REDUCTION AND POST-PROCESSING OF EARLY DATA FROM MAVEN'S NEUTRAL GAS AND ION MASS SPECTROMETER (NGIMS). M. Elrod[1], P. R. Mahaffy[2], and M. Benna[3], [1]CRESST University of Maryland College Park, Greenbelt, MD 20742, Meredith.K.Elrod@nasa.gov, [2]NASA Goddard Space Flight Center, Code 699, Greenbelt, MD 20771, [2]CRESST, University of Maryland Baltimore County, Baltimore, MD 21228.

Introduction: MAVEN's Neutral Gas and Ion Mass Spectrometer (NGIMS) is designed to characterize the source region for escaping atoms, with measurements of the neutral upper atmosphere and ionosphere. Typical altitudes for NGIMS measurements are between ~150-500 km although periodic excursions down to ~125 km are planned. Over the course of the mission a wide range of latitudes, longitudes, and local times will be sampled. The elliptical orbit enables the space environment and the energy inputs into the upper atmosphere to be regularly measured with MAVEN instruments.

NGIMS orbit and data collection: NGIMS conducts science investigations through the periapse segment of the orbit as shown in fig 1. For optimal science, NGIMS runs in idle throughout outbound and apoapse. The filaments and multipliers are turned on during the in-bound segment ~1 hour prior to entering the atmosphere in order to warm up and reach thermal equilibrium. Mahaffy et al.[1] (this meeting) will be discussing more science results from NGIMS.

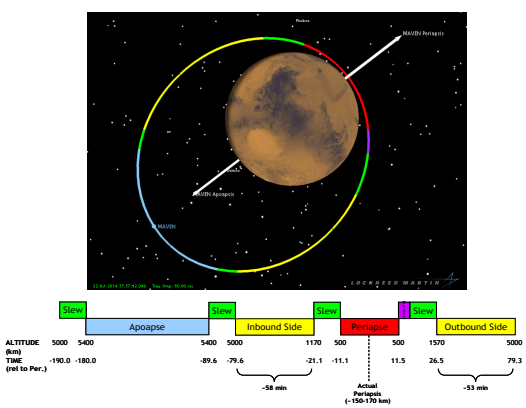

Fig. 1 MAVEN orbit and segment labeling. NGIMS normal operations turn on filaments and multipliers to warm up during the inbound segment for ~ 1 hour prior to periapsis. NGIMS science is conducted through periapsis from ~500 km though closest approach ending just before DSAT at ~ 500 km. Several calibration and background experiments will run through apoapsis to be sure they don't interfere with atmospheric science.

During the Warm up phase the closed source mode is run through a 'fractional sequence' where every mass from 1.5 to 150 by increments of 0.1 is scanned every even minutes in order to obtain a picture of the background counts prior to entering the atmosphere. In addition, a scan using the open source neutral beaming (OSNB) mode was run at apoapsis in order to determine the background for that mode. It is assumed that there is no background in the ion mode of operation.

NGIMS standard mode of operation is to collect data by rapidly switching between closed source neutral (CSN) and open source ion mode OSION on the odd orbits and CSN and OSNB on the even orbits. By switching between the CSN mode and OSNB mode we are able to calibrate the densities and sensitivities off a common value: ^{40}Ar. And with CSN and OSION we are able to make comparisons in one orbit with the neutrals and ions, particularly for the structural changes occurring on a per orbit basis, shown in fig 2.

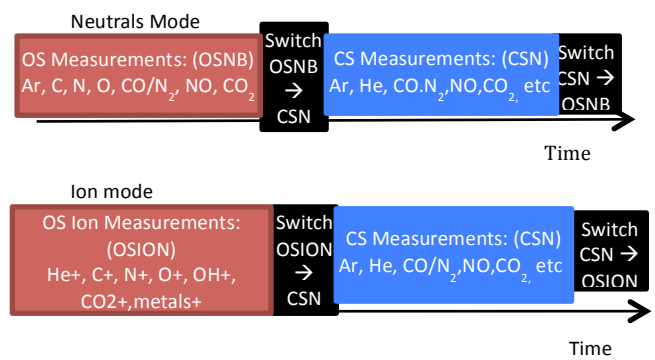

Fig 2 NGIMS Switching modes. On odd orbit numbers, and during Comet Siding Spring NGIMS operates in Ion mode switching between closed source neutral mode and open source ion mode. On even orbits NGIMS operates in open source neutral beaming mode switching between closed source and open source mode. Due to the necessity of warming up the open source filament for an hour before operation there are no plans to switch between open source neutral mode (filament on) and ion mode (filament off). Several times throughout each orbit NGIMS does run a complete scan from mass 2-90 in addition to the targeted scans depicted in this diagram.

