
SIBLES.EU

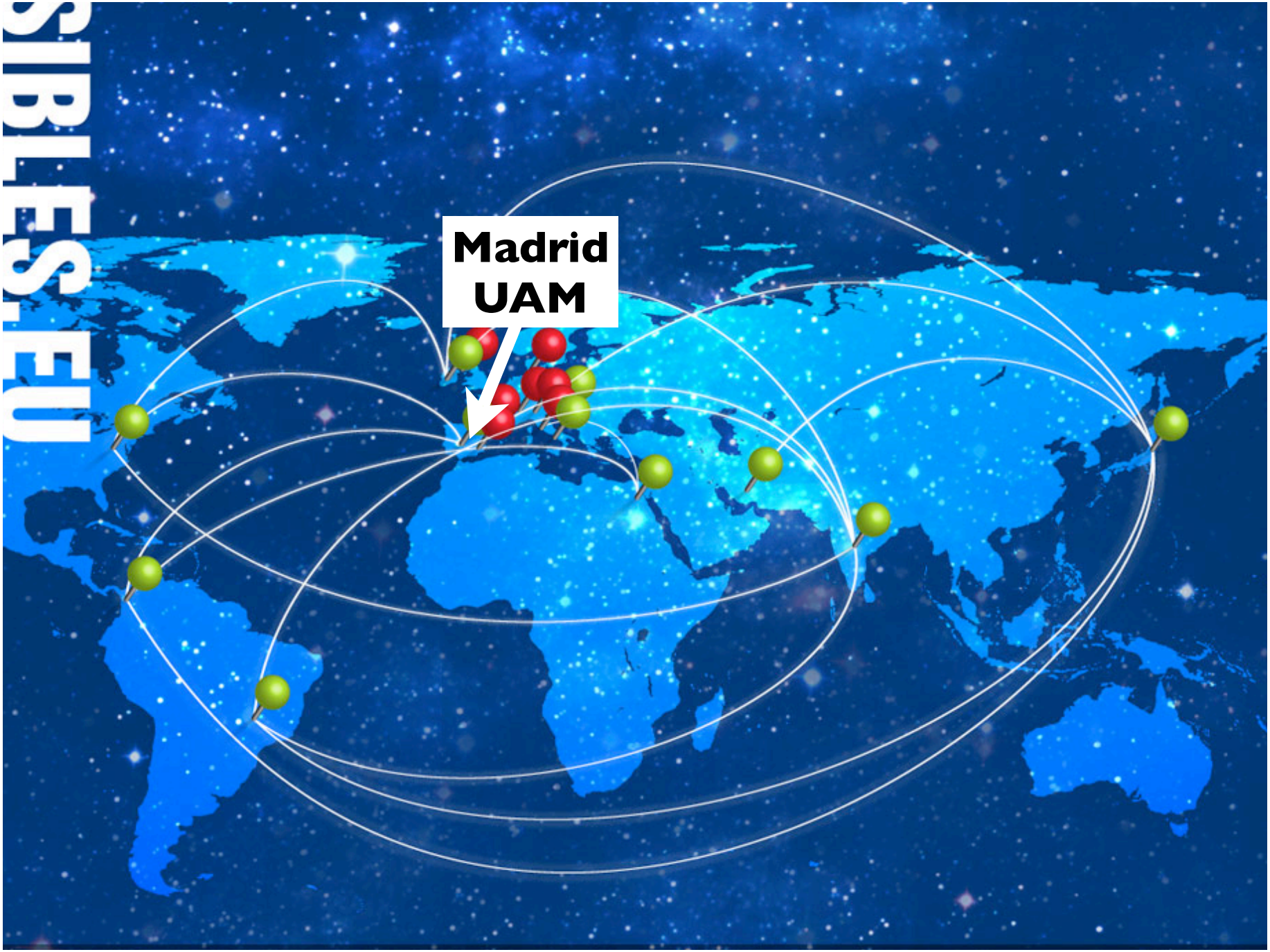
INVISIBLES

Universidad Autónoma

Madrid

INVISIBLES-Madrid:

a bunch of physicists.... who want to do physics !


SIBLES EU
Madrid
UAM

The background: very large group ~130 170

In spite of its name the "Department of Theoretical Physics" (and IFT) includes:

-- **Particle theory**: Gravitation -> Strings -> BSM -> DM -> neutrino physics -> SM -> LHC phenom.

