ASTROPHYSICAL RESEARCH CONSORTIUM

Principles of Operation for SDSS-V

VERSION: v1.1
Approved by the ARC Board of Governors

1 Introduction

Over the past 15 years, the Sloan Digital Sky Survey has carried out some of the most influential surveys in the history of astronomy. Through four prior epochs, called SDSS-I, II, III, and IV, the SDSS has provided world-leading data sets for a vast range of astrophysical research, including the study of extragalactic astrophysics, cosmology, the Milky Way, the solar system, and stars.

The current SDSS-IV project is funded to operate through June 30, 2020. At that time, the 2.5-m Sloan Foundation Telescope at Apache Point Observatory (APO) and its instruments will remain a world-leading facility for wide-field spectroscopy, ready to pursue further state-of-the-art investigations of the Universe. The APOGEE South spectrograph recently commissioned for use at the 2.5-m du Pont Telescope at Las Campanas Observatory (LCO) provides a matching state-of-the-art capability in the Southern hemisphere.

SDSS-V as currently envisaged is a five-year program to use these facilities at APO and LCO to execute the first-ever all-sky, multi-epoch survey involving both near-infrared and optical spectroscopy, with rapid response target allocation enabled by new fiber-positioning robots. SDSS-V consists of three survey components. The Milky Way Mapper will conduct infrared and optical spectroscopy of millions of stars to chart and interpret our Galaxy's history, and to understand the astrophysics of stars and their relation to planets. The Black Hole Mapper will monitor quasars and X-ray sources from next-generation X-ray satellites to investigate the physics and evolution of supermassive black holes. The Local Volume Mapper will implement a wide-field integral field unit (IFU) facility in both hemispheres; this instrument will conduct optical integral field spectroscopy of our Galaxy and its neighbors, placing the Milky Way in context and testing modern theories of star and galaxy formation. The SDSS-V observations are planned to take place between 1 July 2020 and 30 June 2025.

This document defines the scientific objectives, management structure, and basic operational policies for the project.

SDSS-V builds upon the scientific and technical success of the first four phases of the Sloan Digital Sky Survey, which have thus far used the Sloan Foundation Telescope and du Pont

Telescope to perform imaging of over 14,000 deg^2 and optical and infrared spectroscopy of millions of stars, galaxies and quasars. However, SDSS-V is a distinct project; policies and data rights from previous SDSS phases do not carry over to SDSS-V unless explicitly stated in this document.

The principles articulated here have been agreed upon by the SDSS-V Participating Institutions. They may be revised as needed by future agreements. Changes to this document must be proposed by the SDSS-V Advisory Council and approved by the ARC Board of Governors.

1.1 Scope

This document provides the basis for the governance of the SDSS-V collaboration. The Director of SDSS-V will develop and implement more specific procedures and rules in many of the following areas consistent with the principles expressed here. The Director will keep the Advisory Council informed about such procedures and rules, which will be posted to the SDSS-V internal website.

1.2 Key Terms

Certain key terms, when capitalized, will have the following meanings throughout this document:

- **SDSS-I:** The SDSS-I, originally the SDSS, is defined to consist of all operations and data obtained prior to 1 July 2005 with the Sloan Foundation Telescope.
- **SDSS-II:** The SDSS-II is defined to consist of all operations and data obtained between 1 July 2005 and 30 June 2008 with the Sloan Foundation Telescope.
- **SDSS-III:** The SDSS-III is defined to consist of all operations and data obtained between 1 July 2008 and 30 June 2014 with the Sloan Foundation Telescope (as well as some operations and data from the NMSU 1-m Telescope).
- **SDSS-IV:** The SDSS-IV is defined to consist of all operations and data obtained between 1 July 2014 and 30 June 2020 with the Sloan Foundation Telescope, and operations and data obtained under SDSS-IV from du Pont Telescope (as well as some operations and data from the NMSU 1-m Telescope).
- **Advisory Council (AC):** A body representing the Participating Institutions that advises the ARC Board on matters relating to SDSS-V. Until the AC is established, the Steering Committee (SC) will act in its place.
- **ARC:** Astrophysical Research Consortium, a non-profit Washington corporation for research and education in astronomy with the following current institutional membership (as of June 2017): *Georgia State University, Johns Hopkins University, New Mexico State University, University of Colorado, University of Oklahoma, University of Virginia, University of Washington, and University of Wyoming.* ARC has ultimate responsibility for SDSS-V. The ARC Board of Governors (or ARC Board) consists of two representatives from each of ARC's member institutions.

