photon PDF Proton PDF

herwig 6507 6510 GRV-G LO CTEQ SL

pythia 6206 6326 6404 6406 Sas-G 2D CTEQ 6LL

(ver.2) LO ZEUS2005

Sas-G 1D MRST2004nlo

(ver.2) LO CTEQ6m

WHT-G 2 LO

GRV-G HO

DIS NLO

Model description: \_\_\_\_\_

Change the generator parameters

Enter pythia-6406 parameters below and add them before submission  
MSTJ Amy  
MSTJ(1) : MSTJ(2) : MSTJ(3) : MSTJ(4) : MSTJ(5) : MSTJ(6) :  
MSTJ(7) : MSTJ(8) : MSTJ(9) : MSTJ(10) : MSTJ(11) : MSTJ(12) :  
MSTJ(13) : MSTJ(14) : MSTJ(15) : MSTJ(16) : MSTJ(17) : MSTJ(18) :

submit new model

JetWeb – CEDAR

<http://jetweb.cedar.ac.uk/jetweb-webapp/JWSearch>

CEDAR HEPDATA JETWEB HEPFORGE HEPML

ID:32 High-ET Inclusive Jet Cross Sections in Photoproduction at HERA  
Code author(s): Jon Butterworth Contact: J.Butterworth@ucl.ac.uk  
Jet ET > 14 GeV, 134 > W > 277 GeV

Jet ET > 14 GeV, 134 > W > 277 GeV  
 $d(\sigma)/d(\eta)$  vs pseudorapidity

Simulation Measurement

Vector output of plotted data

The default process type for this data is  
ID: 2 High ET in 820.0 GeV p - 27.5 GeV e+ collisions. (More)

list of plots from paper  
compared to Monte Carlo

Fit and  $\chi^2$

JetWeb – CEDAR

<http://jetweb.cedar.ac.uk/jetweb-webapp/JWSearch>

CEDAR HEPDATA JETWEB HEPFORGE HEPML

Energy Flow and Rapidity Gaps Between SPIRES Reference H1 Eur. Phys. J C24 (2002) 4, 517-527 , 03/02

Measurement of Dijet Cross Sections in SPIRES Reference H1 Eur.Phys.J.C25:13-23,2002

Multijet Photoproduction SPIRES Reference ZEUS Acta Phys.Polon.B33:3123-3128,2002; ICHEP 2002 Abstract 849

Dijet photoproduction at HERA and the SPIRES Reference ZEUS Eur.Phys.J.C23:615-631,2002; DESY-01-220; hep-ex/0112029

Measurement of Di-jet Cross-Sections in SPIRES Reference H1 Phys. Lett. B483 (2000) 36-48.

Measurement of Dijet Photoproduction at SPIRES Reference ZEUS The European Physical Journal C 11 (1999) 1 35-50

Measurement of Three-jet Distributions in SPIRES Reference H1 Phys. Letters B 443 (1998) 394-408.

Measurement of inclusive D<sup>+</sup>- and SPIRES Reference ZEUS Physics Letters B 443 (1998) 394-408.

associated dijet cross sections in photoproduction at HERA SPIRES Reference ZEUS The European Physical Journal C6 (1999) 67-83.

list of papers

## Live demonstration

Comparison to HERA data (more complete at the moment in HZSteer). LEP will follow.

New(ish) Pythia parton shower does not (yet) work in ep mode

Can play with the photon/proton radius, minimum PT, photon PDF, compare to ATLAS tuning for Herwig...

## Different PT Min (in Jimmy multiple interactions)

A model defines a generator and its parameter settings.  
Model ID: 10 Generator: herwig-6510; Photon PDF: SaS-G 2D (ver.2) LO; Proton PDF:  
MRST2004nnlo  
Model description: PTJIM=4 GeV

**Available fits using this model**

[More data](#) [Similar data](#)

[Non-default parameters](#)

Compare to another model :  [go](#)

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Generator: herwig-6510 Parameters:

NFLAV	ISPAC	IFLMAX	IOPREM	JIMMY
6	0	5	1	1
<b>PTJIM</b>	PDFPOWCLMAX	PRSOF	PSPLT1	PRRAD
<b>4E0</b>	0E0	3.35E0	1E0	1E0
VGCUTPTRMS	PHRAD	VQCUT	BTCLM	PSPLT2
1E-1	0E0	4.7E-1	4.8E-1	1E0
PHAD	PDFX0	QCDLAMCLPOW	QSPAC	VPCUT
3E2	0E0	1.8E-1	2E0	2.5E0
				4E-1

SaS 2D only  
valid for  $Q^2 > 2\text{GeV}^2$ . SaS  
1D goes below  
 $1\text{GeV}^2$

Try PT Min of  
2, 3 and 4  
GeV

**Measurement of dijet cross-sections in photoproduction and photon structure.**

By H1 Collaboration (C. Adloff *et al.*). DESY-00-035, Mar 2000. 20pp.

