

LOOKING FOR CONFIRMATION OF GRAVITATIONAL WAVES DETECTION IN OPTICAL BAND

– Pi of the Sky involvement in Looc-Up project

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Agenda



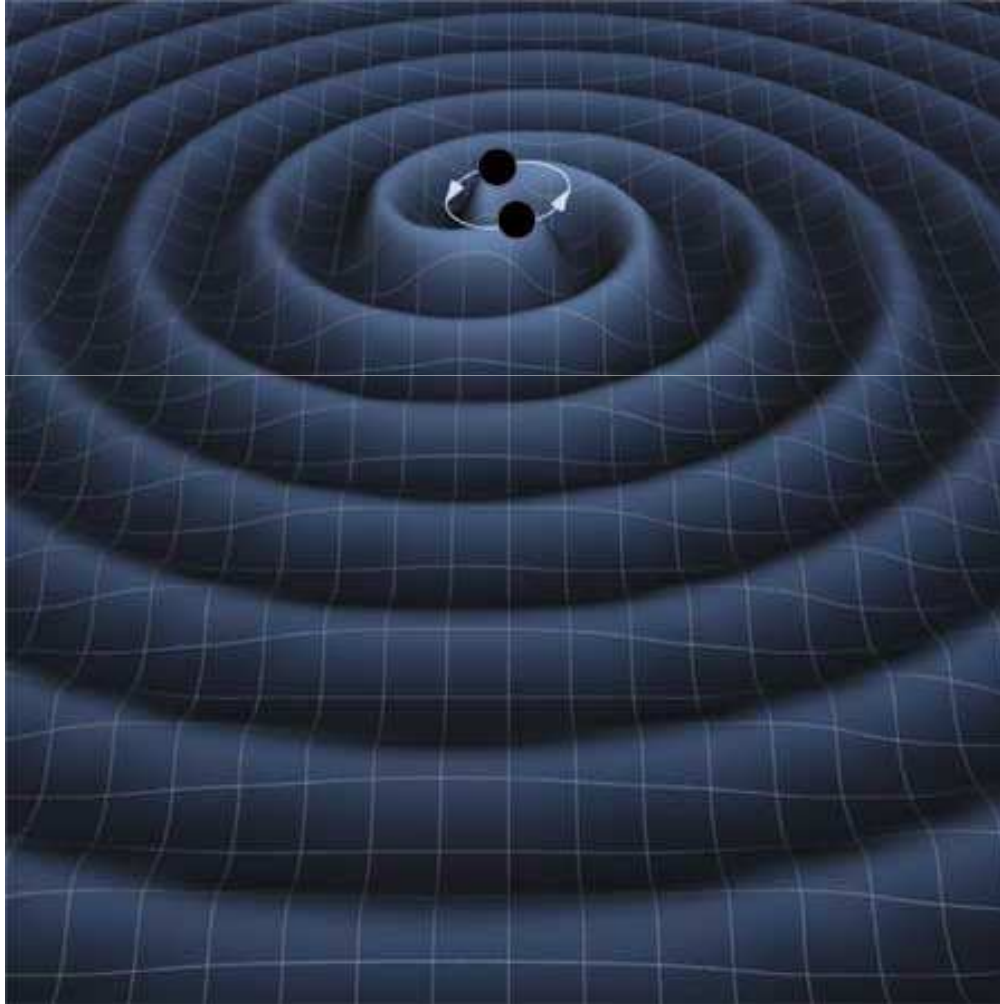
- Introduction
 - ▣ Gravitational Waves
 - ▣ Sources
 - ▣ Detection
- LooC-Up project
- Pi of the Sky
 - ▣ Challenges and chances
 - ▣ Further Improvements



