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Constraints on Universal Extra Dimensions from Scalar boson searches

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In collaboration with ・・・

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What is interesting phenomenology after discovering Higgs?

- Solving RGE
- Fixing S,T parameters
- Higgs signal @ LHC

We can give the strong prediction
on the models with small number of parameters

We focus on
6D Universal Extra Dimension (UED) model
with 2 parameters : M_{KK} , Λ

Our lagrangian

$$\mathcal{L}_{\mathrm{our}} = \mathcal{L}_{\mathrm{SM}} + \sum_{\mathrm{KK}}^{\Lambda} \mathcal{L}_{\mathrm{KK}}$$

What is interesting phenomenology after discovering Higgs?

- Solving RGE → Estimate Λ
  → Omit detail
- Fixing S,T parameters
- Higgs signal @ LHC

} → Bound on M_{KK}
→ This talk

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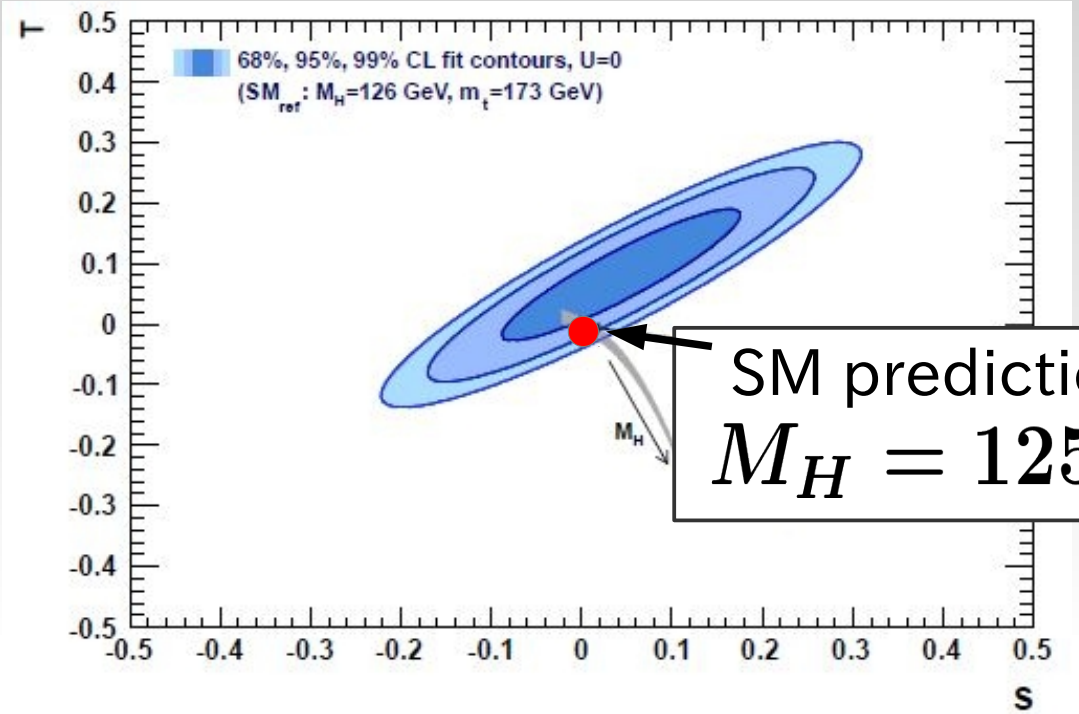
Our lagrangian

$$\mathcal{L}_{\mathrm{our}} = \mathcal{L}_{\mathrm{SM}} + \sum_{\mathrm{KK}}^{\Lambda} \mathcal{L}_{\mathrm{KK}}$$

(We analyzed 7 models,
I will show the result of T^2/Z_2 case)

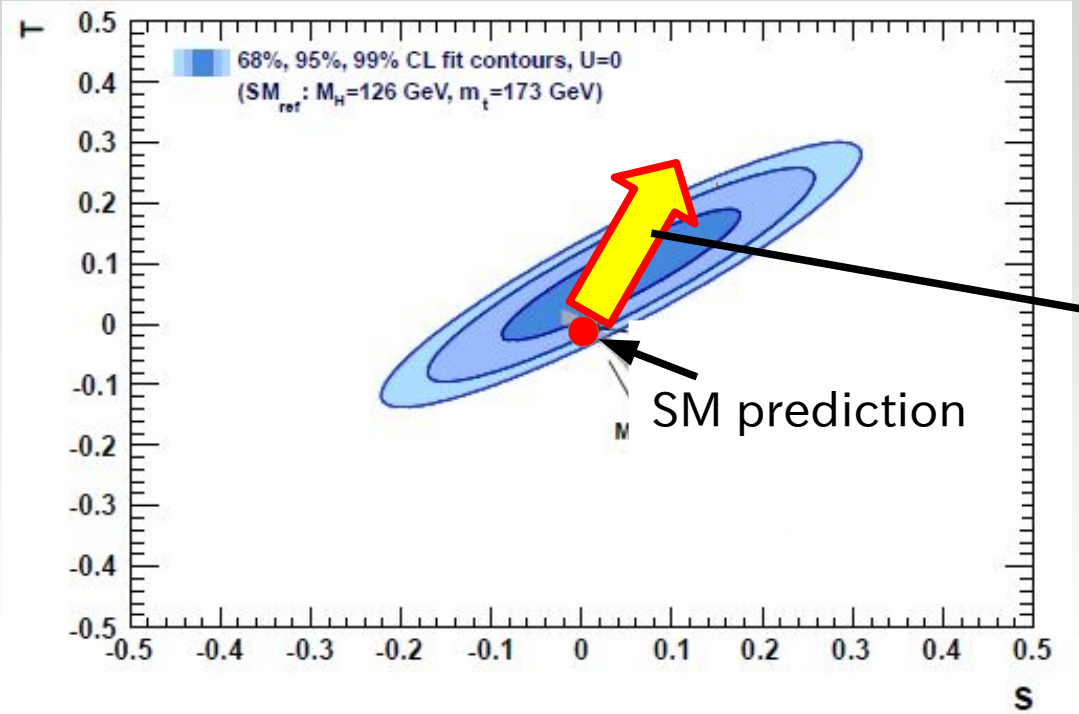
Constraint on M_{KK} from S,T parameters

