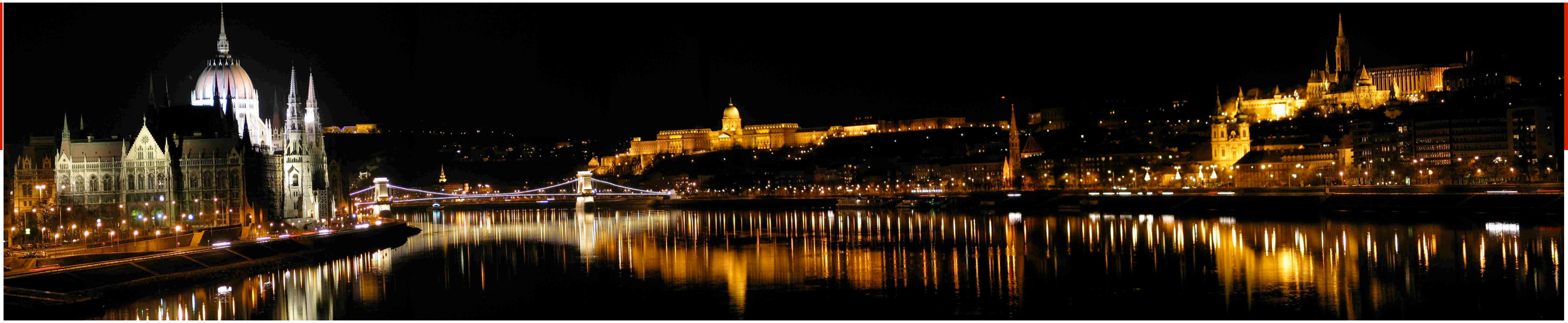
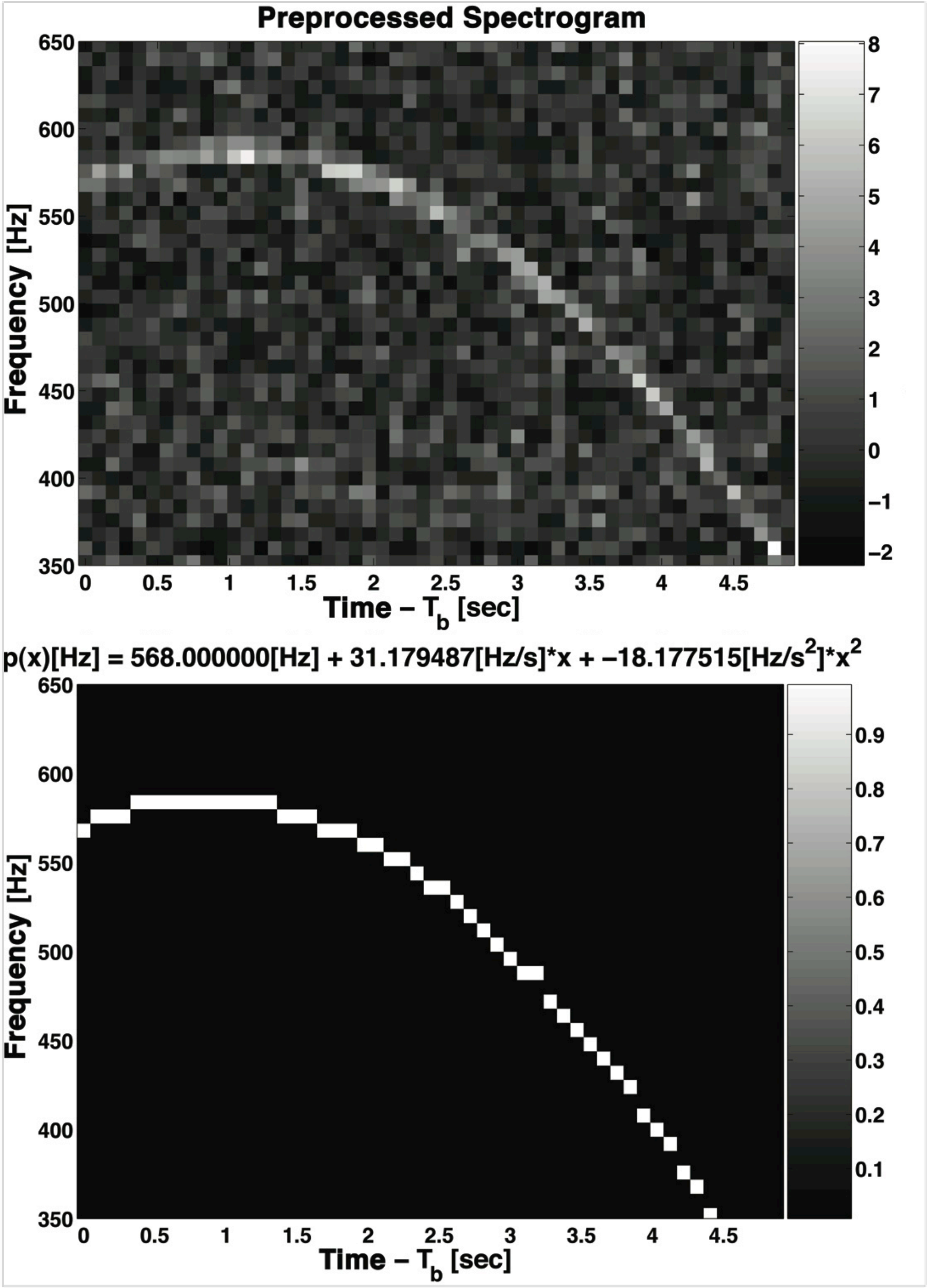


Proposed participation of the Eötvös Gravity Research Group (Hungary) in LSC

Zsolt Frei
Institute of Physics, Eötvös University, Budapest
LSC/VIRGO March 2007, plenary (new member presentation)
DCC: G070053-00-0

Outline

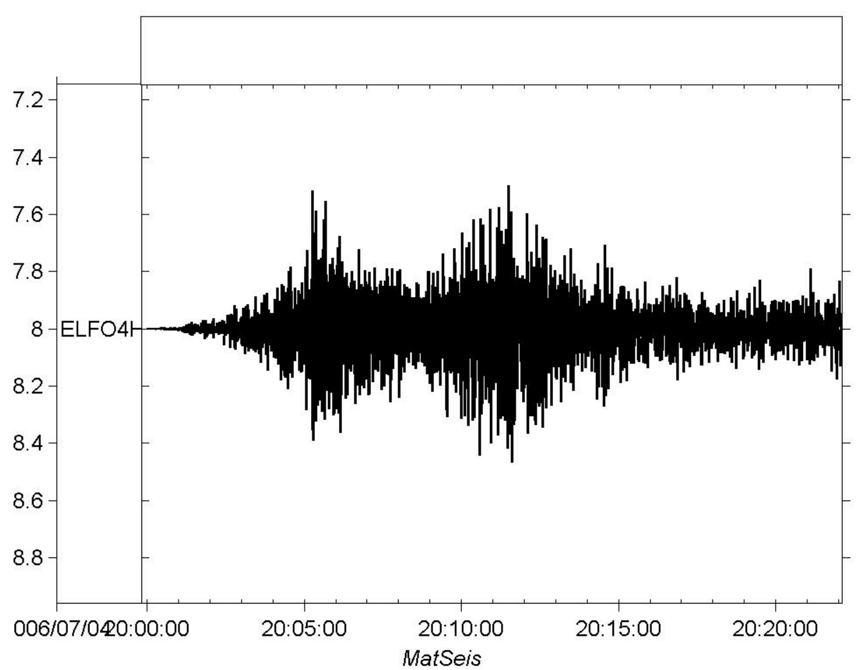
- ❑ MoU particulars
- ❑ Our school, group, and members
- ❑ Funds



