

Gravitation

Conseil scientifique APC

Nov 2017

(Since last Apr 2016)

Gravitation group today

14 members total

7 permanent staff [5 HDR]

- 2 Univ, 4 CNRS + 1 emeritus
- +1: Stas Babak, -1: Gerard Auger

3 postdocs

- -2: Alberto Gatto, Matteo Tacca
- +2: Agata Trovato, Fangchen Feng

4 PhDs + 3 co-advised

- (+) 2 PhD defended last month

12 members as 2nd affiliation

Gravitational waves

AdVirgo and LISA

- Design, construction, installation, commissioning, data analysis, science, multimessenger astronomy

Other related activities

- Broader GW window
- Connection to geophysics

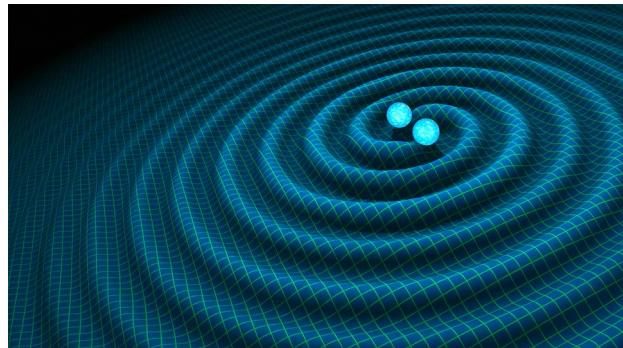
<http://apcweb.in2p3.fr/APCMediaWiki/Gravitation>
Bi-weekly meeting, Monday 11:00
APC-GRAVITATION-L@in2p3.fr

Gravitation by project

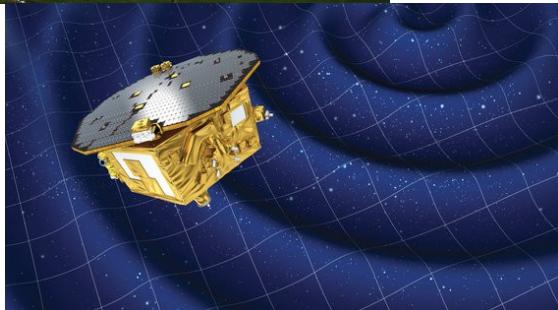
- LISA [4.6]: Stas Babak (.5), Antoine Petiteau (.4), Hubert Halloin (.5), Eric Pagnol (.6), Ed Porter (.2), Matthieu Laporte (1), Jean-Baptiste Bayle (1), [Yann Bouffanais (.4)] + (Chiara Caprini, Joseph Martino, Christelle Buy, ...)
- Virgo [8.8]: Stas Babak (.4), Matteo Barsuglia (.7), Eric Chassande-Mottin (.9), Ed Porter (.8), Donatella Fiorucci (.4), Agata Trovato (1), Fangchen Feng (1), Marc Arene (1), Philippe Bacon (1), [Yann Bouffanais (.6), Eleonora Capocasa (1)] + (Daniele Steer, Christelle Buy, ...)
- EPTA/IPTA: Stas Babak (.1), Antoine Petiteau (.1)
- Optical readout for seismology: Hubert Halloin (.1), Lucille Fayon (.6)
- Geophysics with gravity (e-GRAAL): Matteo Barsuglia (.3), Donatella Fiorucci (.6), Kevin Juhel (1)

staff, postdocs, PhD students

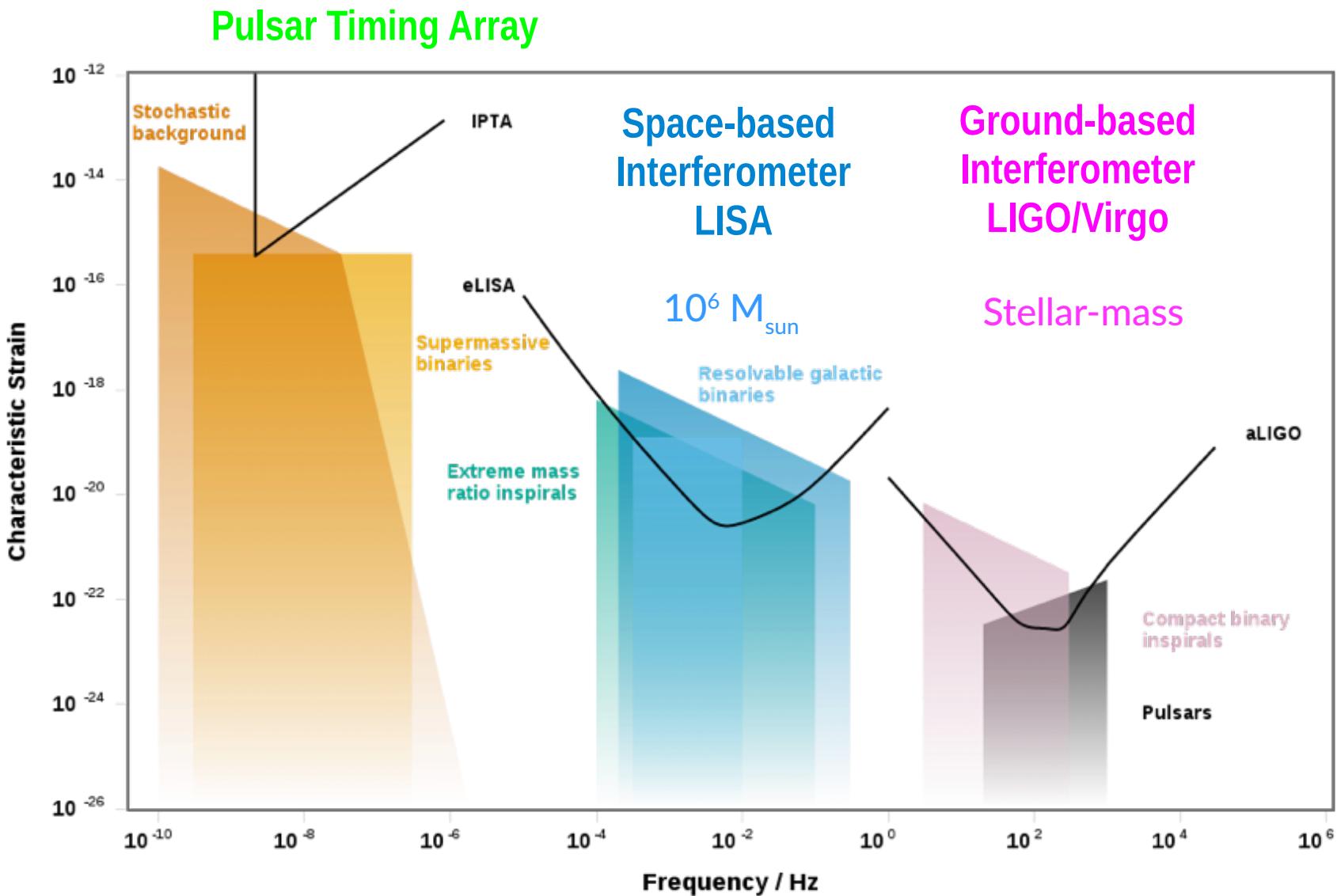
Primer on gravitational waves



- Prediction of general relativity
- Propagating vibrations of the space-time metric
 - Generated during the bulk motion of relativistic, massive systems
 - Strong gravitational field
- Gravitational wave astronomy
 - Compact star binaries – black hole, neutron star
 - Gravitational collapse – supernovae
- New probe useful for astrophysics, fundamental physics and cosmology
 - Test of general relativity
 - Formation of compact objects: star evolution, large structure
 - Physics of gamma-ray bursts
 - Nucleosynthesis in neutron star mergers
 - Physics of dense matter
 - Binaries are standard “gravitational sirens”
 - Early universe and primordial backgrounds
 - “Exotic physics” – Cosmic strings



