Cycle 2 Accepted Science Programs

Cycle 2 Science Programs

PID	Title	PI	Country
3	On the Physics of Prominence Cavities Abstract We propose to use Cryo-NIRSP to study a prominence cavity in the corona. Habbal et al. (2021) recently demonstrated with data from numerous total solar eclipses that prominences are invariably surrounded by a coronal cavity containing plasma at high electron temperatures (~2 MK), often form the base of helmet streamers, and commonly erupt into the solar wind. Despite the importance these structures have in the corona and solar wind, they are relatively poorly understood. The main obstacle for learning more about these structures has been a lack of comprehensive data throughout a prominence cavity. The existing observations are either too low in resolution, or observe emission that is too tenuous in the outer cavity (in the case of EUV observations) to perform the requisite analysis to learn more about these structures. Only the high spatial, spectral and polarimetric capabilities of Cryo-NIRSP at present are able to probe the density, magnetic field, temperature, and flows throughout a prominence cavity. Thus, we will take a collection of spectro-polarimetric data in a scan through a prominence cavity on the solar limb with the Fe XIII line pair as well as the He I line. Equipped with the proposed dataset, we will be able to perform a more detailed and thorough analysis on the prominence cavity than has ever before been achieved.	Benjamin Boe Co-Is Shadia Habbal (US), Bryan Yamashiro (US)	US
6	Helium in the off-limb corona Abstract We propose to obtain with Cryo-NIRSP simultaneous, high signal-to-noise ratio spectroscopic measurements in the off-limb corona of the He I 1083 nm line and of the nearby density-sensitive Fe XIII line pair. The goal is to measure their radiances and line widths, and compare them with the most up-to-date helium atomic model.	Vincenzo Andretta Co-Is Giulio Del Zanna (UK)	IT
8	Unraveling the Interplay of Alfven Waves, Density Fluctuations, and Turbulence in the Quiet Solar Corona Abstract Wave-driven heating models hypothesize that the corona is heated by Alfvén waves. Upward traveling waves encounter sunward-traveling waves or perpendicular gradients in the corona, leading to turbulence, which mediates the transfer of wave energy to particle heating. Wave-driven coronal heating models are supported by observations that Alfvén waves are found throughout the corona and that they appear to be damped so that their energy may go into heating. However, there are still many unresolved problems. One issue that it is not definitely clear whether or not the low corona is turbulent. A second is that previous measurements suggesting wave damping in the quiet Sun have large uncertainties due to limited spectral resolution of the instruments used. Also, the origins of any sunward-propagating waves are not well known. They may originate from excitation at opposite footpoints on closed loops, reflection in the corona, or parametric decay instability (PDI). Our proposed measurements will address these problems. We will look for evidence that Alfvén wave energy loss is associated with turbulence; determine how Alfvén wave and density fluctuation amplitudes change with height; evaluate the relative energy in outward versus sunward traveling waves; and test whether Alfvén waves undergo PDI in the quiet Sun corona. For this we will use Cryo-NIRSP spectra focusing on the Fe XIII 1074.7 nm line. Observations will be obtained for two rasters at different radial distances from the Sun with a cadence of about 30s, which is fast compared to the expected wave periods of minutes.	Michael Hahn Co-Is Daniel Savin (US), Mahboubeh Asgari-Targhi (US), Stefan Hofmeister (DE), Alexandros Koukras (BE), Xiangrong Fu (US), Aneta Wisniewska (DE)	US

9	Poynting Flux and Velocity Inversions in the Photosphere and Chromosphere of the Quiet Sun Abstract How much magnetic energy that heats the Sun's outer atmosphere is transported across the photosphere and processed through the chromosphere? The rate of transport of magnetic energy, the Poynting flux, can be expressed as a cross-product of vector magnetic and electric fields. Limited studies quantified Poynting flux in active regions using the PDFI method and HMI/SDO data (Kazachenko et al. 2014). The PDFI method relies on Faraday's law and spectropolarimetric inversions of high-cadence vector magnetic fields to estimate the electric fields. The properties of the energy fluxes in the quiet Sun (QS) have not yet been characterized due to the paucity of high signal-to-noise observations with high spatial and temporal resolutions. To that end, we propose to use ViSP and DL-NIRSP to invert QS magnetograms that will allow us to obtain Poynting fluxes in the photosphere using PDFI. ViSP and DL-NIRSP present an opportunity for drastic improvements: previous Hinode vector magnetic field observations have insufficiently high cadence to allow us to use the PDFI method, whereas IMaX QS maps do not have the spatial resolution we hope to achieve with DKIST instruments. To complement the magnetograms, we propose to use VBI intensity maps in the photosphere and the chromosphere to 1) correlate energy fluxes with optical features, and 2) derive optical flows using FLCT and DeepVelU methods and compare these with physics-based PDFI quantities. We also plan to investigate how Poynting flux varies with height. This study will improve our understanding of energy transport in the QS in quantitative terms.	Dennis Tilipman Co-Is Benoit Tremblay (US), Maria Kazachenko (US), Ivan Milic (US), Valentin Martinez Pillet (US)	US
10	Mapping the magnetic field of small-scale structures in sunspots penumbrae Abstract High-spatial resolution observations reveal small-scale motions related to the penumbral fine structure, such as lateral downflows at the edges of penumbral filaments. Although some investigations have shed light on essential aspects of lateral downflows, there are still open questions concerning their magnetic field vector, which is key to comprehending the global magnetic field topology in sunspots penumbrae. Moreover, it allows for figuring out the intriguing appearance of jet-like transients in the chromosphere of sunspots penumbrae, the so-called penumbral microjets (PMJs). Therefore, we aim to thoroughly analyze the magnetic field vector of lateral downflows and PMJs using the unprecedented capabilities offered by the DKIST telescope. This investigation will allow us to model a complete (and missing) physical scenario of these small-scale structures. For our purpose, we request high spatial resolution and temporal cadence observations acquired using the FIDO configuration 3a. Specifically, we request spectropolarimetric observations taken with the DL-NIRSP and ViSP instruments in the Fe I 1565 nm, Ca II 854.2 nm, He I 1083 nm, Mg I b2 517.3 nm, Fe I 630.2 nm, and Ca II K lines, which allow us to obtain information from the low photosphere to the mid-upper chromosphere. Besides, observations with VBI in the blue continuum, red continuum, and H-alpha line will provide supplementary information to the spectropolarimetric data.	Sara Esteban Pozuelo Co-Is Luis Bellot Rubio (ES), Andres Asensio Ramos (ES), Azaymi Siu (ES)	ES
11	The Origin of Extreme Broadening of the Hydrogen Emission Lines in Solar Flares. Abstract We propose to use high-cadence ViSP spectroscopy in the Ca II H, H-Beta, and Fe I regions to investigate the relative broadening of hydrogen and calcium in bright solar flare kernels. High-cadence imaging with VBI will be used to identify the white-light kernels and to compare/contrast the evolution and structure of the kernels at an unprecedented spatial resolution. We will determine whether the narrow Ca II H and broad hydrogen Balmer lines occur at different locations and times within the flaring area. These high resolution spectra will provide much-needed constraints on the current modeling approach for stellar flares. We will compare model spectra calculated from a new semi-empirical flare modeling code to determine the electron charge density and optical depth in chromospheric condensations. Then, the ViSP spectra will be used to test the detailed time evolution of the pressure broadening of hydrogen predicted in RADYN/RH simulations of high-flux electron beam heating and the timing of stationary and redshifted components in the Fe I line.	Cole Tamburri Co-Is Adam Kowalski (US), Gianna Cauzzi (US), Maria Kazachenko (US), Yuta Notsu (US), Isaiah Tristan (US), Alexandra Tritschler (US)	US