MoU DAT

Burst UL and ExTrig:

- Astrophysically motivated searches for narrow band signals
- Software already developed for quasi-monochromatic signal searches
- Intend to process S5 data, looking for 10-100 sec signals



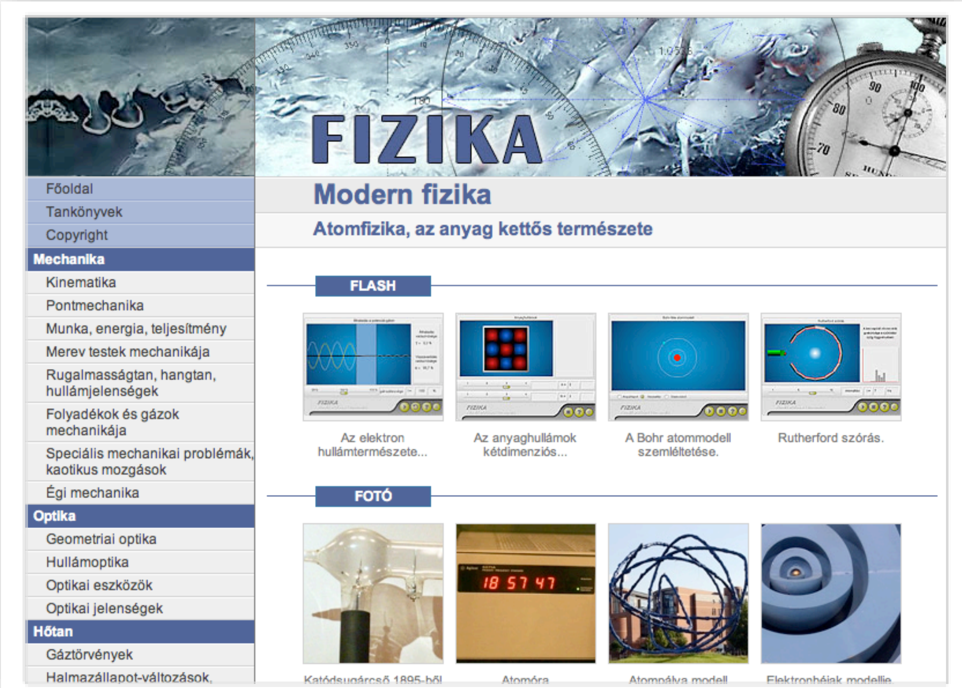
MoU OPS

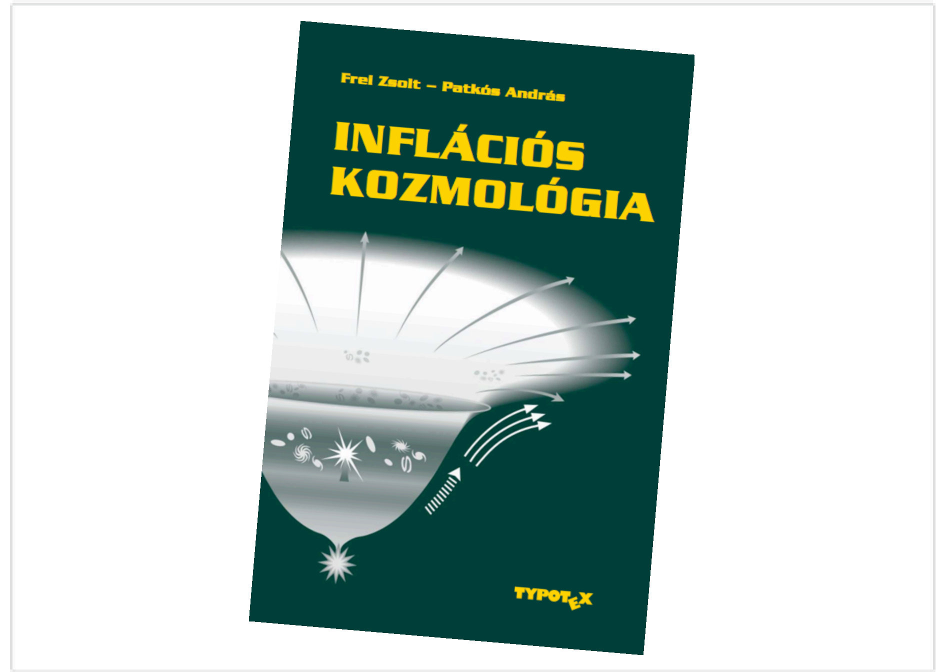
DetChar:

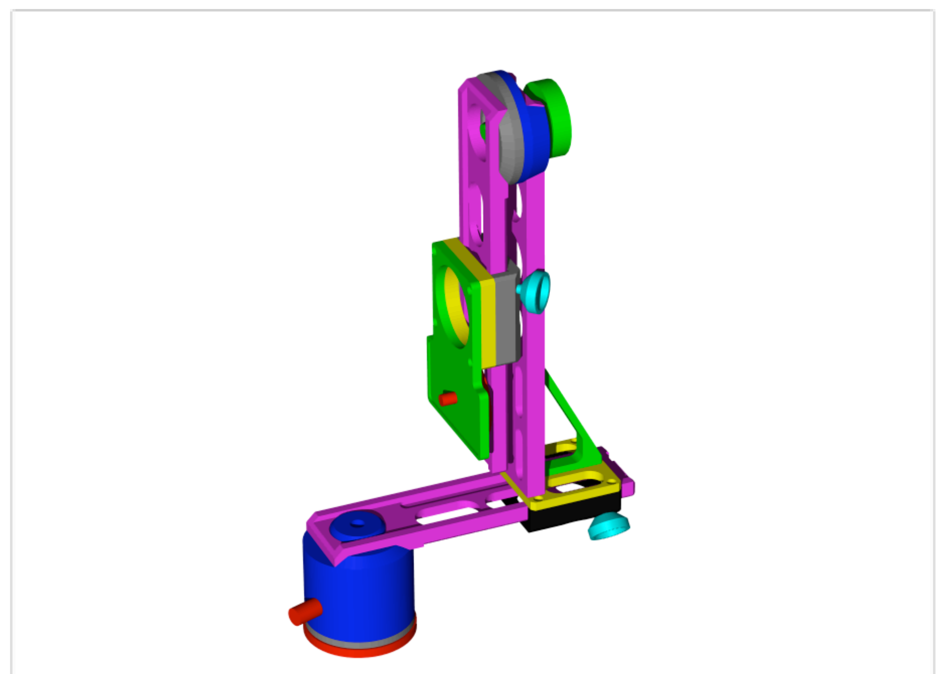
- Will characterize coupling in S5 signals between DARM-ERR and neighboring channels in the 960 Hz range
- Ready to send students/ scientists for commissioning/ operations

Other: PEM

- Will develop self contained, isolated, networked, ultra-low emission multi-instrument pods
- Will install low frequency acoustic environment monitor