Gravitational wave spectrum



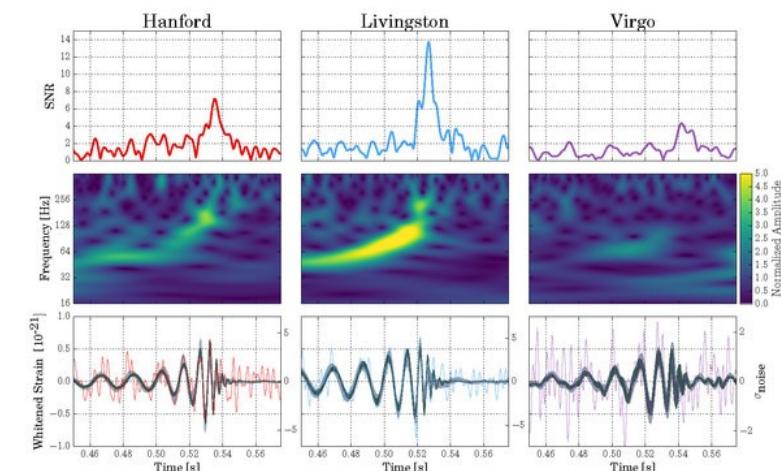
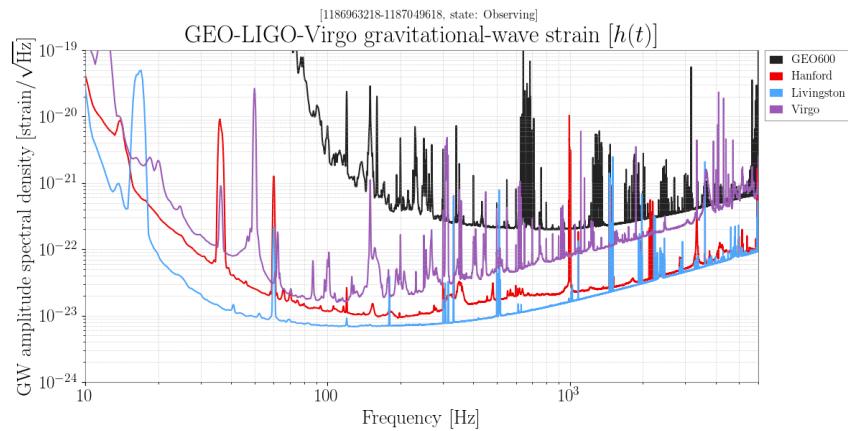
Where are we?

2015-17: **pivotal years** for gravitational waves

- **Ground-based detectors**
 - ◆ 2015 First direct detection of gravitational waves
 - +5 confirmed detections from binary black holes
 - ◆ 2017 Advanced Virgo joins the 2nd LIGO science run
 - First observations: “3-detector” BBH and 1st binary neutron star
- **Space-based detectors**
 - ◆ Success of LISA Pathfinder
 - ◆ LISA selected as ESA L3 mission – Moving to Phase A

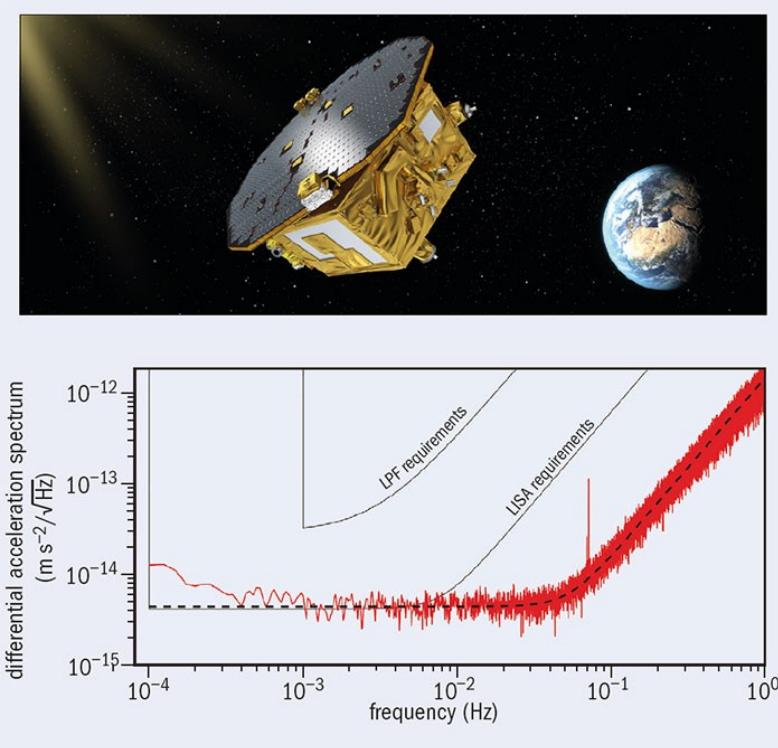
APC heavily involved in all those accomplishments

Highlights - 1



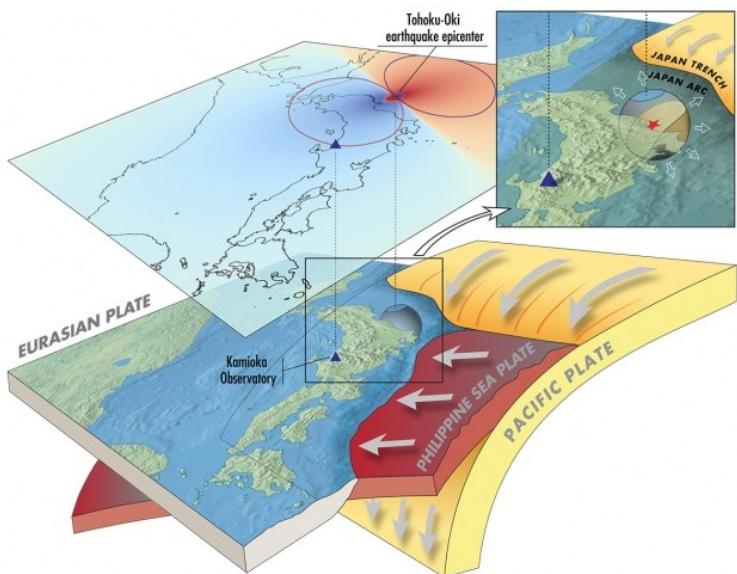
- 2015: first direct detections of gravitational waves
 - +4 binary black hole mergers since
- 2017: Advanced Virgo joins LIGO on Aug 1st
 - Horizon: 27 Mpc, 85 % duty cycle
 - Aug 14: BBH seen with three detectors
 - Aug 17: Binary neutron star
- +30 articles co-authored by 10 members from APC
- APC contributions
 - Design, instrument and commissioning of Advanced Virgo (telescopes)
 - Analysis, paper editing, coordination and review of all 3 seminal papers