- **Architects:** Team members who, on the basis of a significant contribution to the design, construction, execution, or management of SDSS-V, are awarded authorship rights on papers involving proprietary SDSS-V data. Architect status does not grant rights to continued access to SDSS-V data.
- **Code of Conduct:** The policy defining appropriate conduct within the SDSS-V Collaboration and means to address deviations from such conduct, agreed to by Participating Institutions and by Participants and those that they sponsor. The AC will recommend a Code of Conduct for approval by the ARC Board.
- **Collaboration:** Collectively, all Participating Institutions and Participants.
- **Core Programs:** The Black Hole Mapper, Local Volume Mapper, and the Milky Way Mapper, collectively.
- **Director:** The Director of SDSS-V.
- **External Collaborator:** A non-Participant who is granted access to SDSS-V data and/or co-authorship on an SDSS-V paper in order to assist with a specific project, for example in cases that the needed expertise does not exist within the Collaboration.
- **External Participant:** A scientist at a non-Participating institution who is granted full rights for data access and science participation on the basis of substantial contributions to SDSS-V infrastructure and project deliverables.
- **Management Committee:** The group that provides advice on regular operations of the project to the Director and the Central Project Office.
- **Ombudsperson:** An independent, neutral party who helps settle disagreements within the project in an informal manner.
- **Participants:** Long-term scientific staff, e.g. faculty, research-track scientists, and the equivalent, who have access to the SDSS-V Science Archive and rights for scientific exploitation and publication of SDSS-V data prior to public release. The extent of Participant status within each Participating Institution is described in the respective MOU.
- **Participating Institutions:** The institutions participating in SDSS-V. There are two categories of participation: Full and Associate. Full members and Associate members with at least three Participants have voting rights on the Advisory Council. Rights and responsibilities of each institutional member of the collaboration will be governed by an individual Memorandum of Understanding (MOU).
- **Principles of Operation:** This document, which sets forth the operating principles for SDSS-V. These principles are understood to be distinct from the principles that governed SDSS-I, SDSS-II, SDSS-III, and SDSS-IV.
- **Science Archive:** The repository of all scientifically useful SDSS-V data made accessible to Participants.
- **Scientific and Technical Requirements:** A document, drawn up by the Director and approved by the AC, that specifies the scientific performance and interface requirements of each instrument and software package used by the project.
- **Survey Teams:** The teams of people associated with each of the Core Programs.

2 Scientific Program

SDSS-V will conduct three interlocking surveys over a five-year period, with scientific goals as listed below.

The Milky Way Mapper (MWM) plans to survey around 6 million stars throughout the Milky Way to trace the formation and evolution of the disk through chemical, dynamical, and chronological means, and use the diffuse interstellar bands as a probe of gas and dust in the Galaxy. It will perform a stellar census of the solar neighborhood stars within 100 pc, down to late M dwarfs and white dwarfs. MWM will observe Young Stellar Objects, members of young stellar clusters, and OB stars throughout the disk to study the upper mass function and its interaction with the interstellar medium. MWM will measure the properties of nearby dwarfs, including as part of the larger program the transiting planet hosts, massive stars, and red giant branch stars observed by the Transiting Exoplanet Survey Satellite (TESS). It will observe multiple-star systems to understand how binarity varies with environment and mass, investigate the brown dwarf desert across stellar types, to identify and characterize systems with compact objects, to calibrate fundamental stellar properties, including ages and sizes of convective cores. MWM will use both the North and South APOGEE spectrographs and North and South optical spectrographs to complete its all-sky stellar spectroscopic survey. The primary targeting sources will be 2MASS, *Gaia* and TESS catalogs, with supplemental information in the mid-IR (e.g. Spitzer) and variability studies using optical imaging.

The Black Hole Mapper (BHM) will measure fundamental aspects of supermassive black holes (SMBHs), their accretion astrophysics, and their growth and evolution over cosmic time, employing two hallmark signposts of quasars as actively accreting SMBHs: optical spectral variability, and X-ray emission. BHM will provide orders of magnitude advances, via time-domain optical spectroscopy of tens of thousands of known quasars, sampling light-travel, dynamical, and thermal timescales, and with cadences from days to decades, to study accretion astrophysics, structures (at otherwise spatially unresolvable size-scales), and outflows in the near-vicinity of black holes, and with high-cadence reverberation mapping of approximately a thousand quasars to measure the most fundamental of all black hole parameters, the black hole mass. As part of this program, the BHM will also acquire multi-object optical spectra to identify, characterize, and measure redshifts of hundreds of thousands of X-ray sources discovered in the eROSITA mission (2018 launch anticipated), the next-generation in all-sky X-ray surveys. BHM optical spectroscopy combined with X-ray data on AGN will provide another deep view into quasar central engines, while also enabling an obscuration-unbiased census of quasars, and the growth and cosmic evolution of their SMBHs. The BHM Program will also obtain optical spectra of ten thousand X-ray emitting clusters of galaxies, with applications from cluster physics to cosmology, as well as identify large numbers of X-ray emitting stars, e.g., flaring stars and compact accreting binaries.

The Local Volume Mapper (LVM) will take the first step towards a “spectral panopticon”, providing a full spectroscopic image of the sky, providing optical IFU data-cubes to resolve, e.g., star-forming structures, giant molecular clouds, H II regions and young stellar clusters in the Galaxy and the Local Group. LVM will provide essential context to the stellar SDSS-V programs by probing the interstellar medium around the target stars, in particular for young stellar objects (YSOs), stellar mass black holes (e.g. X-ray binaries in the BHM), and different stellar populations across the Galactic disk. The LVM will cover the bulk of the Galactic disk at 0.1 to 1 pc resolution, the Magellanic Clouds at 10 pc resolution, M31 and M33 at 20 pc resolution, and Local Volume galaxies out to a distance of 8 Mpc at 50 pc resolution, over a total solid angle of up to 1 steradian of sky. LVM will use two sets of three medium resolution (resolution R of approximately 4000), fiber-fed, IFU spectrographs covering the full optical wavelength range. These clusters will be fed by a suite of small to medium aperture telescopes outfitted with IFUs with very wide field-of-view (FOV) in the northern and southern hemispheres. The set of telescope apertures provides a range of spatial resolution and FOV tailored to map large areas across nearby galaxies. LVM’s coverage of approximately 2800 deg^2 in the Milky Way, and approximately 100 deg^2 in the Magellanic Clouds, the Local Group, and the Local Volume is 3–4 orders of magnitude larger than any existing IFU dataset.