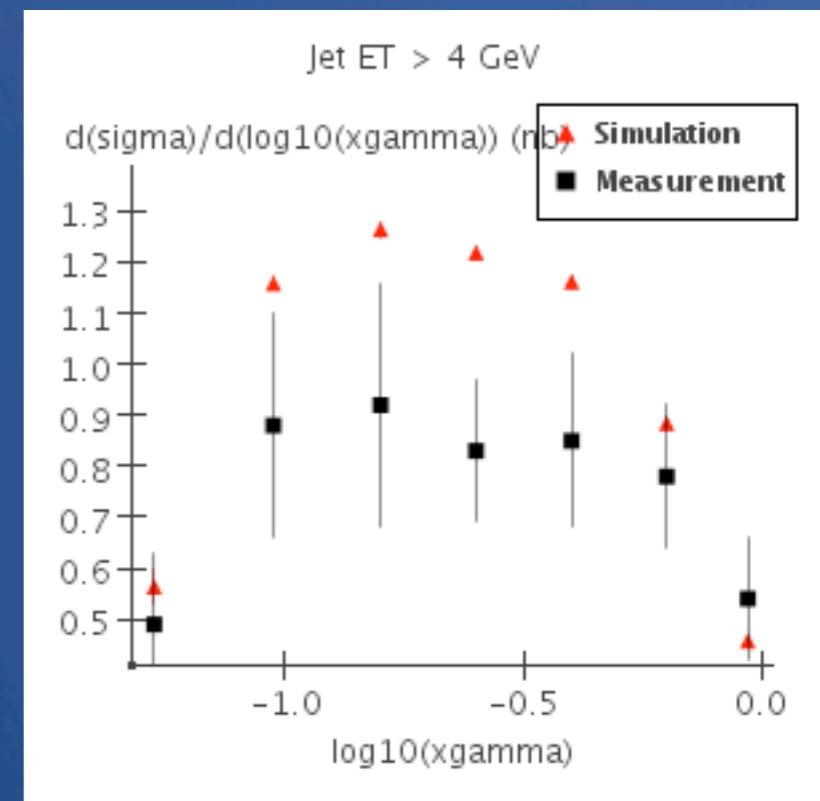
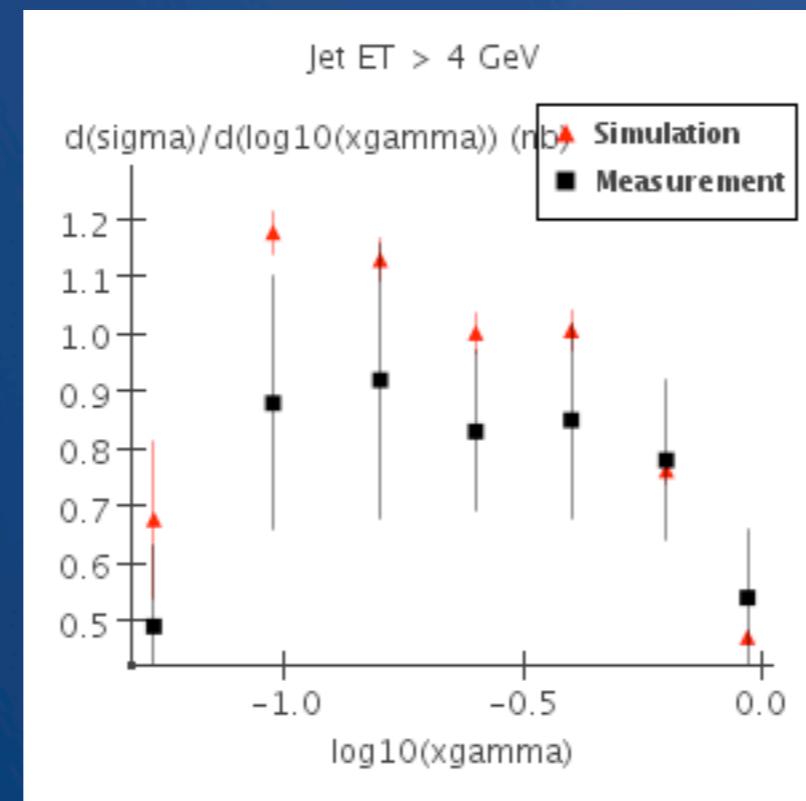
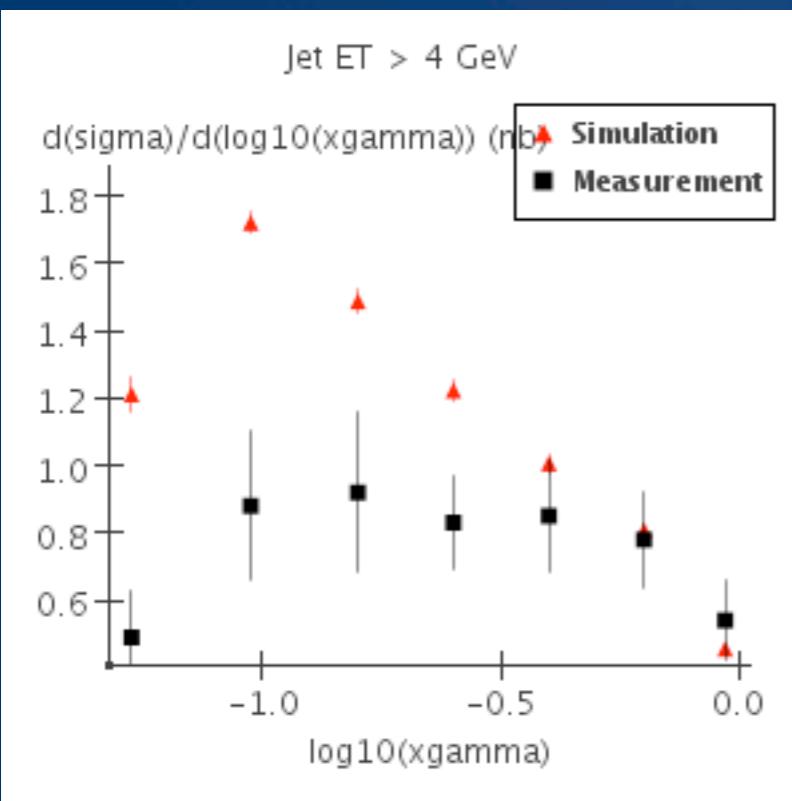
Published in Phys.Lett.B483:36-48,2000.