Highlights - 2



- Great success of LISA Pathfinder
 - Demonstration of key technologies for LISA, specifically for drag compensation and interferometry
- Paper co-authored by 8 members from APC
- APC contributions
 - Laser Modulation Unit
 - LPF characterization (drag-free system, crosstalk, microthrusters, glitches)

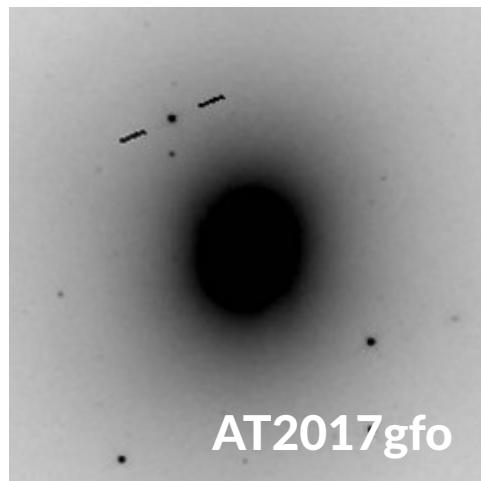
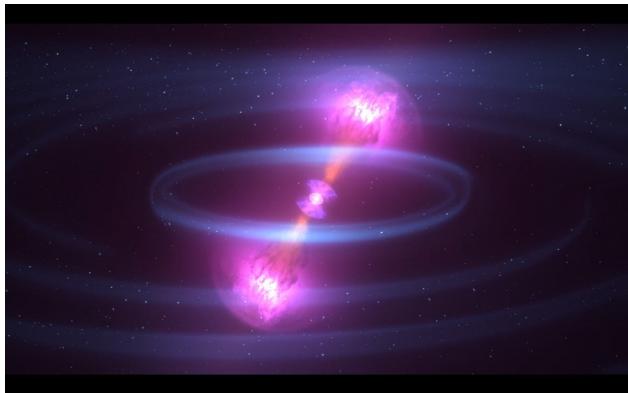
Highlights - 3



In collaboration with Institut de Physique du Globe de Paris, LabEx UnivEarthS, ANR project E-GRAAL

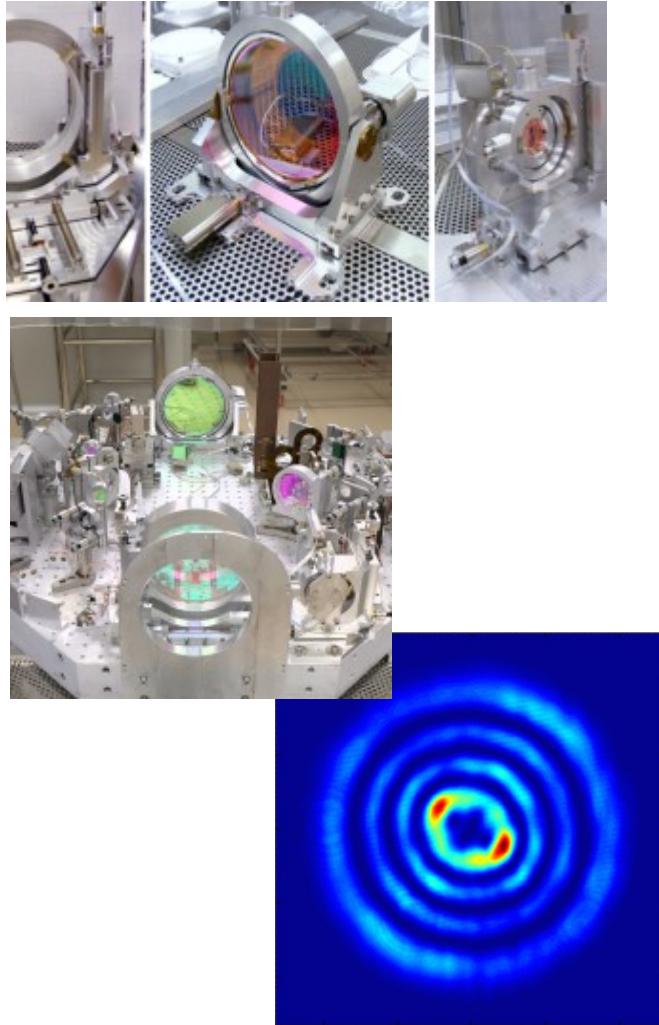
- First observation of the prompt “Newtonian” gravity signal induced by mass redistribution during an Earthquake (Tohoku-Oki, 2011)
- Gravity-based earthquake early-warning systems
 - Faster than current P-wave based systems

Highlights - 4



- Multimessenger observation of the binary neutron star
 - Followed by electromagnetic counterparts: GRB, kilonova, afterglow
- 10 papers co-authored by 10 members from APC
- APC contributions
 - Initial definition of the LIGO-Virgo electromagnetic follow-up program
 - BNS discovery and multimessenger paper writing
 - Involved in VLT/X-Shooter spectrometry, VLBI radio follow-up with the EVN (on-going)
 - Series of preparation discussion meetings at APC

Virgo – Instrument science

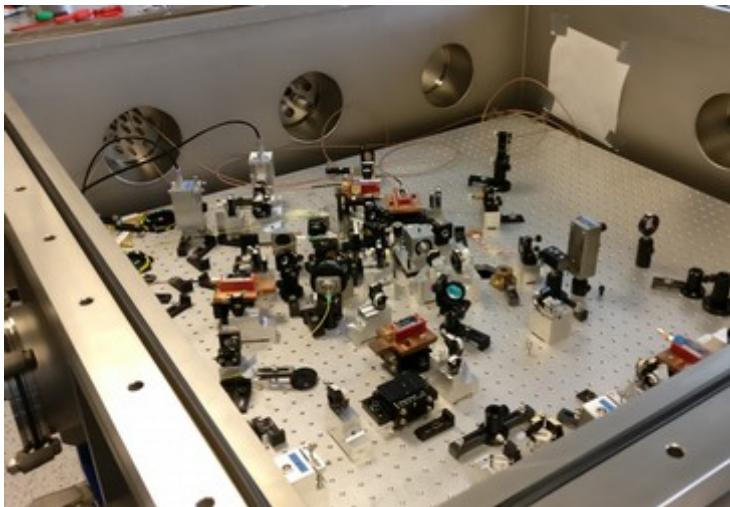


- Realization of the “mode-matching” telescopes
 - Design, construction, test and integration by the group (lead: Matteo B) – Now fully operating
 - R&D to enhance gravitational-wave detector sensitivity
 - To reduce the impact of thermal noise through the use of non-Gaussian laser beams
 - Contribution to a frequency-dependent squeezing experiment, to reduce the quantum noise
 - Impact of low-freq atmospheric Newtonian noise

