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May 25, 2011

Dr. Gilles Joncas
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Dear Dr. Joncas,

RE: Chair's Report for the Joint Committee on Space Astronomy

This Joint Committee for Space Astronomy (JCSA) Chair's Report covers the period from May 15, 2010 to May 15, 2011. The committee met twice in person during this period, on May 24-25 2010 in Halifax and on Feb 7-8 at the Canadian Space Agency (CSA) headquarters in Montréal. In addition, a telecon was held on Feb 28, 2011. The next JCSA meeting will be held on May 30 at the CASCA meeting in London.

A detailed summary of the recommendations from the face-to-face JCSA meetings is provided in two appendices at the end of this report. These can be referred to for the details of JCSA activity. In the body of this report I will focus on the top three high-level space-related issues that should be brought to the attention of the CASCA board.

1. JWST

At the request of US Sen. Barbara Mikulski, the Independent Comprehensive Review Panel (ICRP), led by John Casani (JPL), reviewed the JWST project. The committee concluded that while JWST is in "very good technical shape" the project is way behind schedule and way over budget. The root causes of the cost and scheduling issues are a "badly flawed" budget and the inability of project manager to assess what was really needed. The project is attempting to fix these issues by replacing the project manager and reorganizing the management structure, with central oversight now being handled directly by NASA HQ.

There has been considerable turbulence resulting from this news, although this mainly seems to be behind us now. Nevertheless it might not be a bad idea for the CASCA board to have a contingency plan in place for some rapid high-profile community-wide JWST advocacy in the event that the project needs it sometime in the future. It is clear that if JWST is ever seriously put at risk then Canada could play a very significant role in assisting the project, because in spite of our relatively small contribution to the mission it is known in the US that the project is our largest space science investment, and maintenance of robust relationships with Canada is known to be of strategic importance to the US government.

Another JWST issue that the CASCA board should be aware of is that progress with the Canadian instrument for JWST (the Tunable Filter Imager) has been discouragingly slow. Many technical challenges exist, and not much schedule contingency remains. I anticipate that next time JCSA meets the slow progress of the Tunable Filter Imager will be a major focus of discussion.

2. The Long Range Plan for Canadian Astronomy

The LRP2010 panel has produced the following ranking for new space-based facilities in the coming decade:

Category	Project
Large	Dark energy satellite (Euclid or WFIRST or Canadian Space Telescope)
Medium	1. IXO Research and Development 2. SPICA
Small	1. Astro-H participation 2. Stratospheric balloon programme 3. Nanosat/Microsat programme

The challenge to be faced is that it is not obvious how we can participate in our top-priority Large Category mission, since WFIRST is in crisis because of the US budget situation, and it is not clear that participation in Euclid is even open to us. (Euclid has recently been reorganized by ESA and the lines of communication between CSA and the project are still being built). On the other hand, the Canadian Space Telescope option is not yet well defined.

CSA is moving forward by encouraging negotiations with the ESA Euclid Team and (in parallel) is developing an AO for a Canadian Space Telescope concept study. Discussion of these activities is going to be the major focus of the next JCSA meeting. My impression is that CSA is trying hard to do the right thing, and it is not obvious to me that the CASCA board can do very much to help at this stage. So I am raising this issue with the board as a point of information: I think this issue is sufficiently high profile that the board should be aware of what is going on.

3. CSA Grants and Contributions Program

I'm very pleased to be able to report to the CASCA board that the initial phases of CSA's grants and contributions program are now being implemented, e.g. the CSA FAST program. The main message here is that CSA is showing a real commitment to supporting astrophysics and although CSA is not the most agile funding agency I've interacted with, they do seem to

eventually deliver. Over the course of the next year I expect CSA to kick-off their clusters and academic chairs programs. The criteria by which these are judged are likely to be unfamiliar to astronomers used to dealing with NSERC (e.g. the grants will be tightly focused on areas deemed to be of strategic importance to CSA). The CASCA board may wish to give some thought to ways in which Canadian astronomers can best be encouraged to come up with creative ways of working within these programmatic constraints in order take full advantage of new opportunities for CSA funding. An obvious first step would be to make sure that CASCA uses every means at its disposal to communicate to Canadian astronomers what the CSA's priorities are.

