ENSEM Project

Energetic Neutrals for Space Environment Monitoring

Executive Summary

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CHANGE RECORD

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Distribution list

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Executive summary

ENSEM is an activity led by the Swedish Institute of Space Physics (IRF/5.1-212/14) in response to the ESA/ITT [SOW]. The project ENSEM has conducted comprehensive studies of using Energetic Neutral Atoms (ENAs) for space environment monitoring in the solar system.

Energetic Neutrals for Space Environment Monitoring (ENSEM)	
Contractor	Swedish Institute of Space Physics, Kiruna, Sweden
Subcontractor	University of Bern, Bern, Switzerland
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ENSEM investigates potential use of *energetic neutral atoms* (ENA) for space weather monitoring. ENAs are produced everywhere in the solar system due to the interaction between space plasma and ambient particles (neutrals and other plasma populations). Due to the neutrality, ENAs fly straight, keeping the information of the source plasma. Thus, ENAs are expected to *visualize the plasma in a remote sensing manner*.

Key results

ENSEM identified five ENA populations as "space weather related". Each population needs a dedicated sensor, due to the different energy requiring different types of detection system and the different source direction.

Population	Monitoring	Instrument / Energy	Direction	Preferred orbit
1. SEP HENAs	Prediction	HENA (MeV)	Sun	Any
2. ICME originated ENA	Prediction	MENA (1–10 keV)	Sun	Any
3. Neutralized solar wind	Prediction	LENA (0.5–3 keV)	Sun	Any
4. Inner magnetospheric ENAs	Effects	HENA (MeV)	Earth	GSO/HEO
5. Subsolar magnetopause ENAs	Effects	LENA (keV)	Earth	HEO

The first three populations (1–3) are coming from the Sun direction. They can be used to predict the space weather events. They can be measured at 1 AU (as well as at inner solar system such as planetary orbit), and the measurement requirements only depends on the heliocentric distance. Thus, monitoring of these three populations can be conducted to GSO, HEO, or other earth orbiting spacecraft.

Populations 4 and 5 are for evaluating the effects of the space weather event at Earth. Due to the wide spread of the source inside terrestrial inner magnetosphere, the inner magnetospheric ENAs can be monitored from various orbital configurations around the Earth, but the measurement requirements depend highly on the choice of orbit. The preferable orbit is GSO or HEO. The subsolar magnetospheric ENAs have peculiar characteristics so that it can only be monitored from a very specific orbital configuration, such as HEO.

With current ENA sensors' performances, monitoring of populations 2–5 can be possible with optimization, while a large technology gap (i.e. too low sensitivity) is identified for the solar high energy ENAs (population 1).