



2023 中研院物理所暑期生計畫

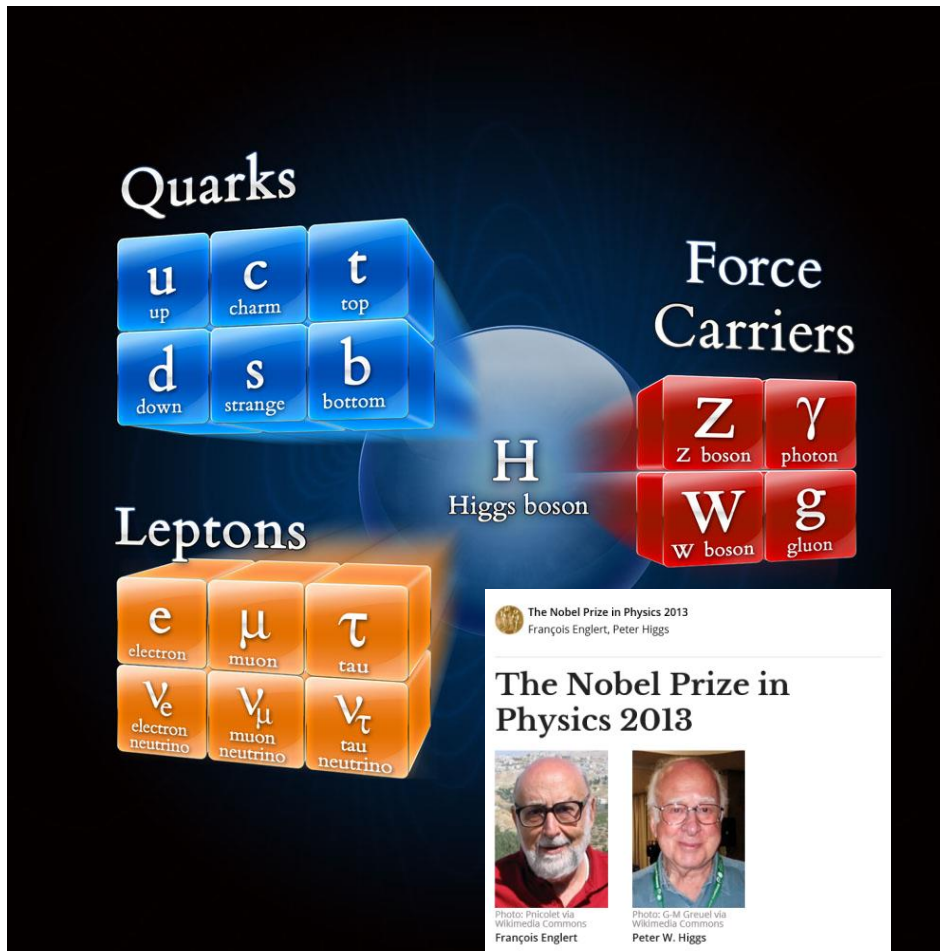
2023/7/5

中高能物理實驗組研究簡介

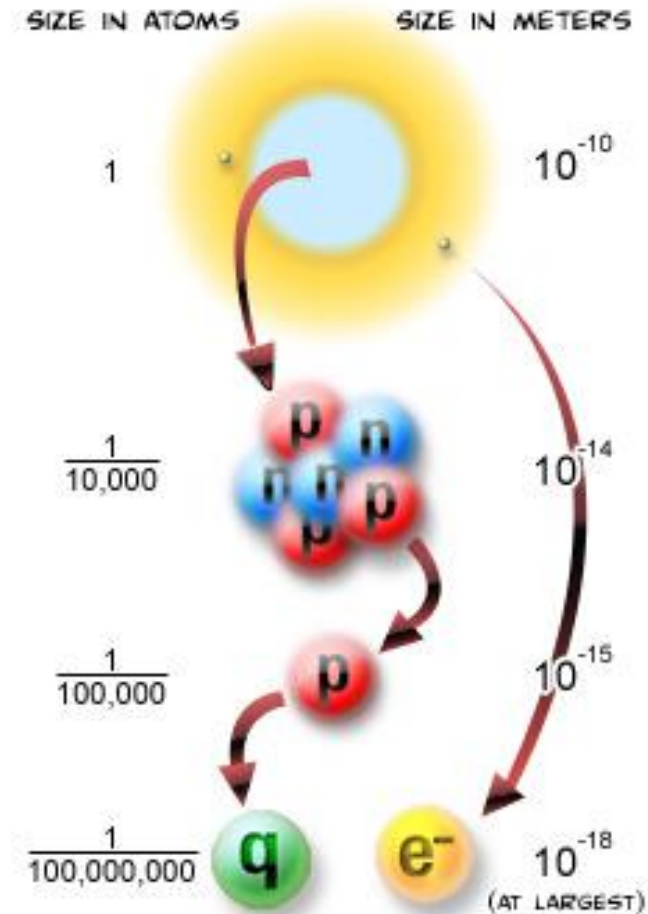
章文箴

On behalf of “Medium and High Energy Physics
Experimental Group”