At present the voting members on the Joint Committee for Space Astronomy are:

Roberto Abraham (Chair) – Term 2008-2011 (University of Toronto)
Laura Ferrarese – Term 2009-2012 (Herzberg Institute of Astrophysics)
David Lafreniere – Term 2011-2014 (Université de Montréal)
Luigi Gallo – Term 2010-2013 (St. Mary's University)
Brian McNamara – Term 2009-2012 (University of Waterloo)
David Naylor – Term 2011-2014 (University of Lethbridge)

Sincerely yours,



Roberto Abraham
Outgoing Chair, JCSA

Appendix 1: JCSA meeting Feb 7-8, 2011
JCSA Recommendations
Feb 7-8 2011
JCSA HQ Montreal

Grants and Contributions Program

The Joint Committee for Space Astronomy wishes to commend the Canadian Space Agency for the steps taken to implement the Grants and Contributions (G&C) program. Early feedback from astrophysicists supported by the program is strongly positive, and the structure of the program seems well matched to the needs of the space astrophysics community. The mechanism of "grandfathering" the Space Science Enhancement Program (SSEP) grants to operate under the aegis of the G&C Program seems to have worked well in general. Looking forward, JCSA notes that in two years six Herschel and two Plank SSEP grants/contributions will expire, but it is likely that future funding will be requested by PIs. In particular we highlight the probable need for Canadian Plank researchers presently supported by SSEPs to obtain extensions, because Planck cosmology results will begin to emerge in 2013. Given the likely need for funding at that time, JCSA suggests that CSA begin planning now for smooth renewal of the relevant grants.

James Webb Space Telescope (JWST)

The JCSA is naturally very concerned by the delay in the JWST launch date. JCSA reaffirms its support of Recommendation 6 in the Long Range Plan for Canadian astronomy, which asserts that: "Completing and launching JWST is the top priority for Canadian space astronomy. CSA should continue working diligently with its international partners (NASA, ESA) to bring this observatory into operation as soon as possible. More specifically, sufficient resources should be allocated to encompass the costs inherent in a launch delay of JWST, and to ensure the success of the science-critical made-in-Canada Tuneable Filter Imager". The present situation in which the CSA-funded workers at the Space Telescope Science Institute (STScI) will have their contracts expire in 2014 (well ahead of launch) is therefore worrisome. It is JCSA's view that not funding the full TFI team at STScI beyond 2014 threatens CSA's investment in JWST, and its future standing as an international partner in Space Astronomy. We strongly urge CSA to support the present complement at STScI up to and beyond launch.

Outreach

JCSA thanks Ruth-Ann Chicoine for her excellent description of the CSA's outreach efforts. JCSA was impressed by the quality of the material presented (especially the multimedia aspects of the AuroraMAX website). However, it seems that the overall quantity of outreach material is disproportionately modest relative to the number of recent successes obtained by CSA, and does not fully exploit developments in social media. As a result, it is JCSA's opinion that the present scope of outreach done at CSA is not optimally communicating to the Canadian public the many successes enjoyed by the agency, particularly in its astrophysics

program. Given present FTE limitations at CSA, and the constraints under which outreach program must operate at CSA (e.g. the difficulty of issuing press releases because of the need for language translation, and the need for special permission for issuing press releases during election cycles), CSA should exploit its links to the University community to help get its message across. Our impression is that there is strong gratitude in the University astrophysics community toward CSA because of its investments in astrophysics, and that Universities would welcome the opportunity to help CSA in outreach efforts. JCSA therefore recommends that the matter of how best to help CSA publicize its successes be referred to CASCA, with a suggestion that CASCA coordinate with CSA to publicize press-worthy results. The desired outcome of this would be greater visibility for CSA through press releases issued in greater numbers, and in a broader range of media, with all these efforts being directed toward enhancing the visibility of the CSA astrophysics program. As an early start on this initiative, JCSA recommends that CSA endorse the idea of having JCSA members directly contact the Hershel and Plank teams presently supported by SSEP grants in order to urge them to contact Ruth-Ann Chicoine in order to begin publicizing their early results.