In collaboration with

- Instrumentation, Mechanics, Electronics

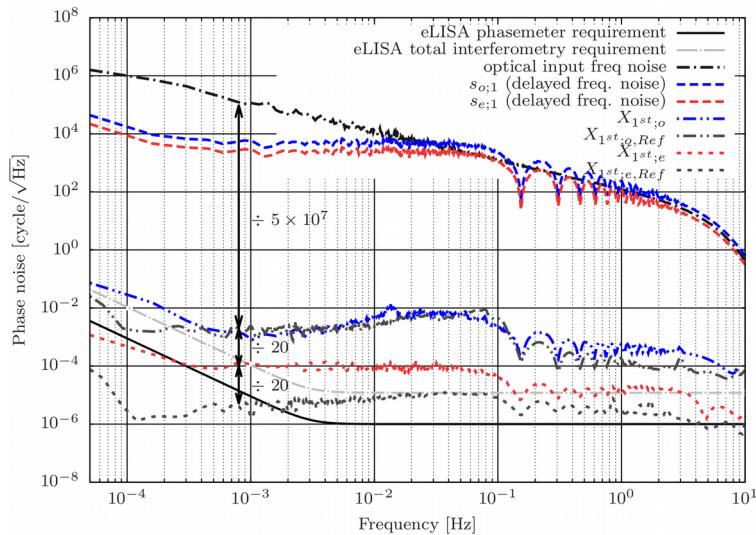
LISA – Instrument science



- Laser Modulation Unit on LISA Pathfinder
- “LISA on table”
 - Table-top experiment to validate time-delay interferometry, a technique used in LISA to cancel the laser freq noise and reach sensitivity specs
 - Reduction of 8 order of magnitude for static, unequal arm length interferometers, with realistic propagation delays
- Preparation of French contributions (AIVT and data processing center) – See later

In collaboration with

- Instrumentation, Mechanics, Electronics, IT, FAcCe



Virgo & LISA – Data analysis and science

- Gravitational waveform modelling
 - Compact binary mergers (eccentricity, ...)
- Development of search and parameter estimation algorithms
 - Transient time-frequency searches
 - Bayesian inference both Virgo and LISA
 - Expertise in Bayesian sampling techniques and development of new technique (e.g., Hamiltonian MC sampler)
- Science
 - Co-responsabilities of analysis group both in Virgo and LISA

Support and grants

- Project fundings
 - AdVirgo activities supported by CNRS (TGIR) through EGO [mission + staff support, construction telescope]
 - LISA activities supported by CNES [LISA France, LPF, LISA R & D]
- Additional grants
 - SP7 Elites (Japan), Mastodons, LabEx UnivEarthS [multimessenger, E3, opt readout], ANR e-GRAAL (2014-18), ANR wavegraph (2015-19), PICS France/Inde (2015-16), CEFIPRA (2016-19), H2020 ASTERICS (2014-2019), H2020 Cost News (2017-21)

Publications (2013-17)

114 articles in peer-reviewed journals

1 book editing

3 contributed book chapters

71 intervention in conferences (17 invited, ~10 from students)

27 proceedings

(Selection of publications in appendix)

Outreach and visibility

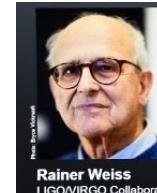


- Outreach

- Contact with the medias
 - Many interviews in major national newspapers, and radio broadcasts
- Events
 - MOOC Gravity! (90 000 attendees)
 - La nuit des ondes gravitationnelles (10 000 participants)
 - Fête de la science



- 13 workshops, conferences, schools co-organized by members of the Gravitation team in the last 5 yrs
- Recognition and prizes
Breakthrough prizes in fundamental physics, Gruber prize



Rainer Weiss
LIGO/VIRGO Collaboration



Barry C. Barish
LIGO/VIRGO Collaboration

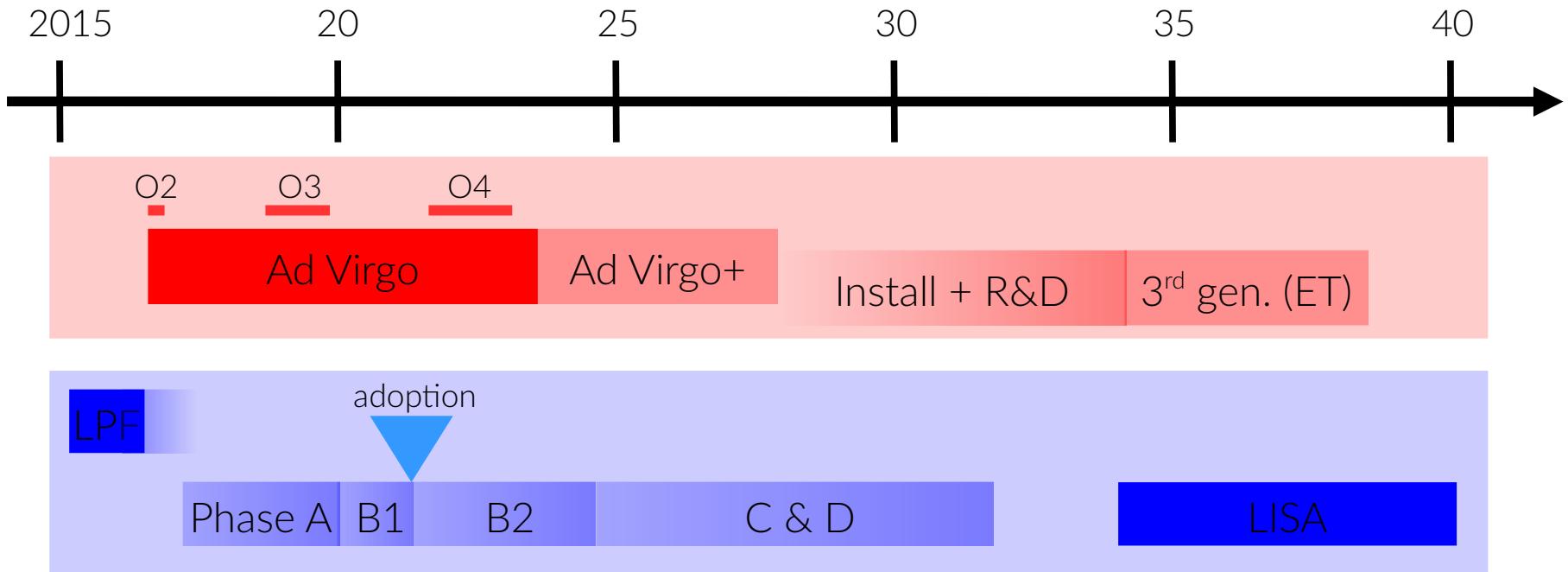


Kip S. Thorne
LIGO/VIRGO Collaboration



5 yr perspective

- Next 5 years – Crucial for the science of the Gravitation group
 - Advanced Virgo will perform **three joint science runs with LIGO**. Last run with sensitivity close to design. **Will produce the bulk of the science**. Future upgrades are being defined (use of squeezed light).
 - LISA – 2018-20: Phase A (feasability studies); 2021-22: Mission adoption



