



Helmholtz International Lab
for the Advancement of
Gravitational Wave Observation

HILAGRO: Helmholtz International Lab for the Advancement of Gravitational Wave Observation

IRL Discussions
remote (DESY), 14 April 2020

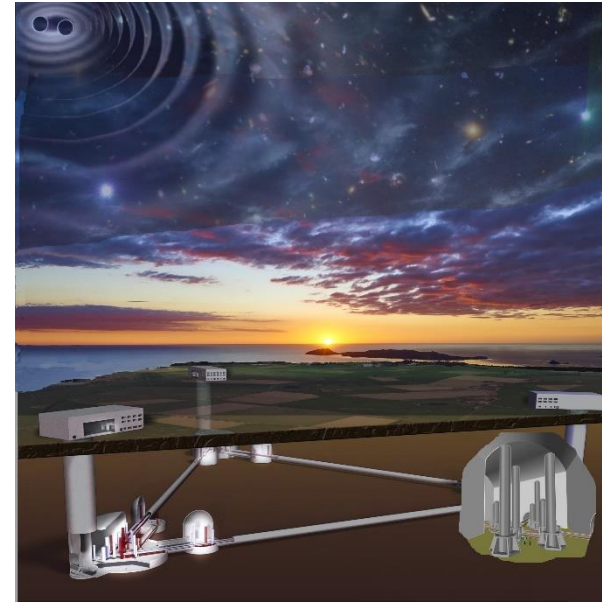
Andreas Haungs for HILAGRO

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES



Motivation, Objectives, Status

- Cooperation between Germany (Helmholtz Matter) and France (IN2P3)
- Fostering trans-disciplinary synergies
- Promotion of early-career researchers
- Preparing the Einstein Telescope project:
 - Cryogenic mirrors for the third generation of Gravitational Wave Detectors
 - Cluster of cosmic ray detectors at Virgo as part of a future monitoring system of ET
 - Explore signatures of the equation-of-state in neutron star mergers
 - Preparation of multi-messenger follow-up studies of gravitational wave events
- PI's: Andreas Haungs, KIT ; Benoît Mours, IPHC
- Participating centers/institutes: DESY-GSI-KIT ; IJCLab-IP2I-IPHC-LAPP
- Proposal submitted (April 2020) ; pre-selection: June 2020 ; decision Sep.2020 ; period 2021-2025



WP1: Cryogenic Mirrors

Steffen Grohmann, KIT; Jérôme Degallaix, IP2I



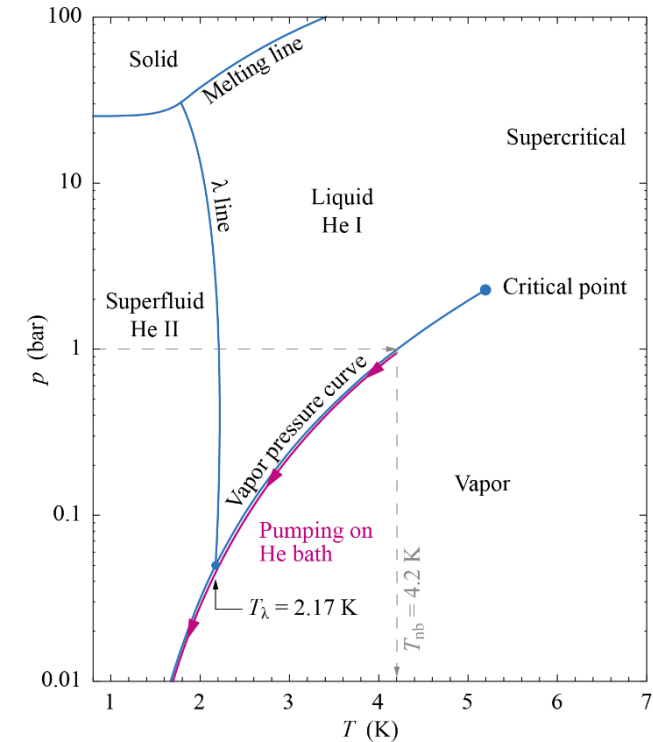
Cryogenic mirrors for the third generation of Gravitational Wave Detectors

- **Objectives**

- Conceptual design of cryostat and full-size He-II cooled payload for ET
- Study of hollow suspension fibers to be filled with He-II
- Conceptual design of 2K mirrors
- Design of test cryostat for reduced scale payload
- Exploration of superconducting coatings
- Study of coating properties at cryogenic temperature

- **Milestones**

- Preliminary design report of He-II cooled ET cryostat
- Report on 2 K mirror and suspension design
- Design report for the test cryostat