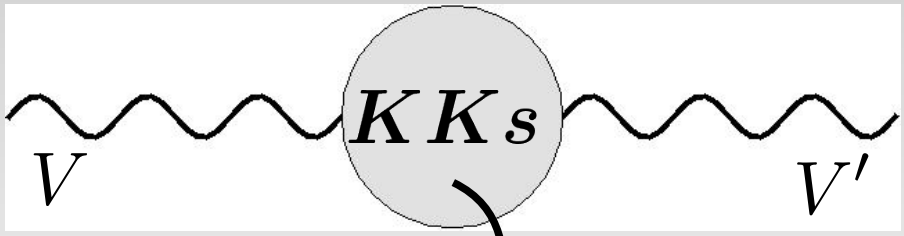


SM prediction with
$M_H = 125.7GeV$

(Sep. 2012 G-fitter)

Constraint on M_{KK} from S,T parameters





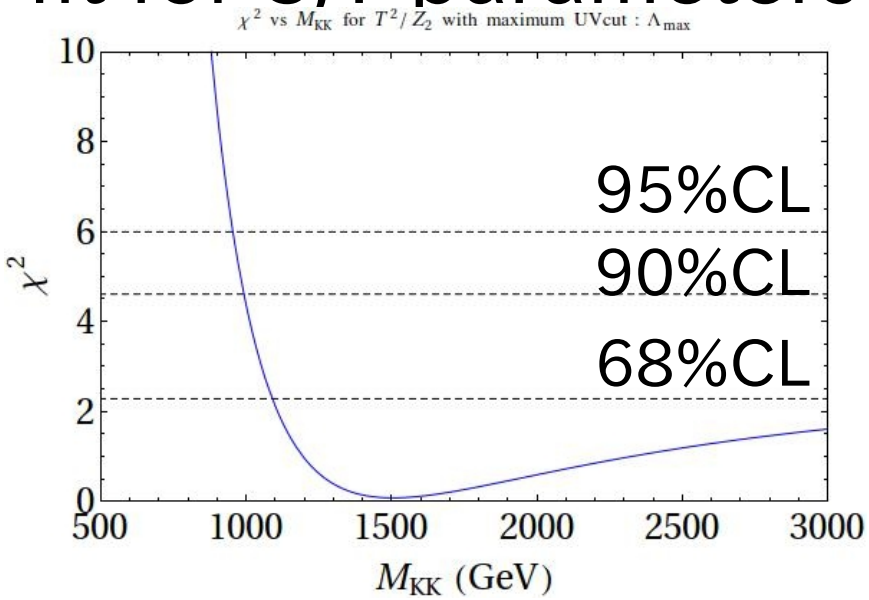
KK top

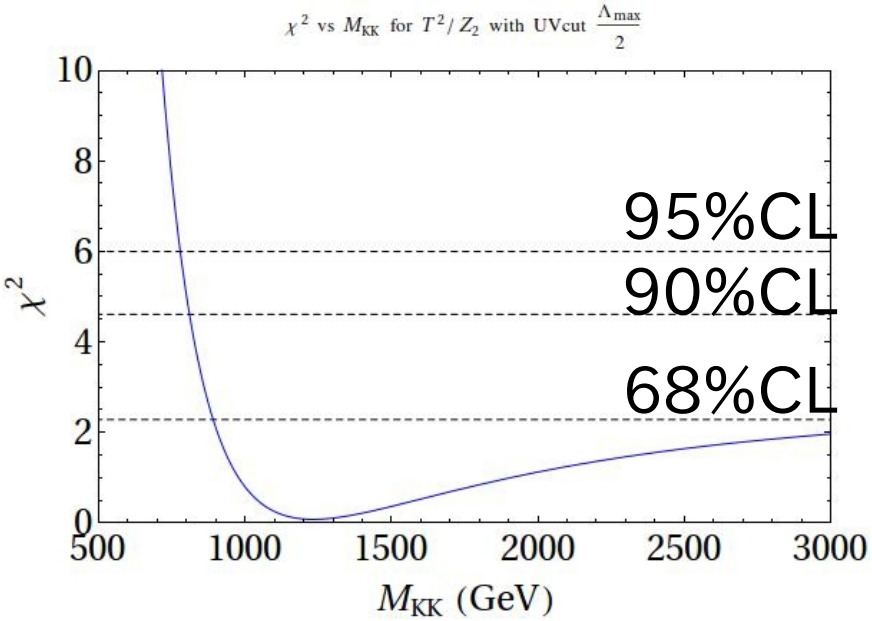
S&T : large enhancement

KK bosons

S&T : small suppression

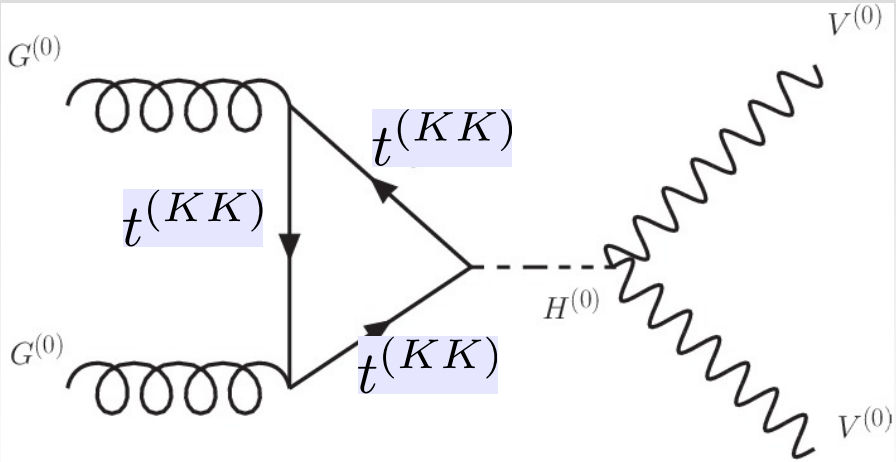
