Top Quark Physics and Effective Field Theory

- in memory of Dr. Cen Zhang

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张岑博士（1984-2021）

研究方向： 高能对撞机唯象学，超出标准模型的新物理，精准计算

2002-2006： 北京大学物理学院（学士）
2006-2011： 美国伊利诺伊大学香槟分校（博士）
2012-2017： 比利时法语天主教鲁汶大学（博士后）
　　　　　　美国布鲁克海文国家实验室（博士后）
2017年回国： 高能所理论室（副研究员）

具体研究内容包括大型强子对撞机上顶夸克和希格斯粒子的相关过程，标准模型的有效场论，以及针对新物理信号的幅射修正等。近几年通过在MadGraph5_aMC@NLO框架中实现自动化计算，将基于有效场论的顶夸克物理精准唯象研究系统地推进到了次领头阶精度。
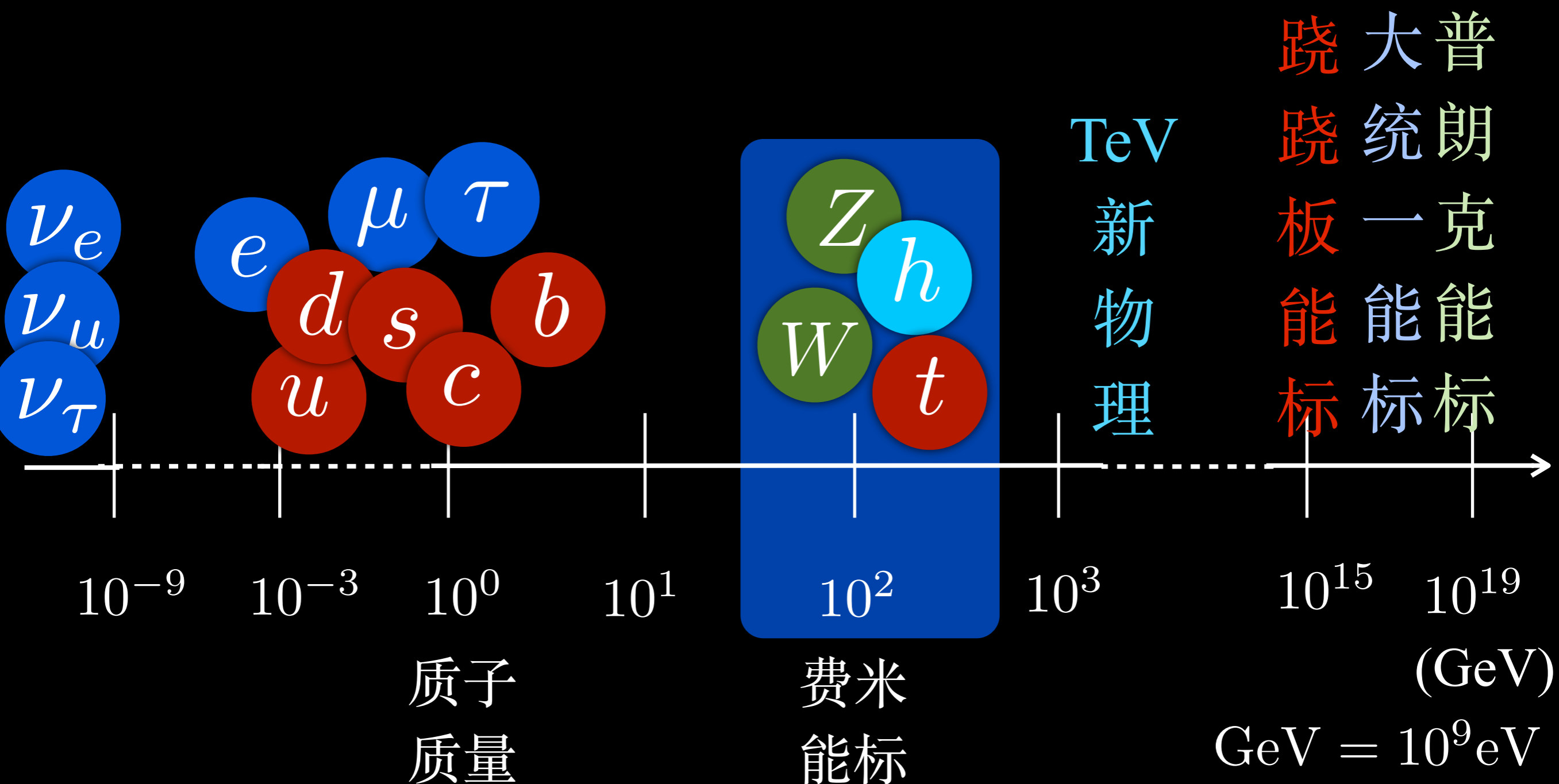
文章列表： http://inspirehep.net/search?p=find+ea+zhang,+cen

张岑博士的科研工作：三个时期

Citation Summary		
	Citeable	Published
Papers	54	41
Citations	2554	2199
h-index	27	26
Citations/paper	47.3	53.6

1）顶夸克有效场论　　　—— 博士期间
2）有效场论的圈图修正　—— 博士后期间
3）LHC inverse problem　—— 归国后工作

顶夸克物理

张岑博士导师Willenbrock是顶夸克物理专家

ν_e ν_u ν_τ e μ τ d u s c b Z W h t

TeV 新物理

跷跷板能标

大统一能标

普朗克能标

10^{-9}	10^{-3}	10^0	10^1	10^2	10^3	10^{15} 10^{19}

质子质量

费米能标

(GeV)