e-Print: hep-ex/0003011

PTMin=2GeV

PTMin=3GeV

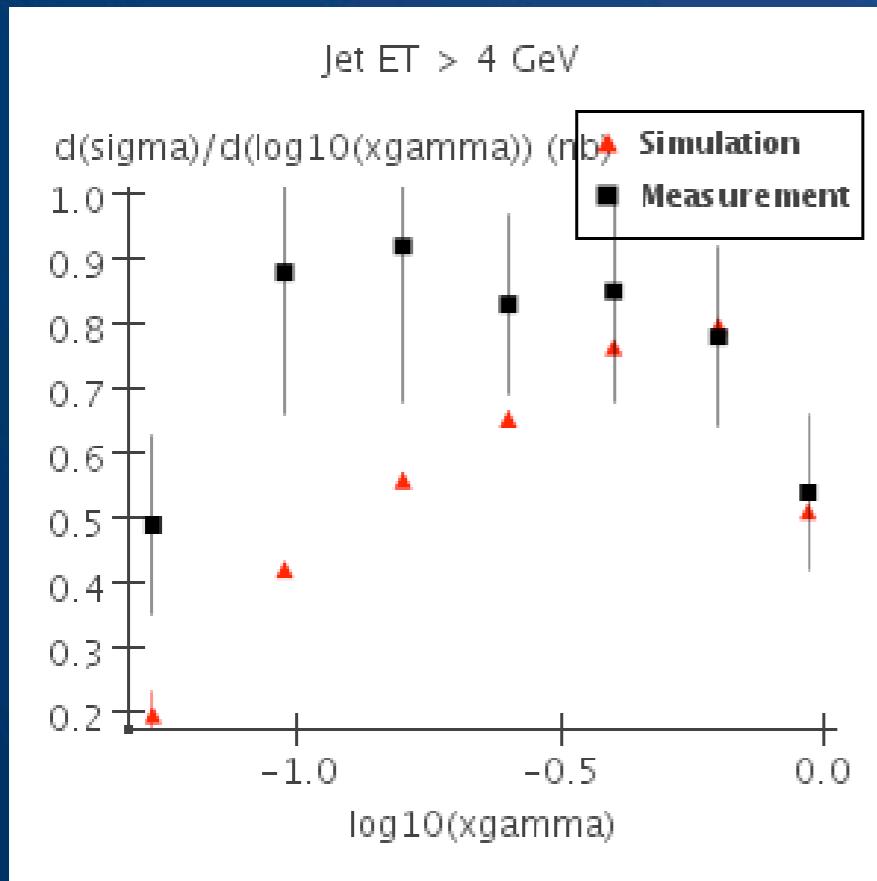
PTMin=4GeV



$$x_{\gamma,jets} = \frac{E_{T,jet1} e^{-\eta_{jet1}} + E_{T,jet2} e^{-\eta_{jet2}}}{2 y_e E_{e,0}},$$

Common sense says 4 GeV is out  
for fitting down to 4 GeV jets

# Out of interest...



## Default

Parameter	Model 8	Model 12
Real : :PTJIM	2.0	4.909999847412109
Real : :PRSOF	1.0	0.0
Real : :PRRAD	0.7099999785423279	1.7999999523162842
Real : :CLPOW	2.0	1.2000000476837158

