# 25th HIGH-ENERGY PHYSICS INTERNATIONAL CONFERENCE IN QUANTUM CHROMODYNAMICS

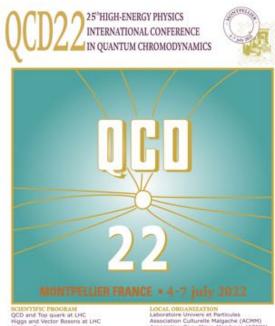


4-7 July 2022 (Montpellier - FR)

#### **Stephan Narison**







Hadron Spectroscopy K, D, B and Tau-decays Quark-Gluon Plasma

Non-perturbative QCD Tests of Standard Model and Beyond

Stephan NARISON Laboratoire Univers et Particules CNRS - Université de Montpellier - FR INTERNATIONAL COMMITTEE

S. Bethke (Munich) A. Di Giacomo (Pisa) M. Knecht (Marseille) A. Pich (Valencia)

Association Gasy Miara-Mandroso (AGMM)

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Laboratoire Univers et Particules
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EMAIL ADDRESSES snarison@yahoo.fr/qcdconf@gmail.com

https://www.lupm.in2p3.fr/users/qcd/qcd22

The (eventual) success of this meeting (if any) also comes from you!

#### **QCD 22-Montpellier (16 nations)**



### Thanks to the Regular Participants

#### Since

- 85 : A. Di Giacomo (committee member since 96)
- 85 : G. C. Rossi (committee member 22)
- 94: J.M Richard (committee member since 94)
- 94: M. Knecht (committe member since 2018)
- 98: F. Navarra, M. Nielsen
- 00: I. Bediaga
- 03: J. Sanz Cillero
- 08: M. Frasca, E. Megias
- 10: R. Albuquerque
- 15: J. Rodriguez-Sanchez







## Thanks to the Contact Persons of $\neq$ Experiments

who helped in preparing the Scientific Program!

ALICE Dariusz Miskowiec, Roberta Arnaldi

ATLAS Sandra Leone

LHCb Chris Parkes

CMS Marta Ruspa

NA62 Patrizia Cenci

BELLE II Jim Libby

BABAR Gerard Bonneaud

CDF Giorgio Chiarelli





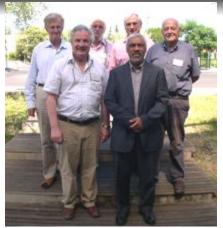






#### Thanks to the (Ex-) International Committee !









#### **CHAIRMAN**

Stephan NARISON Laboratoire Univers et Particules CNRS - Université de Montpellier - FR

#### INTERNATIONAL COMMITTEE

S. Bethke (Munich)

A. Di Giacomo (Pisa)

M. Knecht (Marseille)

A. Pich (Valencia)

G. Rossi (Roma)

V. I. Zakharov (Munich)









#### Thanks to the Chairmen of $\neq$ Sessions for their help!

- R. Albuquerque
- I. Bediaga
- M. Frasca
- A. Di Giacomo
- M. Knecht
- F. Navarra
- M. Nielsen
- J.M Richard
- G. C. Rossi
- J. Sanz Cillero