Plans for Advanced Virgo

- **Instrument science**
 - R&D are **inline with future projects** (Advanced Virgo+, Einstein telescope) : quantum noise with filter cavities, atmospheric Newtonian noise modelling, thermal noise with Laguerre-Gauss beams
 - Active participation to upgrade definition (Virgo and ET science team)
- **Data analysis and science**
 - Increase focus on data analysis and interpretation, in **continuity with on-going activities** (burst searches, rapid CBC parameter estimation)
 - Develop **new links** with cosmology, and astrophysics (binary formation)
 - Get involved in **open science**
- **Multimessenger astronomy**
 - In connection to SVOM and Taranis (being investigated)
 - Radio follow-up – VLBI, NenuFAR

Plans for LISA

- **Priorities:** national mission deliverables
 - Data processing center, instrument AIVT
- **Instrument science**
 - Initial studies for AIVT (phase 0)
 - Scope and lab contributions being defined with CNES
 - Characterization of low noise, low frequency electronics devices (e.g. voltage sources) and development of tunable, ultra-stable RF sources
 - Mission end-to-end simulation: noise budget and time series generation
 - Stray light studies (with Thales Alenia Space, ARTEMIS and LMA) for the design of LISA telescopes
- **Data analysis and science**
 - Data processing center
 - Currently prototype in development
 - *LISA data challenge*: platform for developing the data analysis pipelines using simulated LISA data from source catalogues and "realistic" LPF-based noise model

Connection with other groups

- Series of joint meetings about promising topics
 - Theory
 - Cosmic strings → D Steer
 - Stochastic backgrounds → M Pieroni, V Domcke, C Caprini
 - Cosmology
 - Primordial black holes → internship co-advised by E Porter/J Bartlett, project of a workshop
 - High-energy astrophysics
 - Multimessenger astronomy → ANTARES, INTEGRAL, HESS
LabEx project on compact binary formation with Sylvain Chaty
- Group involvement in GdR Ondes Gravitationnelles
 - National action – networking and community building

SWOT

- Strengths

High visibility and recognized expertise in both advanced Virgo and LISA projects
Involvement in ground-based and space-based experiments allows cross fertilization and exchange of expertise (experimental and data analysis) ... but complementary science (different wavelength, different source reach)

- Weaknesses

Man power is lacking – Does not scale with involvement in two major projects
Age pyramid skewed (over 45 to under 45 ratio is 2) -- Need young researchers!

- Opportunities

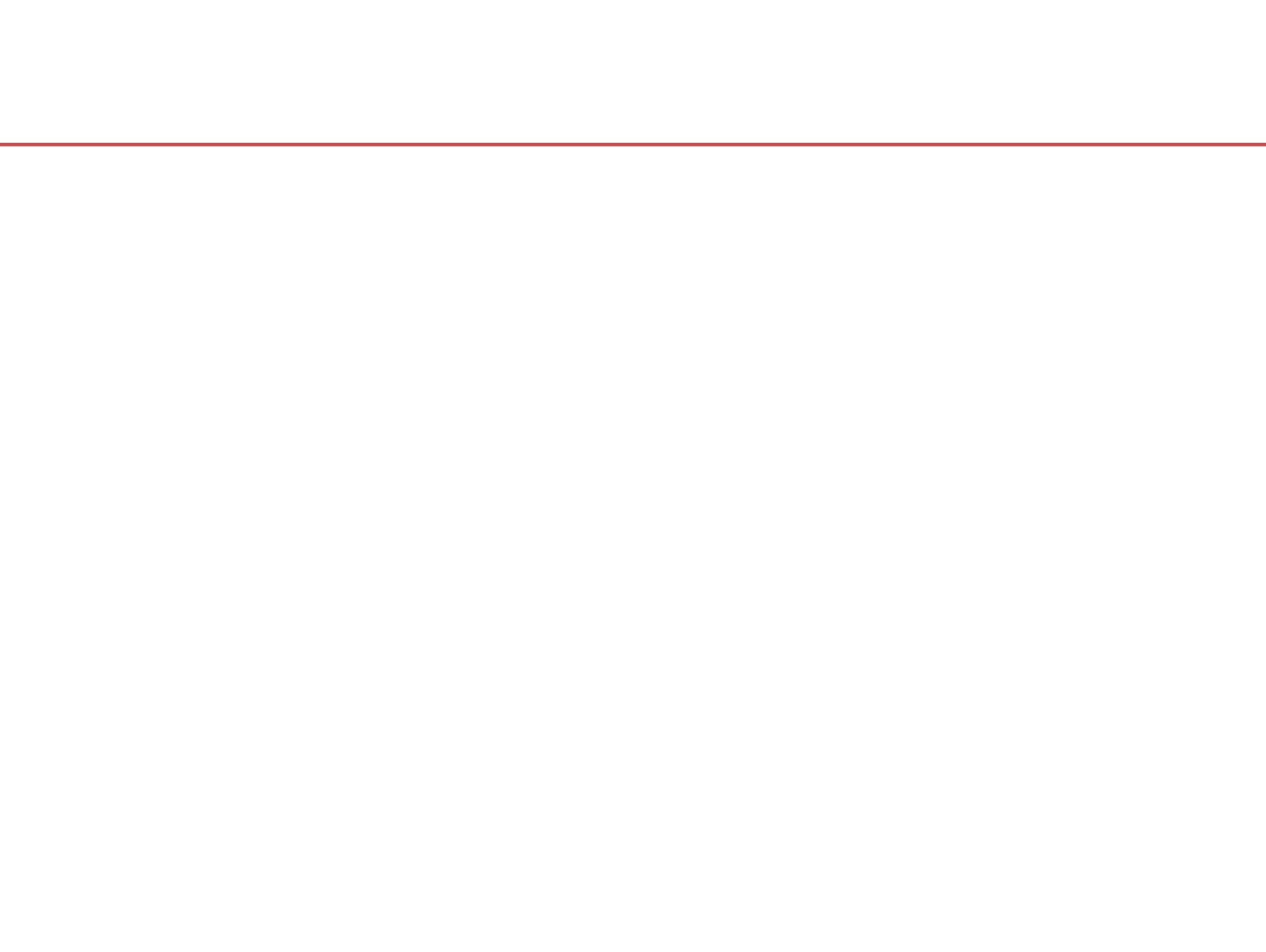
GW astronomy has a large discovery potential – The field will ramp up during the next 20 yrs. AdVirgo funded, LISA selected (strong support from CNES and ESA)

- Threats

GW community (in France) remains limited – Attract new researchers is essential

Conclusions

- ◆ **Next five years exciting**
 - Major science run for Advanced Virgo on the road to design sensitivity – Preparation of upgrades (adVirgo+)
 - LISA on the path to mission adoption
- ◆ **APC is a major player in gravitational wave physics in France**
 - Important realizations
 - Well recognized expertise



