Relazione coordinatore gruppo IV al CL preventivi del 4/7/2016

Enrico Nardi

- Info sul gruppo teorico
- Attivitá delle sigle (contributi)
- Il gruppo teorico nei Laboratori

Le sigle (iniziative specifiche, IS) della CSN4 sono organizzate in 6 linee

IS LNF - 2016

IS LNF - 2017

Linea 1: **Teoria dei Campi e di Stringa**

GSS: Gauge theories, supergravity & string theory ⟷ Chiuso il nodo LNF

FTeCP: Field Theory and Critical Phenomena ⟷ Chiusa la sigla nazionale

Linea 2: **Fenomenologia Particelle Elementari**

PhenoLNF: Phenomenology of Fundamental Interactions

QFT-HEP: QFT for High Energy Physics
Maria Paola Lombardo (BA,NA,LE,CT)

ENP: Exploring New Physics
Gennaro Corcella (RM1, RM2, NA)

Linea 5: **Fisica Astro-Particellare**

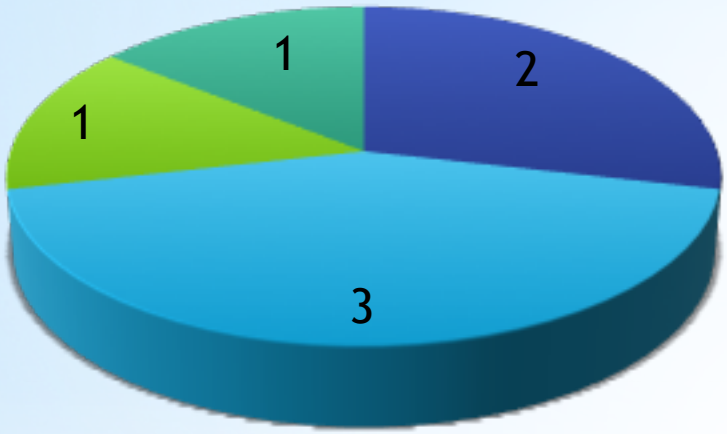
TAsP: Theoretical Astroparticle Physics ⟷ **TAsP: Theoretical Astroparticle Physics**
Enrico Nardi (12 Nodi)

Linea 6: **Fisica Statistica e Teoria di Campo Applicata**

SEMS: Spectroscopies, Electron correlations, Modeling-Simulations and low-dimensional systems ⟷ **NEMESYS: Non Equilibrium dynamics Models and Excited State properties of low-dimensional SYStems**
Stefano Bellucci (g.c. CS, RM2, TIFPA)

Anagrafica (quasi finale)

Ricercatori Dipendenti TI



- ENP (FTE 1+)
- NEMESYS (FTE 2.85)
- QFT-HEP (FTE 1)
- TAsP (FTE 1+)

FTE (preliminary) tot: 5.85

ENP

Exploring New Physics

R.L. Gennaro Corcella

(Ex PHENO-LNF)

Iniziativa Specifica PHENOLNF – Nodi: LNF e Sez. di Napoli

Responsabile Nazionale: G. D'Ambrosio (NA); Responsabile LNF: G. Corcella

Afferenti LNF: G. Corcella (FTE=1), V. Del Duca (FTE=0, ETH Zurigo), G. Pancheri (FTE=0, senior associate)

Nuova Iniziativa Specifica Exploring New Physics (ENP): LNF, Napoli, Roma 1 e 2

Stessi responsabili locale e nazionale di PHENOLNF e membri afferenti di LNF

Assegno di ricerca cofinanziato LNF/RM3 nel 2017-19

Attività di ricerca su vari temi di fenomenologia dei collider:

- Test di precisione del Modello Standard e ricerche di nuova fisica a LHC, in particolare supersimmetria, produzione di bosoni pesanti Z' e Materia Oscura

- Calcoli di precisione per interazioni forti ed elettrodeboli: correzioni di QCD a NNLO all'annichilazione $e^+e^- \to n$ jets $(n \geq 4)$ e alla frammentazione di quark pesanti; correzioni elettrodeboli a due loop alla produzione di Higgs a LHC

- Fisica del top: interpretazione delle misure della massa del top, connessione con la stabilità del vuoto elettrodebole e determinazione incertezze non perturbative

Organizzazione joint workshops LNF/Rome (G.C. e V.D.D.), School of Analytic Computing (V.D.D.), Linear and Future Colliders 2015 (G.C. e G.P.)