#### Thanks to the Institutions and Persons









Participating in the organization



#### Thanks to the Institutions and Persons









#### Participating in the organization



Especially to ZOOM which enables to concretize this hybrid meeting

### Thanks to the Major of Montpellier

#### who has offered "the glass of friendship"





## QCD & HEP Inroduction Books - 1989, 2002, 2015

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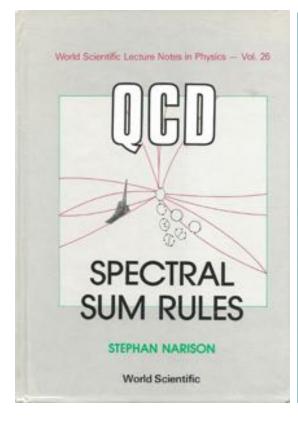
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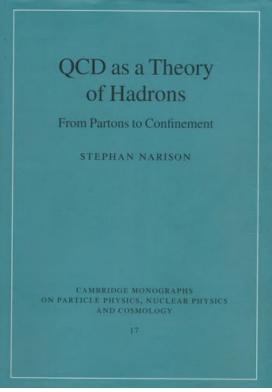
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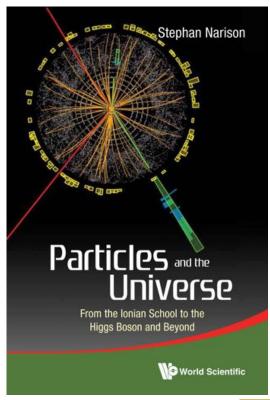
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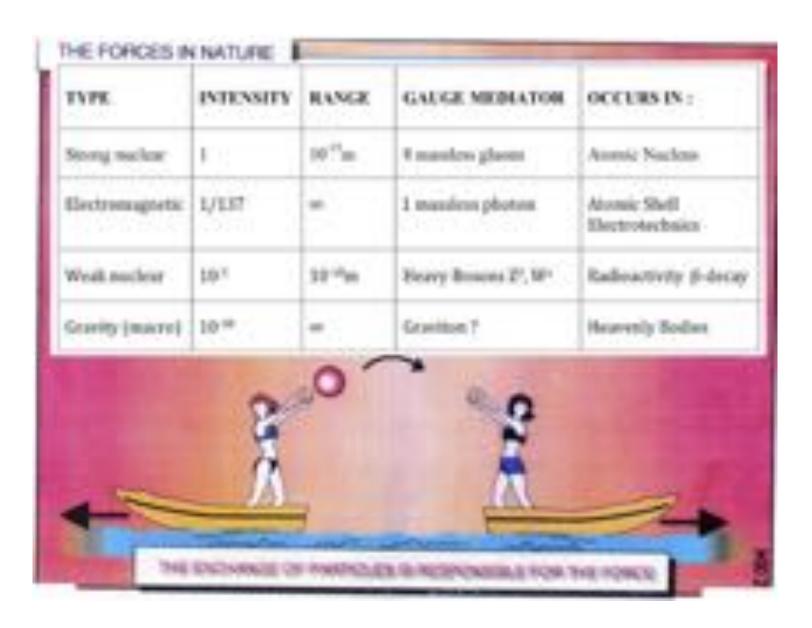








#### **QCD** - A modern theory of strong nuclear force





#### **QCD** completes the **ElectroWeak S**tandard **M**odel

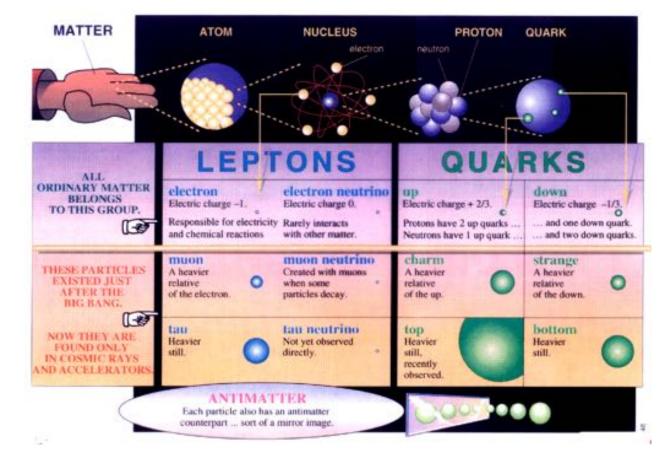
#### ● 6 quarks ⊕ 6 leptons constituents