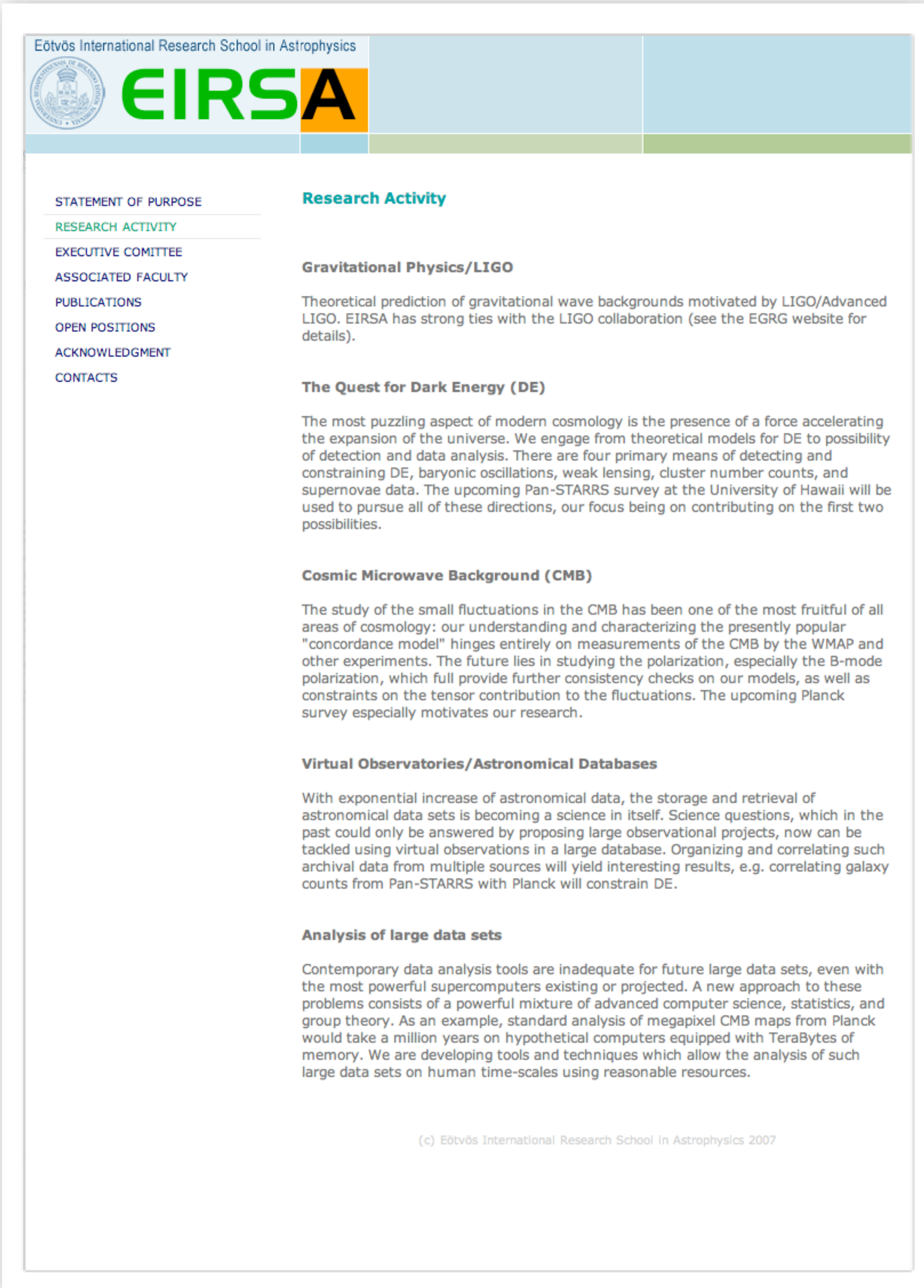


MoU Outreach

Pictures/flash/movies website,   QTVR images (virtual tour),   textbooks

Outline

- [x] MoU particulars
- [ ] Our school, group, and members
- [ ] Funds



Eötvös International Research School in Astrophysics

EIRSA

STATEMENT OF PURPOSE
RESEARCH ACTIVITY
EXECUTIVE COMITTEE
ASSOCIATED FACULTY
PUBLICATIONS
OPEN POSITIONS
ACKNOWLEDGMENT
CONTACTS

Research Activity

Gravitational Physics/LIGO

Theoretical prediction of gravitational wave backgrounds motivated by LIGO/Advanced LIGO. EIRSA has strong ties with the LIGO collaboration (see the EGRG website for details).

The Quest for Dark Energy (DE)

The most puzzling aspect of modern cosmology is the presence of a force accelerating the expansion of the universe. We engage from theoretical models for DE to possibility of detection and data analysis. There are four primary means of detecting and constraining DE, baryonic oscillations, weak lensing, cluster number counts, and supernovae data. The upcoming Pan-STARRS survey at the University of Hawaii will be used to pursue all of these directions, our focus being on contributing on the first two possibilities.

Cosmic Microwave Background (CMB)

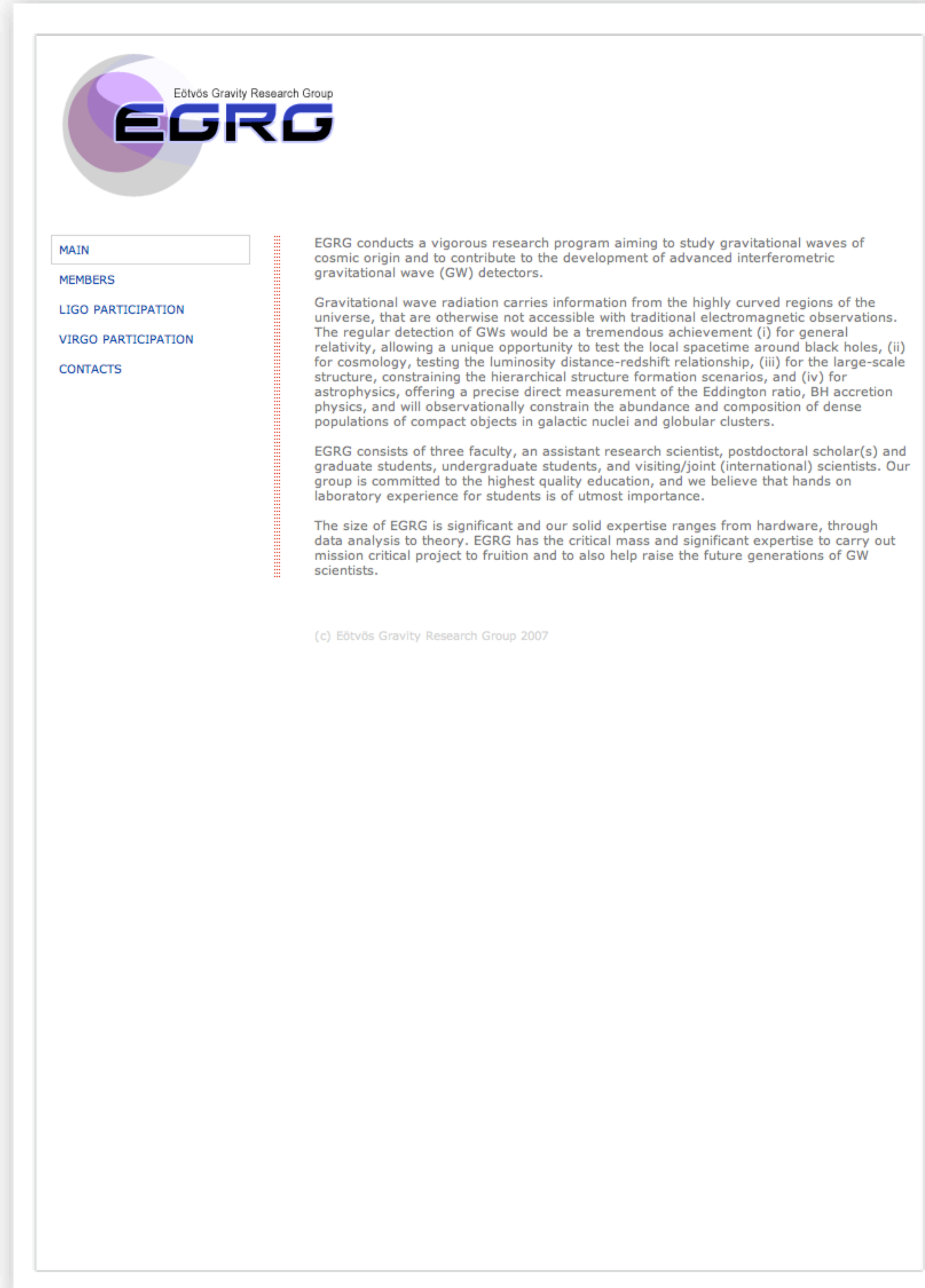
The study of the small fluctuations in the CMB has been one of the most fruitful of all areas of cosmology: our understanding and characterizing the presently popular "concordance model" hinges entirely on measurements of the CMB by the WMAP and other experiments. The future lies in studying the polarization, especially the B-mode polarization, which full provide further consistency checks on our models, as well as constraints on the tensor contribution to the fluctuations. The upcoming Planck survey especially motivates our research.