Gravitation group today

- 7 permanents [HDR en italique]
 - *Stas Babak* (DR), *Matteo Barsuglia* (DR), *Eric Chassande-Mottin* (DR), Hubert Halloin (MC), Antoine Petiteau (MC), *Eric Plagnol* (DR Emerite), *Ed Porter* (CR)
- 2 postdocs
 - Donatella Fiorucci, Virgo/low-frequency, ANR E-GRAAL, 2015-2017
 - Agata Trovato, Virgo/Openscience, H2020 ASTERICS, 2017-2019
 - Fangchen Feng, Virgo/Wavegraph, ANR Wavegraph, 2017-2019
- 6 doctorants
 - Marc Arene, Bayesian estimation LIGO/Virgo, ED, Ed P, 2020
 - Philippe Bacon, Transient search LIGO/Virgo, H2020, Eric CM, 2018
 - Jean-Baptiste Bayle, instrument simulation LISA, ED, Antoine P, 2019
 - *Yann Bouffanais*, Bayesian estimation LISA and LIGO/Virgo, ED, Ed P, 2017
 - *Eleonora Capocasa*, Virgo commission/squeezing, ED/EGO, Matteo B, 2017
 - Matthieu Laporte, LISA on Table, ED, Hubert H, 2018

Bilan de publications (2013-17) - 1

Selection de publications

1. B.-P. Abbott et al., Observation of Gravitational Waves from a Binary Black Hole Merger. VIRGO Collaboration, Phys. Rev. Lett., 116 (2016) 061102
2. B.-P. Abbott et al., Observing gravitational-wave transient GW150914 with minimal assumptions. VIRGO Collaboration, Phys. Rev. D, 93 (2016) 122004
3. B.-P. Abbott et al., Binary Black Hole Mergers in the first Advanced LIGO Observing Run. VIRGO Collaboration, Phys Rev X 6 (2016) 041015
4. B.-P. Abbott et al., GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence, Phys. Rev. Lett., 116 (2016) 241103
5. B. P. Abbott et al., GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2 Phys. Rev. Lett. 118, 221101
6. B.-P. Abbott et al., Localization and broadband follow-up of the gravitational-wave transient GW150914. VIRGO Collaboration, Astrophys. J., 826 (2016) L13
7. B.-P. Abbott et al., Astrophysical Implications of the Binary Black-Hole Merger GW150914. VIRGO Collaboration, Astrophys. J., 818 (2016) L22
8. B.-P. Abbott et al., Properties of the Binary Black Hole Merger GW150914. VIRGO Collaboration, Phys. Rev. Lett., 116 (2016) 241102
9. B.-P. Abbott et al., Tests of general relativity with GW150914. VIRGO Collaboration, Phys. Rev. Lett., 116 (2016) 221101
10. M. Tacca, F. Sorrentino, C. Buy, M. Laporte, G. Pillant, E. Genin, P. La Penna, et M. Barsuglia. 2016. « Tuning of a High Magnification Compact Parabolic Telescope for Centimeter-Scale Laser Beams ». Applied Optics 55 (6): 1275-83. doi:10.1364/AO.55.001275.
11. B.-P. Abbott et al., Implementation and testing of the first prompt search for gravitational wave transients with electromagnetic counterparts. VIRGO Collaboration, Astron. Astrophys., 539 (2012) A124
12. F. Acernese et al. .Advanced Virgo: a second-generation interferometric gravitational wave detector. VIRGO Collaboration, Classical Quant. Grav., 32 (2015) 024001
13. S. Adrian-Martinez et al., .A First Search for coincident Gravitational Waves and High Energy Neutrinos using LIGO, Virgo and ANTARES data from 2007. VIRGO Collaboration, J. Cosmol. Astropart. P., 1306 (2013) 008
14. Armano, M., et al., 2016. Sub-Femto- g Free Fall for Space-Based Gravitational Wave Observatories: LISA Pathfinder Results. Phys.Rev.Lett. 116 (juin): 231101. doi:10.1103/PhysRevLett.116.231101.

Bilan de publications (2013-17) - 2

Selection de publications

15. Armano, M., H. Audley, G. Auger, J. T. Baird, P. Binetruy, M. Born, D. Bortoluzzi, et al. 2017. « Charge-induced force-noise on free-falling test masses: results from LISA Pathfinder ». *Phys.Rev.Lett.* 118 (avril): 171101. doi:10.1103/PhysRevLett.118.171101.
16. P. Gruening, H. Halloin, P. Prat, S. Baron, J. Brossard, C. Buy, A. Petiteau, G. Heinzel, et I. Bykov. 2015. « Status of the ELISA on Table (LOT) Electro-Optical Simulator for Space Based, Long Arms Interferometers ». *Experimental Astronomy* 39 (2): 281-302. doi:10.1007/s10686-015-9448-z.
17. E.K. Porter, et Jérôme Carré. 2014. « A Hamiltonian Monte Carlo method for Bayesian Inference of Supermassive Black Hole Binaries ». *Class.Quant.Grav.* 31: 145004. doi:10.1088/0264-9381/31/14/145004.
18. Y. Bouffanais, et E. K. Porter. 2016. « Detecting compact galactic binaries using a hybrid swarm-based algorithm ». *Phys.Rev.* D93 (mars): 064020. doi:10.1103/PhysRevD.93.064020.
19. P. Binetruy, A. Bohe, C. Caprini, et J-F. Dufaux. 2012. « Cosmological Backgrounds of Gravitational Waves and eLISA/NGO: Phase Transitions, Cosmic Strings and Other Sources ». *JCAP* 1206: 027. doi:10.1088/1475-7516/2012/06/027.
20. J-P. Montagner, K. Juhel, M. Barsuglia, J-P. Ampuero, E. Chassande-Mottin, J. Harms, B. Whiting, P. Bernard, E. Clevede, et P. Lognonne. 2016. « Prompt Gravity Signal Induced by the 2011 Tohoku-Oki Earthquake ». *Nature Communications* 7 (novembre): 13349. doi:10.1038/ncomms13349
21. Taylor, S. R., C. M. F. Mingarelli, et al. (A. Petiteau) 2015. « Limits on Anisotropy in the Nanohertz Stochastic Gravitational Wave Background ». *Physical Review Letters* 115 (4): 041101. doi:10.1103/PhysRevLett.115.041101.
22. Gatto, A., M. Tacca, F. Kefelian, C. Buy, et M. Barsuglia. 2014. « Fabry-Perot-Michelson Interferometer Using Higher-Order Laguerre-Gauss Modes ». *Physical Review D* 90 (12): 122011. doi:10.1103/PhysRevD.90.122011.
23. E. Capocasa, M. Barsuglia, J. Degallaix, L. Pinard, N. Straniero, R. Schnabel, K. Somiya, Y. Aso, D. Tatsumi, et R. Flaminio. 2016. « Estimation of losses in a 300 m filter cavity and quantum noise reduction in the KAGRA gravitational-wave detector ». *Phys.Rev.* D93 082004. doi:10.1103/PhysRevD.93.082004.

