

SOLAR-C meeting summary

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2008 November 21

Two *SOLAR-C* mission concepts under study

- *Plan A: Out-of-ecliptic magnetic/X-ray and helioseismic observations* of the polar and the equatorial regions to investigate properties of the polar region, meridional flow and magnetic structure inside the Sun to the base of the convection zone.
- *Plan B*: High spatial resolution, *high throughput, high cadence* spectroscopic (polarimetric) and X-ray observations *seamlessly from photosphere to corona* to investigate magnetism of the Sun and its role in heating and dynamism of solar atmosphere.
- *Launch Date*: Japanese fiscal year *2016 (provisional)*
 - Expects joint observations with highly complementary missions
 - *NASA SDO* (whole sun field of view)
 - *ESA&NASA Solar Orbiter* (Insitu and stereo obs with SOLAR-C)
 - *NASA Solar probe* (In-situ)

Purpose of the Meeting

Extremely successful meeting!

- Develop science cases for plans A and B *in progress*
- Identify discovery space for both plans *in progress*
- Understand Plan-A constraints, and build the plan A mission *in progress*
- Propose model science instruments *in progress*
- Solar physics community should reach common understanding on issues related to our future *very well done*
- Form international sub working groups for specific critical issues if necessary *open*
- Discuss synergy with other programs *open*

Current understanding

- We are in the golden age for solar physics due to Hinode and other missions.
- The meeting was very successful, and will provide basis for SOLAR-C.
- We are in the era to build one and only one mission by combining all the resources in the world (see particle physics LHC, ILC).
- It is good to have two completely different plans rather than to rely on single plan at this point. ***This situation should not be taken negatively.***
- Both plans have sufficient science motivation to be developed further, and the choice is a matter of priority.
 - Serial approach (plan 1 followed by plan 2 in time)
 - Parallel approach (plan 1 pursued by agency 1, plan 2 by agencies 2+3)
 - Who can do plan A best? Who can do plan B best?

Plan A

- No one has ever done this.
- Address fundamental physics associated with the sun as a star
- Need to develop helio-seismic approach to dynamo problem
- Fully convective late-type stars have active dynamo
- Required development effort including cost and risk associated with interplanetary flight not yet fully visible
- However, expect strong support from JAXA/JSPEC re system development
 - New idea appears from Prof. Kawaguchi
- Smaller community involved in plan A especially in Japan
- Japan can have one solar mission. It is not clear whether we can tolerate the duration of several years before the start of the observations.
- Relationship with ESA&NASA solar orbiter is an issue

Plan B

- Address important scientific issues for chromospheric and coronal heating and dynamics
- Everyone now discusses magnetic reconnection thanks to Yohkoh
- Need to clearly state scientific gain (discovery space) with respect to Hinode result
 - No one blames us even if we can not solve coronal heating problem.
- Development effort (cost) and risk predictable
- Excellent continuity from Hinode
- Larger community involved in plan A

Plan A vs plan B

Factors to be considered

- Scientific value
- Can attract many students (wrt ALMA, ASTRO-G/H, TMT)?
 - Produce 20 PhD thesis or one Nobel prize
 - Can contribute to significant enhancement of solar physics and astronomy in Japan
- Enthusiasm of young Hinode (=SOLAR-C) core team in Japan
 - An issue related to social system and sociology in Japan
- Technical visibility
- NASA and/or ESA participation absolutely needed
- Relationship with other agency's program
- Support from other disciplines in Japan

Other note

- Two approaches
 - To solve single declared problem (e.g. elementary particle physics) Conventional wisdom may be wrong.
 - Increase in instrumental power always brings serendipitous discoveries (astronomy in general)
- Instrument driven or science driven
 - Proposal on new X-ray telescope
 - Proposal on innovative instruments may affect the decision

Our relationship to space agencies

- We continue to invite NASA and ESA to participate in SOLAR-C program.
- Bottom-up process critically important in US and in Europe
- More communication and coordination among space agencies in solar physics needed
 - SOLAR-C, Solar Orbiter, Solar probe
 - Bilateral relationship should be expanded to tri-lateral (NASA-ESA-JAXA).
 - Lessons learned from X-ray astronomy (XEUS, CO-X)
 - We discussed A vs B, how about A vs solar orbiter?
- NASA+ESA+JAXA has >1 billion\$ worth of money for solar physics in the coming 10 years. The issue is how to use this money intelligently.
- We may ask NASA and ESA for formation of NASA/ESA SOLAR-C WG or equivalent to work with us.

Attitude of space agencies

- ISAS
 - Decision should be made purely from scientific point of view with concurrence with international colleagues
- NASA
 - Scientific case should be consistent with NASA roadmap. (We believe that this is the case.)
- ESA
 - Expect collaboration with Japan re SOLAR-C

SOLAR —C development schedule (provisional)

- FY2016 Launch
- FY2015 S/C tests
- FY2011~14 Flight and proto model (PM-FM)
- FY2010 Phase-A
- FY2009 Mission proposal to ISAS SSC
- FY2009 Basic development
- **FY2008** **Concept study**
- FY2007 JAXA SOLAR-C WG (pre-phase-A)

(FY: Japan fiscal year starting April 1.)

Bottom up system for Space Science

The way to select science missions





Mission Selection Criteria

1. Scientific values

- * Creation of a new science field and/or a big jump in the existing discipline anticipated?
- * Japan's unique contribution to the world in the discipline expected?
- * Why urgently needed?

2. Conformity between scientific objectives and payload instruments

3. Technological feasibility

- * Spacecraft system
- * Bus subsystems
- * Each payload instruments

4. Maturity of the scientists / engineers team to be in charge of the mission

(Review Criteria adopted in the Steering Committee for Space Science)

Approval Layers

- 3 approval layers for project authorization.
- Bottom – Approval by ISAS/JAXA
 - Evaluation from scientific/engineering viewpoint
 - Mission Definition Review (MDR)
 - System Requirements Review (SRR)
 - SSC plays role of evaluation on behalf of ISAS
- Middle – Approval by JAXA HQ
 - Evaluation from JAXA management/administration/
budgetary viewpoint
- Top – Approval by Government, MEXT
 - Evaluation by SAC

SOLAR—C Near term development schedule

- By March 2010 Mission proposal to JAXA
- FY2009 Start development of key technology (especially for Plan A)
- *January 2009 Report to JAXA re plan A and plan B (Can we do this?)*
- April 2008 JAXA SOLAR-C WG started
- (FY: Japan fiscal year starting April 1.)

Final Remarks

- This meeting provides basis for SOLAR-C.
- We will discuss and refine the both mission concepts in terms of the issues raised in this meeting. The answer can emerge from further study including continued efforts on Hinode data analysis. Please continue to think about this.
- We have excellent people here, and desire that this group evolves to international working group under JAXA/ESA/NASA.
- We will discuss programmatic aspects with ESA and NASA as well as JAXA/ISAS/JSPEC.
- Ground-based solar observations continue to very important.