Virtual Observatories/Astronomical Databases

With exponential increase of astronomical data, the storage and retrieval of astronomical data sets is becoming a science in itself. Science questions, which in the past could only be answered by proposing large observational projects, now can be tackled using virtual observations in a large database. Organizing and correlating such archival data from multiple sources will yield interesting results, e.g. correlating galaxy counts from Pan-STARRS with Planck will constrain DE.

Analysis of large data sets

Contemporary data analysis tools are inadequate for future large data sets, even with the most powerful supercomputers existing or projected. A new approach to these problems consists of a powerful mixture of advanced computer science, statistics, and group theory. As an example, standard analysis of megapixel CMB maps from Planck would take a million years on hypothetical computers equipped with TeraBytes of memory. We are developing tools and techniques which allow the analysis of such large data sets on human time-scales using reasonable resources.



Eötvös Gravity Research Group

EGRG

MAIN
MEMBERS
LIGO PARTICIPATION
VIRGO PARTICIPATION
CONTACTS

EGRG conducts a vigorous research program aiming to study gravitational waves of cosmic origin and to contribute to the development of advanced interferometric gravitational wave (GW) detectors.

Gravitational wave radiation carries information from the highly curved regions of the universe, that are otherwise not accessible with traditional electromagnetic observations. The regular detection of GWs would be a tremendous achievement (i) for general relativity, allowing a unique opportunity to test the local spacetime around black holes, (ii) for cosmology, testing the luminosity distance-redshift relationship, (iii) for the large-scale structure, constraining the hierarchical structure formation scenarios, and (iv) for astrophysics, offering a precise direct measurement of the Eddington ratio, BH accretion physics, and will observationally constrain the abundance and composition of dense populations of compact objects in galactic nuclei and globular clusters.

EGRG consists of three faculty, an assistant research scientist, postdoctoral scholar(s) and graduate students, undergraduate students, and visiting/joint (international) scientists. Our group is committed to the highest quality education, and we believe that hands on laboratory experience for students is of utmost importance.

The size of EGRG is significant and our solid expertise ranges from hardware, through data analysis to theory. EGRG has the critical mass and significant expertise to carry out mission critical project to fruition and to also help raise the future generations of GW scientists.

eirsa.elte.hu

egrg.elte.hu

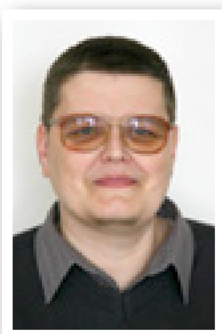
EIRSA and EGRG websites

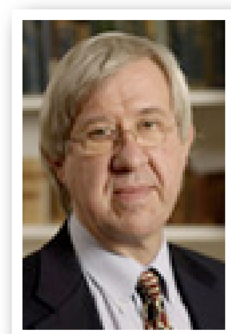
EIRSA Executive Committee




Frei (Budapest)
Haiman (Columbia)
Márka (Columbia)
Szapudi (IfA Hawaii)

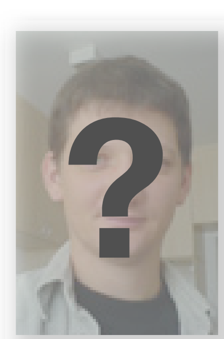
EIRSA Associated Faculty

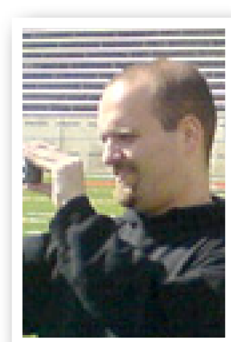
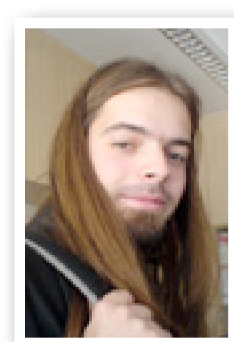
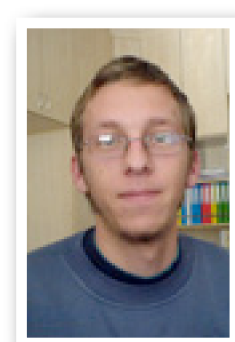
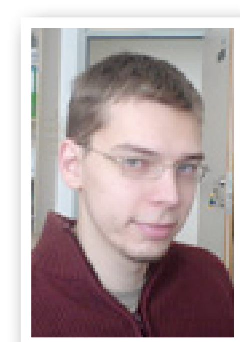