Introduction

Gravitational Waves, Sources and all that stuff

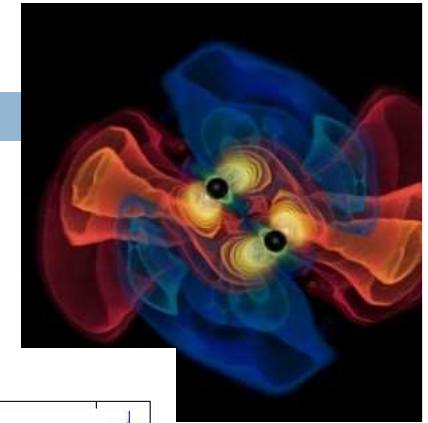
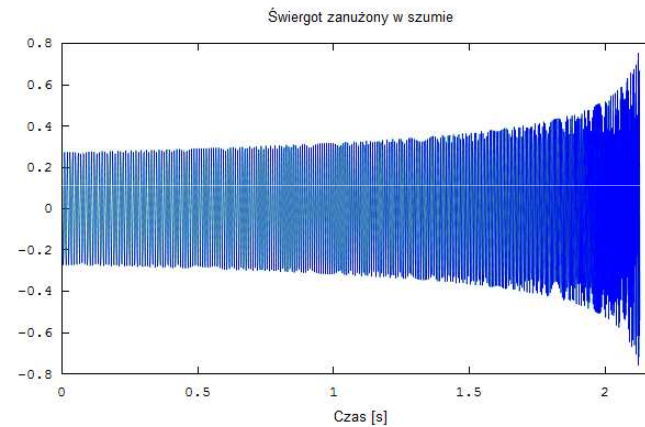
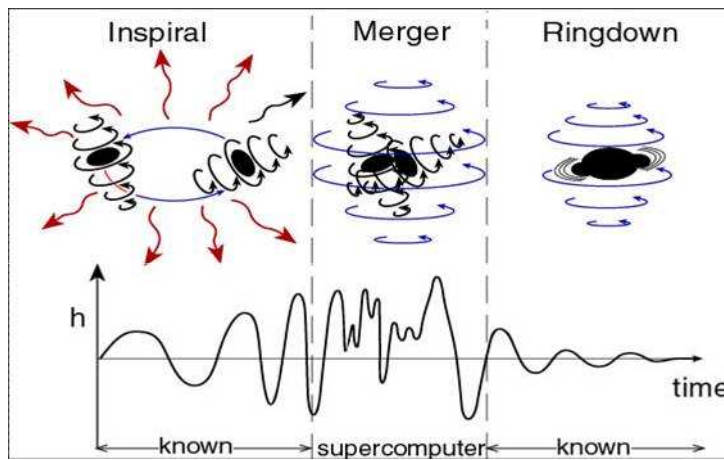
Gravitational Waves



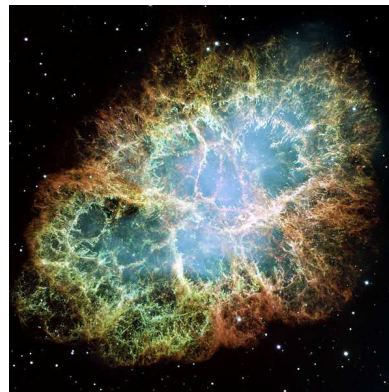
$$G_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Binary Coalescence and Supernova Explosions