基本粒子標準模型



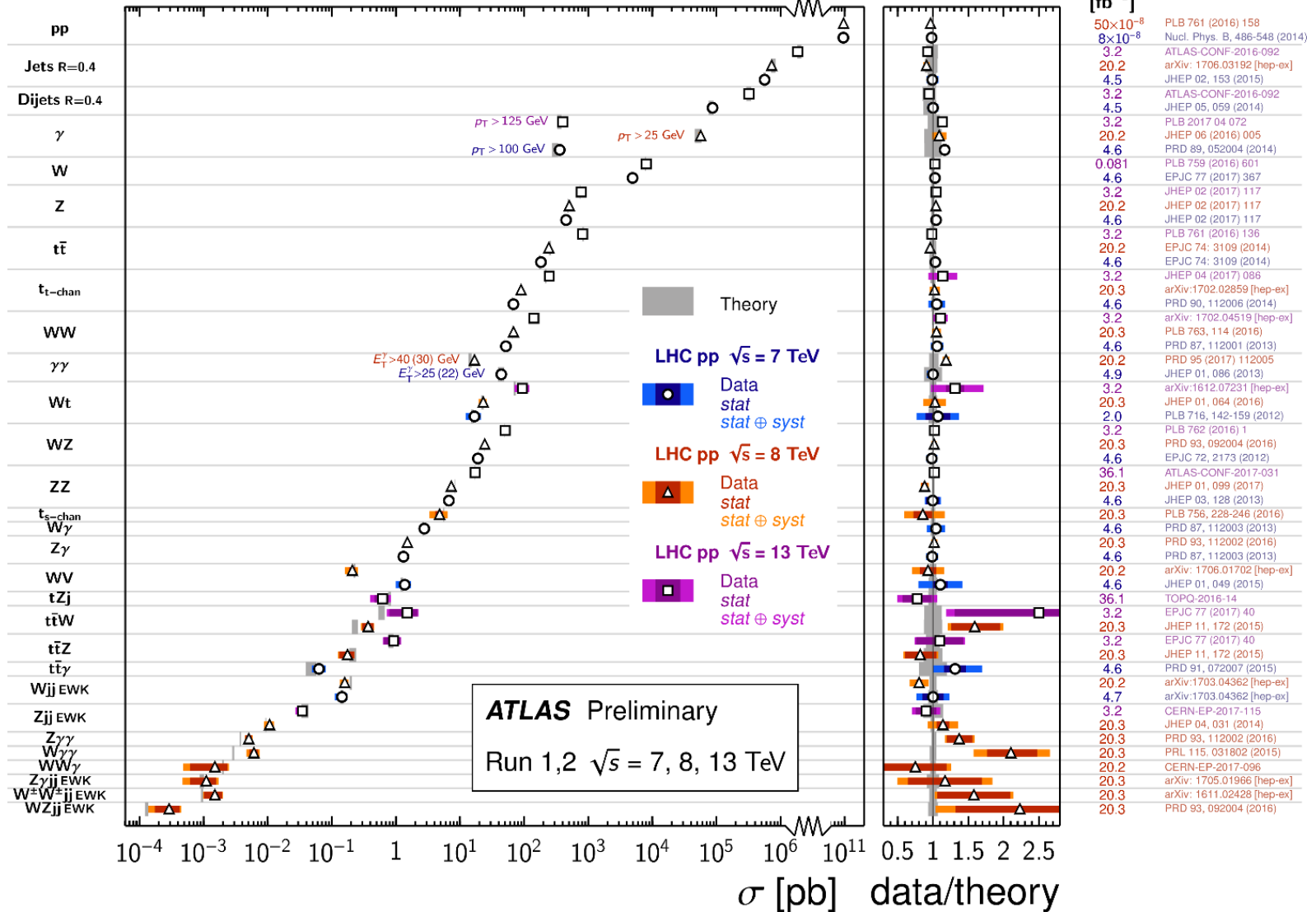
The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"



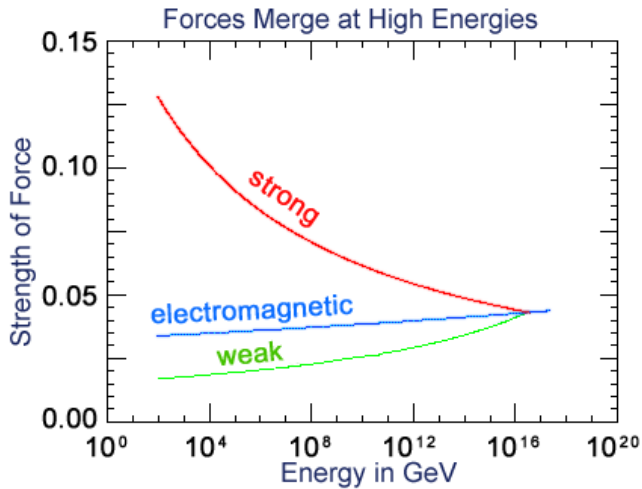
標準模型實驗檢證

Standard Model Production Cross Section Measurements

Status: July 2017



未解之謎



Are there Extra Dimensions?



An indication for extra dimensions may be the extreme weakness of gravity compared with the other three fundamental forces (gravity is so weak that a small magnet can pick up a paper clip overwhelming Earth's gravity).

Why is the Universe Accelerating?



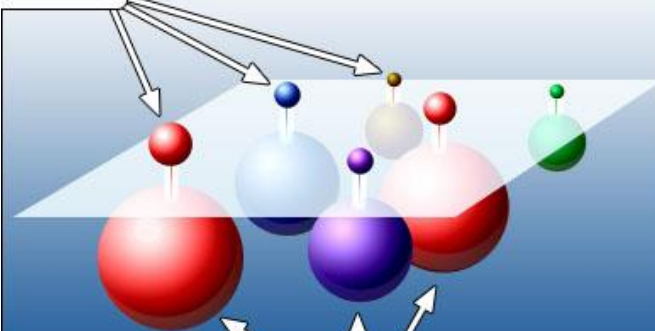
The expansion of the universe appears to be accelerating. Is this due to Einstein's Cosmological Constant? If not, will experiments reveal a new force of nature or even extra (hidden) dimensions of space?

Why No Antimatter?



