Report on BlackHoleCam simulator WP meeting

Location: IMAPP telecon room
Date: 23 April 2015
Subject: Simulation work package and South African involvement
Present: Roger Deane (Rhodes, RSA), Ciriaco Goddi, Elmar Körding (first half), Heino Falcke, Salome Dibi, Monika Moscibrodzka, Michael Janßen, Thomas Bronzwaer, Christiaan Brinkerink (IMAPP), Ilse van Bemmel (JIVE, chair & notes)

The purpose of the meeting is to discuss the deliverables in the WP management plan, in particular the connection between the work done in RSA and the theory work in Monika's team. Michael Janßen has joined as an MSc student with Heino, working on VLBA 43GHz data of Sgr A*.

1. Brief introduction of everyone

2. Interfacing the GRMHD simulations with MeqTrees
Roger is interested in the range and resolution of parameters in the models. Monika explains that some parameters are computationally expensive, such as black hole spin and mass, while others are easily changed, such as the inclination and electron distribution. The latter has large impact on the final result.
The models include turbulence, which is implemented with a random number, therefore two models with identical physical parameters will never look exactly the same. At the moment the results only include total intensity, but polarization is being worked on by e.g. Thomas. The effect of hot spots (periodicity) is added a posteriori. Variability due to particle acceleration is included, and the disk in the models has a weak magnetic field.
The GRMHD simulations are used to fit the full spectrum of Sgr A* and are constrained by high energy observations.

For the Bayesian analysis there are plenty of variable parameters in the models. After the meeting Roger and Monika discuss the full range and the computational expense.

The interstellar scattering will be implemented in MeqTrees. Heino mentions that a simple Gaussian may not be accurate, but it is the fastest way to implement this now. The scattering module should allow for future implementation of more complex scattering models. This work will be done in RSA by a MSc student of Roger's (Tariq Blecher).

3. Tropospheric module for MeqTrees
The existing ionospheric module in MeqTrees needs to be ported to the current MeqTrees version, adjusted to simulate the troposphere, and tested. The porting is simple and will be done by Pim Schellaert. Roger and Ilse will make sure he gets access to the code and write a quick document with required input and output for the module. They will also verify the physical model.

The challenge here is finding a good way to test the module. Christiaan has access to CARMA data that have information on the troposphere. These data can be used as a test case. Roger and Ilse will discuss how to set up the test. This test can also be part of the MeqTrees tutorial at the workshop.

4. Including polarization in the GRMHD: see agenda item 2

5. Other deliverables from Management Plan dd 24 February 2015
    1. Basic simulation: done
    2. MS tools: this is work in progress in RSA
    3. Troposphere: Pim Schellaert will work on porting, Roger, Ilse and Christiaan will work on a test
    4. Fringe noise: after discussing with Oleg Smirnov and a few more, the conclusion was that the troposphere is the dominant error for which fringe finding is needed. Other errors are slowly varying. For the BHC simulations they do not need to be included.
    5. DPP: as the above deliverables are evolving, simulations will be run to test the functionality and output of MeqTrees
    6. Scattering: Roger will find someone to work on this in RSA
    7. Polarization: MeqTrees can only handle linear or circular. We need to discuss how the data processing will handle the mixed polarizations before we can implement this further in MeqTrees.
    8. Simulator: as item 5
    9. End-2-end: as item 5, and see also agenda point 7

6. Access to real data
Associated with points 2 and 5 it becomes clear that we need access to real data sets. First of all, we would like to run a simulation based on the actual observation to verify that the simulator reproduces the observed visibilities. The 2013 EHT data have most of the meta-data required for this. Second, we would like to have actual EHT datasets to test the software being developed in JIVE. Last but not least, a real dataset will be required for the workshop. Christiaan and Ciriaco will contact Thomas Krichbaum and/or the Haystack team to discuss this.

7. Update on the pipeline development
Ilse reports on the progress made in JIVE. Des Small is making the first rudimentary scripts for the CASA fringe finder. He is in contact with people who have worked on similar scripts, and progress is steady. Mark Kettenis is trying to process an EVN C-band dataset in CASA to identify additional problems of compatibility of CASA with VLBI data. He found several issues, such as the assumption that the array consists of identical elements, but so far there are no show-stoppers. Ilse will process the same dataset in AIPS to serve as verification.

8 Any other business
    • Workshop: there will be a meeting on data processing and simulations in Leiden, 8-11 June. It is by invitation only. Monika and Heino suggest to invite someone from the Frankfurt theory group. Ciricaco will make contact with them.

- Regular meetings: for the simulation work we would like to have a short telecom every 2 weeks. This should include Monika, Ciriaco, Roger and Ilse, as well as other people who are actively involved at that time.
- Wiki and BHC meetings: the wiki should be online soon, enabling easier access to mailing lists. Heino mentions that the plan is to have a BHC status meeting and regular telecons with WP leaders.
- To formalize the collaboration between Rhodes University and BlackHoleCam we need to draft an MoU.

Actions
- Roger: assign the implementation of scattering to student (done)
- Roger & Ilse: get Pim the information on MeqTrees atmospheric module
- Christiaan: provide a CARMA dataset for verification tests
- Roger & Ilse: discuss the verification test for atmospheric sims
- Ciriaco & Christiaan: find an EHT dataset for simulations and testing
- Ciriaco: contact Frankfurt group to invite to workshop
- Ilse: set up a mailing list for regular telecons

Workshop topics
- Insterstellar scattering
- Processing a real EHT dataset
- Simulating a real EHT dataset
- Polarization handling in the data processing and simulations
- Verification of the troposphere module
- Simulate an African mm-VLBI telescope in EHT