NewCompStar: exploring fundamental physics with compact stars

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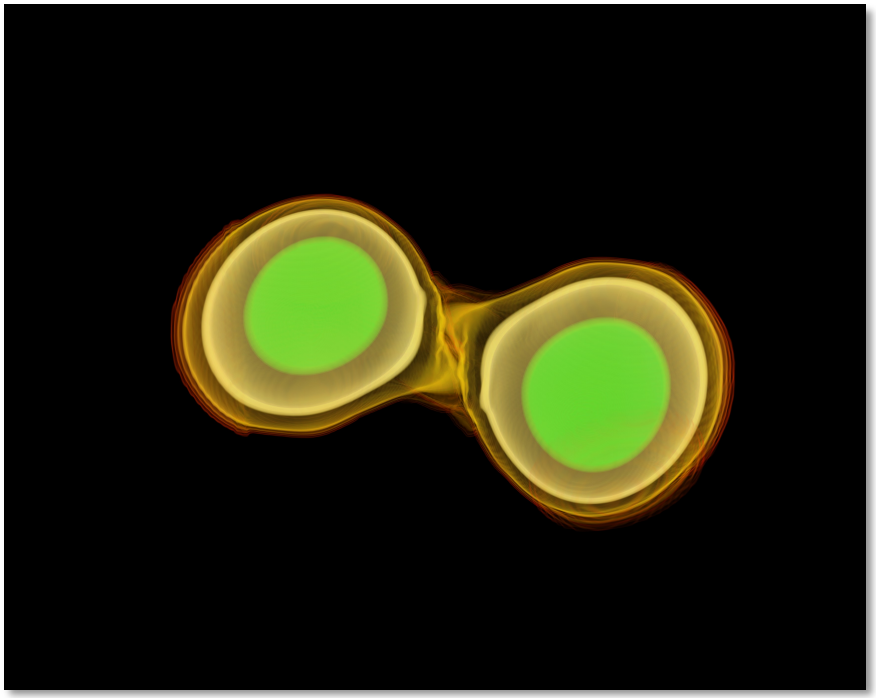
Objective: *provide an innovative connection between the micro- and macrophysics of compact stars; explore the behavior of matter and spacetime under the most extreme physical conditions, not accessible to laboratory experiments*



WG1 Observations and modelling of compact stars.
WG2 Physics of strong interaction, theory and experiment.
WG3 gravitational-physics theory and observations.

