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

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Outline

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

Background

Lepton collider != zero hadronic background

Photons can also be a bag of partons

Plenty of photons at a linear collider...

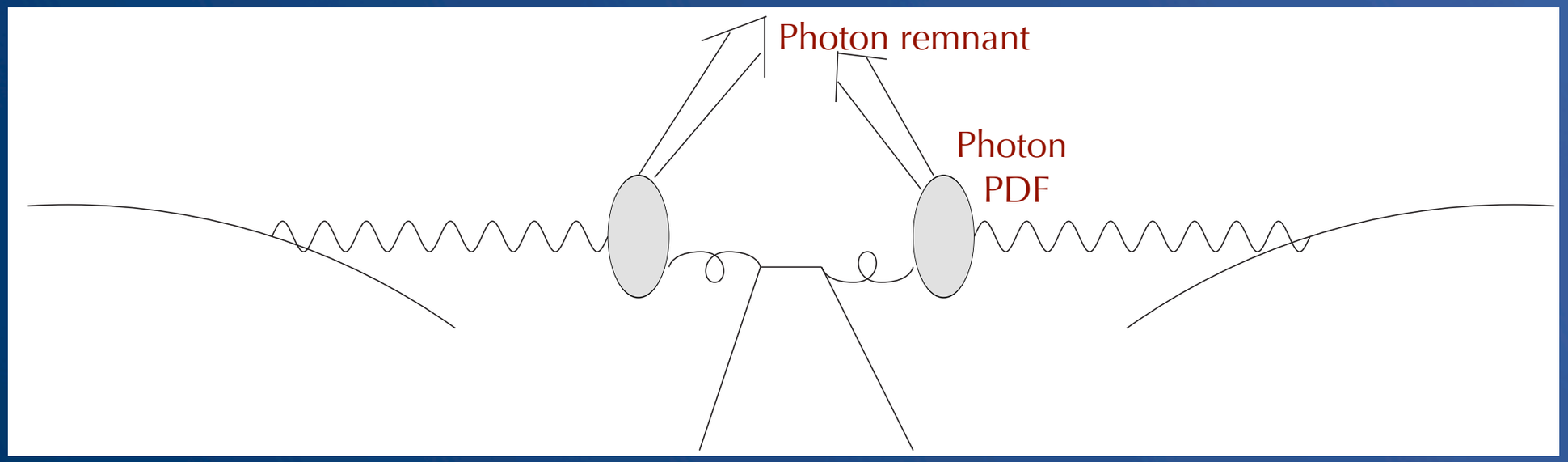
Pinch effect

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

Increases luminosity but smears beam energy...

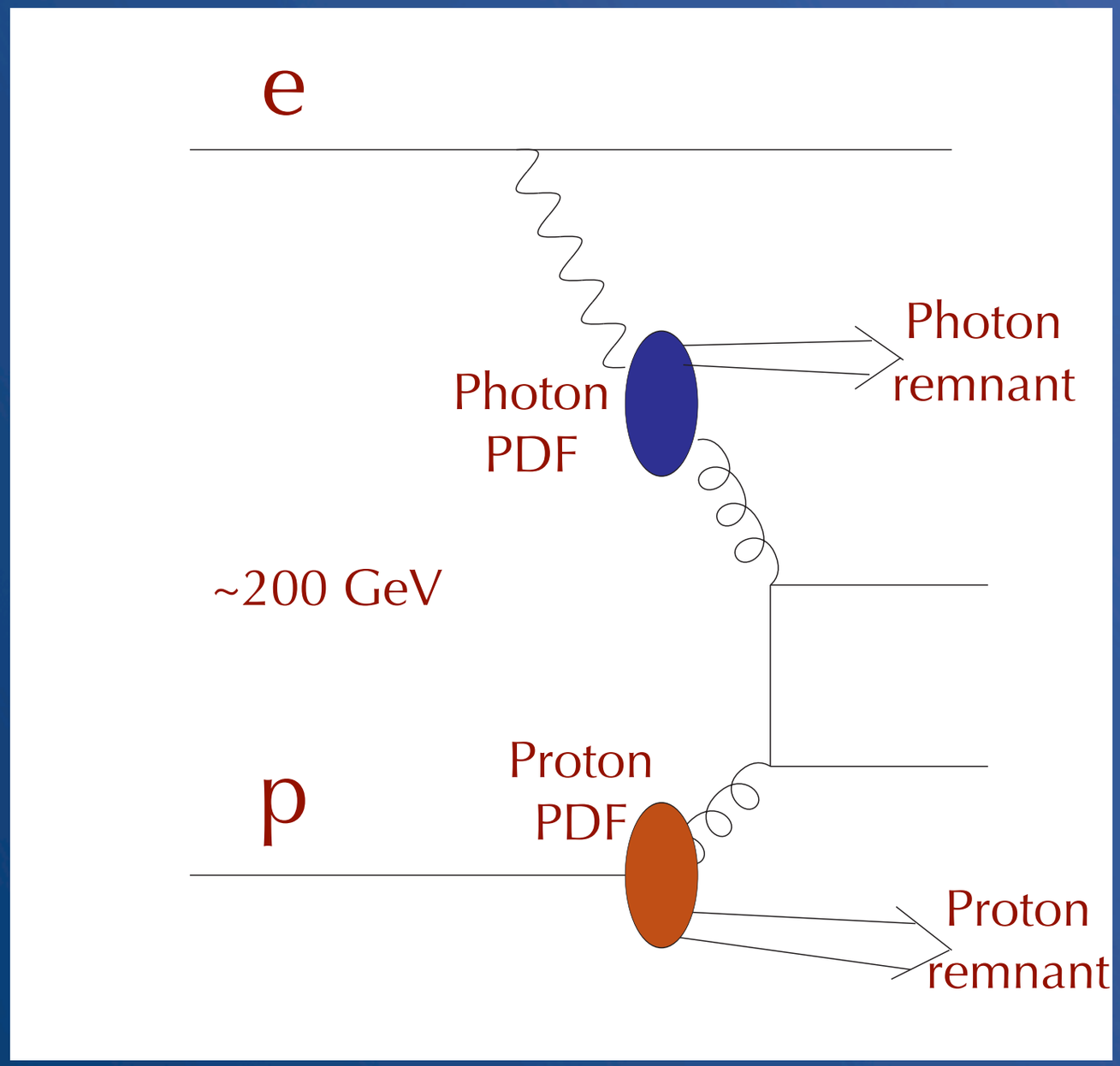
Beamstrahlung

... and leads to photon-photon background



Similar to γp 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...

