

## APPENDIX 7 – Astronomy and astroparticle research

Organization	Short name	Sub-domain	Country (head office)	Website	Answer	Status
Agua Negra Deep Experiment Site	ANDES	astroparticles	Argentina	<a href="http://andeslab.org/">http://andeslab.org/</a>	yes	Complete
Deep underground laboratory that will provide the science community a world class site for leading experiments to operate in the Southern Hemisphere. It will have its underground installations located in the Agua Negra tunnel to be built between Argentina and Chile. Two close-by support laboratories will be installed in both sides of the tunnel.						
SNOLAB	SNOLAB	astroparticles	Canada	<a href="https://www.snolab.ca">https://www.snolab.ca</a>	yes	Complete
Deep underground research facility located within an operational mine, near Sudbury, Ontario, Canada. The science programme at SNOLAB is currently focused on sub-atomic physics, largely neutrino and dark matter physics. These pose some of the most pressing questions in contemporary physics.						
Large High Altitude Air Shower Observatory	LHAASO	astroparticles	China	<a href="http://english.ihep.cas.cn/">http://english.ihep.cas.cn/</a>	yes	Complete
High altitude cosmic rays experiment, to search for the galactic cosmic ray sources, and studies on new physics, such as dark matter particle.						
Very Energetic Radiation Imaging Telescope Array System	VERITAS	astroparticles	United States	<a href="https://veritas.sao.arizona.edu/">https://veritas.sao.arizona.edu/</a>	yes	Complete
VERITAS (Very Energetic Radiation Imaging Telescope Array System) is a major ground-based gamma-ray observatory located at the basecamp of the Fred Lawrence Whipple Observatory in southern Arizona. VERITAS comprises an array of four 12m optical reflectors for gamma-ray astronomy in the very high energy (VHE: 50 GeV - 50 TeV) range.						
Laser Interferometer Gravitational-Wave Observatory	LIGO	gravitational waves	United States	<a href="https://www.ligo.caltech.edu/">https://www.ligo.caltech.edu/</a>	yes	Complete
LIGO is a sophisticated physics experiment designed to detect gravitational waves from some of the most violent and energetic events in the Universe. LIGO is comprised of four distinct facilities across the United States: two gravitational wave detectors (the interferometers) and two university research centers.						

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Kamioka Gravitational Wave Detector	KAGRA	gravitational waves	Japan	<a href="https://gwcenter.icrr.u-tokyo.ac.jp/en/">https://gwcenter.icrr.u-tokyo.ac.jp/en/</a>	yes	Complete
Gravitational wave detector in Japan. Recently finalised construction phase.						
Thirty Meter Telescope	TMT	infrared / optical	United States	<a href="https://www.tmt.org/">https://www.tmt.org/</a>	yes	Complete
30m aperture telescope currently under construction. The TMT will be an infrastructure enabling scientific research to be carried out by the international astronomical community.						
Daniel K. Inouye Solar Telescope	DKIST	infrared / optical	United States	<a href="https://dkist.nso.edu/">https://dkist.nso.edu/</a>	yes	Complete
When completed, DKIST will be the world's most powerful solar observatory, poised to answer fundamental questions in solar physics by providing transformative improvements over current ground- based facilities.						
Giant Magellan Telescope	GMTO	infrared / optical	United States	<a href="https://www.gmt.org/">https://www.gmt.org/</a>	yes	Complete
The GMT will have a transformative impact on areas spanning observational astrophysics from exoplanets around neighboring stars to the formation of the first, most distant stars, galaxies, and black holes in the universe.						
Southern African Large Telescope	SALT	infrared / optical	South Africa	<a href="https://www.salt.ac.za/">https://www.salt.ac.za/</a>	yes	Complete
Largest single optical telescope in the southern hemisphere and among the largest in the world. Its mission includes leading the advancement and development of optical astronomy on the African continent and inspire and educate new generations of scientists and engineers worldwide.						
Event Horizon Telescope	EHT	mm	United States	<a href="https://eventhorizontelescope.org/">https://eventhorizontelescope.org/</a>	yes	Complete
The EHT links radio dishes in a VLBI network and processes the data at correlation centers in order to create a virtual Earth-sized telescope capable of resolving the event horizon of a black hole.						

