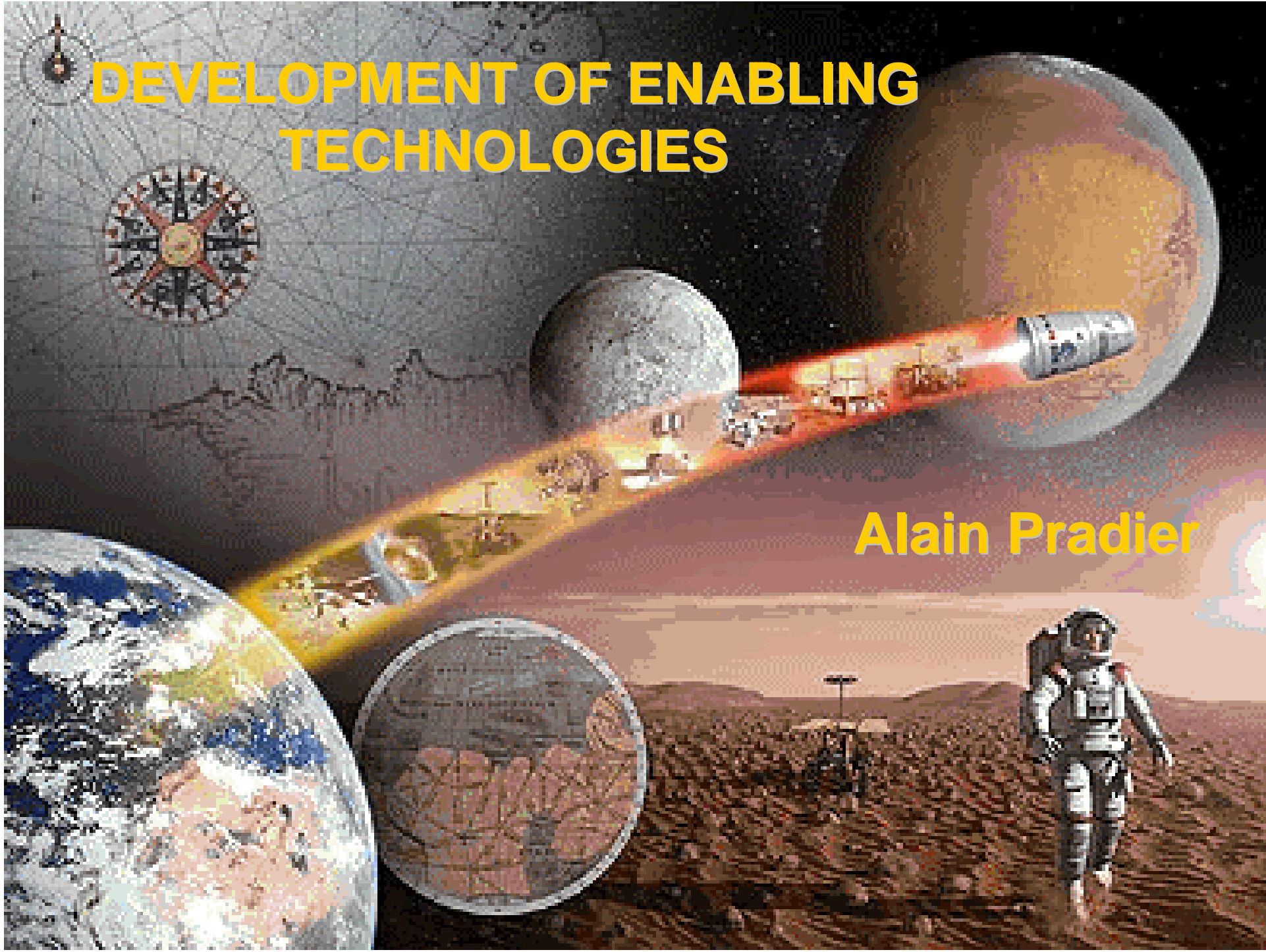


DEVELOPMENT OF ENABLING TECHNOLOGIES

Alain Pradier





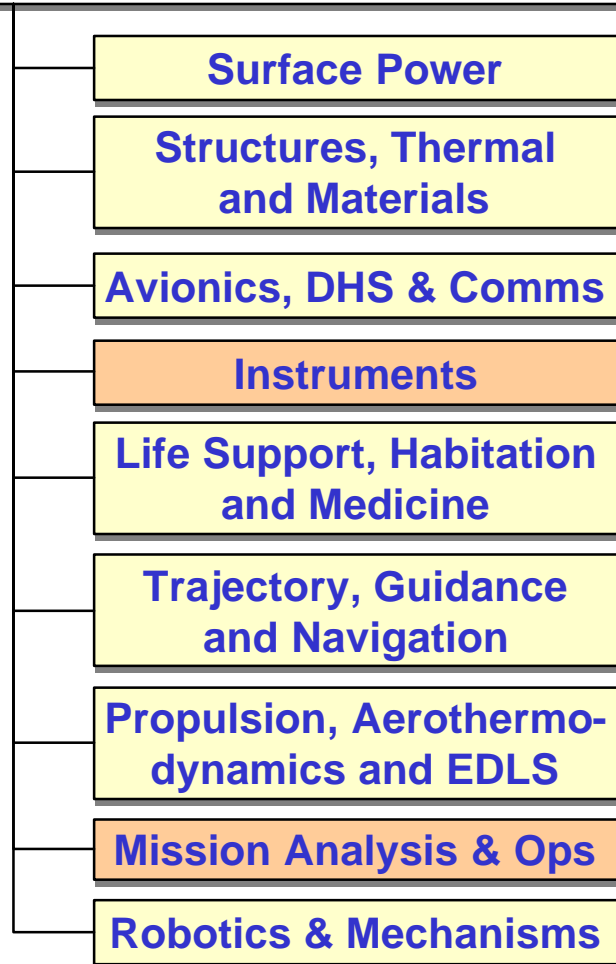
GENERAL APPROACH TO EXPLORATION TECHNOLOGY DEVELOPMENT

- THERE IS A STRONG NEED TO PROVIDE A SOUND AND FOCUSED FOUNDATION OF KNOWLEDGE AND VALIDATED TECHNOLOGIES;
- THE PRIME TECHNICAL OBJECTIVES ARE TO **SUPPORT THE PREPARATION OF PROPOSED NEAR-TERM EXPLORATION MISSIONS** e.g. EXOMARS, EVD, MSR;
- ANY **CRITICAL GAPS IN NEEDED CAPABILITIES** AND/OR TECHNOLOGIES THAT EMERGE DURING THE (PRE) DEFINITION PHASES A/B ARE ADDRESSED ON A PRIORITY BASIS;
- THE EFFORT TO FORMULATE AND TIMELY IMPLEMENT COHERENT **MISSION SPECIFIC TECHNOLOGY DEVELOPMENT ACTIVITIES** IS CONSIDERED AN INTEGRAL PART OF THE PREPARATORY EUROPEAN SPACE EXPLORATION PROGRAMME;
- **LOW TRL GENERIC / HIGHLY INNOVATIVE TECHNOLOGIES** HAVING A BROAD AND MORE LONG-TERM RELEVANCE FOR FUTURE EXPLORATION MISSIONS ARE IDENTIFIED, RECOMMENDED, BUT IMPLEMENTED IN CLOSE COORDINATION WITHIN THE **TRP/GSTP PROGRAMMES**