Glashow-Salam-Weinberg: Nobel Price 1979



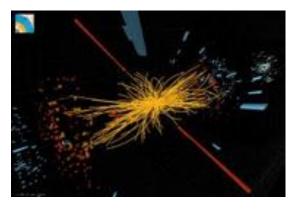


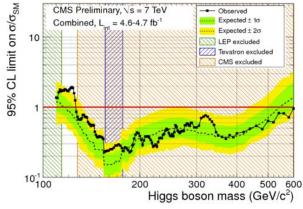


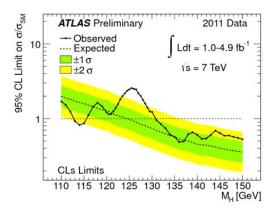




## • SM More Robust after the Higgs Boson Discovery at CERN-LHC in 2012 - 10 Years ago : $M_H \simeq 125$ GeV.

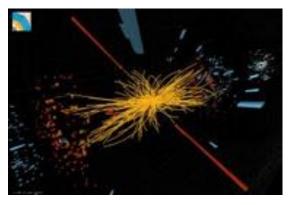




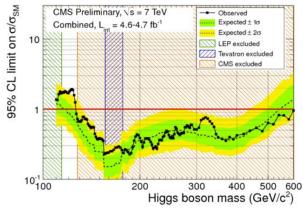


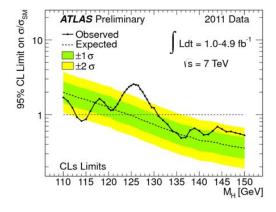


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Higgs Boson gives Masses to Elementary Particles?

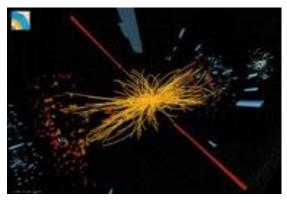






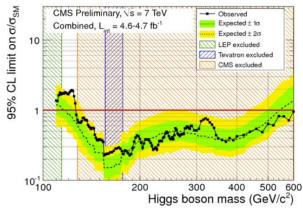
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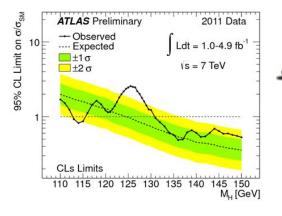
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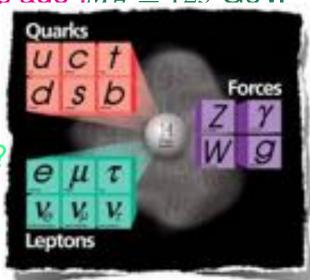


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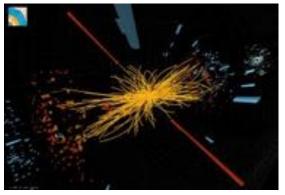






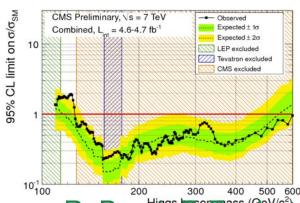
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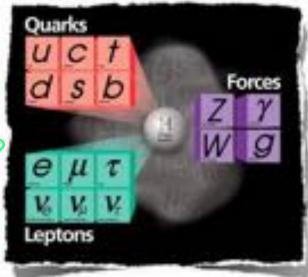


R. Brout, F. Englert, P. Higgs (Nobel Price 2013)











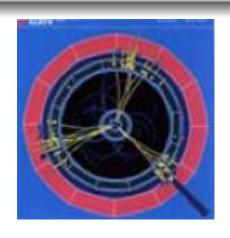
#### **QCD** - An asymptotically free theory







of quarks and gluons

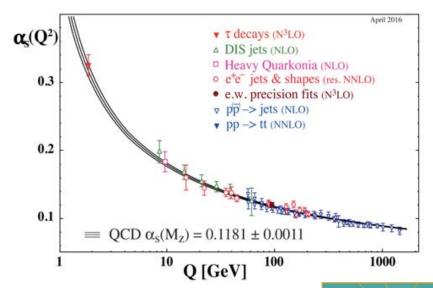


D. Gross D. Politzer F. Wilczek Nobel Price 2004





G. t' Hooft M. Veltman Nobel price 1999 D. Gross (QCD 98 host ) G. t'Hooft (QCD 98-00 host)



Hadrons built with quarks u, d

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- M. Gell-Mann 1961 (Prix Nobel 1969)