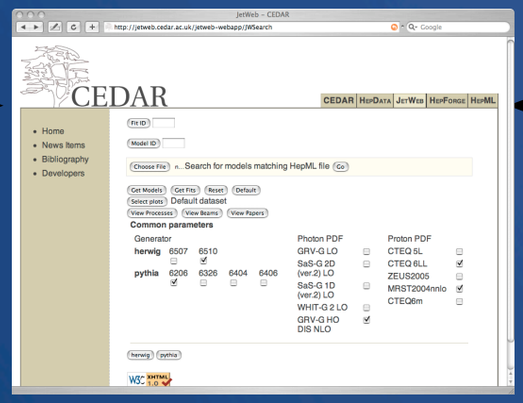
Cedar

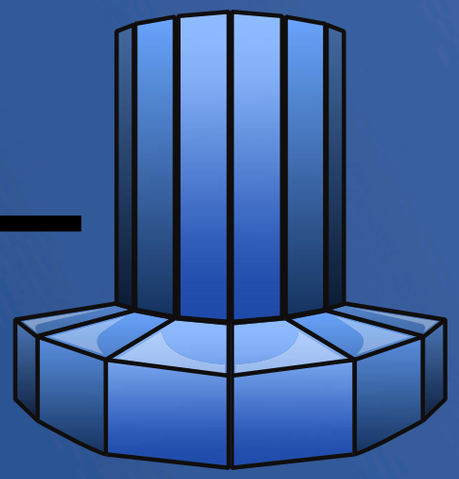
Cedar

JetWeb
(web interface, database of models)

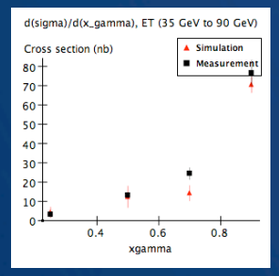
HepData

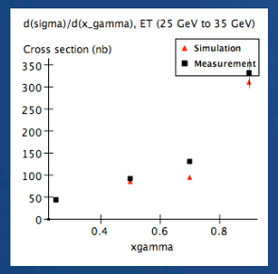
(results going back to the '70s)

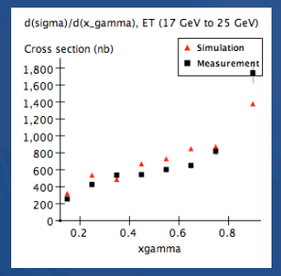




HZTool/Rivet
generated on grid





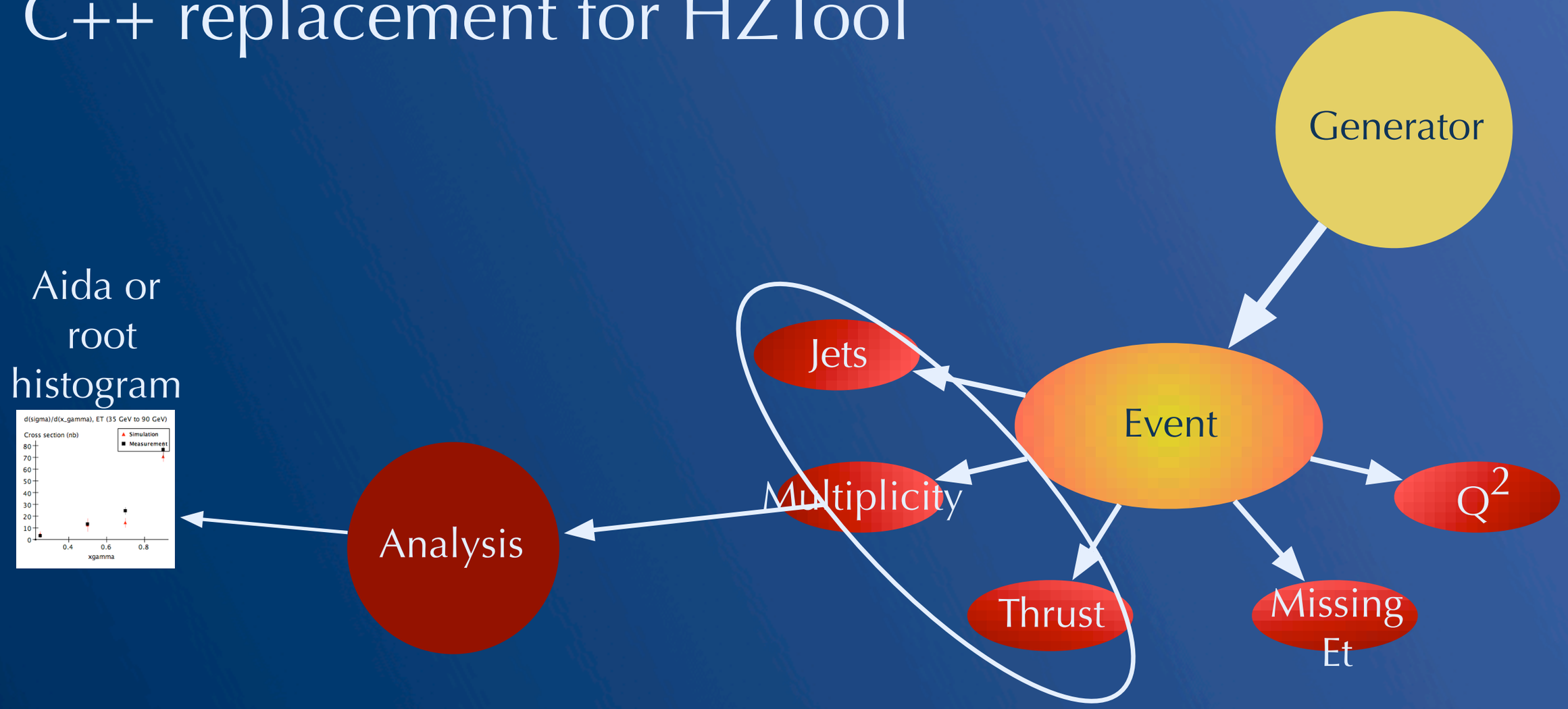


Comparison plots between experimental measurement and Monte Carlo for any set of Monte Carlo parameters

Rivet

A quick slide about Rivet (Robust Indepedent Verification of Experiment against Theory)