Gennaro Corcella: Fisica del top, Z' e supersimmetria a LHC

1. Massa del top: connessione tra osservabili misurate e definizioni teoriche

Misure si basano sull'uso generatori Monte Carlo e ricostruzione di stati finali in $t \to bW$

Massa misurata prossima a 'pole mass', ma incertezze dovute ad assenza nei generatori di correzioni NLO complete, effetti di larghezza e riconnessione di colore

Strategia: simulare mesoni fittizi $T^{\pm,0}$, collegare la massa del mesone a pole mass (reticolo, NRQCD, etc.) e infine alla massa nei programmi Monte Carlo

G.C., PoS TOP2015 (2016) 037, G.C. and M.L.Mangano, in preparation

2. Ricerche di supersimmetria a LHC nei decadimenti della Z' in teorie U(1) e MSSM

Decadimenti supersimmetrici abbassano $\mathrm{BR}(Z' \to \ell^+\ell^-)$ e limiti sulla massa della Z'

Processi $Z' \to \tilde{\ell}\tilde{\ell}^*, \tilde{\nu}\tilde{\nu}^*, \tilde{\chi}_i^+\tilde{\chi}_j^-, \tilde{\chi}_i^0\tilde{\chi}_j^0, \ldots$ danno luogo a stati finali con massa invariante fissata da $m_{Z'}$, diversamente dalla produzione di sparticelle in annichilazione $q\bar{q}$ o gg

Decadimenti $Z' \to \tilde{\chi}_1^0\tilde{\chi}_1^0$ fondamentali per ricerche di Materia Oscura a LHC

G.C., Eur.Phys.J. C75 (2015) 264; PoS PLANCK2015 (2015) 027

Talks: TOP 2015, Planck 2015, Dark Matter 2016, Vienna, Manchester e Torino U.

Vittorio Del Duca

Calcoli di precisione nel Modello Standard e in QCD perturbativa

- completare uno schema per il calcolo di sezioni d'urto al NNLO in α_S in modo indipendente dal particolare processo[a,b]
- sviluppare un nuovo metodo di calcolo di ampiezze di scattering a due loop, e applicarlo alle correzioni di massa del top alla produzione di Higgs + 1 jet[c]
- calcolo dello spazio di funzioni delle ampiezze di scattering in N=4 SYM nel limite di alta energia[d]

a VDD, C. Duhr, A. Kardos, G. Somogyi, Z. Trocsanyi,
Three-jet production in electron-positron collisions using the CoLoRFulNNLO method,
[arXiv:1603.08927 [hep-ph]]

b VDD, C. Duhr, A. Kardos, G. Somogyi, Z. Szor, Z. Trocsanyi, Z. Tulipant,
Jet production in the CoLoRFulNNLO method: event shapes in electron-positron collisions,
[arXiv:1606.03453 [hep-ph]]

c R. Bonciani, VDD, H. Frellesvig, J.M. Henn, F. Moriello, V.A. Smirnov,
Heavy quark mass corrections to the two-loop amplitudes for the production of Higgs + 1 jet, in preparation

d VDD, S. Druc, J. Drummond, C. Duhr, F. Dulat, R. Marzucca, G. Papathanasiou, B. Verbeek,
Multi-Regge kinematics and the moduli space of Riemann spheres with marked points, in preparation

* Attivita' di Lia Pancheri 2015-2016

Pubblicazioni su rivista

1. *Soft edge of hadron scattering and minijet models for the total and inelastic pp cross sections at LHC and beyond*, Phys. Rev. D 91 (2015) 114011
2. *Photoproduction total cross section and shower development*, Phys.Rev. D92 (2015) 114011

Proceedings di conferenze

1. *Total Cross-sections at LHC and Cosmic ray Energies*, Frascati Phys.Ser. 61 (2016) 171
2. *Fine structure of the diffraction cone: from ISR to the LHC*, Gribov Memorial Workshop 2015

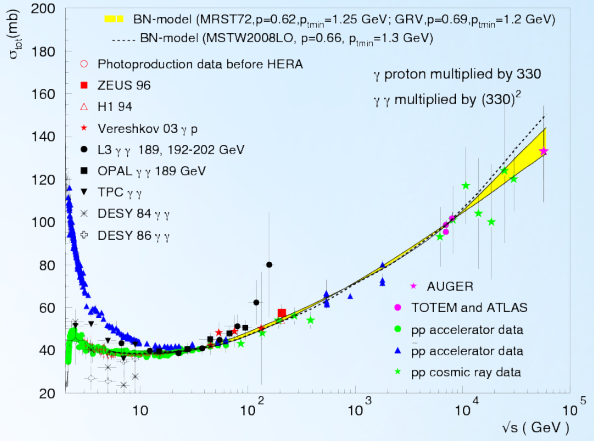
Organizzazione Conferenze e edizione Proceedings