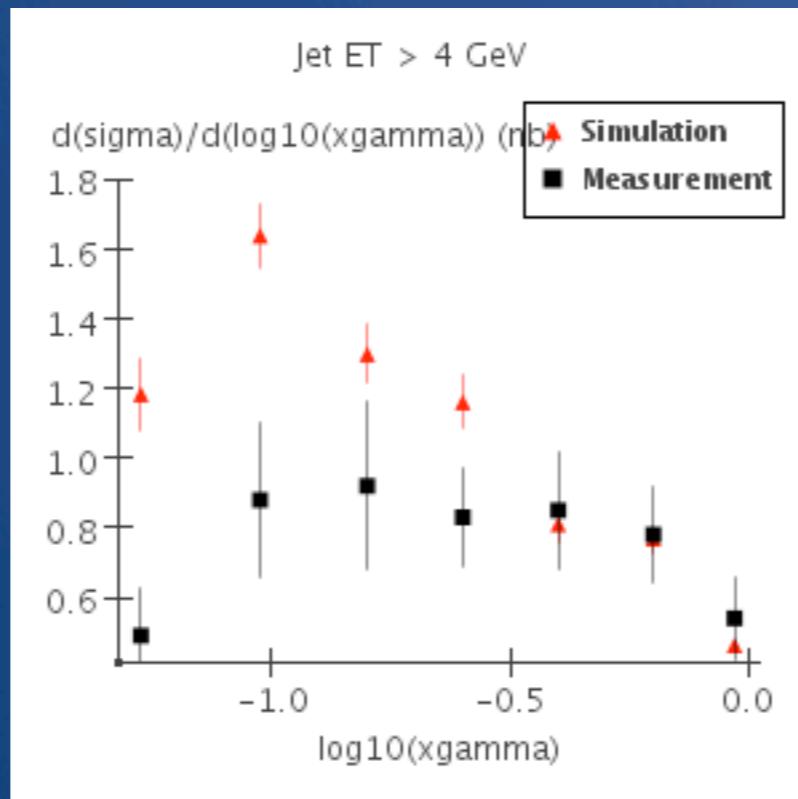
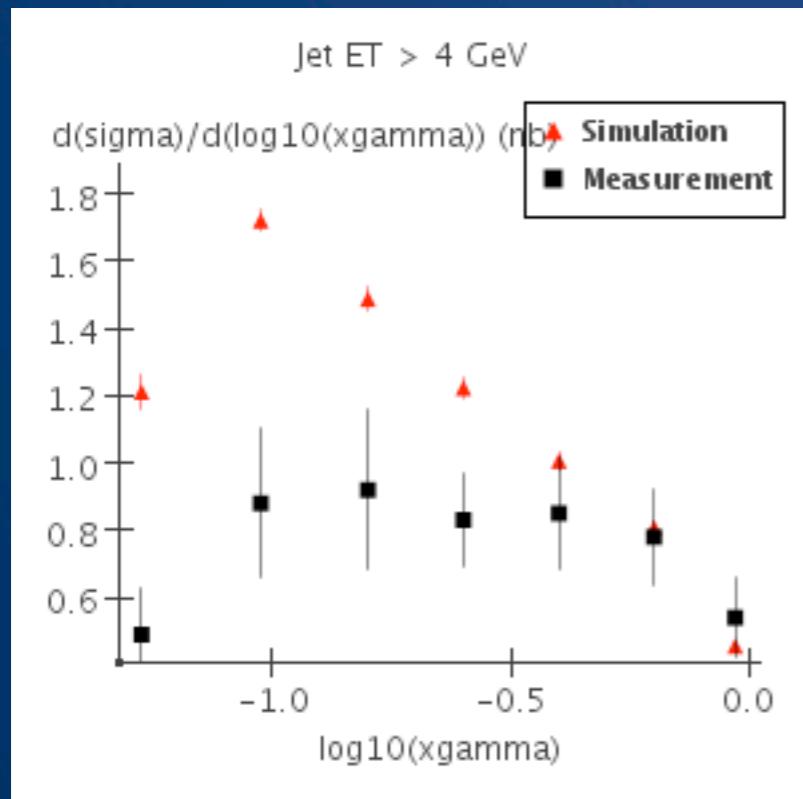
ATLAS tune suppresses multiple interactions by making PT Min high.