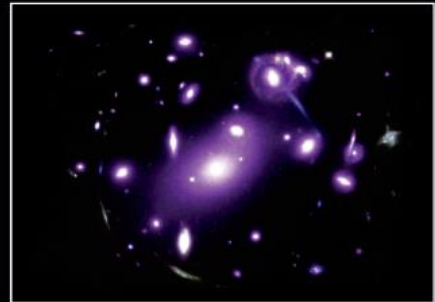
Matter and antimatter were created in the Big Bang. Why do we now see only matter except for the tiny amounts of antimatter that we make in the lab and observe in cosmic rays?

Particles



Supersymmetric "shadow" particles

What is Dark Matter?



Visible forms of matter make up much of the mass observed in galaxies and clusters of galaxies. Does this dark matter consist of new types of particles that interact very weakly with ordinary matter?

中研院物理所中高能實驗團隊



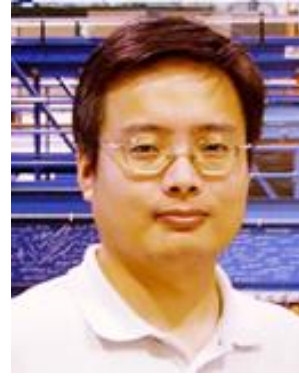
Yuan-Hann Chang
張元翰



Henry Tsz-King Wong
王子敬



Suen Hou
侯書雲



Song-Ming Wang
王嵩銘



Sadakazu Haino
灰野禎一



Wen-Chen Chang
章文箴



Ming-Lee Chu
朱明禮



Chih-Hsun Lin
林志勳



Eric Yen
嚴漢偉

Institute of Physics, Academia Sinica

MHEP (Expt)

Collider Physics
Search for new particles
and new physics



ATLAS
1999 ~
S.M. Wang/ S. Hou

Astroparticle Physics
Study cosmic-rays, search for
anti-matter, dark matter



AMS
1995 ~
S. Haino/ Y.H. Chang

**Experimental support;
novel detectors &
applications**

Instrumentation
M.L. Chu/ C.H. Lin



CEPC – Higgs factory
S. Hou

**Neutrino & Dark Matter
Physics**
With low energy detectors



TEXONO
1996 ~
H.T. Wong

Asian Grid Center
From HEP to other
Sciences



Computing
Y.H. Chang/ E. Yen

Hadron Physics
probing nucleons by GeV
photons and hadrons



**LEPS, SeaQuest,
COMPASS, J-PARC**
1999 ~
W.C. Chang

Gravitational Wave
New tool to study our
universe



2018 ~
S. Haino

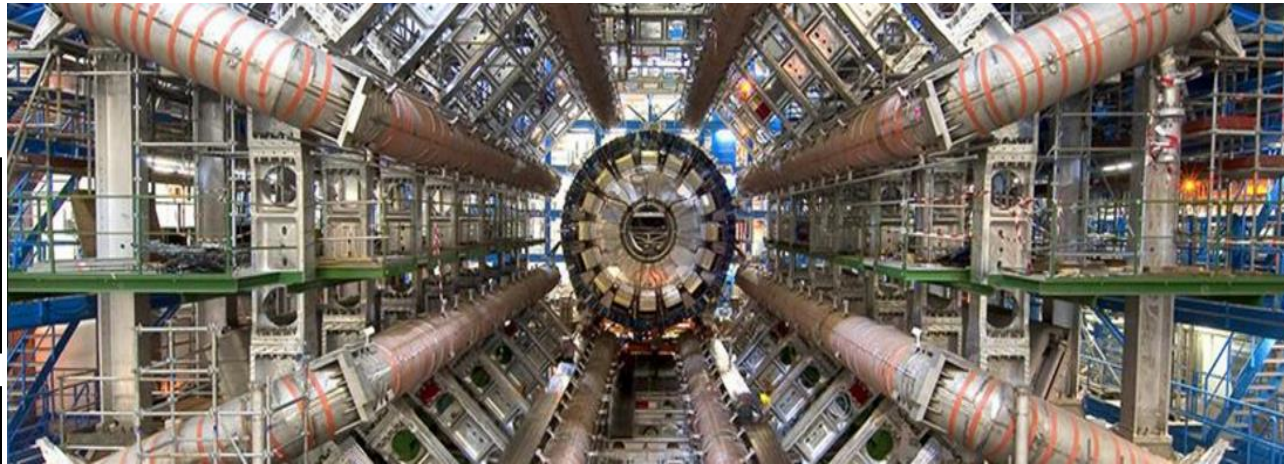


2021 ~
H.T. Wong

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MHEP (Expt)