Évolution récente (5 dernières années)

- Permanents

- + Stas Babak (DR), arrivé en 2017
- Eric Plagnol (DR > emerite) en 2015
- Gérard Auger (emerite), parti en 2015
- Eric Lebigot (CR), parti en 2015

- Postdocs

- Matteo Tacca, Commissioning AdVirgo, EGO, 2013-2017
- Alberto Gatto, Laguerre Gauss, ANR, 2015-2016

- HDR obtenues ou imminentes

- Chassande-Mottin, 2014
- Porter, 2014
- Halloin, prochainement

- Visiteurs (> 1 mois)

- Sergey Klimenko (Florida)
- Bernard Whiting (Florida)

Historique des doctorants

Soutenue depuis 2012

- Eleonora CAPOCASA, oct 2014-nov 2017, Dir: Matteo Barsuglia, Etudes optiques et de bruit pour advanced Virgo et cavités de filtrage pour la réduction du bruit quantique dans les détecteurs interferométriques des ondes gravitationnelles
- Yann BOUFFANNAIS, oct 2014-oct 2017, Dir: Ed Porter, The identification of compact objects in the galaxy
- Henri INCHAUSPE, 2012--Nov 2015, Dir: Eric Plagnol: From LISA pathfinder to eLISA: building of a dynamics simulator for the eLISA space mission. <http://hal.in2p3.fr/tel-01292840>
- Pierre GRUNING, 2012--Déc 2015, Dir: Eric Plagnol (Hubert Halloin): Développement et exploitation d'un stimulateur électro-optique pour le futur détecteur spatial à ondes gravitationnelles eLISA <http://hal.in2p3.fr/tel-01307782>
- Jérôme CARRE, 2009--2012, Eric Plagnol (Ed Porter), The modeling and detection of gravitational waves for Lisa, <http://www.sudoc.fr/193367890>

En cours

- Marc ARENE, oct 2017, Dir: Ed Porter, en cours
- Jean-Baptiste BAYLE, oct 2016, Dir: Antoine Petiteau, en cours
- Philippe BACON, oct 2015, Dir: Eric Chassande-Mottin, en cours
- Matthieu LAPORTE, oct 2015, Dir: Matteo Barsuglia (Hubert Halloin), en cours

En cotutelle

- Kévin JUHEL, JP Montagner/Matteo Barsuglia, 2014-dec 2017 Système d'alerte rapide aux tremblements de terre à partir des anomalies gravimétriques instantanées
- Lucie FAYON, Philippe Lognonné/Hubert Halloin, oct 2014, Système de lecture optique pour sismométrie planétaire et modélisation mécanique du système de nivellation de l'instrument SEIS, en cours
- Hien PHAN THANH, Philippe Laurent/Hubert Halloin, oct 2015, Développement du détecteur de rayons gamma et électrons (scintillateur) à bord du satellite IGOSat, en cours

Responsabilités scientifiques – 1

- Member of the Virgo Steering Committee (since 2008, M. Barsuglia)
- Membre du LIGO Program Advisory Committee (PAC), (2012-2014, M. Barsuglia)
- Co-chair of the Compact Binary Coalescence (CBC) group for the Advanced LIGO/Virgo collaboration (2016-present, E. Porter)
- Member of the Data Analysis Council (DAC) for the Advanced LIGO/Virgo collaboration (2016-present, E. Porter)
- Co-chair of the LISA Data Analysis working group (2012-present, E. Porter)
- Member of the EGO/Virgo Science and Technology Advisory Committee (STAC), (2010-2015, E. Porter)
- Member of the EGO/Virgo External Computing Committee (ECC), (2012-2014, E. Porter)
- Eric Chassande-Mottin, Co-chair of the committee in charge of defining the LIGO Virgo electromagnetic follow-up program (2013-2014)
- Eric Chassande-Mottin, Co-chair of the Burst group of the LIGO/Virgo collaboration (2014-2016)
- Eric Chassande-Mottin, Member of the Data Analysis Council (DAC) for the LIGO/Virgo collaboration (2014-2016)

Responsabilités scientifiques – 2

- Antoine Petiteau, Member of Scientific Council of “Action Spécifique” GPhys (Gravitation et Physique fondamentale) of Observatoire de Paris (2014-present)
- Antoine Petiteau, French lead of LISA Data Processing Center (2014-present)
- Antoine Petiteau, French PI of LISAPathfinder mission (2014-present)
- Antoine Petiteau, co-chair of LISA Simulation Working Group (2014-2017)
- Antoine Petiteau, Member of the LISA Consortium Board (2017-present)
- Antoine Petiteau, Co-PI of LISA and member of the LISA Consortium Executive Board (2017-present)
- Antoine Petiteau, Member of the LISA Science Study Team at ESA (2017-present)
- Eric Plagnol, French PI of LISAPathfinder mission (2005 – 2014)
- Hubert Halloin, co-chair of the LISA Science of Measurement Working group (2014-Present)

Conferences (2013-17) – 1

- 2013: Eric Chassande-Mottin, Atelier SIERRA, Lyon (invited)
2014: Eric Chassande-Mottin, Atelier GPhys, Meudon
2014: Eric Chassande-Mottin, LSST France, Paris
2015: Eric Chassande-Mottin, EWASS 2015, Tenerife
2015: Eric Chassande-Mottin, Atelier PNHE, SF2A, Toulouse
2015: Eric Chassande-Mottin, ASTROGAM workshop, Paris
2016: Eric Chassande-Mottin, Conférence-débat, Académie des sciences, Paris
2016: Eric Chassande-Mottin, ADASS XXVI, Trieste (plenary, invited)
2016: Eric Chassande-Mottin, Séminaire Poincaré XXII, Paris
2017: Eric Chassande-Mottin, Commémoration du prix Abel d'Yves Meyer, Cachan
2017: Eric Chassande-Mottin, XXVIe GRETSI, Juan les Pins (plenary, invited)
2013: Ed Porter, eLISA Consortium Meeting, Hannover
2014: Ed Porter, LISA Symposium X, Florida (plenary)
2014: Ed Porter, LISA Symposium X, Florida
2014: Ed Porter, San Cugat forum on Astrophysics, San Cugat (plenary, invited)
2014: Ed Porter, Atelier LISA-France, Paris
2014: Ed Porter, Cosmo in the Med, Malta (plenary, invited)
2014: Ed Porter, eLISA Consortium Meeting, Milan
2014: Ed Porter, APPeC Workshop, Paris
2015: Ed Porter, Rencontres de Moriond, La Thuile (plenary, invited)
2016: Ed Porter, Modern aspects of gravity and cosmology, Orsay (plenary, invited)
2016: Ed Porter, TeV Particle Astrophysics Workshop, CERN (invited)
2016: Ed Porter, Gravitational wave astrophysics in the high event rate regime, Tokyo (plenary, invited)
2016: Ed Porter, Workshop on numerical relativity in matter spacetimes for gravitational wave astronomy, Valencia (plenary)
2013: Antoine Petitjeau, European Pulsar Timing Array, Paris
2013: Antoine Petitjeau, GRAMMAP, Paris
2013: Antoine Petitjeau, International Pulsar Timing Array, Paris