Also turns Herwig underlying event off and makes proton small

# Photon radius

Default

0.19



Smaller value =  
bigger photon

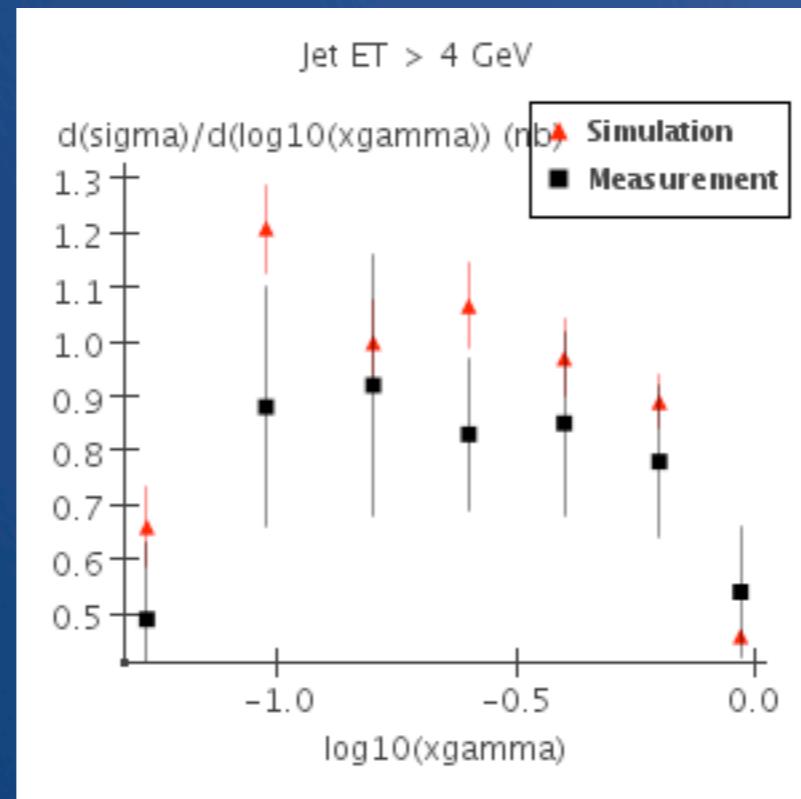
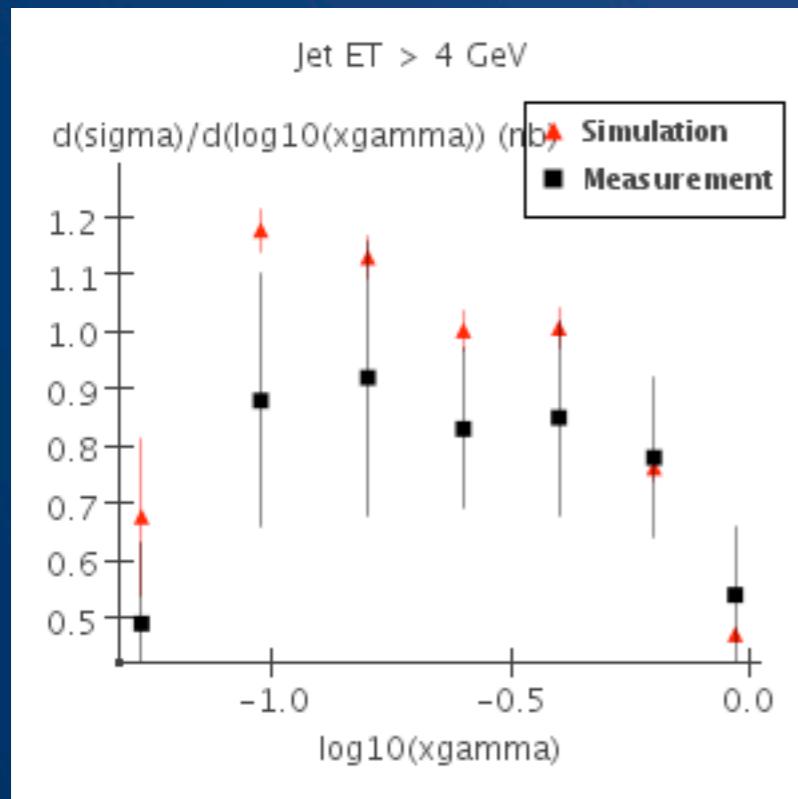
PTMin 2 GeV

Parameter	Model 8	Model 11
Real ::PHRAD	0.4699999988079071	0.1899999976158142

# Photon radius

Default

0.19



PTMin 3 GeV

Can trade off photon size Vs. PTJim

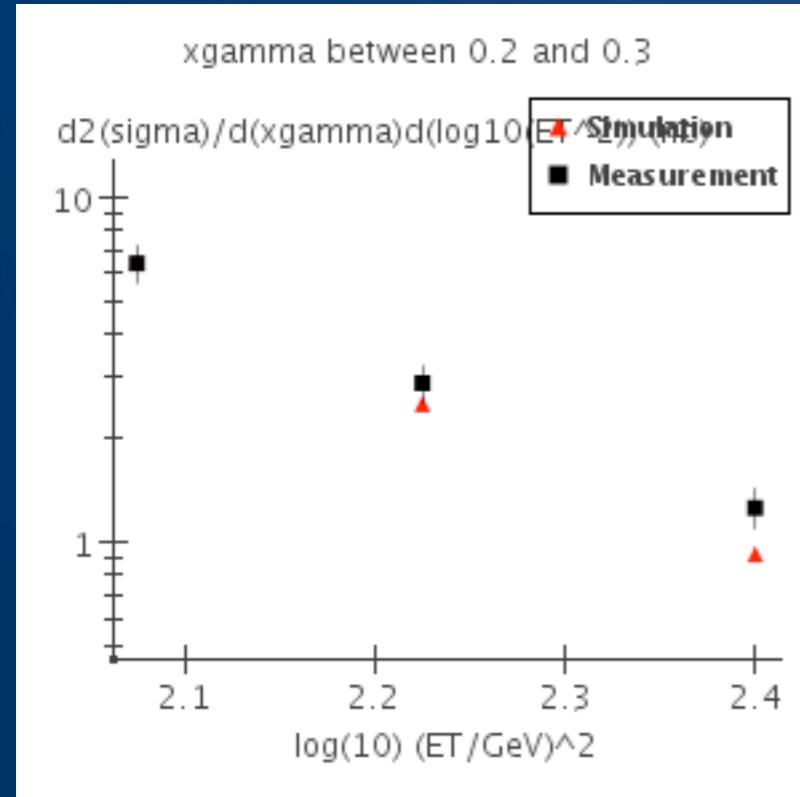
**Measurement of the inclusive dijet cross-section in photoproduction and determination of an effective parton distribution in the photon.**

By H1 Collaboration (C. Adloff *et al.*). DESY-97-164, Sep 1997. 19pp.