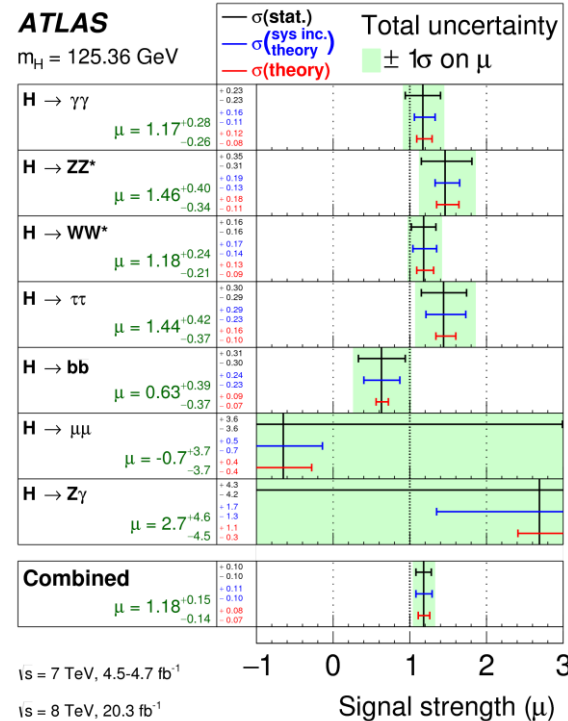
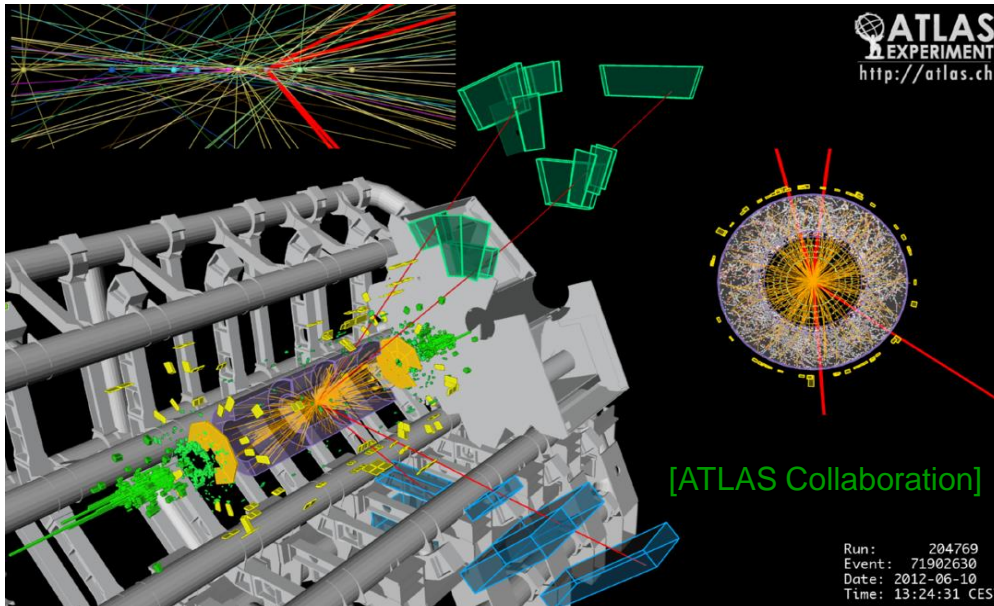
Collider Physics
Search for new particles
and new physics




ATLAS
1999 ~
王嵩銘/侯書雲



CEPC – Higgs factory
侯書雲



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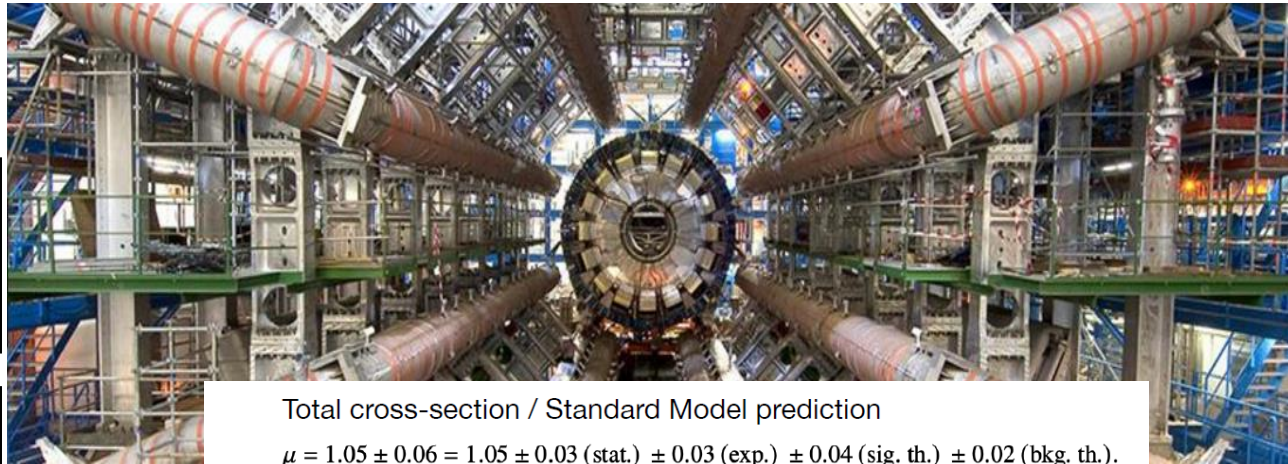
Collider Physics
Search for new particles
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ATLAS
1999 ~
王嵩銘/侯書雲



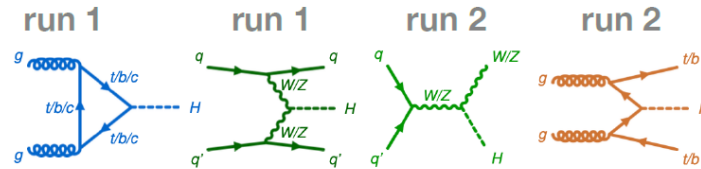
CEPC – Higgs factory
侯書雲



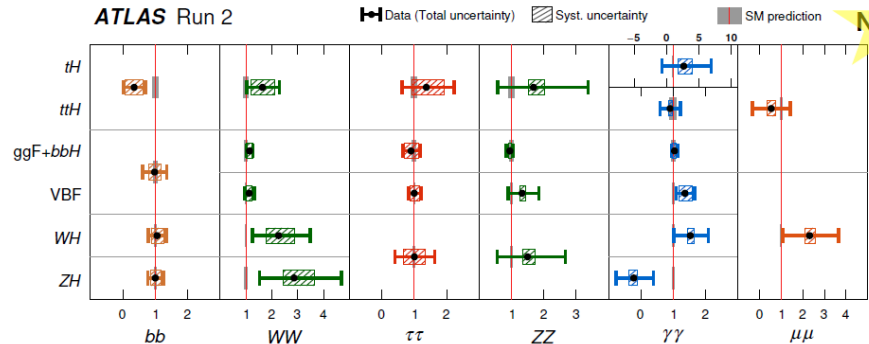
Total cross-section / Standard Model prediction

$$\mu = 1.05 \pm 0.06 = 1.05 \pm 0.03 \text{ (stat.)} \pm 0.03 \text{ (exp.)} \pm 0.04 \text{ (sig. th.)} \pm 0.02 \text{ (bkg. th.)}$$