AstroSat/UVIT

JCSA is concerned by the rather weak lines of communication between the Canadian AstroSat team and the Indian Space Research Organization (ISRO). JCSA encourages CSA to assist Canadian UVIT PI Hutchings in establishing stronger lines of communication with ISRO. JCSA urges CSA to ensure that the AstroSAT team (particularly the two critical engineers at the University of Calgary and Bristol Aerospace) are adequately supported through launch, and encourages the CSA to exploit synergies between Astro-H and AstroSat when determining contract scope and lifetimes. Lines of communication between the Hutchings and CSA itself seem reasonably strong, but would benefit from further strengthening in some areas. JCSA was pleased to see that the JCSA meeting offered an opportunity for Hutchings to meet the new CSA program manager (Genevieve Marchand) for the project. JCSA suggests that CSA develop further the idea of associating AstroSat observing time with funding for Canadian investigators who succeed in obtaining AstroSat/UVIT time via open competition. JCSA suggests that the idea of archiving at least the UVIT data from AstroSat at the Canadian Astronomical Data Centre (CADDC) be further developed.

John Hutchings

JCSA would like to commend John Hutchings of the Herzberg Institute of Astrophysics (HIA) for the outstanding job he has been doing for many years in support of Space Astronomy in Canada. Hutchings is the Canadian PI of AstroSat/UVIT and of the JWST Fine Guidance Sensor. JCSA also notes that Hutchings is a "single point success", in the sense that there does not seem to be an obvious successor to him at HIA (or, indeed, anywhere in Canada). JCSA encourages both CSA and HIA to develop a strategy to enable a smooth transition from Hutchings to other PI's in the event that Hutchings chooses to retire.

Canadian Space Telescope

JCSA thanks John Hutchings for his summary of the outcome of the CSA-funded Dark Ener-

gy study. The Report of the Long Range 2010 Panel ranks participation in Euclid/WFIRST as the top priority for post-JWST large astrophysics missions, but notes that "In the event that participation in either Euclid or WFIRST is not possible, then the LRPP recommends exploring the possibility of a Canadian-led imaging satellite focusing on UV-visible wavelengths, as a complement to WFIRST/Euclid. Leading such a project would break new ground for Canadian space astronomy and present numerous opportunities for Canadian companies to showcase technological capabilities." Based upon the low likelihood that Canada will be welcomed into either Euclid or WFIRST, JCSA recommends that CSA issue a RFP for a concept study for a Canadian-led wide-field UV-visible wavelength imaging space telescope.

Nanosatellites

JCSA thanks Holly Maness (Dunlap Institute) and Robert Zee (UTIAS) for their presentations on nanosatellites. The Report of the Long Range 2010 Panel notes that "Canada continues to be a world leader in micro- and nano-satellite technology" and "The LRPP strongly supports this [nanosat] program as a cost-effective way of answering tightly focused science questions." The parameter space for astrophysical interesting nanosat missions is not well defined at present. Therefore JCSA recommends that CSA issue an AO for initial concept studies on nanosatellite missions.

Herschel and Planck

JCSA is gratified by the spectacular results now emerging from Herschel and Planck and commends CSA in the strongest possible terms for their support of both missions in Canada. Both missions look set to be outstanding successes and will shed new light on the Universe at infrared wavelengths. Canada made notable contributions to these missions, and it is imperative that the Canadian project teams make every effort to fully acknowledge the role played by CSA in this success. A template message noting support from the SSEP program should be prepared and sent to the supported PI's.