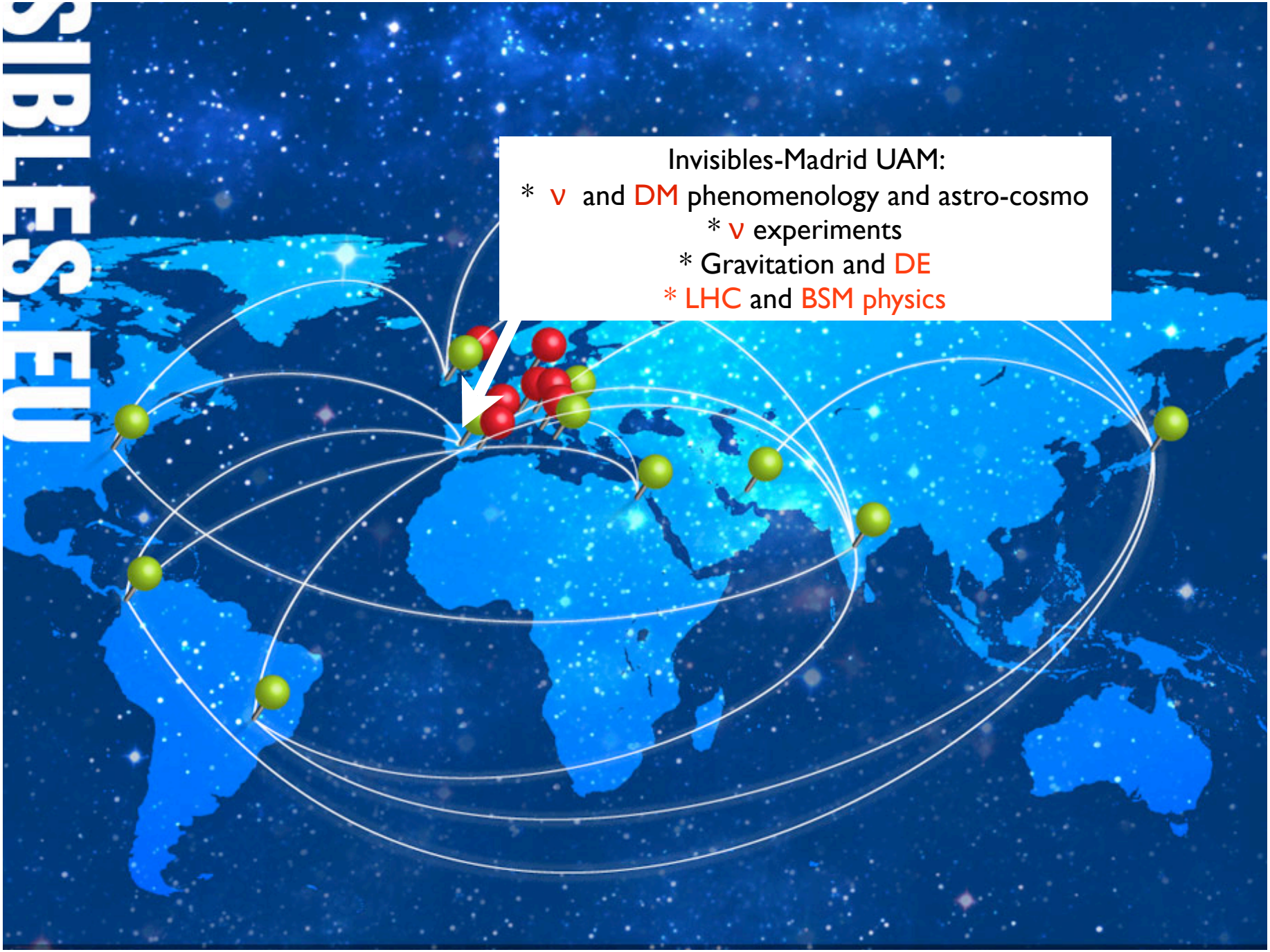
-- **Particle physics experiments**: ATLAS, CMS, SuperKamiokande, NEXT

-- **Theoretical Nuclear Physics**

-- **Theoretical Astrophysics and Cosmology (computational and inflationary)**

-- **Observational Astrophysics (Galactic, Planets)**

-- **Neuroscience, Quantum computing**...