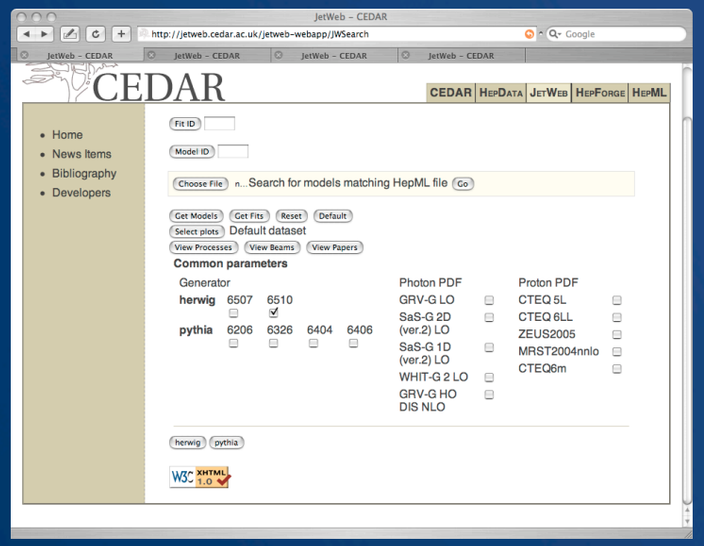
C++ replacement for HZTool



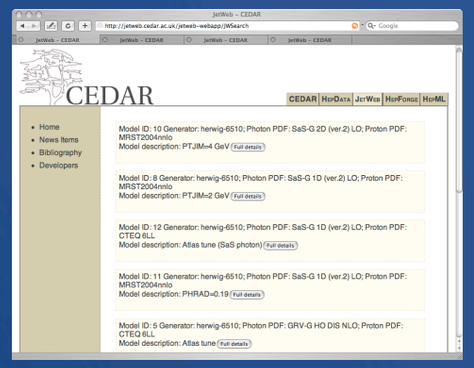
Only need do each projection once per event

JetWeb

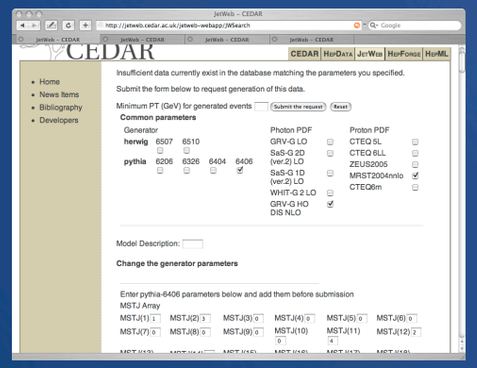
Search for models/tunes



list of matching models

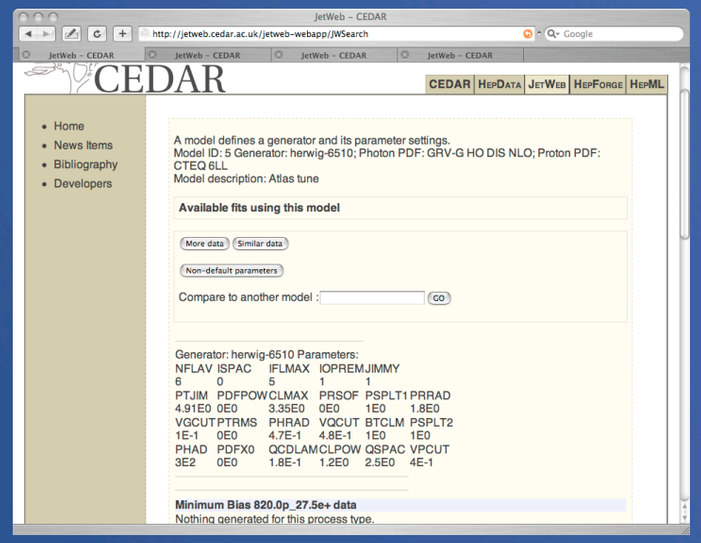


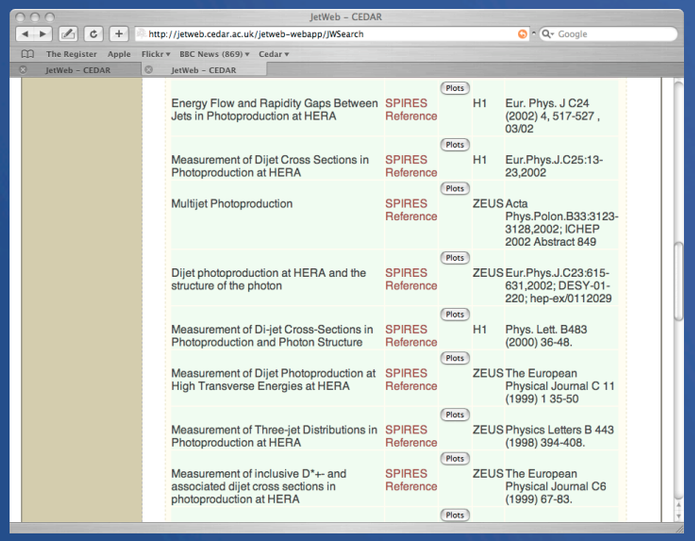
or



submit new model

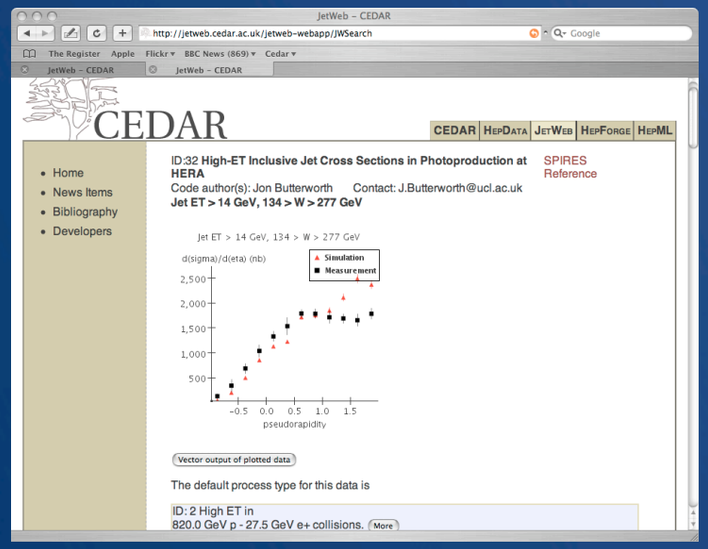
model details





list of papers

list of plots from paper compared to Monte Carlo



Fit and χ^2

Demo

Live demonstration

Comparisons

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...

