Strong V_L V_L Scattering

Veronica, Jay, Adam, Christophe, Roberto, Rogerio...

- V_L V_L scattering probes EWSB sector

- Many recent advances:
  > new models for BSM physics involving strongly coupled particles
  > new simulation tools

- Is it possible to test these models in V_L V_L scattering?

- New processes to test these models?

Attempt to classify models

	No (light) Resonances	Light Resonances OBS: not all resonances are related to EWSB
No (light) Higgs	Chiral lagrangians (non-linear realization)	Low Scale Technicolor Higgsless BESS
Light Higgs	SM Strongly Interacting Light Higgs	Warped/Composite Holographic Higgs Little Higgs Gaugephobic Higgs Twin Higgs

Strong V_L V_L Scattering

• Find a general lagrangian (a la Contino et al.?) with a scalar, vector and axial vector (color octet also?) resonances;
composite fermions are more model dependent;
higher dimensional operators(?).

• Implement it in Madgraph in unitary gauge (strong coupling with V_L arises from kinematics); Pt distribution of forward jets and interference between SM and BSM can be studied.

Strong V_L V_L Scattering

- User can tune parameters (masses and mixings) to get his/her favorite model;

- Ensure choice of parameters such that bounds on unitarity violation, EWPT and anomalous gauge couplings are satisfied.