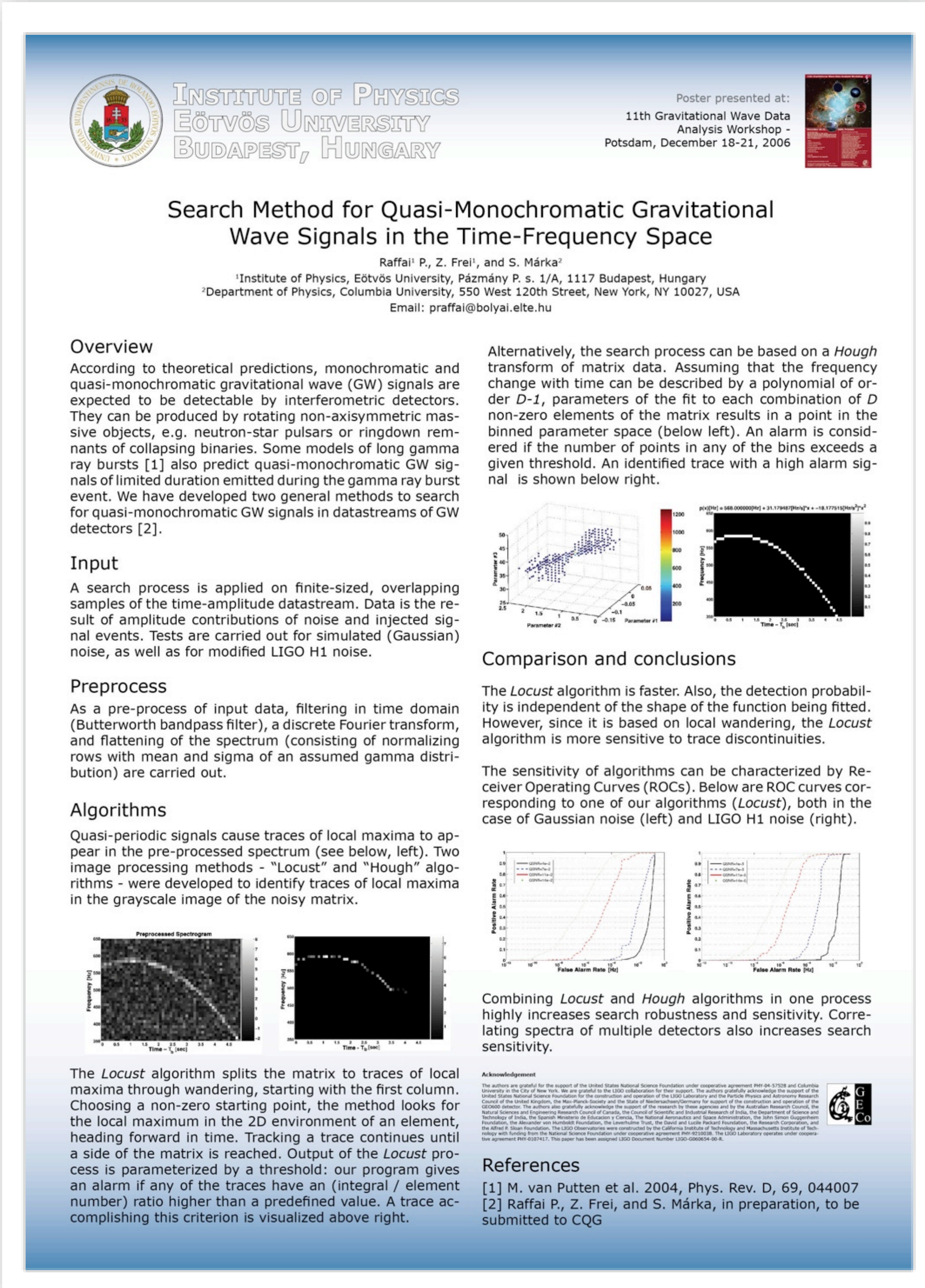
Csótó (Budapest)
Forgács (Budapest)
Patkós (Budapest)
Szalay (Johns Hopkins)

EGRG members (scientists, students)



Szokoly ?
Egri ?
Kocsis
Raffai
Szeifert
Gelencsér
Fejős



Institute of Physics
Eötvös University
Budapest, Hungary

Poster presented at:
11th Gravitational Wave Data Analysis Workshop -
Potsdam, December 18-21, 2006

Search Method for Quasi-Monochromatic Gravitational Wave Signals in the Time-Frequency Space

Raffai[1] P., Z. Frei[1], and S. Márka[2]
[1]Institute of Physics, Eötvös University, Pázmány P. s. 1/A, 1117 Budapest, Hungary
[2]Department of Physics, Columbia University, 550 West 120th Street, New York, NY 10027, USA
Email: praffai@bolyai.elte.hu

Overview

According to theoretical predictions, monochromatic and quasi-monochromatic gravitational wave (GW) signals are expected to be detectable by interferometric detectors. They can be produced by rotating non-axisymmetric massive objects, e.g. neutron-star pulsars or ringdown remnants of collapsing binaries. Some models of long gamma ray bursts [1] also predict quasi-monochromatic GW signals of limited duration emitted during the gamma ray burst event. We have developed two general methods to search for quasi-monochromatic GW signals in datastreams of GW detectors [2].

Input

A search process is applied on finite-sized, overlapping samples of the time-amplitude datastream. Data is the result of amplitude contributions of noise and injected signal events. Tests are carried out for simulated (Gaussian) noise, as well as for modified LIGO H1 noise.

Preprocess

As a pre-process of input data, filtering in time domain (Butterworth bandpass filter), a discrete Fourier transform, and flattening of the spectrum (consisting of normalizing rows with mean and sigma of an assumed gamma distribution) are carried out.

Algorithms

Quasi-periodic signals cause traces of local maxima to appear in the pre-processed spectrum (see below, left). Two image processing methods - "Locust" and "Hough" algorithms - were developed to identify traces of local maxima in the grayscale image of the noisy matrix.

The *Locust* algorithm splits the matrix to traces of local maxima through wandering, starting with the first column. Choosing a non-zero starting point, the method looks for the local maximum in the 2D environment of an element, heading forward in time. Tracking a trace continues until a side of the matrix is reached. Output of the *Locust* process is parameterized by a threshold: our program gives an alarm if any of the traces have an (integral / element number) ratio higher than a predefined value. A trace accomplishing this criterion is visualized above right.

Alternatively, the search process can be based on a *Hough* transform of matrix data. Assuming that the frequency change with time can be described by a polynomial of order *D-1*, parameters of the fit to each combination of *D* non-zero elements of the matrix results in a point in the binned parameter space (below left). An alarm is considered if the number of points in any of the bins exceeds a given threshold. An identified trace with a high alarm signal is shown below right.

Comparison and conclusions

The *Locust* algorithm is faster. Also, the detection probability is independent of the shape of the function being fitted. However, since it is based on local wandering, the *Locust* algorithm is more sensitive to trace discontinuities.