12	Probing Flare Reconnection Dynamics from High-Cadence Ribbon Observations Abstract Magnetic reconnection is a fundamental process in solar flares, believed to take place within elusive coronal current sheet structures. The exact mechanisms through which the current sheet breaks down at flare onset, needed to trigger the fast reconnection rate observed in solar flares, are not yet certain. Recent work points to the role of plasma instabilities, such as the tearing-mode of Kelvin-Helmholtz instability, which can catalyze fast reconnection through a turbulent cascade. Utilizing the magnetic connectivity between the current sheet in the corona and flare footpoints in the chromosphere, we propose using high temporal/spatial resolution VBI imaging to search for small-scale structure within flare ribbons. By examining the growth rates and timing of the spatial scales observed in the ribbons, we can compare observed rates with those predicted by theory for different plasma instabilities candidates. Using inversions and extrapolations from ViSP polarimetric scans, we can backmap the scales observed in the chromospheric ribbons to the size at their origin in the corona. Determining the physical scales at which current sheets break up is crucial to understanding the onset of solar flares in the corona.	Ryan French Co-Is Maria Kazachenko (US), Rahul Yadav (US), Marcel Corchado-Albelo (US)	US
13	Contribution to Solar Brightness of small-size magnetic elements Abstract Magneto hydrodynamic simulations of the solar photosphere and chromosphere show that the magnetic field is organized at spatial scales that have not been accessible so far with the 1 meter class telescopes. We plan to utilize observations acquired with the DKIST to investigate the contribution of these small-size magnetic elements to the radiative emission at different spectral ranges. By spatially degrading our observations to mimic the spatial resolution of full-disk images typically employed for irradiance variation studies, we will evaluate the impact of such ‘hidden’ fields to estimates of solar irradiance variability. Our results will be used to compare and validate 3D MHD simulations of the solar atmospheres obtained with two MHD codes.	Serena Criscuoli Co-Is Martin Snow (US), Mark Rast (US), Matthias Rempel (US), Courtney Peck (US), Alexandra Tritschler (US), Viacheslav Sadykov (US), Irina Kitiashvili (US)	US
14	Multi-height magnetic observations of a solar active region Abstract We propose a set of DKIST observations of a solar active region (AR) that provide simultaneous measurements of magnetically sensitive spectral lines from several atmospheric layers in both the photosphere and chromosphere, and near the magnetic polarity inversion line of an AR. The goal of the project is to investigate the AR magnetic structure, in particular determine photospheric and chromospheric magnetic fields and plasma temperatures at different heights, as well as compute energy and current-related characteristics (vertical currents, amount of the magnetic shear, vertical Poynting flux). To determine the physical parameters, we will employ state-of-the art multi-line inversion codes. The inferred magnetic field vector maps at multiple heights will be used to derive physical properties of the AR. We will also compare the inferred photospheric and chromospheric magnetic fields and related derived quantities to modeled coronal values from data-driven numerical simulations.	Andrei Afanasev Co-Is Maria Kazachenko (US), Rahul Yadav (US), Dennis Tilipman (US), Yuhong Fan (US), Lucas Tarr (US), Mark Linton (US), Nathaniel Dylan Kee (US)	US
16	Inferring vector magnetic fields at the base of the heliosphere using spectro-polarimetric and alfvenic wave propagation techniques Abstract We propose to use the novel capabilities of DKIST Cryo-NIRSP to study the polarization profiles and magnetic fields above an active region. It is critical to quantify model departures from long-standing assumptions like magnetic exrtrapolations and to properly interpret the increased sensitivity of coronal measurements. This will allow for the community to accurately model, invert, and interpret coronal structures at the base of the heliosphere. For this, a 135-180 minute continuous raster observations of the corona above an active region using the Cryo-NIRSP instrument is required. Both spectroscopy and polarimetric measurements are required. At least one line change is required to satisfy the main science objectives.	Alin Paraschiv Co-Is Momchil Molnarat (US), Daniela Lacatus (US)	US
17	Heating and jets in plage atmosphere Abstract Heating of the plage chromosphere is under debate. Both the wave dissipation heating and the magnetic reconnection heating are discussed as plausible mechanisms. We would like to diagnose the plage chromosphere and photosphere spectro-polarimetrically in high temporal and spatial resolution which can be attained by the DKIST facilities.	Reizaburou -Kitai Co-Is Tetsu Anan (US), Kevin Reardon (US)	JP

18	Evolution of magnetic fields in flares Abstract Solar flares are the most energetic events in our solar system. While they predominantly occur in conjunction with complex sunspots and thus complex configurations of the magnetic field, their exact timing, strength, and evolution varies from flare to flare and cannot be predicted in advance. It is therefore crucial to study the evolution of the magnetic field before, during, and after flares to better understand their physics. We propose to observe the restructuring of the magnetic field in 3D by using photospheric and chromospheric polarimetry with ViSP and DL-NIRSP observations of multiple spectral lines, covering a large range of formation heights. We will derive temporal sequences of the evolution of the vector magnetic field in both layers. Our results will contribute to the understanding of the overall flare energy budget and allow us to probe the standard flare model, in terms of evolution of the flare ribbons and flare energy dissipation on the smallest spatial scales.	Lucia Kleint Co-Is Jaime de la Cruz Rodriguez (SE), Xudong Sun (US), Gianna Cauzzi (US), Graham Kerr (US), Kevin Reardon (US), Matthias Rempel (US)	CH
19	Unraveling the magnetic landscape of solar coronal loops with DKIST Abstract The puzzling origin of the million degrees Kelvin hot solar corona is one of the central questions in solar physics. Despite decades of significant efforts, a comprehensive picture and understanding of coronal heating is still lacking. Nevertheless, it is abundantly clear that magnetic fields that couple through different layers of the solar atmosphere play a key role in heating the coronal plasma to more than a million Kelvin. The missing piece in this puzzle therefore is closely linked to the question of predominant magnetic processes that could supply the required mass and energy to continually replenish the hot coronal plasma. One emerging picture from recent studies is that the emergence and cancellation of magnetic flux on granular scales leads to chromospheric reconnection, that could play a governing role in coronal heating. To this end, unraveling the magnetic landscape of coronal loops at high spatial resolutions (better than 0.1"), will significantly improve the picture of coronal heating through chromospheric reconnection. Thanks to its large 4-m aperture, the DKIST, for the first time, will be able to probe surface magnetic fields at coronal base at spatial resolutions better than 0.1". Comparison of these high-resolution surface magnetic field observations along with the imaging diagnostics obtained with the DKIST will be instrumental in enabling us to draw refined and solid conclusions on the fundamental magnetic processes in the lower atmosphere that might be responsible for the coronal heating.	Lakshmi Pradeep Chitta	DE
21	The Observation and Simulation of the Magnetic Field and Plasma Properties in the Off-limb Active Region Abstract The direct measurement of the coronal magnetic field provides crucial insight into the physical processes related to coronal heating and solar eruptions. With the help of the Cryogenic Near-Infrared Spectropolarimeter (Cryo-NIRSP) on DKIST, we propose to observe spectropolarimetric signals of the magnetic dipole lines Fe XIII 10747 and 10798 in an off-limb active region with a field of view (FOV) of 60" by 230". A “single-point inversion” algorithm CLEDB, assuming most emissions originate at one location along the line of sight (LOS), will invert the observed Stokes parameters to obtain the vector magnetic field, plasma properties, and the emitting position along the LOS. We plan to compare the coronal magnetic field reconstructed by the widely-used Potential Field Source Surface (PFSS) model and Non-linear Force-Free Field (NLFFF) extrapolations at the emission position. Furthermore, the magnetic field and plasma properties will be compared with the global steady-state corona simulated by the Alfvén Wave Solar Model (AWSoM). These comparisons allow an assessment of the capabilities of different models and provide new constraints to improve the performance of field extrapolations.	Yingjie Zhu Co-Is Enrico Landi (US), Judit Szente (US)	US

