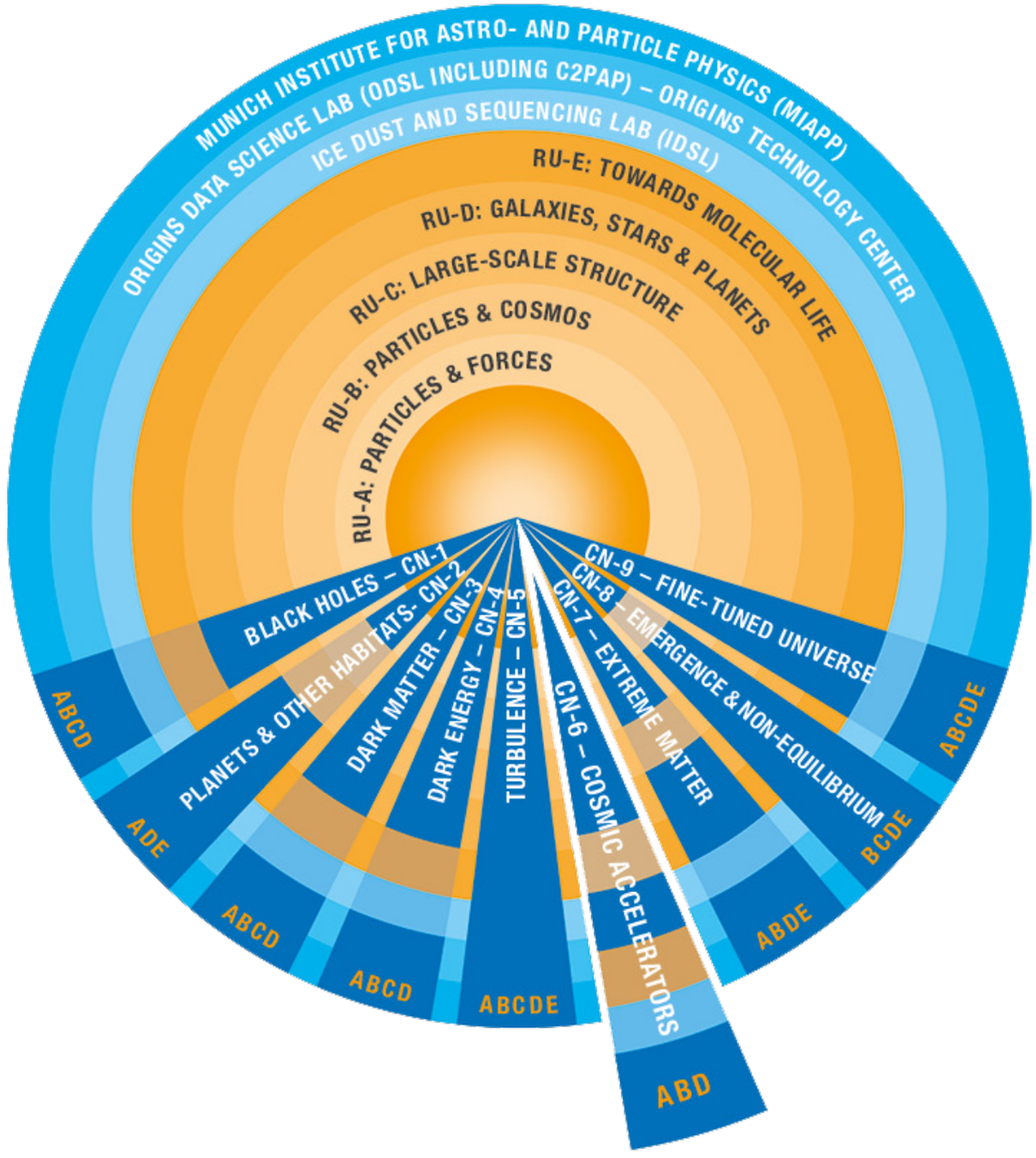
Origins 2.0 Brainstorming Meeting
19.10.2022

