

# **Introduction for China Seismo- Electromagnetic Satellite (CSES)**

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# Outline

- **Project Objectives of CSES**
- **Scientific Payloads Selection**
- **Orbit Parameters**
- **Design of the Platform**
- **CSES Ground Segment**
- **The Status of CSES**
- **Future Plan**



# Project Objectives of CSES

**China Seism-Electromagnetic Satellite (CSES) is proposed to be the first experimental satellite for earthquake-related electromagnetic emission monitoring from ionosphere and make technical preparation for future operational satellite monitoring system in China.**

**The objectives of the Project CSES are described in the following aspects:**

**scientific, engineering and application ones**



# Scientific objectives of CSES

**The objectives in the scientific aspect of the project are:**

- To study the ionospheric perturbations possibly associated with earthquakes, specially with those destructive ones.
- To explore the new approaches for short-term and imminent prediction, as well as to find a new orientation for the theoretic studies on the mechanism of the earthquake preparation processes



# Engineering objectives of CSES

**The targets in the engineering aspect of the project are as follows:**

- To check the reliability and effectiveness of the proposed electromagnetic satellite monitoring system by utilizing a set of new techniques and equipments,
- To obtain world-wide data of space environment of the electromagnetic field, plasma and energetic particles, specially those ones of the real-time observation when the satellite over the Chinese territory
- To provide a good bases for pushing forward a well jointed space-ground system in earthquake monitoring in the near future in China.



# Application objectives of CSES

**The purposes for the aspect of application of the project are:**

- To extract the electromagnetic information associated possibly with the earthquakes of  $M_s \geq 6$  within Chinese territory and its neighboring area and that of  $M_s \geq 7$  in the global scale.
- To analyze the features of seismo-ionospheric perturbations, in order to test the possibility for short-term earthquake forecasting experimentally in terms of satellite observation
- To provide the data sharing service for international cooperation and scientific community