Strong V_L V_L Scattering

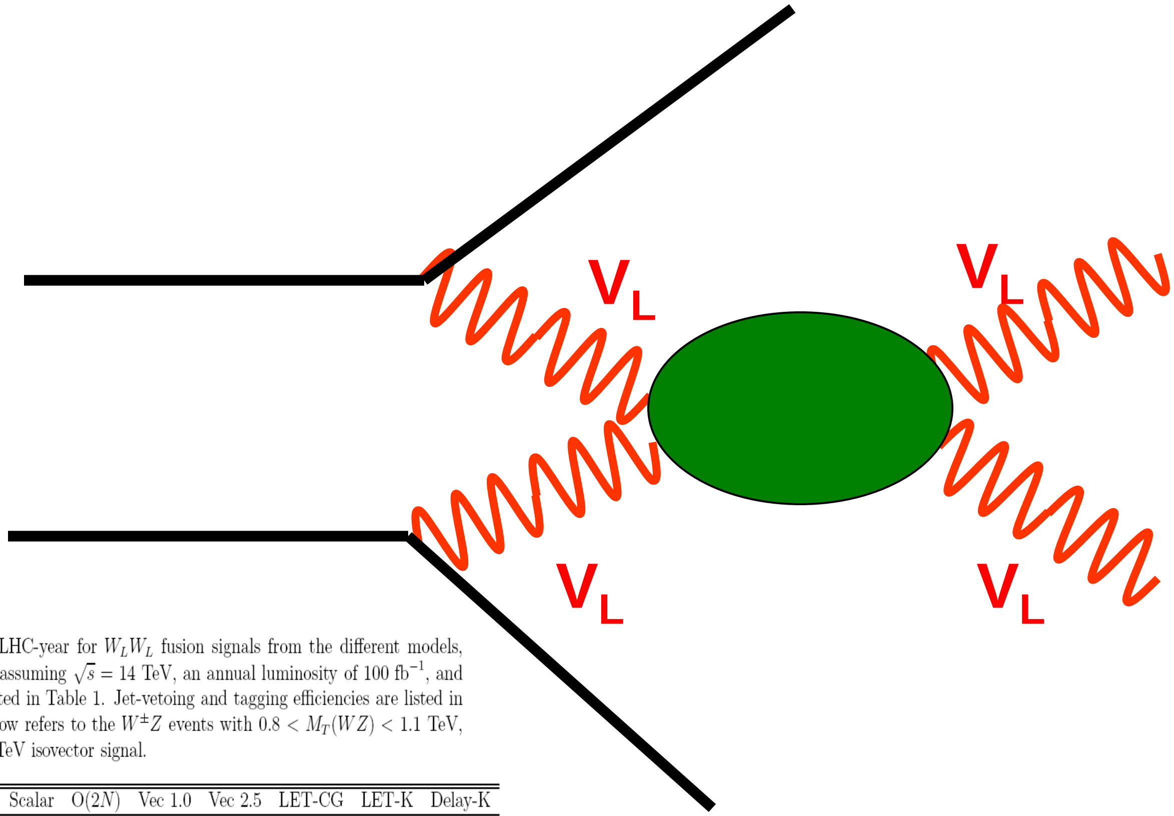


Table 3: Event rates per LHC-year for $W_L W_L$ fusion signals from the different models, together with backgrounds, assuming $\sqrt{s}$ = 14 TeV, an annual luminosity of 100 fb^{-1}, and m_t = 175 GeV. Cuts are listed in Table 1. Jet-vetoing and tagging efficiencies are listed in Table 2. The $W^\pm Z(M_T^{cut})$ row refers to the $W^\pm Z$ events with $0.8 < M_T(WZ) < 1.1$ TeV, optimized to search for a 1 TeV isovector signal.

	Bkgd.	SM	Scalar	O(2N)	Vec 1.0	Vec 2.5	LET-CG	LET-K	Delay-K
$ZZ(4\ell)$	0.7	9	4.6	4.0	1.4	1.3	1.5	1.4	1.1
$ZZ(2\ell 2\nu)$	1.8	29	17	14	4.7	4.4	5.0	4.5	3.6
W^+W^-	12	27	18	13	6.2	5.5	5.8	4.6	3.9
$W^\pm Z$	4.9	1.2	1.5	1.2	4.5	3.3	3.2	3.0	2.9
$W^\pm Z(M_T^{cut})$	0.82				2.3				
$W^\pm W^\pm$	3.7	5.6	7.0	5.8	12	11	13	13	8.4

Studied in 94 and 95 by Bagger et al.
Very challenging….

Study with a technirho should be similar to W' (Atlas 2001): it is important if coupling of W' to fermions is strongly suppressed.

Comparison between DY and VBF
back of the envelope

Effective W approximation + narrow width approximation:

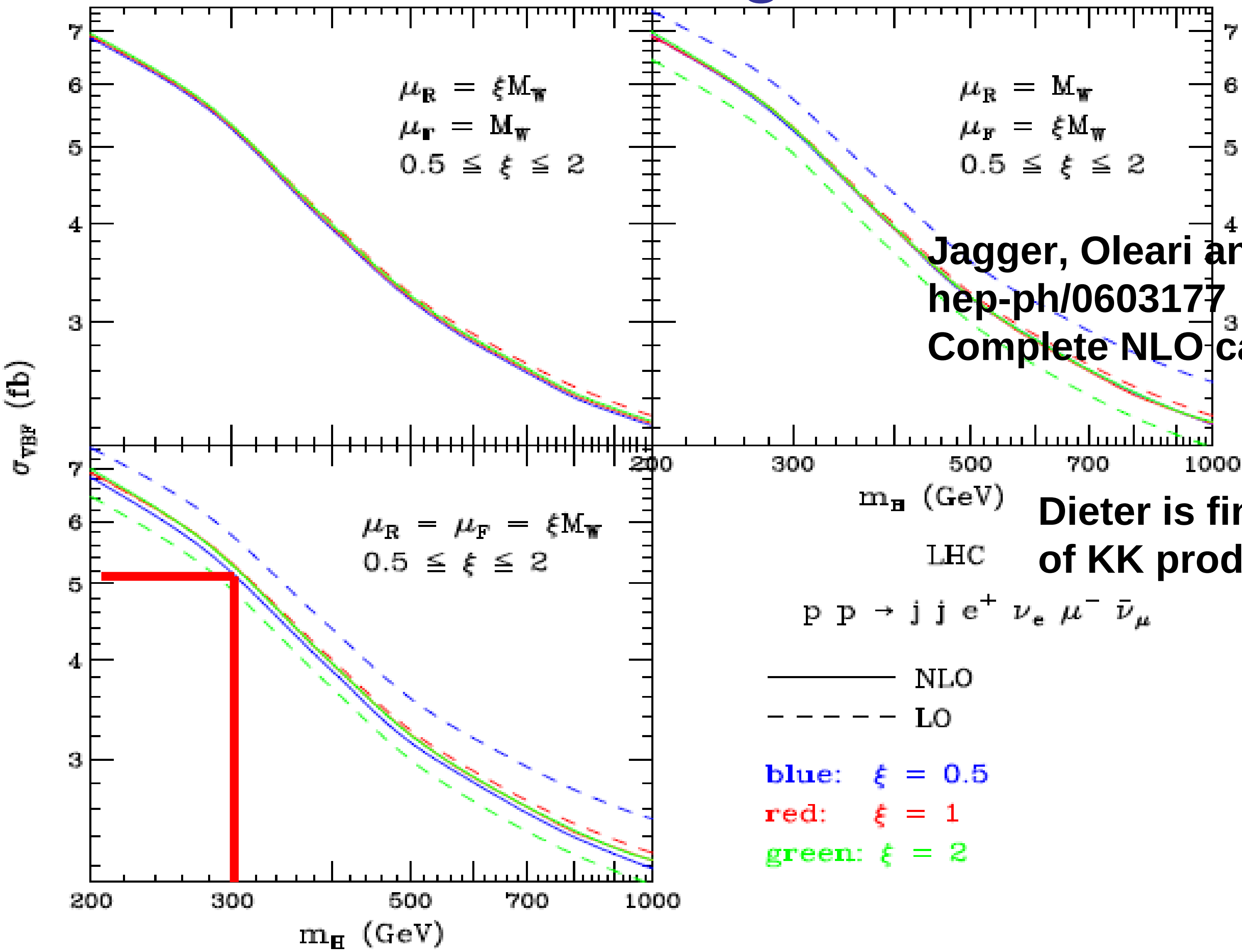
$$\frac{\sigma^{VBF}}{\sigma^{DY}} = \frac{\Gamma(R \to VV)}{\Gamma(R \to qq)} \times \frac{\left(\frac{dL}{d\tau}\right)_{pp/VV}}{\left(\frac{dL}{d\tau}\right)_{pp/qq}}$$

model dependent

model independent ~ 10^{-5}

If resonance couples to mass (like Higgs), VBF dominates

WW Scattering in SM



Jagger, Oleari and Zeppenfeld
hep-ph/0603177
Complete NLO calculation

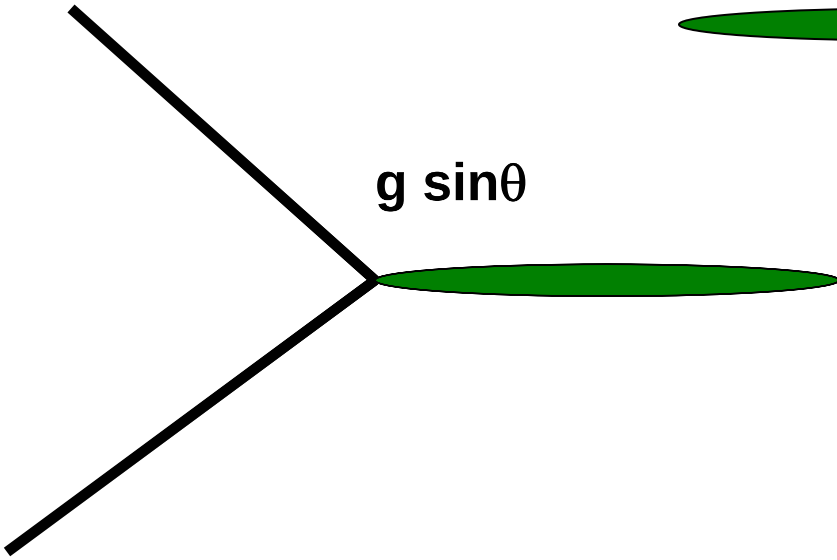
Dieter is finishing a study of KK production in VBF