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Five-hundred meter Aperture Spherical radio Telescope	FAST	radio	China	<a href="http://www.bao.ac.cn">http://www.bao.ac.cn</a>	yes	Complete
Megascience project to build the largest single dish radio telescope in the world. The main observables of FAST are pulsars, the 21cm atomic hydrogen hyperfine transition, molecular transitions including masers, and radio continuum.						
VLBI Exploration of Radio Astrometry	VERA	radio	Japan	<a href="http://www.miz.nao.ac.jp/en">http://www.miz.nao.ac.jp/en</a>	yes	Complete
Network of 4 radio telescopes of VERA spread over Japan. These 4 telescopes are operated as a VLBI array to synthesize a telescope as big as Japan.						
Giant Metrewave Radio Telescope	GMRT	radio	India	<a href="http://www.ncra.tifr.res.in">www.ncra.tifr.res.in</a>	yes	Complete
Radio telescope, very versatile instrument for investigating a variety of radio astrophysical problems ranging from nearby Solar system to the edge of observable Universe.						
Ukrainian T-shaped radio telescope	UTR-2	radio	Ukraine	<a href="http://rian.kharkov.ua/index.php/en/">http://rian.kharkov.ua/index.php/en/</a>	yes	Complete
T-Shaped radio telescope composed of 12 sub-arrays. Its mission is the investigation of Universe at low radio frequencies.						
Ukrainian Radio interferometer of the Academy of Sciences	URAN	radio	Ukraine	<a href="http://rian.kharkov.ua/index.php/en/">http://rian.kharkov.ua/index.php/en/</a>	yes	Complete
Network of radio telescopes spread in 4 sites in Ukraine, reaching a maximal baseline of 950 km						
Giant Ukrainian Radio Telescope	GURT	radio	Ukraine	<a href="http://rian.kharkov.ua/index.php/en/">http://rian.kharkov.ua/index.php/en/</a>	yes	Complete
Radio telescope designed to operate at very low frequencies currently under construction. Expected to be operational in 2025.						

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KVN and VERA array KaVa	KaVa	radio	Korea	<a href="https://radio.kasi.re.kr/kava/main_kava.php">https://radio.kasi.re.kr/kava/main_kava.php</a>	yes	Complete
KaVA is an international VLBI facility consisting of 7 radio telescopes located at Korea and Japan. It aims to unveil major astrophysical issues by high-resolution VLBI observations, especially birth, evolution, and death of stars; physical properties around supermassive black holes in active galactic nuclei; galaxy structure and dynamics.						
East Asia VLBI Network	EAVN	radio	Korea	<a href="https://radio.kasi.re.kr/eavn/main_eavn.php">https://radio.kasi.re.kr/eavn/main_eavn.php</a>	yes	Complete
EAVN is an international VLBI facility consisting of more than 20 radio telescopes located at China, Korea, and Japan.						
International VLBI Service for Geodesy and Astrometry	IVS	radio	United States	<a href="https://radio.kasi.re.kr/eavn/main_eavn.php">https://radio.kasi.re.kr/eavn/main_eavn.php</a>	yes	Complete
International collaboration of organizations which operate or support Very Long Baseline Interferometry (VLBI) components. Aims at providing highly precise reference coordinates on Earth and in space required for monitoring Global Change. At the same time, it monitors the variable rotation of the Earth for securing terrestrial positioning and navigation carried out with global navigation satellite systems such as GPS.						
W.M. Keck Observatory	Keck	infrared / optical	United States	<a href="http://www.keckobservatory.org/">http://www.keckobservatory.org/</a>	no	Declined
The twin Keck Observatory telescopes operate in the optical and infrared. The telescopes' primary mirrors are 10-meters in diameter and are each composed of 36 hexagonal segments that work in concert as a single piece of reflective glass.						
Australia Telescope Compact Array	ATCA	radio	AU	<a href="https://www.narrabri.atnf.csiro.au/">https://www.narrabri.atnf.csiro.au/</a>	no	Declined
Array of six 22-m antennas used for radio astronomy. It is operated by CSIRO's Astronomy and Space Science division.						
Long Wavelength Array	LWA	radio	United States	<a href="http://lwa.unm.edu/">http://lwa.unm.edu/</a>	no	Declined
The LWA is an effort to advance astronomy by using inexpensive antenna stations to build a very large aperture to probe the depths of space at the lowest frequencies. Currently under development.						

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Murchison Wide Field Array	MWA	radio	Australia	<a href="http://www.mwatelescope.org/">http://www.mwatelescope.org/</a>	no	Declined
Low-frequency radio telescope, developed by an international collaboration, including partners from Australia, New Zealand, Japan, China, Canada and the United States.						
Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy	TAIGA	astroparticles	Russia	<a href="https://taiga-experiment.info/">https://taiga-experiment.info/</a>	no	No answer
Detector system for ground-based gamma-ray astronomy from a few TeV to several PeV, and for cosmic ray studies from 100 TeV to several 100's of PeV. Collaboration between Russian and Germany.						
High Altitude Water Cherenkov Gamma ray Observatory	HAWC	astroparticles	Mexico	<a href="https://www.hawc-observatory.org/">https://www.hawc-observatory.org/</a>	no	No answer
Facility designed to observe gamma rays and cosmic rays between 100 GeV and 100 TeV. Operated by a collaboration between US and Mexico.						
Telescope Array Project	TA	astroparticles	United States	<a href="http://www.telescopearray.org/">http://www.telescopearray.org/</a>	no	No answer
The Telescope Array project is a collaboration between universities and institutions in the United States, Japan, Korea, Russia, and Belgium. The experiment is designed to observe air showers induced by cosmic rays with extremely high energy.						
Major Atmospheric Cherenkov Telescope Experiment	MACE	astroparticles	India		no	No answer
21 m diameter $\gamma$ -ray telescope which is presently being installed in India. It will help to explore the exciting energy range of gamma ray energy region in between satellite and the traditional Atmospheric Cerenkov experiments.						