Default 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

Generator: herwig-6510 Parameters:

NFLAV	ISPAC	IFLMAX	IOPREM	JIMMY	
6	0	5	1	1	
PTJIM	PDFPOW	CLMAX	PRSOF	PSPLT1	PRRAD
4E0	0E0	3.35E0	1E0	1E0	7.1E-1
VGCUT	PTRMS	PHRAD	VQCUT	BTCLM	PSPLT2
1E-1	0E0	4.7E-1	4.8E-1	1E0	1E0
PHAD	PDFX0	QCDLAM	CLPOW	QSPAC	VPCUT
3E2	0E0	1.8E-1	2E0	2.5E0	4E-1

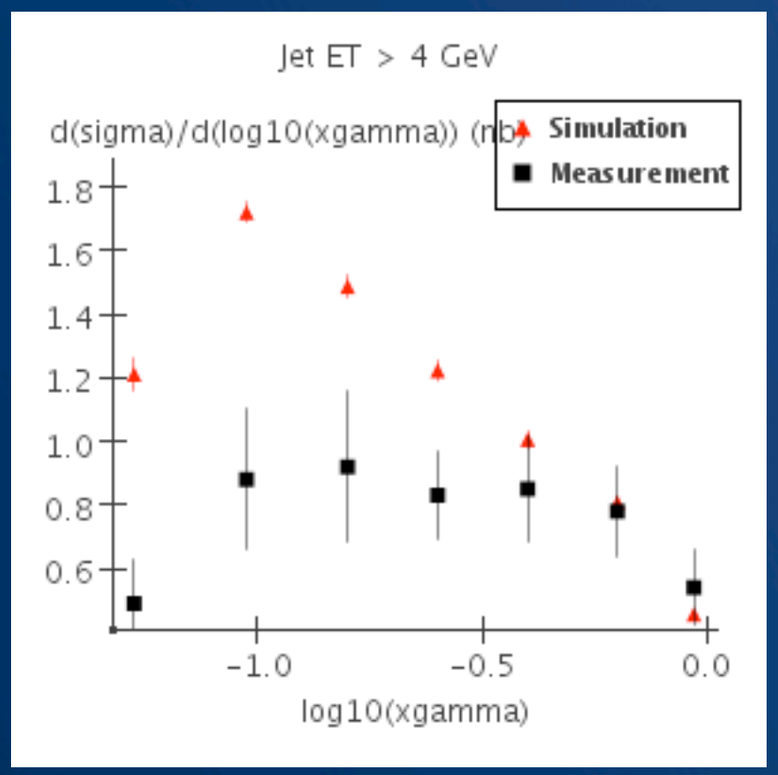
SaS 2D only valid for Q^2 $>2GeV^2$. SaS 1D goes below $1GeV^2$