Aurora Technology Programme

Aurora Technology Streams



1. Sizable technology development effort already implemented (#50% of 2002-2004 period budget)
2. 35 awarded contracts (generic & mission specific technologies)
3. 23 still running activities (completion date:Mid 2005)
4. 2 ongoing ITTs (aerothermodynamics of high speed entry and Phase A integrated simulator)
5. Special emphasis placed on the following mission specific technology areas:
 - Descent/Landing (large size parachute / vented airbag);
 - Rover locomotion system design tool;
 - Sealing / Monitoring;
 - Solar cell / Dust removal system;
 - TPS ablaters for hyperbolic Earth entry;
 - Capture / Docking



MISSION SPECIFIC TECHNOLOGIES (1/2)

EXOMARS:

- UNDER THE LEAD OF PHASE B1 INDUSTRIAL PRIME, FURTHER TECHNOLOGY MATURATION ACTIVITIES WILL BE PERFORMED IN THE FOLLOWING CRITICAL AREAS:
 - » **EDLS TECHNOLOGIES;**
 - » **ROVER CHASSIS / NAVIGATION;**
 - » **ROVER OPERATIONS CENTRE.**

- AFTER SCIENTIFIC AND TECHNICAL CONSOLIDATION OF THE PASTEUR INSTRUMENT COMPOSITION, A BREADBOARD DEVELOPMENT EFFORT HAS BEEN RECOMMENDED FOR SEVEN INSTRUMENTS BEFORE THE DESIGN OF FLIGHT UNITS CAN BE ENGAGED WITH CONFIDENCE;

- THIS PACKAGE OF INSTRUMENT DEVELOPMENT SUPPORT ACTIVITIES WILL BE RUN IN PARALLEL TO PHASE B1 MISSION ACTIVITIES SO AS TO ENSURE AN ACCELERATED INITIATION.



Aurora Technology Programme

Aurora Technology Streams

- Surface Power
- Structures, Thermal and Materials
- Avionics, DHS & Comms
- Instruments**
- Life Support, Habitation and Medicine
- Trajectory, Guidance and Navigation
- Propulsion, Aerothermodynamics and EDLS
- Mission Analysis & Ops
- Robotics & Mechanisms

I15: Infrared Fourier Transform Spectrometer

I25: Gas-Chromatograph/Mass Spectrometer

I35: Ultraviolet Spectrometer

I45: Dust and Water Vapour Instrument Suite

I55: X-Ray Diffractometer (XRD)

I65: Combined Raman Spectrometer / Laser Induced Breakdown Spectrometer (C)

I75: Life Marker Chip (C)

DIRECT NEGOTIATION

OPEN COMPETITION



MISSION SPECIFIC TECHNOLOGIES (2/2)

- NEW PRIORITY DEVELOPMENT NEEDS HAVE BEEN IDENTIFIED IN THE FRAME OF THE INDUSTRIAL EVD / MSR (Pre) PHASE A MISSION STUDIES;
- THE INTERNAL ASSESSMENT OF STUDY RESULTS HAS FURTHER ALLOWED TO HIGHLIGHT ADDITIONAL MISSION SPECIFIC AREAS REQUIRING FOCUSED DEVELOPMENT EFFORT

Mars Sample Return (MSR):

- » PAYLOAD AUTONOMY;
- » ADVANCED OPTICAL/RF COMMUNICATIONS;
- » AVIONICS SOFTWARE ARCHITECTURE CONCEPTS;
- » SAMPLE CONTAINER DESIGN;
- » DRILLING AND SAMPLING TECHNIQUES;
- » ADVANCED LANDING TECHNOLOGIES;
- » CAPTURE/DOCKING MECHANISM TESTING;
- » BIO-SEALING / MONITORING.

Entry Vehicle Demonstration (EVD):

- » PLASMA TESTING OF MASS EFFECTIVE HEAT SHIELD CONCEPTS
- SEPARATE INDUSTRIAL CONTRACTS WILL BE AWARDED IN PARALLEL TO PHASE A2 MSR & Phase A EVD MISSION ACTIVITIES.



CONTINUATION OF **GENERIC** EXPLORATION TECHNOLOGY DEVELOPMENT EFFORT IN **TRP**

- FOLLOWING THE POSITIVE IPC VOTE, THE GENERIC EXPLORATION TECHNOLOGY STUDIES OUT OF THE ORIGINAL PREPARATORY EUROPEAN SPACE EXPLORATION PROGRAMME PROPOSAL WILL BE INITIATED IN 2005 IN THE FRAME OF THE TRP PROGRAMME.

- THESE ACTIVITIES ENCOMPASS A BROAD RANGE OF GENERIC EXPLORATION TECHNICAL AREAS NOT YET COVERED IN TRP SUCH AS:
 - » IMPROVEMENT OF MARS ENVIRONMENT KNOWLEDGE (ATMOSPHERE & RADIATION ASPECTS);
 - » TECHNIQUES TO ENSURE PLANETARY PROTECTION (DRY HEAT PROCESS);
 - » CHARACTERISATION OF MARS ENTRY CONDITIONS (DUST EFFECTS);
 - » PV BASED SURFACE POWER GENERATION;
 - » ADVANCED THERMAL CONTROL DEVICE FOR MARS ROVER (PARAFIN ACTUATED THERMAL SWITCH);
 - » GNC TEST FACILITIES (SOFT LANDING / AUTONOMOUS RENDEZ-VOUS – REAL TIME SIMULATION WITH HARDWARE IN THE LOOP);
 - » SOLAR CELL TEST FACILITIES (ELECTRICAL CHARACTERISATION, MARTIAN DUST DEPOSITION SIMULATION).

- AN ADEQUATE COORDINATION EFFORT WILL BE PERFORMED TO ENSURE / MONITOR THE TECHNICAL COHERENCE OF THESE NEW TRP ACTIVITIES WITH RESPECT TO THE MAIN GOALS OF EXPLORATION PROGRAMME.



CONCLUSIONS

- INVITATIONS TO TENDER WILL BE ANNOUNCED/PUBLISHED SOON ON EMITS ([HTTP://EMITS.ESA.INT](http://emits.esa.int)):
 - 17 NEW MISSION SPECIFIC TECHNOLOGY ACTIVITIES (AURORA / 6 M€);
 - 19 NEW GENERIC TECHNOLOGY STUDIES (TRP / 7.5 M€).
 - THIS BATCH OF NEW ACTIVITIES IS FURTHER ITEMIZED IN **ANNEX**
- THE **FOCUSED & COORDINATED** EXPLORATION PROGRAMME TECHNOLOGY DEVELOPMENT EFFORT WILL:
 - IN PRIORITY, ADDRESS **SPECIFIC CAPABILITY GAPS** THAT MAY EXIST FOR THE **NEAR-TERM ROBOTIC MISSIONS**;
 - DEVELOP, DEMONSTRATE AND DELIVER TECHNOLOGIES THAT COULD PROVIDE A **SUBSTANTIAL IMPROVEMENT** IN KEY ASPECTS OF SYSTEM-LEVEL CHARACTERISTICS OF **MEDIUM-TERM EXPLORATION MISSIONS**.