# Scientific Payloads

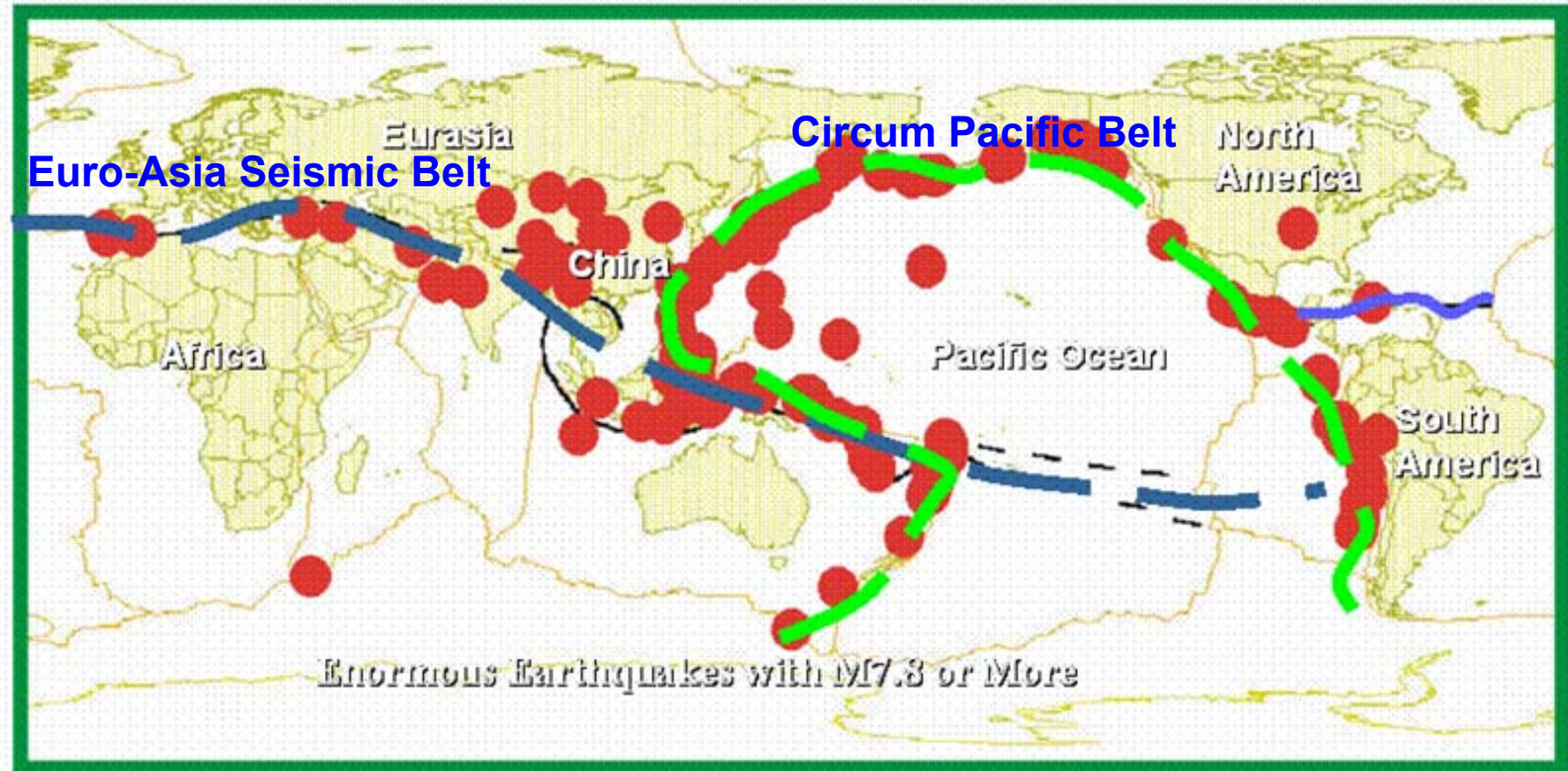
In order to fulfill the objectives of CSES, 8 scientific payloads are selected for CSES :

Physical Parameter	Payloads	Main Specification
Electromagnetic Field	Search Coil magnetometer	Frequency Range: 10Hz ÷ 20 kHz
	Fluxgate Magnetometer	Frequency Range: DC ÷ 15Hz
	Electric field detector	Frequency Range: DC ÷ 3.5MHz
Plasma Construction	GNSS Occultation Receiver	Tomography and TEC by GNSS Occultation Signal
	Tri-Frequency Transmitter	Tomography and TEC by VHF/UHF/LF Signal
In situ Plasma	Plasma analyzer	Composition: H <sup>+</sup> , He <sup>+</sup> , O <sup>+</sup> Ion density: $5 \times 10^2 \div 1 \times 10^7 \text{ cm}^{-3}$ Ion temperature: 500K ÷ 10000K
	Langmuir probe	Electron density: $5 \times 10^2 \div 1 \times 10^7 \text{ cm}^{-3}$ Electron temperature: 500K ÷ 10000K
Energetic Particle	Energetic particle detector	Proton: 3MeV ÷ 200MeV Electron: 200KeV ÷ 10MeV