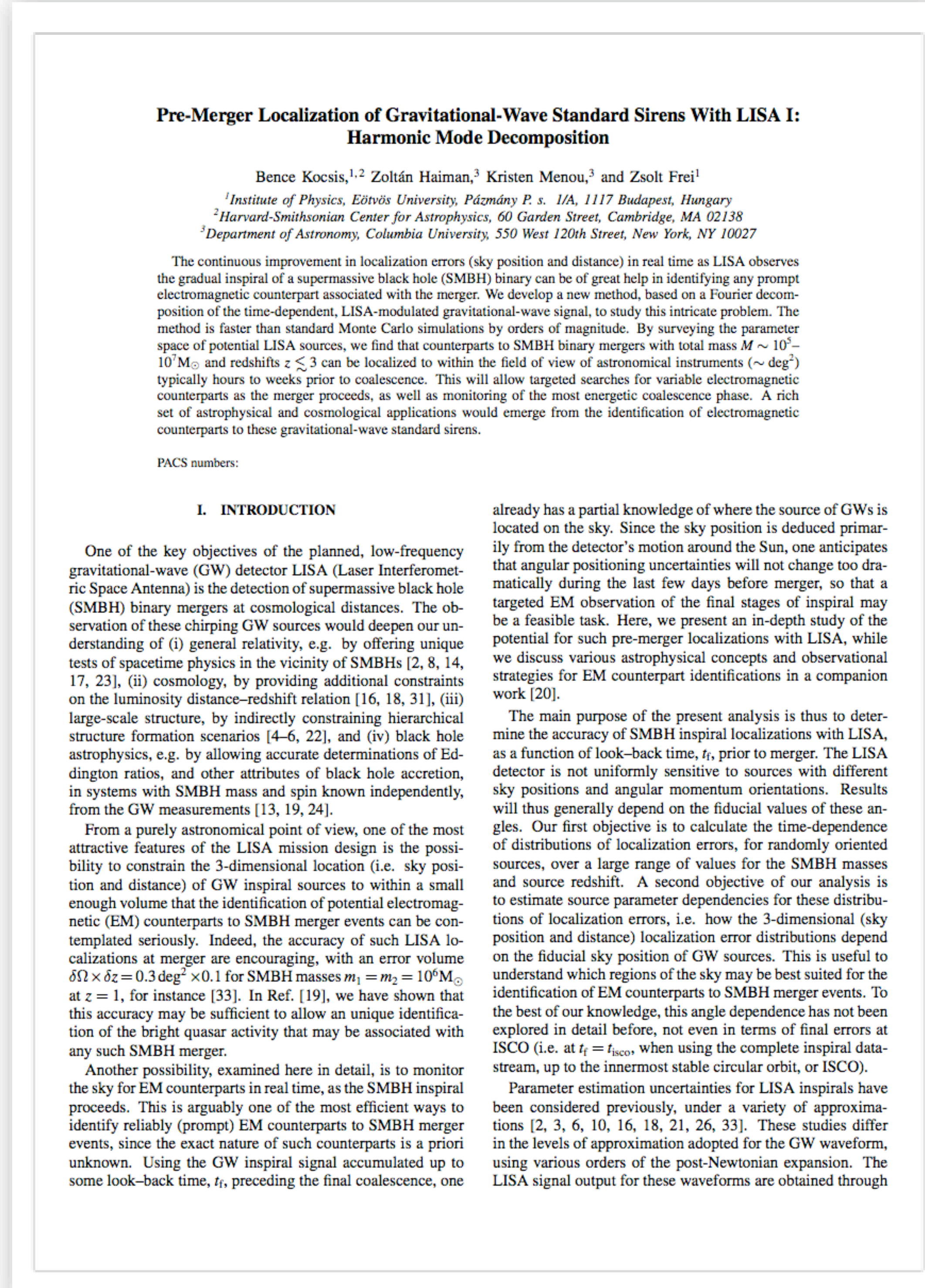
The sensitivity of algorithms can be characterized by Receiver Operating Curves (ROCs). Below are ROC curves corresponding to one of our algorithms (*Locust*), both in the case of Gaussian noise (left) and LIGO H1 noise (right).

Combining *Locust* and *Hough* algorithms in one process highly increases search robustness and sensitivity. Correlating spectra of multiple detectors also increases search sensitivity.

References

[1] M. van Putten et al. 2004, Phys. Rev. D, 69, 044007
[2] Raffai P., Z. Frei, and S. Márka, in preparation, to be submitted to CQG

Poster at GWDA11



Pre-Merger Localization of Gravitational-Wave Standard Sirens With LISA I: Harmonic Mode Decomposition

Bence Kocsis,[1,2] Zoltán Haiman,[3] Kristen Menou,[3] and Zsolt Frei[1]
[1]Institute of Physics, Eötvös University, Pázmány P. s. 1/A, 1117 Budapest, Hungary
[2]Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138
[3]Department of Astronomy, Columbia University, 550 West 120th Street, New York, NY 10027

The continuous improvement in localization errors (sky position and distance) in real time as LISA observes the gradual inspiral of a supermassive black hole (SMBH) binary can be of great help in identifying any prompt electromagnetic counterpart associated with the merger. We develop a new method, based on a Fourier decomposition of the time-dependent, LISA-modulated gravitational-wave signal, to study this intricate problem. The method is faster than standard Monte Carlo simulations by orders of magnitude. By surveying the parameter space of potential LISA sources, we find that counterparts to SMBH binary mergers with total mass $M \sim 10^5$–$10^7 M_\odot$ and redshifts $z \lesssim 3$ can be localized to within the field of view of astronomical instruments ($\sim \deg^2$) typically hours to weeks prior to coalescence. This will allow targeted searches for variable electromagnetic counterparts as the merger proceeds, as well as monitoring of the most energetic coalescence phase. A rich set of astrophysical and cosmological applications would emerge from the identification of electromagnetic counterparts to these gravitational-wave standard sirens.

PACS numbers:

I. INTRODUCTION

One of the key objectives of the planned, low-frequency gravitational-wave (GW) detector LISA (Laser Interferometric Space Antenna) is the detection of supermassive black hole (SMBH) binary mergers at cosmological distances. The observation of these chirping GW sources would deepen our understanding of (i) general relativity, e.g. by offering unique tests of spacetime physics in the vicinity of SMBHs [2, 8, 14, 17, 23], (ii) cosmology, by providing additional constraints on the luminosity distance–redshift relation [16, 18, 31], (iii) large-scale structure, by indirectly constraining hierarchical structure formation scenarios [4–6, 22], and (iv) black hole astrophysics, e.g. by allowing accurate determinations of Eddington ratios, and other attributes of black hole accretion, in systems with SMBH mass and spin known independently, from the GW measurements [13, 19, 24].

From a purely astronomical point of view, one of the most attractive features of the LISA mission design is the possibility to constrain the 3-dimensional location (i.e. sky position and distance) of GW inspiral sources to within a small enough volume that the identification of potential electromagnetic (EM) counterparts to SMBH merger events can be contemplated seriously. Indeed, the accuracy of such LISA localizations at merger are encouraging, with an error volume $\delta\Omega \times \delta z = 0.3\,\deg^2 \times 0.1$ for SMBH masses $m_1 = m_2 = 10^6 M_\odot$ at $z = 1$, for instance [33]. In Ref. [19], we have shown that this accuracy may be sufficient to allow an unique identification of the bright quasar activity that may be associated with any such SMBH merger.

Another possibility, examined here in detail, is to monitor the sky for EM counterparts in real time, as the SMBH inspiral proceeds. This is arguably one of the most efficient ways to identify reliably (prompt) EM counterparts to SMBH merger events, since the exact nature of such counterparts is a priori unknown. Using the GW inspiral signal accumulated up to some look–back time, t_f, preceding the final coalescence, one already has a partial knowledge of where the source of GWs is located on the sky. Since the sky position is deduced primarily from the detector's motion around the Sun, one anticipates that angular positioning uncertainties will not change too dramatically during the last few days before merger, so that a targeted EM observation of the final stages of inspiral may be a feasible task. Here, we present an in-depth study of the potential for such pre-merger localizations with LISA, while we discuss various astrophysical concepts and observational strategies for EM counterpart identifications in a companion work [20].

The main purpose of the present analysis is thus to determine the accuracy of SMBH inspiral localizations with LISA, as a function of look–back time, t_f, prior to merger. The LISA detector is not uniformly sensitive to sources with different sky positions and angular momentum orientations. Results will thus generally depend on the fiducial values of these angles. Our first objective is to calculate the time-dependence of distributions of localization errors, for randomly oriented sources, over a large range of values for the SMBH masses and source redshift. A second objective of our analysis is to estimate source parameter dependencies for these distributions of localization errors, i.e. how the 3-dimensional (sky position and distance) localization error distributions depend on the fiducial sky position of GW sources. This is useful to understand which regions of the sky may be best suited for the identification of EM counterparts to SMBH merger events. To the best of our knowledge, this angle dependence has not been explored in detail before, not even in terms of final errors at ISCO (i.e. at $t_f = t_{isco}$, when using the complete inspiral datastream, up to the innermost stable circular orbit, or ISCO).

