28th SPINE workshop

INFLUENCE OF THE SPACECRAFT POTENTIAL ON LOW-ENERGY ION MEASUREMENTS MADE BY THE JOVIAN PLASMA DYNAMICS AND COMPOSITION ANALYSER (JDC) ON JUICE

Author : Matteo BOCHET (IRF)

Supervisors : Sofia BERGMAN (IRF)

Mika HOLMBERG (ESTEC)

INSTITUTET FÖR RYMDFYSIK
Swedish Institute of Space Physics

Summary

I – JUICE mission & JDC instrument

II – Use of SPIS & numerical model of JDC

III – Exploitation of & Expected results

IV – Conlusion & Issues encountered

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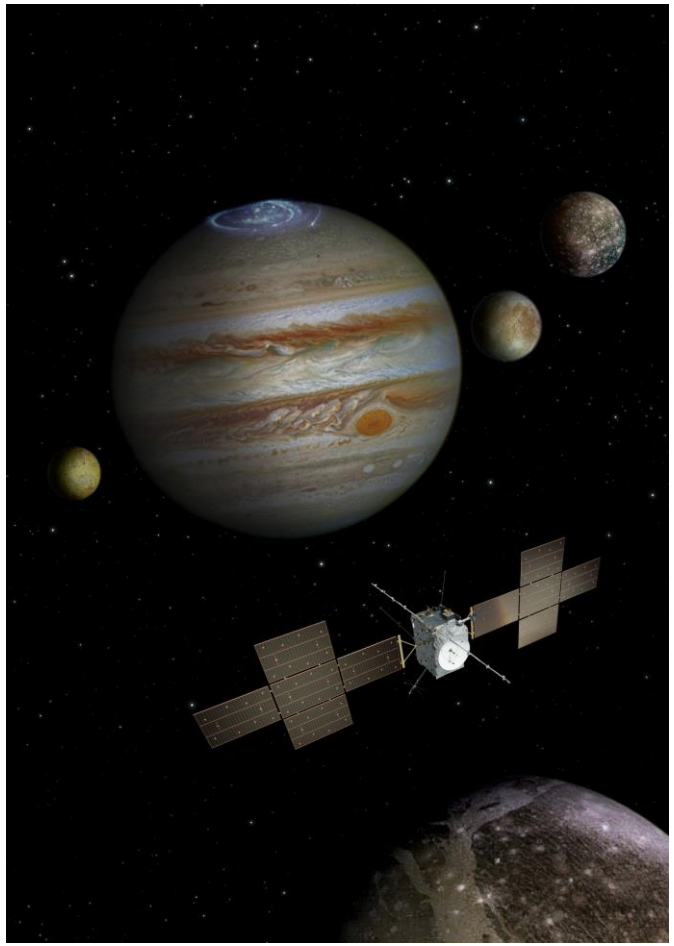

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The JUpiter ICy moon Explorer mission :

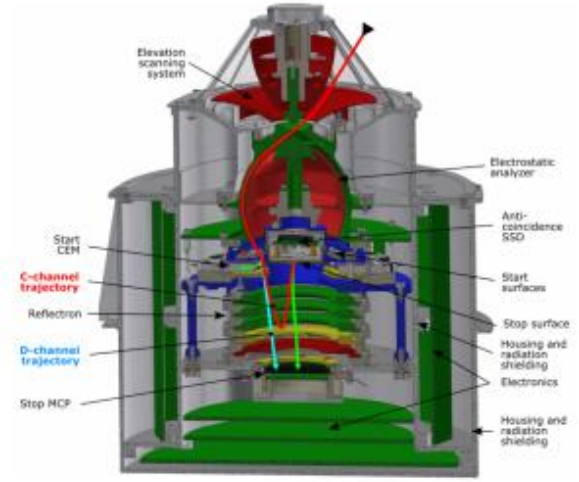
- Investigation of the Jovian system
- Investigation of 3 Jupiter's icy moons : Ganymede, Europa & Callisto
- Ganymede : intrinsic **B** field
  - Interactions b/w the 2 magnetospheres
  - Magnetic field measures, Plasma characterisation (Particles type, energy, speed, direction…)