χ^2 fit for S,T parameters





Constraint on M_{KK} from LHC data

Higgs production & decay in UED

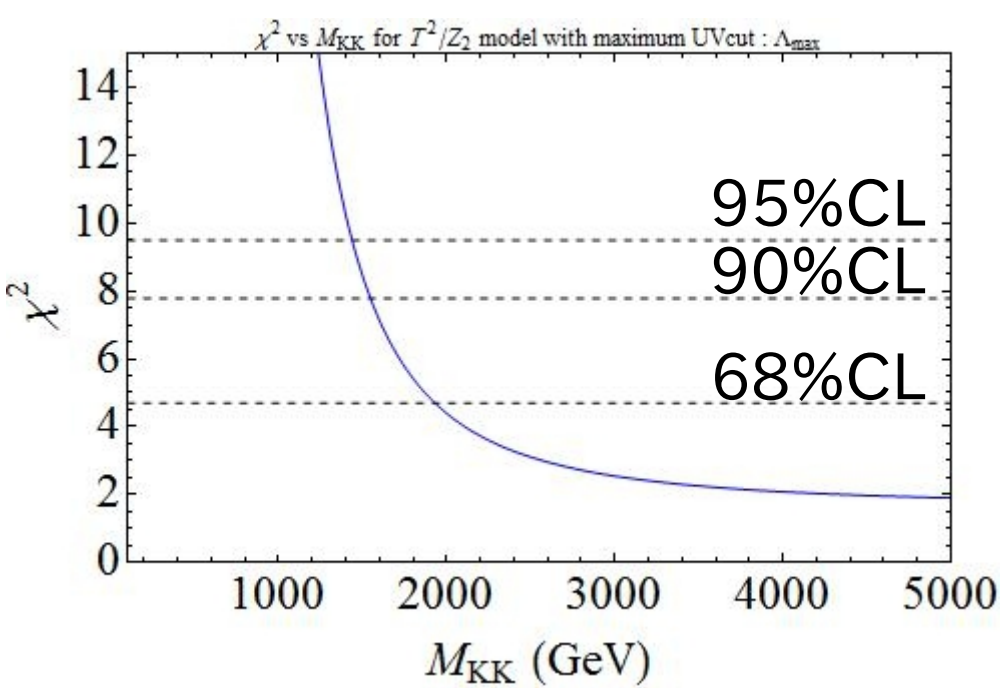


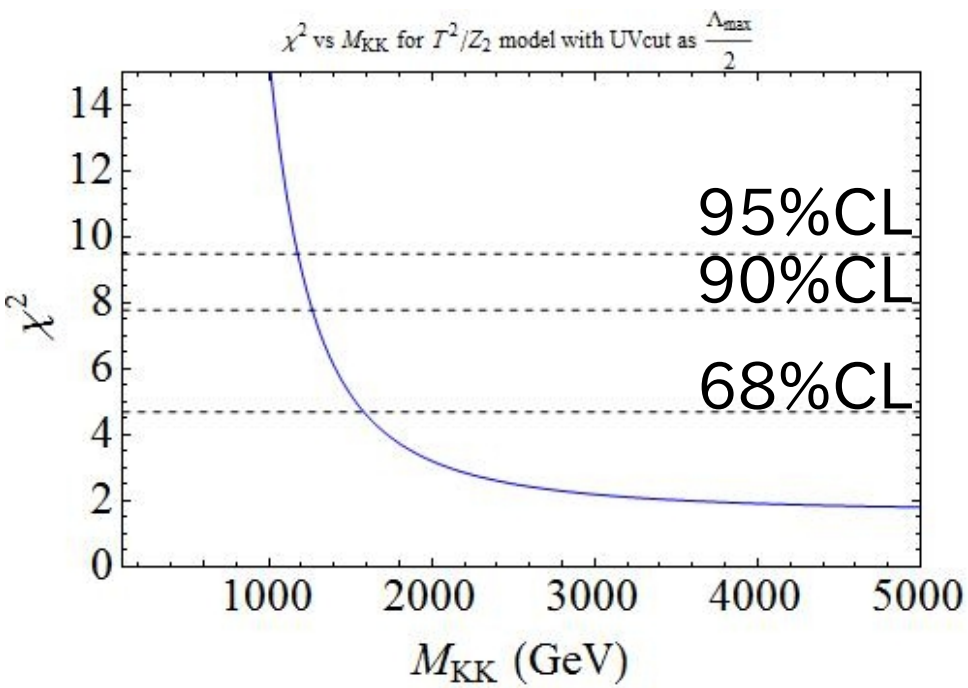
Gluon fusion is enhanced by KK top loops

$H \to ZZ, WW$ are enhanced

Data : ATLAS-CONF 2012-170 (ATLAS)
HIG-12-045-pas (CMS)