Try PT Min of 2, 3 and 4 GeV

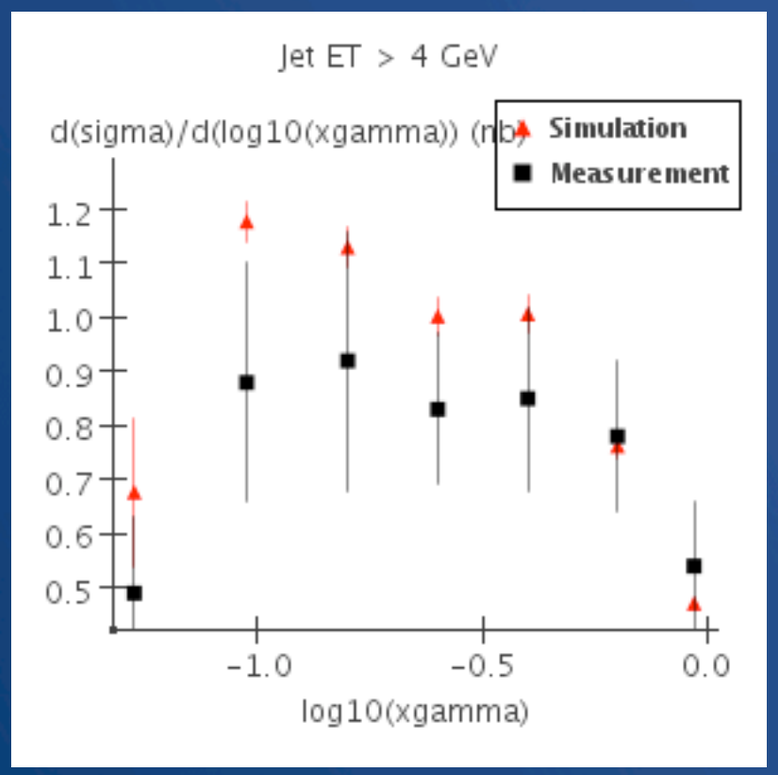
PTMin

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**

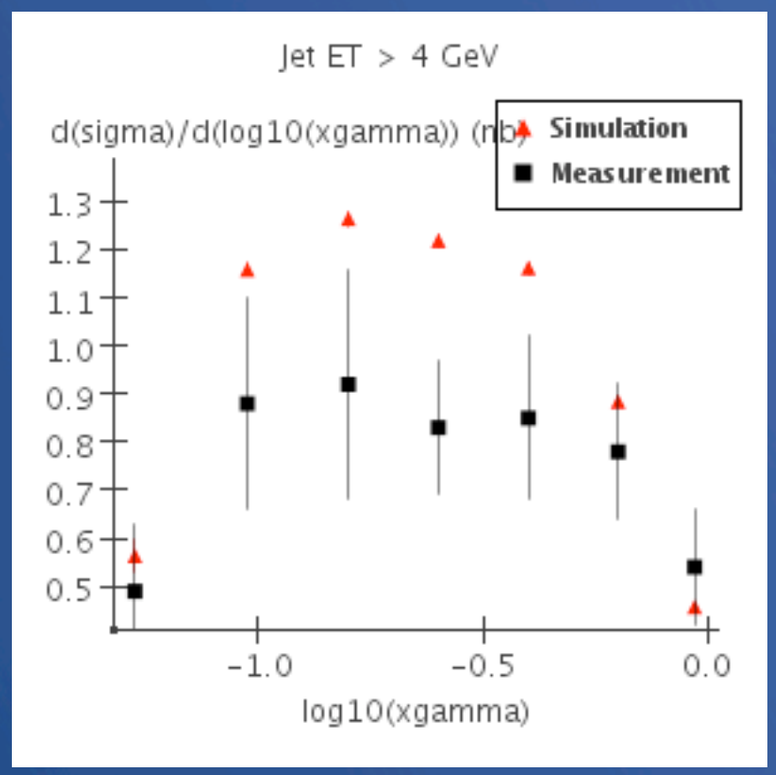
PTMin=2GeV



PTMin=3GeV



PTMin=4GeV

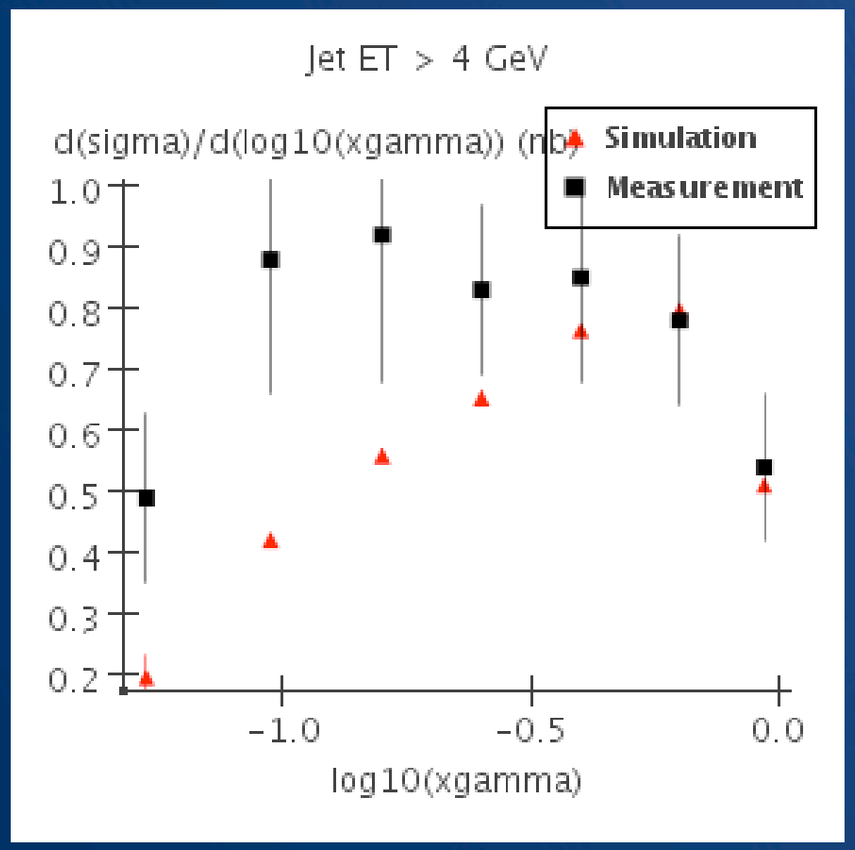


$$x_{\gamma,jets} = \frac{E_{T,jet1} e^{-\eta_{jet1}} + E_{T,jet2} e^{-\eta_{jet2}}}{2\, y_e\, E_{e,0}},$$

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

ATLAS tune

Out of interest...



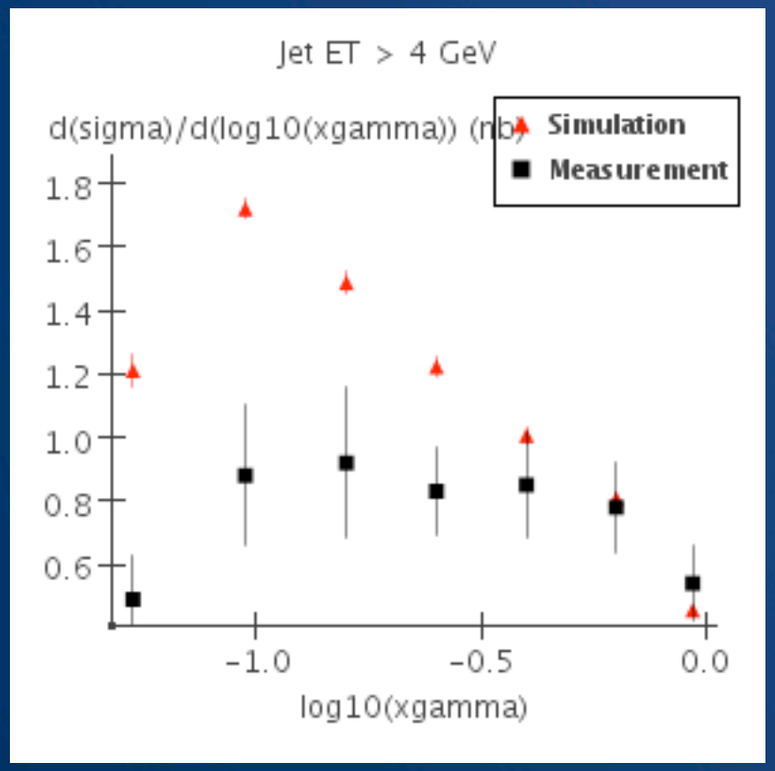
Parameter	Default: Model 8	ATLAS: Model 12
Real : :PTJIM	2.0	4.909999847412109
Real : :PRSOF	1.0	0.0
Real : :PRRAD	0.7099999785423279	1.7999999523162842
Real : :CLPOW	2.0	1.2000000476837158

ATLAS tune suppresses multiple interactions by making PT Min high.

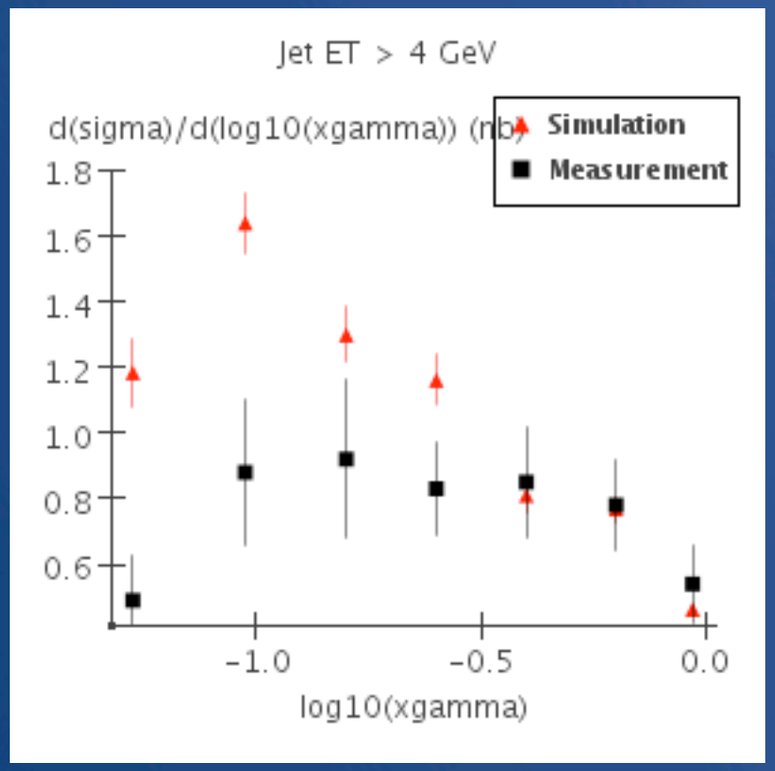
Also turns Herwig underlying event off and makes proton small