22	Thermodynamic and magnetic properties of solar filaments Abstract Solar filaments are cool chromospheric plasma overdensities embedded in the extremely hot and low-density corona. In all filament models, the solar magnetic field plays a fundamental role in the formation, support, and eruption of these structures. Although it is such a fundamental ingredient, the details of the topology are not well known. A variety of configurations have been found in different observations: some of them having vertical fields, helical magnetic fields, or a series of local horizontal dips sustaining plasma; showing that the precise topology is still a matter of debate. The study of the surroundings is also important to identify the mechanisms involved in their formation (such as emerging flows, reconnection in the lower atmosphere, or shearing motions) but also those which could promote their destabilization and eruption. Previous studies on filaments have suffered from observational limitations that have prevented a complete interpretation or ignoring effects which could lead to a misinterpretation. Because of its multi-line capability, spectral sampling, and the polarimetric accuracy of its instrumentation, DKIST can provide unambiguous information on the plasma motions, thermodynamics, magnetic configuration, and the relationship of the filament to its surroundings. The observations will be interpreted with modern radiative transfer codes such as Multi3D, STiC, and Hazel. For this, we request continuous Config3a observations of a solar filament, using DL-NIRSP (CaII 854.2 nm, HeI 1083 nm, FeI 1565 nm) for the chromospheric magnetic characterization and ViSP (CaIIK 393.4 nm, MgIb2 517.3 nm, FeI 630.2 nm) for the large-scale properties of the region.	Carlos José Co-Is Christoph Kuckein (ES), Flavio Calvo (SE)	SE
23	Investigating the degree of magnetic field alignment of chromospheric fibrils Abstract In 1908, George Ellery Hale studied chromospheric flocculi (or fine structure) in newly available (at that time) H-alpha spectroheliograms and noted a "definitenesss of structure, indicated by radial or curving lines, or by some such distribution of the minor flocculi as iron filings present in a magnetic field." His conjecture that fibrils may denote the direction of a local magnetic field vector is one that is often assumed true. Confirmation of this hypothesis, however, is not a simple task; nor is the question of limited impact. Due to the relatively weak ionization ratio of the solar photosphere and chromosphere, as well as the lower density of the chromosphere, partial ionization effects allow decoupling of the thermal structure and magnetic structure. Such ambipolar diffusion provides a heating term that may be significant in the upper chromosphere. One cannot thus assume that linear structures correspond directly to the local magnetic field vector at a given moment in time. Now, more than a century after Hale's observations, DKIST's great light-collecting capability allows us to capitalize on advancements in the modeling of non-LTE line formation and atomic-level polarization in order to test Hale's conjecture. This proposal seeks to conduct the most extensive study of the relationship between thermal and magnetic structure in the chromosphere to date, by utilizing the advanced chromospheric polarimetric diagnostics of the DKIST. We herein propose an experiment using FIDO configuration 3c that combines DL-NIRSP, VISP, VBI-Red, and VBI-Blue.	Thomas Schad Co-Is Tetsu Anan (US), Karin Muglach (US), Jaime de la Cruz Rodriguez (SE), Andres Asensio Ramos (ES), Xudong Sun (US), María Jesús Martínez González (ES)	US
24	Unraveling plasmoid-mediated vs turbulent-induced magnetic reconnection Abstract Magnetic reconnection is the mechanism responsible for releasing magnetic energy in a wide range of solar transient phenomena. It is clear from the observed temporal scales and plasma conditions that Sweet-Parker reconnection acts too slowly to explain the rapid release of energy that is observed. Despite its importance, the physical mechanisms driving fast reconnection are still a subject of intense debate. Recent works have proposed different mechanisms such as tearing instability (associated with small-scale plasmoids) and turbulent velocity fields. In the first case, magnetic reconnection is enhanced as a result of magnetic island formation in the current sheet, and only recently very high-spatial observations have been able to reveal them during some microflares. In contrast, other studies propose the presence of a random magnetic field that enhances the reconnection rate whose signature has been also found before the onset of similar events. We propose to analyze the relation between the occurrence of a particular mechanism with the thermodynamic and magnetic environment is an essential point to understand the nature of the reconnection phenomenon. The very high-resolution observations together with the combination of multi-line observation with high-polarimetric accuracy of the DKIST instrumentation suite fulfill all the requirements to address this project. The observations will be interpreted with modern radiative transfer codes such as Multi3D, STiC, and Hazel. For this, we request continuous Config3a observations of at least a microflare, using ViSP with high-cadence for detecting the plasmoids and DL-NIRSP with deep-polarimetry for the magnetic characterization of the event.	Carlos José Co-Is Luc Rouppe van der Voort (NO), Jaime de la Cruz Rodriguez (SE), Viggo Hansteen (US)	SE

26	Strategic Advancement of DKIST Coronal Magnetometry through Data-Model Comparisons and Tomography Abstract We propose coronal polarimetric observations of multiple active regions for the purposes of systematically and strategically advancing coronal magnetometry, which is a critical part of the DKIST science mission. We justify this approach and the associated modestly-size, yet multi-observing day, observing request by emphasizing three unique aspects of DKIST coronagraphy. The ability of DKIST to (1) achieve high signal-to-noise in coronal Stokes V, (2) observe with unprecedented coronal spatial and polarimetric resolution from the ground, and (3) conduct multiwavelength polarimetry moving into the mid-IR in later cycles, requires strategic investment in developing and interpreting data products. We take the conservative, and arguably-reasoned, approach of reducing observing risk by observing multiple active regions that will then be validated through comparisons with multiple coronal models, so as to scrutinize both the models and the observations themselves. We also are provisioning for data to perform needed development for tomographic reconstructions of the vector coronal magnetic field. Establishing reliable and trustworthy coronal polarimetry is a worthwhile investment to make in the Operations Commissioning Phase and goes well beyond the coronal commissioning efforts that have occurred to date. This proposal has the right tools at its disposal to make this experiment successful including relevant data analysis experience and the critical personnel with instrumentation and data knowledge specific to DKIST/CryoNIRSP. Starting this effort with the offered, and most often measured, Fe XIII coronal lines at 1074 nm and 1079 nm is an excellent way to move this program forward during Cycle 2.	Thomas Schad Co-Is Andre Fehlmann (US), Jeffrey Kuhn (US), Lucas Tarr (US), Gabriel Dima (US), Maxim Kramar (US), Haosheng Lin (US)	US
27	Probing Fine-Scale Magnetic and Electric Current Systems in the Low Solar Atmosphere Abstract The low solar atmosphere is highly structured where magnetic fields constantly interact with plasma flows. We propose to use DKIST observations to study the fine-scale magnetic field and electric current systems in AR plage regions, which are important for many dynamic phenomena, and may hold the key to the coronal heating problem. DKIST's high spatial resolution, high polarimetry sensitivity, and multi-line observations will allow us to attack three specific scientific goals. First, we will search for the under-reported minority-polarity magnetic flux patches. Second, we will characterize layers of intensified electric current density and their potential correlation with small-scale energetic events. Third, we will assess the vector electric current and Lorentz force density using novel data analysis methods.	Xudong Sun Co-Is Thomas Schad (US), Lucas Tarr (US), Sarah Jaeggli (US), Matthias Rempel (US), Jiayi Liu (US), Kai Yang (US), Peter Sadowski (US)	US
28	Zooming in on the Magnetic Fields in the Solar Polar Region Abstract Magnetic flux in the solar polar field region mostly roots in photospheric elements a few arcseconds across with an intrinsic field strength in the kilogauss range. Their exact nature remains unclear due to the limited spatial resolution and polarimetry sensitivity of the existing facilities. The weaker fields of the internetwork regions are not well constrained. We propose to obtain high-resolution observations (~0.1) of the magnetic fields in the polar coronal hole using ViSP and DL-NIRSP with the Fe I 1565 nm, Fe I 630.2 nm, Mg I b2 517.3 nm, Ca II 854.2 nm, and He I 1083 nm lines. We aim to address the following questions: (1) what is the nature of the fine-scale field vectors inside/outside the magnetic elements? (2) how much magnetic flux does each component provide? (3) How much do the flux tubes expand in the lower chromosphere? These observations will help correct several systematic biases in the magnetic field inference process, allowing for a better understanding of the polar fields.	Xudong Sun Co-Is Ivan Milic (US), Sarah Jaeggli (US), Bryan Yamashiro (US), Milan Gosic (US), Rebecca Centeno (US), Shah Mohammad Bahauddin (US)	US