The requirements for observing time for the three programs will be balanced so that the scientific goals of all are optimized within the five-year duration of SDSS-V observations, to efficiently use the observing systems, adapting to weather. To do so, we will rebalance the three survey time allocations as the survey progresses, based on weather and other uncontrollable losses of observing time. The top priority will be to ensure the scientific integrity of the Core Programs. The intent is that the survey will be so designed and the data set of sufficient quality that it will remain of scientific interest for many years after the survey has concluded.

The main product of SDSS-V is the Science Archive, consisting of reliable and easily utilized data sets, data products, and software interfaces from all three surveys. SDSS-V will construct periodic public releases of validated and calibrated data according to a schedule devised in consultation with the funding agencies. All SDSS-V participants will have access to all of the contents of the Science Archive. Participants may pursue whatever scientific projects they choose using SDSS-V data, subject to the policies discussed in §3, §6, and §7.

3 Participation in SDSS-V

3.1 Membership in SDSS-V

Membership in SDSS-V is open to individual institutions. Benefits of membership include proprietary access to SDSS-V data as well as the ability to participate actively in survey planning. Membership in SDSS-V provides access to data from all three surveys.

A Participating Institution formally joins the SDSS-V project through a Memorandum of Understanding (MOU) with ARC. One element of that MOU will be the acceptance of these Principles of Operation. Membership in SDSS-V is recommended by the Advisory Council (or by the Steering Committee, prior to the time that the AC is formed) to the ARC Board of Governors. On behalf of the ARC Board of Governors, the Chair of the ARC Board will approve entry of all Participating Institutions into SDSS-V following vetting of the MOUs by the ARC Business Manager and ARC Secretary/Treasurer.

3.2 Participation in SDSS-V

A Participant at an SDSS-V institution is understood to be a long-term scientific staff member -- e.g. faculty (tenured and non-tenured), research-track scientist, or equivalent.

In all cases, an individual Participant, postdoc, or other staff member is considered to be “at an institution” if at least 50% of his or her salary is paid by the institution. Exceptions must be specified in the institutional MOU. In the case of multi-institutional postdoctoral fellowship programs, in which a post-doc spends some years at a participating institution and some years at a non-participating institution, the full term of the fellowship may be considered when determining the 50% salary threshold, at the option of the participating institution; note that this rule applies to ongoing programs, not custom arrangements for individuals. Unless otherwise specified in the institutional MOU, graduate and undergraduate students must be enrolled full-time at the institution in question to be considered “at an institution”. Individuals employed with at least half-time salary by their institution who are no more than three years after their first bachelor degree (e.g., individuals working for a year before going to graduate school) may be sponsored as if they are full-time undergraduates.

Full Institutional Membership includes proprietary data rights for an unlimited number of Participants from the institution, and these Participants may sponsor an unlimited number of postdocs or other short-term staff from the institution and an unlimited number of graduate and undergraduate students enrolled at the institution. Full Membership requires a total contribution of $1150K. In most cases this membership fee will be paid in annual installments over the lifetime of the project (see below), with details spelled out in the MOU between ARC and the institution. All partners are encouraged to join as Full members.

To accommodate institutions that cannot commit to a Full membership, Associate Institutional Membership includes proprietary data rights for a specified number of Slots, where the cost-per-Slot is set to one-fifth of the cost of a Full membership, i.e. $230K. Typically a Slot will cover one Participant and one postdoctoral researcher sponsored by the Participant, but this

balance may be negotiated in specific cases. The Participants and postdocs at an Associate Member Institution are named rather than pooled. Participation rights can be moved from one researcher to another with the consent of the Director; the Director (and AC if necessary) has the authority to limit overuse of this flexibility. Participants may sponsor graduate and undergraduate students at their institutions who are working under their supervision, and they may also sponsor individuals employed by their institution who are within three years of their first bachelor degree (e.g., individuals working for a year before going to graduate school or masters students). In addition to these sponsored individuals, postdocs and other professionals whose salary is paid at least 50% by SDSS-V, or whose work is counted as an in-kind contribution at at least a 0.5 FTE level, will also have data-access and other participatory privileges. A minimum of three Slots is required for an Associate Member Institution to have a vote on the AC, and to have a representative on the Collaboration Council (CoCo). However, an institution may join with one or two Slots.

Associate Member institutions may gather themselves together into Participation Groups (PGs) with the approval of the Director and the SC (or AC when it is formed). MOUs will be signed independently with each institution. Designation of a PG with three or more Slots total will allow the PG as a whole to have a single vote on the AC. If a PG has ten Slots or more it will have two votes on the AC.

“Individual institutions” as used here will typically refer to an individual university campus, a national lab, or other clearly single entity. Entities whose status as in individual institution is unclear or other collaborative buy-in arrangements will be treated on a case-by-case basis, taking into consideration the scope of the proposed arrangement, its potential benefit to the project, and potentially other factors.

The SDSS-V Director, upon approval by the AC, may designate scientists at non-SDSS-V institutions to be “External Participants,” with full rights of data access and participation in SDSS-V science projects. Significant existing or potential contributions to the project as a whole will be given special consideration in deciding on External Participant status, with the typical expectation of a 1-year FTE contribution to SDSS-V infrastructure and project deliverables. Designation as an Architect (see § 6.2) is not necessarily sufficient to earn External Participant status, as the contributions considered for Architect status may be broader in character than those that qualify as contributions for External Participant status. Participants who leave a Participating Institution, or who otherwise lose their Participant qualifying status, retain their Participant status only with an External Participant designation. Rights to share data access with postdoctoral fellows, students, or others will be considered on an individual basis. External Participant status does not automatically continue for a person if they return to an SDSS-V institution or their institution becomes an SDSS-V institution.

