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 ~5°)
- Figuring out scopes for observations
- Helping human to make decisions about observations
- LUMIN sends up to one alert per day
Telescopes Involved in Looc-Up Project

- Quest (Chile, FOV 4.6° x 4.1°)
- Tarot
  - North (France, FOV 1.86° x 1.86°)
  - South (Chile, FOV 1.86° x 1.86°)
- Pi of the Sky (Chile, FOV 20° x 20°)
- Zadko (Australia, FOV 0.23° x 0.23°)
- 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 followed 3 alerts
  - TAROT had followed 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° x 20°
- 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
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
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
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- Observing an optical counterpart might be a great help for confirming a gravitational waves event.

- Pi of the Sky because of its very wide field of view might be helpful for the Looc-Up project.

- Some of our improvements might be helpful for fast recognition of a possible transient.
Questions?