SIBLES.EU
Invisibles-Madrid UAM:
* ν and DM phenomenology and astro-cosmo
* ν experiments
* Gravitation and DE
* LHC and BSM physics

Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

Michele Maltoni

- A key feature of our research activity is its deep connection with the experimental results, which are coming right now.
- Two complementary directions: neutrino phenomenology and neutrino astrophysics.

Neutrino phenomenology

- Aims at providing theoretical support for the upcoming generation of ν experiments;
- goals:
  - reconstruct the neutrino mass matrix in the standard scenario;
  - search for New Physics beyond three-neutrino oscillations;
- solid and well-tested, and lots to do

Neutrino astrophysics

- Aims at fully exploiting the potentialities of forthcoming neutrino telescopes;
- approach:
  - understand the detectors; recognize key features for each task;
  - study the potentialities of atmospheric neutrinos (guaranteed signal);
  - learn about ν properties using astro-ν
    - from diffuse fluxes;
    - from point sources;
  - use collected data to learn about the sources;
- new research line, but with many links to well-known activity.

Enrique Fernandez-Martinez

Research Interests

- Neutrino phenomenology
  - Measurement of unknown neutrino parameters
  - Phenomenology of models of neutrino masses
  - New physics in neutrino interactions
- Dark Energy
  - Extracting info on the DE eos from SN and BAO
- Dark Matter
  - "Alternative" (non WIMPy) models of DM (ADM, ν...)
  - DM probes (collider, direct, indirect and new!)

Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

* **ν theory, lepton flavour viol. and BSM**:
AdR, EFM, B. Gavela, M.J. Herrero

Maria José Herrero

**********+
-->Main motivations in research:
I am interested in:
** Understanding the origen of mass and Exploring the Higgs sector within and beyond the Standard Model
** Understanding the origen of the flavor structure of quarks and leptons within and beyond the Standard Model
** Exploring the phenomenological consequences of flavor in present and future experiments.
** Understanding the connection, if any, between flavor oscillations in neutrino physics and Lepton Flavor Violation.
** Exploring the sensitivity to new physics beyond the Standard Model via Flavor Physics.Exploring both Flavor mixing in the quark sector (B-physics, D-physics, K-physics, top quark physics, etc) and in the Lepton sector (Lepton Flavor Violating processes, like mu-> egamma, mu-> 3e, tau->mu gamma, tau->3mu, mu-e conversion in Nuclei, etc)
** Exploring the sensitivity to new physics beyond the Standard Model via Higgs Physics. In particular: sensitivity to neutrino physics via Higgs mediated processes and/or Higgs observables and vice-bersa.
--> Present and Future Work
At present I am working on the various subjects above, with more emphasis on models beyond SM that are based on
SUSY. On one hand I am exploring the constraints to new physics from the present data on rare B-decays and B-Bbar mixing. On the other hand I am studying some implications of the heavy Majorana neutrinos on Higgs physics and on Lepton Flavor Violation within a context of SUSY-seesaw models. In the future I will continue exploring these SUSY models but also plan to treat the flavor issues with the use of a more general effective lagrangian approach, that could be used to analize other Non-SUSY models. In particular I would like to explore the connection between neutrino oscillations and Lepton Flavor Violation using a model independent approach, i.e, by means of effective lagrangian tools, etc.

Understanding the origen of the flavor structure of quarks and leptons within and beyond the Standard Model

** Exploring the phenomenological consequences of flavor in present and future experiments.

** Understanding the connection, if any, between flavor oscillations in neutrino physics and Lepton Flavor Violation.

** Exploring the sensitivity to new physics beyond the Standard Model via Flavor Physics.Exploring both Flavor mixing in the quark sector (B-physics, D-physics, K-physics, top quark physics, etc) and in the Lepton sector (Lepton Flavor Violating processes, like mu-> egamma, mu-> 3e, tau->mu gamma, tau->3mu, mu-e conversion in Nuclei, etc)

** Exploring the sensitivity to new physics beyond the Standard Model via Higgs Physics. In particular: sensitivity to neutrino physics via Higgs mediated processes and/or Higgs observables and vice-bersa.