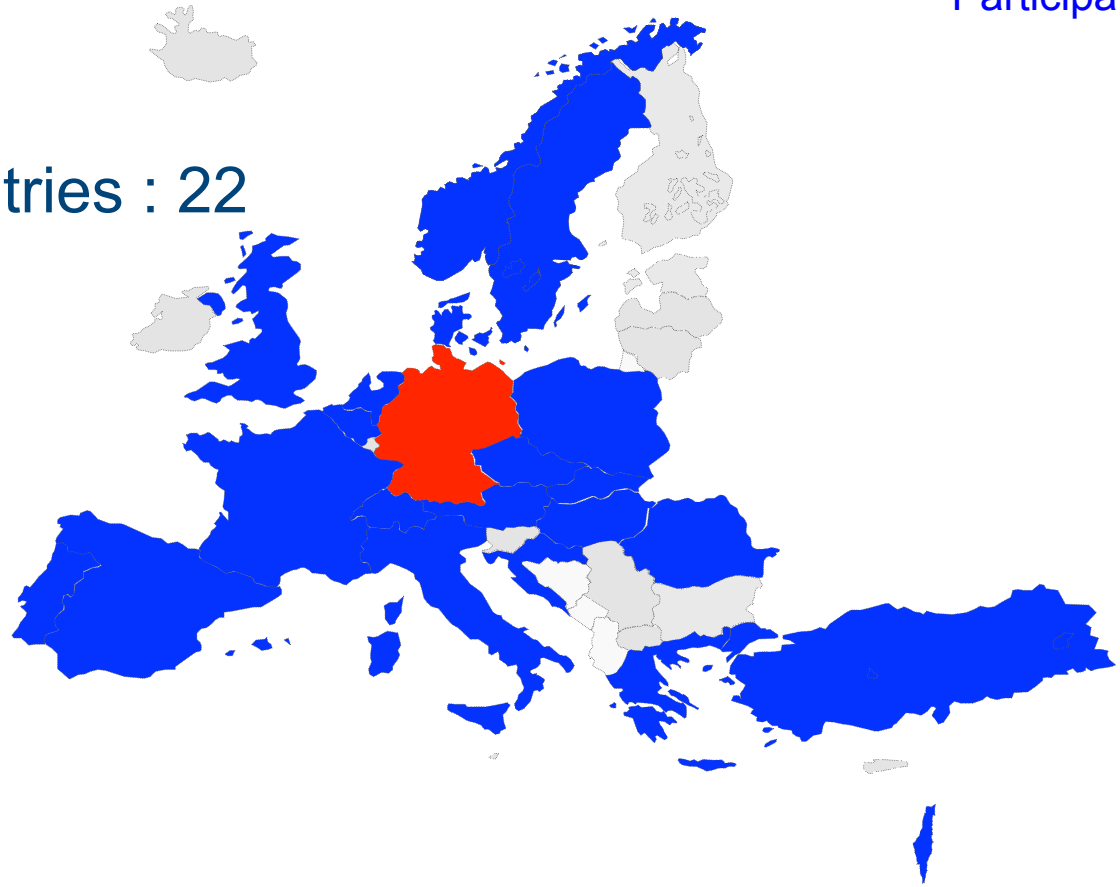
Proposer : red

Participants: blue

Associated Countries : 22

Proposer : DE

AT, BE, CH, CZ, DK, EL, ES, FR, HR, HU, IL, IT, NL, NO, PL, PT, RO,SK, SE, TR, UK

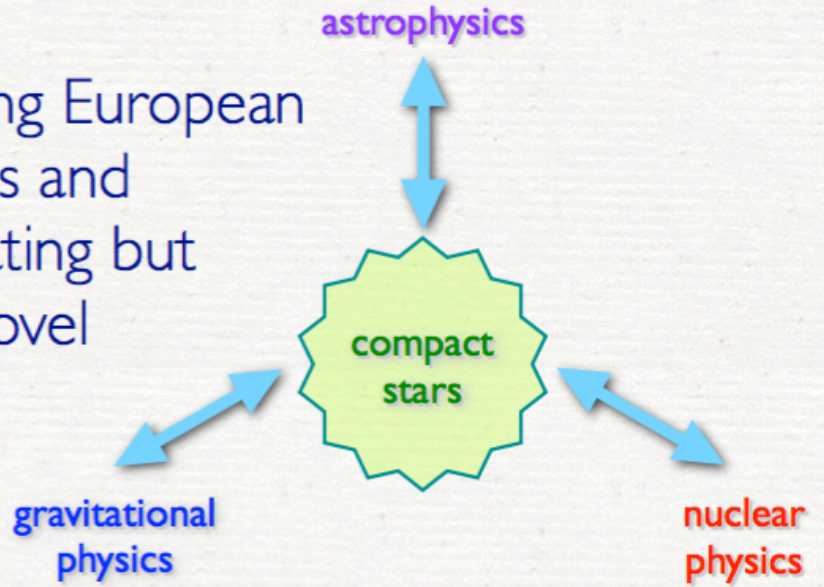


*NON-COST : AR, AU, RU

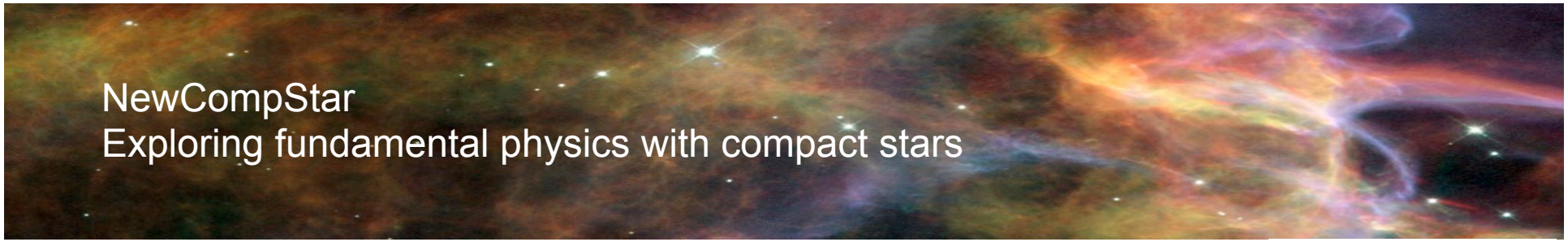
*included within the full proposal

Driven by science to exploit synergies

- This Action is driven to research fundamental physics, although technological and industrial fallbacks are expected (more later).
- This Action will address a few fundamental but challenging questions concerning the physics and astrophysics of compact stars.
- This Action will bring together leading European experts in astrophysics, nuclear physics and gravitational physics to tackle a fascinating but challenging research area through a novel interdisciplinary approach.



- This Action will provide important value to the large-scale European efforts in observational astrophysics and experimental nuclear physics.



Working Group 2: physics of the strong interaction, theory and experiment

WG coordinators: Jérôme Margueron (IPN Lyon)

Topic coordinators:

- *Nuclear equation of state for compact stars and supernovae*
  Isaac Vidaña (Univ. of Coimbra),
- *Low energy QCD and super-dense matter*
  Gergely Barnafoldi (TL, WRCP Budapest),
- *Superconductivity and superfluidity in compact stars*
  Nicolas Chamel (TL, IAA Bruxelles),
- *Transport phenomenon and reaction rates for compact stars and supernovae*
  Laura Tolos (TL, ICE Barcelona).

Synergy agents:

- *Nuclear-Gravity*: Micaela Oertel (LUTh Meudon)
- *Nuclear-astrophysics*: Pawel Haensel (CAMK, Warsaw)

NewCompStar
Exploring fundamental physics with compact stars

Several meetings per year

Internal meetings between WG1+2+3+CompOSE

External meetings: associated to workshops and conferences.

NewCompStar WG2 meeting, November 18th, 2014, IPN Lyon

Memorandum of Understanding of the COST Action MP1304