29	Study of a Delta-Sunspot Polarity Inversion Line from the Deep Photosphere to the Upper Chromosphere Abstract Delta-sunspots, where umbrae with opposite magnetic polarity are contained within a common penumbra, are highly interesting and important magnetic configurations within active regions. Regions with delta-sunspots are responsible for producing the majority of strong flares. The polarity inversion line in these sunspots are the sites of unusual, long-lasting behavior: stretched penumbral filaments with strong upflows and downflows, magnetic fields parallel to the solar surface exceeding the umbral magnetic field in strength, and complicated spectral line profiles that hint at multiple components. The aim of this proposal is to obtain DKIST observations of a delta-sunspot polarity inversion line using multi-height diagnostics of the plasma velocity and magnetic field at high spatial resolution. DKIST is the only facility capable of carrying out simultaneous observations of plasma diagnostics that span from the deep photosphere (Fe I 1565 nm), through the temperature minimum (Na I D 589.6 nm) and chromosphere (H-beta 486.1 nm, Ca II 854.2 nm), to the transition region (He I 1083.0 nm). These observations will be used to determine the topology of the magnetic field, how the flows along the polarity inversion line are connected through the atmosphere, and if the complex line profiles are due to structure that was previously unresolved by other instruments or if it is due to multiple structures along the same line of sight.	Sarah Jaeggli Co-Is Xudong Sun (US), Jiayi Liu (US), Lucas Tarr (US)	US
31	Generation of small-scale turbulence and interaction with magnetic fields in the solar photosphere Abstract Small-scale flows driven by turbulent convection are critical in creating fine magnetic structures through a local dynamo mechanism as well as in the generation and injection of Poynting flux into the upper atmosphere. A turbulent cascade is expected to create significant power in the flow fields smaller than 100 km and to interact with magnetic fields. The unpreceded spatial resolution achieved with DKIST allows us to examine velocity and magnetic fields at hat spatial scales for the first time. It is also possible that there are significant contributions of unresolved flows, such as micro-turbulence and LOS velocity gradients, even with the DKIST resolution. The most powerful approach to diagnosing micro-turbulence and the LOS velocity gradient is to use spectral line profiles, especially line broadening and asymmetry, which contain information on the flow fields that happened in a fading phase of granules (Ishikawa et al. 2020). The line broadening in a fading granule is thought to be caused by turbulent motions generated in the lower photosphere. Thus, the primary objective of the proposed observation is to investigate the temporal evolution of turbulent motions and magnetic fields. To achieve this, we will obtain the spectro-polarimetric profiles of the Fe I 1565 nm, Si I 1082.7, and C II 854 nm lines with DL-NIRSP together with the spectroscopic profiles of Fe I 630 nm lines with a high temporal cadence to capture the temporal evolution of the micro-turbulence, LOS velocity gradient, and magnetic fields in the photosphere and the chromosphere.	Ryohtaroh Ishikawa Co-Is Alfred de Wijn (US), Marc De Rosa (US), Mark Rast (US), Carlos Quintero (ES), Tino L. Riethmueller (DE), Yukio Katsukawa (JP)	JP
34	Constraining chromosphere heating of plage with DKIST observations Abstract This proposal aims at studying the role of four different energy dissipation mechanisms in plage targets. In plage regions, magnetic fields are expected to be highly concentrated in intergranular lanes in the photosphere. In the chromosphere gas pressure decreases with height much more rapidly than magnetic pressure and therefore the magnetic fields form a hot canopy above the photosphere. In the chromosphere of plage regions, enhanced radiative cooling is found in observations acquired in optically thick lines and continua of H I, Mg II and Ca II. The exact identification of physical processes that heat the chromosphere of plage and give sufficient energy input to sustain the radiative losses over time, remain elusive. Many heating processes such as magneto-acoustic waves/shocks, Joule heating through current dissipation, turbulent cascade of Alfvén waves, ambipolar diffusion and a nano-flare reconnection model have been proposed and might well all be simultaneously operating. However, their exact contribution remains unconstrained from observational studies. Our ultimate goal is to find observational evidence of the heating mechanisms that are at work in the lower and upper chromosphere. We will attempt an estimation of the electrical current distribution, the ion-neutral collision frequency, the magnitude of viscous heating and wave energy. This observational study will be only achievable if the three components of the magnetic field can be inferred from the observations. We will use DKIST large aperture to acquire datasets with unprecedented S/N ratio at the spatial resolution of a 1-m solar telescope.	Jaime de la Cruz Rodriguez Co-Is Jorrit Leenaarts (SE), Adur Pastor Yabarat (SE), Sanja Danilovic (SE), Rebecca Centeno (US), Matthias Rempel (US)	SE

36	Chromospheric heating through ubiquitous small-scale magnetic reconnection in the quiet-Sun Abstract The solar chromosphere is not in radiative equilibrium with the photosphere. Therefore energy transfer must be carried by physical processes other than radiation. A canonical value of approximately 4 kW m^2 has been commonly assumed for the quiet-Sun chromosphere, which was derived from the inversion of spatially-averaged solar spectra. Even though this number has been known since the late 70's, we still do not know the exact mechanisms that sustain the lost of 4 kW m^2 at any given time, but we know that acoustic waves alone do not provide sufficient energy. Magnetic fields could potentially regulate the dissipation of extra energy output that is required. This proposal aims at studying the role of very small-scale magnetic flux emergence in the heating of the quiet-Sun chromosphere. We will use DKIST observations to calculate spatially-resolved chromospheric radiative losses in the QS and assess the role of ubiquitous small-scale flux emergence.	Jaime de la Cruz Rodriguez Co-Is Jorrit Leenaarts (SE), Adur Pastor Yabar (SE), Sanja Danilovic (SE), Rebecca Centeno (US), Matthias Rempel (US)	SE
38	DKIST Coronal Cavity Study Abstract Coronal prominence-cavity systems are regions of stored magnetic energy that often erupt in CMEs. The goal of this proposal is to choose between flux-rope and sheared-arcade models of these CME precursors. The DKIST CryoNIRSP makes this possible through full Stokes vector measurements (linear and circular polarization) in both dipolar and quadrupolar (pseudostreamer) prominence cavity systems. This enables direct measurement of line-of-sight oriented magnetic field strength and diagnosis of magnetic topologies including magnetic O-points. This will be achieved by repeated rasters of CryoNIRSP in the FeXIII 1074.7 nm line across the cavity, allowing measurements of line of sight magnetic field strength and diagnosis of the presence and location of magnetic O-points in relation to the cavity emission, and also through observations in He I 10830 nm across the cavity and prominence, allowing measurement of prominence mean magnetic fields and potentially of the coronal unsaturated Hanle regime.	Sarah Gibson Co-Is Jie Zhang (US), Suman Dhakal (US), Yuhong Fan (US), Roberto Casini (US), Urszula Bk-Stlicka (PL), Mari Paz Miralles (US), Susanna Parenti (FR), Nour E. Raouafi (US)	US
45	Fine-scale Dynamics of Sunspot Umbrae: The Relationship Between Small-Scale Umbral Brightenings, Short Dynamic Fibrils, and Umbral Flashes Abstract The chromospheres of sunspots are highly dynamic, evolving on spatial and temporal scales which test the current 1-m class of telescopes to their limits. These regions of strong vertical magnetic fields host a plethora of magnetohydrodynamic (MHD) waves and shocks which somehow combine to form localised (sub-arcsecond) events such as small-scale umbral brightenings (SSUBs) and short dynamic fibrils (SDFs). Such events are still not fully understood simply because we have never been able to probe them with enough spatial or spectral resolution. Our aim here is to better understand the complex physics occurring within sunspot chromospheres through the investigation of the localised dynamics of the umbra on the smallest possible scales. Firstly, we will investigate how important SDFs /SSUBs are in the global dynamics of sunspots through statistical analysis of their properties (spatial extents, frequencies, lifetimes) using incredibly high-spatial resolution imaging data sampled by the VBI. Secondly, we will extract physical parameters of the sunspot atmosphere from the 630.2 nm, 854.2 nm, and 1083 nm spectra sampled by ViSP and DL-NIRSP co-spatial to SDFs /SSUBs, using numerical inversion codes such as NICOLE. This will help us to understand the formation mechanisms of these events. The polarimetric data collected by DKIST will allow us to infer the velocity and temperature stratification within SDFs/SSUBs with exquisite detail meaning it will be possible to determine whether MHD waves are steepening into shocks at heights sampled by these lines. The results obtained here could have important consequences for our understanding of physics in the wider atmosphere.	Chris Nelson Co-Is Mihalis Mathioudakis (UK), Vasco M .J. Henriques (NO), Luc Rouppe van der Voort (NO), Sanjiv Tiwari (US)	NE