I – JUICE mission & JDC instrument

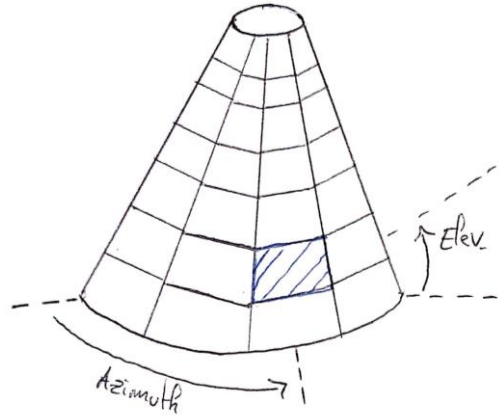
@Wittman P., IRF

The Jovian plasma Dynamics and Composition analyser instrument :

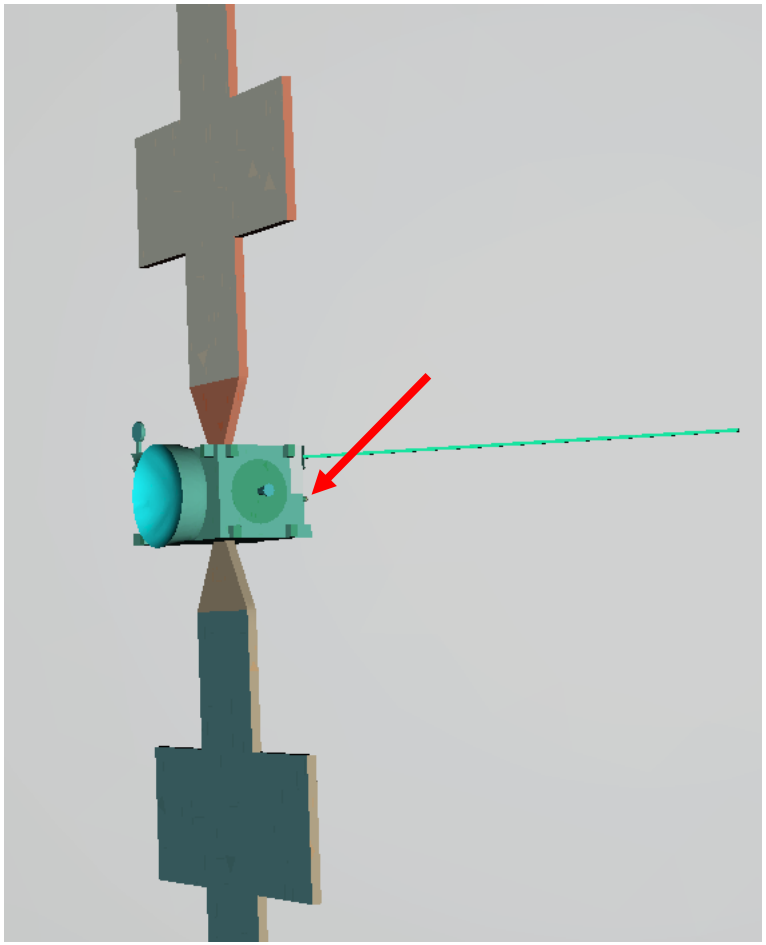
- Mass resolved +/- ions & e-
  - E range ∈ [1eV ; 40keV]
- Enable the characterisation of :
  - Type of particles
  - Trajectory
  - Speed / Energy
- Field Of View :
  - Full hemispherical coverage : 360° x 90°
  - Resolution : 19.5° (az) x 5.5° (elv)

