

CA18108: Quantum gravity phenomenology in the multi-messenger approach (QG-MM)

- **Challenge:**

Investigate **possible signatures** predicted by **quantum gravity models** in the **observation of different cosmic messengers**, by creating the conditions for a **close collaboration** between **theorists** and the **various experimental communities** involved in the detection of such cosmic messengers

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- **Secondary objectives (research coordination):**
 1. To publish an **updated state-of-the-art** of the research on QG phenomenology (scenarios and expected signatures from theory, reported constraints and inherent limitations of experimental data for each cosmic messenger)
 2. To clarify **apparent contradictions** in different analyses of experimental data, by comparing methods of analysis and theoretical hypotheses
 3. To systematically **derive constraints and combine them** into a consistent picture (e.g., comparison between LIV and DSR scenarios)
 4. To study & resolve open theoretical issues associated with the prediction of **modified dispersion relations** (generality, universality...)

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- **Secondary objectives (research coordination):**
 5. To investigate the possible role of quantum gravity effects on **possible anomalies** in the production and propagation of the cosmic messengers
 6. To develop and **optimize strategies** for studies of QG effects, both separately and in combination within a real **multi-messenger astronomy**
 7. To investigate how genuine QG effects could be disentangled from the **intrinsic physical properties of the sources** (considering also our limited knowledge about their physical properties)
 8. To convert the efforts of separated research groups in a **common, well-defined, research strategy**

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- **Secondary objectives (capacity building):**

9. To promote the **interaction and knowledge exchange** between the different (experimental and theoretical) communities participating in the COST Action
10. To **join the experimental communities** working with different cosmic messengers in order to promote combined analyses and a **multi-messenger approach** to the phenomenology of QG
11. To foster the future development of this field by **training a generation of young scientists** in the necessary combined experimental and theoretical expertise
12. To support and provide opportunities for recognition and visibility to **ECIs**, researchers from **ITCs** and from the underrepresented **gender** in the field
13. To **disseminate the results** to the general public, school pupils, university students, as well as to scientists from other disciplines

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- **Deliverables (can be modified):**

1. Publicly available **web page** with **results of existing searches** for quantum gravity signatures for each cosmic messenger (month 12)
2. Development of **web page**, **social networks** (Twitter, Telegram), and a **YouTube channel** (month 24)
3. Development of **optimal strategies and methods of analysis** for performing new quantum gravity studies for each cosmic messenger (month 36)
4. Publication of **at least 8 papers per year** in major, high impact, international journals (month 48)
5. A comprehensive **wrap-up report of the progress and insights** of each year (month 48)
6. Development of **multi-messenger search strategies** based on the phenomenological models developed by the theory WGs (month 48)

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- **1st Grant Period Goals:**

1. **First draft** of a comprehensive **review** on theoretical predictions of possible observations, and of current experimental constraints for each cosmic messenger (**secondary objectives 1 and 4**)
2. A **comparison** of different methods of analyses and the theoretical hypotheses behind them, collect **possible sources** for data analysis and consider the **future prospects** of experiments (**challenge; secondary objectives 2 and 10**)
3. Development of **web page**, a **logo** and **social networks** (Twitter, Telegram) (**secondary objectives 12 and 13**)
4. To identify and gather a **pool of experts** from which input is required in multi-messenger phenomenology, such as the astrophysics of possible multi-messenger sources and atmospheric physics (**secondary objective 8**)

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- **1st Grant Period Goals:**

5. **First version** of a **publicly available database** with results of existing searches for quantum gravity signatures for each cosmic messenger (**secondary objectives 1 and 3**)
6. To reach out to the local general public by giving **public lectures** to the laymen at the foreseen meeting venues (**secondary objectives 12 and 13**)
7. To develop **specific activities and strategies** to enhance the involvement of researchers in their early career and/or from an underrepresented country or gender (**secondary objective 13**)