

Capra Wrap-up

Bernard Whiting (University of Florida)
Niels Bohr Institute, Copenhagen, DENMARK
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Historical perspective

- Capra began when a LISA mission appeared possible
- Its purpose was (and is) to deliver waveforms for EMRIs
- Many successes behind us (1st order, tests, ... 2nd order fluxes, 0PA and 1PA waveforms)
- We still face many hard challenges in the decade ahead of us
- **EDI has an important role:**
 - **At my 1st Capra meeting in 2001, there were about 22 attendees, including 2 females, 1 who officially spoke**
 - **2021: 244 registrants (44 institutes), 10 women speakers**
 - **2022: 70 in person, 82 online, 9 women speakers, some new institutes**
 - **2023: 114 in person, 46 online, 8 women speakers, 94 institutes, ~1.7 psi**

This Capra Meeting

- Second Order - are we seeing a sea-change in how we do things?
 - Guidance coming on how to get involved!
- Role of comparisons: PN - EOB - GSF - NR?
- Scattering - fascinating results; **how to cultivate synergy?**
- Resonances - essential to consider; how to manage in practice?
- Numerical Techniques - improving what we can already do!
- **EDI - Can it help keeping Capra coherent?**

My Impressions

- We are becoming very systematic! Started with first talk
- We have a good sense of a common goal
- There is strength in our diversified backgrounds
- We continue to build as a community
- Serious thought goes into the organized discussions
- Does anybody really understand the global picture?

Recent Capra changes

- **Our community now has its own EDI team**
- An online presence seems a future necessity
- Tremendous presence of young researchers - fantastic!
- **Are we becoming like a collaboration (should we)?**
- Some of us are members of LISA, or Kagra/LIGO/Virgo/ET
- ~50-90 at talks and discussions, ~15-30 participate online

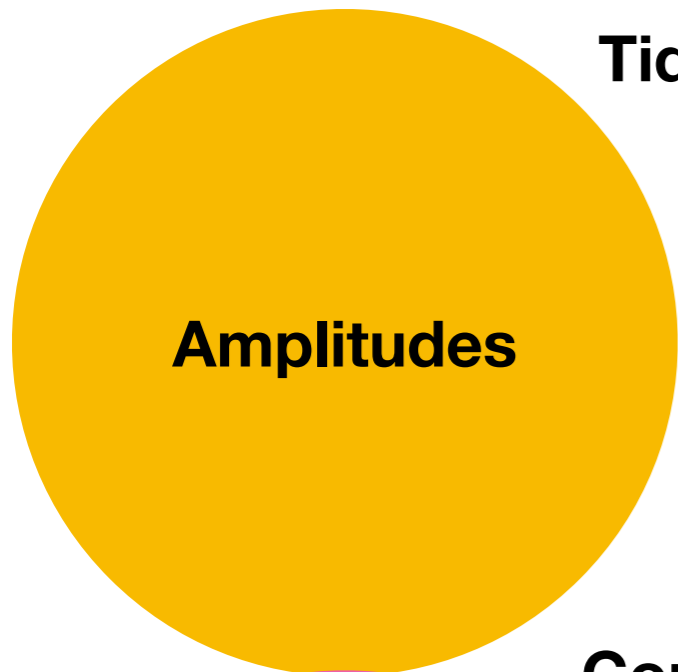
Where have we come from?

- Twenty years ago, it seemed important to get on to Kerr
- Can compare gauge invariants between SF, PN, and PM?
- We have good understanding of geodesics, resonances, transition to plunge, 1SF effects, 2SF sources, barriers ...
- We can compare with gauge invariants from amplitudes
- We have grown in number and diversity
- **Have we (others) understood how far behind we are?**