(benefits also from reduced theory uncertainty)



Measurements per production mode * decay channel:



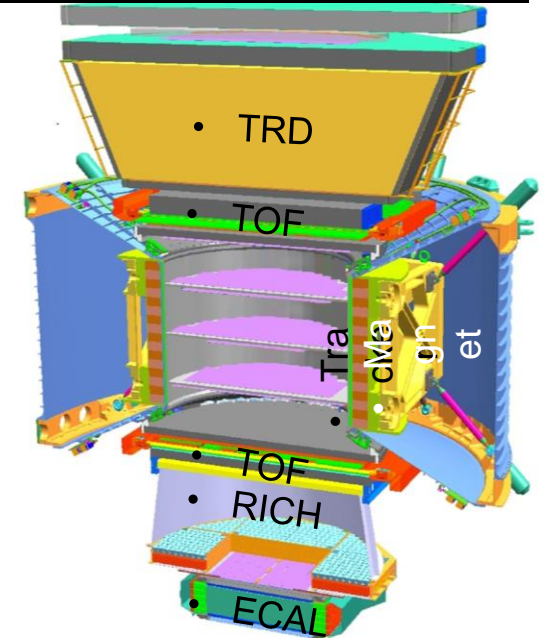
Nature 607 (2022) 52

$\sigma \times \text{BR}$ normalized to SM prediction

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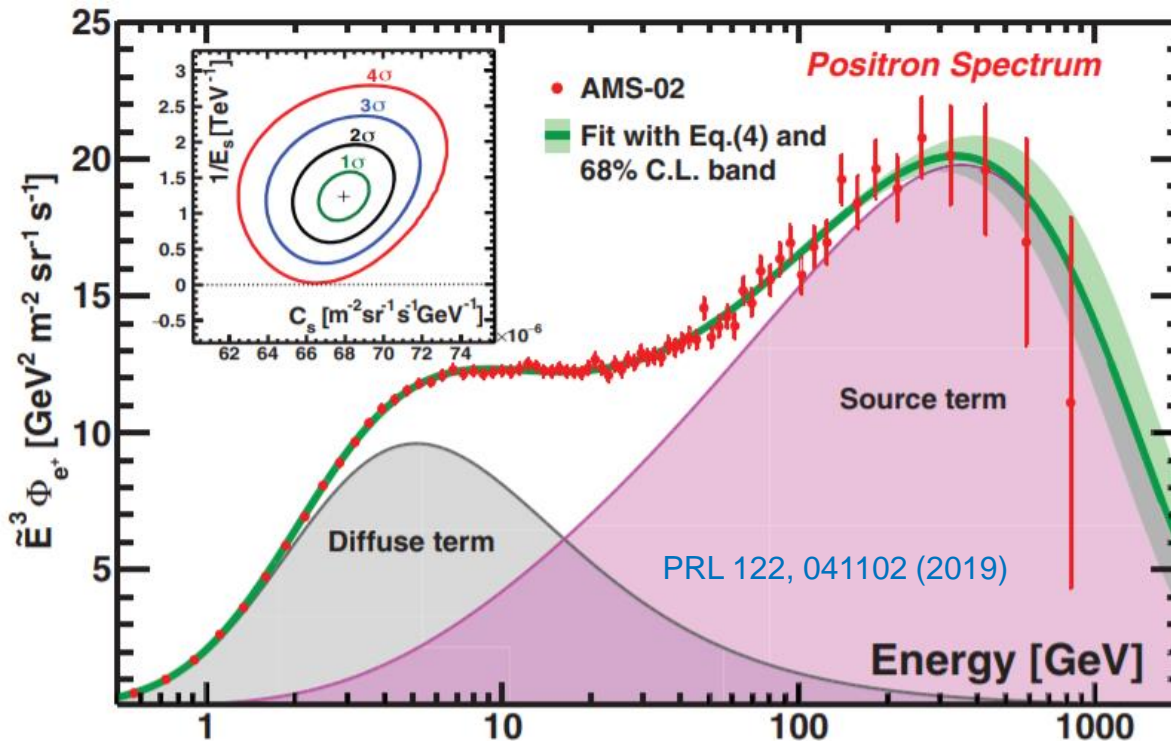
MHEP (Expt)