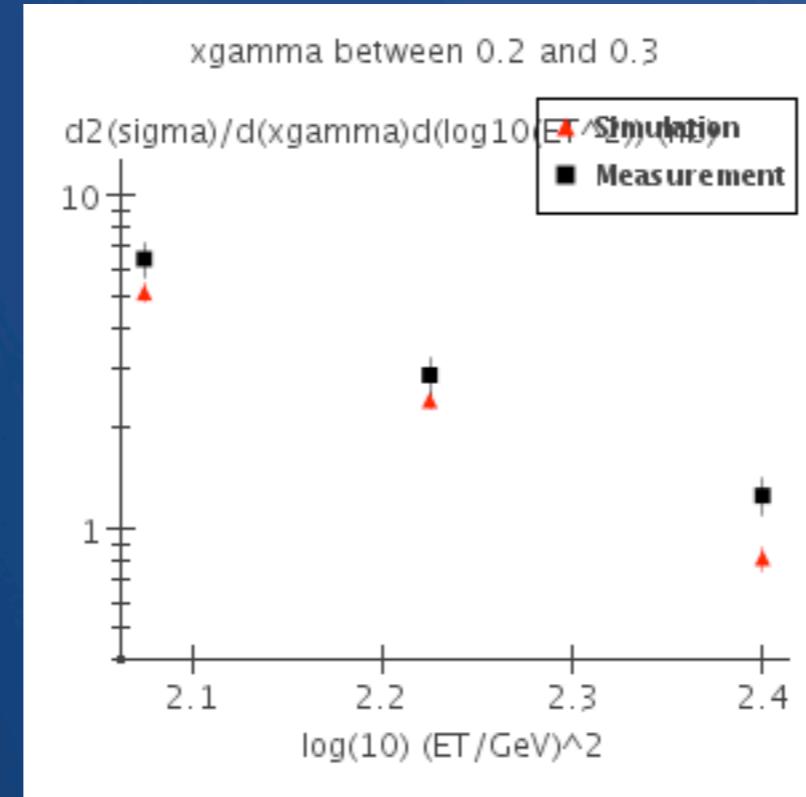
Published in Eur.Phys.J.C1:97-107,1998.

e-Print: [hep-ex/9709004](http://arxiv.org/abs/hep-ex/9709004)

PTJim 2 GeV



PTJim 3 GeV



Not so  
different

$$x_{\gamma,jets} = \frac{E_{T,jet1}e^{-\eta_{jet1}} + E_{T,jet2}e^{-\eta_{jet2}}}{2ye_e E_{e,0}},$$

Some cancellation

This paper differs from the previous in the way it reconstructs the photon momentum from the calorimeter.

**Dijet cross-sections in photoproduction at HERA.**By ZEUS Collaboration (J. Breitweg *et al.*). DESY-97-196, Oct 1997. 24pp.