Photon radius

Default



0.19



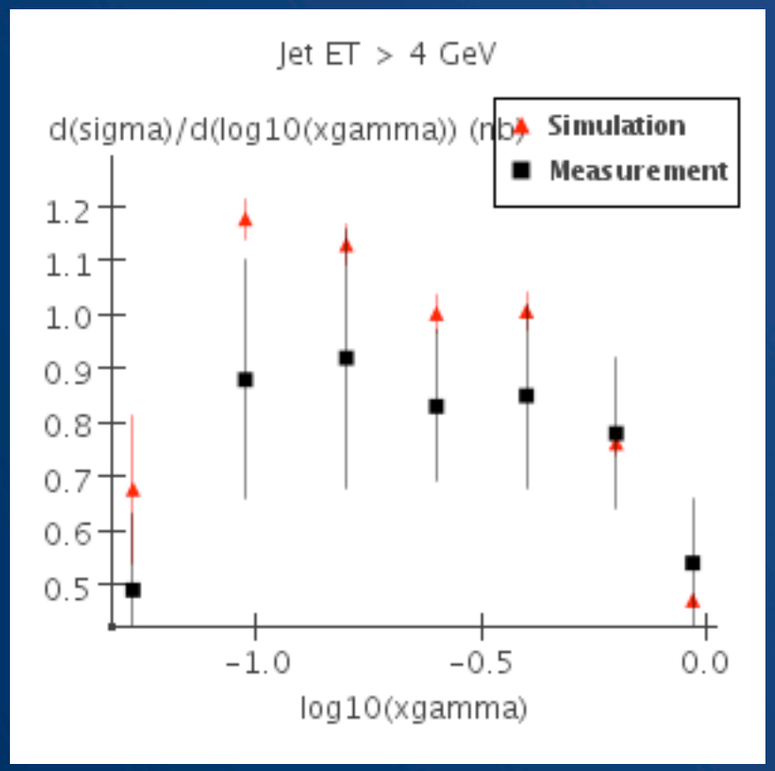
Smaller value = bigger photon

PTMin 2 GeV

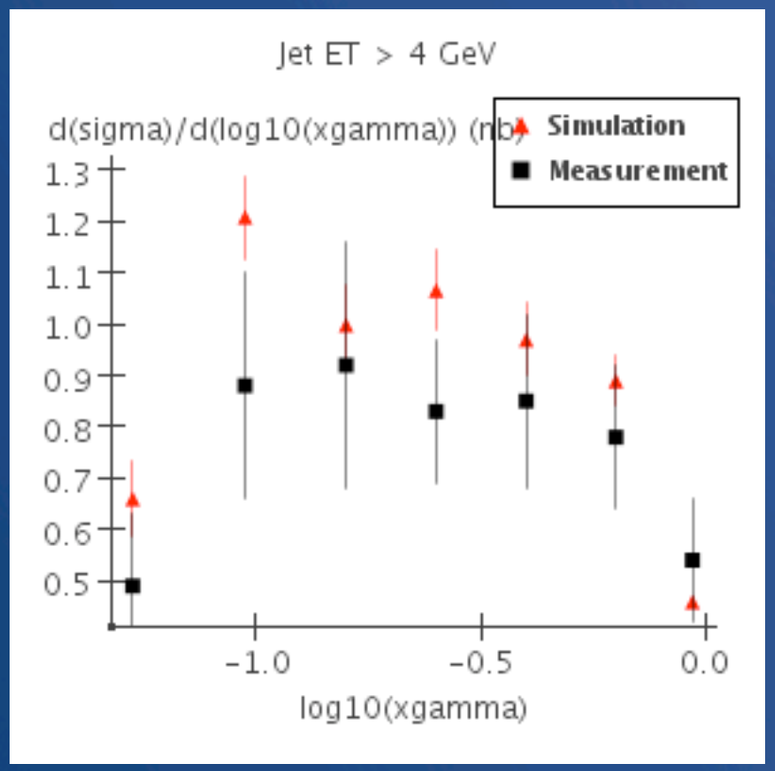
Parameter	Model 8	Model 11
Real : :PHRAD	0.4699999988079071	0.1899999976158142