--> Present and Future Work

At present I am working on the various subjects above, with more emphasis on models beyond SM that are based on

SUSY. On one hand I am exploring the constraints to new physics from the present data on rare B-decays and B-Bbar mixing. On the other hand I am studying some implications of the heavy Majorana neutrinos on Higgs physics and on Lepton Flavor Violation within a context of SUSY-seesaw models. In the future I will continue exploring these SUSY models but also plan to treat the flavor issues with the use of a more general effective lagrangian approach, that could be used to analize other Non-SUSY models. In particular I would like to explore the connection between neutrino oscillations and Lepton Flavor Violation using a model independent approach, i.e, by means of effective lagrangian tools, etc.

Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

* **ν theory, lepton flavour viol. and BSM**:
AdR, EFM, B. Gavela, M.J. Herrero

* **ν experiments**: SuperKamiokande, NEXT
L. Labarga

Luis Labarga

We are most interested in ***a)*** proton-decay physics, ***b)*** the nature of the *neutrino* and its interactions, particularly CP violation in the leptonic sector, ***c)*** Dark Matter searches via *neutrinos*.

FOR THAT:

1. The UAM is member of the Super-Kamiokande experiment. Among other works it is fully involved in its R&D program on neutron tagging which will hopefully convert water Cerenkov detectors in the best devices for measuring relic or nearby Core Collapse Supernova *neutrinos* and Nuclear Reactor *neutrinos* and, in general, for matter-flavor tagging of the detected *neutrino*. In this meeting, it is worth mentioning its radio-purity campaign being carried out in the *"Canfranc Underground Laboratory"* (LSC).

2. In a fully synergic activity, the UAM is member of the NEXT experiment at LSC to study the Majorana nature of the *neutrino*; its main responsibility is its corresponding radio-purity program.

3. The UAM is pursuing a next generation *neutrino* and proton-decay experiment. It has contributed very much to LAGUNA; it has lead a thorough Feasibility Study for the LSC to host such experiment.

Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

* **ν theory, lepton flavour viol. and BSM**:
AdR, EFM, B. Gavela, M.J. Herrero

* **ν experiments**: SuperKamiokande, NEXT
L. Labarga

* **Nuclear matrix elements for 00ν-betadecay**:
A. Poves

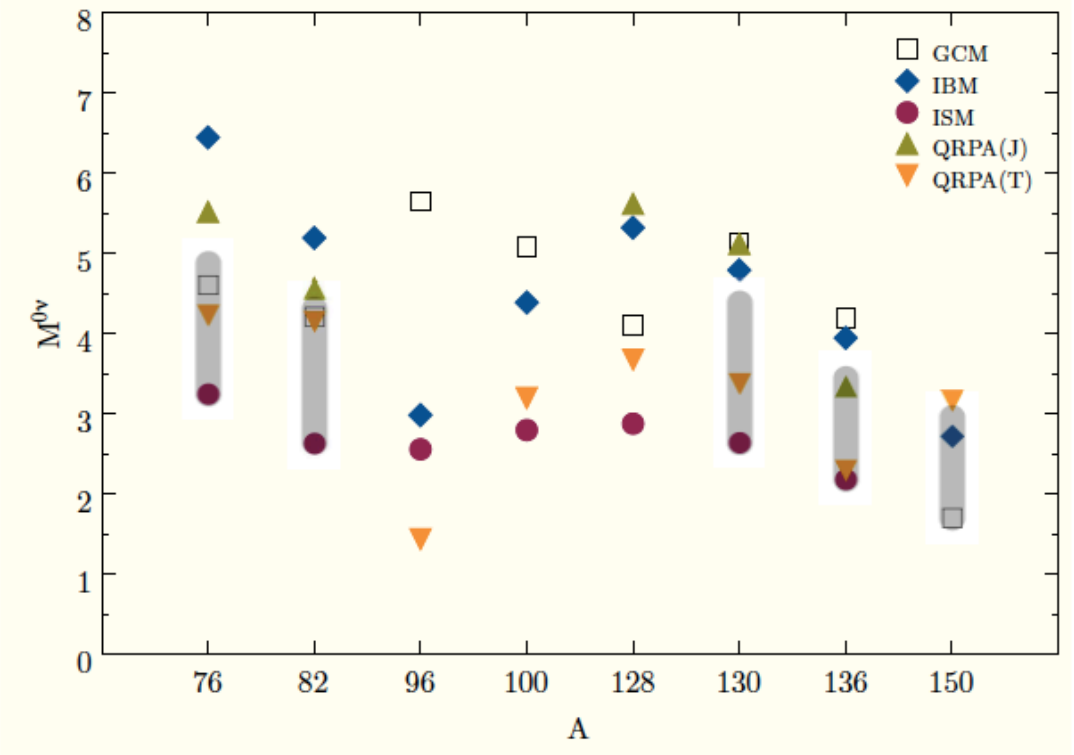
Alfredo Poves

The goal of this line of research is to improve the reliability of the nuclear matrix elements for the neutrinoless double beta decay in the framework of the Interacting Shell Model. For that we need to benchmark our nuclear wave functions with other observables, among them:

- The half-lives of the two neutrinos mode
- The Gamow-Teller strength functions of the participant nuclei as measured in charge exchange reactions
- The occupation numbers of the relevant orbits around the Fermi surface, which are obtained in stripping and pick-up reactions
- The pair transfer amplitudes, in particular for J=0^+ pairs which explore the degree of superfluidity of the nucleus

In view of the plans to measure the decay of ^{150}Nd at SNO, it is crucial to explore the influence in the NME of the difference in deformation between the initial and final nucleus, because ^{150}Sm is much more deformed than ^{150}Nd

The ultimate goal is to be able to reduce the present uncertainties and the dispersion of the NME's calculated with different methods agreeing a protocol of quality marks related to the previous list of observables. The present status of the NME's is shown in the graph below. The shadowed areas give an idea of the present uncertainties.



Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

* **ν theory, lepton flavour viol. and BSM**:
AdR, EFM, B. Gavela, M.J. Herrero

* **ν experiments**: SuperKamiokande, NEXT
L. Labarga

* **Nuclear matrix elements for 00ν-betadecay**:
A. Poves

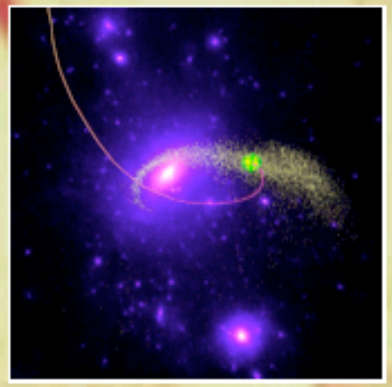
* DM **physics...** DE **phen.**:
A. Knebe, E. Majerotto.... EFM, B. Gavela

*

Alexander Knebe

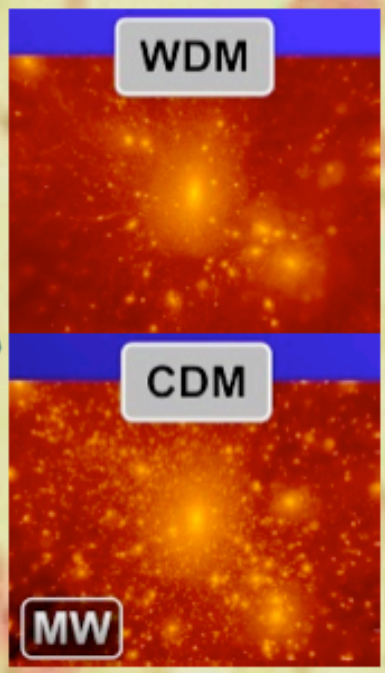
Alexander Knebe (RyC Investigator)

Near-Field Cosmology



Alternative Cosmologies

- Warm Dark Matter (right)
- Vector Dark Energy
- Coupled Dark Matter-Dark Energy
- Modified Newtonian Dynamics



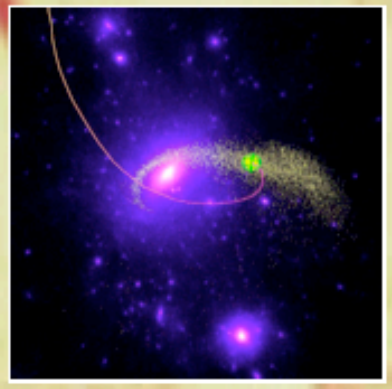
High-Performance Computing

- galaxy finder for simulations (left)
- parallel algorithms
- code verification projects