Astroparticle Physics
Study cosmic-rays, search for
anti-matter, dark matter





AMS
1995 ~
灰野禎一/張元翰

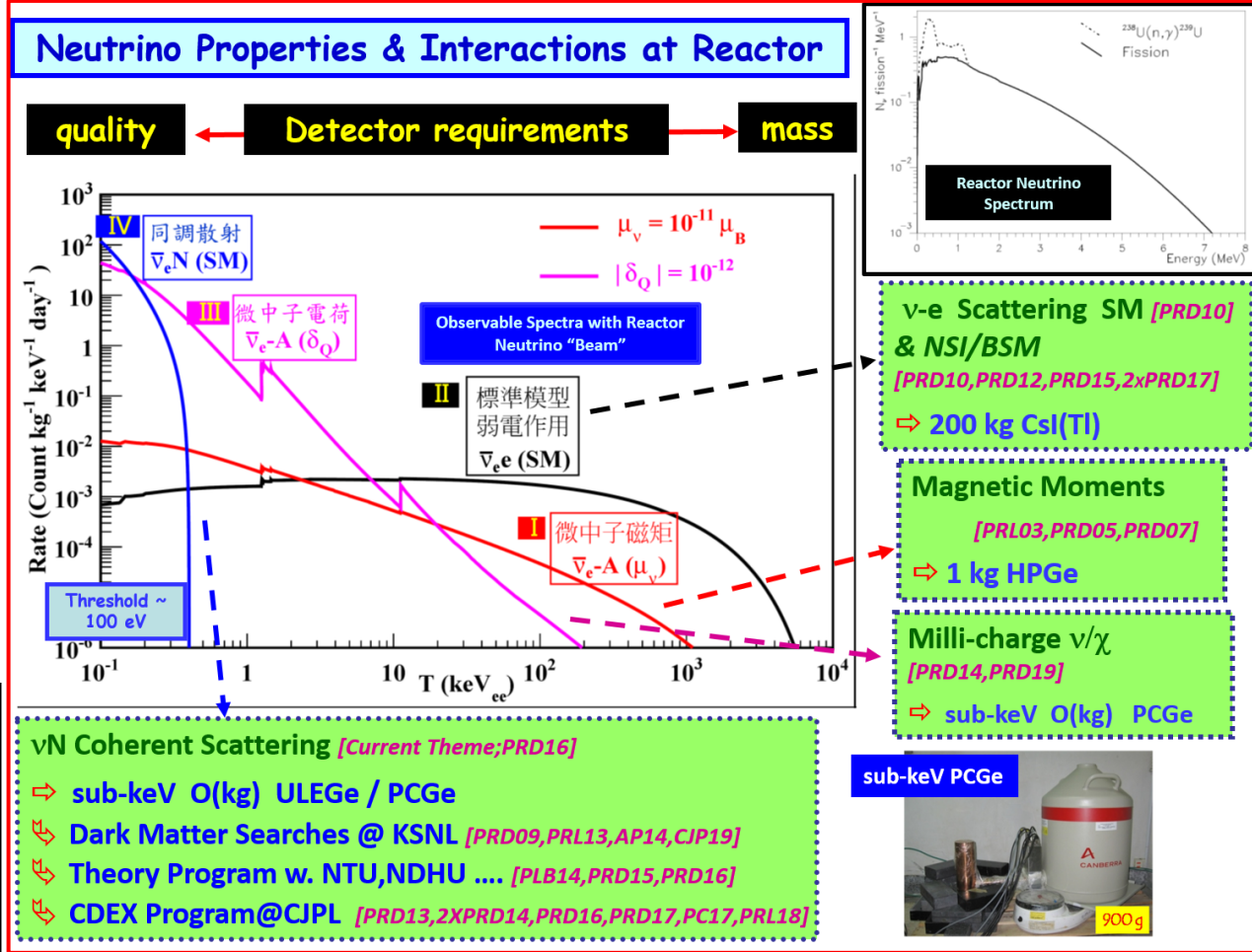
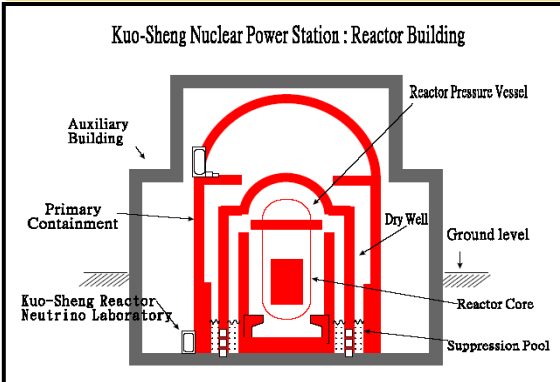
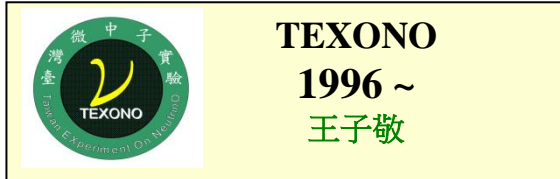


	e ⁻	P	Fe	e ⁺	\bar{P}	\bar{He}
TRD						
TOF						
Tracker + Magnet						
RICH						
ECAL						
Physics example	Cosmic Ray Physics Strangelets			Dark matter		Antimatter

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MHEP (Expt)