χ^2 fit for signal strength @ LHC (ATLAS&CMS, ZZ&WW combine)





Summary

Constraints for KK scale

- From S,T → $M_{KK} >$ 1TeV
  (1.5TeV is best)
- From $H \to ZZ, WW$ → $M_{KK} >$1.5TeV

At 2 σ arrowed with maximum UVcut case

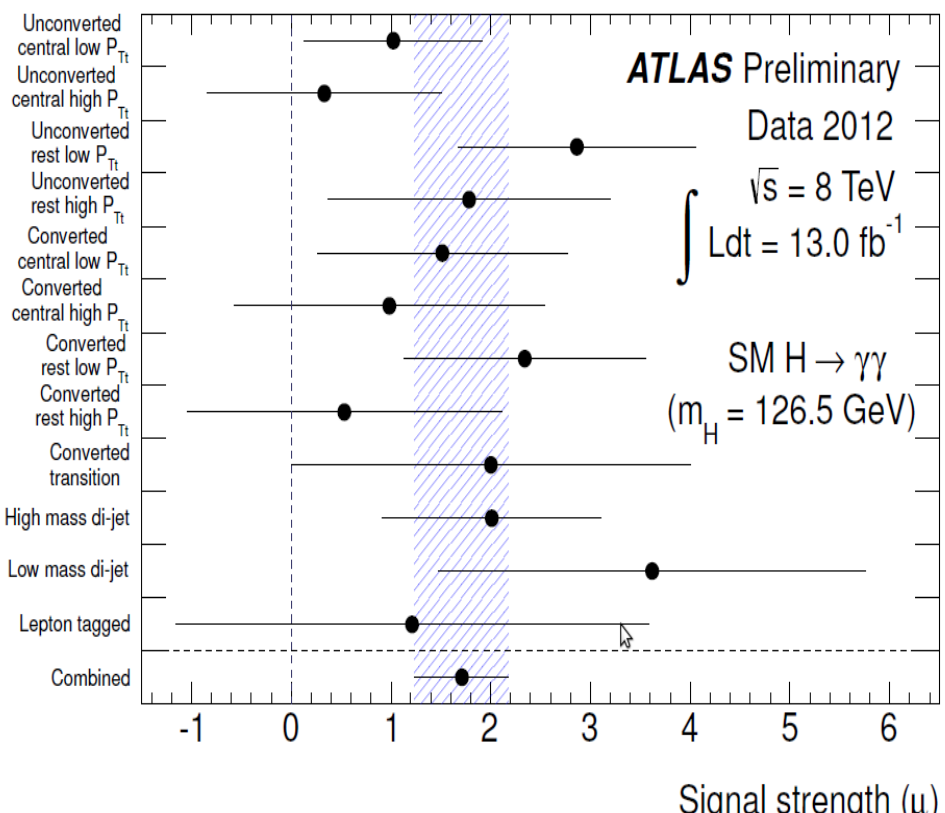
If $H \to ZZ, WW$ are enhanced,
We are happy!
Let's look forward new data.