Alexander Knebe

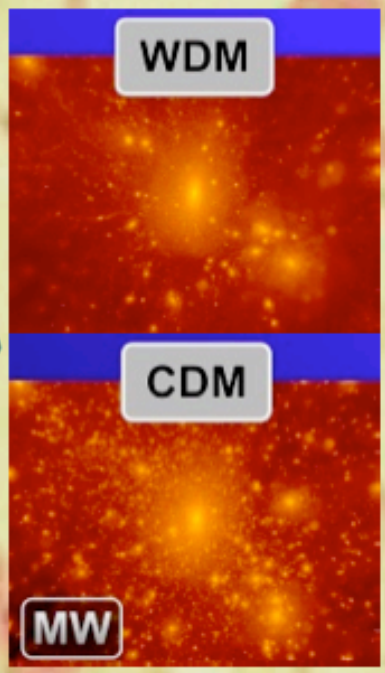
Alexander Knebe (RyC Investigator)

Near-Field Cosmology



Alternative Cosmologies

- Warm Dark Matter (right)
- Vector Dark Energy
- Coupled Dark Matter-Dark Energy
- Modified Newtonian Dynamics



High-Performance Computing

- galaxy finder for simulations (left)
- parallel algorithms
- code verification projects

Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

* **ν theory, lepton flavour viol. and BSM**:
AdR, EFM, B. Gavela, M.J. Herrero

* **ν experiments**: SuperKamiokande, NEXT
L. Labarga

* **Nuclear matrix elements for 00ν-betadecay**:
A. Poves

* DM **physics...** DE **phen.**:
A. Knebe, E. Majerotto.... EFM, B. Gavela

* **Gravitation and** DE, **cosmology**
Enrique Alvarez

Enrique Alvarez

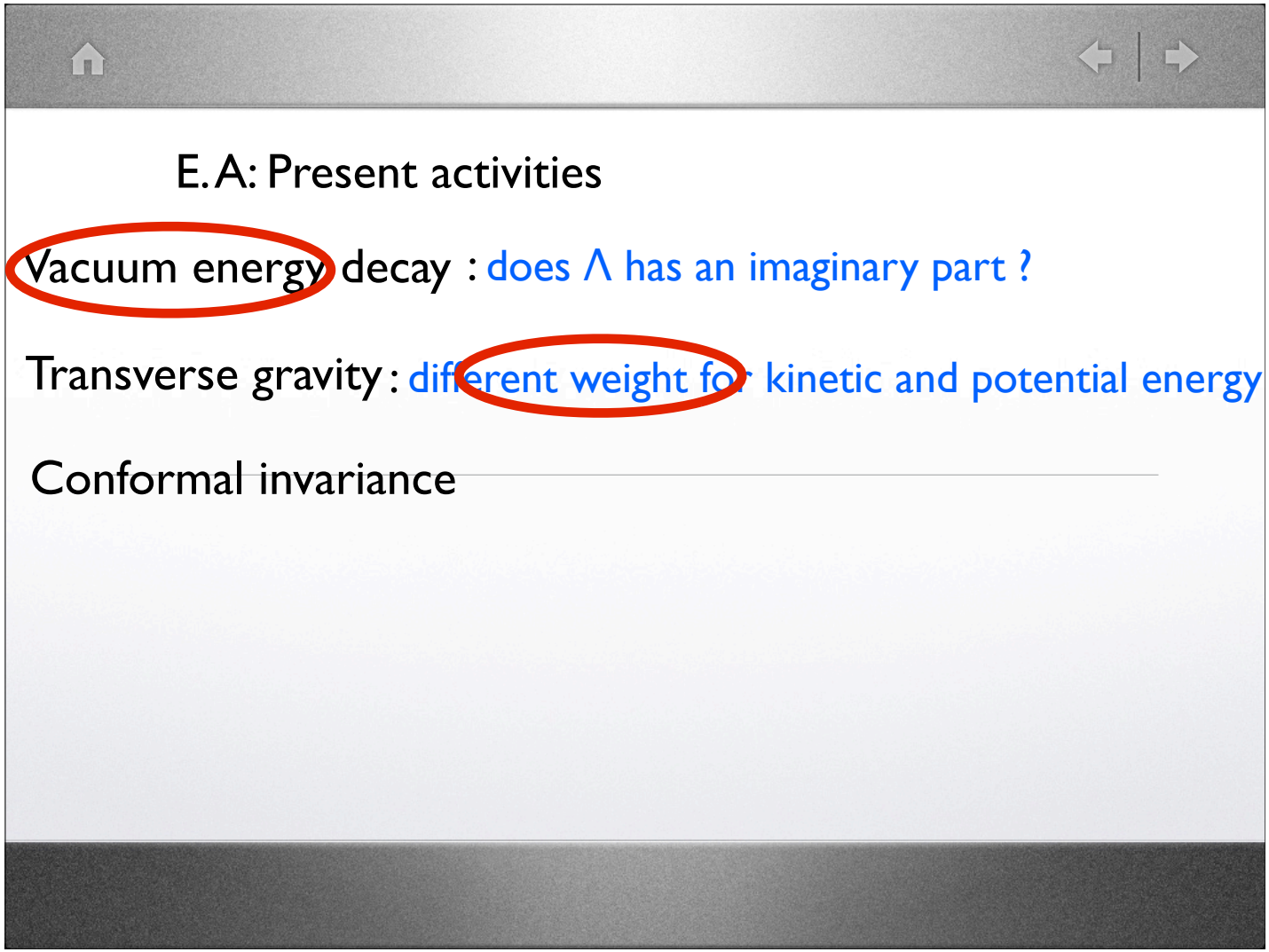
E. A: Present activities

Vacuum energy decay : does Λ has an imaginary part ?

Transverse gravity : different weight for kinetic and potential energy

Conformal invariance

Enrique Alvarez



Invisibles-Madrid

* **ν oscillation phenomenology**:
M. Maltoni --> E. Fdez-Martinez --> A. de Rujula-->B. Gavela
closer to expt.----------> closer to theory

* **ν theory, lepton flavour viol. and BSM**:
AdR, EFM, B. Gavela, M.J. Herrero

* **ν experiments**: SuperKamiokande, NEXT
L. Labarga

* **Nuclear matrix elements for 00ν-betadecay**:
A. Poves

* DM **physics...** DE **phen.**:
A. Knebe, E. Majerotto.... EFM, B. Gavela

* **Gravitation and** DE, **cosmology**
Enrique Alvarez

* **LHC phenomenology**:
Alvaro de Rujula

Alvaro de Rujula

Recent Interests of Alvaro De Rújula

