Plot and Data Description

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We here describe the QuickLook plots and where to find the corresponding data in the ESA PSA and NASA PDS archives.

PLOT 1 & 2: IES electron & ion spectra

Data files used: Electron/Ion flux tab-files from PSA/PDS

- Access online by: PSA/PDS → Rosetta mission → Mission phase → IES calibrated data → data → year → month → day → flux_v2_.tab
- (Example) Link to data from 2016 Aug 02 (doy 215):
  (Electrons):
  pds-smallbodies.astro.umd.edu/holdings/ro-c-rpcies-3-ext3-v2.0/data/2016/08/02/rpcies2016215_l3elc_flux_v2.tab
  (Ions):
  pds-smallbodies.astro.umd.edu/holdings/ro-c-rpcies-3-ext3-v2.0/data/2016/08/02/rpcies2016215_l3ion_flux_v2.tab

y-axis: Electron/Ion Energies

- Unit: [eV]
- Logarithmic energy scale, 3eV-20keV
- Energies corresponding to the energy level index in the data flux tab-files. Indices and corresponding energy levels are found in the energy_steps.tab file (Rosetta mission → Mission phase → IES calibrated data → calib\ → energy_steps.tab, for example pds-smallbodies.astro.umd.edu/holdings/ro-c-rpcies-3-ext3-v2.0/calib/energy_steps.tab.

Color scale: Differential flux

- Unit: [cm^2 sr eV s]$^{-1}$
- Logarithmic scale.
- Electrons: Lower limit: 1e3. Upper limit: 1e8
- Ions: Lower limit: 1e1. Upper limit: 1e6.
- The original files contain *differential energy flux*. This has been converted to *differential number flux* by dividing the value at each energy level with that energy.
- The differential energy flux thus obtained has been averaged over all azimuth and elevation bins.

PLOT 3: ICA solar wind ions

Data files used: The data plotted are found in the "phys-mass" datasets from the ICA archives at the PSA/PDS. However, to speed up the development of the quick look plots, a reformatted version of these data were used in the actual plot production, in contrast to all other instruments and datasets which were accessed on the fly, file by file, when producing the overview plots.

- Access online by: PSA/PDS → Rosetta mission → Mission phase → ICA phys-mass data → data → phys-mass → year → month → day
- (Example) Link to directory of phys-mass data from 2016 Aug 2: pds-smallbodies.astro.umd.edu/holdings/ro-c-rpcica-4-ext3-phys-mass-v1.0/data/phys_mass/2016/aug/d02/

y-axis: Ion Energy

- Unit: [eV]
- Logarithmic energy scale, 100 eV - 20 keV
- Energy levels listed in the e.tab files in the daily data directories.

Color scale: Differential flux of solar wind ions

- Unit: [cm^2 sr eV s]$^{-1}$
- Logarithmic scale. Lower limit: 10^0. Upper limit: 10^5
- The plot shows *average differential flux*. In the data processing, the mean of differential energy flux for all azimuth angles was calculated.
- The sum of the differential fluxes for H+, He+ and He++ ions (H, HE and HE2 tab files in the ICA data directories) were used.

PLOT 4: ICA comet ions and LAP/MIP Ion Energy

1. ICA

Data files used: The data plotted are found in the "phys-mass" datasets from the ICA archives at the PSA/PDS. However, to speed up the development of the quick look plots, a reformatted version of these data were used in the actual plot production, in contrast to all other instruments and datasets which were accessed on the fly, file by file, from PSA/PDS during plot production.

- Access online by: PSA/PDS → Rosetta mission → Mission phase → ICA phys-mass data → data → phys-mass → year → month → day
- (Example) Link to directory of phys-mass data from 2016 Aug 2: pds-smallbodies.astro.umd.edu/holdings/ro-c-rpcica-4-ext3-phys-mass-v1.0/data/phys_mass/2016/aug/d02/

y-axis: Ion Energy

- Unit: [eV]
- Logarithmic energy scale, 5 eV - 5 keV
- Energy levels listed in the e.tab files in the daily data directories.

Color scale: Differential flux of solar wind ions
- Unit: [cm^2 sr eV s]$^{-1}$
- Logarithmic scale. Lower limit: 10^0. Upper limit: 10^5
- The plot shows *average differential flux*. In the data processing, the mean of differential energy flux for all azimuth angles was calculated.
- The differential fluxes for heavy ions (HVY tab files in the ICA data directories at PSA/PDS) were used.