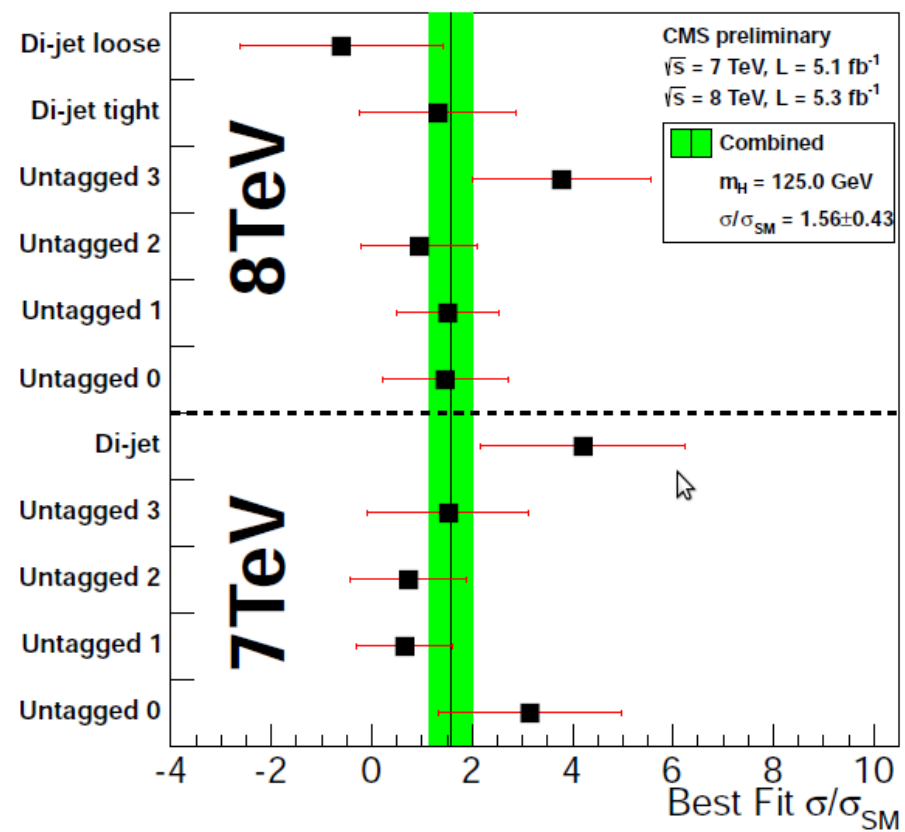
Comment

We can also estimate the bound from $H \to \gamma\gamma$ analysis...

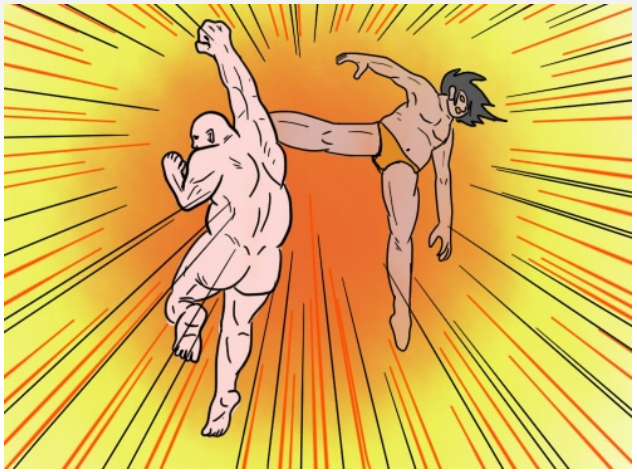
But latest data has large deviation for each event category...

So bound is very loose (M_{KK} >200GeV as 90%CL)