1. Validate available equation of state across different experiments and observations. The WG will define a protocol where the equation of state, and the underlying interactions, are consistently checked and compared with nuclear experiments and observations of compact stars.

2. Investigate the predictions for the phase diagram of hot and dense matter, clarifying the role of phase transitions and exotic degrees of freedom predicted by nuclear physics and low-energy QCD.

3. Investigate superfluidity and superconductivity in dense matter. The WG will employ the numerous observations to understand the occurrence of superfluidity and superconductivity in various regions of compact stars and predict signatures revealing their presence in compact stars.

4. Calculate the transport properties and the reaction rates for validated equations of state. The WG will supply the simulations modelling core-collapse supernovae and binary neutron-star mergers with the transport properties and reaction rates of hot and dense nuclear matter.

The main methods and means used within this WG will be:

• Density functional theory

• Mean -field theory and its extensions to collective behaviour and to pairing properties

• Ab-initio approaches including Green-function, Brueckner, Fermi Hyper-Netted Chain, and MonteCarlo methods

• Renormalization group techniques and effective field theory

• Band-theory approaches

• Statistical modelling for dilute nuclear matter

• Thermodynamical approaches to phase transitions

Close collaboration with WG1 and WG3

http://compstar.uni-frankfurt.de/wp-content/uploads/2014/02/MP1304-e.pdf

Take home messages

- Have an excellent scientific discussion within this NewCompStar session

- Do not hesitate to participate to other internal and external NewCompStar meetings

  → Find the list of meetings on the web site: compstar.uni-frankfurt.de

- A white-book on the activities of NewCompStar will be written in 2017. Please contact us if you wish to participate.