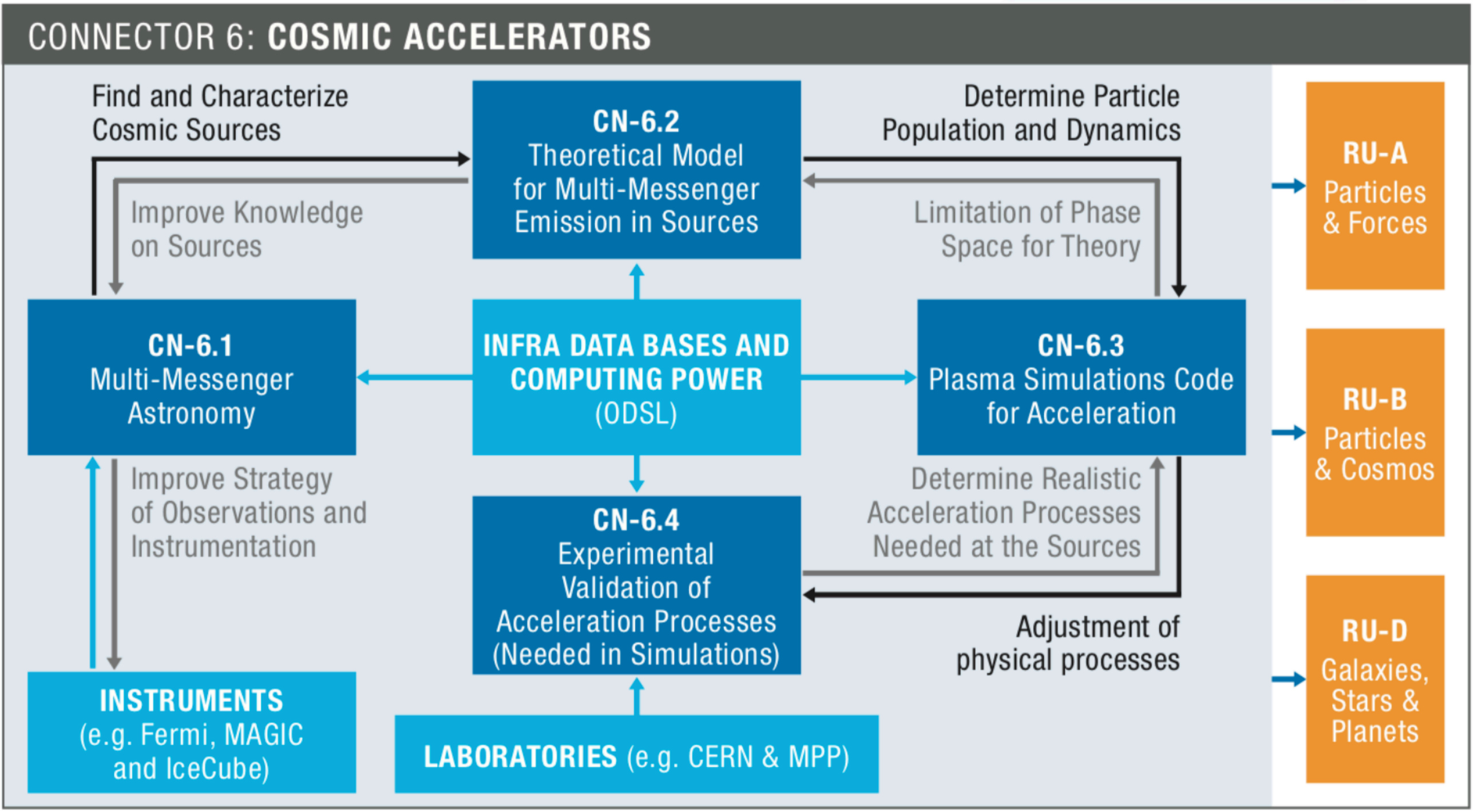
Connector 6

Cosmic Accelerators

How do cosmic accelerators work and what are they accelerating?