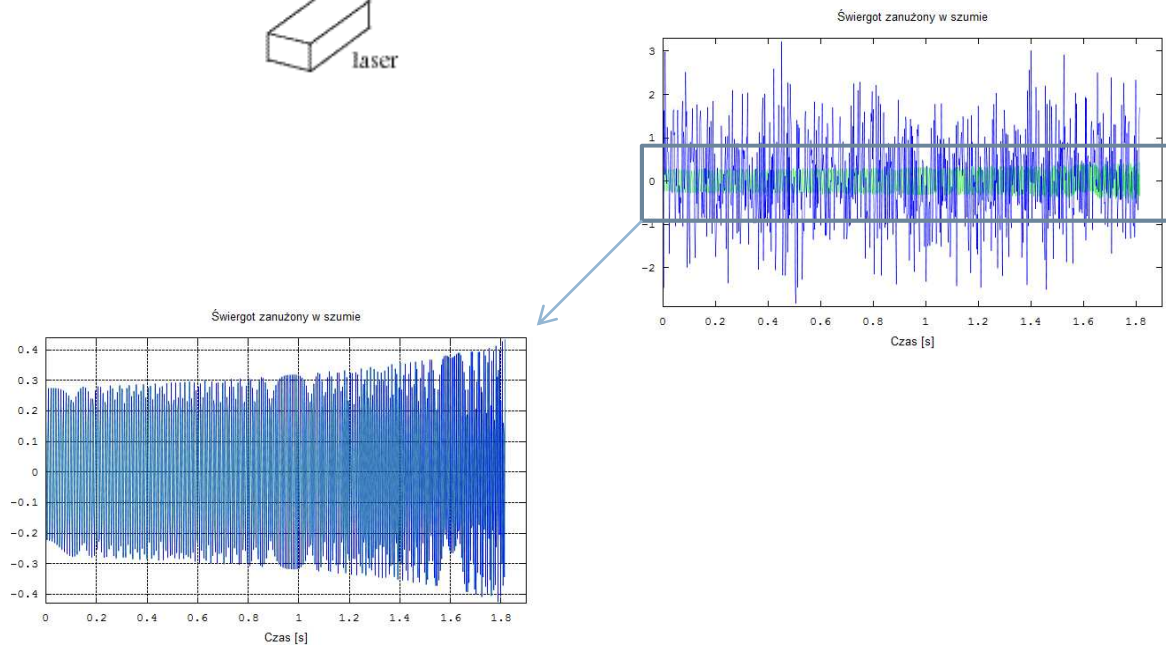
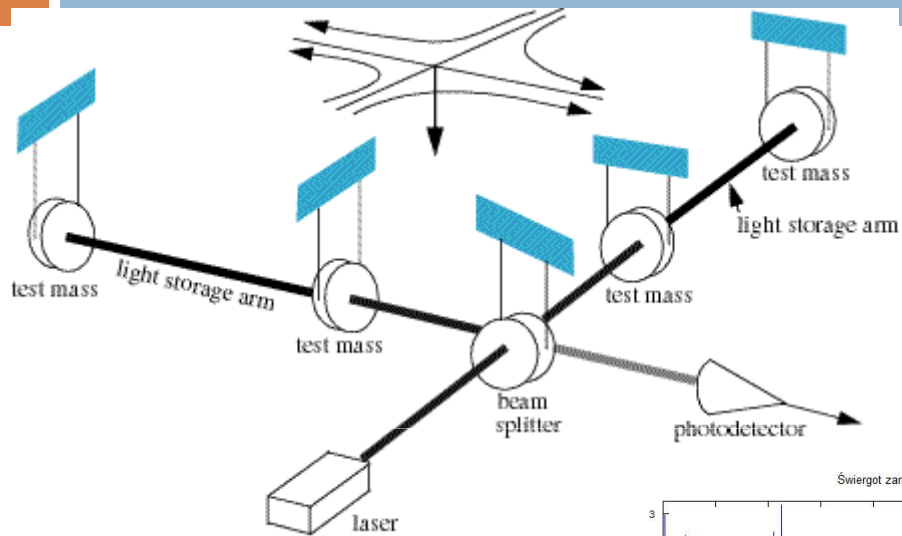
□ Neutron star / Blackhole binaries



□ Supernova



Detection of gravitational waves



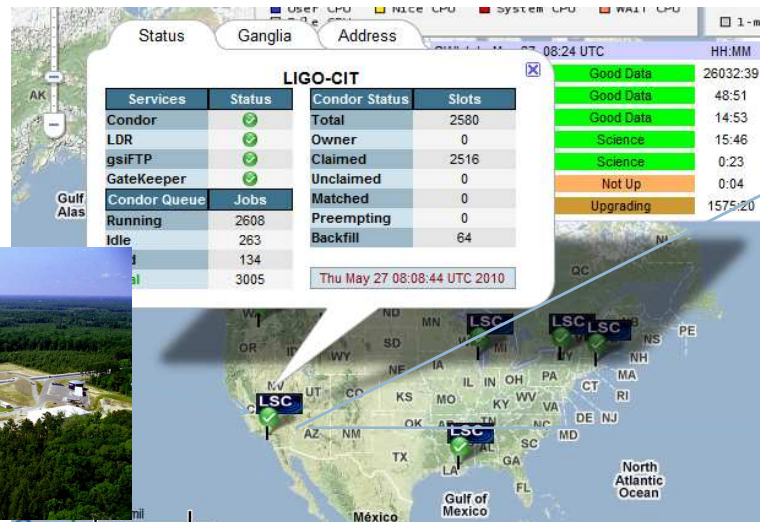
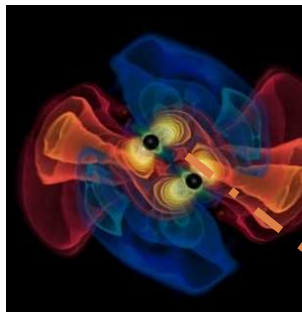
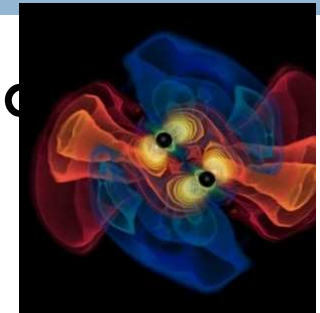


