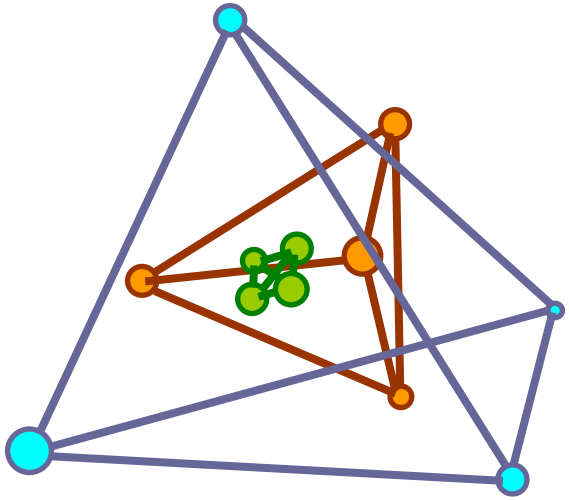
Cross-Scale

the mission formerly known as M³



The Cross-Scale team

- S. Barabash, W. Baumjohann, L. Blomberg, K.-H. Glassmeier, T. Horbury, H. Koskinen, P. Louarn, R. Nakamura, C. Owen, T. Pulkkinen, A. Roux, J-A. Sauvaud, S. Schwartz, K. Svenes, A. Vaivads

Cross-Scale will study

- Multi-scale, 3D plasma dynamics
- Fundamental plasma processes responsible for energy release and particle acceleration throughout the Universe