Any Participant can propose to sponsor an “External Collaborator”, a non-Participant who is granted access to SDSS-V data and/or co-authorship on an SDSS-V paper in order to assist with a specific project. The sponsor must present the proposal to the Collaboration Council (see

§4.11), conforming to standards set out by them. The CoCo reviews the case and issues a recommendation, which the SDSS-V Spokesperson brings to the MC for final approval. Should an External Collaborator be proposed from an Associate Member or Participation Group, the Director will consult with the Chair of the AC about the proposal prior to the decision being made. If granted, data access and/or co-authorship rights will be restricted to the specific person for the specific project. All such appointments will be reviewed annually by the SDSS-V Spokesperson to determine if continuation is warranted.

Participants, postdocs, or students leaving a Participating Institution without External Participant designation should use the External Collaborator mechanism in order to complete the specific projects on which they have been actively working. Such requests follow the same mechanism as above; however, the standards for approval of the proposal set by the Collaboration Council may be more lenient for these cases.

Full details of membership in the project will be described in the individual MOU with each institution.

3.3 Responsibilities of Participants and Sponsored Members

All Participants and the members they sponsor are expected to read and abide by the Principles of Operations and the *SDSS-V Publication Policy* and are responsible for protecting the scientific integrity of SDSS-V and the data rights of other Participants.

Participants and collaboration members sponsored by participants are expected to abide by the SDSS-V Code of Conduct. SDSS-V fully endorses the principles of professional conduct articulated in Article X of the Bylaws of the American Astronomical Society and expects all those associated with the project to follow those precepts. Specifically, SDSS-V communications (meetings, phone conferences, e-mail exchanges) are intended to “provide an environment that encourages the free expression and exchange of scientific ideas.” It is the responsibility of members of the SDSS-V Collaboration to ensure that such discourse is “conducted in a professional atmosphere in which all participants are treated with courtesy and respect.”

The failure of individuals to adhere to the *SDSS-V Publication Policy* or the SDSS-V Code of Conduct can result in sanctions as specified in those policies, up to and including revocation of membership (in which case ARC Board of Governor approval will be required). No refunds of institutional contributions can be made in such circumstances.

3.4 Contributions to SDSS-V

Fees for Full Institutional Membership in SDSS-V will be set by the ARC Board of Governors. Contributions can be cash or in-kind and are measured in US dollars. In-kind expenditures in other currencies will be determined on the basis of exchange rates near the time of the

expenditure, or by other arrangement in the MOU. Only direct costs will be counted as in-kind contributions (i.e., including fringe benefits but excluding institutional overheads). All in-kind contributions need to specifically address items in the Director's budget and must be approved in advance by the Director, in consultation with the MC. These in-kind contributions will be reported annually to the AC. All such details, including the schedule and value of in-kind contributions, will be elaborated in the institutional MOU with ARC. Hardware and software developed previously for SDSS-I, II, III, or IV will generally not be counted as an in-kind contribution for SDSS-V.

The standard SDSS-V institutional membership payment schedule will require a total of seven payments. For Full Members, the first payment of $180,000 is due by June 30, 2018 or three months after the signing of the MOU, whichever is later. Subsequent payments are $170,000 due by October 31 of 2019, and five payments of $160,000 due by October 31 of 2020, 2021, 2022, 2023, and 2024. For Associate Institutional Members or Participation Groups, all payments are scaled according to the 1/5 factor per Slot, as described above.

Recognizing the importance of early funding to SDSS-V preparation and the greater risk attached to earlier contributions, SDSS-V may offer financial incentives to encourage such contributions, e.g., by crediting them at more than face value.

Each institution’s MOU will define the penalties should the institution fail to fulfill a promised payment. Typically the penalty will be that, effective the date of the contribution deadline, the institution will forfeit access rights to all SDSS-V data that is not publicly released, as well as access to collaboration private communications and any voting rights in the Advisory Council and Collaboration Council. Specific situations will be dealt with if and when they arise by the Director and the AC.

Participation in SDSS-V is on a shared-risk basis. The project will make its best effort to meet the goals set out under “Scientific Program” above, but it cannot guarantee success for any particular specification listed there. There will be no refunds of project contributions in the event of descope of SDSS-V or withdrawal of an institution. If the SDSS-V project is dissolved entirely prior to January 1, 2024, then the remaining cash, after payment of all residual obligations as well as any settlements with funding agencies, will be distributed to the member institutions, with pro-rated fractions set by the amount of cash contributions toward MOU obligations, excluding any incentive bonuses.

It is ARC policy that all work packages negotiated for support of the SDSS projects (e.g., in which ARC provides funds for hardware or software development or operations support at one of the Member Institutions) require a waiver of overhead rates, with the sole exception of operations at Apache Point Observatory. This policy of having institutions where work is done carry the burden of the IDC costs has been a critical factor in obtaining previous support for SDSS from funding agencies, foundations, and institutions. SDSS-V will continue to operate under this policy.

4 Management

4.1 ARC Board of Governors

The ultimate responsibility for all aspects of SDSS-V rests with the ARC Board, including approval of annual budgets, requests for outside funding, and the appointment of the Director.