Photon radius

Default



0.19



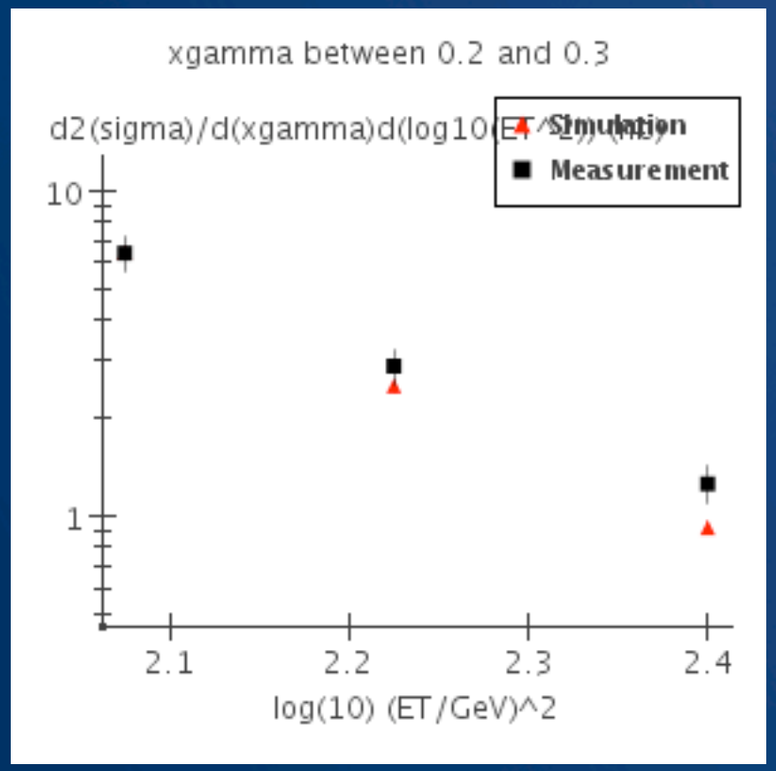
PTMin 3 GeV

Can trade off photon size Vs. PTJim

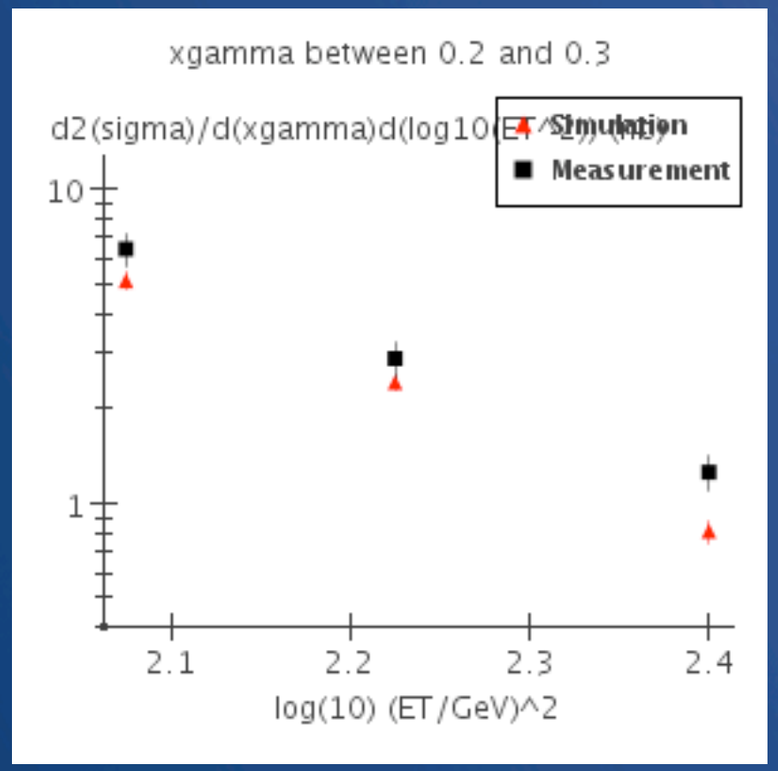
PTJim

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**

PTJim 2 GeV



PTJim 3 GeV



Not so different

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

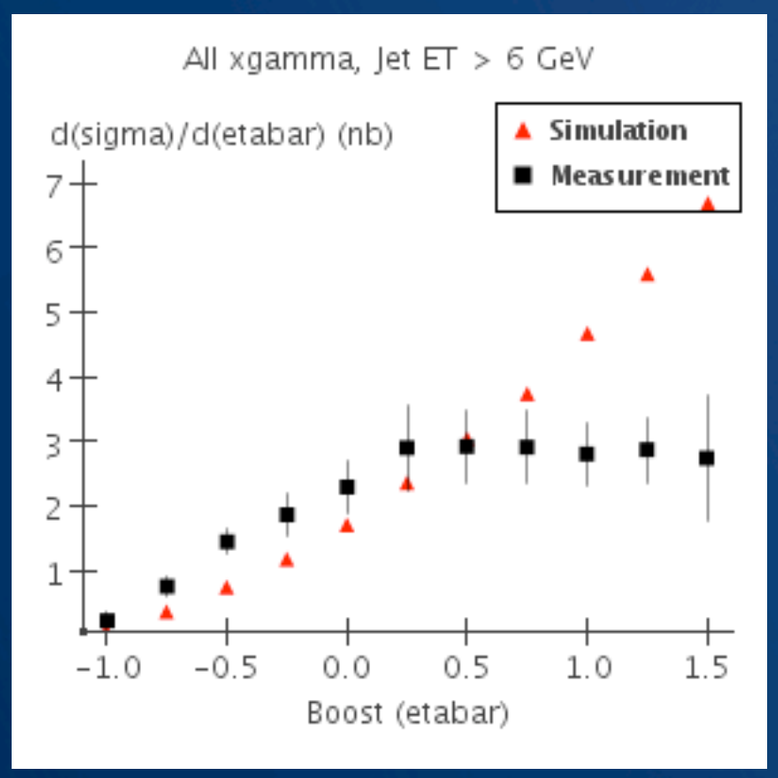
Some cancellation

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

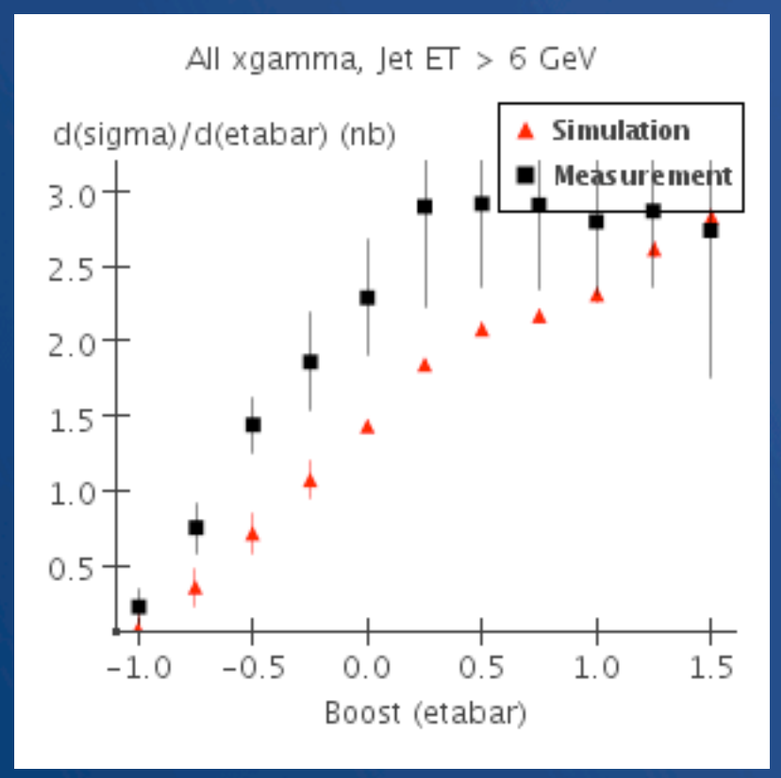
PTJim

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**

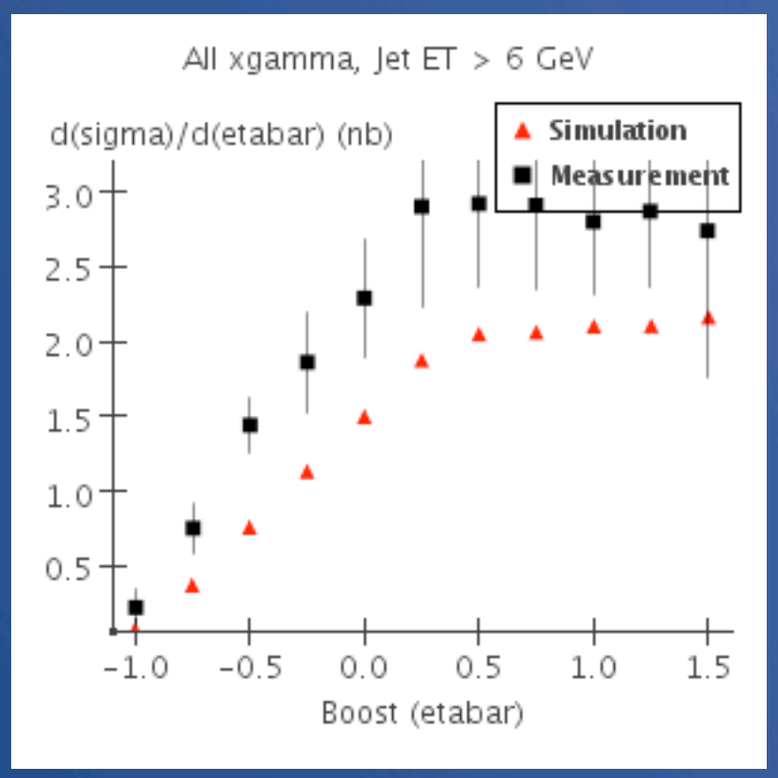
2 GeV



3 GeV



4 GeV