Linear and other Future Colliders after the Discovery of the Higgs (LFC15) , Trento, Italy, September 7-11, 2015

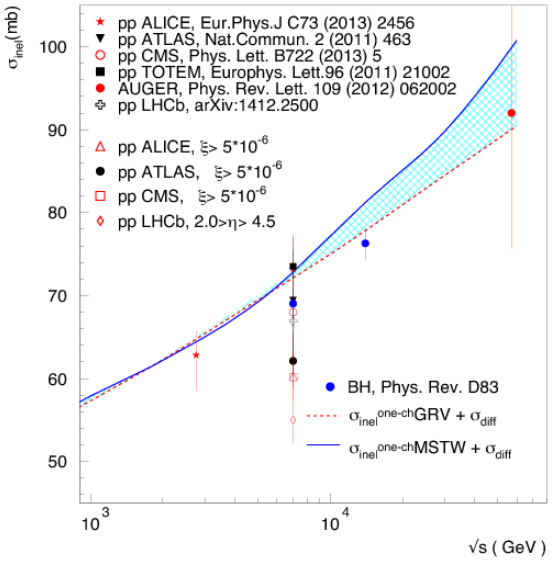
Attivita' divulgativa e storica

1. *Bruno Touschek: From Betatrons to Electron-Positron Colliders, Rev.Accel.Sci.Tech. 08 (2015) 269-290*
2. *Birth of colliding beams in Europe, two photon studies at Adone*, Photon 2015, Novisibirsk

Il modello Frascati-Bloch Nordsieck per la sezione d'urto totale (banda gialla)



E per l'inelastica (banda blu)



* **Giugno 2016: Lavori in corso e quasi completi di Lia Pancheri**

* Con D. Fagundes, A. Grau O. Shekhovstova e Y.N.Srivastava,

The inelastic non-diffractive cross-section at LHC and beyond

* Con F. Cornet, Garcia Canal, A. Grau e e S. Sciuto ,

AIRES MC and the Frascati resummation model for total cross-sections (titolo provvisorio)

* Review per EPJC con Y.N. Srivastava

Introduction to the total cross-section at LHC

* Documentario per i 60 anni di LAL con Enrico Agapito

Soixante d'exploration de la matiere avec les accelerateurs de particules

NEMESYS

Non Equilibrium dynamics Models and Excited State properties of low-dimensional SYStems

R.L. Stefano Bellucci

(Ex SEMS)

NEMESYS-Non Equilibrium dynamics Models and Excited state properties of low-dimensional SYStems- *S. Bellucci (LNF spokesperson) + M. Benfatto, I. Aguzzi, S. Bistarelli, G. Gionti, K. Hatada, A. Maffucci, L.Pierantoni, D. Mencarelli, I. Tabacchioni; Resp. Naz. Unical (gruppo CS, A. Sindona), additional nodes: RM2 (G. Stefanucci), TIFPA (S. Taioli)*

Main research issues

Spectroscopies, Electron correlations, Density Functional Theory, Modeling-Simulations and low-dimensional systems

Richiesta 2017 16,5 KE Missioni

Personnel associated in 2016, as of today, (100% except for Benfatto)

- I. Aguzzi, R. Baldini, S. Bellucci, M. Benfatto (80%), S. Bistarelli, G. Gionti, K. Hatada, A. Maffucci, D. Mencarelli, l. Pierantoni, I. Tabacchioni,

(+ M. Bozzi, A. Cataldo, F. Micciulla, A. Pantano, whose association will be soon proposed)

FTE 10,8 (14,8)

NEMESYS INHERITS earlier project SEMS (closing end 2016)

NEMESYS-Non Equilibrium dynamics Models and Excited state properties of low-dimensional SYStems- *S. Bellucci (LNF spokesperson) A. Sindona (Resp. Naz.), continued*

LNF activities in 2017

A multidisciplinary and convergence research proposal in statistical physics and many body Green´s function theory. Central to its overall theme is an investigation of the striking out-of-equilibrium properties and excited-state features of many fermions and bosons in low-dimensions. These include a wide variety of systems as diverse as:

(i) mutually interacting electrons in a honeycomb lattice potential,
(ii) ensembles of ultra-cold atomic gases,
(iii) magnetic and spin systems,
(iv) quantum wires and dots.