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Astrophysical Radiation with Ground-based Observatory at YangBajing Experiment	ARGO YBJ	astroparticles	China	<a href="http://argo.na.infn.it/">http://argo.na.infn.it/</a>	no	No answer
Experiment is to study cosmic rays, mainly cosmic gamma-radiation, at an energy threshold of ~100 GeV, by means of the detection of small size air showers.						
Yakutsk Array	-	astroparticles	Russia	<a href="https://ikfia.ysn.ru/en/eas/">https://ikfia.ysn.ru/en/eas/</a>	no	No answer
Air shower array experiment that studies cosmic rays of extremely high energies above 10 PeV (=10 <sup>16</sup> eV), i.e. in the field of cosmic ray astrophysics. The main goals are the investigation of cascades of elementary particles in atmosphere initiated by primary cosmic rays; reconstruction of astrophysical properties of the primaries – intensity, energy spectrum, mass composition and their origin.						
Super Kamiokande	SuperK	astroparticles	Japan	<a href="http://www-sk.icrr.u-tokyo.ac.jp/sk/index-e.html">http://www-sk.icrr.u-tokyo.ac.jp/sk/index-e.html</a>	no	No answer
Large water Cherenkov detector operated by an international collaboration between Japan, the United States, Korea, China, Poland, Spain, Canada, UK, Italy and France.						
Gemini Observatory (N+S)	-	infrared / optical	Chile, United States	<a href="https://www.gemini.edu/">https://www.gemini.edu/</a>	no	No answer
The Gemini Observatory consists of twin 8.1-meter diameter optical/infrared telescopes located on two of the best observing sites on the planet. From their locations on mountains in Hawai'i and Chile, the telescopes can collectively access the entire sky.						
Global Oscillation Network Group	GONG	infrared / optical	United States	<a href="https://gong.nso.edu/">https://gong.nso.edu/</a>	no	No answer
The Global Oscillation Network Group (GONG) is a community-based program to conduct a detailed study of solar internal structure and dynamics using helioseismology. In order to exploit this new technique, GONG has developed a six-station network of extremely sensitive, and stable velocity imagers located around the Earth to obtain nearly continuous observations of the Sun's "five-minute" oscillations, or pulsations.						
Dunn Solar Observatory	DST	infrared / optical	United States	<a href="https://www.nso.edu/telescopes/dunn-solar-telescope/dunn/">https://www.nso.edu/telescopes/dunn-solar-telescope/dunn/</a>	no	No answer
Once the finest instrument of its kind in the world. Managed by NSO for almost half a century, its 0.2 arc-seconds resolution unveiled a multitude of secrets surrounding the complex magnetic fields that dominate the solar atmosphere.						

