

Chapter 1 Introduction

The DSA telescope (formerly DSA–2000, this name is sometimes still used throughout this document) is an innovative radio camera that will consist of 1650 6.15-m dishes operating at radio frequencies of 700 MHz to 2 GHz. It will serve diverse astronomy communities through the production of prompt, science-ready data products that will enable a host of scientific breakthroughs. The aim of this “Community Science Document” is to capture possible the large range of science cases for the DSA, along with the technical specifications necessary to enable them.

This document initially arose out of the “Scientific Frontiers and Synergies for the DSA-2000 Radio Camera” conference held from March 20-22, 2023, in Pasadena. The DSA Science Advisory Committee (SAC) asked each speaker to write up a two-page document summarizing their talk. The SAC provided a template to each speaker which included four sections: a summary of the science case, a description of the current state of the field, a discussion about DSA’s possible impact on the field, and the system requirements/desired additions to the baseline design necessary to achieve the science goals. There was an overwhelming positive response to this request, with all speakers at this meeting submitting two-page documents, some more than one. The SAC soon realized that there were some relevant science cases not covered at this meeting and solicited additional two-page documents from other community members. This is a living document, and community members are encouraged to submit additional cases.

DSA science projects can be categorized into four main science areas: multi-messenger astronomy, the dynamic radio sky, the dark sector, and our cosmic history. The DSA is uniquely poised to make critical advances in all of these areas which directly map to goals identified in the Astro2020 Decadal Survey and are synergistic with new telescopes and facilities being planned at other wavelengths.

We present this material in seven chapters. The second chapter provides a project overview and a discussion of synergies with other telescopes and surveys. The third chapter explores how the DSA will probe properties of slow (e.g. timescales of hours or longer) transients, and the fourth chapter describes the advances in our understanding of fast transients that DSA will make possible. The fifth chapter details DSA’s role in pulsar timing, in particular for the detection and characterization of low-frequency gravitational waves. The sixth chapter explains how DSA will fulfill its critical science mission of detecting and characterizing high-frequency gravitational wave counterparts due to compact binary coalescences. The seventh chapter of this book describes the broad array of continuum science that DSA will make possible and the final eighth chapter will describe DSA’s spectral line science, both within the Milky Way and beyond.