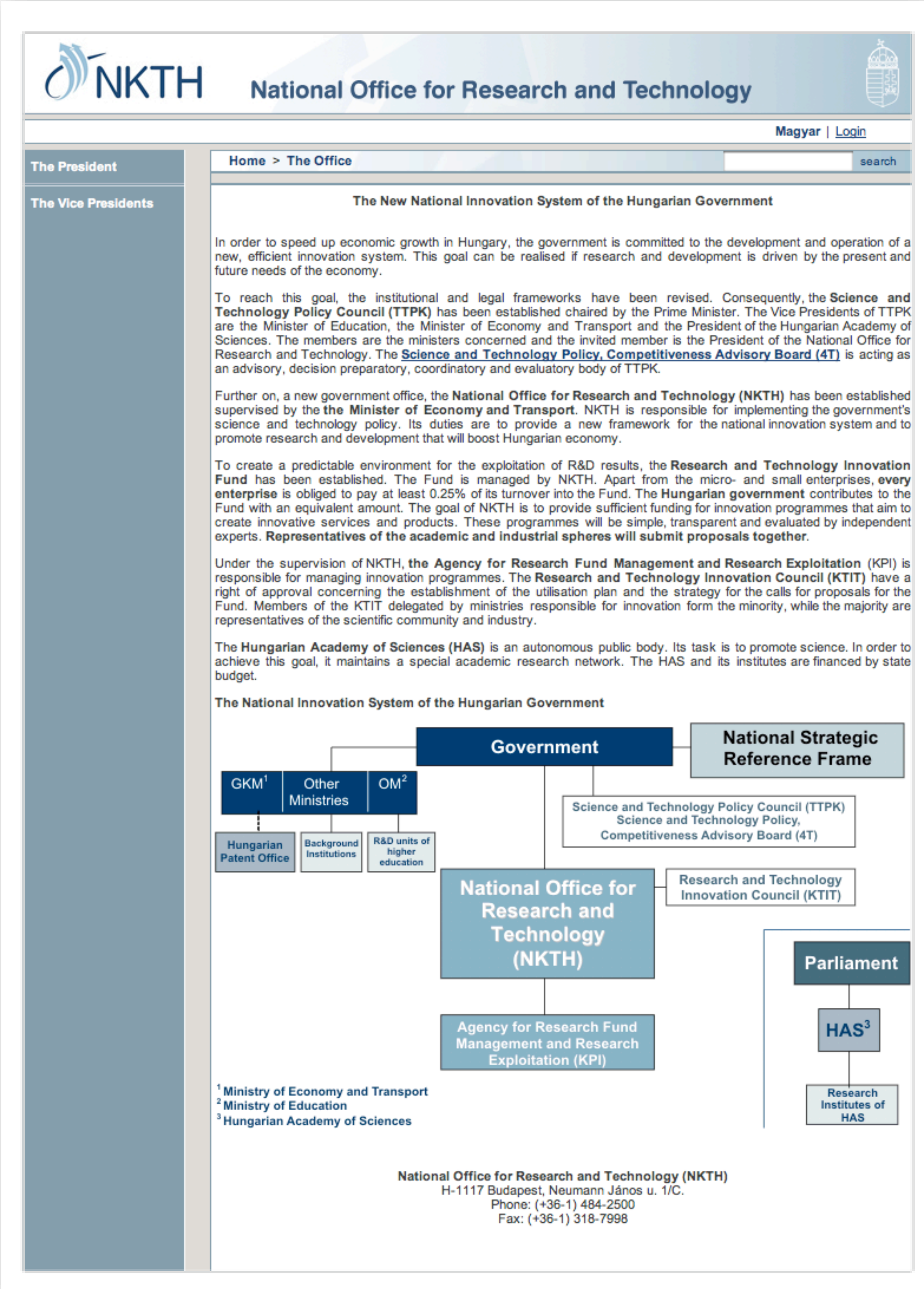
Parameter estimation uncertainties for LISA inspirals have been considered previously, under a variety of approximations [2, 3, 6, 10, 16, 18, 21, 26, 33]. These studies differ in the levels of approximation adopted for the GW waveform, using various orders of the post-Newtonian expansion. The LISA signal output for these waveforms are obtained through

recent Phys. Rev. paper

Publications

Outline

- ☑ MoU particulars
- ☑ Our school, group, and members
- ☐ Funds



NKTH National Office for Research and Technology

Magyar | Login

The President

The Vice Presidents

Home > The Office search

The New National Innovation System of the Hungarian Government

In order to speed up economic growth in Hungary, the government is committed to the development and operation of a new, efficient innovation system. This goal can be realised if research and development is driven by the present and future needs of the economy.

To reach this goal, the institutional and legal frameworks have been revised. Consequently, the **Science and Technology Policy Council (TTPK)** has been established chaired by the Prime Minister. The Vice Presidents of TTPK are the Minister of Education, the Minister of Economy and Transport and the President of the Hungarian Academy of Sciences. The members are the ministers concerned and the invited member is the President of the National Office for Research and Technology. The **Science and Technology Policy, Competitiveness Advisory Board (4T)** is acting as an advisory, decision preparatory, coordinatory and evaluatory body of TTPK.

Further on, a new government office, the **National Office for Research and Technology (NKTH)** has been established supervised by the **the Minister of Economy and Transport**. NKTH is responsible for implementing the government's science and technology policy. Its duties are to provide a new framework for the national innovation system and to promote research and development that will boost Hungarian economy.

To create a predictable environment for the exploitation of R&D results, the **Research and Technology Innovation Fund** has been established. The Fund is managed by NKTH. Apart from the micro- and small enterprises, **every enterprise** is obliged to pay at least 0.25% of its turnover into the Fund. The **Hungarian government** contributes to the Fund with an equivalent amount. The goal of NKTH is to provide sufficient funding for innovation programmes that aim to create innovative services and products. These programmes will be simple, transparent and evaluated by independent experts. **Representatives of the academic and industrial spheres will submit proposals together.**

Under the supervision of NKTH, **the Agency for Research Fund Management and Research Exploitation** (KPI) is responsible for managing innovation programmes. The **Research and Technology Innovation Council (KTIT)** have a right of approval concerning the establishment of the utilisation plan and the strategy for the calls for proposals for the Fund. Members of the KTIT delegated by ministries responsible for innovation form the minority, while the majority are representatives of the scientific community and industry.

The **Hungarian Academy of Sciences (HAS)** is an autonomous public body. Its task is to promote science. In order to achieve this goal, it maintains a special academic research network. The HAS and its institutes are financed by state budget.