$GeV = 10^9 eV$

顶夸克或许是我们和新物理间的有效联系

顶夸克有效场论

Top quark anomalous couplings or operators

$t\bar{t}$

single-t

| 88 | 1995 | | 2007 | 2008 | 2010 |

Top Discovery — 1995

Singe-Top Discovery — 2008

Top EFT — 2010

Whisnant,Yang, Young, Zhang
hep-ph/9702305

Hikasa, Whisnant, Yang, Young
hep-ph/9806401

Cao, Wudka, Yuan
EFT analysis of single-t channel

CZ,
Willenbrock,
EFT Approach to Top-Quark Production and Decay,
1008.3869, cited=187

Greiner, CZ, Willenbrock
1104.3122, cited=38

CZ, Greiner, Willenbrock
1201.6670, cited=75

with Degrande et al
Annal. Phys. 1205.4231, cited=285

有效场论的量子修正和自动化计算

Top2014
Workshop

Working
Month
@CHEP PKU

IHEP
Recruiting
Committee

2013   2014   2015   2016

1304.1789:   EFT of Precision Electroweak Physics at One Loop

1305.7386:   Top-quark decay into Higgs boson and a light quark
        at next-to-leading order in QCD

1306.3380：   Constraints on Electroweak Effective Operators at One Loop

1311.3107：   Electroweak Effective Operators and Higgs Physics

1404.1264：   EFT approach to top-quark decay at next-to-leading order in QCD,
        Cen Zhang, cited=52

1412.7166:   Global approach to top-quark flavor-changing interactions, cited=106

1503.08841:   Probing the top-quark chromomagnetic dipole moment at NLO in QCD,
        cited=75

1601.06163:   Single Top Production at NLO in SMeFT, cited=60

1601.08193:   Probing top quark neutral couplings in SMEFT at NLO in QCD, cited=134

1607.05330:   Higgs production in association with a top-antitop pair in SMEFT
        at NLO in QCD, cited=90

2008.11743: Automated one-loop computations in the SMEFT

Inverse problem in SMEFT

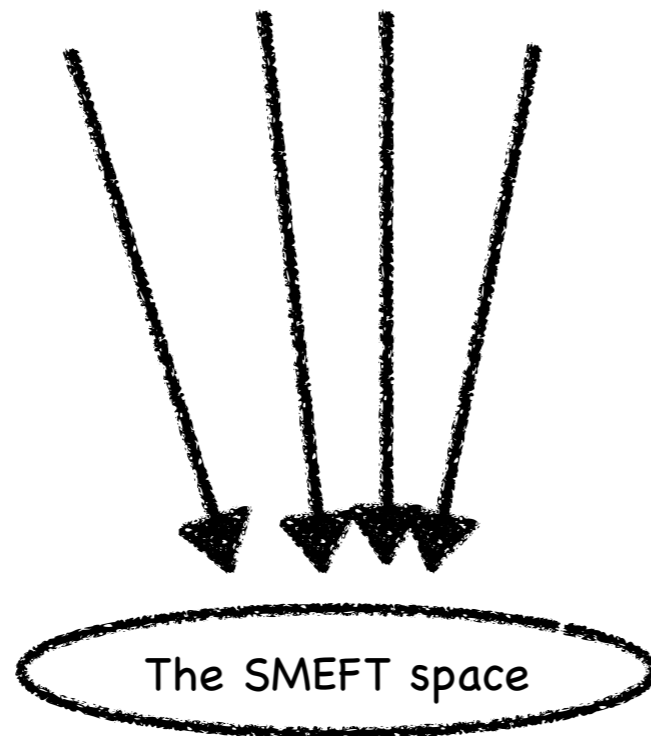| 2004	IHEP 2016	AEPSHEP School 2017	T.D. Lee Fellow 2019	2021

Arkani-Hamed, Kane, Thaler, Wang
hep-ph/0512190

SUSY Inverse Problem

Many BSM models

The SMEFT space

- SMEFT is useful because it describes (infinitely) many models by finitely many Wilson coefficients.
- They are being determined by global fit to LHC data.

Positivity Bound

Not all EFTs have a UV completion QFT (Causality, Unitarity, etc)

Positivity in SMEFT at dim-8

Elastic scattering is not enough
Convex Geometry
External Ray

Inverse problem in SMEFT

1808.00010: Positivity bounds on vector boson scattering at the LHC

1902.08977: Positivity constraints on aQGC: carving out physical parameter space

2004.03992: Generalized positivity bounds on chiral perturbation theory,

2009.02212: Positivity in electron-positron scattering: testing the axiomatic QFT principles and probing the existence of UV states

2009.04490: Elastic positivity vs extremal positivity bounds in SMEFT: a case study in transversal electroweak gauge-boson scatterings

2005.03047: Convex Geometry Perspective on the (Standard Model) EFT Space

2011.03055: An unambiguous test of positivity at lepton colliders

2011.05190: Generalized elastic positivity bounds on interacting massive spin-2 theories

陈省身先生："你一定要和比你好的人在一起，你才会有进步。"

张岑博士（1984-2021）

他发展了标准模型的有效场论，在MadGraph5_aMC@NLO框架中实现自动化计算，将基于有效场论的顶夸克物理精准唯象研究系统地推进到了次领头阶精度。

他是我见过的最谦逊的物理学工作者之一，没有和他合作学习是我一生的遗憾。

Requiescat in Pace