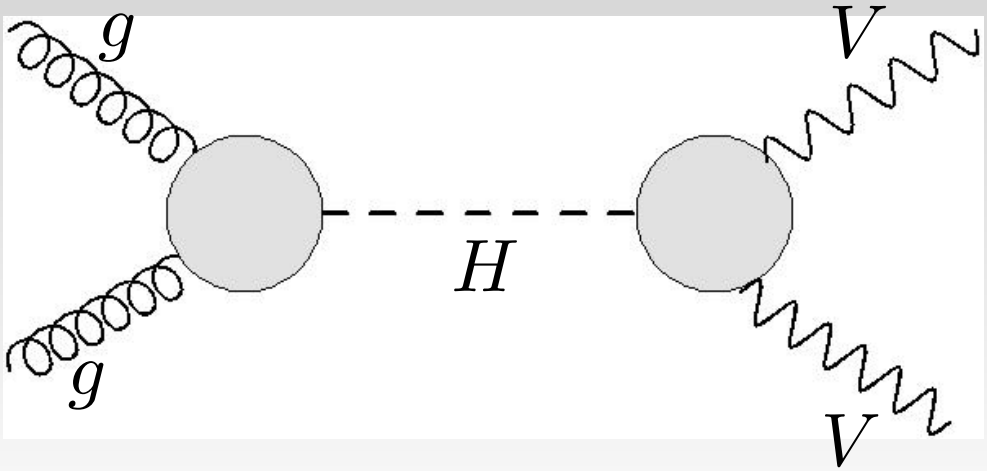




Back upper

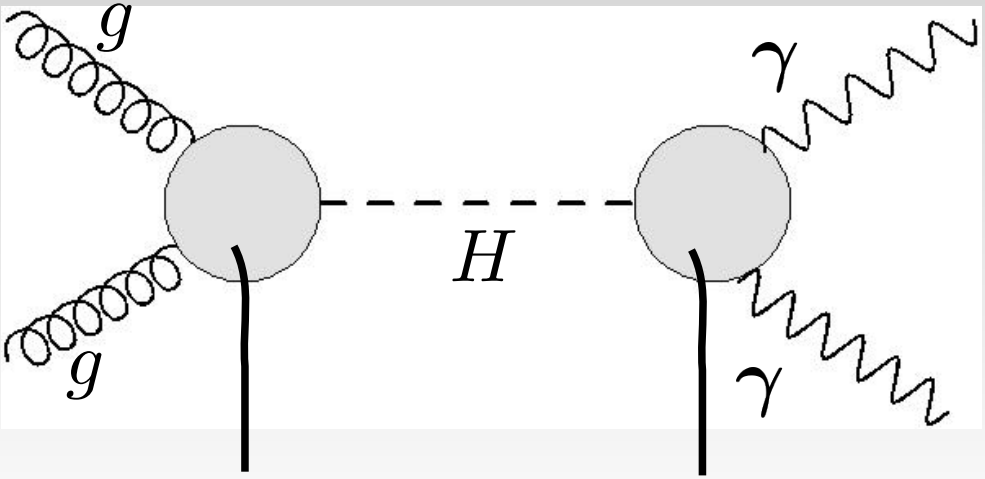


Signal strength



$$\mu_{gg\to H\to VV} \equiv \frac{\sigma_{gg\to H}\times Br(H\to VV)}{\sigma^{SM}_{gg\to H}\times Br(H\to VV)^{(SM)}}$$

$\gamma\gamma$ case



KK top
→enhance

KK top and KK W
→suppress

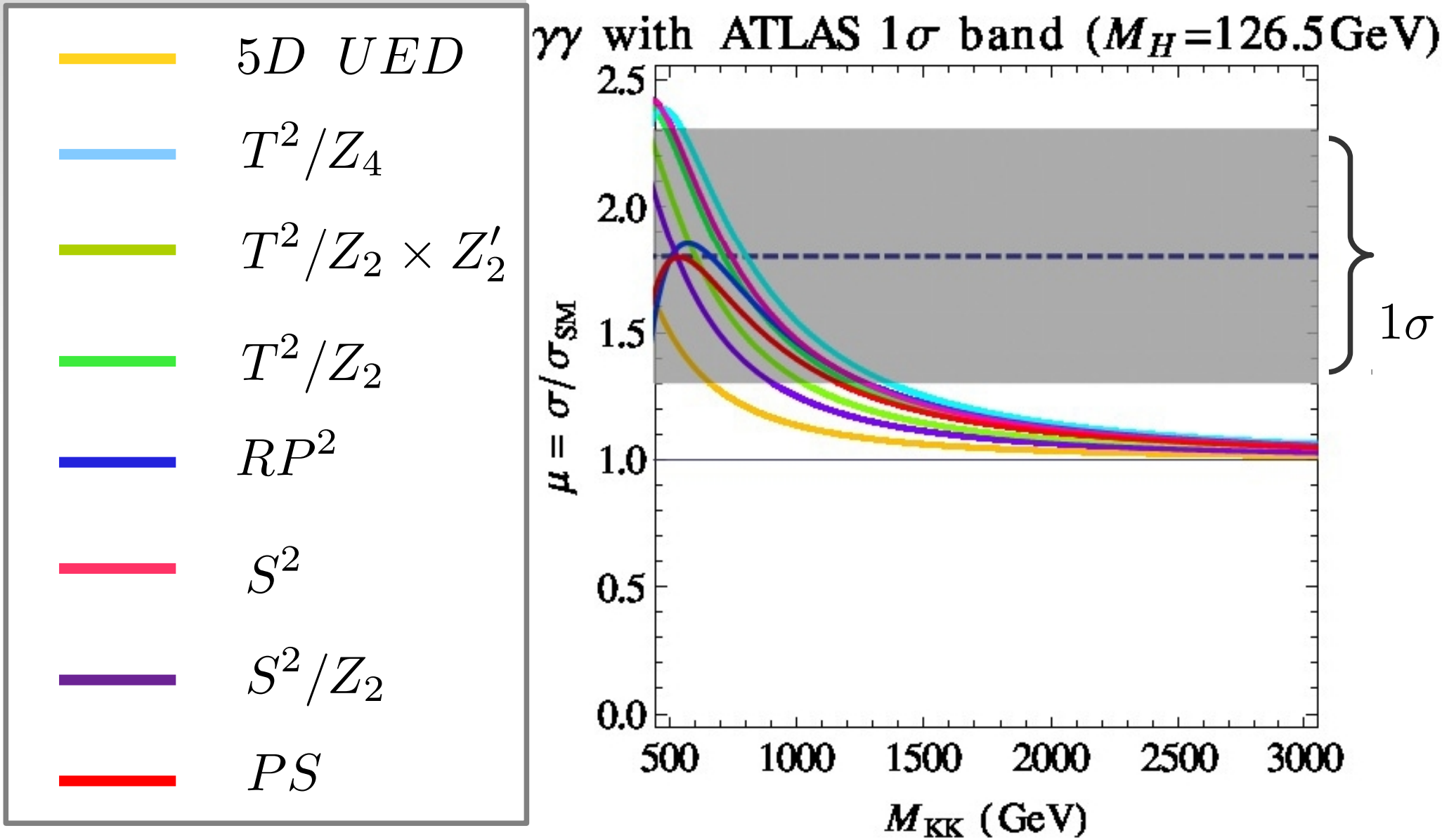
$\gamma\gamma$ decay is loop induced
→ $\gamma\gamma$ enhancement is smaller than ZZ,WW