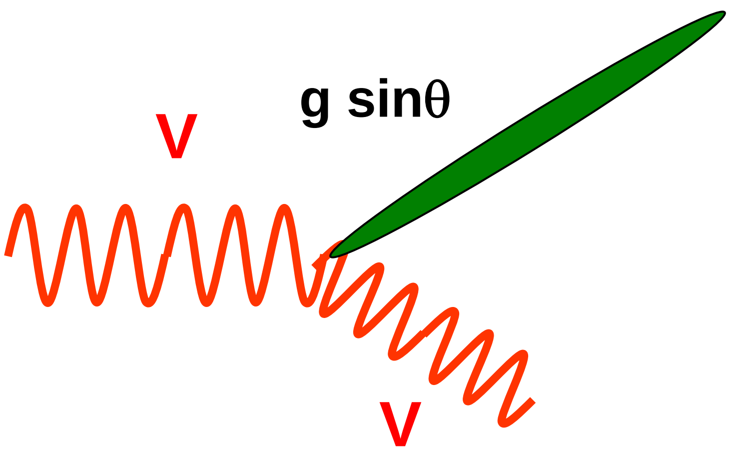
Figure 9: *Higgs mass dependence of the total $pp \to jj\, e^+\nu_e\, \mu^-\bar{\nu}_\mu$ cross section at LO and NLO within the cuts of Eqs. (4.1)–(4.6). Results are shown for renormalization and factorization scales $\mu = 0.5\, m_W$, m_W and $2\, m_W$.*