4.2 Advisory Council (AC)

The AC advises the ARC Board on matters relating to the SDSS-V project. The AC consists of one representative from each of the Participating Institutions with voting rights, i.e., all Full Institutional Members plus Associate Institutional Members and Participation Groups with three or more slots. The Chair of the AC may invite additional non-voting attendees to any meeting, but institutions with fewer than three slots do not have voting representation on the AC.

The Chair of the AC will be appointed by the ARC Board for a specified term. The ARC Board will request nominations by the Participating Institutions for representatives to be appointed to the AC. The AC members are the primary channel through which information flows between the ARC Board and Participating Institutions. A majority vote of the AC is required before a recommendation to admit a new Participating Institution is made to the ARC Board. One of the important functions of the AC is to transmit the annual operations budget of the project, as formulated by the Director, along with its recommendations to the ARC Board for its approval.

The AC will meet as deemed necessary, generally at least twice per year. Meetings will typically be scheduled by the AC chair, but can also be scheduled on the request of two or more AC voting members. Meeting dates will be set and announced well in advance to assure good attendance. The agenda will be distributed at least five working days in advance of the meeting to AC members, the ARC Chair, the ARC Secretary, the ARC Treasurer and the SDSS-V Director, Project Scientist, and Spokesperson. The AC Chair is responsible for timely filing of approved meeting minutes with the ARC Secretary, and is responsible for informing the Collaboration of any decisions by the AC. The SDSS-V Spokesperson will ensure that a public version of the minutes is posted to the Collaboration in a timely manner.

A quorum of the AC will consist of a simple majority of the voting members, including proxies. AC decisions will be approved by a simple majority of a quorum. Each voting member of the AC will have one vote. If an AC member is unable to attend a meeting, his or her institution may appoint an alternate to attend and vote in his or her place or may give its proxy to another AC member. The Chair may vote or not, at his or her discretion; the Chair may, but is not compelled to, break a tie vote.

Any action of the AC may be taken by electronic ballot. The electronic ballot period shall be no less than seven calendar days. The results of any electronic ballots will be distributed by email to the AC after the close of the ballot period and filed with the minutes of the succeeding AC meeting.

It is the responsibility of AC members to ensure that their Participants and relevant institutional officers (e.g. Departmental Chair, Director of Sponsored Programs, etc.) are informed of SDSS-V policies and decisions.

The AC will also have an AC Executive Committee (AC EC). It is chaired by the Chair of the AC and includes the Chair of the ARC Board (ex officio, non-voting). In addition to these two individuals, the AC EC includes four at-large members appointed by the AC.

The AC EC will provide advice and guidance to the SDSS-V Director through more frequent communication than the AC will necessarily have. The AC EC will work with the Director to negotiate institutional memberships and other MOU-level agreements. Minutes of AC EC meetings will be circulated to the full AC within two weeks.

In addition, the AC can vote to give the AC EC the right to act on its behalf for certain tasks, such as approval of memberships and External Participant applications. In exceptional cases, with approval of both the Chairs of the AC and the ARC Board, the AC EC has the authority to act for the AC on other matters. When the AC EC acts on behalf of the AC, the AC Chair will inform the AC of the action within two weeks. All actions and approvals by the AC EC will require positive votes from at least 3 of the 5 AC EC voting members, with no negative votes. If the AC EC cannot reach a consensus, then the AC Chair may bring the issue to the full AC without prejudice.

4.3 SDSS-V Director

The ARC Board has delegated to the SDSS-V Director the authority for organizing and directing all aspects of the project, including the development and delivery of all necessary hardware and software and the operation of the survey. To those ends, the SDSS-V Director is responsible for:

- Creating job descriptions and making appointments of key personnel to the roles defined in this document, and maintaining the list of those personnel;
- Keeping the AC informed on the status of the project, including any major problems and plans for resolving them;
- Drafting MOUs with any new Participating Institution for concurrence by the AC and approval by the ARC Board;
- Formulating, with the assistance of the Project Scientist, the formal set of instrument, software, and data requirements needed to meet the scientific goals of the three surveys;

- Supervising all financial aspects of the project;
- Preparing, with the assistance of the ARC corporate office, annual budgets, to include the funds and in-kind services needed for all SDSS-V operations, as well as regular financial summaries of expenditures and obligations;
- Leading the preparation of proposals to fund the operations of SDSS-V (§ 7) and assisting the ARC Board and AC in other relevant fund-raising activities as requested;
- Working with ARC officers in conducting the project so as to comply with the terms of funding awards received by ARC from federal agencies and private entities;
- Ensuring that other goals specified in funding proposals, such as SDSS-V's Education and Public Outreach plans, are met;
- Ensuring inclusiveness and diversity in the project's scientific activities and leadership;
- Undertaking other responsibilities identified in this document.

The SDSS-V Director will be appointed for a fixed term by the ARC Board, taking into consideration the recommendation of the AC. The AC will identify and evaluate candidates for the position of SDSS-V Director when the incumbent's term is coming to an end or when the position is vacated unexpectedly.

The Director has final authority over the individual surveys as well as the authority to resolve conflicting needs between surveys, including allocation of fibers and distribution of observing time. The Director also has the authority to approve the detailed observing plan within the spirit of the goals described in Section 2.