SPICA

JCSA strongly supports the request made by David Naylor that the existing SPICA contract with the University of Lethbridge be extended by \$68,000 until 31 Dec 2011 in order to maintain the Canadian SPICA team in place to at least the point where it is known whether the SPICA mission will be moving forward.

Astro-H

JCSA notes that a total of \$75K/year has been allocated by CSA for support of the Astro-H science team. The amount should support travel expenses and a student for the three scientists on the team. JCSA recognises the strict time constraints involved in the mission and anticipates a need for further support to the science team in the form of a dedicated support scientist to focus on the implementation of the Canadian hardware contribution. We also urge CSA to move quickly to define the science team so that they can begin their work.

WISH

JCSA thanks Marcin Sawicki for his presentation on the plans for the JAXA-led WISH imager. Sawicki's presentation was seen as a good example of how the community can use JCSA as a conduit for informing CSA of future opportunities. Given the priorities elucidated in the CASCA Long Range Plan it is not obvious that CSA involvement in WISH makes sense at the present time. However, the international situation is fluid and WISH may increase in priority in the future. JCSA recommend CSA offer to support Sawicki's travel to the WISH science working group meetings in Japan in order to inform CSA about developments in this potentially interesting project.

Appendix 2: JCSA meeting May 24-25, 2010

Joint Committee on Space Astronomy Minutes of meeting - May 24-25, 2010

Day 1

Location: Atrium Building, Room AT 306, Saint Mary's University
May 24, 2010

Attendees:

Roberto Abraham (JCSA, Chair, University of Toronto)
Luc Brûlé (CSA, ex-officio)
Jean Dupuis (CSA, executive secretary)
Greg Fahlman (HIA, ex-officio)
Laura Ferrarese (JCSA, HIA, by teleconference)
Luigi Gallo (JCSA, Saint Mary's University)
Alexandre Horth (CSA, COOP student)
Alan Hildebrand (University of Calgary, guest, by teleconference)
John Hutchings (HIA, guest)
Dave Kendall (CSA, ex-officio, by teleconference for morning session)
Denis Laurin (CSA)
Brian McNamara (JCSA, University of Waterloo)
Pierre-Olivier Quirion (CSA, guest)
Bob Rutledge (JCSA, McGill)
Ludovic Van Waerbeke (JCSA, University of British Columbia)

Introductions

Discussion about governance of astronomy in Canada

Dave Kendall CSA update (by teleconference)

Refer to Dave Kendall PowerPoint presentation for the new CSA org chart.

The new space exploration branch at CSA is responsible for delivering space exploration activities at the CSA. It includes ISS, On-Orbit Servicing planetary exploration and space astronomy.

The new space science and technology (SS&T) branch (directed by D. Kendall) is responsible for developing, sustaining and enhancing Canada's scientific, technological and engineering capability so that Canada becomes more competitive and that space is used more efficiently.

The planning of CSA activities will be somewhat different from the previous mode of operation and will tend to use a more top-down approach. It will be possible to make adjustments

to roadmaps to respond to unforeseen opportunities but in the end CSA will be limited by budgetary limitations. CSA will continue to be flexible to optimize return on its investments.

CSA is looking for ways to stimulate research within the agency. CSA currently does not have the budget to have more research scientists (including astronomers) but it is in the plan to hire more scientists in the longer term.

SS&T is also responsible for provision of infrastructure and services required for space qualification (i.e. DFL). It is in the plan to make these resources more easily available to academia.

The Science and Academic Development directorate (A. Berinstain) is the scientific research branch that includes most of CSA's scientific researchers (classified as RES government employees) which dedicate half of their time to research activities and the other half to support of exploration missions.

Grants & contributions:

CSA now has authority to put out grants & contributions. We have a new set of tools to meet CSA objectives when government is not the primary beneficiary. CSA should be allowed to be able to issue contributions within a month.