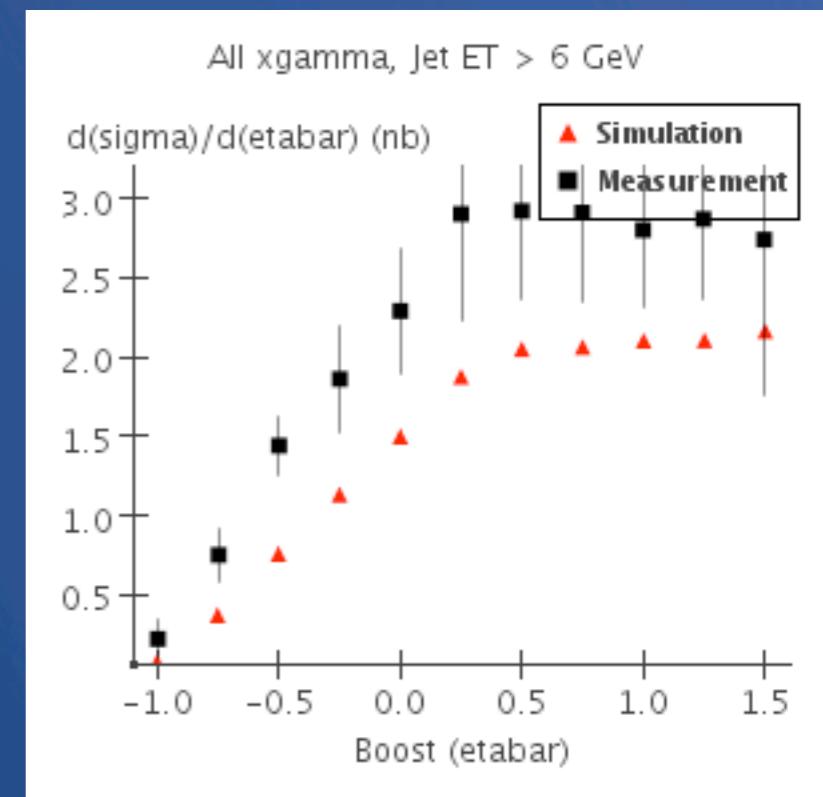
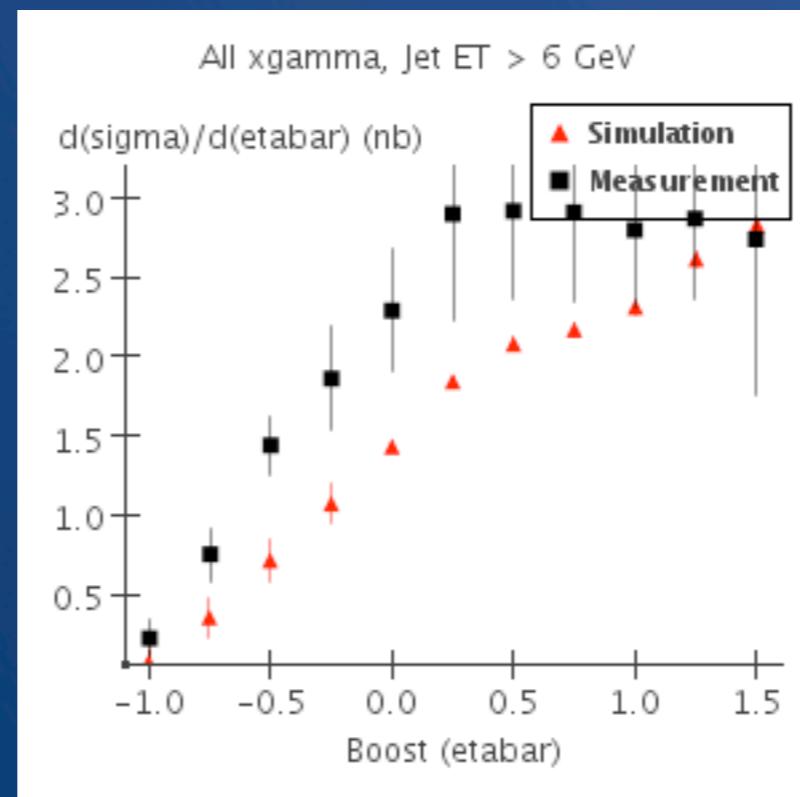
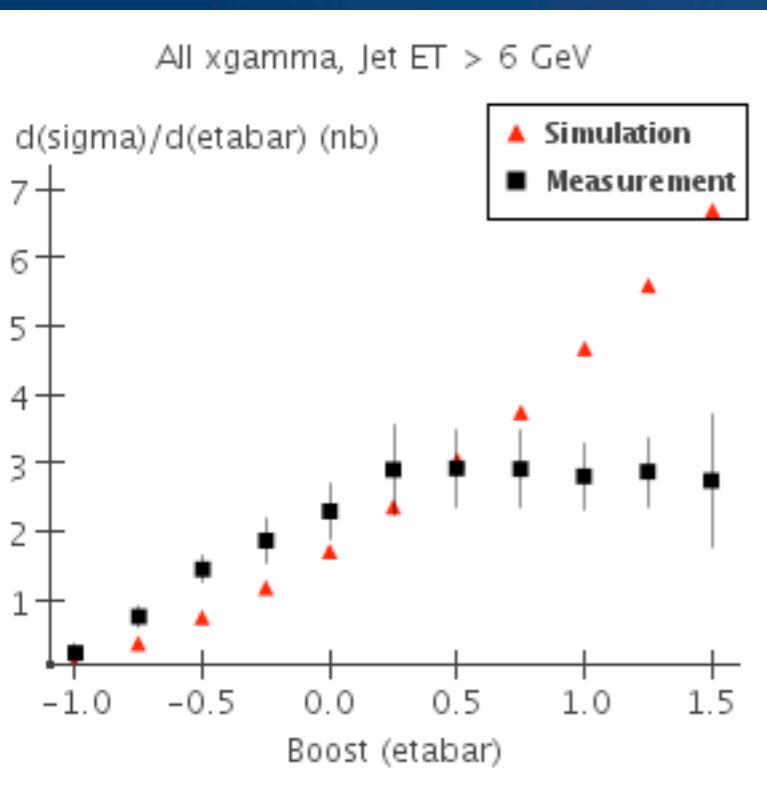
Published in Eur.Phys.J.C1:109-122,1998.

e-Print: [hep-ex/9710018](http://arxiv.org/abs/hep-ex/9710018)