Frank Jenko (IPP), Elisa Resconi (MPP) coordinators


CONNECTOR 6: COSMIC ACCELERATORS
Find and Characterize Cosmic Sources
Improve Knowledge on Sources
CN-6.2 Theoretical Model for Multi-Messenger Emission in Sources
Determine Particle Population and Dynamics
Limitation of Phase Space for Theory
RU-A Particles & Forces
CN-6.1 Multi-Messenger Astronomy
INFRA DATA BASES AND COMPUTING POWER (ODSL)
CN-6.3 Plasma Simulations Code for Acceleration
RU-B Particles & Cosmos
Improve Strategy of Observations and Instrumentation
Determine Realistic Acceleration Processes Needed at the Sources
CN-6.4 Experimental Validation of Acceleration Processes (Needed in Simulations)
Adjustment of physical processes
RU-D Galaxies, Stars & Planets
INSTRUMENTS (e.g. Fermi, MAGIC and IceCube)
LABORATORIES (e.g. CERN & MPP)

CN-6.1: GAMMA-RAY ASTRONOMY [DAVID PANEQUE, MPP]

Dr. Axel Arbet-Engels

- Study with multi-instrument observations on the TeV blazar Markarian 421 during a peculiar period that shows orphan gamma-ray activity.
- Study of the TeV blazar Markarian 501 with extensive multi-instrument observations spanning 4 years (—> 12 years for some energy bands).
- Performing for the first time time-dependent modeling of the broadband blazar emission, using multi-band data with 15 min time bins

and much more …

Connecting element: Use of SOPRANO code

CN-6.1: SEARCH FOR COSMIC ACCELERATORS WITH ICECUBE [E.R.]

Dr. Christian Haack (+ Dr. Martina Karl TUM/ESO)

IceCube Collaboration, Evidence for neutrino emission from the nearby active galaxy NGC 1068, accepted in Science, to be announced early November - Under embargo

The source is a well studied object which will allow to link together the main blocks of CN-6. Setting up a new work from acceleration of CR till the neutrino signal.

IceCube Collaboration, Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A, *Science* 361 (2018) 6398

IceCube Collaboration, Neutrino emission from the direction of the blazar TXS 0506+056 prior to the IceCube-170922A alert, *Science* 361 (2018) 6398, 147-151

P. Padovani, P. Giommi, E. Resconi et al., Dissecting the region around IceCube-170922A: the blazar TXS 0506+056 as the first cosmic neutrino source, *Mon.Not.Roy.Astron.Soc.* 480 (2018) 1, 192-203

IceCube Collaboration, Detection of a particle shower at the Glashow resonance with IceCube, *Nature* 591 (2021) 7849, 220-224

CN-6.1: PLAN FOR A FUTURE OBSERVATORY, P-ONE [E.R.]