- Hadrons built with quarks u, d
- M. Gell-Mann 1961 (Prix Nobel 1969)
- (Pre-QCD) Quark Model

a) Mesons :  $\bar{q}_1q_2$ :  $M_{\pi}=140~\text{MeV}$ 

 $M_{\rm p}=775~{
m MeV}$ 

b) Baryons :  $q_1q_2q_3$  :  $M_p = 938 \text{ MeV}$ 



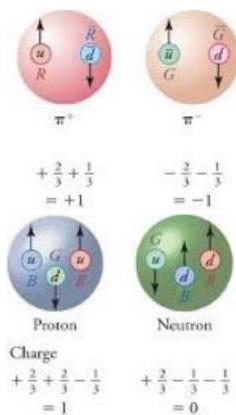
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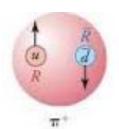
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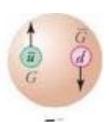
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Proton

Charge

Neutron

**NEW**: Exotic Hadrons



Hybrid

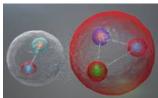
Tetraguark

Hadronic Molecule

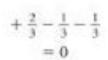












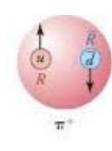
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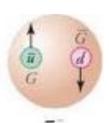
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 $-\frac{2}{3}-\frac{1}{3}$ 



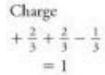


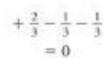
Proton

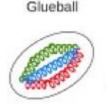
Neutron

NEW : Exotic Hadrons











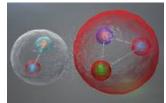
Hybrid



Tetraquark







Described at present by QCD: The theory of Colour

#### QCD

◆ A Simple (unbroken gauge theory ⊕ asymptotic freedom )
BUT complicated (confinement) theory!



♦ A Simple (unbroken gauge theory ⊕ asymptotic freedom ) BUT complicated (confinement) theory!

Old BUT Still Active Theory: Primordial Role for

New Physics Searches:



**Traditional QCD:** 

LHC: a lot of QCD events!...

g-2: hadronic contributions

**CP-violation** 

Top quark



Confinement

 $\alpha_s$ , PDF,  $m_Q$ , ... Exotic hadrons  $B, K, \tau$  decays Quark-gluon plasma

♦ A Simple (unbroken gauge theory ⊕ asymptotic freedom ) BUT complicated (confinement) theory!

Old BUT Still Active Theory: Primordial Role for

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**Traditional QCD:** 

Motivate the organization of the QCD Montpellier Series

LHC: a lot of QCD events!...

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Top quark



Confinement

 $\alpha_s$ , PDF,  $m_Q$ , ... Exotic hadrons  $B, K, \tau$  decays Quark-gluon plasma

#### Already Ends ... after One hard week (at least for me!)



QCD and Top quark at LHC Higgs and Vector Bosons at LHC Hadron Spectroscopy K, D, B and Tau-decays Quark-Gluon Plasma Non-perturbative QCD Tests of Standard Model and Beyond