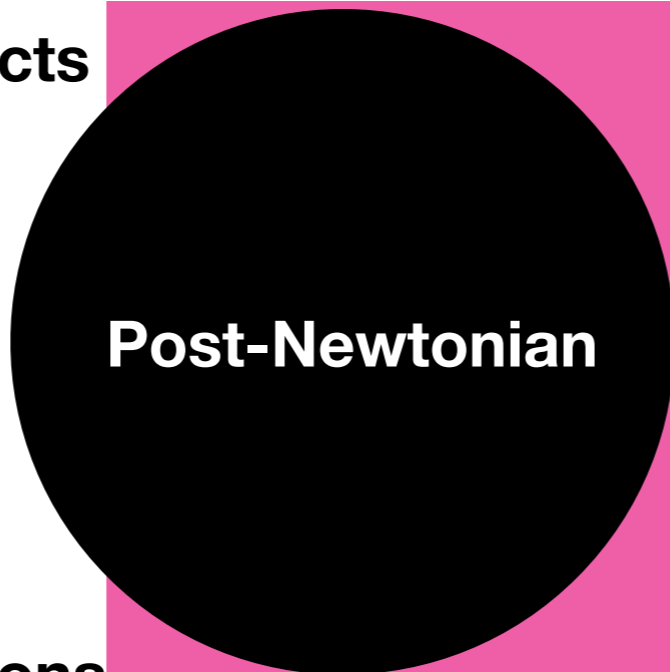
Where are we now?

- We are in a position to bring some efforts together
- More and more focus on finishing Schwarzschild
- Enriched by a diversity of interests, experience, skills
- Now many more institutes represented here than there were people at early Capra Meetings
- This Capra meeting ~ a third the size of Virgo Collaboration
- In growing, can we remain efficient and focused?