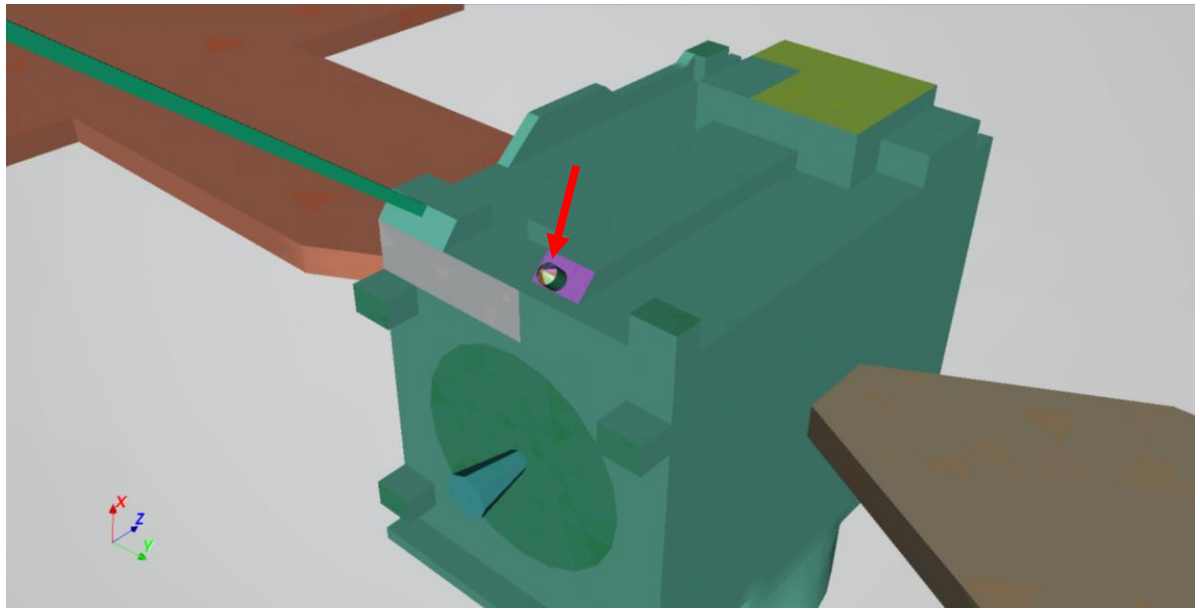


Wittmann et al, The JDC analyser – Performance evaluation, 2019,EPSC



JDC on JUICE :





➢ **Non-null potential on spacecraft surfaces will affect the properties of the measured particles (energy, speed, trajectory)**

➢ **Study aim : Observe the FOV distortion**

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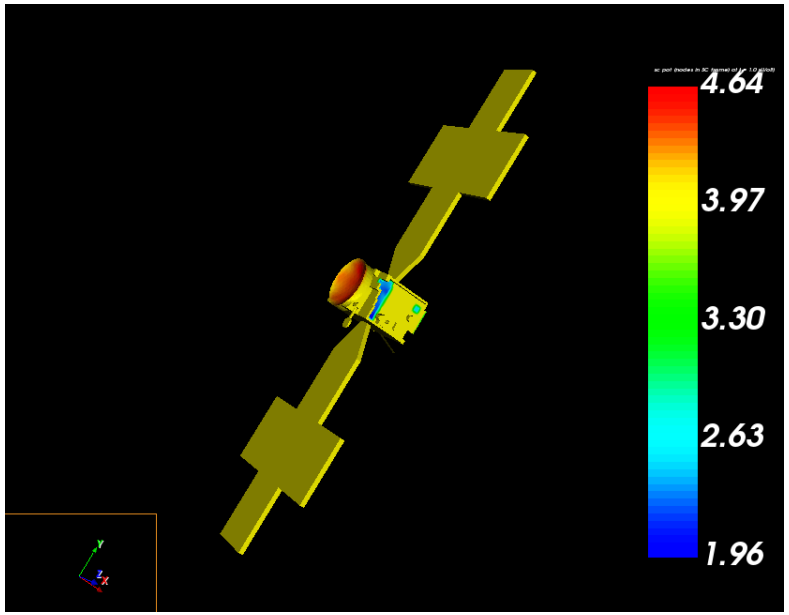
II – Use of SPIS & numerical model of JDC

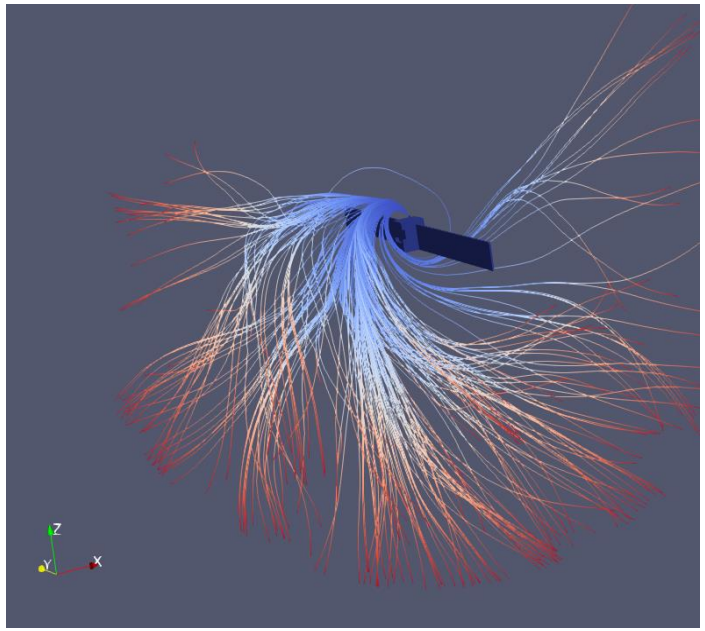
Objective :

