FRAMING CAMERA COLOR FILTER IMAGING ON CERES APPROACH. A. Nathues[1], M. Hoffmann[1], M. Schäfer[1], C. T. Russell[2], T. Schäfer[1], K. Mengel[3], V. Reddy[4], G. S. Thangjam[1], H. Sierks[1], U. Christensen[1], M. V. Sykes[4], J.-Y. Li[4], H. Hiesinger[5], L. Le Corre[4], P. Gutiérrez Marqués[1], I. Buettner[1], I. Hall[1], J. Ripken[1], and the Dawn Science Team. [1]Max Planck Institute for Solar System Research , Göttingen, Germany, (nathues@mps.mpg.de); [2]University of California, Institute of Geophysics, Los Angeles CA, USA; [3]Clausthal University of Technology, Clausthal-Zellerfeld, Germany; [4]Planetary Science Institute, Tucson AZ, USA; [5]Inst. für Planetologie, Westfälische Wilhelms-Universität Münster, Germany.

Introduction: The Framing Cameras (FC) onboard the Dawn spacecraft are expected to map the dwarf planet Ceres in seven color filters from different orbits starting in April 2015. We intend to present the first color imaging results from the approach phase to Ceres, including images exceeding the spatial resolution of the Hubble Space Telescope by a factor of 7 (~4 km/pixel).

Ceres's approach phase data are crucial in several aspects:

1. It allows a first, spatially resolved analysis of color variations across the surface.

2. It reveals the first details of surface features and topography (see also [1]).

3. It reveals the phase curve which is required to define the correct exposure times for the upcoming orbiting phases (see also [2]).

Information gathered during the approach phase will allow us to draw first conclusions on the nature and evolution of Ceres. We will discuss the relationship of the most prominent color surface features to resolved data from HST [3] and indications on spectral variations from ground-based observations [4, 5] as well as the recent findings on Ceres's volatile activity [6]. Implications for the upcoming high-resolution data will also be presented.

First results: A set of Ceres FC data has been obtained for color filter calibration purposes on December 1, 2014. The images have a projected pixel size of approximately 150 km (see Fig. 1).

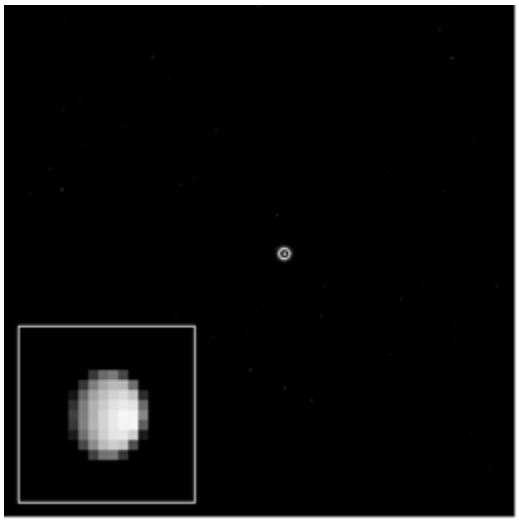

Fig.1: Clear filter image composite of Ceres acquired by Dawn FC on December 1st 2014. The apparent diameter of Ceres is about 9 pixels. Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

Seventeen pixels around the center of the visible disk have been co-registered and integrated to a single spectrum ranging between 0.44 and 0.96 µm (Fig. 2). Within the accuracy of the data (± 0.01 in reflectance), the color spectrum is essentially flat over all bands and thus consistent with previous ground-based spectra [7, 8, 3].

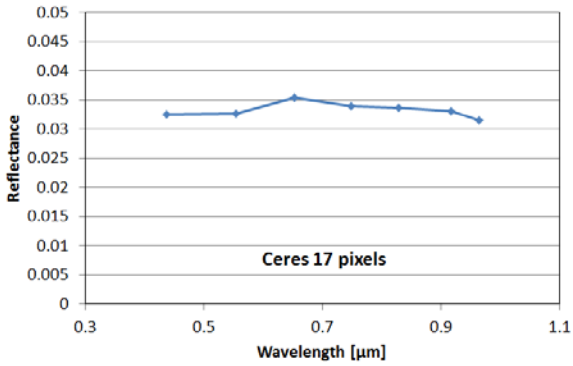

Fig. 2: First integrated absolute color spectrum of 1 Ceres from Dawn FC.

On the basis of these very first Dawn data of Ceres, we find that the distribution of reflectance values relative to the sub-solar point pixel confirms the phase effect as observed by ground-based data. In comparison to images of Vesta obtained at the same low spatial resolution, increasing phase angles at Ceres result in a generally steeper decrease of the reflectance. At Vesta, a steep decrease has been observed only at the highest phase angles.

Hunting for water: The detection of near-surface water vapor at two different longitudes [6] can arise from a variety of processes including cryovolcanism, recent impacts, and comet-like activity. These should be colorimetrically distinguishable from the relatively flat and dark spectral background of the average Ceres surface. The water vapor emission observed requires activity over a small area [6] and at the higher resolution of the approach imagery, color differences from the background due to evaporates or other hydrated materials can be significantly enhanced. Because the water vapor emissions are episodic, the color maps of the entire surface even on approach may reveal a history of emissions and insights into the mechanism(s) giving rise to them. This provides an important complement to topographic and clear-filter albedo investigations to identify current and past surface processes.

Identifying native materials: Dawn's first target, Vesta, revealed a surface with remarkable heterogeneities, that were more dramatic over small spatial scales (black against the native bright background) [9]. Given Ceres' larger size it is likely to be similarly contaminated. However, bright materials added to a dark background may be darkened rapidly as they mix through micrometeoroid impacts [10]. Colorimetry coupled with the improving resolution provided by the Framing Camera will provide a means by which native Ceres material can be distinguished from exogenous components. The experience gained from the approach to the first target of the Dawn mission, asteroid Vesta [9], is helpful as a blue print for the upcoming refinement of the evidence on spectral and geologic features of Ceres.

References: [1] Nathues et al. (2015) LPSC 46. [2] Li et al. (2015) LPSC 46. [3] Li et al. (2006) Icarus 182, 143-160. [4] Cochran and Vilas (1997) Icarus 127, 121-129. [5] Fornasier et al. (1999) Astron. Astrophys. Suppl. Ser. 135, 65-73. [6] Küppers et al. (2014) Nature 505, 525-527. [7] Vilas and McFadden (1992) Icarus 100, 84-95. [8] Burbine et al. (2008) Reviews in Mineralogy and Geochemistry 68, 273-343. [9] Nathues et al. (2011) EPS/DPS joint meeting abstract. [10] Clark, R. (1981) J. Geophys. Res. 86, 3074-3086.