CHARRAN Stephan NARISON

Laboratoire Univers et Particules CNRS - Université de Montpellier - FR

INTERNATIONAL COMMITTEE

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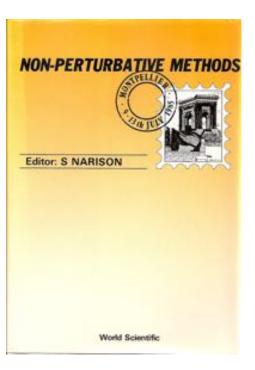
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snarison@yahoo.fr/qcdconf@gmail.com

https://www.lupm.in2p3.fr/users/qcd/qcd22 Registration: 3 June 2022

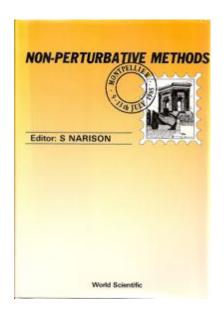
Abstracts: 3 June 2022 Proceedings: 9 September 2022

#### Since 1985!

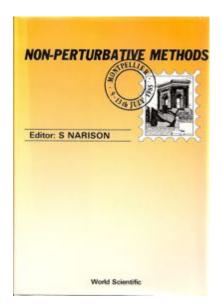


International Conferences
 Non Perturbative Methods 85,
 QCD 90, 00, 02, 03, 04, 05, 06,
 08, 10, 12, 14,
 QCD 15 (30th anniversary)
 QCD 16, QCD 17, QCD18, QCD19
 QCD 20 (35th anniversary), QCD 21

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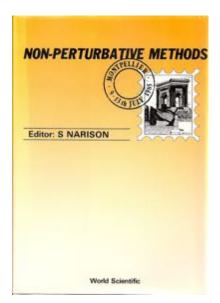


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   QCD 16, QCD 17, QCD18, QCD19
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- CD 94, 96, 97, 98, 99





QCD 97-98 : Anniversaries : 100th of electron - 25th of QCD

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Nobel Price Winners: J. Steinberger (1988) D. Gross (2004), G. 't Hooft (1999)

QCD97 QCD98 QCD 98-02



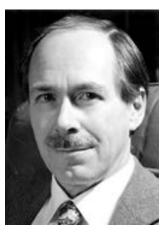
QCD 97-98: Anniversaries: 100th of electron - 25th of QCD











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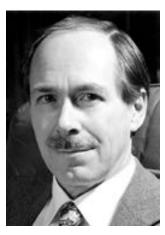
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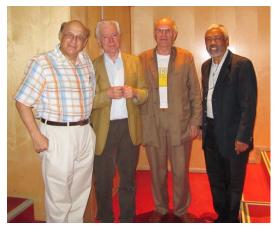


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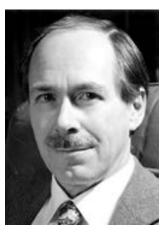
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QCD 15 & 20 : 30 & 35 th Anniv. of the QCD conference

Spirit



- Spirit
  - Young Physicists & World Experts together



- Spirit
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  - Balance between Experiments & Theory



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  - Stronger Interactions among Participants



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  - Better Scientific & Social Organizations
  - Family Atmosphere
  - Stronger Interactions among Participants
  - Origin of New Collaborations



Training

Most of the "good" European Physicists have presented their first international talks here. I wish that young participants in this meeting will become like them!



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   V. Zakharov: (since 1996 & committee member)



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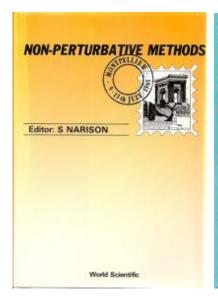


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- Sakurai price winners 1999: M. A. Shifman: (2008, 2010)
   V. Zakharov: (since 1996 & committee member)
- Sakurai price winner 2007: S.J. Brodsky: (1990, 2014)



# QCD Proceedings

Sold Here: 30 €





QCD 15

















#### Challenges & Difficulties

Unique in Sub-Saharian (exept South Africa!)
 and Indian Ocean Countries









- Unique in Sub-Saharian (exept South Africa!)
   and Indian Ocean Countries
- No specialized national researcher in this field









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#### Achievements

Series of the HEPMAD International Conferences since 2001.









#### Challenges & Difficulties

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- Creation of the iHEPMAD research institute in 2004.