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Large Binocular Telescope	LBT	infrared / optical	United States	<a href="http://www.lbto.org/">http://www.lbto.org/</a>	no	No answer
The binocular design of the Large Binocular Telescope (LBT) has two identical 8.4m telescopes mounted side-by-side on a common altitude-azimuth mounting for a combined collecting area of a single 11.8m telescope. Located in southeastern Arizona at an altitude of 3200m.						
Fuxian Solar Observatory	FSO	infrared / optical	China	<a href="http://fso.ynao.ac.cn/">http://fso.ynao.ac.cn/</a>	no	No answer
The 1m New Vacuum Solar Telescope (NVST), formerly known as 1m Yunnan Solar Telescope (YNST), is the primary facility of FSO, which mains goals are high resolution imaging and spectral observations, including measurements of the solar magnetic field.						
Subaru	-	infrared / optical	United States	<a href="https://subarutelescope.org/">https://subarutelescope.org/</a>	no	No answer
Submillimeter Array	SMA	mm	United States	<a href="https://www.cfa.harvard.edu/sma/">https://www.cfa.harvard.edu/sma/</a>	no	No answer
Korean VLBI Network	KVN	radio	Korea	<a href="https://radio.kasi.re.kr/kvn/main_kvnp.php">https://radio.kasi.re.kr/kvn/main_kvnp.php</a>	no	No answer
Very Long Baseline Array	VLBA	radio	United States	<a href="https://science.nrao.edu/facilities/vlba">https://science.nrao.edu/facilities/vlba</a>	no	No answer
Long Baseline Array	LBA	radio	Australia	<a href="http://astronomy.swin.edu.au/cosmos/L/Long+Baseline+Array">http://astronomy.swin.edu.au/cosmos/L/Long+Baseline+Array</a>	no	No answer
African VLBI Network	AVN	radio	Ghana, South Africa	<a href="http://www.aerap.org/africanradioastronomy.php?id=32">http://www.aerap.org/africanradioastronomy.php?id=32</a>	no	No answer
21 CentiMeter Array	21CMA	radio	China	<a href="http://english.nao.cas.cn/Research2015/rp2015/201701/t20170120_173603.html">http://english.nao.cas.cn/Research2015/rp2015/201701/t20170120_173603.html</a>	no	No answer
BICEP	-	astroparticles	United States	<a href="https://www.cfa.harvard.edu/CMB/bicep1/">https://www.cfa.harvard.edu/CMB/bicep1/</a>	no	Not contacted
Big Bear Solar Observatory	BBSO	infrared / optical	United States	<a href="http://www.bbso.njit.edu/">http://www.bbso.njit.edu/</a>	no	Not contacted
Udaipur Solar Observatory	USO	infrared / optical	India	<a href="https://www.prl.res.in/~uso/">https://www.prl.res.in/~uso/</a>	no	Not contacted
Mauna Loa Solar Observatory	MLSO	infrared / optical	United States	<a href="https://www2.hao.ucar.edu/mlso/mlso-home-page">https://www2.hao.ucar.edu/mlso/mlso-home-page</a>	no	Not contacted

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Global Millimeter VLBI Array	GMVA	radio	Global, coordinated by MPIfR Bonn	<a href="https://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/">https://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/</a>	no	Not contacted
Hydrogen Epoch of Reionization Array	HERA	radio	United States	<a href="https://reionization.org/">https://reionization.org/</a>	no	Not contacted
Expanded Owens Valley Solar Array	eOVSA	radio	United States	<a href="http://www.ovsa.njit.edu/">http://www.ovsa.njit.edu/</a>	no	Not contacted
Nobeyama Radioheliograph	NoRH	radio	Japan	<a href="https://solar.nro.nao.ac.jp/norh/">https://solar.nro.nao.ac.jp/norh/</a>	no	Not contacted
Parkes	-	radio	Australia	<a href="https://www.parkes.atnf.csiro.au/">https://www.parkes.atnf.csiro.au/</a>	no	Not contacted
Canadian Hydrogen Intensity Mapping Experiment	CHIME	radio	Canada	<a href="https://chime-experiment.ca/">https://chime-experiment.ca/</a>	no	Not contacted
Very Large Array	VLA	radio	United States	<a href="https://public.nrao.edu/telescopes/vla/">https://public.nrao.edu/telescopes/vla/</a>	no	Not contacted
MeerKAT	-	radio	South Africa	<a href="https://www.ska.ac.za/gallery/meerkat/">https://www.ska.ac.za/gallery/meerkat/</a>	no	Not contacted
Australian Square Kilometre Array Pathfinder	ASKAP	radio	Australia	<a href="https://www.atnf.csiro.au/projects/askap/index.html">https://www.atnf.csiro.au/projects/askap/index.html</a>	no	Not contacted
Tibet AS-gamma Experiment	-	astroparticles	China	Tibet AS-gamma Experiment	no	Not eligible
LIGO-India	IndIGO	gravitational waves	India	<a href="http://www.gw-indigo.org/tiki-index.php">http://www.gw-indigo.org/tiki-index.php</a>	no	Not eligible
TAMA300 Interferometer	TAMA300	gravitational waves	Japan	<a href="http://tamago.mtk.nao.ac.jp/spacetime/tama300_e.html">http://tamago.mtk.nao.ac.jp/spacetime/tama300_e.html</a>	no	Not eligible
McMath-Pierce Solar Telescope	-	infrared / optical	United States	<a href="https://www.noao.edu/outreach/kptour/mcmath.html">https://www.noao.edu/outreach/kptour/mcmath.html</a>	no	Not eligible



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Distributed Array Radio Telescope	DART	radio	United States	<a href="http://www.erau-prescott-observatory.com/DART.htm">http://www.erau-prescott-observatory.com/DART.htm</a>	no	Not eligible
Korean Space Weather Center	KSWC	radio	Korea	<a href="https://spaceweather.rra.go.kr/?lang=en">https://spaceweather.rra.go.kr/?lang=en</a>	no	Not eligible