Near Universe Advisory Panel

Science challenges over the next 10-15 years and the facilities required to address them

			Relative importance of facilities in addressing challenges in priority order		
			High	**Medium**	**Low**
What controls the properties and evolution of the Sun and other stars?	1.1	What are the processes that lead to convection and the generation of stellar magnetic fields, how do they evolve and what is their role in controlling activity?	Theory & modelling (incl HPC), BiSON, CoRoT, ESA Plato, SDO, SolarC (plan A), ING, ESO/LaSilla, ATST/EST, Hinode	Kepler, Solar Orbiter, STEREO, XMM, IXO, UKIRT/UKIDSS, ESO/VLT	SOHO, LT, ESO/ELT, Song, HST
	1.2	What are the stellar content of and stellar distribution in the Milky Way?	Gaia, ING, ESO/VST, ESO/VISTA, ESO/LaSilla, HST, UKIRT/UKIDSS	ESO/VLT, Chandra, XMM, Gemini N/S, e-Merlin, JWST, LSST, PanSTARRS, Lofar	LT, ESO/ELT, UKIRT
	1.3	What are the interior and atmospheric structures of low-mass stars and substellar objects, and how do they evolve?	UKIRT/UKIDSS, ESO/VISTA, Gemini-N, ESO/VLT, JWST, ING	ESO/VLTI, MROI, UKIRT, WASP	Chara, ESO/ELT
	1.4	How do binary and multiple systems, including those that emit gravitational radiation or become Type !A supernovae, evolve?	ING, ESO/VLT, Theory/HPC, HST, Chandra, ESO/LaSilla, LSST, PanSTARRS, LISA Pathfinder, Ligo, SKA	LISA, GEO600, Lovell telescope, e-Merlin, ESO/ELT, Gemini-N, XMM, IXO, LoFAR	LT, Gemini-S, UKIRT, ET
	1.5	What are the fundamental laws of physics under extreme conditions and how do relativistic outflows work?	XMM, IXO, Chandra, SKA, Theory/HPC, HST, UV	Gemini-N, e-Merlin, Swift, JWST, UV, ESO/VLT, MROI, LoFAR, ESO/VLTI, ESO/ELT	Chara, LT, Gemini-S, Integral, TeV facilities, ING, ESO/LaSilla, UKIRT

How do the Sun and other stars affect their environments?	2.1	How does solar activity affect the near-Earth space environment as well as those of other planets, and how does the Sun influence our climate?	Solar Orbiter, KuaFu, STEREO, Cluster/Double Star, SDO, Ground based STP, Theory & modelling (incl HPC), Cassini, ESA Europa Jupiter System Mission	Hinode, Venus Express, BepiColombo, Mars Express, Rosetta	Themis, RBSP, HiRISE, SOHO, Juno, Messenger, HST, UKIRT, IRTF
	2.2	How are natural plasmas important for civilisation?	KuaFu, Cluster/Double Star, Ground based STP, Theory and Modelling (inc. HPC), Cassini, ESA Europa Jupiter System Mission	Venus Express, Bepicolombo, Mars Express, Rosetta	Themis, RBSP, Juno, Messenger, HST, UKIRT, IRTF
	2.3	How do intermediate mass and massive stars evolve and die, what remnants do they leave and how do they affect galactic chemical evolution?	ESO/VLT, Theory/HPC, e-Merlin, HST, ESO/ELT, UV, Gemini-N	JCMT, ALMA, ING, Herschel, JWST, SKA	UKIRT, Gemini-S, LT
	2.4	What is the history of stellar ejecta now in young stars and planetary systems?	cosmochemistry labs, HPC, ESO VLT, Herschel	ESA Marco Polo, Gemini, WHT	
	2.5	How does star formation feedback work and affect local and global galactic evolution?	HPC, e-Merlin, ALMA, Herschel, JWST, VLT	JCMT, UKIRT, VST, Gemini	Vista, Gaia, e-VLA
How do planetary systems, including their host stars, form and evolve?	3.1	What processes, including those leading to prebiotic molecules, govern the evolution of molecular clouds to form stars and planets?	HPC, ALMA, JCMT, ESO VLT and VLTI, MROI, lab molecular Ap and cosmochemistry, e-MERLIN, ESA Marco Polo	JWST, Herschel, UKIRT, ELT, SKA, ESA Spica, C-CAT, Gemini, WHT, FIRI, Darwin	VST, VISTA, Gaia, SMA, HST, e-VLA
	3.2	What are the distributions and properties of exoplanets and the natures of their atmospheres around different types of stars?	ESA Plato, UKIRT (UPF), WASP, ING, ESO/VLT/VISTA, Microlensing (ground based), ESA JWST, UKIRT/UKIDSS	CoRoT, Kepler, LT, ESA Gaia, UKIRT(WFCAM), HST, ESA SPICA, Gemini-N, ESO/ELT	LoFAR, ESA Euclid, ALMA

	3.3	Can we detect bio-markers in exoplanetary atmospheres?	ESO/ELT & VLT	ESA Plato, UPF, ING	
What is the nature and origin of the Solar System, and what can we learn about fundamental processes from its constituents?	4.1	How did the Solar System evolve and what can it tell us about other planetary systems?	Cosmochemistry, Marco Polo, Theory and modelling (inc. HPC), Aurora (to MSR), ESA Europa Jupiter System Mission, ESA CrossScale	MoonLite, Curation Facility, Cassini, BepiColombo, Rosetta, KuaFu, Cassini, Cluster/Double Star, Ground based STP, HST, UKIRT, IRTF	Venus Express, Mars Express, Juno, Messenger, Chandrayaan-1
	4.2	What are the limits, past and present, for life in the Solar System?	Aurora (to MSR), Cosmochemistry, EJSM, Instrumentation/Robotics; Curation Facility	Marco Polo, MoonLite, Rosetta, Cassini	Venus Express, Bepi Columbo, Chandrayaan-1
	4.3	Is there a universal model of magnetospheres and atmospheres?	ESA Europa Jupiter System Mission, Cluster/Double Star, Cassini, Ground based STP, Theory and Modelling (inc. HPC)	Venus Express, BepiColombo, KuaFu, Mars Express, Rosetta	Themis, RBSP, Juno, Messenger, HST, UKIRT, IRTF
	4.4	What are the fundamental processes that transport, convert and release energy in plasmas?	ESA CrossScale, Solar C (plan B), Solar Orbiter, Theory and modelling (ncl. HPC), RHESSI, LoFAR, Hinode	Cluster/Double Star, ATST/EST, HiRISE, STEREO, KuaFu, Ground based STP	Cassini, BepiColombo, SOHO
	4.5	How are energetic particles accelerated in Nature?	ESA CrossScale, Solar Orbiter, LoFAR, RHESSI, Theory and modelling (inc. HPC)	Cluster/Double Star, KuaFu, STEREO, Ground based STP	Cassini, BepiColombo

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