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- Popularization of HEP :









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  - Public Institutions (Academie, Alliance Française,...)



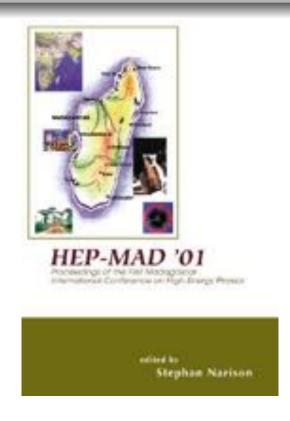




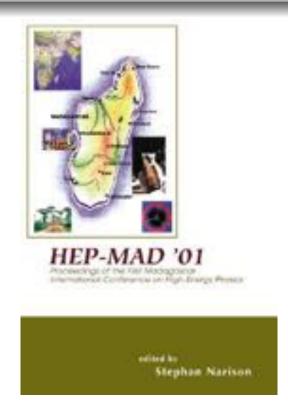


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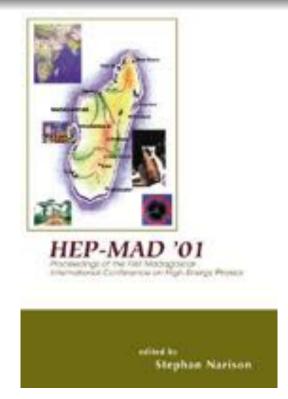
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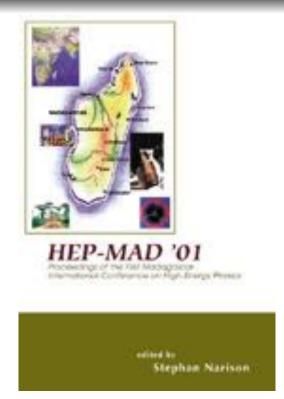


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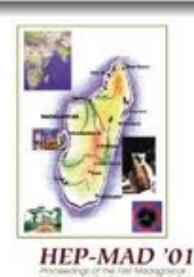


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- - Master and PhD (since 2013)





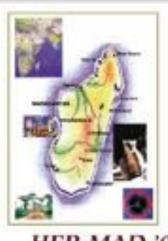
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- HEPMAD Institute 2004
  - Master and PhD (since 2013)
  - Cooperation with CERN-Geneve-CH (LHCb), ICTP-Trieste-IT, Fermilab-US, Brazil, Marseille-FR, Montpellier-FR



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HEP-MAD '01

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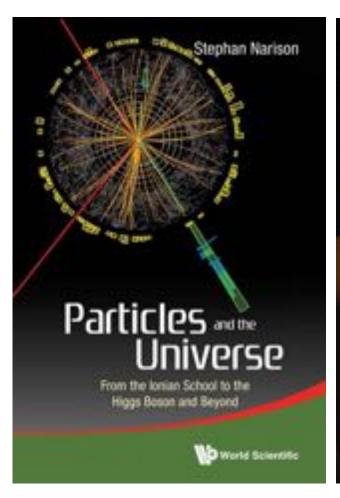
Schools : African School of Physics,
 CERN-Geneve, Trieste-IT

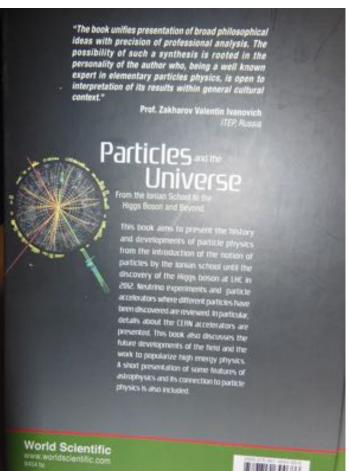




## Popularizing / Promoting HEP in Madagascar

### Popularizing Book







Sold by World Scientific Company and On-line by Amazon.com 77€

Malagasy Academy

Malagasy Academy



Malagasy Academy



Alliance Française

Malagasy Academy

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High-Schools
 Association Père Pedro