ANNEX

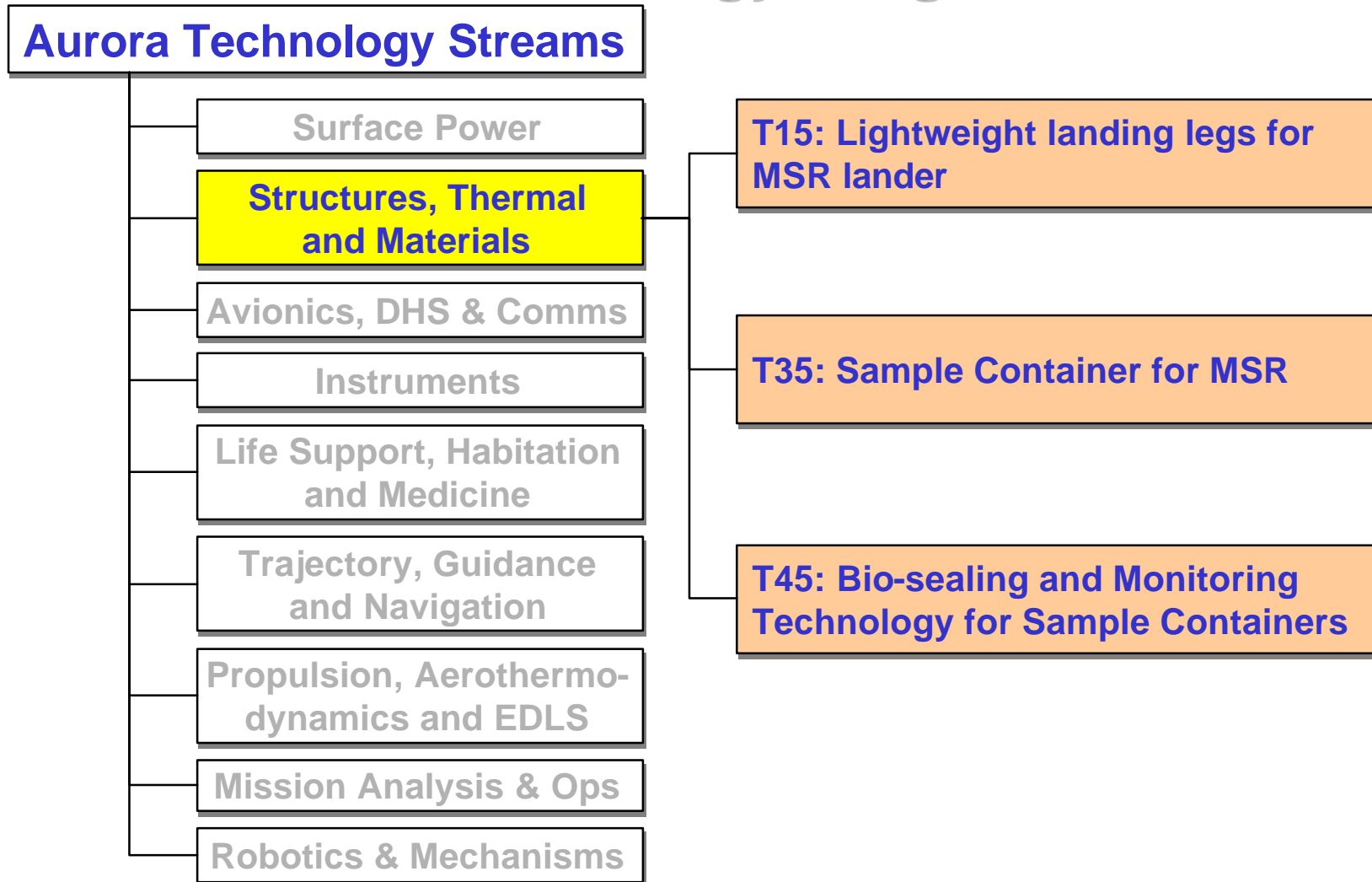


Aurora Technology Programme



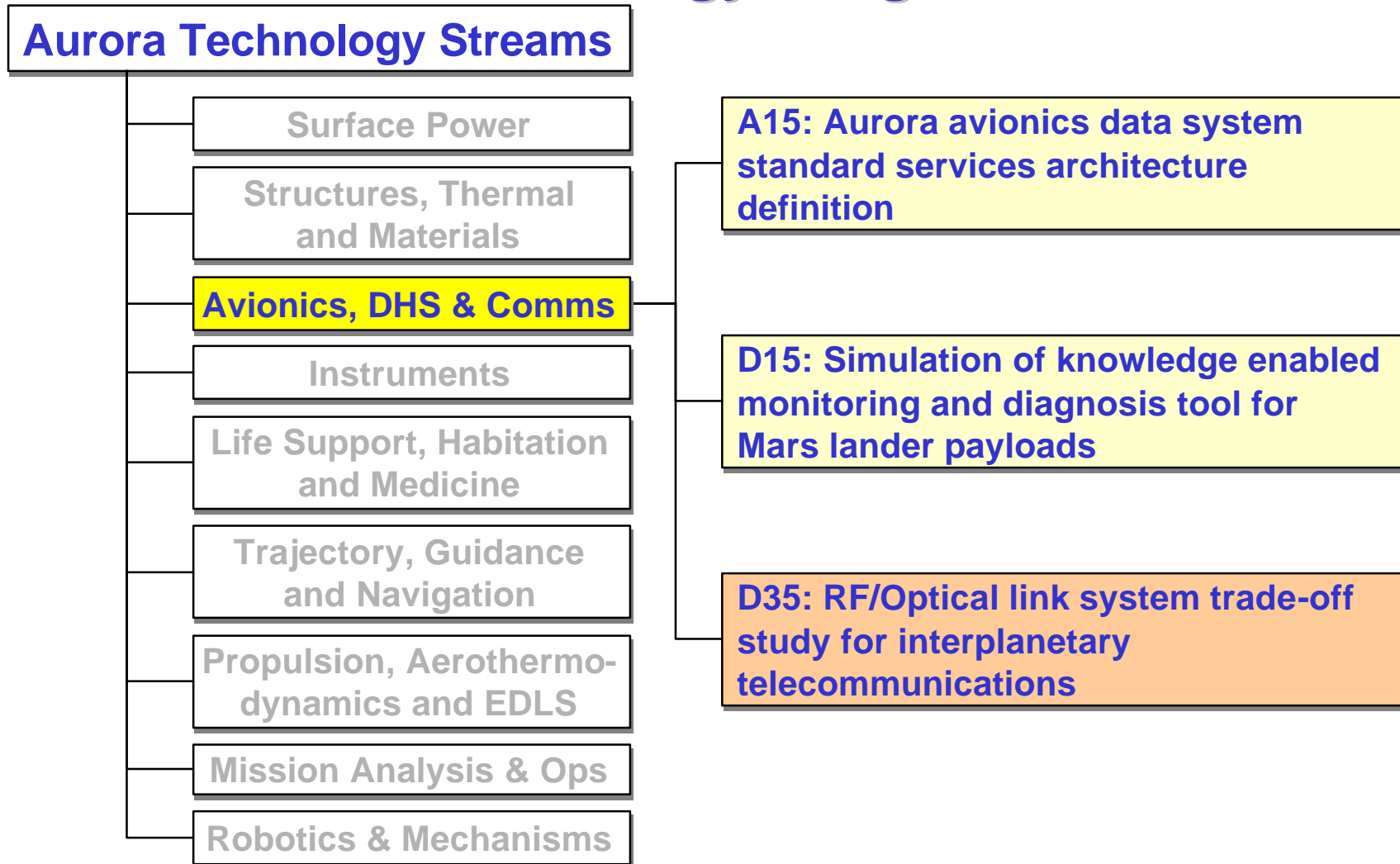


Aurora Technology Programme





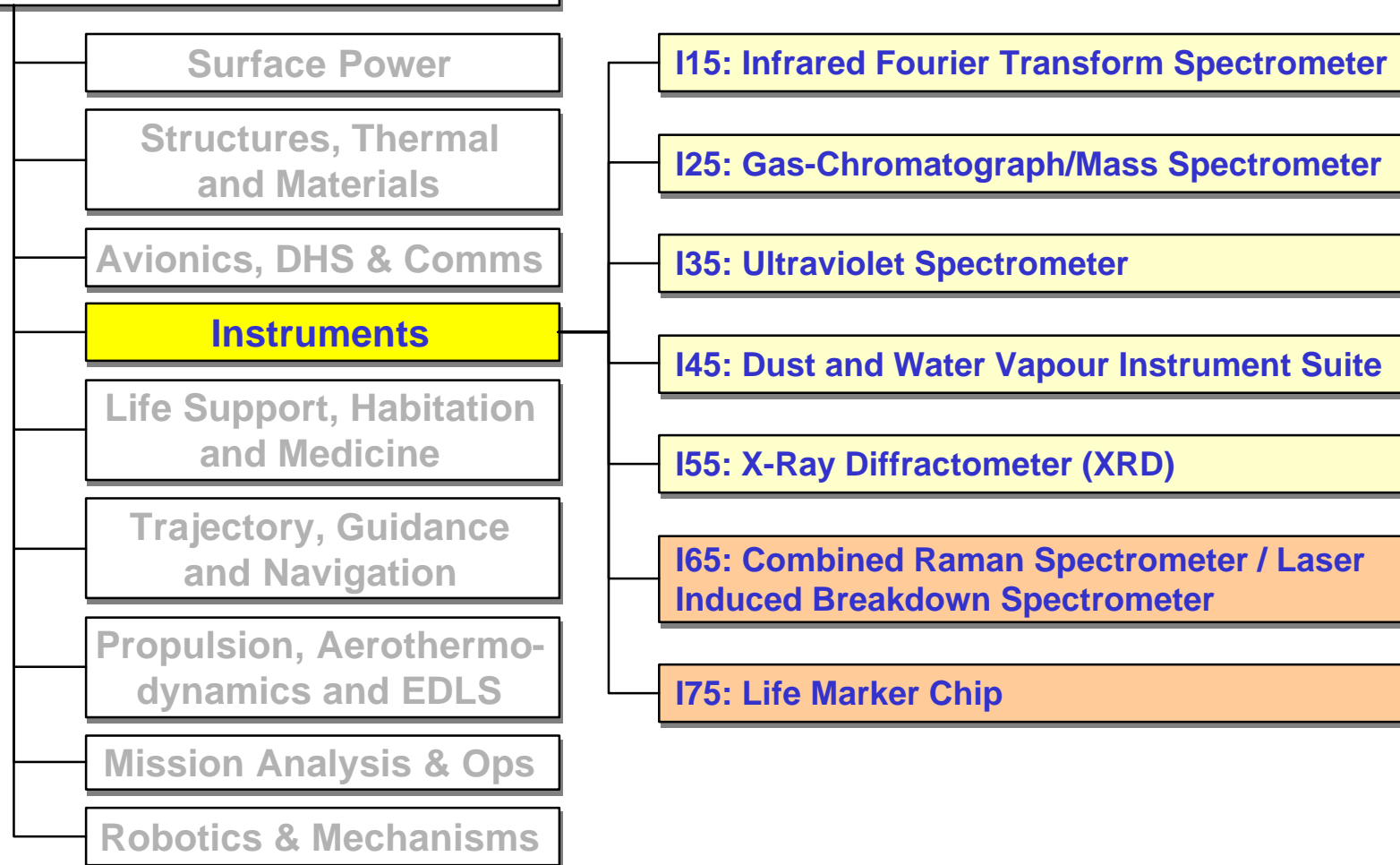
Aurora Technology Programme





Aurora Technology Programme

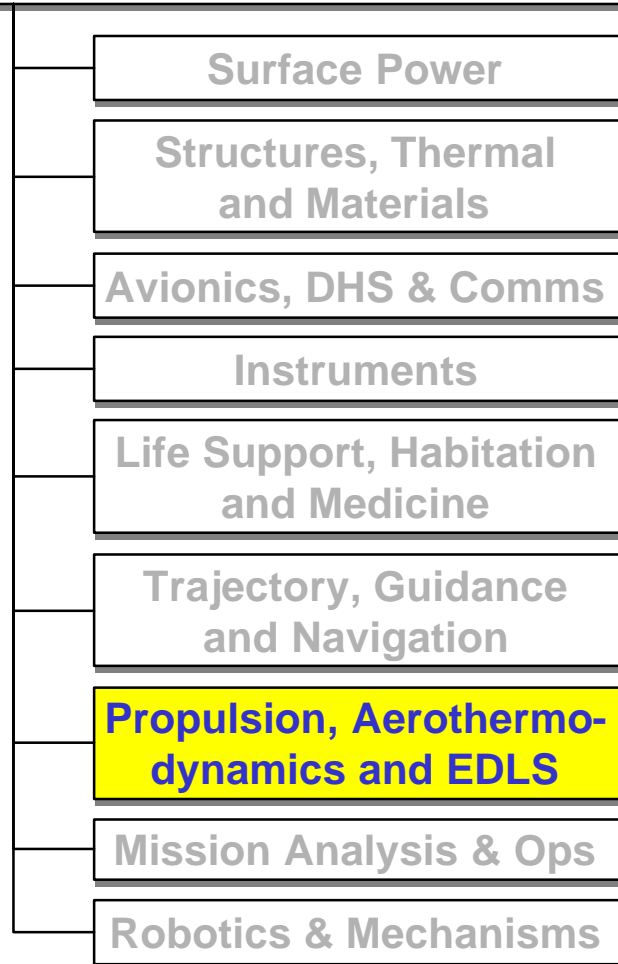
Aurora Technology Streams





Aurora Technology Programme

Aurora Technology Streams