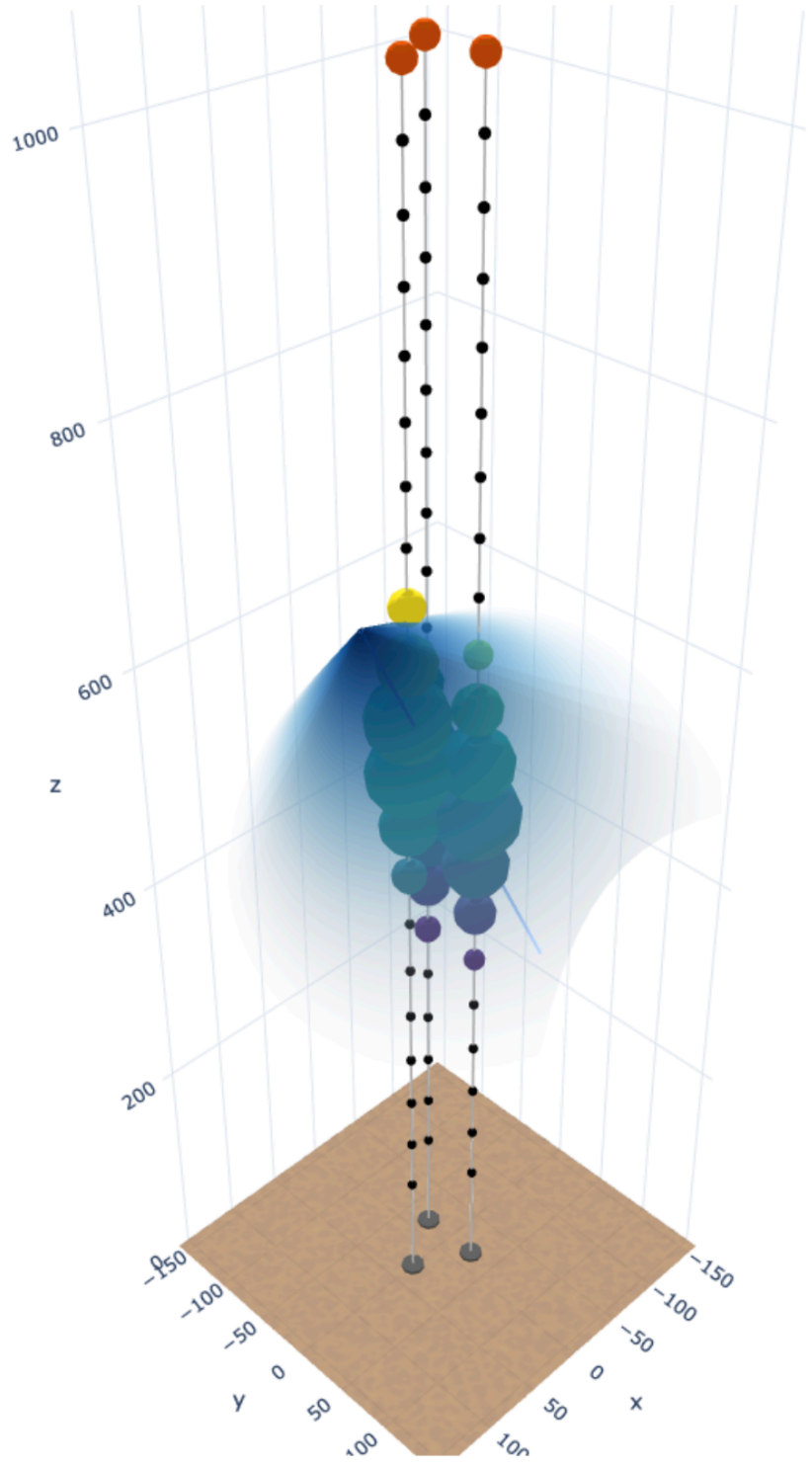
PhD student Christian Spannfellner

P-ONE Collaboration, The Pacific Ocean Neutrino Experiment, *Nature Astron. 4 (2020) 10, 913-915*

STRAWb, second pathfinder mission for hardware test and qualification of the site, 2020.

Exceptional contribution from ORIGINS, engineering and first cable of P-ONE-1

==> ERC Advanced Grant (E. Resconi) for the demonstrator phase of P-ONE



Dr. Damien Begue

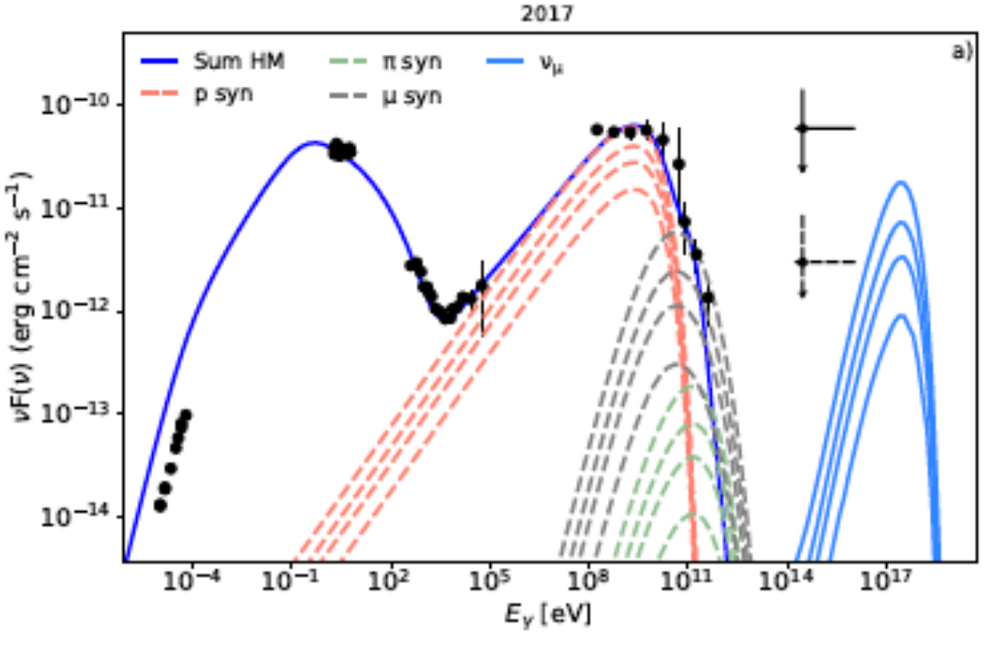
CN-6.2:

The first publicly available lepto-hadronic model including time variabilities.

MNRAS 000, 1–?? (0000) Preprint 15 September 2021 Compiled using MNRAS LATEX style file v3.0

Time-dependent lepto-hadronic modeling of the emission from blazar jets with *SOPRANO*: the case of TXS 0506+056, 3HSP J095507.9+355101 and 3C 279

S. Gasparyan[1]★, D. Bégué[2,3] † & N. Sahakyan[1,4,5] ‡
[1] *ICRANet-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia*
[2] *Department of Physics, Bar Ilan University, Ramat-Gan 52900, Israel §*
[3] *Max-Planck-Institut für extraterrestrische Physik, Giessenbachstrasse, D-85748 Garching, Germa*
[4] *ICRANet, P.zza della Repubblica 10, 65122 Pescara, Italy*
[5] *ICRA, Dipartimento di Fisica, Sapienza Universita' di Roma, P.le Aldo Moro 5, 00185 Rome, Italy*



CN-6.3 [FRANK JENKO]

Dr. Martin Weidl

- PIC simulations for AWAKE
- PIC simulations of bi-ion, collisionless shocks in Gamma-Ray Bursts have been carried out by Jonas Graw (PhD student)
- NEW: Dr. Artem Bohdan, who is an expert in shock acceleration and will begin a two-year appointment at IPP on Nov 1, 2022. He will strengthen our team considerably.

CN-6.4: [ALLEN CALDWELL, MPP]

Wakefield Acceleration in the Universe

Toshikazu Ebisuzaki[1], Toshiki Tajima[2], and Barry C. Barish[3]

[1] RIKEN, Cluster for Pioneering Research, 2-1 Hirosawa, Wako 351-1198, Japan
[2] Depart. of Physics and Astronomy, University of California, Irvine, CA 92679, USA
[3] LIGO, California Institute of Technology, Pasadena, CA 91125, USA

Abstract

The important role of magnetic fields in the phenomena in and evolution of the Universe is well appreciated. A salient example of this is to make (often episodic) large magnetic fields in AGN accretion disks and their emanation of well collimated and longitudinally extended astrophysical jets. Such typical cases or related astrophysical processes, we find, provide a fertile ground for exciting large amplitude oscillations in the magnetic fields that constitute the spine of the jets. The energy sources of these oscillations can be traced originally to the gravitational energy of the central object. During their long propagation along the jet, because of the gradual changes of the density and magnetic fields, these large magnetic pulsations turn into relativistic amplitude electromagnetic (EM) pulses,

In Summary:

- all the sub-projects are progressing very well -
- need of more cross collaboration, getting ready for that -
- plan to re-start in person meetings to foster more collaboration -

A new natural astronomical laboratory (NGC1068 or M77) as first playground where we will connect from first principle acceleration to the interpretation of the secondary particles (including Dark Matter, maybe).

With more telescopes (from CTA to P-ONE), CN-6 should be propagated to O-II.

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NEW element emerging from some elements of CN-6, for a potential new Connector [element of a new connector]

Scientific Ethics in many authors publications & large international collaboration -