High-Schools
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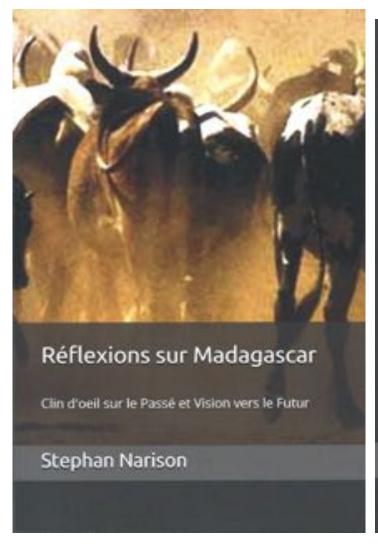




Association Gasy Miara-Mandroso (AGMM) Needs more support for developing education : Donation, Partnership,...



#### Societal Book

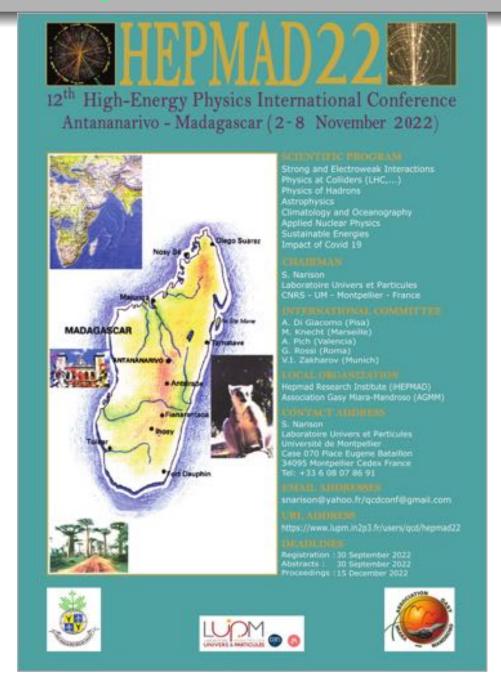


Ce livre présente, d'une manière succincte, les différents aspects de Madagascar, cette île Mystérieuse aux Milles Facettes qui trône sur l'Océan Indien dans l'hémisphère sud. Il s'adresse à tou(te)s ceux (celles) qui veulent connaître, d'une façon simple et rapide la Géographie et l'Histoire de Madagascar depuis son origine jusqu'en 2018 où se déroulent les elections présidentielles. La 1ère partie retrace l'origine du pays et du peuple malgache et son histoire avant l'indépendance en 1960. Les 2ème et 3ème parties présentent la situation politique depuis 1960. Ses conséquences socio-économiques désastreuses sont discutées dans la 4ème partie. La 5ème partie montre l'Association Gasy Miara-Mandroso (AGMM) et ses actions de développement de la physique des hautes énergies (HEP) dans les lycées, collèges, universités et institutions publiques de Madagascar. La vision du futur de l'AGMM sur le développement durable du pays est présentée dans la 6ème partie. L'auteur, en tant que candidat, montre, dans la 7ème partie, les anomalies constatées lors des élections présidentielles 2018. Dans l'annexe se trouvent des photos sur les conférences de vulgarisation et les actions de propagande de l'auteur. Le livre se termine par sa biographie et ses contributions sur la recherche en HEP. Stephan Narison est Directeur de Recherche Emerite au Laboratoire Univers et Particules du CNRS de Montpellier en physique des Hautes Energies II est spécialisé sur l'approche des régles de somme spéctrale de la chromodynamique quantique (OCD). Il est membre de l'Academie Nationale et Grand Croix de l'Ordre National Malgaches II est Président Fondateur de la Série des Conferences Internationales OCD Montpellier et HEPMAD Antananarivo, de l'institut de recherche IHEPMAD et de l'Associaion Gasy Miara-Mandroso.