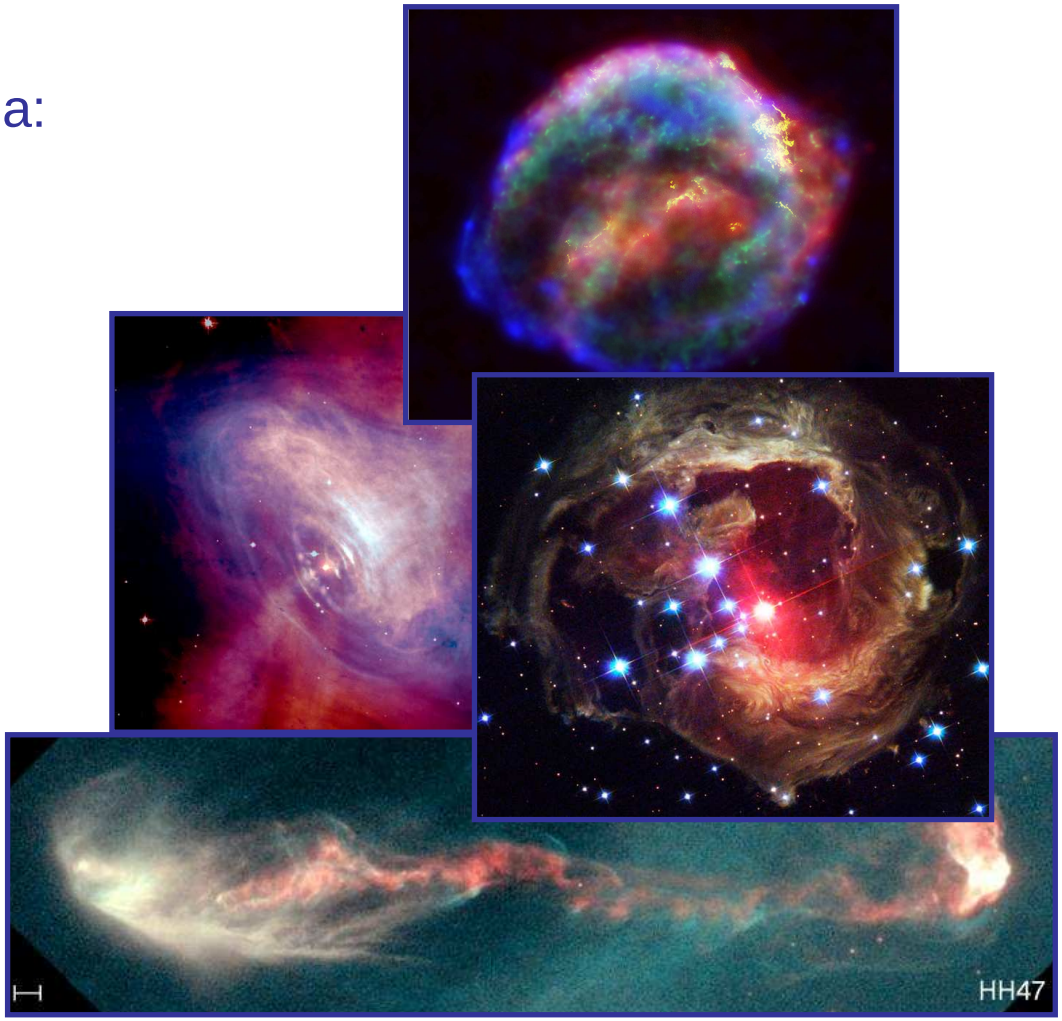
Plasmas throughout the Universe

Several key plasma phenomena:

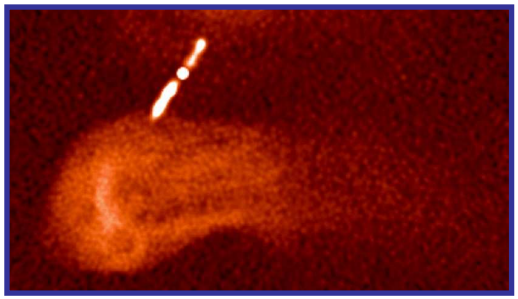
- Reconnection
- Shocks
- Turbulence
- Particle acceleration
- Wave-particle interactions

All of these processes are:

- Variable on several scales
- Fundamentally 3D
- Time-varying
- Poorly understood

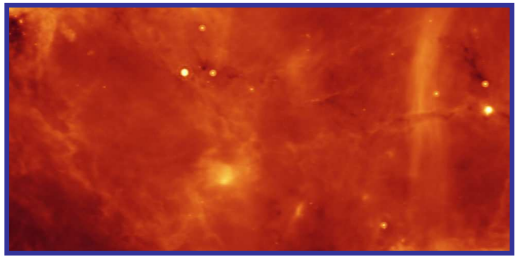


Collisionless plasma physics: key phenomena



- **Reconnection**
  - Steady vs pulsed
  - Time scales

- **Shocks**
  - Particle injection and acceleration
  - Reformation and internal structure



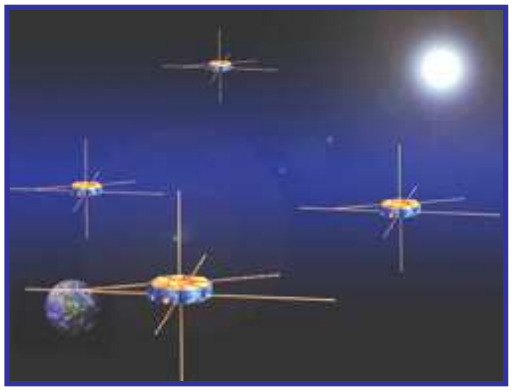
- **Turbulence**
  - Heating
  - Anisotropy and particle transport

- All of these questions involve **multi-scale**, **3D**, **time-varying** plasmas!