# Operating Mode



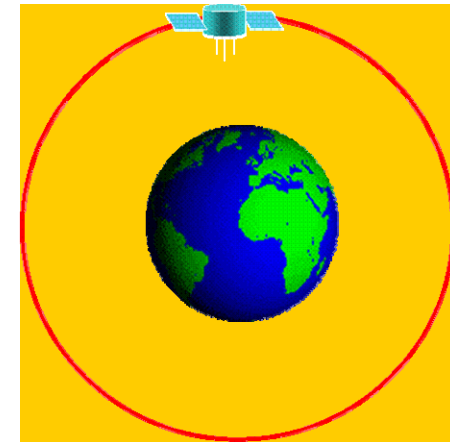
**key monitoring Area**



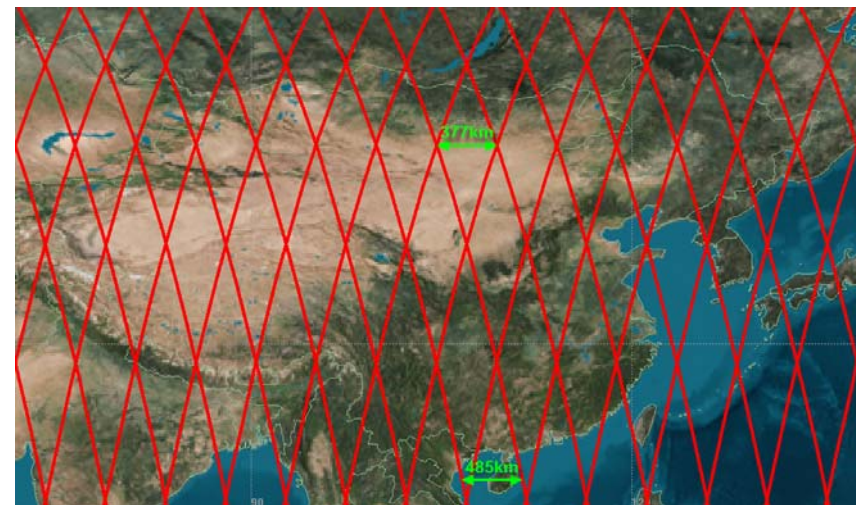


# Orbit Parameters

Based on the EM monitoring requirements and the operational experience of existing EM satellites.



Style of orbit	Sun synchronous orbit
Altitude (km)	507
Inclination (deg)	97.4°
Period (min)	94.6
Local time of descending node	14:00pm
Revisiting period (day)	5