(KK W & KK top reduce $H \to \gamma\gamma$ width)

Enhancement of Higgs signal strength in UED

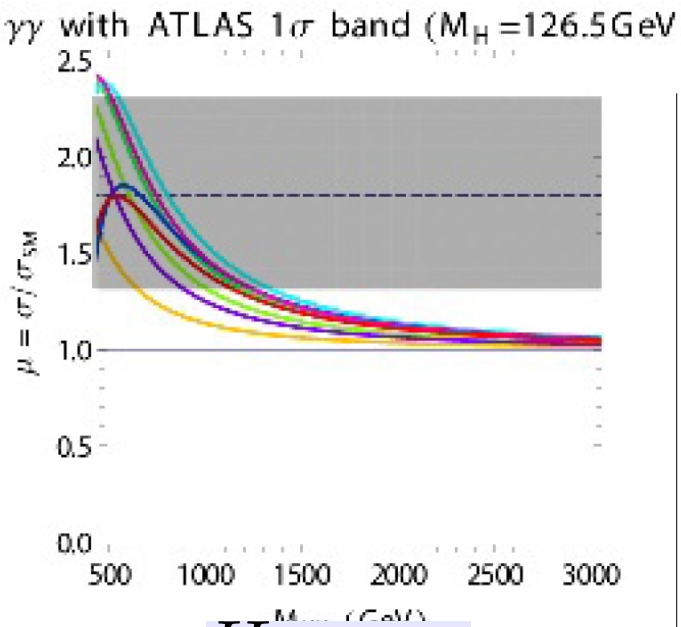
$$\mu_{H\to ZZ,WW} > \mu_{H\to\gamma\gamma}$$

If we use combined data for $H \to \gamma\gamma$ ...

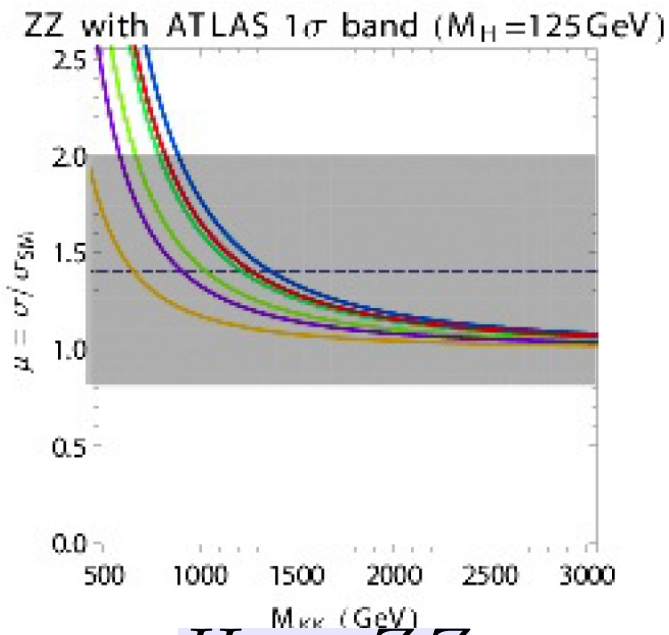


Using data released in July 2012

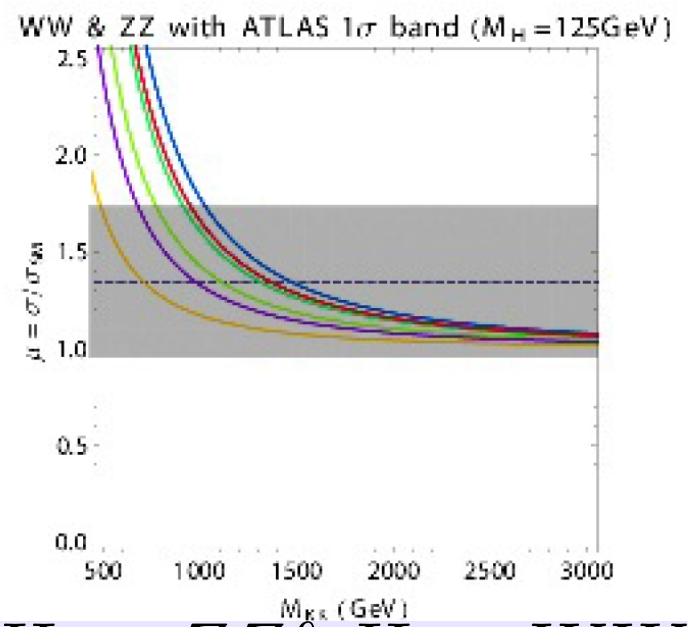
All the result for Higgs to diboson (using July 2012 data)