2 GeV

3 GeV

4 GeV



4 GeV has best shape (SaS 2D PDF also)

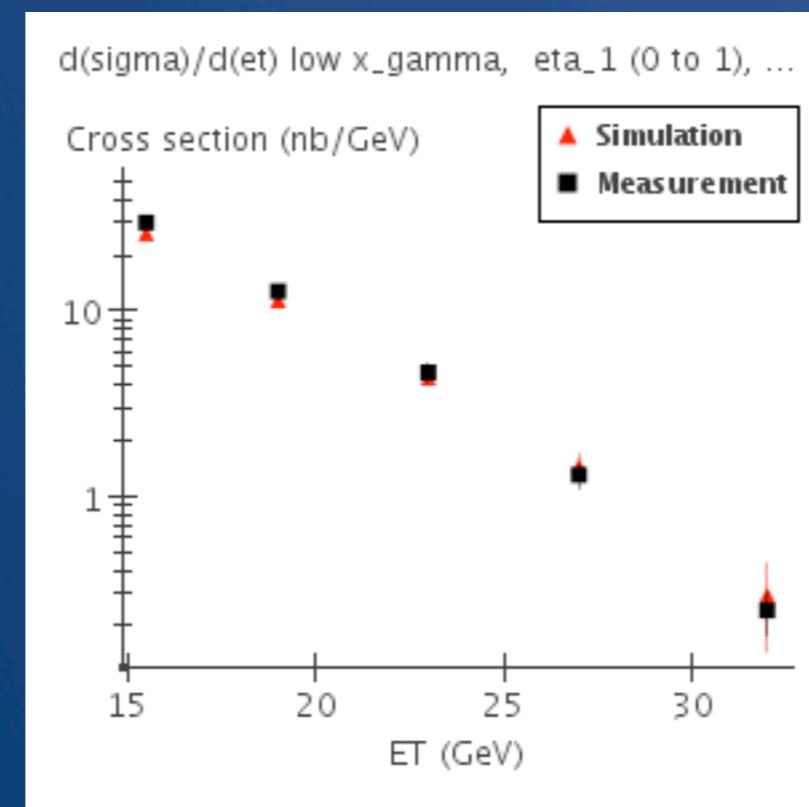
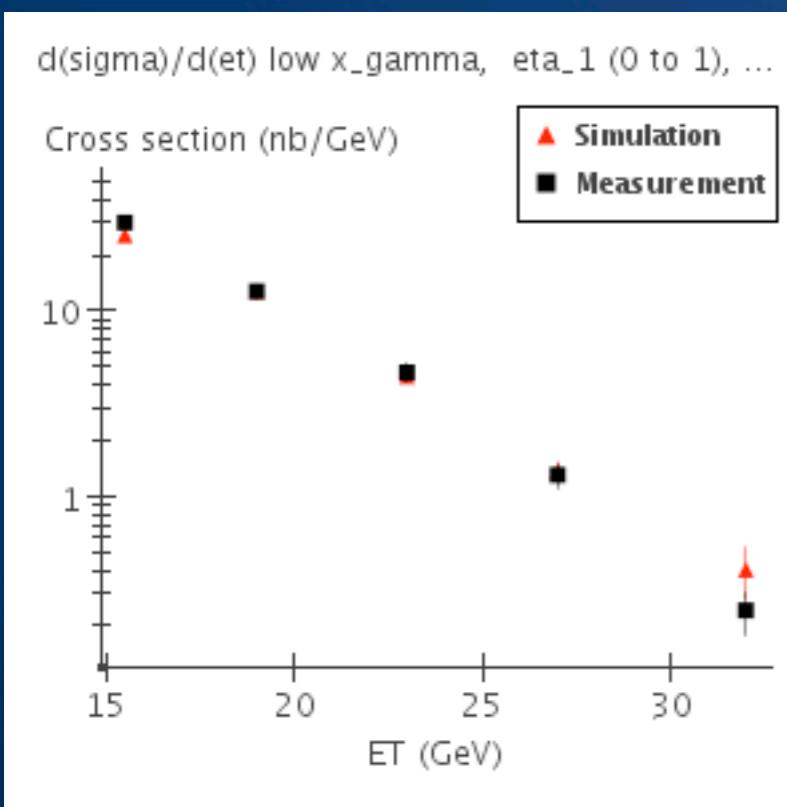
## Dijet photoproduction at HERA and the structure of the photon.

By ZEUS Collaboration (S. Chekanov *et al.*). DESY-01-220, Dec 2001. 38pp.  
 Published in Eur.Phys.J.C23:615-631,2002.  
 e-Print: hep-ex/0112029

Can be used to scale the Monte Carlo points

2 GeV

3 GeV



Not much wrong with normalisation

Can tune the proton to min bias from the Tevatron

Use that proton with the HERA data to tune the photon

Not yet though

- Even at linear collider there is hadronic background
- Would like to tune and validate Monte Carlo to simulate that background
- Cedar are providing tools to do that
- JetWeb pretty much up and running, though still being developed.
- JetWeb Will be useful for validating Monte Carlo for a future linear collider