51	Small-Scale Chromospheric Dynamics in Quiet Sun Areas and at Boundaries of Coronal Holes Abstract This observing proposal is focused on small-scale jets and spicules that occur around clusters of photospheric bright points. This research plan is based on DKIST VBI (Ca II K, H, G-band) imaging and ViSP (H and Mg I b2) spectrometry data as well as DL-NIRSP (He I 1083 and Fe I 1565 nm) polarimetry measurements. We will study the origin and evolution of type II spicules and small-scale jets. We will investigate the formation process of various features and associated plasma flows using VBI imaging and ViSP spectral data. We will explore their physical parameters using ViSP spectroscopy data. We will look for evidence of enhanced energy release at the base of spicules. The process of RBE/type II spicule formation is expected to leave a footprint in both photosphere and chromosphere that can be detected using DL-NIRSP 1083 and 1565 nm lines. DKIST will allow us to unveil new, previously not accessible knowledge on the small-scale dynamics phenomena. Advanced understanding of these is essential for advancing studies of coronal heating and small-scale magnetism. The use of DKIST data is justified by the object of the study: very narrow (<0.2 arcsec) and fast evolving plasma structures. DKIST's unique capabilities are required to resolve their spatial and temporal structures. DKIST ViSP and DL-NIRSP are the only instruments capable of measuring magnetic fields with 10^{-4} sensitivity, which is needed for studying quiet sun magnetic fields, including chromospheric fields. This critical information is so far missing from the existing data sets.	Vasyl Yurchyshyn Co-Is Jeong woo Lee (US), Wenda Cao (US), Eun-Kyung Lim (KR), Nour E. Raouafi (US), Xu Yang (US), Haimin Wang (US)	US
52	Origin and role of Moving Magnetic Features in the evolution of sunspots Abstract High resolution magnetograms show the presence, around sunspots, of small-size magnetic elements, called moving magnetic features (MMF) that are generally seen to stem out from the penumbra and later on merge with the surrounding magnetic field. These magnetic patches seem to be related to the slow disaggregation of the magnetic flux tubes that were previously stuck together in sunspots. MMFs can be of different types, depending on the sign of magnetic polarity closer to the parent sunspots. Their interpretation is related to different configurations of the magnetic field (whether resembling a U-loop, an -loop or a serpentine-like shape). The MMFs observed so far have generally a size of few arcsec, but it is possible that higher spatial resolution observations will reveal the presence of smaller structures and this finding would be important to verify whether they have a hierarchical subdivision and how they contribute to the erosion/disappearance of sunspots. The spectropolarimetric capabilities of DKIST instruments would allow us to detect the very first phase of detaching of MMFs from the penumbra or even from the umbra and verify whether both occur following a similar process. The capabilities of the VISP and DL-NIRSP will be fundamental in order to characterize the magnetic properties of the MMFs at different atmospheric levels and reveal the role that patches characterized by different magnetic polarities have in the umbra erosion. The imaging capabilities of the VBI could help us in detecting possible brightening at photospheric and chromospheric levels, probably related to small-scale reconnection processes.	Francesca Zuccarello Co-Is Sanjiv Tiwari (US), Hanna Strecker (ES), Serena Criscuoli (US)	IT
57	Resolving the convective collapse with DKIST Abstract Previously ignored, we now know that the quiet-sun magnetic field outside of sunspots is omnipresent, covering most of the solar surface at any given time. It is not only responsible for the energies required to maintain the hot corona of quiet regions but is also the main contributor to the solar UV irradiance variability conceivably influencing our climate on earth. We propose to study the process that generates the kiloGauss quiet-sun magnetic field population. This process, the so-called convective collapse, is a very dynamic one with sudden changes in density, magnetic field strength and velocity happening in a time period of seconds. The onset of the process and the conspicuous oscillations seen in physical parameters of the forming magnetic element are open questions in the description of this fundamental plasma-physical process. We also search for signatures of the magnetic pumping effect that is suspected to be responsible for the excitation of longitudinal tube waves within magnetic elements. With DKIST we aim for the first time to spatially and temporally resolve the convective collapse process. These data can be expected to provide new insights into the details of the formation of the kiloGauss magnetic field population of the quiet sun; they also bear the potential for the discovery of new, unexpected physics of the Sun.	Catherine Fischer Co-Is Oskar Steiner (DE), Karin Muglach (US), Luis Bellot Rubio (ES), Saida Milena Diaz Castillo (DE), Elena Khomenko (ES), Anjali John (DE), Alexandra Tritschler (US), Friedrich Woeger (US)	US

58	Understanding small-scale flaring dynamics with Cryo-NIRSP Linear Polarization Abstract We propose using Cryo-NIRSP to investigate plasma and magnetic parameters within a small, off-limb solar flare. Linear polarization measurements are able to provide insight into sub-pixel dynamics, at critical regions within the solar flare (such as the current sheet or flare loop tops). Supporting these measurements, simultaneous non-thermal velocity, Doppler velocity and plasma density measurements can provide context and further clues into the regions of energy release in flares, and the nature of magnetic reconnection within them. We propose comparing these observed parameters with those predicted by simulations. These observations would be optimal for an off-limb active region with a high likelihood of C-class flaring or above. Alternatively, the decaying post-flare loops of an X-class event (starting up to two hours after flare onset), would also be suitable.	Ryan French Co-Is Maria Kazachenko (US), Marcel Corchado-Albelo (US), Joel Dahlin (US)	US
59	Spectropolarimetric diagnostics of off-limb spicules from inversions of the Ca II 8542 Å line Abstract Spicules are one of the main constituents of the solar chromosphere. It is widely accepted that they are key to understand the dynamic and energetic balance of the lower solar atmosphere. A reliable quantitative measurement of the physical parameters in spicules is extremely challenging due to the scales of their dynamism which are very often close to the resolution limit of modern solar telescopes. Furthermore, modelling and interpretation of chromospheric spectral lines, in which spicules are emitting, are always challenging as it requires solving the complex non-LTE (i.e., departures from Local Thermodynamic Equilibrium) radiative transfer problem. We plan to study solar spicules using high-resolution full Stokes spectropolarimetric data in the Ca II 8542 Å line that can be obtained with the ViSP instrument on the DKIST. Spectropolarimetric inversions using a new version of the non-LTE code NICOLE will be used to construct semiempirical models of the spicules. The models will be used to obtain height stratification of the temperature, mass density, velocity and optical thickness along the spicule.	David Kuridze Co-Is Kevin Reardon (US), Rebecca Centeno (US), Ramon Oliver (ES), Gianna Cauzzi (US), Matheus Kriginsky (ES), Hector Socas-Navarro (ES)	UK
62	Revealing the picture of coronal Alfvénic waves: exploring a new frequency regime with Cryo-NIRSP Abstract Alfvénic waves are thought to be a key mechanism for energy transfer in the Sun's atmosphere, providing the energy to meet the radiative losses of the dense chromosphere and hotter, tenuous corona, along with the demands required to accelerate the solar wind. In recent years there has been clear evidence for the presence of low-frequency (f<10 mHz) Alfvénic waves through the chromosphere and corona, and they are ever-present throughout the solar cycle. The low-frequency waves are difficult to dissipate without an additional process that can transfer the wave energy to small-scales (e.g., phase mixing, resonant, absorption, MHD Turbulence) where large gradients can develop to enhance diffusive and resistive processes. Hence, high-frequency Alfvénic waves are critical for efficient energy dissipation. Moreover, multiple Alfvénic modes are expected to exist in the corona, with only the kink mode having been identified routinely in the corona The high temporal and spatial resolution of Cryo-NIRSP offers an unprecedented opportunity to discover whether multiple Alfvénic modes and high-frequency Alfvénic waves are present in the corona. The unique data from Cryo-NIRSP will be compared with sythnetic observables derived from state-of-the-art 3D reduced MHD models of Alfvenic wave turbulence. This will open a new and exciting view into coronal wave physics and permit discoveries into wave energy deposition and the development of coronal wave turbulence.	Richard Morton Co-Is Hui Tian (CN), Zihao Yang (CN), Rahul Sharma (UK), Yajie Chen (CN), Steven Tomczyk (US)	UK
63	Magnetic Structure and Motions of Prominences Abstract Studying fine structure, mass transfer, motions, and magnetic fields in solar prominences allows us to probe the still mysterious prominence formation process and magneto-hydrodynamic instabilities. Studying the evolution of the magnetic field and motion of prominences simultaneously was impossible before the DKIST. Now, Cryo-NIRSP is the only instrument that can observe the He I 1083.0 nm line with both spectrograph and context imager simultaneously. For the first time, we are able to study the relationship between the magnetic field and the motion of prominences simultaneously in the bright neutral helium line. We propose to obtain spectropolarimetric observations of the prominence in order to infer magnetic field configuration of the prominence in the plane of the sky. Furthermore, the analyzer of the context imager provides line integrated polarized measurements which will help us to investigate the evolution of the magnetic field with the cadence of seconds for the first time.	Shuo Wang Co-Is Thomas Schad (US), Ivan Milic (US), Valentin Martinez Pillet (US), Qiang Hu (US), R. T. James McAteer (US)	US