NGIMS data products: MAVEN orbits Mars in ~ 4.5 hour orbit producing ~ 5-6 orbits per day. We download data in daily chunks and

separate data out on per orbit chunks in a preliminary file containing our raw data of counts, mass, spacecraft time, and telemetry information. From this data we produce a more sophisticated file that separates out the warm-up data, corrects for 'deadtime', computes and subtracts appropriate background, and includes appropriate ephemeris data. Above approximately $2x10^6$ counts per second (cps) the instrument begins to become saturated and the counts begin to 'pileup' the effect is known as deadtime and can be corrected [2]. Above ~$1x10^7$ cps the instrument becomes completely saturated and sends out error counts. To correct for this there is an attenuation factor for each mass that is used the first is approximately factor of ten, the second is ~100. Fig 3 shows correction for m44 and m40 on orbit 371. This allows for measurements much deeper into the atmosphere where the CO2 and Ar are much higher than the upper layers of the atmosphere.

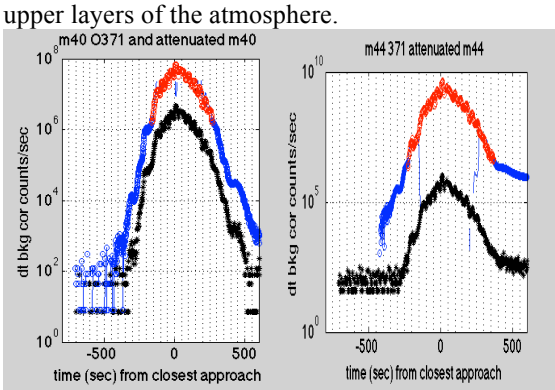

Fig 3: Attenuated and Non-attenuated counts per second of mass 40 and mass 44. Black line is the attenuated cps, blue is the non-attenuated cps and red indicates the adjusted attenuated cps after is has been multiplied by a correction factor.

In processing the data, the first product created is a file containing simply, spacecraft time, mode, mass, counts, and cps, and cps deadtime corrected. The second product subtracts the computed background from the deadtime corrected cps, and adds ephemeris (altitude, latitude, longitude, spacecraft velocity, RAM pointing angle). The final product determines denisites for the key parameter products (CO2, Ar, CO/N2, NO, He, O, N2, O2, and their ions).

In order to determine densities for the ions, it is necessary to compare computed total ion values computed from the NGIMS instrument with electron densities determined by the Langmuir probe (LPW). In addition, we will compare our results with the determined ion values from the Suprathermal and Thermal Ion Composition (STATIC) instrument.

Neutral density calculation is a more complicated method. This process requires determining the mass fraction break out and sensitivity and cross section of each species. The reactive species, O, NO, and C, can only be derived through the open source mode, while the non-reactive species, Ar, He, CO2 etc. can be derived through the closed source mode.

PDS delivery schedule: Daily delivery of level 0 files to the instrument team facility will be stored at the facility, Goddard Space Flight Center, and at the Science Data Center (SDC) at LASP, Boulder, CO. There is no current plan for the level 0 data to be delivered to the PDS. Level 1 data, which will be derived per orbit with time, counts, cps, and cps deadtime corrected, will be delivered to the PDS after 6 months operation. Level 1b files are intended for MAVEN team use that has background correct cps and ephemeris data. Level 2 data products that contain densities, ephemeris, cps, counts, and cps deadtime corrected, will be delivered to PDS after six months operation and every two weeks thereafter. Level 3 products, which are level 2 products re-sampled and re-calculated, will be delivered 4-6 months after level 2 products.

References:

[1] Mahaffy, P, Benna, M, Elrod, M, This meeting

[2] Benna, M., Mahaffy, P, Elrod, M, Mars Atmosphere and Volatile Evolution(MAVEN) (NGIMS PDS Software Interface Specification)