➢ Observe the FOV distortion for each pixel (for a given environment)

Method :



1 – JUICE spacecraft charging

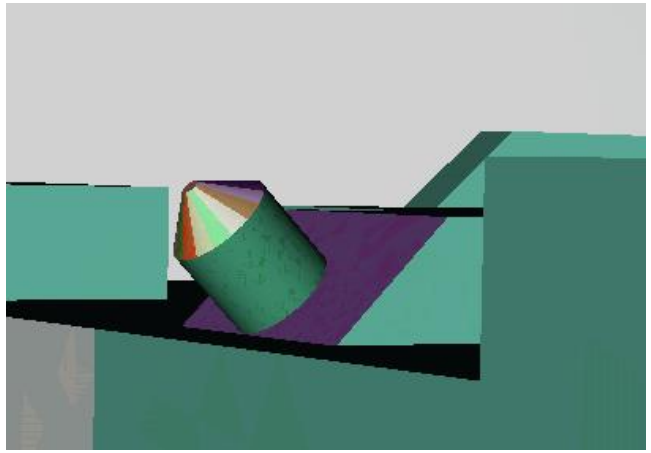


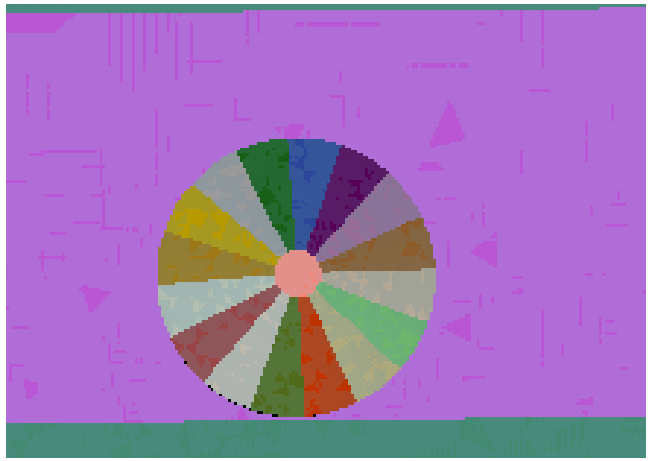
Bergman et al, 2020a & 2020b

2 – Perform Particle Tracing in the equilibrated environment

II – Use of SPIS & numerical model of JDC

JUICE spacecraft charging :

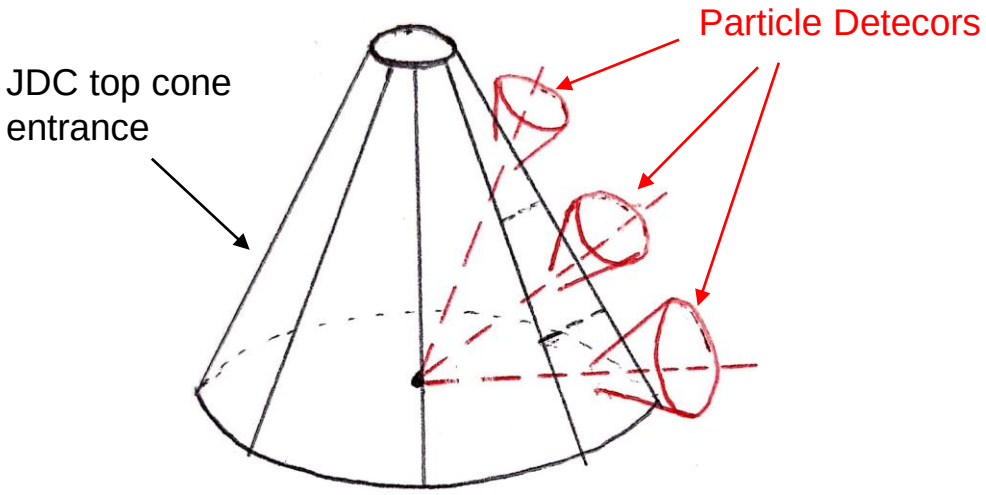




- JDC modelisation :
  - Approximated shape : 1 cylinder with a top cone
  - Materials : Cylinder covered by MLI, Cone in stainless steel Grounded
  - 1 Sector = 1 Surface Group
  - Elevation division at Particle Tracing level