64	Flare Signatures in the Photosphere and the Chromosphere Abstract Solar flares are the most energetic events on the Sun. They are typically characterized by a rapid increase in light emission in a wide range of the electromagnetic spectrum, which affects not only different layers of the solar atmosphere quasi-simultaneously but also the space weather and the Earth's environment. Although solar flares have been observed and investigated for decades, their prediction and detailed mechanisms throughout the solar atmosphere are still unclear. A single solar layer or spectral line is not sufficient to understand different aspects of flares. Therefore, multi-line spectropolarimetric observations in different layers of the solar atmosphere are required to present a complete picture of flares. We propose to investigate the fundamental flare mechanisms and observational signatures in the solar atmosphere by combining the data from the DL-NIRSP, ViSP, and VBI instruments at the DKIST. This study will explain the role of the lower solar atmosphere in the triggering of flares and their subsequent development, which was mainly hindered in the past due to lack of sufficient chromospheric polarimetry. The comparison of the obtained semi-empirical models with the flare simulations will put new constraint on the existing flare theory, and will further improve the physics of chromospheric flares.	Rahul Yadav Co-Is Maria Kazachenko (US), Gianna Cauzzi (US), Ryan French (US), Marcel Corchado-Albelo (US)	US
66	Probing the Photospheric Conditions for Spectral Line Scattering in Sr 4607 Abstract Scattering polarization in the Strontium 4607 spectral line at the center of the solar disk has been theoretically predicted but only statistical detection has been reported so far. Clear detection of these signals will help validate numerical simulations and radiative transfer calculations that involve scattering polarization and the Hanle effect. More importantly, they will allow us to diagnose weak magnetic fields with mixed polarity on very small scales, that are undetectable via the Zeeman effect. With this proposal, we will attempt to detect scattering polarization in the Sr 4607 line and to constrain, using a complementary set of spectral lines, physical conditions in the photosphere where Sr 4607 takes place. This will open possibilities for performing 3D modeling on semi-empirical models of the solar atmosphere and thus open possibilities for developing Hanle inversion codes for the photosphere. Finally, we will be able to constrain the properties of very weak, possibly tangled magnetic fields on very small spatial scales in the solar photosphere. It is only with the large collecting area of DKIST, combined with its multi-instrument philosophy, that we can achieve these goals.	Ivan Milic Co-Is Kevin Reardon (US), Rebecca Centeno (US), Ryan Hofmann (US), Franziska Zeuner (CH), Gianna Cauzzi (US)	US
67	Unveiling the Origin of Umbral Fine-Structure Abstract Extreme fine structuring in the chromospheric umbra is largely unstudied and poorly understood. It consists of both small-scale umbral microjets and dark thin fibrils that are revealed during umbral flashes. First observed by Socas-Navarro (2009), precise semi-empirical modelling of these features is instrumentally limited. Both microjets, other brightenings and fibrils are visible that are not synchronous with umbral flashes (Bharti et al. 2013, Nelson et al. 2017). The accuracy of inversion schemes in the highly dynamic umbra when using wavelength scanning instruments (Felipe et al., 2018) is limited. Still, insight using inversion schemes is possible and has revealed that phase differences in the flow fields, secondary to acoustic wave steepening, plays a role in the joint formation of both bright and dark structures (Henriques et al. 2020). However, what quantity exactly causes the dark components to be visible at all is an open problem and the literature disagrees on the nature of the small-scale brightenings and on the atmospheric models behind umbral flashes themselves. Multi-line spectra at DKIST allow for a resolution of the exiting degeneracies at sufficiently fast acquisition times that overcome the limitations identified by Felipe et al. (2018), not to mention sufficient resolution as necessary to these sub-arcsecond structures. This proposal provides an observation strategy to achieve semi-empirical modelling success and allows a scientific answer to the nature of umbral chomospheric fine structure. Understanding such fine structures also provides a new ultra-local window into the conditions of the umbral chromosphere.	Vasco M. J. Henriques Co-Is Chris Nelson (NL), Sanjiv Tiwari (US), Luc Rouppe van der Voort (NO), Mihalis Mathioudakis (UK)	NO

68	Measuring Strong Coronal Magnetic Fields Abstract This is a proposal to measure magnetic field strengths above an active region on the solar limb with Cryo-NIRSP, and to compare them with simultaneous radio measurements. The radio data will be acquired with the Expanded Owens Valley Solar Array (EOVSA), and will use the well-established gyroresonace technique for magnetic field measurements. Cryo-NIRSP will be used to measure the full polarized spectrum of the Fe XIII 10747 A line. The Cryo-NIRSP slit will be placed parallel to the solar limb, centered above the active region, and moved outwards to a height of 60 arcseconds. The science goal is to compare the density-weighted line-of-sight measurements from Cryo-NIRSP with the radio measurements of absolute field strength that are much less sensitive to density. Strong (kilogauss) field strengths in the corona have traditionally been observed with radio telescopes, and should be readily detectable with Cryo-NIRSP.	Stephen White Co-Is Valentin Martinez Pillet (US), Gianna Cauzzi (US), Bin Chen (US), Dale Gary (US), Timothy Bastian (US), Kevin Reardon (US)	US
69	Mini-filaments at a low-latitude coronal hole boundary Abstract Small-scale energy release events frequently occurring in the solar chromosphere are believed to play an important role in the heating and structuring of the corona and in the acceleration of the solar wind. The project targets at the study of physical properties of mini-filaments and associated small-scale jets as an important feature that might relate the chromosphere to solar wind. Mini-filaments are relatively larger than spicules and jets, and so it is more feasible to measure their flux and flows around them. Since mini-filaments can also generate jets upon eruption, coronal jets and spicules can be studied together using high-resolution observations of erupting mini-filaments. From the DKIST observations, we will derive magnetic flux, helicity, and twist number, swirl motion, and wave-like activity in and around mini-filaments at the heights of the photosphere and the chromosphere. Although we may not be able to trace the ejection to identify an exact counterpart in the solar wind, we can compare our results with an existing database of small-scale flux ropes in solar wind to provide an assessment of possible solar surface sources of the solar wind transients in the inner heliosphere.	Jeongwoo Lee Co-Is Hameedullah Farooki (US), Haimin Wang (US), Shuo Wang (US), Kevin Reardon (US)	US
70	Spatio-temporally resolved linear scattering polarization in the Sr I line at 4607 A: a window to the small-scale photospheric magnetism Abstract Resolved observations of the scattering polarization in the Sr I 4607 A line are very demanding in terms of instrumentation, but have been predicted to be observable with ViSP/DKIST by del Pino Aleman & Trujillo Bueno (2021). This spectral line has been proven to complement Zeeman effect based magnetic field diagnostics, because the scattering polarization is modified by weak but highly mixed and/or dynamic magnetic fields (Hanle effect) in the photosphere, which otherwise cancel in the spatio-temporal resolution element of the observations. Here we propose to observe the Sr I line at disk center in a quiet Sun region, with unprecedented spatio-temporal resolution and at the same time unprecedented signal-to-noise ratio. The combination with the VBI instrument allows to identify granules and inter-granules within the observed region by ViSP, providing the opportunity to test the hypothesis that the micro-turbulent magnetic field component is spatially structured.	Franziska Zeuner Co-Is Roberto Casini (US)	CH
71	Observing coronal Alfvén-like waves with Cryo-NIRSP Abstract We propose to observe the signatures of the Alfven-like waves in the low solar corona with the Cryo-NIRSP instrument. These waves, which have been previously detected with CoMP, could be energetically important for maintaining the corona in its thermodynamic state. The improved resolution of DKIST will allow for the more precise constraints on the wave energy fluxes carried by these waves, which is an important astrophysical question with implications to stellar coronae.	Momchil Molnar Co-Is Alin Paraschiv (US), Steven Cranmer (US), Kevin Reardon (US), Chris Gilly (US)	US

