Dynamical complexity in astrophysical contexts

February 6-10 2023, IFPU, Trieste

An interdisciplary workshop - setting the stage

Genesis

- Recognition that several astrophysica contexts share properties of complex dynamical systems: non-linearity, feedback, scale invariance and power-law distribution functions and correlations, stochastic behaviour, etc.
  - ➡accretion disks and winds around black holes
  - ➡chaotic cold accretion on galactic nuclei
  - ➡the formation of bright central galaxies in galaxy clusters
  - ➡star-formation and black hole accretion histories
  - ➡etc..
- Preparation of a first paper on dynamical complexity in accretion disks and winds systems around black holes, which prompted a series of discussions with Stefano Ruffo and Lucilla De Arcangelis during the past year.
- The idea that not only astrophysical problems can benefit of a new approach based on statistical methods developed for complex dynamical systems, but that they can be used as test-bed for the research in this field.

The difficulty and prospects of interdisciplinary research

Cons:

- different communities speak different languages
- it is hard and time consuming to enter in a new field, read a lot of papers and books, but not sure if all relevant and up-to-date
- seen and treated by outliers by both communities (no one's son syndrome): difficulty in publishing, finding funds, finding students and post-docs

Pros:

- field cross-fertilization
- potential breakthrough
- fun!

This experiment

- Looking at problems from the perspective of complex dynamical systems turned out to be an extremely useful approach in condensed matter, evolutionary biology, neurology, geology, social sciences and many fields
- limited use so far in astrophysics, despite galaxies, stars, planetary atmospheres are definitely complex systems, showing usually stochastic behaviour, feedback, power-law scaling laws
- start from one of the few applications in astrophysics: solar flares and coronal mass ejections
- to expand to accretion disks, galaxy formation and evolution, etc.

This experiment

- present promising astrophysical contexts
- present introductions/reviews on statistical physics
- present past applications

- discuss new applications: how to better understand an astrophysical system using the tools of statistical physics. Which system? Which tool?
- discuss new insigth in statistical physics : how to improve the tools and gain insight of statistical physics using astrophysical examples

This experiment

- record and share presentations
- start new exercises
- prompt collaborations

Logistic

- Presentations/full discussions in room 205
- Small meetings, splinter discussions etc can be done in the IFPU free offices 206, 207, 208, 209, 210, 211
- Eduroam should be freely available
- Connections with Trieste: bus n. 6. https://www.triestetrasporti.it/wp-content/uploads/2022/11/linea-6-1.pdf Six rides/hr 7-8 am, 4 rides/hr 9am-8pm, 2-3 rides 9pm 1 ride 10-11pm
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