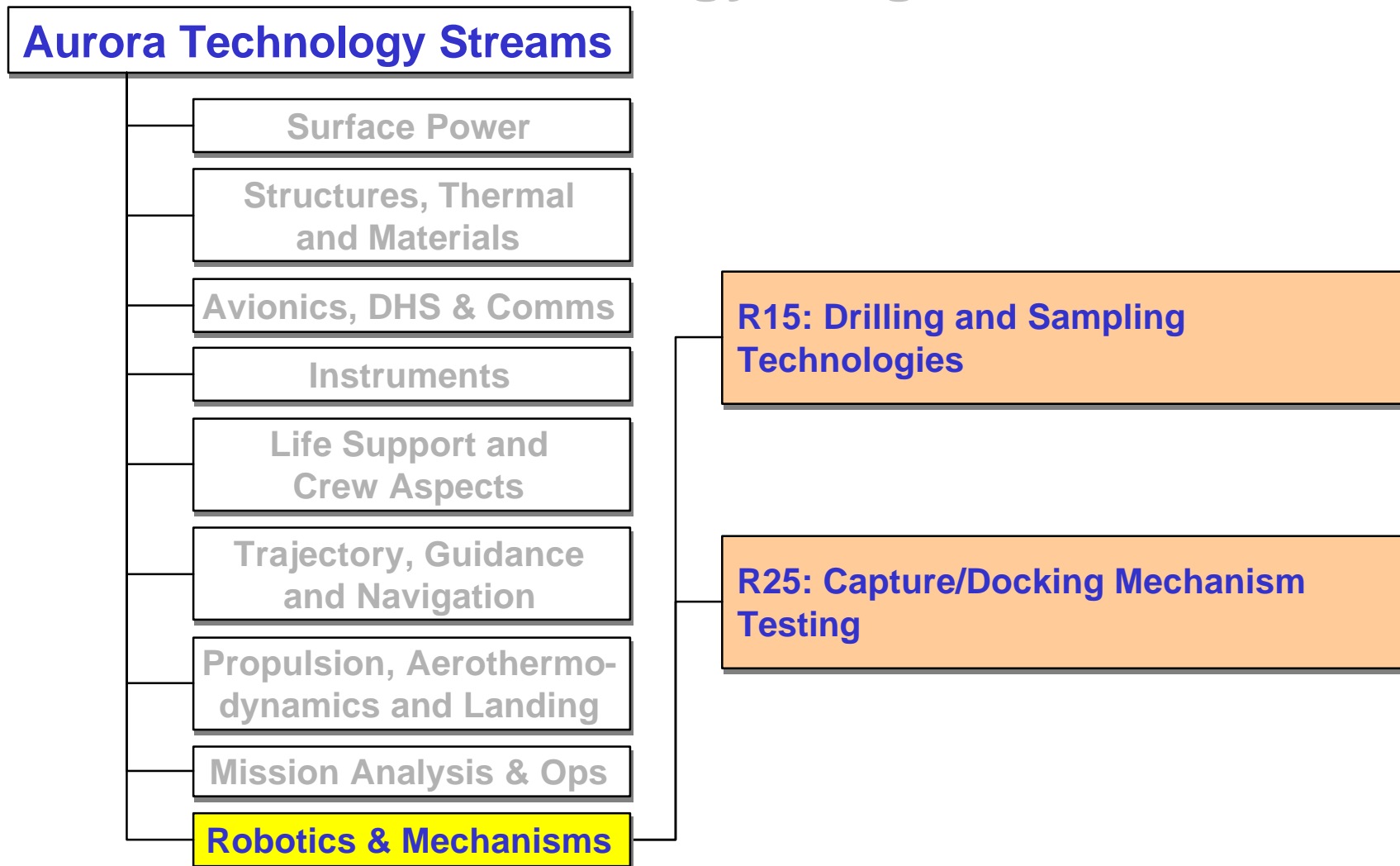


E15: Plasma testing of heat shield concepts for high speed Earth entry

E20: Moon and Mars Human Mission Re-entry Technologies

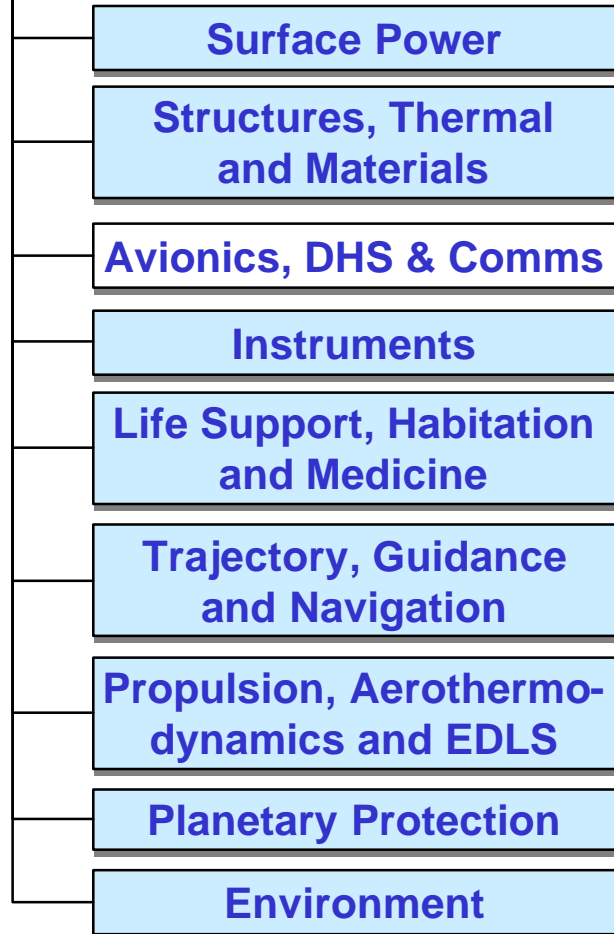


Aurora Technology Programme





Aurora Technology Streams



Aurora Related TRP Activities

19 NEW GENERIC EXPLORATION TECHNOLOGY ACTIVITIES

DIRECT NEGOTIATION

OPEN COMPETITION