Related missions

Cluster

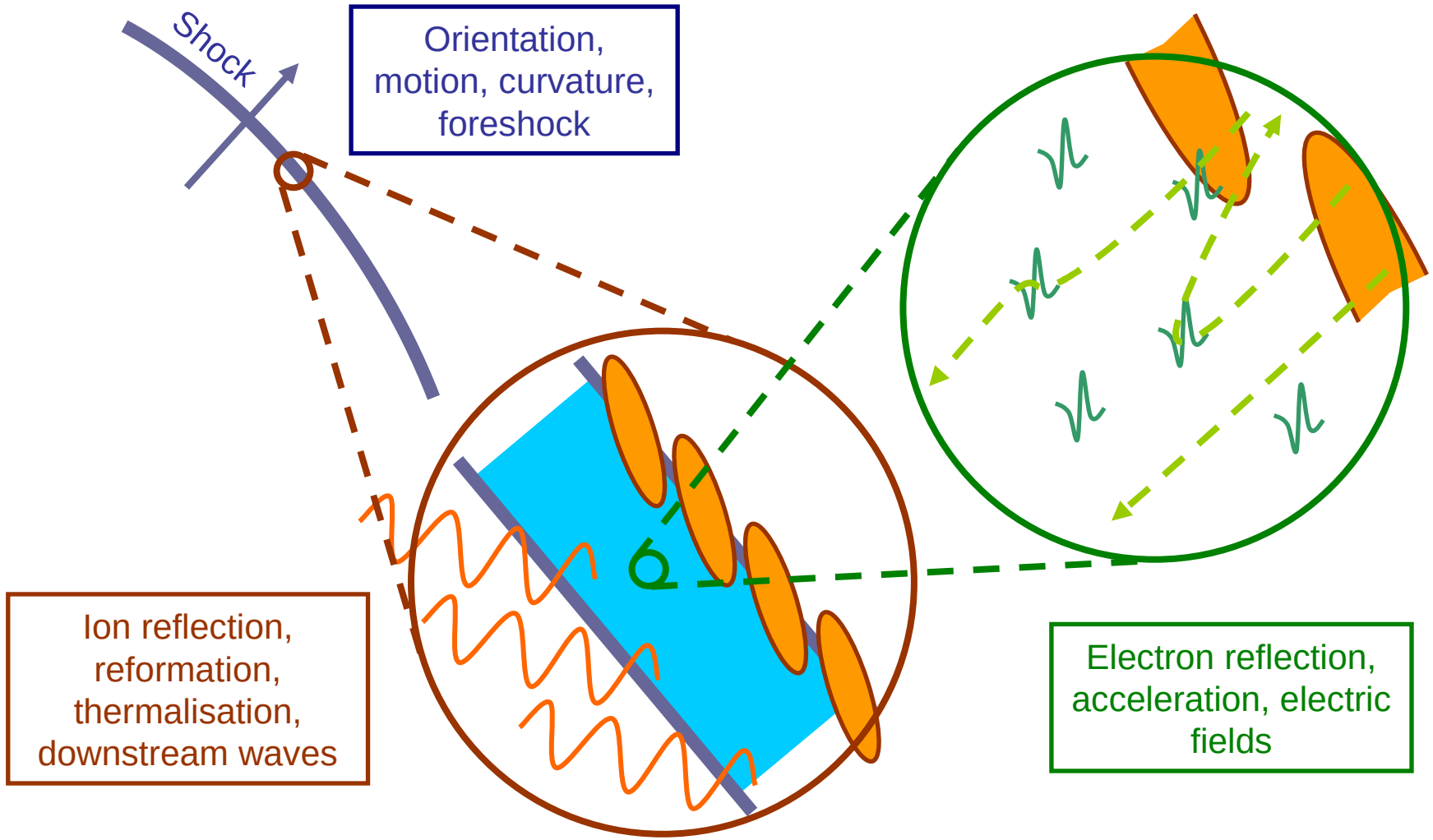
- First 3D plasma measurements
- Multiple scales, but only one scale at a time
- Limited access to electron scales, both time resolution and spatial separation
- Multi-scale extension can't measure in 3D
- Mission end ~2010