Extremely large thermal conductivity of superfluid He-II

WP2: Cosmic-Ray Detectors at Virgo

Ralph Engel, KIT; Jacques Marteau, IP2I



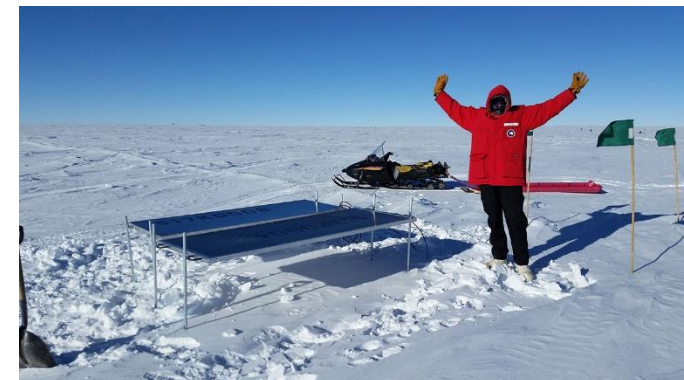
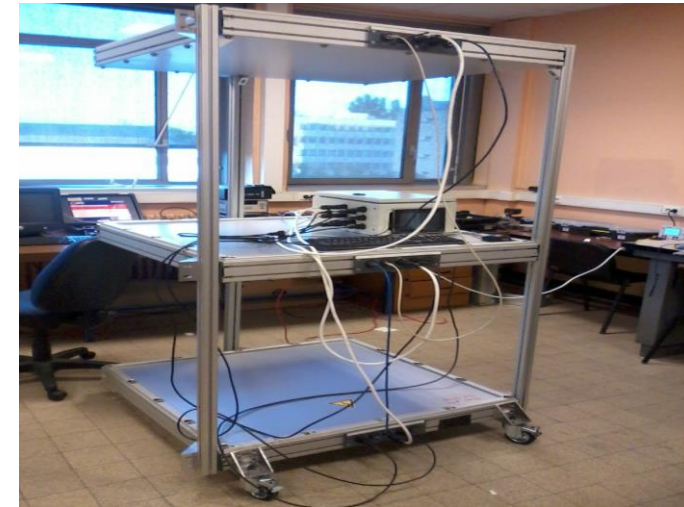
Cluster of cosmic ray detectors at Virgo as part of a future monitoring system of ET

- **Objectives**

- Part of environmental control and noise mitigation
- Study of disturbances by cosmic rays on mirrors and interferometer
- Develop network of scintillator based monitoring detectors
- Install and test at Virgo
- Integrate concept in monitoring system of ET
- Extend activity at KIT to geophysics and computing

- **Milestones**

- Tests of muon telescope at IP2I
- Installation of muon and air shower monitoring system at Virgo
- Data integration and conceptual design for ET



WP3: High-Density EoS in Neutron Star Mergers

Tetyana Galatyuk, GSI; Jérôme Margueron, IP2I

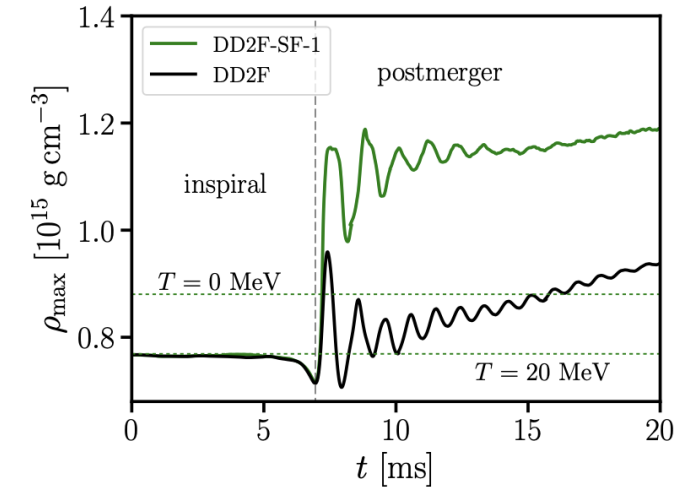
Explore signatures of the equation-of-state in neutron star mergers

- Objectives

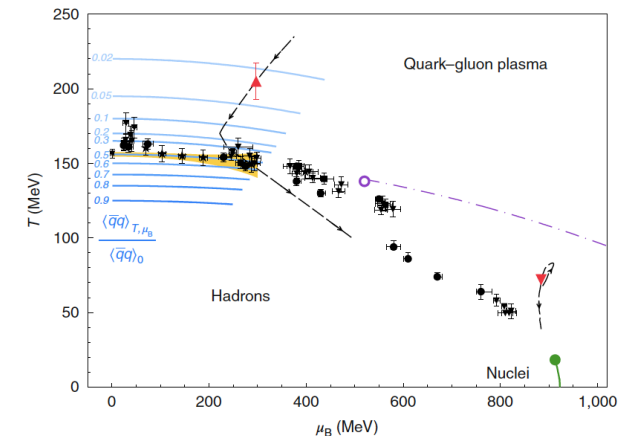
- Development of high-density EoS of Neutron Star Mergers
- Use input of heavy-ion-collision measurements
- Produce signatures of EoS for GW analysis
- Understand the hadron-quark phase transition