Aurora Related TRP Activities

Aurora Technology Streams

Surface Power

Structures, Thermal
and Materials

Avionics, DHS & Comms

Instruments

Life Support, Habitation
and Medicine

Trajectory, Guidance
and Navigation

Propulsion, Aerothermo-
dynamics and EDLS

Planetary Protection

Environment

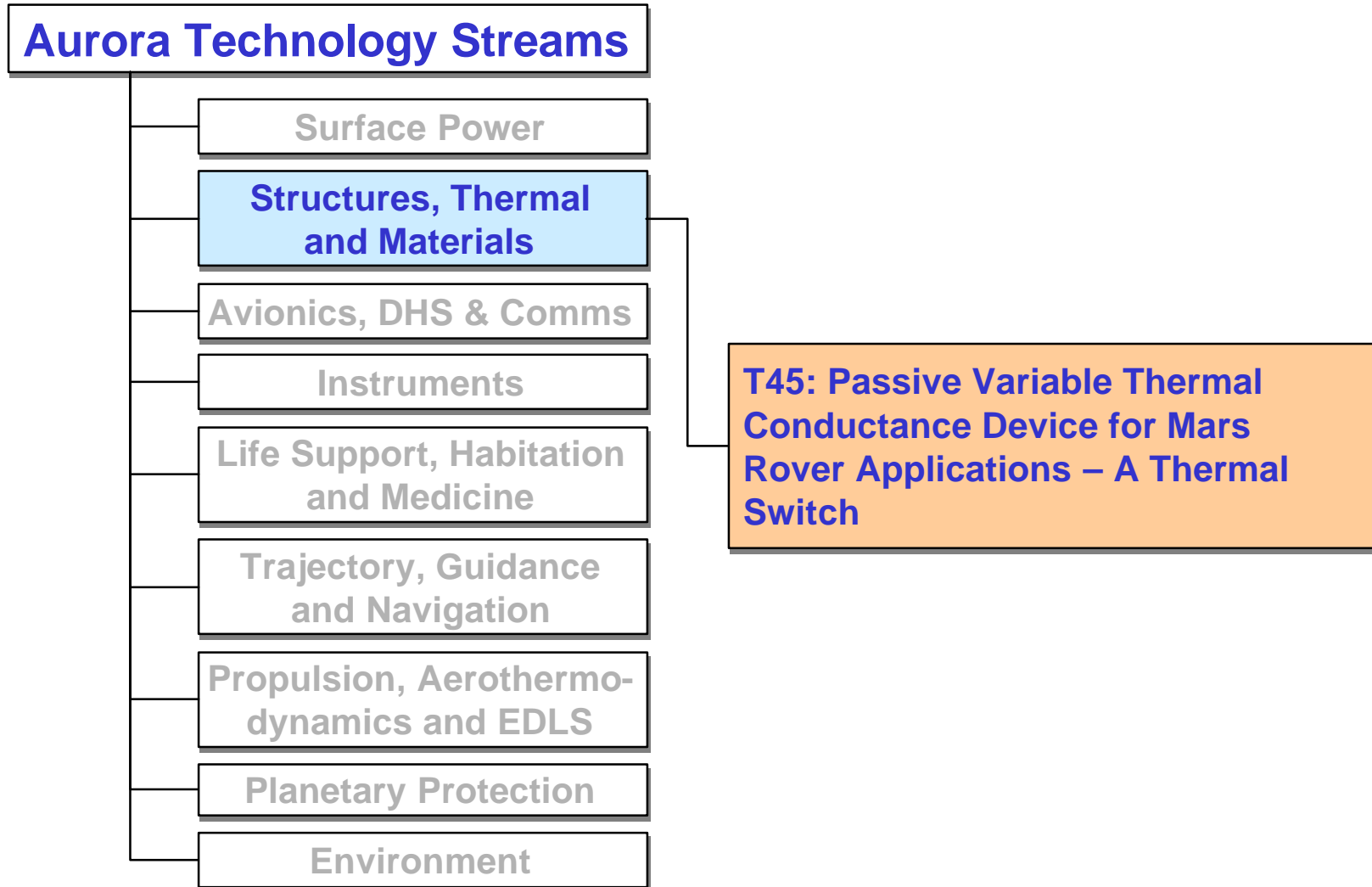
W15: Solar Cell Development for
Mars Exploration Missions