2. LAP/MIP Ion Energy

Data files used: ASW tab-files from PSA/PDS
- Access by: PSA/PDS → Rosetta mission → Mission phase →LAP Derived (Physical Units) data → data/ → derived/ → year → month → day → _asw.tab (all the files of that day)
- Column used: V_ION_EFF_XCAL (ion bulk velocity)
- Link to data from 2016 Aug 02 (ASW): https://pdssbn.astro.umd.edu/holdings/ro-c-rpclap-5-ext3-deriv2-v1.0/data/derived/2016/aug/d02/lap_20160802_000001_610_asw.tab

y-axis: Ion Energy
- Unit: [eV]
- Same range as ICA

Notes:
- The ion bulk velocity in the LAP ASW files was converted to kinetic energy assuming a mass of 18 amu (H_2O^+). To make the data comparable to the ICA ion energies, which are affected by the s/c potential, the Vsc parameter (see Plot 5 description below) was subtracted from the ion energy, after resampling to the same timeline if needed.
- The resulting ion energy is plotted as red dots in white circles to contrast to all backgrounds.

PLOT 5: LAP Vsc and LAP/MIP Electron Temperature

Data files used: USC and ASW tab-files from PSA/PDS
- Access by: PSA/PDS → Rosetta mission → Mission phase →LAP Derived (Physical Units) data → data/ → derived/ → year → month → day → _asw.tab and _usc.tab (all the files of that day)
- Columns used: U_SC (spacecraft potential)
  T_E (electron temperature of the warm population)
  T_E_XCAL (electron temperature of the cold population)

- Link to data from 2016 Aug 02 (USC):
  https://pdssbn.astro.umd.edu/holdings/ro-c-rpclap-5-ext3-deriv2-v1.0/data/derived/2016/aug/d02/lap_20160802_000001_610_usc.tab
  Link to data from 2016 Aug 02 (ASW):
  https://pdssbn.astro.umd.edu/holdings/ro-c-rpclap-5-ext3-deriv2-v1.0/data/derived/2016/aug/d02/lap_20160802_000001_610_asw.tab

y-axis: Vsc, Te (warm) and Te (cold)
- Unit: [V, eV]
- Logarithmic scale, 0.03 - 300 V or eV

Notes:
- The U_SC parameter from the USC files has been rescaled to a parameter
  Vsc = [U_SC + 5.5 exp(U_SC/8)]/0.95
  as a best estimate of the spacecraft potential. The transformation inside the square bracket was found by Johansson et al. [2021, doi:10.1051/0004-6361/202039959] to map the U_SC variable to a parameter known as the photoelectron knee potential, which in turn was suggested by Odelstad et al. [2017, doi:https://dx.doi.org/10.1093/mnras/stx2232] to on average catch about 95% of the s/c potential.
- The electron temperature derived from LAP sweeps (T_E data in the ASW files), which should mostly pertain to a warm population, is plotted as red dots.
- The electron temperature from comparison of the LAP sweep slope on the electron collections side to the plasma density, cross-calibrated with MIP (T_E_XCAL data in the ASW files) is plotted as black dots. This should mostly pertain to a cold population.
- Vsc values are plotted in green if positive, and (the absolute value of) in blue if negative (as is mostly the case).
- Vsc values may be sensitive to s/c orientation changes (see Plot 9 below).
- Te values show a large random spread. Useful for trends rather than individual values.
- Changes coinciding with a spacecraft attitude change (angles SAA, CAA, SEA and CEA in Plot 9 below) should be treated with a healthy amount of suspicion.

PLOT 6: LAP/MIP Plasma Density and ROSINA COPS Neutral Gas Density

1. LAP/MIP Plasma Density

Data files used: NED tab-files from PSA/PDS
- Access by: PSA/PDS → Rosetta mission → Mission phase →LAP Derived (Physical Units) data → data/ → derived/ → year → month → day → _ned.tab (all the files of that day)
- Column used: N_ED (plasma density)
- Link to data from 2016 Aug 02 (NED):
  https://pdssbn.astro.umd.edu/holdings/ro-c-rpclap-5-ext3-deriv2-v1.0/data/derived/2016/aug/d02/lap_20160802_000001_610_ned.tab

y-axis: Plasma Density

- Unit: [cm^-3]
- Logarithmic scale, 1-10^4 cm^{-3}

2. ROSINA COPS Neutral Gas Density

Data files used: NED tab-files from PSA/PDS

- Access by: PSA/PDS → Rosetta mission → Mission phase →ROSINA → data/ → mtp…/ → COPS/ → cops_l4_mtp….asc
- Column used: NG_LOCAL_DENSITY (nude gauge local density)
- Time resolution: 5 minutes
- Example link: https://pds-smallbodies.astro.umd.edu/holdings/ro-c-rosina-4-ext3-v2.0/data/mtp31/cops/cops_l4_mtp31.asc

y-axis: Nude Gauge Local Density

- Unit: [cm^-3]
- Logarithmic scale, 10^6-10^{10} cm^{-3}

Notes:

- Thruster firings can give impulsive signatures, typically (but not always) at 10:00 and 22:00 UT.
- Turning of the spacecraft changes the illumination of various parts on the spacecraft, which can influence the COPS data. Features coincident with changes in s/c pointing, as indicated by changes in the CAA, CEA, SAA and SEA angles (which indicate s/c orientation, see discussion of Plot 9 below) must be interpreted with care. This is particularly so when SAA crosses multiples of 90 degrees, or CEA deviates from zero, as s/c surfaces without illumination for possibly a long time then become sunlit, which may give a pulse of evaporating material.