4.4 SDSS-V Project Scientist

The SDSS-V Director has delegated to the SDSS-V Project Scientist the responsibility for providing the overall quality assurance for the project and ensuring its scientific integrity. From this perspective, the SDSS-V Project Scientist monitors the project in all its phases and evaluates the scientific impact of changes or compromises made in the course of constructing the hardware, preparing the software, and developing the plans for commissioning and operations. The SDSS-V Project Scientist plays a leadership role in organizing and overseeing the scientific effort of the Collaboration.

The Project Scientist works to ensure that management decisions support the science goals and technical requirements of SDSS-V and that the surveys function together cleanly. He or she will work with the Program Heads and Survey Scientists to ensure that each survey develops detailed requirements and validates their data processing and data releases against those requirements. He or she is responsible for informing the SDSS-V Director and SDSS-V Program Manager of the state of compliance of Survey Operations with survey metrics.

4.5 SDSS-V Program Manager

The SDSS-V Program Manager assists the Director in the execution of his or her responsibilities. The Program Manager, with the support of the other members of the Central Project Office, is responsible for developing and maintaining project schedules. He or she is responsible for preparing annual and cost-to-complete budgets for consideration by the SDSS-V Director and SDSS-V Project Scientist prior to their submission by the SDSS-V Director to the AC. He or she is responsible for tracking project expenditures and reporting them, together with any deviations from the approved budgets, to the SDSS-V Director on a timely basis. He or she is responsible for preparing the quarterly reports that are distributed to the AC and for tracking expenditures against the approved budget.

The Program Manager coordinates the engineering efforts within SDSS-V with the efforts of the engineering groups at the Participating Institutions, with Apache Point Observatory, with Las Campanas Observatory, and with the requirements of the observing program. He or she develops an adequate set of internal project reviews and is responsible for organizing and chairing these reviews. He or she identifies resources at the Participating Institutions when additional resources are needed to meet schedules. He or she is also responsible for keeping the SDSS-V Director and SDSS-V Project Scientist informed on the cost and schedule performance of Survey Operations.

4.6 SDSS-V Spokesperson

The SDSS-V Director has delegated to the SDSS-V Spokesperson the primary responsibility for fostering the scientific productivity of the Participants, representing SDSS-V to the outside world, raising the visibility of SDSS-V within the astronomy and physics communities, maintaining good morale, and ensuring inclusiveness in the Collaboration. He or she is charged with formulating and implementing guidelines for project publications and for coordinating public presentations. The SDSS-V Spokesperson is elected by the Collaboration from a slate of candidates nominated by the Collaboration and approved by the MC. The Director may appoint an interim Spokesperson prior to the first election, which should occur some time before the end of 2019.

The Spokesperson, in concert with the CoCo and the MC, will establish additional structures for the Collaboration science efforts, such as the formation of Working Groups or the appointments for Survey Science Team Chairs.

4.7 Central Project Office (CPO)

SDSS-V is managed by the Central Project Office, chaired by the Director and including the Program Manager, Project Scientist, ARC Business Manager, and the Spokesperson.

The CPO is responsible for financial management of the project. It requests and receives annual payments from the Participating Institutions. It receives and manages funds from sponsoring governmental agencies and private sources, including the management of contracts

to organizations and vendors. Details of CPO operations in these and other areas will be given in the Project Execution Plan.

4.8 SDSS-V Management Committee

The Central Project Office is assisted by and solicits advice from the Management Committee (MC), which includes the above CPO members as well as other key personnel named by the Director. The Director has the authority to change the makeup of the MC or delegate specific areas of responsibility within the MC as he or she sees fit. Formal communications of the MC with the ARC Board or AC are through the SDSS-V Director.

The Director, Project Scientist, Program Manager, and Spokesperson constitute the Executive Management Committee, which is authorized to make decisions in the event that it is not practical to convene the whole Management Committee.

4.9 Program Teams

For each Core Program, there is an associated Program Team led by a Program Head who reports to the Central Project Office and sits on the Management Committee. The Program Teams develop observing strategies, calibrations programs, necessary systems or software development, and data release content, and organize Science Working Groups. A Team may propose to the Project Scientist plans for improvements for calibration, analysis software, data processing software, and data distribution to the Collaboration. A more exhaustive list of the structure of the teams and the scopes of responsibility will be listed in the Project Execution Plan.

4.10 Construction Teams

For the Fiber Positioning System and the LVM instrument, Construction Teams will exist to deliver the hardware and software systems. Each team will have a designated lead who will sit on the Management Committee; individuals may be on both the Construction Team and the Program Teams. A more exhaustive list of the structure of the teams and the scopes of responsibility will be listed in the Project Execution Plan.

4.11 Operations Teams

The SDSS-V Central Project Office will oversee the creation and staffing of Operations Teams to execute the common efforts in the survey, primarily observatory operations, infrastructure support, and data management tasks. Each team will have a designated lead who will sits on the Management Committee. A more exhaustive list of the structure of the teams and the scopes of responsibility will be listed in the Project Execution Plan.

4.12 Collaboration Council

The Collaboration Council (CoCo) advises and supports the Spokesperson concerning scientific matters and collaboration policies. The Spokesperson chairs the CoCo. This group consists of one member from each Participating Institution with three or more Participants plus at-large members who represent, and are elected by the Lead Scientists for the Associate Institutions with fewer than three Participants. There will be one at-large member for every five Slots in Associate Institutions. The CoCo will usually meet on a biweekly basis.

