MASTCAM-Z: DESIGNING A GEOLOGIC, STEREOSCOPIC, AND MULTISPECTRAL PAIR OF ZOOM CAMERAS FOR THE NASA MARS 2020 ROVER. J. F. Bell III[1], J. N. Maki[2], G.L. Mehall[1] , M.A. Ravine[3], M.A. Caplinger[3], and the Mastcam-Z Team. [1]Arizona State Univ., Tempe, AZ (Jim.Bell@asu.edu); [2]JPL/Caltech, Pasadena, CA; [3]Malin Space Science Systems, Inc., San Diego, CA.

Introduction: The Mast Camera Zoom (Mastcam-Z; [1,2]) is a stereoscopic, multispectral imaging investigation selected for flight on the Mars 2020 rover mission. The cameras and their associated electronics and software are being designed and developed primarily at Malin Space Science Systems, Inc. (MSSS) and associated subcontractors, under the academic leadership of Arizona State University and in cooperation with the Mars 2020 Payload Office at JPL.

The Mastcam-Z instrument hardware and software have very high heritage from the Mastcam instruments on the MSL *Curiosity* rover, and the operations strategy will leverage heavily the experience and lessons learned from both MSL/Mastcam and MER/Pancam. We passed our PDR in late 2015 and are preparing for CDR in late 2016 and delivery in mid-late 2018. In this presentation we review our science goals and requirements and describe our CDR-level design and operational plans. Additional high-level details about the development of Mastcam-Z can be found in [1-3].

Science Goals: The Mastcam-Z investigation goals and objectives respond directly to Objectives A-D of the Mars 2020 mission [4,5]. Specifically, the primary goals of Mastcam-Z are:

Goal 1: *Characterize the overall landscape geomorphology, processes, and the nature of the geologic record (mineralogy, texture, structure, and stratigraphy) at the rover field site.* Mastcam-Z observations will provide a full description of the topography, geomorphology, geologic setting, and the nature of past and present geologic processes of the Mars 2020 field site, especially as they pertain to habitability and other astrobiology topics [6]. This includes observations of rocks and outcrops to help determine morphology, texture, structure, mineralogy, stratigraphy, rock type, history/sequence, and associated depositional, diagenetic, and weathering characteristics. Meeting this goal also requires observations of regolith to help evaluate physical and chemical alteration, along with stratigraphy, texture, mineralogy, and depositional/erosional processes.

Goal 2: *Assess current atmospheric and astronomical conditions, events, and surface- atmosphere interactions and processes.* This will be achieved by Mastcam-Z observations of clouds, dust-raising events, properties of suspended aerosols (dust, ice crystals), astronomical phenomena, and aeolian transport of fines. This goal also encompasses characterization of potential ice- or frost-related (periglacial) geomorphic features, and even the characterization of frost or ice, if present, and its influence on rocks and fines.

Goal 3: *Provide operational support and scientific context for rover navigation, contact science, sample selection, extraction, and caching, and the other selected Mars 2020 investigations.* Mastcam-Z images will assist rover navigation by determining the location of the Sun and of horizon features, and by providing information pertinent to rover traversability (*e.g.*, distant hazards, terrain meshes, etc.). This goal also includes observations enabling other Mars 2020 science instruments to identify and characterize materials to be collected for in situ analyses, coring, and caching, or other purposes (*e.g.*, hardware monitoring).

Instrument Description: Mastcam-Z consists of an identical pair of zoom-lens cameras that provide images in broad-band Bayer red/green/blue (RGB), 11 unique narrow-band visible/near-infrared colors, and 4-color direct solar imaging, with fields of view (FOV) from ~5° to ~15°. The cameras will have the ability to resolve (across 4-5 pixels) features ~1 mm in size in the near field and ~3-4 cm in size at 100 m distance.

Each Mastcam-Z camera consists of newly-designed (compared to MSL) optics and associated focus, ~3:1 zoom, and 8-position filter wheel mechanisms, a CCD detector assembly that is identical to that used on MSL/Mastcam, and digital electronics cards (one per camera) and firmware that are nearly identical to those used on MSL. A newly-designed external passive color/grayscale calibration target, based on the MSL/Mastcam cal target design but enhanced based on lessons learned, will be mounted on the rover deck at a similar place as the MSL target. The two Mastcam-Z cameras will be separated by ~24.5 cm and mounted on the Mars 2020 rover's Remote Sensing Mast (RSM), which sits approximately 2 meters above the local surface.

References: [1] Bell *et al., Internat. Workshop on Instrum. for Plan. Missions,* Abstract #1151, 2014. [2] mars.nasa.gov/mars2020/mission/instruments/mastcam-z/ [3] www.planetary.org/explore/projects/mars-2020/ [4] mars.nasa.gov/mars2020/mission/overview/ [5] Mustard, J.F. *et al.* (2013) Report of the Mars 2020 Science Definition Team, http://mepag.jpl.nasa.gov/reports/MEP/Mars_2020_SDT_Report_Final.pdf. [6] Williford, K. and K. Farley, *Biosig. Pres. & Detec. in Mars Analog Env. Workshop,* Abstract #2070, 2016.