About me

▶ Undergrad in Pisa
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▶ Postdoc at Berkeley
▶ Fellow at Cern since Oct 2014

Recent collaborators:
▶ S. El-Showk, M. Paulos, S.Rychkov, D. Poland, D. Simmons-Duffin
▶ M. Papucci, K. Zurek
Outline

1. BSM and the origin of conformal bootstrap

2. DM@colliders
A bit of history..

Nice example of how "wild" model building triggered the development of a new research line.
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2004: *Conformal Technicolor*  Luty,Okui

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<th>Technicolor</th>
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- Flavor
  - Higgs field $H$ is elementary $[H] \sim 1$
  - Yukawa couplings are the only marginal operators
  - all 4 fermion interactions are suppressed by the cut-off scale
  - Technicolor Higgs is a fermion condensate $[H^2] \sim 6$
  - Yukawa couplings are as irrelevant as the Higgs mass term

- Hierarchy problem:
  - SM Higgs mass term is strongly relevant $[H^2] \sim 2$
  - Naturally of cut-off scale

Question: Can one build a CFT where $[H] \sim 1$ and $[H^2] \geq 4$?
A bit of history..

2008: Conformal bootstrap is possible E.Tonni,R.Rattazzi,S.Rychkov,AV
2009: ... formal developments...
2010: ... formal developments...
2011: Answer: generically NO D.Poland,D.Simmons-Duffin,AV
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Today conformal bootstrap is an established research line, as presented yesterday
MET searches

- Indirect evidence of DM: worth exploring at colliders
- Stable particles are a common feature of many BSM scenarios
- Common approach until recently: let’s be agnostic
- Parametrize our ignorance with an EFT description of SM-DM interactions
MET searches

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- Dress EFT interaction with SM gauge bosons
- Look for mono-jet, mono-photon, mono-W/Z
EFT not valid @ LHC: finally understood

- Expansion in $Q_T^2/\Lambda^2$
- $Q^2$ distribution at LHC8:

- At LHC, corrections to EFT are $\sim O(1)$.
- Need to go beyond...

EFT exclusion limit:
Simplified models: t-channel example

- Consider simplified models: stable particle(s) + mediator(s)
- EX: squarks + a fermion

\[ \mathcal{L} = \mathcal{L}_{SM} + g_M \sum_{i=1,2} \left( \tilde{Q}_L^i \tilde{Q}_L^i + \tilde{u}_R^i \tilde{u}_R^i + \tilde{d}_R^i \tilde{d}_R^i \right) \chi + \text{mass terms} + c.c. \]

Why consider only monojet searches? List all possible allowed final states:

- Monojet, monophoton,....
- jets+ missing energy
- Dijets (in the case of a Z’ or a higgs like mediator)
- ....
Searches comparison

- **Dijets+met:**
  - ATLAS-CONF-2013-047
  - ATLAS-CONF-2012-109
  - CMS-PAS-SUS-13-012
  - ATLAS-CONF-2012-033
  - CMS-PAS-SUS-11-022
  - CMS-PAS-SUS-12-011

- **Monojet:**
  - ATLAS-CONF-2013-068
  - CMS-PAS-SUS-12-048
  - ATLAS-CONF-2012-147
  - ATLAS-CONF-2011-096
  - CMS-PAS-SUS-11-059

M. Papucci, AV, K. Zurek
Ongoing projects (on the BSM side)

- A roadmap for simplified models with missing energy at LHC@14Tev w/ M. Papucci, K. Zurek, S. P. Liew
- Minimal dark matter @100Tev (beyond Higgsino, Wino)