73	Coronal Magnetic Field Observations in Support of PSP and Solar Orbiter Abstract Together with DKIST, new solar encounter missions, such as Parker Solar Probe (PSP) and Solar Orbiter (SO), will form an unprecedented multi-messenger campaign to understand how the solar corona is structured and maintained. Among the ways DKIST will contribute to this campaign, remote-sensing measurement of the low-coronal magnetic field will be most fundamental. A major impediment to understanding the coronal field has been the scarcity of measurements due to the relative faintness of coronal emission. DKIST's 4m aperture and all-reflective design, together with cryogenic cooling of the Cryo-NIRSP instrument, will enable coronal magnetic observations of unprecedented accuracy and detail. Here we propose to take multiple ~daily scans of full-Stokes polarization of the brightest, most active features in the infrared forbidden Fe XIII line at 1074.7nm during a solar rotation preceding a PSP or SO perihelion encounter, and thereby produce improved reconstructions of the coronal magnetic vector field most relevant to those missions. The coronal plasma is optically thin, such that multiple locations along the LOS contribute to the observed signal. To accommodate this complication, and ambiguities intrinsic to the linear polarization, we would adopt two approaches: we would (1) apply the coronal tomographic techniques of Kramar and co-workers to full-Stokes Cryo-NIRSP data and produce 3D coronal magnetic synoptic maps; and (2) forward-model the Stokes parameters using the FORWARD coronal magnetometry toolset applied to MHD simulation data to provide unprecedented observational magnetic constraints on the MHD modeling.	Gordon Petrie Co-Is Valentin Martinez Pillet (US), Kevin Reardon (US), Pete Riley (US), Maxim Kramar (US)	US
75	Penumbral superstrong magnetic fields Abstract The strongest magnetic fields on the solar surface were long thought to be associated with the umbrae of large sunspots. Thanks to the advances in instrumentation and inversion techniques, observers have recently reported even stronger magnetic fields outside the umbra, at the endpoints of coalescing penumbral filaments close to the outer boundary of a sunspot. At these locations, strong magnetic field concentrations (SMFs) with strengths larger than 7 kG were found. SMFs are accompanied by supersonic downflows reaching speeds of 20 km/s and more. The presence of such strong fields is still highly controversial: They were only detected in the deepest layers of the solar atmosphere by using a newly developed technique to infer the magnetic field strengths from observations by Hinode. The spatial resolution of those observations was barely sufficient to resolve the fine structure within these 1 Mm-sized features. The high spatial resolution of DKIST and the possibility to perform multi-line observations to access a larger height range in the solar photosphere offer a unique opportunity to unambiguously confirm the existence of SMFs, and study their properties. Once confirmed, the DKIST observations could lead to a change in one of the most fundamental taxonomic aspects of sunspots, which is that their strongest magnetic fields at the surface appear situated within their umbrae. DKIST observations will also help to understand the basic plasma physical processes required to amplify the fields to these high strengths and clarify their relevance for the stability and evolution of sunspot penumbrae that harbor SMFs.	Sebastian Castellanos Duran Co-Is Andreas Korpi-Lagg (DE), Alex Feller (DE), Sami Solanki (DE), Lakshmi Pradeep Chittaat (DE), Smitha Narayanamurthy (DE)	DE

76	High-Resolution Observations of the Sun's Polar Fields Abstract Accurate measurement of the Sun's polar fields is necessary to the success of key solar physics projects including modeling the global coronal /heliosphere and understanding the solar dynamo. The polar fields are composed of facular concentrations of about 5 arcsec in size, often with field strengths exceeding a kilogauss, but the mean overall flux density is only of order 5-10 gauss. The polar fields are mostly radially directed and are mostly unipolar, but viewed from the ecliptic these mostly weak fields must be observed mostly in the transverse component. It is well known that the Zeeman effect for the transverse component is an order of magnitude less sensitive than for the longitudinal component. Existing measurements of the polar field have therefore lacked the polarimetric sensitivity and spatial resolution to capture all polar magnetic field structures. The unique 4m and all-reflective design of DKIST provides an unparalleled opportunity to resolve the smallest and weakest magnetic structures with high-SNR full-Stokes spectro-polarimetry. In addition, the IR lines observed by DL-NIRSP have sensitivities to LOS fields twice that of visible lines, and four times higher for transverse fields, besides smaller image disturbances from the Earth's atmosphere. We propose to observe the polar fields using DKIST's ViSP and DL-NIRSP spectra-polarimeters, and the VBI. Reliable polar field measurements would enable us to measure polar flux distributions reliably and comprehensively, including small, weak structures, leading to improved global coronal field models that are central to solar physics and space weather research and operations projects.	Gordon Petrie Co-Is Valentin Martinez Pilletat (US), Alexandra Tritschler (US), Serena Criscuoli (US), Sanjay Gosain (US), Xudong Sun (US)	US
78	Towards an understanding of sources of heating in plage regions Abstract Plage regions are bright chromospheric patches that coincide with concentrations of strong, predominantly unipolar magnetic fields in the photosphere. Several physical mechanisms have been suggested to play a role in the plage heating, but their contribution to the energy budget of the chromosphere has not been quantified and thus remains poorly understood. This is partly due to the lack of spatial resolution and polarimetric accuracy in previous observations to adequately investigate the interplay between plage fields and energy deposition in the chromosphere. We aim to improve the magnetic field measurements in plages and study the heating rates' dependence on the field strength and topology. This will be achieved using configuration 3a, providing multiple spectral diagnostics suitable for data inversions. Comparisons between observations and spectral synthesis from state-of-the-art radiative-magnetohydrodynamics simulations will provide further insight into the plage atmosphere. We request observations of the same (or different) plage region(s) at two different positions: (1) offset from the disk center but not too close to the limb, and (2) at or close to the disk center. Furthermore, we will run two experiments each day: a large context scan and a high-cadence program in a smaller field of view (FOV). The large FOV can be used to investigate the stratification of the magnetic field and how it relates to the spatial inhomogeneities of the heating rates. The high-cadence experiment will study dynamic phenomena such as waves and reconnection to track down the mechanisms behind the enhanced heating rates in plage regions.	João M. da Silva Santos Co-Is Juan Martínez-Sykora (US), Bart De Pontieu (US), Thomas Schad (US), Alexander Pietrow (DE), Momchil Molnar (US)	US
80	Connection of magnetic bright points to the plasma supply in filaments Abstract Filaments are characteristic objects in the chromosphere and corona of the Sun. There are different hypotheses on the formation of filaments, but the plasma supply, however, is far from being completely understood. The aim of this project is to study the connection between tiny photospheric magnetic bright points (MBPs) located at the footpoints of the filament and the filament body located in the chromosphere. Studies on the relation of magnetic bright points to filament footpoints are rare. The combination of the high-resolution data and spectropolarimetric measurements in photospheric and chromospheric simultaneously will allow us to study this relationship in more detail.	Andrea Diercke Co-Is Christoph Kuckein (ES), Sergio Javier Gonzalez Manrique (ES), Catherine Fischer (US), Alexandra Tritschler (US)	US

81	Investigating Interchange Reconnection as the Origin of Switchbacks Abstract Currently the origins of the various components of the solar wind remain unclear, making tracers of the wind formation region highly desirable. One potential such tracer is the ubiquitous population of switchbacks detected in situ during the Parker Solar Probe encounters. The number of these large-scale changes in magnetic polarity shows no apparent dependence on distance from the solar photosphere, arguing for a formation mechanism near the solar surface. Therefore, we propose DKIST observations that probe one of the leading theories for switchback formation near the solar surface, namely interchange reconnection in coronal holes. Specifically, the proposed observations will provide much needed constraints on the magnetic field topology, and especially the degree of mixed polarity, in predominantly unipolar coronal holes. This will allow us to track the magnetic field structure as it evolves in time and how it varies over photospheric and coronal heights with unprecedented detail. In turn, this allows us to place limits on the rate of interchange reconnection, and thereby determine if such reconnection events provide a plausible seed for the observed population of switchbacks.	Nathaniel Dylan Kee Co-Is Valentin Martinez Pillet (US), Lucas Tarr (US), Sarah Jaeggli (US), Stuart Bale (US)	US
83	Latitudinal Variation of Faint HeI 1083 nm Coronal Emission Abstract The existence of a diffuse coronal component to neutral helium emission, discovered during eclipse observations, has shown promise for diagnosing the helium abundance of the inner corona and the coronal magnetic field. Yet, the nature and extent of this emission remains incompletely characterized. We propose to leverage the unique capabilities of DKIST and the Cryo-NIRSP to study the circumsolar distribution of the He I 1083 nm triplet line together with the density sensitive Fe XIII 1075, 1079 nm lines. Previous measurements of He I have determined the line to be quite faint (<1 x 10-6 Idisc), yet present at elongations between 1 - 1.5 Rsun. Thanks to the larger, unobscured, off-axis design of DKIST, and the significantly reduced scattered light it provides, DKIST is uniquely positioned to map out the faint triplet HeI 1083 nm emission in order to better understand the origin of this signal, and to develop it further as an essential tool that supports multi-messenger and lower coronal science. The goal of this proposal is to study the distribution of the He I 1083 nm emission and its correlation with coronal structure through well calibrated spectropolarimetric observations of the HeI 1083 nm line, closely followed by FeXIII 1075, 1079 observations of the same region to provide an estimate of the electron densities. We plan to compare these observations against predictions from two hypotheses of the emission source: desorption from an inner dust source or as an equilibrium population in the million degree corona.	Gabriel Dima Co-Is Andre Fehlmann (US), Jeffrey Kuhn (US), Thomas Schad (US), Isabelle Scholl (US), Ian Cunnyngham (US)	US
84	Exploring the propagation and dissipation of high-frequency waves throughout the lower solar atmosphere Abstract The solar chromosphere is dominated by radiative losses, which are a few kW/m^2 larger than the sum of all of its heating sources. There are have been many proposed theoretical explanations for the origin of the heating, but none have satisfactory observational constraints. One of the most prominent candidates for chromospheric heating is the dissipation of high-frequency waves driven from the convective overshoot at the base of the photosphere. Recent work has provided evidence in both directions, as authors disagree if high-frequency waves could provide the required energy flux to sustain the quiescent chromosphere. We propose observational program with DKIST that could provide better observational limits to the high-frequency flux carried in the chromosphere. Furthermore, the polarimetric capabilities of DKIST could provide us with the first observational estimate of the role of the magnetic field in the propagation and dissipation of waves in the lower solar atmosphere.	Momchil Molnar Co-Is Kevin Reardon (US), Steven Cranmer (US), Ivan Milic (US)	US