W25: Solar Cell Electrical
Characterisation Facility for Mars
Exploration Missions

W35: Martian Dust Simulation
Facility for Solar Cells

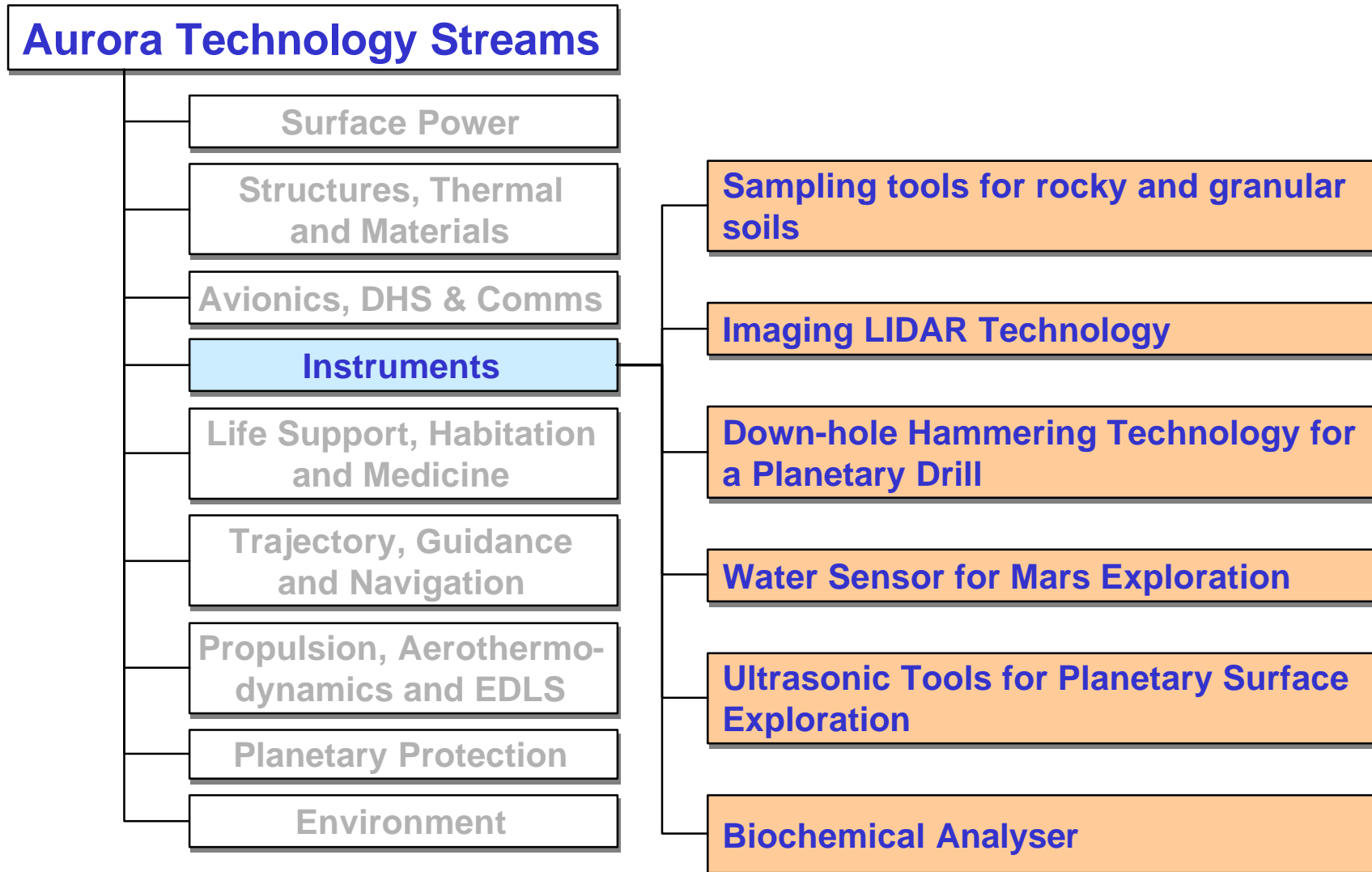


Aurora Related TRP Activities



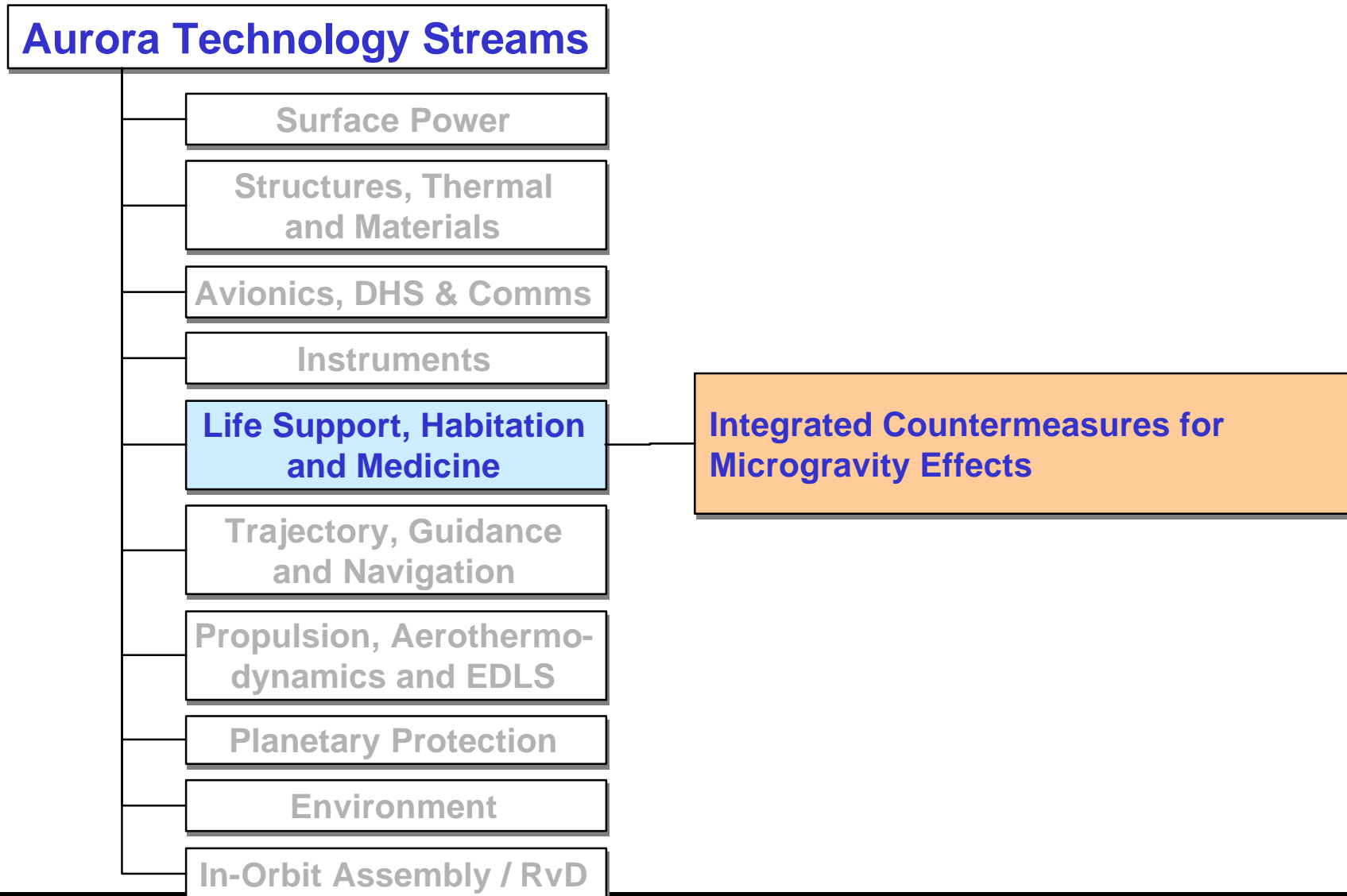


Aurora Related TRP Activities



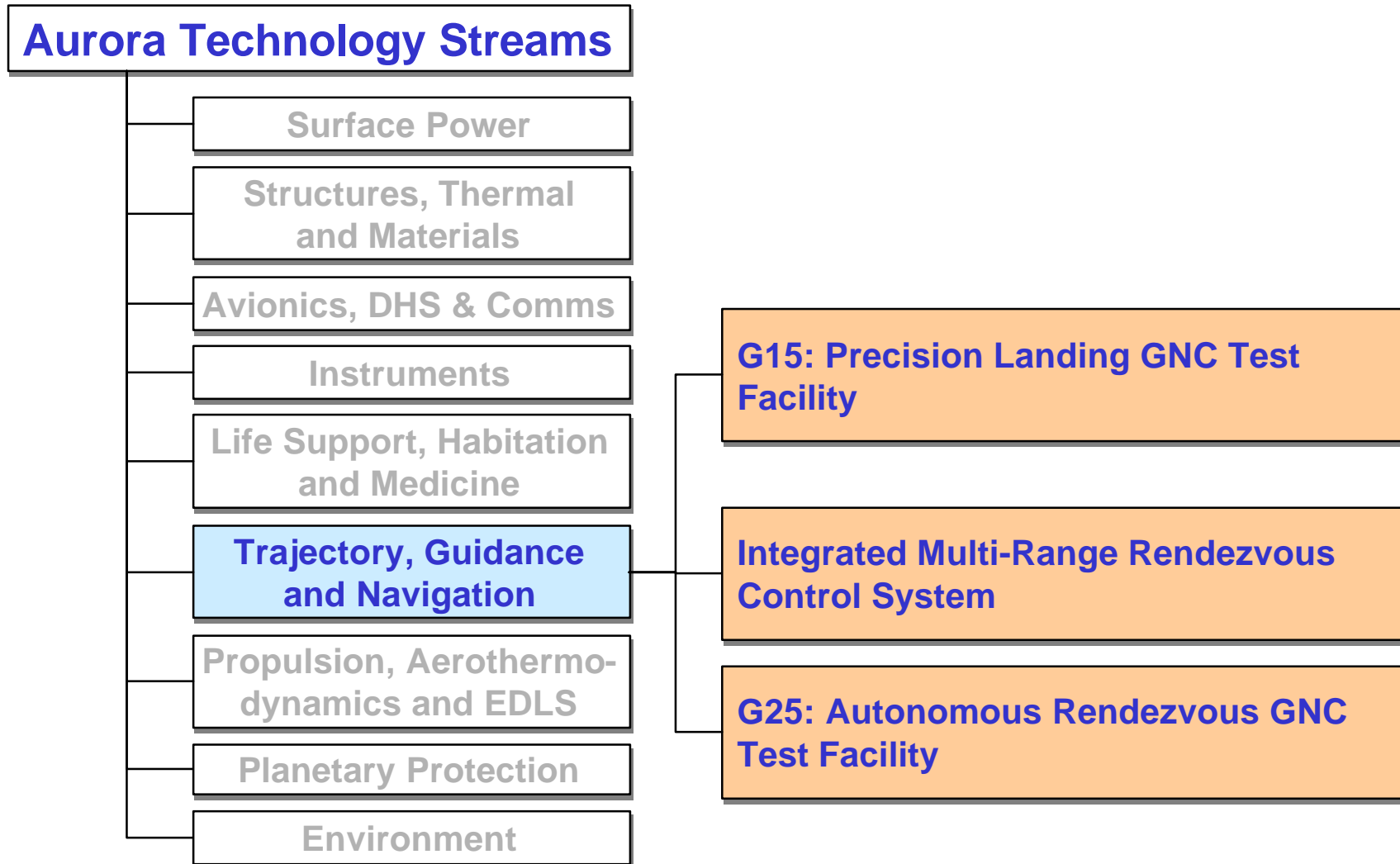


Aurora Related TRP Activities



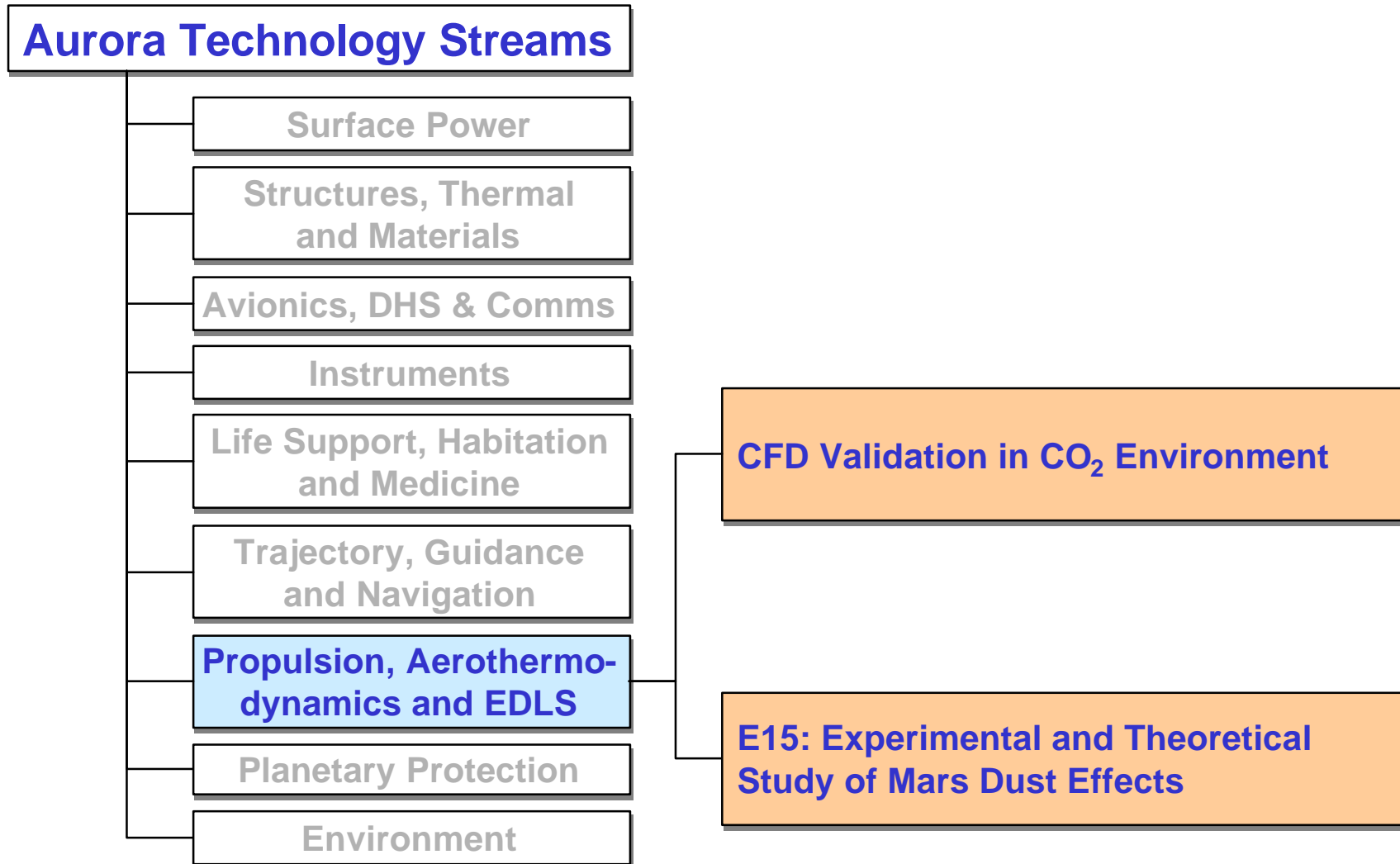


Aurora Related TRP Activities