4.13 Change Control Board

It is inevitable that deviations from the intended plan will occur. A standing Change Control Board (CCB) will be constituted by the Director and charged to give formal evaluations of any substantive departures from the Scientific and Technical Requirements. The Director, Project Scientist, and Program Manager will be members of the CCB. Other CCB members will be chosen to provide expertise across a broad range of project components; temporary additional members may be added by the Director as appropriate.

4.14 Ombudsperson

The ARC Board will appoint one or more standing Ombudspersons for the project to help resolve disagreements arising in any aspect of the project in an informal manner. As a neutral third party, the Ombudsperson does not advocate for the project or for either party in a dispute. The objective is to provide a process for achieving a fair and reasonable settlement working within existing policies and procedures. When a request for services is received, the Ombudsperson will work with each party to identify appropriate alternatives that address the conflict and to achieve a mutually satisfactory resolution. Consultation with the Ombudsperson does not preclude later pursuit of a resolution through formal channels if that procedure is desired.

5 Risk Management

The SDSS-V project includes hardware and software development at distributed sites in order to meet specifications defined by the scientific and technical requirements. The project schedule includes delivery dates for critical items; normally, it is expected that any delays in the delivery or implementation of critical items will be absorbed by the contingency built into the schedule.

Significant departures from the intended plan may occur, for example due to delays in excess of contingency, unanticipated technical issues, or rescheduling outside the control of SDSS-V (such as for eROSITA or TESS programmatics that may affect optimal SDSS-V targeting). In

such cases, the Change Control Board can be convened. The Director, as advised by the Management Committee, will determine when invoking the CCB is warranted. The Director will charge the CCB with providing a specific recommendation or set of options to address the problem while balancing the needs of the various programs. The recommendations may include schedule changes or descopes, for example, or a recommendation for a major redirection of resources. The CCB may also be invoked to expand the Scientific and Technical Requirements in the event that some aspect of the project requires further definition.

CCB recommendations that alter the project goals or structure as described in these Principles must be submitted to the SDSS-V AC for its approval before they are implemented by the Director.

Pursuant to these policies, should new SDSS-V instrumentation be delayed in its construction and commissioning, the SDSS-V collaboration will develop alternative observing plans using the existing facility to pursue the SDSS-V science goals to the best extent possible. These plans will be reviewed and approved by the CCB.

Las Campanas Observatory facilities will be used by SDSS-V through an agreement with The Observatories of the Carnegie Institution for Science (OCIS) to grant SDSS-V permission to use the facilities. To move forward with the use of these facilities will require a signed agreement between ARC and OCIS allowing the use of the facilities to be recommend by the AC and approved by the ARC Board and OCIS by December 1, 2018. If a signed agreement does not exist by that point, the CCB will be convened to make a recommendation to the SDSS-V AC regarding plans for a southern survey.

Should SDSS-IV end earlier than June 30, 2020, then SDSS-V will work with ARC and the SDSS-IV collaboration to develop a smooth transition. This may result in commencing SDSS-V observing operations at APO as early as January 1, 2020. New instrumentation for SDSS-V may not be ready by this date, which would imply that early operations will be less efficient for pursuit of the SDSS-V science goals.

Should major descopes be necessary to SDSS-V due to financial constraints, the first considered descope will be to reduce the length of the survey to 4 years. If this proves insufficient, other descopes will be considered, including to the hardware under development. The minimally acceptable SDSS-V project shall be considered to be a 3.5 year program operating robotic positioners at each of the 2.5 meter telescopes. Specific commitments associated with funding awards may constrain decision-making further or possibly alter these priorities. A proposal for a descope that terminates *any* of the three core programs must undergo the change control procedure described above, before final approval by the ARC Board.

6 Publication Policies

Any member of the project who is authorized to have access to the SDSS-V Science Archive has authorship rights on published papers as described in the policies and procedures specified below.

Full details will be provided in the document *SDSS-V Publication Policies*, to be developed by the CoCo for approval by the AC. A copy of these Publication Policies will be available on the project web site or available from the Spokesperson. The guidelines must be read and agreed to by the Participants, a relevant institutional officer at Participating Institutions, and collaborators. The Publication Policies must be consistent with and may not supersede the basic principles of these Principles of Operation. The SDSS-V Spokesperson is responsible for keeping the published Publication Policies up to date.

6.1 Research Projects and Publications

SDSS-V is intended to be an open collaboration, and members are entitled to work on any project undertaken within the purview of SDSS-V. Each research project must be announced to the Collaboration, specifying the subject matter, project leader, known collaborators, a contact person, and the anticipated duration of the project. Lists of proposed projects and publications will be maintained by the SDSS-V Spokesperson and made available on the internal project website. Student thesis projects will also be listed; any special protections for such projects will be described in the *SDSS-V Publication Policy*. These policies apply only to data that have not been released to the public at the time the analysis was started. It is understood that people who join projects make themselves available to undertake appropriate tasks in support of the effort as assigned by the project leader.

Publications are expected to be posted for review within the collaboration a minimum of three weeks before being submitted to a journal or publisher.

6.2 Authorship

Any member of SDSS-V who is authorized to have access to the Science Archive may, at any stage of a research project within the SDSS-V collaboration, request that his/her name be added to the list of authors, with the presumption that permission will be granted if he or she has made a significant contribution to that specific research project.