- Milestones

- Reconstruction of baryonic resonances in heavy-ion collisions
- Development of new equation-of-state models
- Determine signatures of HD EoS in Gravitational Waves



Phys. Rev. Lett. 122, 061102 (2019)



Nature Physics 15 (2019) 1040

WP4: Multi-Messenger with Gravitational Waves

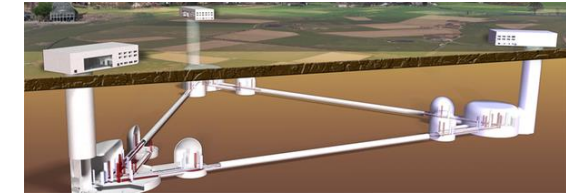
Marek Kowalski, DESY; Frédérique Marion, LAPP

Preparation of multi-messenger follow-up studies of gravitational wave events



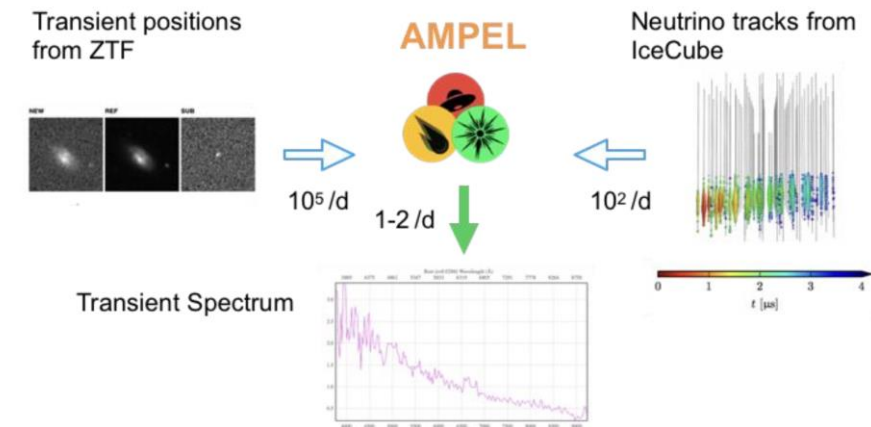
- Objectives

- Prepare extended multi-messenger follow-up studies for ET
- Cover wide science range of astrophysics, cosmology, element synthesis, Lorenz-violation, ...
- Perform a messenger-overarching FAIR data management



- Milestones

- Provide improved search pipeline for BNS candidates
- Provide software for automatic scheduling of follow-up observations of robotic telescopes
- Automated search for sub-threshold counterparts of GW by optical/UV/gamma/neutrino telescopes



HILAGRO Infrastructure



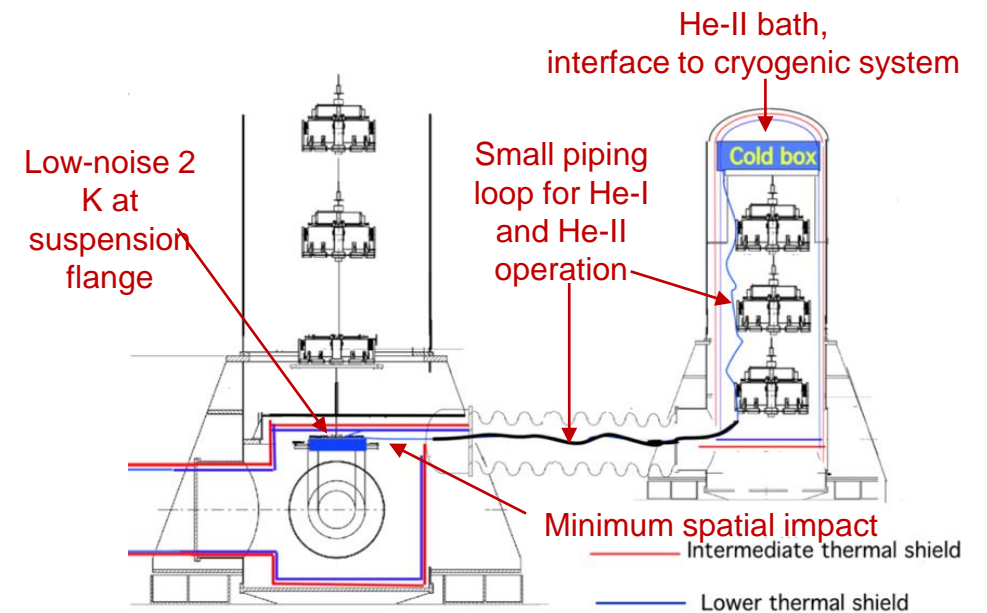
- The HILAGRO Lab will be at the “Laboratoire des Matériaux Avancés” (LMA) in Lyon
- LMA has large experience in mirror coating
- Include low temperature test facility in the LMA extension
- Main target will be a sophisticated He-II cryo-plant and a dedicated cryostat



LMA, Lyon



Largest IBS coating chamber





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