85	Unresolved flux removal process at magnetic flux cancellation sites: manifestation of magnetoconvective evolution Abstract The purpose of this project is to understand the flux removal process from the photosphere at the magnetic flux cancellation site. Our target is the magnetic flux cancellation events at granular scales and smaller in the network region at the disk center. We will investigate the dynamics of the horizontal magnetic fields connecting the canceling opposite polarity magnetic elements in the photosphere and chromosphere by the multi-wavelength spectropolarimetric measurements with ViSP and DL-NIRSP. Such study allows us to understand whether the submergence or emergence of magnetic field lines takes place at the magnetic flux cancellation sites. We also study how the surrounding convective motions affect the difference between the flux cancellations caused by the submergence and emergence of magnetic field lines from the comparison with the flow patterns derived from the G-band images with VBI. The flux removal process at the flux cancellation site is not yet spatially resolved even by the recent state-of-the-art instruments. The large aperture of DKIST, combined with a unique suite of instruments, allows to acquire for the first time high spatial and temporal data with the high spectropolarimetric sensitivity necessary to resolve the long-standing question of the dynamic nature of the flux cancellation process.	Masahito Kubo Co-Is Serena Criscuoli (US), Marc De Rosa (US), Shin Toriumi (JP), Yukio Katsukawa (JP), Joten Okamoto(JP)	JP
86	New and multi-scale measurements of photospheric flows as drivers of coronal energy flux Abstract DKIST can resolve dynamic processes on smaller spatial and temporal scales than have previously been accessible. We will analyze horizontal photospheric motions in quiet sun and in plage regions (if present near the central disk) via bright-point tracking and local correlation tracking (LCT) applied to high-time-resolution, G-band VBI sequences of photospheric convection, with photospheric magnetic context provided by ViSP scans, and with spatially- and temporally-resolved magnetograms from DL-NIRSP over a small sub-region. Bright-point shape changes will be treated with new methods to study thin-tube wave modes unaccessible with pre-DKIST observations. The magnitudes, morphology (curls, divergences, coherence lengths), and lifetimes of photospheric flows, on the smallest observable scales, have major implications for our understanding of atmospheric heating, magnetic evolution, and fundamental properties of convection. We will address three primary questions. First, what is the approximate energy budget attributable to a variety of thin-tube wave modes? Second, what are the lifetimes of small-scale flow patterns? Rapidly changing photospheric flows can drive turbulence in the overlying magnetic field as recently launched, upward-propagating Alfvénic waves interfere with reflected, downward-propagating waves. Dissipation of such turbulence could lead to atmospheric heating. Third, are small-scale vortical motions present, and if so what are their properties? Such flows were long ago hypothesized to play a key role in coronal heating and have been seen in more recent radiative-MHD simulations of near-photosphere convection. We will address these science themes with a relatively simple observation program, and we will also address several additional questions.	Sam Van Kooten Co-Is Steven Cranmer (US), Brian Welsch (US), Kevin Reardon (US), Johnathan Stauffer (US), James Klimchuk (US), Gianna Cauzzi (US)	US
87	The propagation and dissipation characteristics of slow magneto-acoustic waves in a sunspot umbra Abstract The ubiquitous acoustic oscillations in the photosphere can be channelled into the outer layers of the solar atmosphere via magnetic fields. Upon interaction with magnetic fields, the acoustic oscillations get converted into the slow and the fast magnetohydrodynamic modes, of which the slow mode waves continue to propagate along the magnetic field. It has been shown that the umbral flashes, running penumbral waves, and the propagating coronal disturbances observed in the sunspots are different manifestations of this propagation. The high thermal conduction and other dissipative processes in the solar corona, are known to cause rapid decay and eventual disappearance of slow waves. However, recent studies reveal a significant damping in these oscillations in the lower atmospheric layers. It is likely that this damping in the lower atmosphere is due to a combination of dissipative (e.g., radiative losses, shock dissipation) and non-dissipative processes (e.g., reflection, mode conversion). In order to assess their true dissipation and develop a comprehensive understanding on their propagation across the solar atmosphere, we need full spectral information at multiple heights along their propagation path. To achieve this goal, we intend to make use of the multi-wavelength and ultra-high resolution capabilities of DKIST.	Krishna Prasad Sayamanthula	BE

92	Properties of internetwork magnetic fields at 10^-4 sensitivity Abstract The main goal of this proposal is to determine the properties of quiet Sun internetwork magnetic fields in the photosphere and the chromosphere by means of Zeeman and Hanle sensitive lines. We will take advantage of the unprecedented photon collecting power of DKIST to measure the elusive polarization signals produced by the weak internetwork fields at high polarimetric sensitivity (~10^-4), high spatial resolution (~75 km) and high cadence (~20 s). These data will be used to: 1. Determine the three components of the vector magnetic field in the internetwork, by inverting the four Stokes profiles of several spectral lines simultaneously 2. Determine whether or not internetwork fields are "turbulent", by comparing simultaneous Zeeman and Hanle measurements that are spatially and temporally resolved 3. Determine the total flux content of the quiet-Sun internetwork, both in the photosphere and in the chromosphere 4. Determine the 3D topology of internetwork fields: are they low-lying structures, or do they reach the chromosphere?	Luis Bellot Rubio Co-Is David Orozco (ES), Roberto Casini (US), Thomas Schad (US), Haosheng Lin (US), Azaymi Siu (ES), Valentin Martinez Pillet (US), Karin Muglach (US)	ES
94	Acoustic sources and Local Wavefield Abstract The solar acoustic oscillations are likely stochastically excited by convective dynamics in the solar photosphere, though few direct observations of individual source events have been made and their detailed characteristics are still unknown. On the other hand, observations have revealed that the photospheric and chromospheric magnetic fields are immersed in an acoustic wave field that originates in the photosphere below. Recently, identification of individual source locations and the mapping of the propagating wavefronts associated with them has become possible using deep learning powered filters. While these techniques have been developed and tested on synthetic observations from numerical simulations, with the advent of the Daniel K. Inouye Solar Telescope, ground based observations can achieve the resolution and temporal cadence needed for their application to real solar-image time-series. Extending previous investigations on the wave propagation and the leakage of solar p-modes into the chromosphere, we propose: mapping the photospheric sources of individual wave excitation events, following the waves emitted from those sources with height, and study height dependent interaction between wave field and the ambient magnetic field. The effort will offer well resolved, high cadence multi-height observations of the magnetic-acoustic interaction.	Shah Mohammad Bahauddin Co-Is Mark Rast (US), Ivan Milic (US)	US
95	Height dependence of the photospheric magnetic field as inferred from inversions Abstract Magnetic field extrapolations are a crucial method to understand the magnetic topologies in the solar atmosphere. Such extrapolations are much more reliable if the input magnetic field is measured at a height in the atmosphere where the fields are primarily force-free. Otherwise, ad hoc corrections must be applied to account for plasma forces on the field. Therefore, it of significant importance to know at what heights the force-free approximation can be reliably applied. Previous efforts to address this question have been carried out by Metcalf et al. (1995), Tiwari (2012), and Liu et al. (2015) but the results remain inconclusive. Only Metcalf et al. used magnetic field measurements in the upper photosphere (using Na I 5896 Å) in order to characterize the magnetic field with height through the bulk of the photosphere. We plan to observe multiple lines simultaneously and apply modern inversion techniques to more robustly measure the components of the vector magnetic field over a wider range of heights than has previously been determined. Analysis by Zhang et al (2017) suggests that this can only be achieved with the high signal-to-noise provided by the DKIST aperture. We will then use our results to determine the heights at which the force-free approximation is valid. This knowledge may guide future efforts to make routine vector field measurements higher in the atmosphere as the basis of more robust coronal field extrapolations.	Ryan Hofmann Co-Is Kevin Reardon (US)	US

The 2-letter country codes are taken from https://www.iban.com/country-codes following the ISO 3166 international standard.