A few words about Looc-Up project

Search for an optical counterpart of
gravitational waves event

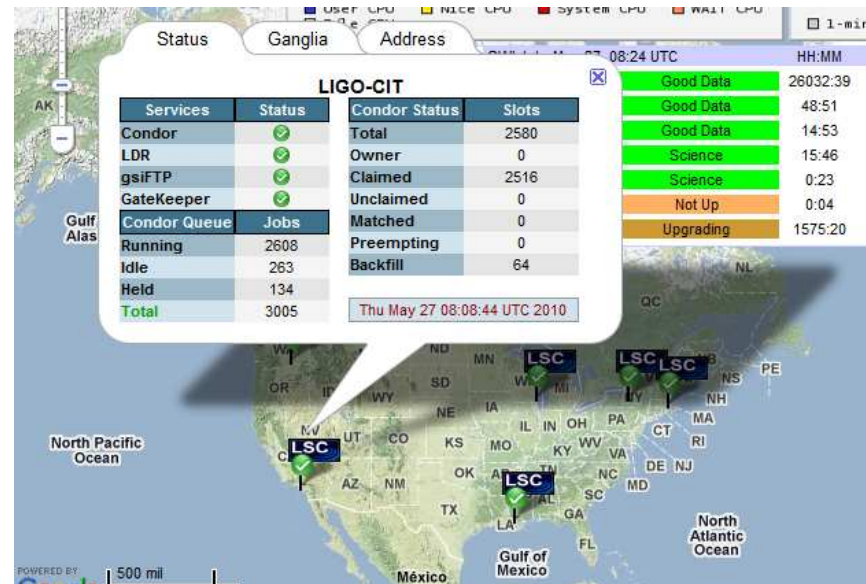
Locating and Observing Optical Counterparts to Unmodeled Pulses

- Search for an optical counterpart to a gravitational waves event
 - ▣ to confirm an event
 - ▣ to gather more information



LUMIN

- A system for locating a position of an event on the sky (accuracy of positioning $\sim 5^\circ$)
- Figuring out scopes for observations
- Helping human to make a decisions about observations
- LUMIN sends up to one alert per day



Telescopes Involved in Looc-Up Project

- Quest (Chile, FOV $4.6^\circ \times 4.1^\circ$)
- Tarot
 - ▣ North (France, FOV $1.86^\circ \times 1.86^\circ$)
 - ▣ South (Chile, FOV $1.86^\circ \times 1.86^\circ$)
- Pi of the Sky (Chile, FOV $20^\circ \times 20^\circ$)
- Zadko (Australia, FOV $0.23^\circ \times 0.23^\circ$)
- Will join:
 - ▣ SkyMapper and Rotse



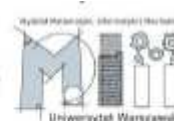
Winter 09/10 Science Run



- From 18.XII.2009 to 08.I.2010
- 8 alerts has been send to scopes TAROT and QUEST
 - ▣ QUEST had fallowed 3 alerts
 - ▣ TAROT had fallowed 1 alert
- Gathered images are now being processed
- Next science runs:
 - ▣ Late July
 - ▣ September