The extraction of the spin, parity and coupling properties of a Higgs-Boson candidate particle in the "golden" channel: H to ZZ to leptons [1]

The alleged violation of QED in muonic Hydrogen [2]

Phase-space techniques to optimize the measurement of the mass of a W in a hadronic collider [3]

Phase-space techniques to maximize the information on a Higgs-Boson candidate in the "workhorse" channel: H to WW to leptons [4]

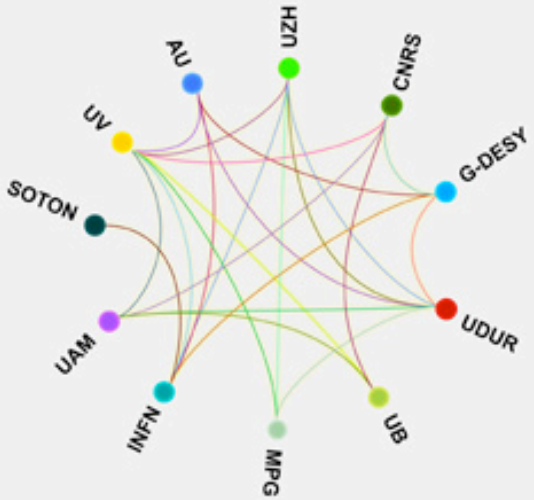
Current Interests, a continuation of [1,3,4]

The construction of a "Sieve": an optimized multi-dimensional filter of signal vs backgrounds for a Higgs-Boson candidate in the channel WW to leptons

The development of similar sieves to the search for dark-matter candidates at the hadron colliders

inVisibles

neutrinos, dark matter & dark energy physics



FULL PARTNERS

- Universidad Autonoma de Madrid
- University of Durham
- Aarhus Universitet
- CNRS
- Max Planck Gesellschaft
- University of Goettingen-DESY
- INFN
- Universidad de Barcelona
- Universidad de Valencia
- University of Zurich
- University of Southampton

ASSOCIATED PARTNERS

- University of Tokyo
- CERN
- Columbia University
- Fermi National Laboratory
- Harvad University
- Universidade de Sao Paulo
- Universidad Antonio Nariño
- British University in Egypt
- University of Delhi
- Harish Chandra Research Institute
- Inst. for Research in Fundamental Science
- Hamamatsu Photonics
- GMV Aerospace and Defense
- Kromek
- Medialab
- Narcea Prod. Multimedia 2MDC

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

* Desiring new collaborations across the whole network