Neutrino & Dark Matter
Physics
With low energy detectors



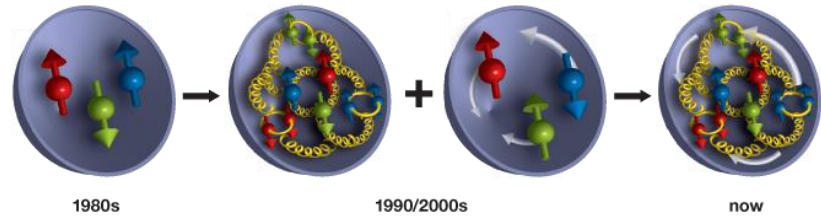
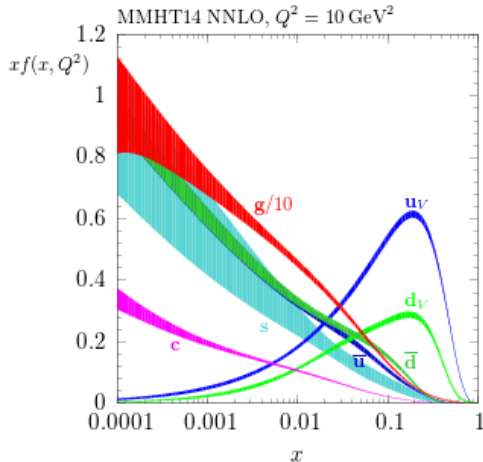
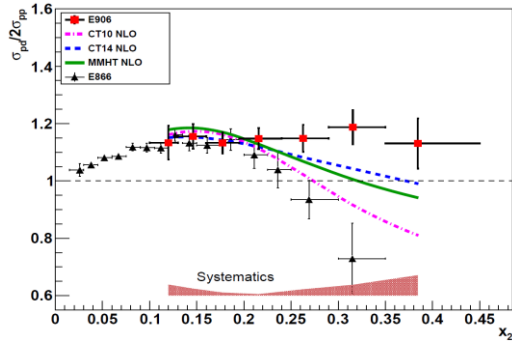
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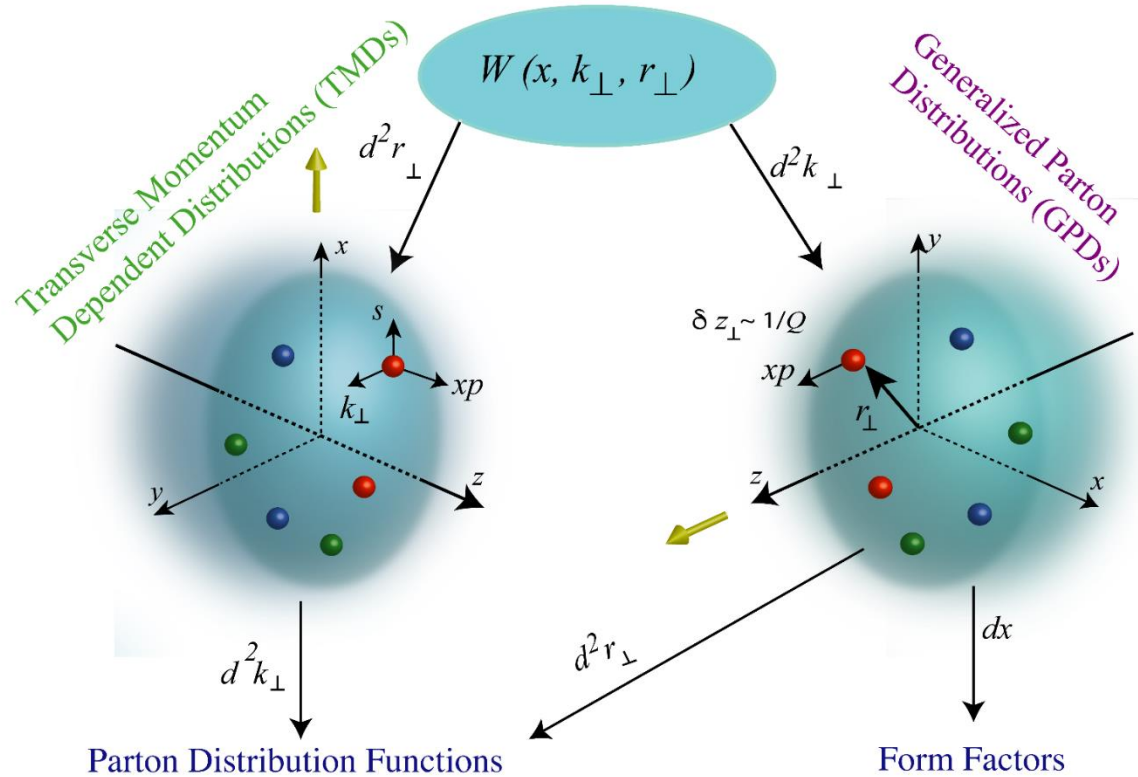
Hadron Physics
probing nucleons by GeV
photons and hadrons