MMS

- Access to electron scales in 3D
- Only one scale at a time
- Launch 2013

Three scales of plasmas – shocks as an example

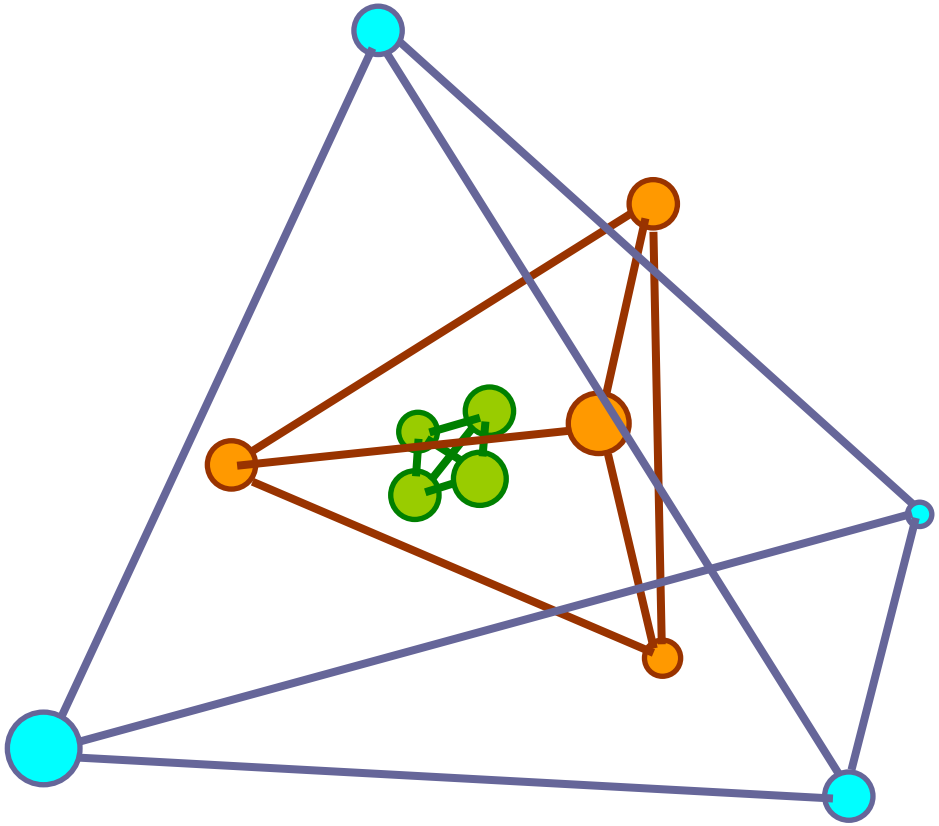


Cross-Scale – the three scales

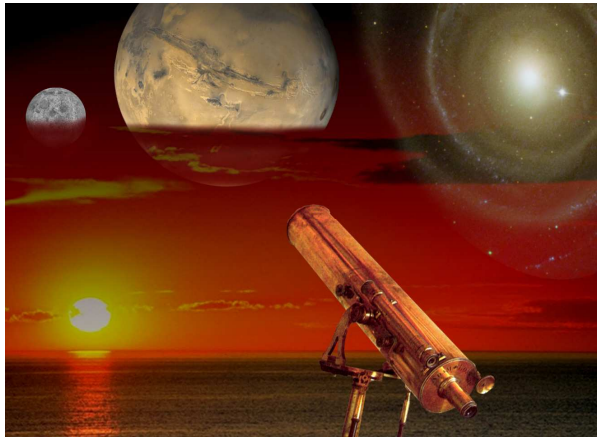
Electron scale (~10km)
- Fast electron data
- 3D electric field

Ion (~500km)
- Fast ion data
- Composition

Fluid (~2000km)
- Energetic particles
- Composition



The ESA context

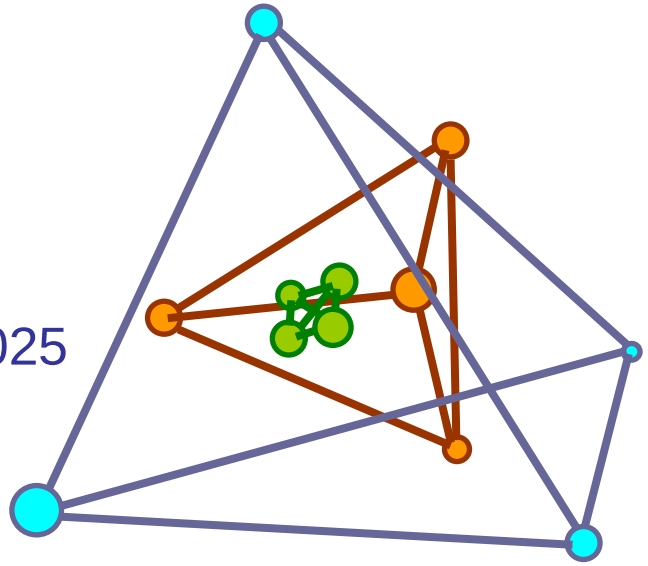


- Cosmic Vision 2015-2025

- Relative to other CV mission concepts, Cross-Scale is:
  - **Cheap**: <€300M, baseline of single Soyuz-Fregat launch
  - **Quick**: early in programme - by 2015?
  - **Easy**: no technological show-stoppers

- Potential for international collaboration: JAXA
  - **SCOPE**: 5-s/c mission for cross-scale plasma dynamics
  - Led by M. Fujimoto
  - More information in next talk

Summary



- Compelling science concept
  - Multi-scale plasma dynamics
- Possibility to fly within Cosmic Vision 2015-2025 programme
- Mission has many variables
  - Not fully defined at this stage
  - Compromises will have to be made
- Team is working towards a science requirements document
  - Draft available soon
- Challenge to the community
  - Need to work quickly to define mission
- We welcome all comments and suggestions