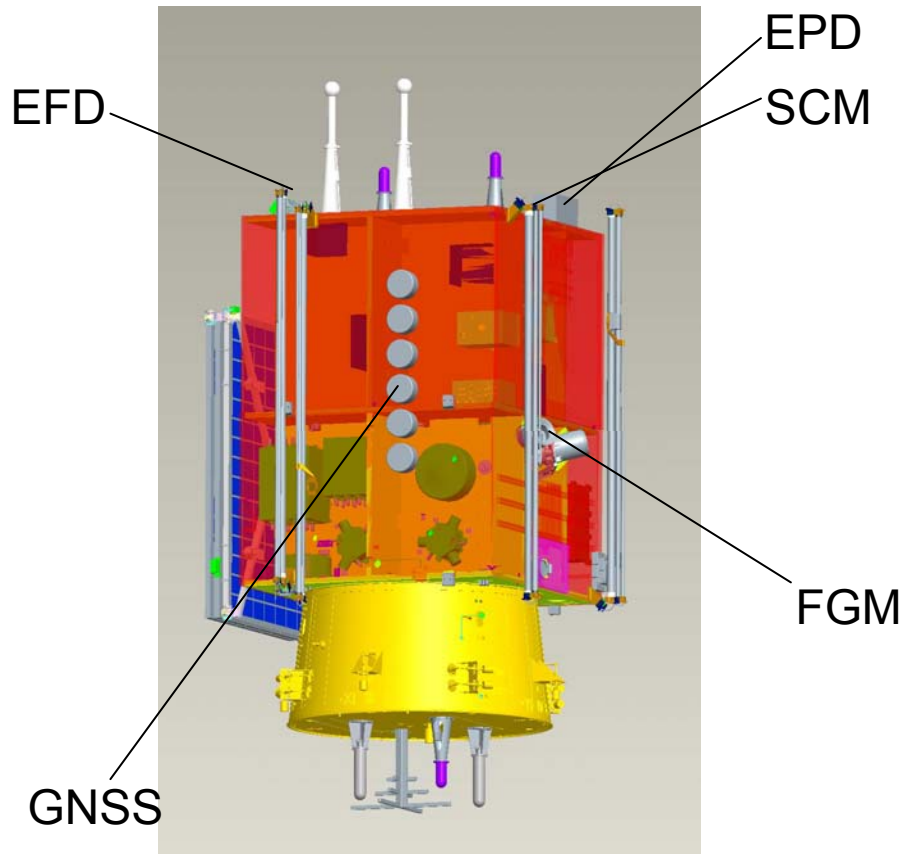


# The design of the platform

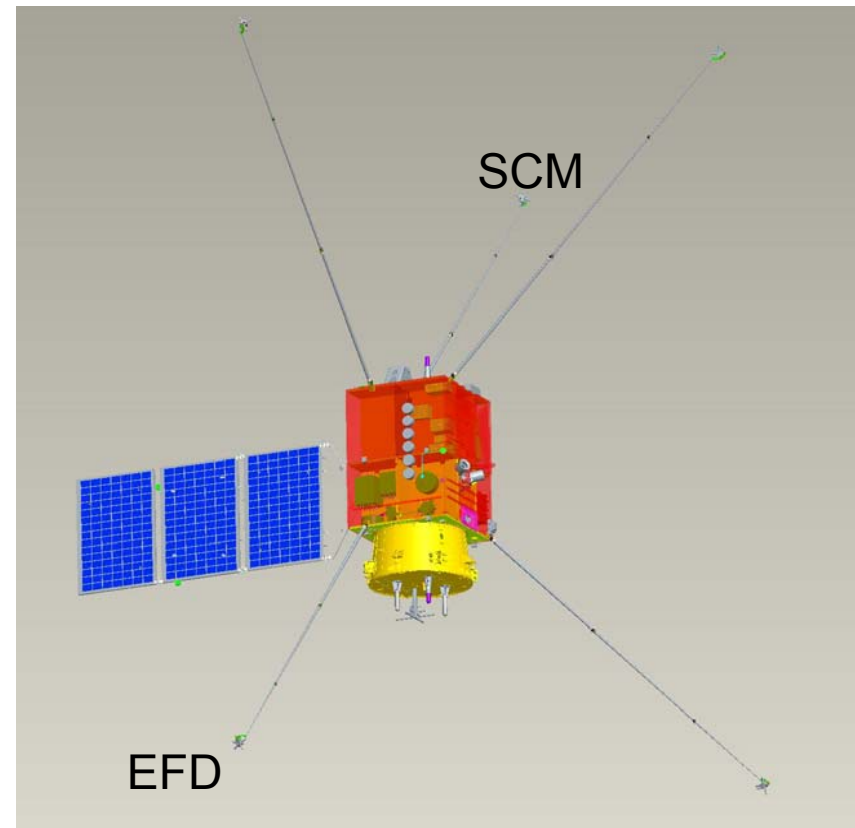
The platform module is redesigned upon the CAST2000