New methods and computational strategies to unravel the fundamental excitations and corresponding relaxation dynamics of novel low dimensional materials, which are also of strategic interest for nanoelectronics and quantum computing technologies.
transport mechanisms and collective phenomena in condensed matter investigated b ab-initio and Montecarlo methods, as well as semicalssical multiscale approaches.
Quantum Field Theory effects induced by geometry and topology, i.e. defects in mesoscopic systems (but also cosmic strings), with boundary conditions. The applications are mesoscopic physics, e.g. nanotubes and graphene properties (but also cosmology, black holes physics).
Massive simulations of spectral features, dielectric screening, conductivity response and electro-mechanical properties of graphene-related and beyond-graphene materials, including interfaces and contacts with supporting substrates. Verification and validation of models by comparison of predictions with measurements taken from surface-science spectroscopies and microscopies, leading to realization of simple devices. Irreversible properties of ultracold Fermi and Bose gases, following a change of their trapping potentials. Quantum thermodynamics of such interacting many-body systems will be studied.

NEMESYS-Non Equilibrium dynamics Models and Excited state properties of low-dimensional SYStems- *S. Bellucci (LNF spokesperson), A. Sindona (Resp. Naz.), continued*

Collaborations in 2017

- University of Lorraine, and Belarus State University, 7th FRAMEWORK PROGRAMME, International Research Staff Exchange "Nano-thin and micro-sized carbons: Toward electromagnetic compatibility application (NAmiceMC)", 2013-2017. S. Bellucci

- GRAPHENE Flagship. Graphene-based disruptive technologies, GrapheneCore1, Project reference: 696656, 2016-2018, S. Bellucci.
Funded under H2020-EU.1.2. - EXCELLENT SCIENCE - Future and Emerging Technologies (FET)

- Grant ASI Italian Space Agency: 2014-2017 "SHAPE- A New Theoretical Framework of the Microgravity-Cell Interaction" , S. Bellucci

Italian Ministry for Health, Research Project "Delivery and imaging of micro RNAs by multifunctional carbon nanotubes and circulating micro RNAs as innovative therapeutic and diagnostic tools for pediatric pulmonary hypertension", 2014-2017, S. Bellucci

Publications 2016

Equilibrium Between Five-and Six-Fold Coordination in the First Hydration Shell of Cu (II)
G Chillemi, E Pace, M D'Abramo, M Benfatto, J. Phys. Chem. A, 2016, 120 (22), pp 3958–3965.

Bottom-up realization and electrical characterization of a graphene-based device
A Maffucci, F Micciulla, A Cataldo, G Miano, S Bellucci, Nanotechnology 27 (9), 095204

SEMS - . Bellucci (nat. spokesperson) + A. Sindona (CS local spokesperson)

Publications 2016 (continued)

Regulation of angiogenesis through the efficient delivery of microRNAs into endothelial cells using polyamine-coated carbon nanotubes, A Masotti, MR Miller, A Celluzzi, L Rose, F Micciulla, ... Nanomedicine: Nanotechnology, Biology and Medicine 12 (6), 1511-1522

Electromagnetic properties of graphene nanoplatelets/epoxy composites
A Plyushch, J Macutkevic, P Kuzhir, J Banys, ..., Composites Science and Technology 128, 75-83

Hadamard function and the vacuum currents in braneworlds with compact dimensions: Two-brane Geometry, S Bellucci, AA Saharian, V Vardanyan, Physical Review D 93 (8), 084011

Finite temperature fermion condensate, charge and current densities in a (2+ 1)-dimensional conical space S Bellucci, ER de Mello, E Bragança, AA Saharian, The European Physical Journal C

Temperature induced modification of the mid-infrared response of single-walled carbon nanotubes MV Shuba, AG Paddubskaya, PP Kuzhir, ..., Journal of Applied Physics 119 (10), 104303

Biological interactions of carbon-based nanomaterials: From coronation to degradation
K Bhattacharya, SP Mukherjee, A Gallud, SC Burkert, S Bistarelli, ...
Nanomedicine: Nanotechnology, Biology and Medicine 12 (2), 333-351