PLOT 7: MAG Magnetic Field

Data files used: MAG tab-files from PDS

- Access by: PDS → Rosetta mission → Mission phase → MAG Resampled data → data/ → resampled/ → year → month → level_g→ob/→day → …a60.tab
- Columns used: B_x, B_y, B_z (6,7,8)
- Link to data from 2016 Aug 02: https://pds-smallbodies.astro.umd.edu/holdings/ro-c-rpcmag-4-ext3-resampled-v9.0/data/resampled/2016/aug/level_g/ob/rpcmag160802_clg_ob_a60.tab

y-axis: Magnetic field components (CSEQ coordinates, xyz → rgb color order) and magnitude (black) at 1 minute time resolution.

- Unit: [nT]
- Autoscaling, linear

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Notes
Changes coinciding with a spacecraft attitude change (angles SAA, CAA, SEA and CEA in Plot 9 below) should be treated with a healthy amount of suspicion.

PLOT 8: Geometry Data - Positions

Data files used: LAP geometry tab-files from PDS

- Access by: PDS → Rosetta mission → Mission phase → LAP Calibrated data → data/ → calibrated/ → year → month →day → _geom.tab
- Columns used: X_TSO, Y_TSO, Z_TSO, X_TSEQ, Y_TSEQ, Z_TSEQ (3,4,5,6,7,8)
  TSO = target-centred solar orbital coordinates, becomes CSO at 67P, analogous to GSE at Earth
  TSEQ = target-centred solar equatorial coordinates, becomes CSEQ at comet
- Link to data from 2016 Aug 02:
  https://pds-smallbodies.astro.umd.edu/holdings/ro-c-rpclap-3-ext3-calib2-v1.0/data/calibrated/2016/aug/d02/lap_20160802_000000_geom.tab

y-axis: S/C position around comet nucleus
- Rosetta position vector wrt the barycentre of 67P in CSO (solid) and CSEQ (dashed) coordinates (xyz → rgb color order), and magnitude (cometocentric distance) in black.
- Unit: [km]
- Autoscaling, linear

Notes:
- Taken from the LAP archive data at 32 s time resolution. Originates from SPICE.
- CSO and CSEQ share the same X axis.
- TSO = target-centred solar orbital coordinates, becomes CSO at 67P, analogous to GSE at Earth.
- TSEQ = target-centred solar equatorial coordinates, becomes CSEQ at comet.

PLOT 9: Geometry Data - Angles and Positions

Data files used: LAP geometry tab-files from PDS

- Access by: PDS → Rosetta mission → Mission phase → LAP Calibrated data → data/ → calibrated/ → year → month →day → _geom.tab
- Columns used: LAT, LON, SZA, SAA, TAA, SEA, TEA, (9,10,11,12,13,14,15)
- Link to data from 2016 Aug 02:
  https://pds-smallbodies.astro.umd.edu/holdings/ro-c-rpclap-3-ext3-calib2-v1.0/data/calibrated/2016/aug/d02/lap_20160802_000000_geom.tab

y-axis: Angles

- Unit: [°]
- Range: -180 to 180 degrees

Notes:

- Taken from the LAP archive data at 32 s time resolution. Originates from SPICE.
- LAT and LON are latitude and longitude for the Rosetta position in the rotating comet nucleus reference frame. With the cometocentric distance r from Plot 8, they form the spherical polar counterpart of the Cartesian components in Plot 8.
- The solar zenith angle SZA also describes s/c position, the angle sun-nucleus-Rosetta.
- Remaining angles describe the Rosetta orientation with respect to the direction to the Sun (SAA, SEA) and the nucleus (CAA, CEA). As data can be influenced by orientation changes (because of changing solar illumination, changing gas flow, changing fields of view and changing alignment to the magnetic field), apparently interesting phenomena in the data occurring together with changes in the orientation angles need to be interpreted with care.
- SAA and CAA can be defined as the longitude of the Sun and the nucleus, respectively, in the spacecraft coordinate system, with the solar panel axis (+Y in s/c coordinates) as the polar axis and +Z defining the zero meridian.
- SEA and CEA are similarly the latitudes of the Sun and the nucleus, respectively, in the spacecraft coordinate system, with the ZX plane as the equatorial plane.