# Structure of the platform



Launch State



Flying State

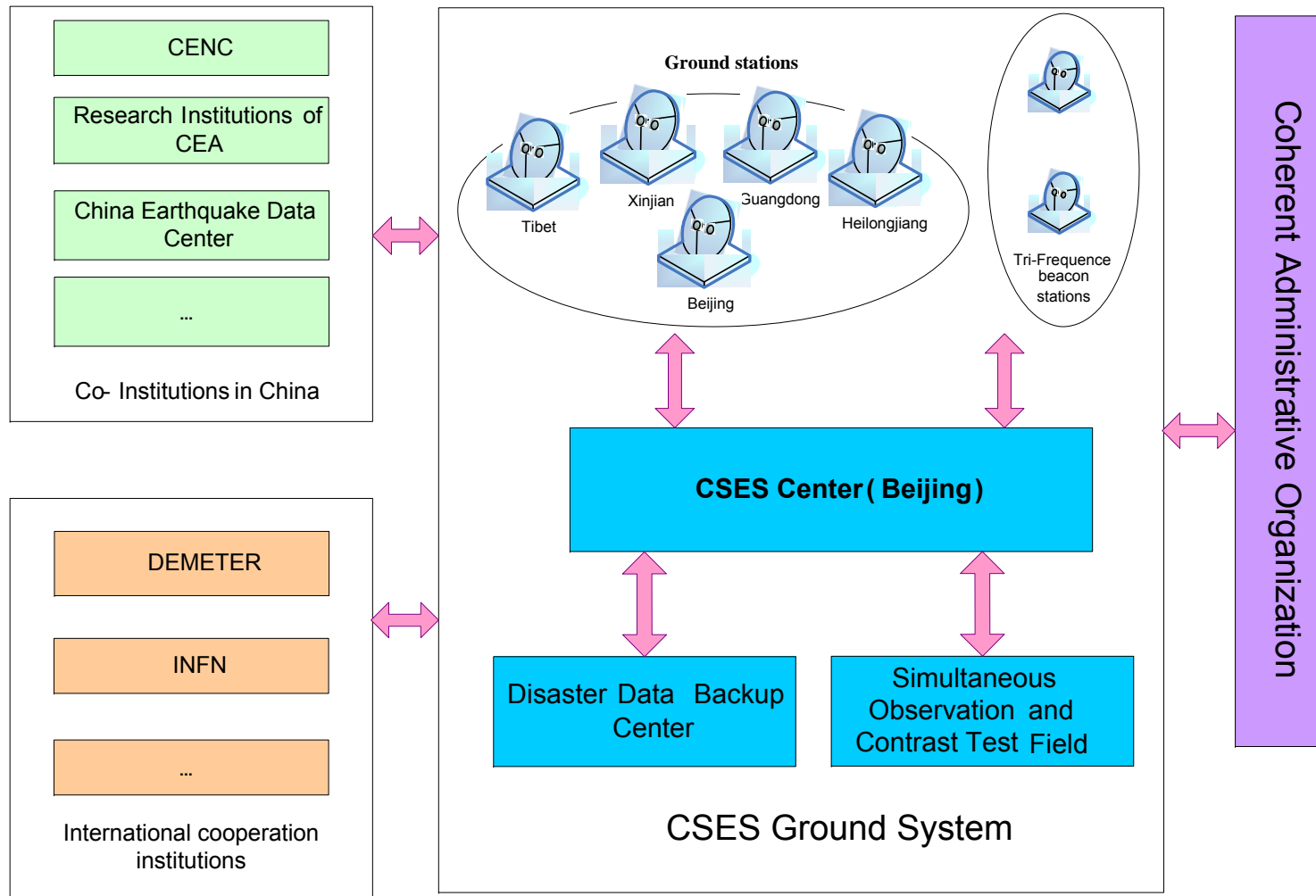


# Main Specifications of platform

- Earth Oriented 3-axis stabilized Control Mode
- X Band Data Transmission for Scientific Data.
- Satellite Mass: ~450kg.
- Life Span: 5 years.