Scientists who have SDSS-V “Architect” status can opt to be co-authors on any paper based on proprietary SDSS-V data. (However, technical papers describing aspects of the SDSS-V hardware, software, or procedures are not automatically open to authorship requests.) Architect status is granted based on significant contributions, typically 1 year FTE effort within SDSS-V, to

the optics, telescope, infrastructure, instruments, calibration, data reduction and archiving software, commissioning, management, collaboration climate, centrally organized or sponsored work in the areas of education and public outreach, and major fundraising. Requests for such status should be made to the Spokesperson, who will bring the case to the CoCo for recommendation and to the MC for approval.

By signing their names to an SDSS-V paper, all co-authors are understood to be accepting responsibility for the paper according to the guidelines given in the *SDSS-V Publication Policies* and the *Guidelines for Professional Conduct* of the American Physical Society (http://www.aps.org/policy/statements/02_2.cfm).

Disputes concerning matters of authorship will be referred to the SDSS-V Spokesperson. If the Spokesperson is a party to the dispute or is unable to resolve it, the matter will be referred to the Collaboration Council who will select a neutral mediator. Unresolved disputes may be appealed to the Director or, if the Director has a conflict of interest, to the AC Executive Committee, whose decisions will be final.

6.3 Sanctions

The *SDSS-V Publication Policies* document will specify the sanctions that can be imposed for infractions of the stated policies. These may include a delay in publication and, in extreme cases, debarment from access to SDSS-V data. No refunds of institutional contributions can be made in such circumstances.

7 Proposals and Initiatives

7.1 Proposals by ARC As-A-Whole

Proposals submitted by ARC as-a-whole to government or philanthropic sources to secure funds to support the construction, operation, or scientific exploitation of SDSS-V require approval by the ARC Board following a recommendation by the AC.

7.2 Other Proposals to Fund Scientific Research

Proposals from Participating Institutions involving use of SDSS-V data or facilities that have the potential to conflict or compete with the Project's own fund-raising proposals must be brought to the attention of the Director well ahead of submission. In unusual circumstances, the Director or Chair of the ARC Board may require modification of such a proposal prior to submission, with notification of the action to the AC. The guiding principle is that the Project must be able to present an organized, rational funding plan to financial sponsors and the scientific community.

Particular caution is required when a proposal requests funding for work that is implied to be important to producing the SDSS-V public release data sets, or when a proposal states that results from the supported work will be included in the SDSS-V public Data Releases. Uncertain cases should be discussed in advance with the Director. The Director may provide endorsement letters as documentation for a proposal when appropriate.

Funding proposals for scientific exploitation of SDSS-V data do not require approval or vetting from the Project. However, such proposals must not conflict with the Principles of Operation or with the submitting institution's own MOU (e.g., by implying data access rights to someone who is not entitled to them), and they may not commit to public release of SDSS-V data ahead of the Project's planned public Data Releases. Proposing institutions or individuals are responsible for all incremental costs deriving from the proposed research.

7.3 Initiatives for Extension Beyond the Primary Survey

Initiatives to use or augment SDSS-V hardware, operations, or data for purposes that are not part of the Core Programs may be approved by the SDSS-V Director after review by the SDSS-V Project Scientist to assess scientific merit, and then by the SDSS-V Program Manager to ensure their technical appropriateness and assess their financial impact. Subsequent review by the AC and approval by the ARC Board is required only if the SDSS-V Director determines that there may be financial impact on the Collaboration or potential conflict with existing institutional arrangements. If there are deemed to be such impacts, the SDSS-V Director will determine any required modification of the Principles of Operation and will prepare a recommendation to the AC. The Chair of the AC will transmit the Initiative, the SDSS-V Director's recommendation, and the AC's own recommendations to the ARC Board if necessary. Approval of the Initiative may be granted contingent upon the proponents securing the necessary financial resources.

7.4 Initiatives for Use of Intellectual Property

Initiatives to use the intellectual property of the SDSS-V Collaboration will be covered by the Intellectual Property Policy of ARC, Inc., a copy of which is available from the ARC Secretary.

8 The Observatories

SDSS-V facilities for northern hemisphere operations will operate at ARC's Apache Point site and share infrastructure and administrative staff with the 3.5-meter telescope, affording both projects the benefits of a broader skill mix. Shared staff and other common operations support costs will be apportioned between the projects by mutual agreement of SDSS-V and 3.5-meter directors. SDSS-V will provide its own dedicated observing staff. Data from SDSS-V and 3.5-meter environmental monitoring equipment will be available to users of both telescopes.

SDSS-V facilities for southern hemisphere operations will operate at the Carnegie Institution for Science's Las Campanas site. Telescope operator and telescope and facility engineering support will be provided by Las Campanas, and observing and engineering support for SDSS-V equipment will be provided by SDSS-V, on a basis defined by the agreement to utilize the facilities described in Section 5.

Hardware and equipment funded through ARC, accepted as in-kind contributions for SDSS-V membership by ARC, or directly purchased by ARC, remains the property of ARC. ARC commits to the availability of this equipment for the implementation of SDSS-V throughout the duration of the project, except in the case that an alteration of project plans (through the process described in Section 5) means the equipment is no longer required. ARC reserves the right to make arrangements for the disposition of hardware and equipment after the end of SDSS-V or after such descopes, either for alternative uses, for transfer to other organizations, or for other purposes.

The disposition of other hardware and equipment utilized by SDSS-V may be made in accordance with special provisions in individual institutional MOU's.

9 Document Revision History

- v1.0 Approved by ARC Board of Governors, 2017-11-06
- v1.1 Edited cessation policy in Section 3.4, approved by ARC Board 2017-12-12