22€ in Amazon.com - English version in preparation

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■ HEPMAD 19 : Opening at the Malagasy Academy of Sciences



■ HEPMAD 19: Opening at the Malagasy Academy of Sciences





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Published by : Elsevier : Nuclear Physics Proceedings





- Published by : Elsevier : Nuclear Physics Proceedings
- Deadline: 15th September 2022





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  - 4 pages 15mn short Contribution
  - 6 pages 20 mn Contribution : narrow review
  - 8 pages 25 mn Contribution : wide review





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#### Have

Enjoyed spending virtually and physically a week together!





#### Have

- Enjoyed spending virtually and physically a week together!
- Learned more about QCD, LHC and some other Experiments!





#### Have

- Enjoyed spending virtually and physically a week together!
- Learned more about QCD, LHC and some other Experiments!
- Started some new Project and / or a new Collaboration!

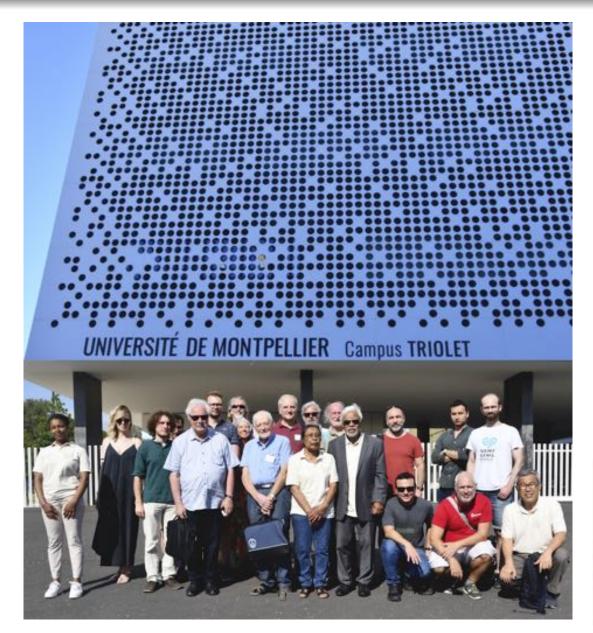




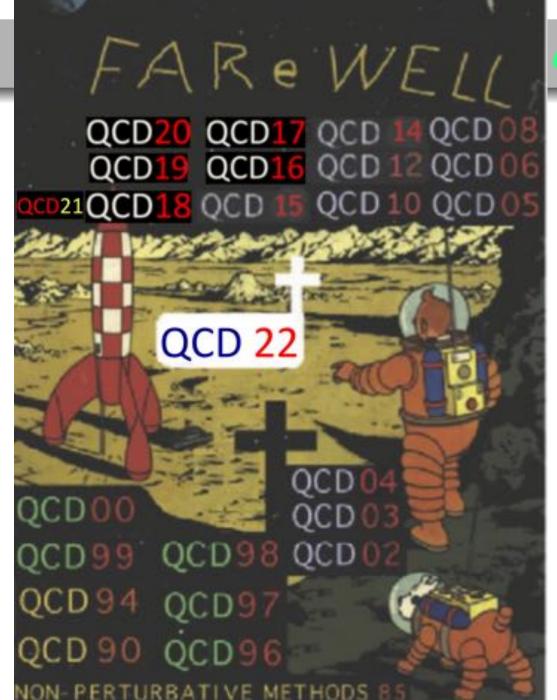
- Have
  - Enjoyed spending virtually and physically a week together!
  - Learned more about QCD, LHC and some other Experiments!
  - Started some new Project and / or a new Collaboration!
- Will come back or/and
   Send some other colleagues in the future!











#### and Good Week-End !





# Misaotra Anareo @ ny Faharetana!

Merci pour Votre Patience!

Thanks for Your Patience!



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