# CSES Ground Segment



Layout of the Ground Segment



# CSES Ground Segment

**Satellite ground receiving**

**station:** Beijing, Xinjiang,  
Heilongjiang, Guangdong, Tibet.

**Beijing:** For All Data

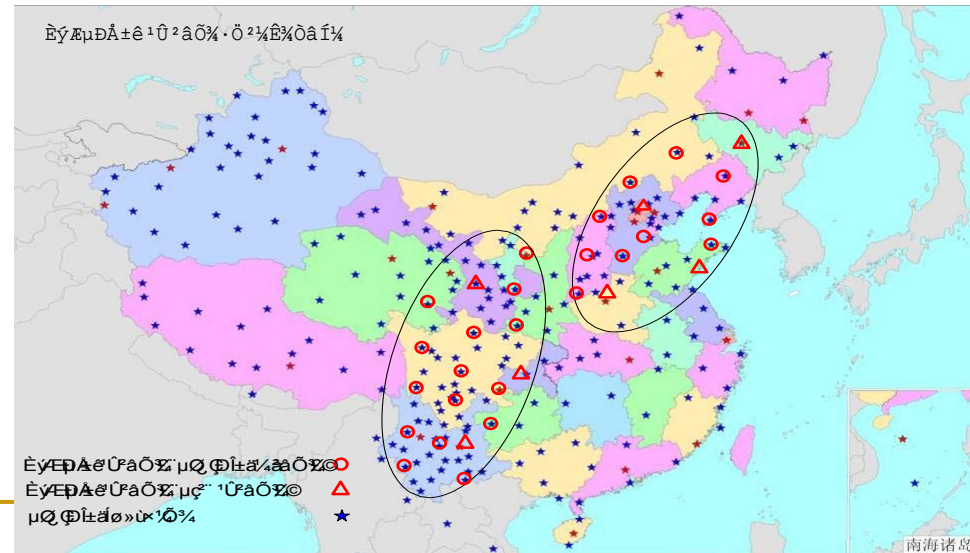
**Others:** Real time Data



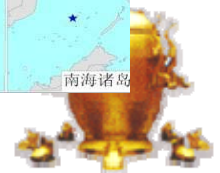
**Satellite ground receiving station**

**Tri-Frequency beacon stations:**

32 stations along the North China  
seismic area and North-South  
seismic belt.



**Tri-Frequency beacon stations**





# **The Status CSES PROJECT**

- **CSES Project was sponsored by:**  
**China National Space Administration (CNSA)**
- **Administrated by:**  
**China Earthquake Administration (CEA)**
- **Executed by:**
  - **Ground Segment : CEA**
  - **Satellite: DFH Satellite Co.LTD**
  - **Rocket: Aerospace Engineering Institute of Shanghai**
  - **Launch □ Jiuquan Satellite Launch Centre**
  - **Other relevant units**



# The Status of CSES Project

- **CSES satellite is now under developing with collaboration with several countries.**
- **It propose to be launched before the end of 2014.**



# The Status of CSES Project

## 1. Data Policy in Comments

CSES standard scientific data will be free available for the world under the framework following ☐

- ☐ international scientists work team will be founded for the data application and evaluation
- ☐ Registered scientific Users



# The Status of CSES Project

## 2. International Cooperation Interesting

- ❑ Data processing methods developing
- ❑ Lithosphere-Atmosphere-Ionosphere (LAI) coupling models developing
- ❑ The key techniques facing the following constellation
- ❑ Ground Segment cooperation (Include sharing the concerned ground station and establish tri-frequency beacon receiver array )
- ❑ To organize multilateral research mechanism.



# **Future Plan**

**After the first CSES satellite,  
It is expected that a functional  
electromagnetic monitoring  
system could be systematically  
arranged.**



# Future Plan

## CSES Requirement Satellite

- Most of the requirements in terms of elements, spatial resolution and key region monitoring are satisfied.
- But there are still some key requirements could not be fulfilled:
  - Only 4-5 days temporal resolution could be achieved by using CSES and it is yet a great

**>1 satellite is needed → Constellation**





# “2+2” Constellation

- Constellation solution for temporal resolution
  - Minimize the probability any EM disturbance is missed.
  - In 2017, a 2-satellite constellation on 500km orbit is proposed for in situ observations.
- Ionosphere plasma profile acquisition issue
  - “Top Ionosphere Detector” equipment should be used at the top of ionosphere (Around 1000km).
  - In 2020, a 2-satellite constellation is proposed for 1000km orbit.



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# Thanks to :

- CNES, FRANCE
- DEMETER Mission Center, FRANCE
- IZMIRAN, RUSSIAN
- INFN, ITALY
- Other institutes



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**Thanks for your attention!**