permanents, postdocs et doctorants

Conferences (2013-17) – 2

- 2013: Antoine Petiteau, International Pulsar Timing Array, Paris
2013: Antoine Petiteau, European Pulsar Timing Array, Cagliari
2014: Antoine Petiteau, LISA Symposium X, Florida
2014: Antoine Petiteau, eLISA Consortium Meeting, Milan
2014: Antoine Petiteau, COSPAR, Moscou
2014: Antoine Petiteau, European Pulsar Timing Array, Cambridge
2014: Antoine Petiteau, Journée Atelier GPhys, Meudon
2015: Antoine Petiteau, Journée Ecole Doctorale, Caen (invited)
2015: Antoine Petiteau, LISA Cosmology Working Group, CERN
2015: Antoine Petiteau, Workshop distributed Computing in Astrophysics, Paris
2015: Antoine Petiteau, eLISA Consortium Meeting, Paris
2015: Antoine Petiteau, European Pulsar Timing Array, Bonn
2015: Antoine Petiteau, Journée Atelier GPhys, Paris
2015: Antoine Petiteau, LISA Cosmology Working Group, Stavanger
2015: Antoine Petiteau, Conférence SUCCES, Paris
2016: Antoine Petiteau, Journée LISA-France, Paris
2016: Antoine Petiteau, LISA Symposium 11, Zurich (invited)
2016: Antoine Petiteau, SF2A, Lyon
2016: Antoine Petiteau, Journée LISA-France, Paris
2016: Antoine Petiteau, Journée Atelier GPhys, Paris
2016: Antoine Petiteau, LISA Cosmology Working Group, Hambourg
2017: Antoine Petiteau, GW School, Benasque (invited)
2017: Antoine Petiteau, SF2A, Paris
2017: Antoine Petiteau, International Pulsar Timing Array, Paris (invited)
2014: Henri Inchauspé, COSPAR, Moscou
2014: Henri Inchauspé, LISA Symposium X, Florida
2014: Eric Plagnol, LISA Symposium X, Florida
2016: Eleonora Capocasa, GWADW, Ile d' Elbe

Conferences (2013-17) – 3

- 2013: Hubert Halloin, Gravitational Waves: New Frontier, Seoul, Invited
- 2014: Hubert Halloin, LISA France, Paris, Invited
- 2014: Hubert Halloin, Journées GRAM, Bordeaux, Invited
- 2015: Hubert Halloin, LISA Consortium meeting, Hanovre
- 2015: Hubert Halloin, INFIERI, Hambourg, Invited
- 2015: Hubert Halloin, Enseigner la Physique, Paris, Invited
- 2015: Hubert Halloin, CCT CNES - Environnement Spatial, Toulouse
- 2016: Hubert Halloin, LISA France, Paris, Invited
- 2016: Hubert Halloin, Journées GRAM, Paris, Invited
- 2016: Hubert Halloin, La relativité Générale en Action, Palais de la Découverte, Paris
- 2016: Hubert Halloin, 1er Workshop CubeSat Etudiant, Paris
- 2017: Hubert Halloin, LISA France
- 2016: Mathieu Laporte, LISA Symposium, Zurich
- 2016: Philippe Bacon, ADASS, Trieste
- 2017: Philippe Bacon, GWPAW, Annecy
- 2017: D.Steer, Cargese "Hot topics in modern cosmology", invited

Évolution prévue (en personnel)

- 1 départ à la retraite
- Post-doctorants
 - + 4 arrivées
 - - 1 départ

Visibilité et rayonnement

Organization of conferences, workshop, schools

2013: Ecole de Physique des AstroParticules, Observatoire de Haute Provence

2014: Frontiers in fundamental physics, APC, Paris

2016: Ecole Virtual Observatory (ASTERICS), Strasbourg

2016: Workshop on numerical relativity in matter spacetimes for gravitational wave astronomy, Valencia

2016: 1st International interdisciplinary workshop on time series analysis, APC, Paris

2016: 2nd International interdisciplinary workshop on time series analysis, APC, Paris

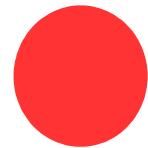
2016: Journées GRAM, Paris

2016: 1er Workshop Cubesat Etudiant, Paris

2017: 2nd Workshop Cubesat Etudiant, Paris

2017: Journées LISA France, APC, Paris

2017: Ecole Advanced Software Programming for Astrophysics and Astroparticle Physics (ASTERICS), LAPP, Annecy



Enseignement, animation, gestion

- Teaching
 - 2 maîtres de conférences
 - Numerical methods for physicists (Antoine P)
 - Optics, laser and aerospace studies (Hubert H)
 - PhD students and postdoc with teaching assignments
 - Involvement of CNRS researchers (doctoral school)
- Scientific animation at APC
 - Series of joint meetings with Cosmology, High-energy astro
 - Many contributions to Colloquia
 - Visit of Virgo site during Biennale
 - GdR Ondes Gravitationnelles

Enseignement, animation, gestion

Antoine Petiteau, Algorithm and Programming for Physicist, Licence 3 Physics (2011-2014)

Antoine Petiteau, Renewable Energy, Master 1 Physics (2011-2014)

Antoine Petiteau, Data Processing, Engineer School (2011-2014)

Antoine Petiteau, Algorithm and Programming for Physicist, Licence 2 Physics (2014-present)

Antoine Petiteau, Simulation, Licence 2 Physics (2014-present)

Hubert Halloin, Introduction to Celestial Mechanics, Master 1 USTH (2013 - Present)

Hubert Halloin, Algorithmes et Programmation, Licence 3 Physique Paris Diderot (2013)

Hubert Halloin, Physique du Laser, Master 1 Physique et EIDD Paris Diderot (2013)

Hubert Halloin, Science et Syst. Spatiaux, Licence 3 Physique, Paris diderot, (2014-present)

Hubert Halloin, Telecommunications spatiales, Master 2 OSIE, (2015 - present)

Hubert Halloin, Sources et détecteurs d'ondes gravitationnelles, Université Ouverte Paris Diderot, (2013 et 2014)

Hubert Halloin, Projets IGOSat (CubeSat étudiant), EIDD et master OSIE (2013 - present)

Matteo Barsuglia+Danièle Steer, ED STEP-UP, cours sur "Different aspects of the first GW direct detection", 2017&2018.

Matteo Barsuglia, Magistere Physique, Approche lagrangienne et relativité, (2013-15)

Eric Chassande-Mottin, Bayesian statistics, Ecole doctorale STEP'UP (2014-présent)

Auto-analyse AFOM

(aka SWOT = Strengths, Weaknesses, Opportunities, Threats)

- Atouts

High visibility and recognized expertise in both advanced Virgo and LISA projects

Involvement in ground-based and space-based experiments allows cross fertilization and exchange of expertise (experimental and data analysis) ... but complementary science (different wavelength, different source reach)

- Faiblesses

Man power is lacking – Does not scale with involvement in two major projects

Age pyramid skewed (over 45 to under 45 ratio is 2) -- need young researchers!

- Opportunités

GW astronomy has a large discovery potential – The field will ramp up during the next 20 yrs.

AdVirgo funded, LISA selected (strong support from CNES and ESA)

- Menaces

GW community (in France) remains limited – Attract new researchers is essential