The National Innovation System of the Hungarian Government

National Office for Research and Technology (NKTH)
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Phone: (+36-1) 484-2500
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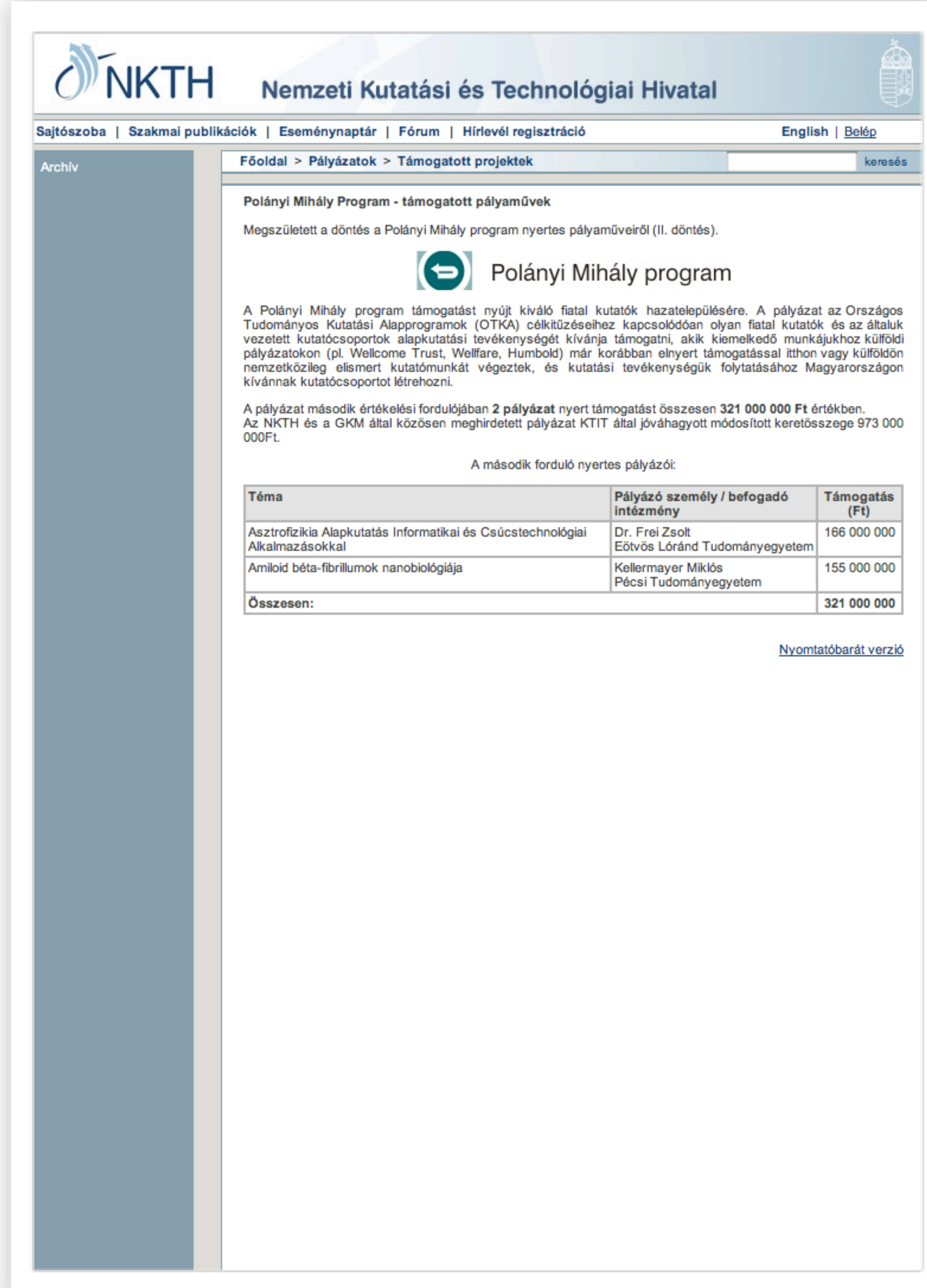


NKTH Nemzeti Kutatási és Technológiai Hivatal

Sajtószoba | Szakmai publikációk | Eseménynaptár | Fórum | Hírlevél regisztráció English | Belép

Archív

Főoldal > Pályázatok > Támogatott projektek keresés

Polányi Mihály Program - támogatott pályaművek

Megszületett a döntés a Polányi Mihály program nyertes pályaműveiről (II. döntés).

Polányi Mihály program

A Polányi Mihály program támogatást nyújt kiváló fiatal kutatók hazatelepülésére. A pályázat az Országos Tudományos Kutatási Alapprogramok (OTKA) célkitűzéseihez kapcsolódóan olyan fiatal kutatók és az általuk vezetett kutatócsoportok alapkutatási tevékenységét kívánja támogatni, akik kiemelkedő munkájukhoz külföldi pályázatokon (pl. Wellcome Trust, Wellfare, Humbold) már korábban elnyert támogatással itthon vagy külföldön nemzetközileg elismert kutatómunkát végeztek, és kutatási tevékenységük folytatásához Magyarországon kívánnak kutatócsoportot létrehozni.

A pályázat második értékelési fordulójában **2 pályázat** nyert támogatást összesen **321 000 000 Ft** értékben.
Az NKTH és a GKM által közösen meghirdetett pályázat KTIT által jóváhagyott módosított keretösszege 973 000 000Ft.

A második forduló nyertes pályázói:

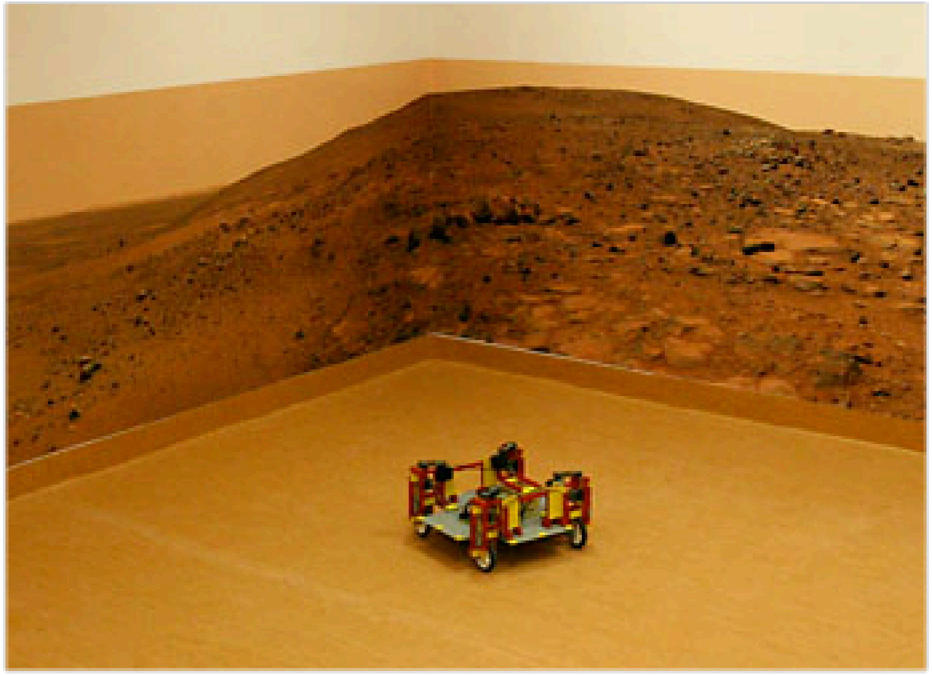
Téma	Pályázó személy / befogadó intézmény	Támogatás (Ft)
Asztrofizikia Alapkutatás Informatikai és Csúcstechnológiai Alkalmazásokkal	Dr. Frei Zsolt Eötvös Lóránd Tudományegyetem	166 000 000
Amiloid béta-fibrillumok nanobiológiája	Kellermayer Miklós Pécsi Tudományegyetem	155 000 000
Összesen:		**321 000 000**

Nyomtatóbarát verzió

Funding agency

and grant won



New lab space under construction at Eötvös

The End