Particle Tracing :

➢ 1 Particle Detecor / Pixel



Particle detectors position on the JDC top cone entrance

➢ Acceptance angles = JDC angular resolutions (5.5° x 19.5°)

➢ Test population :

Particles	T (eV)	N (m^-3)	V (m/s)	Distrib
Ions 2 (O+)	50	1E3	**0**	PIC

➢ Ouput : Velocity distributions to compute the detected flux

$$\mathrm{F} = \iiint V f(V) dV$$

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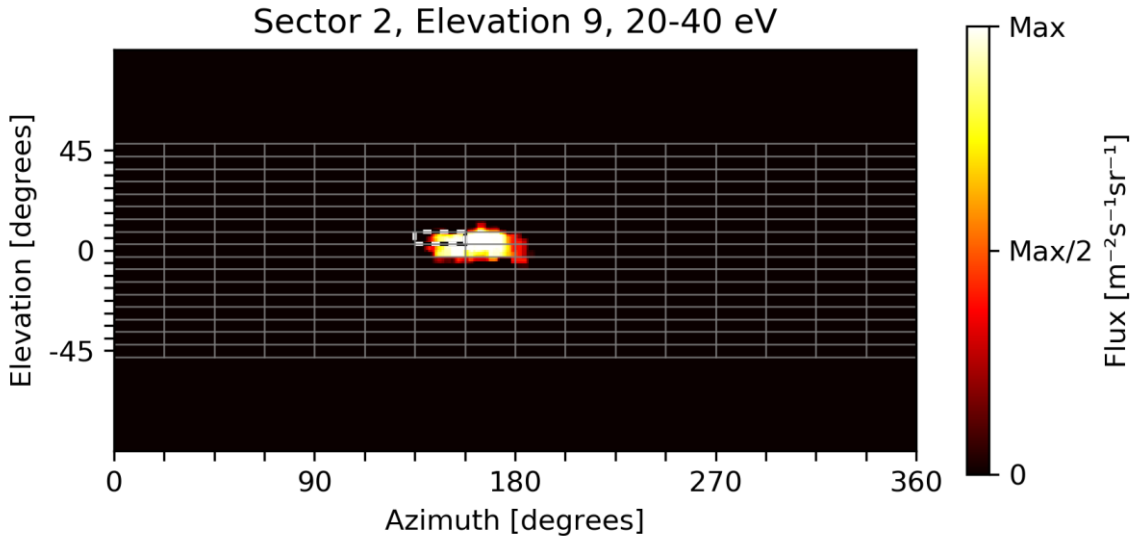
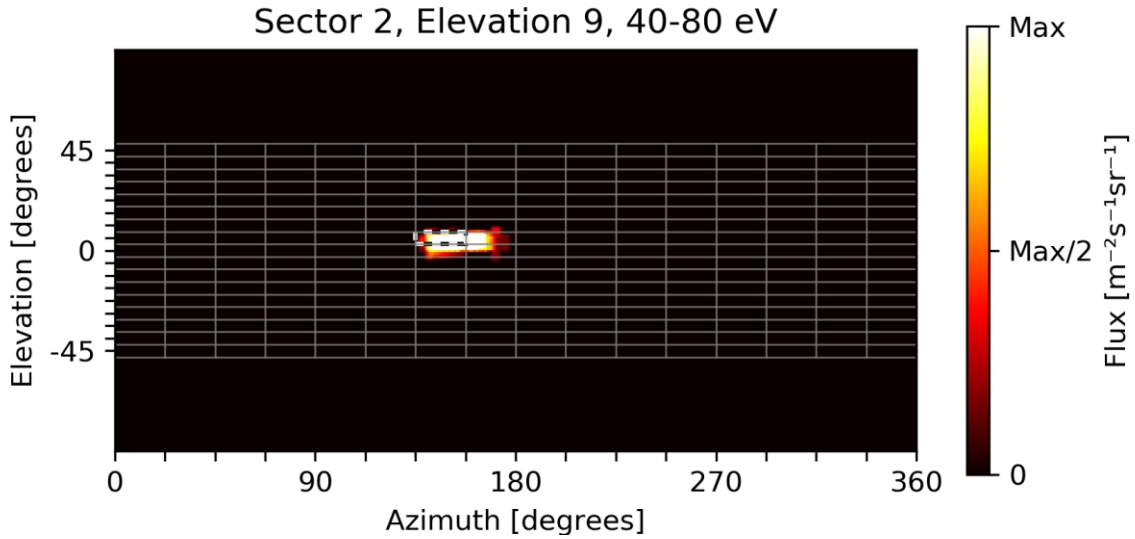
Expected results :