Pi of the Sky

Preparing Pi of the Sky for Looc-Up project



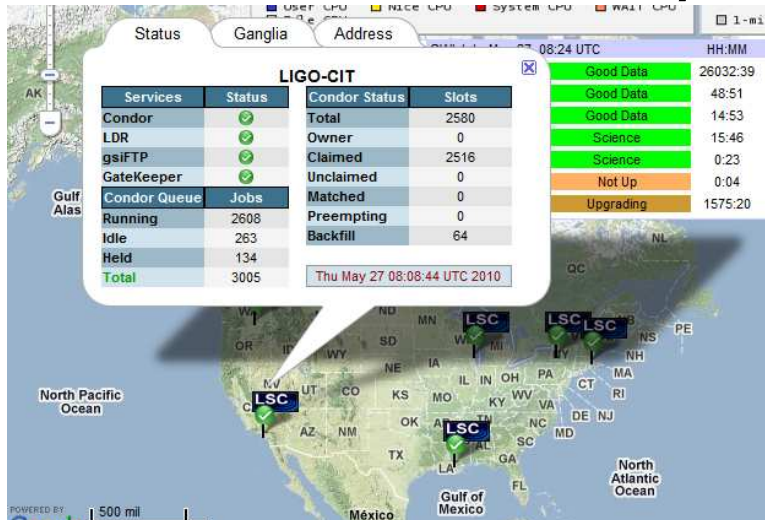
Pi of the Sky telescope

- Location: Chile, Las Campanas Observatory
- FOV: $20^\circ \times 20^\circ$
- Range:
 - ▣ 12m (1 frame)
 - ▣ 13m (20 frames)
- 10s exposures
with 2s of a dead time



Communication with LUMIN – lumin_server

- Listening to incoming alerts -lumin_server
 - ▣ Communication through tcp/ip socket communication
 - ▣ Robust alerts handling
- Storing alerts and observing an position of an alerts for few days



An Alert



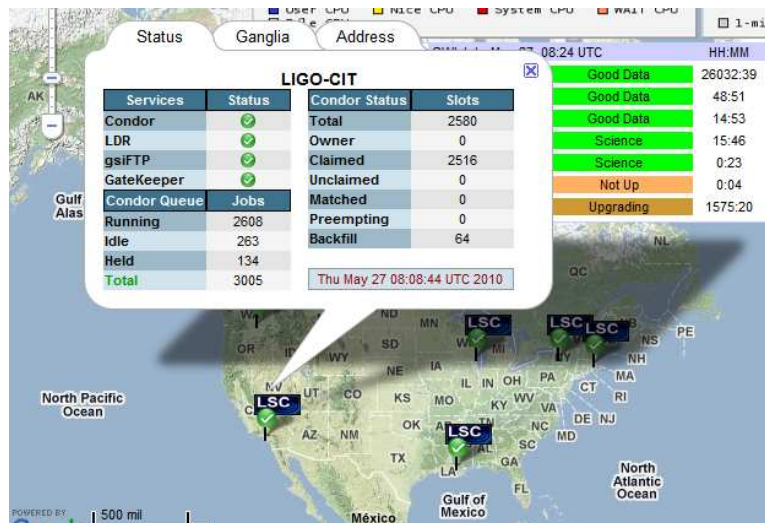
lumin_server

Challenges and chances for Pi of the Sky

- Pi of the Sky has a huge field of view $20^\circ \times 20^\circ$
 - ▣ Wide field of view helps a lot when an object described in an alert is not placed directly in the sky
- Unfortunately Pi of the Sky is limited to objects stronger than 12m-13m
- So Pi of the Sky have to respond to alerts fast
- Automatic identification of optical transient candidates

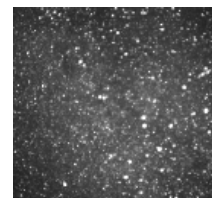
Further Improvements 1

- Fast preview of a pictures taken for Looc-Up project
 - ▣ Pictures can be viewed and processed by person on Looc-Up shift just after being taken
 - ▣ That might help to make a right decision about continuing observations or not



An Alert

Images



Further Improvements 2



- Technology used for creating a fast preview for Lumin
 - XML-RPC and python
 - HTTP protocol is used to transfer pictures in simple and robust way
- All those technologies can be used on all common OS
- Currently proof of concept has been done



Summary

Summary



- Observing an optical counter part might be a great help for confirming a gravitational waves event
- Pi of the Sky because of a very wide field of view might be helpful for Looc-Up project
- Some of our improvements might be helpful to fast recognition of a possible transient

Questions?