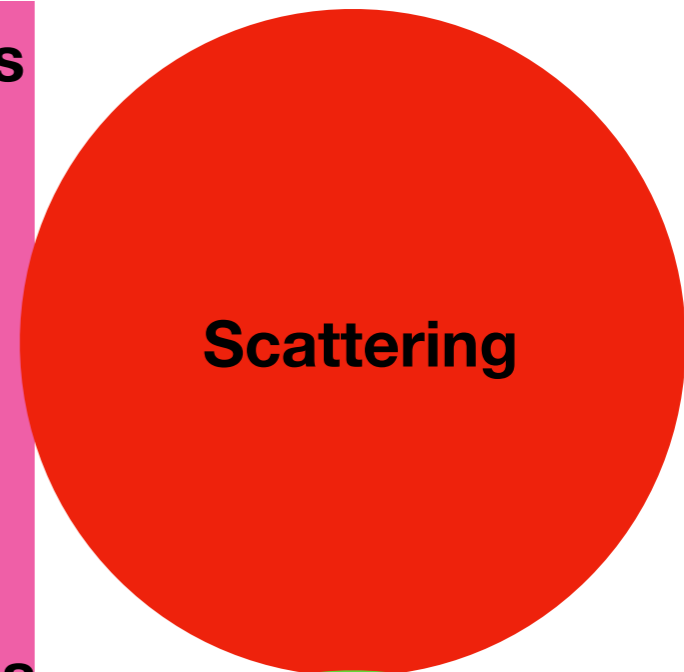
Computational schemes



Tidal effects

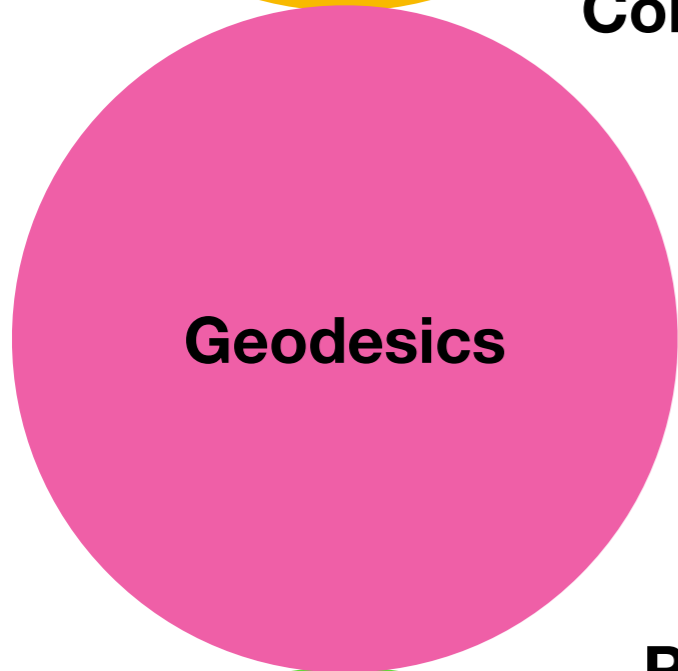


Rates

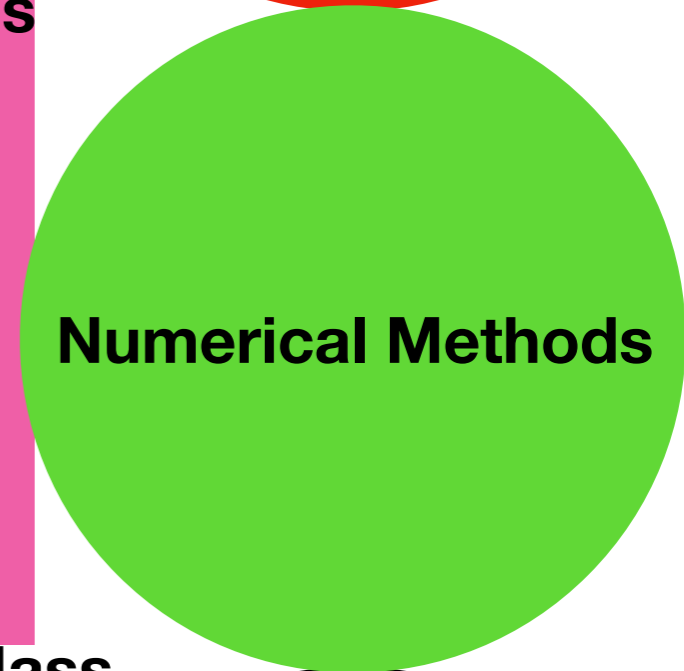
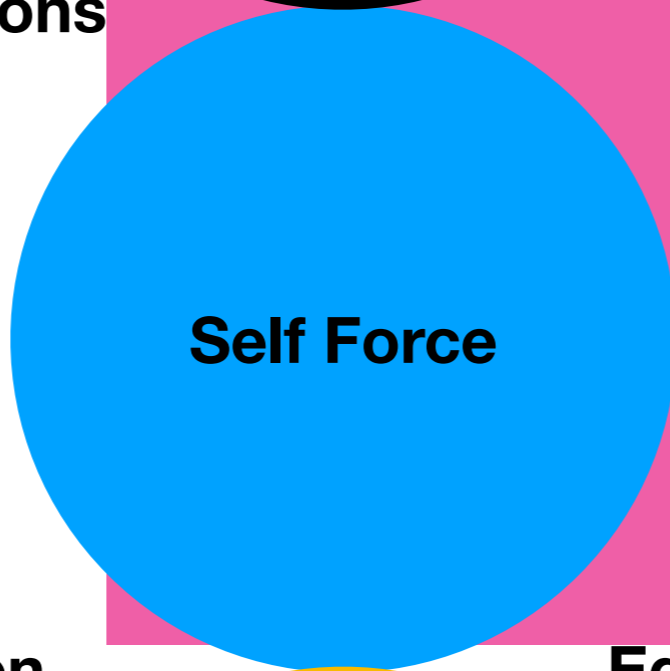