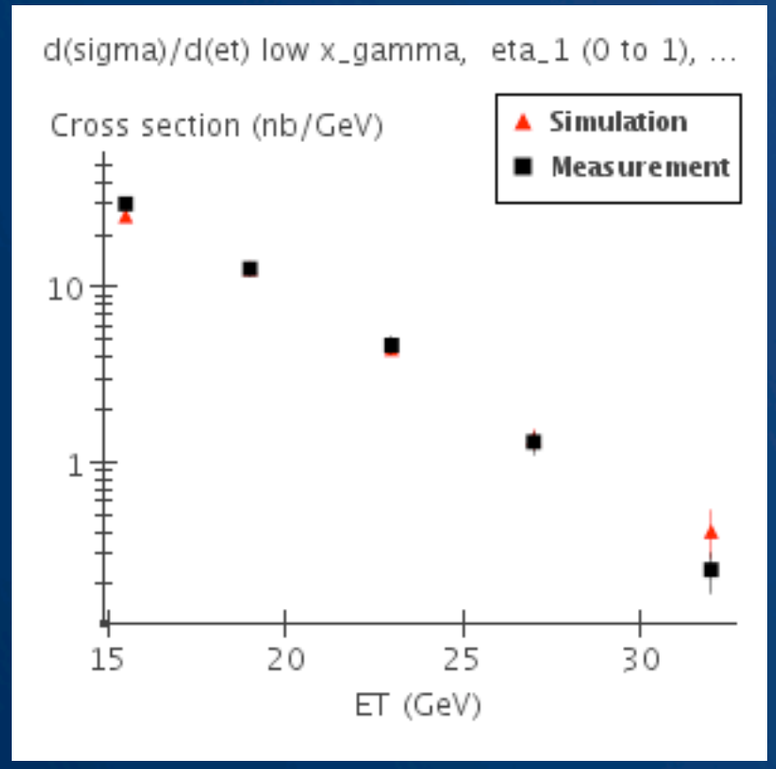


4 GeV has best shape (SaS 2D PDF also)

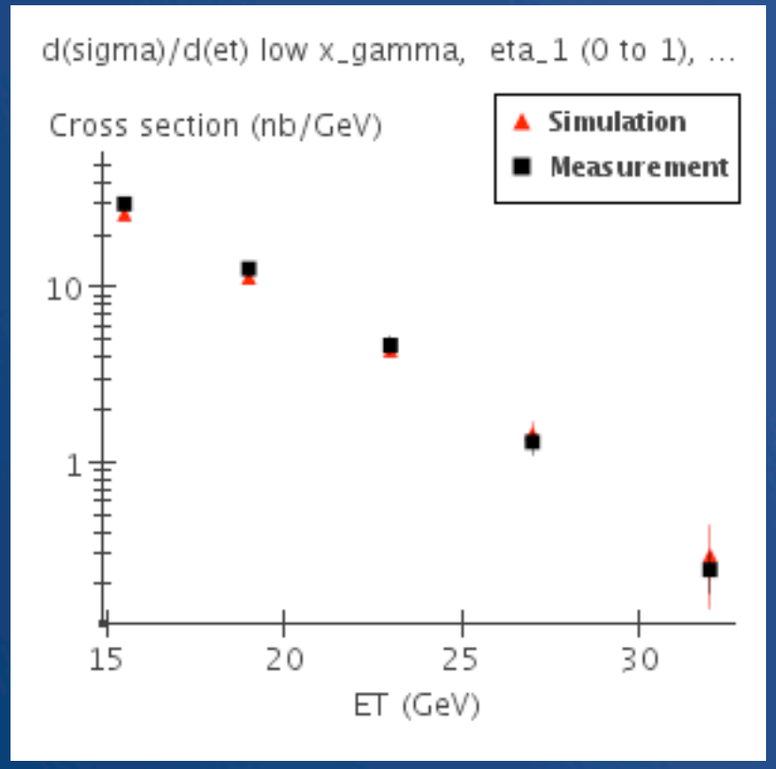
Dijet photoproduction at HERA and the structure of the photon.
By ZEUS Collaboration (S. Chekanov *et al.*). DESY-01-220, Dec 2001. 38pp.
Published in **Eur.Phys.J.C23:615-631,2002**.
e-Print: **hep-ex/0112029**

Can be used to scale the Monte Carlo points

2 GeV



3 GeV



Not much wrong with normalisation

Proton

Can tune the proton to min bias from the Tevatron

Use that proton with the HERA data to tune the photon

Not yet though

Summary

- 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