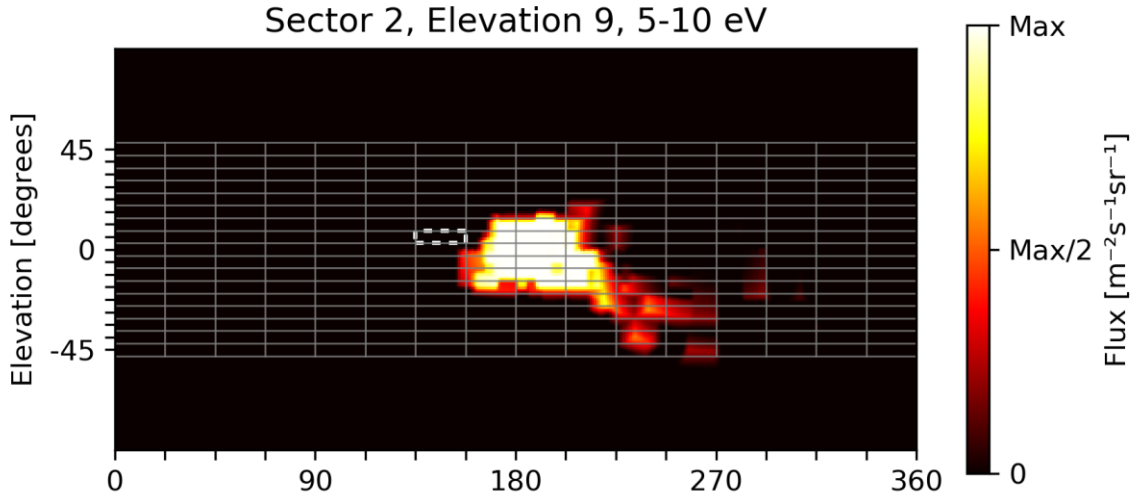
➢ Results taken from :

Bergman et al, The influence of spacecraft charging on low-energy ion measurements made by RPC-ICA on Rosetta, 2020a, JGR Space Physics

➢ S/C ground potential : -21V







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Objective :

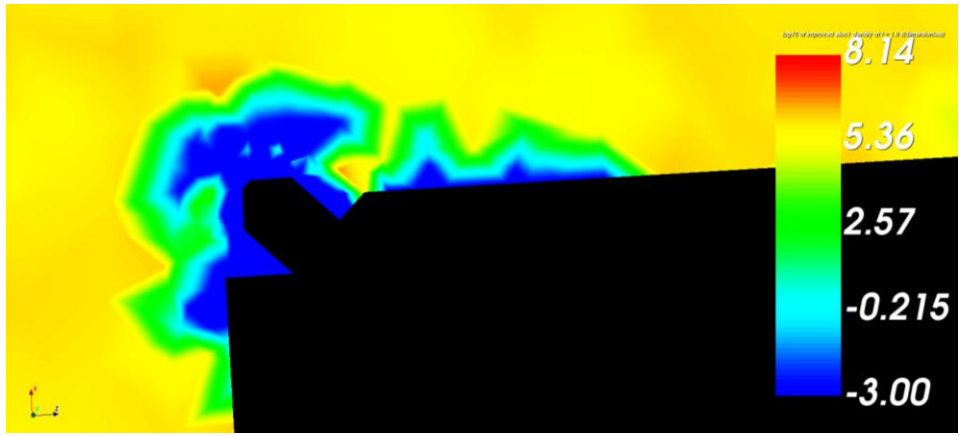
- ➢ S/C surface potentials affect the JDC measurements (trajectories, speed, energy of measured particles)
- ➢ Characterize the FOV distortion for each instrument's pixel

Methodology :

- ➢ SPIS simulations S/C + instrument divided in sectors
- ➢ Particle Tracing tool : Characterize the initial position of the detected flux

Issues encountered :

- ➢ Particle Tracing not compatible with a **B** field (v. 6.0.4)
- ➢ Low density around JDC
- ➢ Large computational time issue



Log10 of elec1 density around JDC – Final time step