Parameter estimates

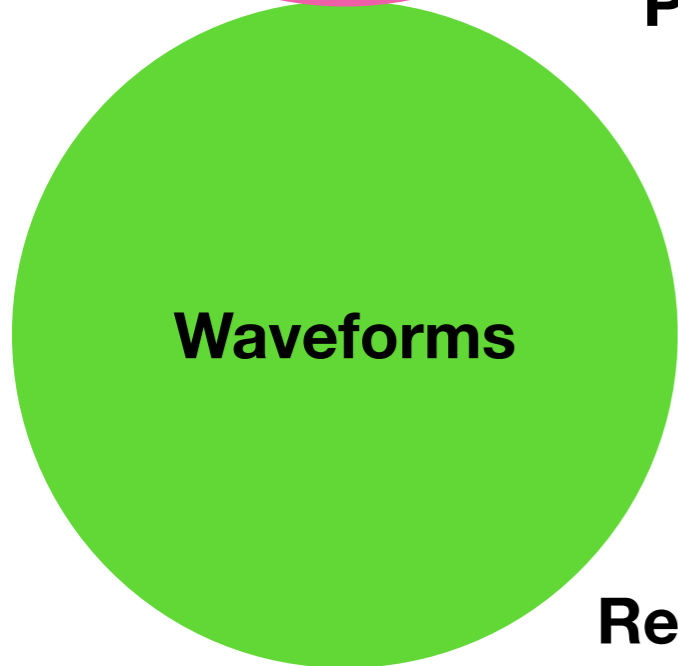
Comparisons



EMRIs

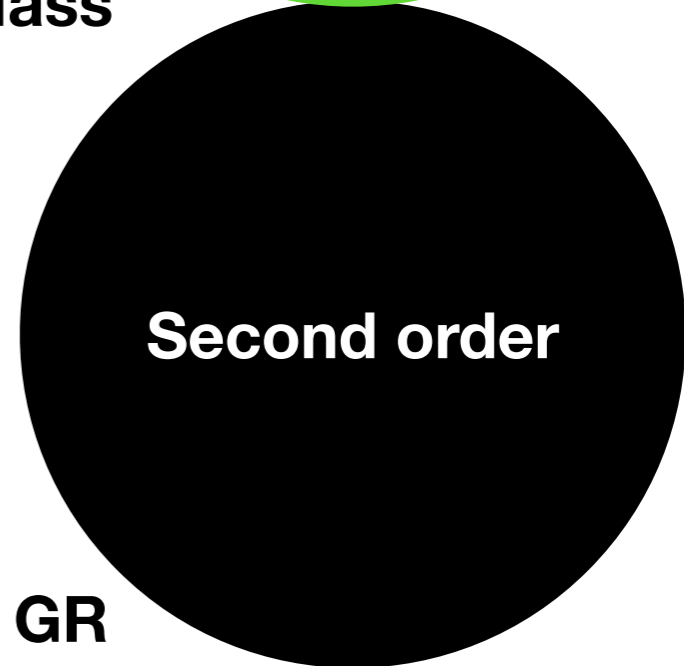


Data analysis



Precision

Equal Mass



Matter induced effects

Resonances

Beyond GR

Where are we going?

- We are going into countdown and we must strategize for it!
- Need more discussions where we ask:
 - What is now needed? What would improve what we have? How can we help?
- LISA working groups can help focus our efforts. **How can we make this work?**
- Would more regular meetings during the year, each on a subset of topics, help?
 - Beginning to happen!
- Need to develop a timeline for all to see and be able to respond to
- Need ability to identify & avoid potential show stoppers! May be under control?

LISA Consortium

- 1726 members in total
- 79 of those among the 160 participants in this 2023 Capra meeting
 - These include two Waveform Working Group Chairs (*Maarten van de Meent and Niels Warburton*); Others WGs of relevance: Astrophysics, LISA Data Challenges, Advocacy & Outreach
 - Two Waveform Work Package Chairs (*Leor Barack and Anna Heffernan*); Others WPs of relevance: Data Analysis Framework and Tools, Detection and Parameter Estimation, Science Interpretation
- We could be more represented, but ...
- LISA Consortium is neither owned nor operated by ESA!

Where is ESA taking us?

- LISA Mission adoption is expected at the beginning of 2024
- LISA Science Team (LST) will be formed by ESA(/NASA) before the next Capra
 - Will probably include about 10 scientists
 - Will stay in existence until about two years before mission launch (L-2)
- There will be an open call for Working Group Chairs about the middle of next year
- We can expect a call for Working Group Members by about the beginning of 2025
- LST will establish a set of Science Topical Panels (STP) with Chairs and Co-chairs at L-2
- STPs will work with Dedicated Data Processing Center (DDPC) at APC in Paris
- **Where will we be positioned during the next 10-12 years, and into LISA data taking?**

How can we get there?

- Being systematic and coherent across multiple fronts
- Organize more: workshops, code base, connectedness
- With talent here, we can make better progress together
- Make better use of the person power we have
- Determine and obtain the person power we need

Summary

- When can we have a comparison of waveforms?
 - timely, important, essential - we are now getting there!
- Many-fronted progress - could be better coordinated:
 - analytical, conceptual, numerical, theoretical
- Can/should LISA workgroup chairs "recruit" from Capra?
- Discussions becoming more effective - room to improve

Questions

- Should we have a code workshop for junior members?
- Should we have intermediate meetings on some topics?
- Should we have a strategy component in future Capra events?
- **How could we make discussions be more productive?**
- Should we define/manage our relationship with LISA?
- Can we introduce a better way to stay more connected?
- How should we invest more heavily in code databases?