Plasmon Modes in Extrinsic Graphene: Ab initio Simulations vs Semi-classical Models
A Sindona, M Pisarra, D Mencarelli, L Pierantoni, S Bellucci,
Fundamental and Applied Nano-Electromagnetics, 125-144

QFT-HEP

Quantum Field Theory for High Energy Physics

R.L. Maria Paola Lombardo

(Replaces FT&CP)

FT&CP -> QFT-HEP

2017 M.P. Lombardo

Richieste per il 2017:
Si chiede la chiusura della sigla FT & CP e l'apertura della nuova QFT-HEP

In alternativa, per ridurre il numero di sigle, se e' amministrativamente semplice si puo' anche accorpare QFT-HEP@LNF a Dot.Iv oppure a QFT-HEP@Bari.

Title:

Flavor physics, electroweak vacuum stability, phases of strong interactions as possible paths to New Physics

Acronym:

QFT-HEP National Coordinator: Fulvia de Fazio (Bari)

The research topics and the collaborations among the Units in the network are organized as follows:

Bari, Lecce and Napoli Units:

- New Physics scenarios, implications in flavor analyses and in phenomenology at LHC.

Catania and Lecce Units:

- Stability of the EW vacuum studies within extensions of SM, cosmological implications.

Bari, LNF and Lecce Units:

- Phases of the strong interactions using lattice methods associated with holographic approaches, investigations of the conformal window of QCD, implications.

TAsP

Theoretical Astroparticle Physics

R.L. Enrico Nardi

TAsP-LNF Main Research Topics

- Cosmological matter/antimatter asymmetry (Leptogenesis)
- Dark Matter (models & properties – Asymmetric DM)
- Neutrinos (Majorana, Dirac, models for masses and mixings)
- Lepton Flavor, Lepton Flavor Violation in theories BSM
- Spont. Flavor Symmt. Breaking & theories for Yukawa couplings
- Axions (in particular astrophysical/cosmological implications)

A sample of selected publications

- Dark matter from the vector of SO (10)
- Quark Yukawa pattern from spontaneous breaking of flavour $SU(3)^3$
- Minimal Asymmetric Dark Matter
- Leptogenesis in SO(10)
- Non-abelian gauge extensions for B-decay anomalies
- Dark Radiative Inverse Seesaw Mechanism
- The LHC diphoton resonance from gauge symmetry
- Decaying Leptophilic Dark Matter at IceCube
- Are the B decay anomalies related to neutrino oscillations?
- Phenomenologically preferred hadronic axion models *(in preparation)*
- Quasi-Dirac neutrinos at the LHC *(in preparation)*

TAsP Collaborations

U. Barcelona	- Spain	(F. Mescia)
U. Sao Paulo	- Brasil	(Chee Sheng Fong)
U. Roma 3	- Italy	(D. Meloni)
SISSA - Trieste	- Italy	(S. Petkov, M. Spinrath, I. Girardi)
U. Colima	- Mexico	(A. Aranda)
Stony Brook	- USA	(M.C. Gonzalez-Garcia)
U. Wurzburg	- Germany	(W. Winter, W. Porod)
U. Valencia	- Spain	(J.W.F. Valle, M. Hirsch)
U. Southampton	- UK	(S.F. King, P. Di Bari)
U. Antioquia	- Colombia	(D. Restrepo, O. Zapata)
U. Genova	- Italy	(L. Di Luzio)
U. Napoli	- Italy	(G. Ricciardi, F. Buccella)
U. Liège	- Belgium	(D. Aristizabal Sierra)

Eventi LNF (co-)organizzati dal Gr-Th

8 workshops/conferenze/scuole *presso i LNF* nell' anno passato

- INdAM-CMTP-INFN Intensive Period
  "Mathematics and Physics at the Crossroad" *(MP. Lombardo)* (June – September 2016)

- XVIII Frascati Spring School "Bruno Touschek" in nuclear, subnuclear and astroparticle physics, & 4th Young Researcher Workshop *(E. Nardi)* (May 2016)

- ETMC Spring Meeting *(MP. Lombardo)*
(March 2016)

- 3rd RJW: Challenges in the Dark Sector:
  Alternatives to the WIMP paradigm *(G. Corcella, E. Nardi)* (December 2015)

- Nanoscience & Nanotechnology 2015 *(S. Bellucci)* (October 2015)