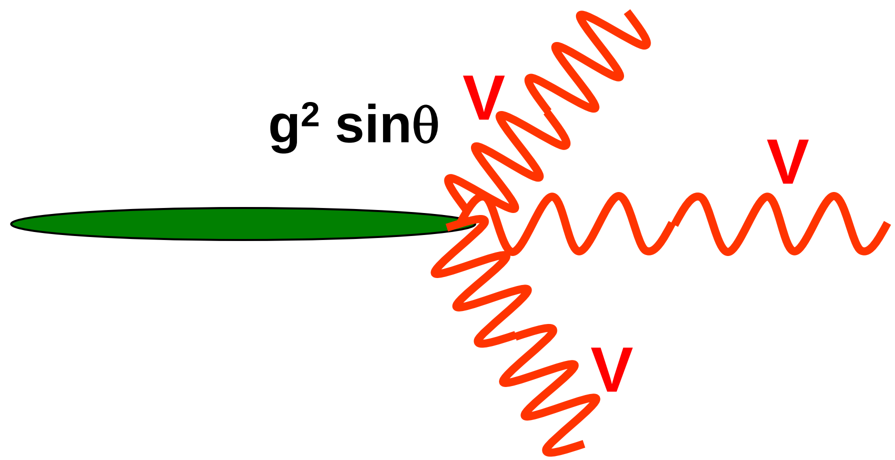
New possibilities


= vector resonance that mixes with SM gauge bosons

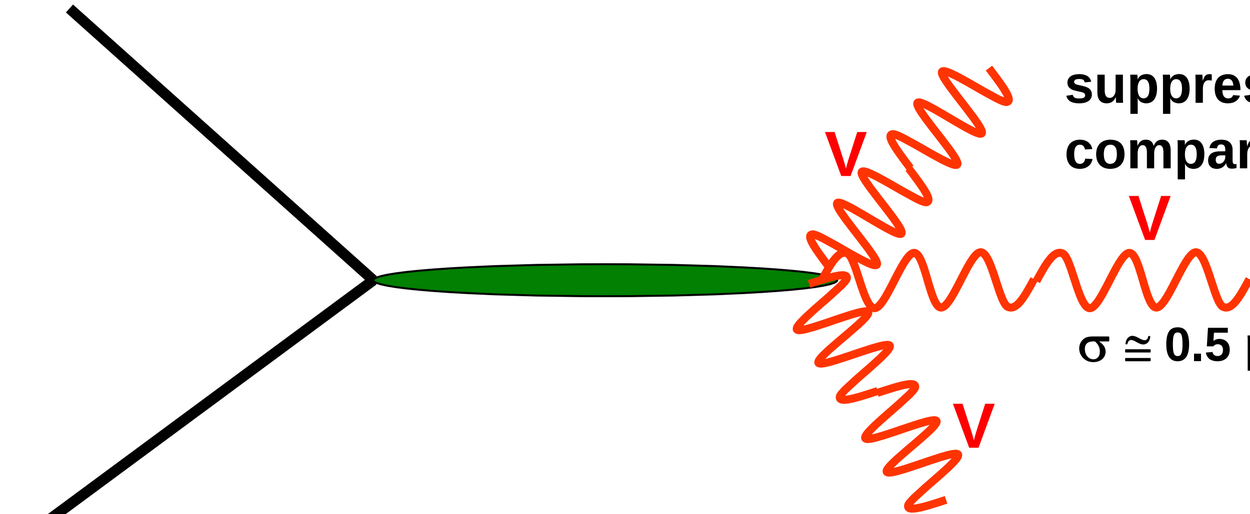
mixing angle $\sin\theta \cong m_W/M$





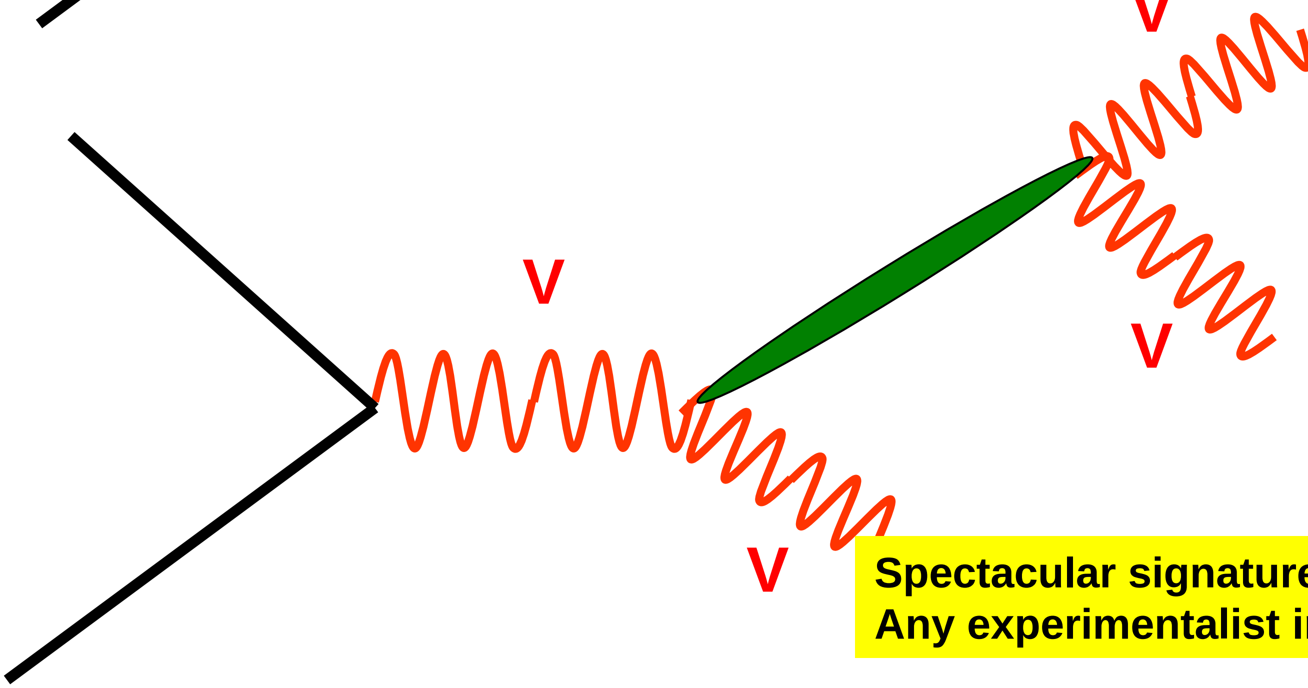


New possibilities



suppressed by $g^2_{weak} \cong 0.2$
compared to WZ production
in Drell-Yan

$\sigma \cong 0.5$ pb (no BR's) in
Ken's model



Spectacular signature for large luminosities!!
Any experimentalist interested??