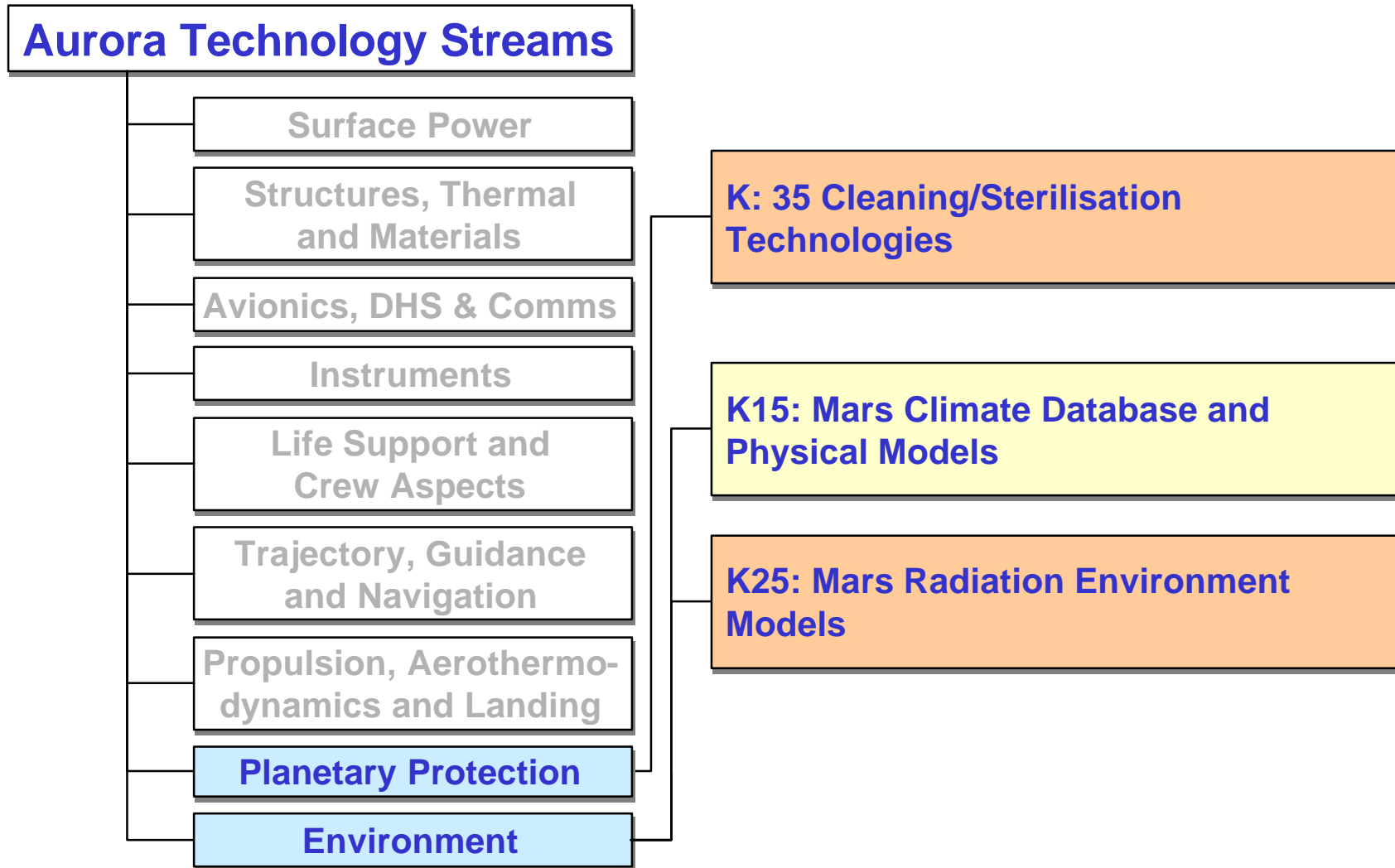


Aurora Related TRP Activities





Aurora Related TRP Activities





ESA Technology Readiness Levels (TRL)

- **Level 1:** Technology concept and/or application formulated
- **Level 2:** Analytical & experimental critical function and/or characteristic proof-of-concept
- **Level 3:** Component and/or breadboard validation in laboratory environment
- **Level 4:** Component and/or breadboard validation in relevant environment
- **Level 5:** System/subsystem model or prototype demonstration in a relevant environment (ground or space)
- **Level 6:** System prototype demonstration in a space environment
- **Level 7:** Actual system completed and “Flight qualified” through test and demonstration (ground or space)
- **Level 8:** Actual system “Flight proven” through successful mission operations