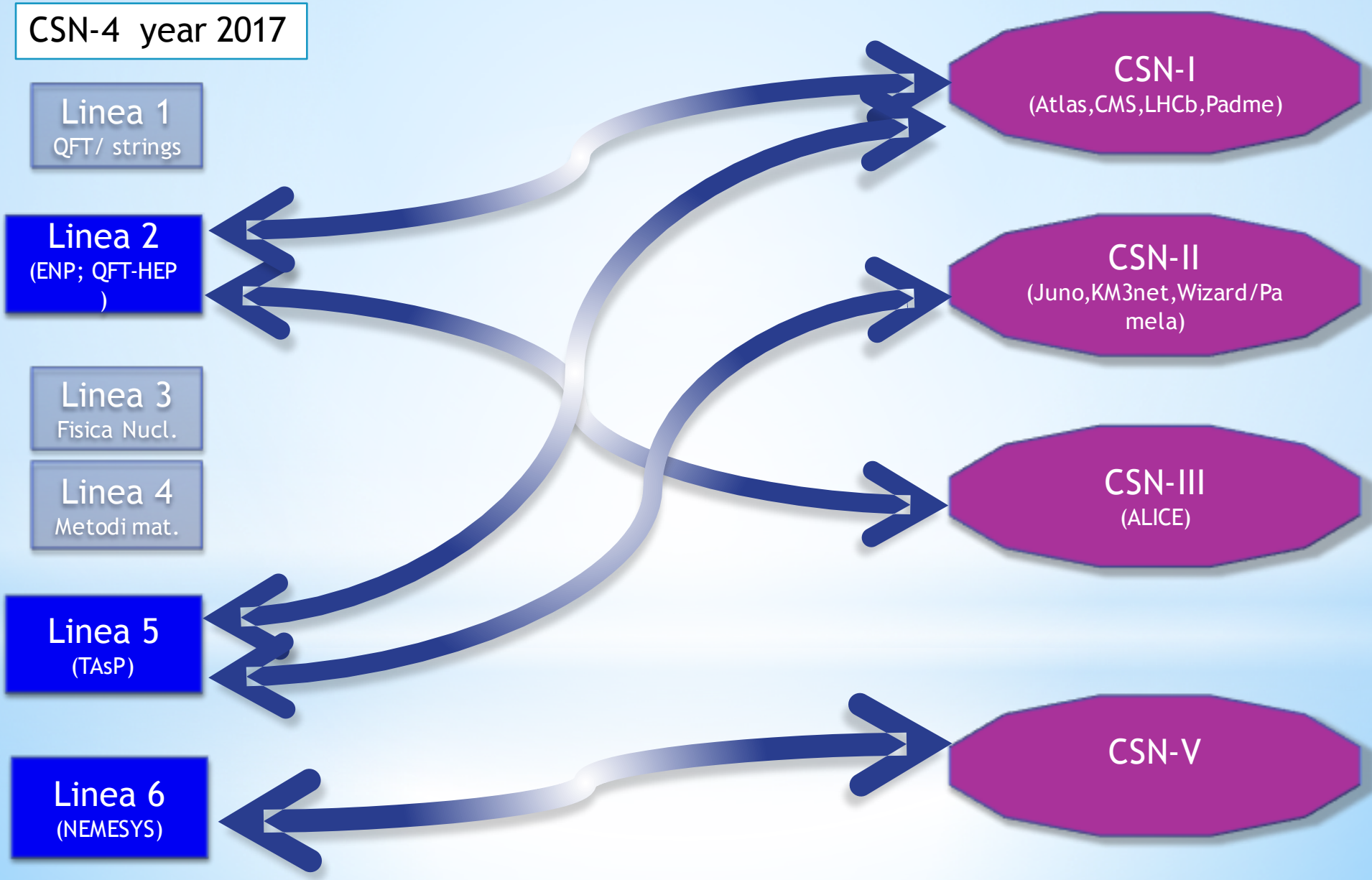
- Light Cone 2015 *(MP. Lombardo)* (September 2015)

- Constructive Renormalization Group
  (A conference in memory of Pierluigi Falco) *(MP. Lombardo)* (June 2015)

- 2nd RJW: Top mass:
  challenges in definition and determination *(G. Corcella, E. Nardi)* (May 2015)

Relazioni fra il TH-GR e gruppi LNF di altre CSN

CSN-4 year 2017



Richieste supporto (generiche)

- Servizi di segreteria
- SIDS (FotoAudioVideo)
- Eventualmente supporto di Direzione per organizzazione di Workshops tematici (qualche Keu)

GRAZIE PER L'ATTENZIONE