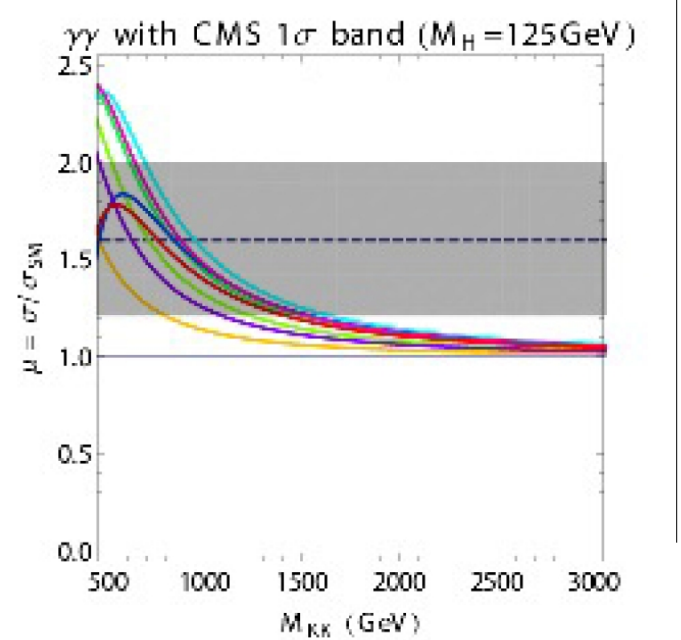
$H \to \gamma\gamma$

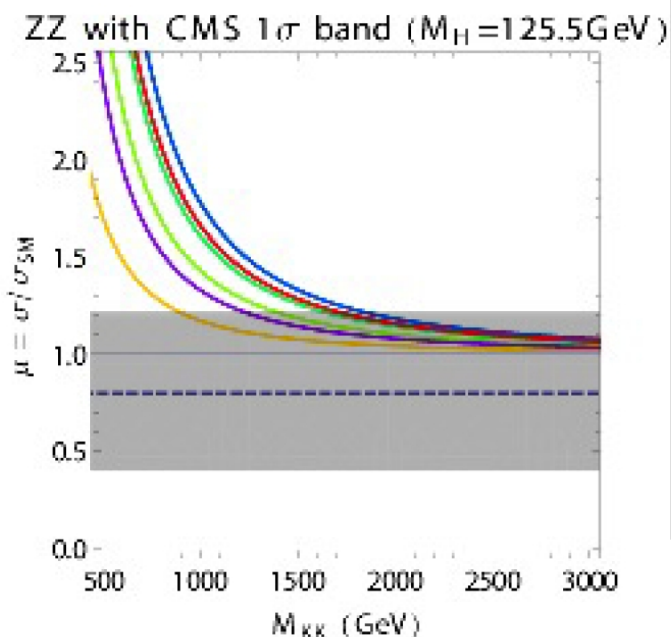


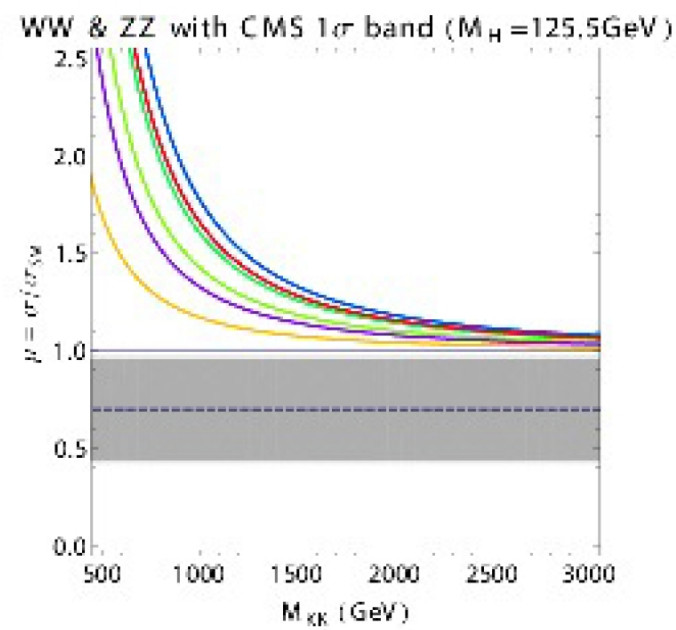
$H \to ZZ$



$H \to ZZ \& H \to WW$







Suppression

Twice DOF. compare with SM

↑

KK fermions are vector-like

↓

$$\Gamma_{(H\to\gamma\gamma)} \sim |\underbrace{(W\ \ loop) + (t\ \ loop)}_{\text{Plus sign}} + \underbrace{(KK\ \ W\ \ loop) + (KK\ \ t\ \ loop)}_{\text{Minus sign}}|$$