LEPS, SeaQuest,
COMPASS, J-PARC

1999 ~
章文箴



Wigner Distributions



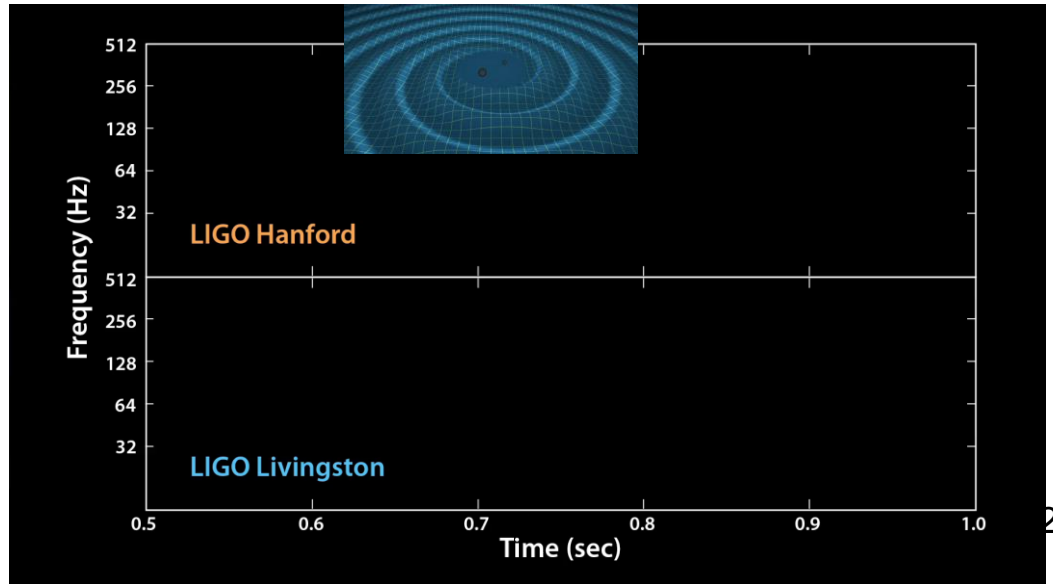
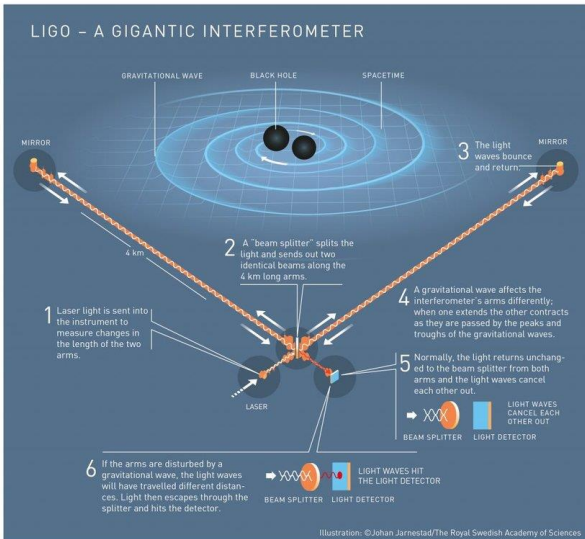
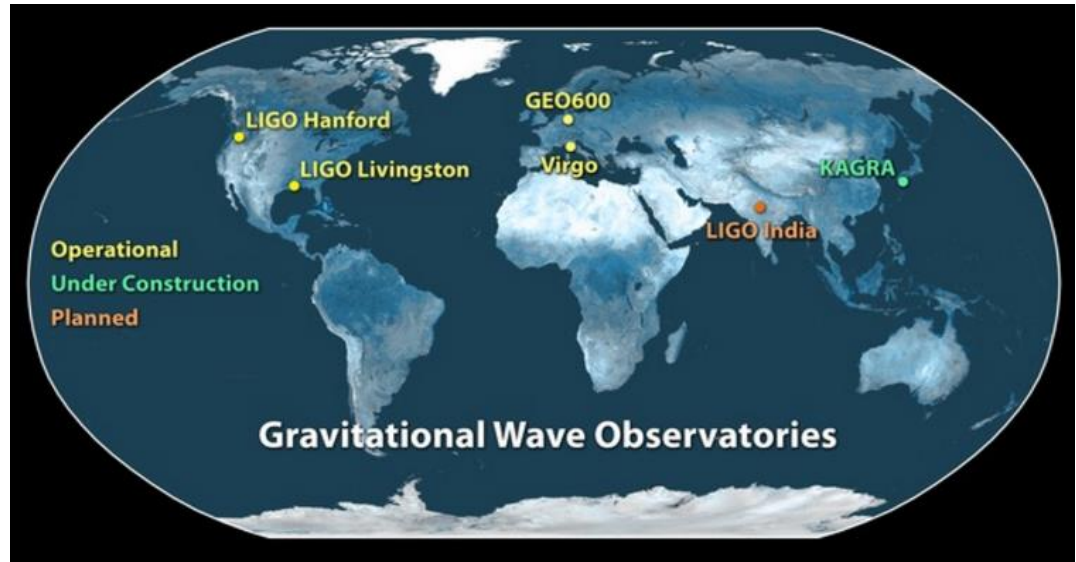
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MHEP (Expt)

Gravitational Wave New tool to study our universe

KAGRA 2018 ~
灰野禎一

LIGO 2021 ~
王子敬



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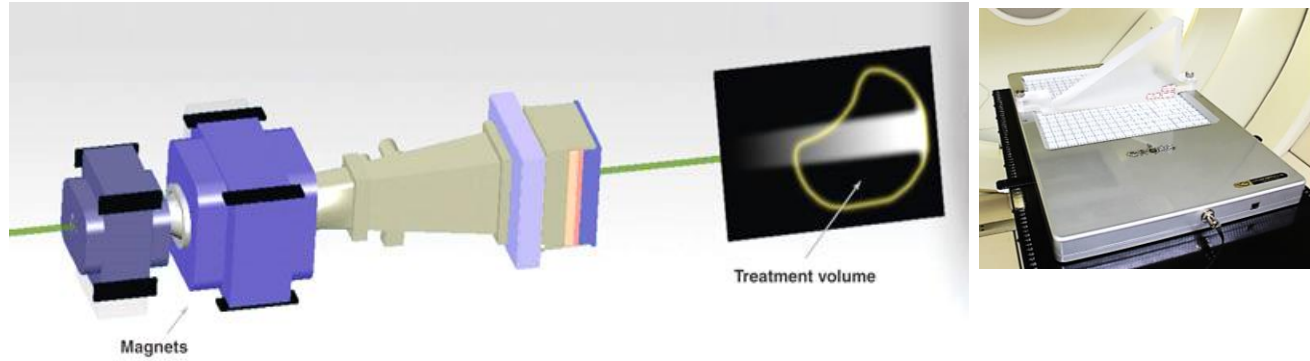
MHEP (Expt)

- Proton Therapy Detector 質子治療探測器

Experimental support;
novel detectors &
applications

Instrumentation

朱明禮/林志勳



Asian Grid Center
From HEP to other Sciences



Computing

張元翰/嚴漢偉

DiCOS Web Services



CPU Cluster (single/multiple cores, MPI) by VM/Container

CryoEM, Photon, HPC, HEP

GPU Cluster (GTX-1080ti)

CryoEM, Gravitational Wave

GPU Cluster (P100)

HPC, HEP, DL

GPU Cluster (V100)

QCD, HPC, DL

DiCOS Storage Services (DiCOSBox, Ceph, Distributed Storage)