Academic Development Program (Berinstain).

- University Chairs in strategic areas

- Clusters in strategic areas where Canada is or could be a world leader.

- Initial studies for science concepts.

- Accelerators to stimulate recruitment of students.

FAST:

- University-driven research project (space and sub-orbital missions).

RIP:

- Infrastructure program for long-term capacity building

Medium-term activities: (12-18 months timeframe)

- CFI partnership for national platforms competition

- Kick-off CSA clusters program

- Kick-off CSA chairs program

- Kick-off of initial studies program

Summary of sub-orbital workshop (120 participants):

- Small group using sounding rockets.

- Interest in nanosatellites.

- Balloons: growing field of interest in Canada, tremendous interest for having a Canadian infrastructure to launch and receive balloons in collaboration with international partners.

The governance of CSA is being reviewed which may have consequences on the current sci-

entific advisory structure. The JCSA is encouraged to advise CSA on how to best modify and improve its external governance structure.

JCSA should also suggest technology priorities addressing the need of space astronomy in Canada.

Break for coffee

Space Exploration in Canada, Luc Brûlé (presentation available on the JCSA extranet site)

Summary of Exploration group structure:

Exploration planning (J.-C. Piedboeuf): group in charge of producing roadmaps, identifying priority technologies, and strategic exploration development plans.

Astronomy & planetary missions (A. Ouellet): management of phase 0, phase A and phase-E and phase-F (operation and disposal).

Exploration projects (E. Laliberté): responsible for mission development (phase B through D).

Exploration operations and infrastructure (P. Jean): ISS operation, operation of satellites (Radarsat-2).

Astronaut office, life science and space medicine (J.-M. Comtois)

Why exploration?

See slides for list of arguments

LRP panel plan: add in the LRP recommendations on how to better respond to mission opportunities.

Recommendation: Regular discipline working groups should be formed again as a mean of informing CSA about mission opportunities.

-List of priorities on slide.

-Cradle to grave mission development.

A list of signature technologies was presented which had more a planetary exploration flavor.

Action: JCSA to provide suggestions for technology priorities pertinent to space astronomy.

Objective is to release the Canadian Space Exploration strategic plan by March 2011. The process will include consultation with international and national partners. This will result in mission roadmaps including mission of opportunities for Canadian signature technology and scientific expertise.

CSA is in the process of reviewing its governance process. There is still a need for receiving input from the community although the actual format might change.

Lunch break

CSA Space Astronomy update
D. Laurin

MOST:

Questions about continuing support US guest observer program. JCSA is to provide recommendation about this issue. NASA has not communicated their intention for cycle 3.

Mission concepts:

- discussion about Astro-H
- discussion about Dark Energy Mission study

NEOSSat presentation
A. Hildebrand

Summary:

Mission objective is the detection of large NEAs (greater than 1km in diameter)

Assessment of inner Earth orbit objects.

Main challenge is zodiacal light (will lose about 1 mag of sensitivity)

Integration will be about 100 second (limited by asteroid proper motion)

Would go down to about 19.5 near the ecliptic. No filters (therefore determined by CCD response).

Space will discover 1-2 asteroid of interest per day. Ground-based observatories are to be notified for astrometry follow-up.

Baffle performance is poorly constrained and may not meet specifications.

Communication problems between contractor and science team because of CSA data management structure.

Short description of Euclid by Ludovic Van Waerbeke:

Broad-band survey of galaxy shapes.

Need photometric redshift to meet mission objectives.

Dependence on LSST or equivalent for science results?

Continuation of Denis Laurin presentation (15h40):

CSA now has an appropriate contribution mechanism to fund BRITE and SPIDER.

Performance indicators:

The committee is concerned by the low publication rate reported for space astronomy in CSA's survey.

PLATO presentation

P-O Quirion

The presentation is available on the JCSA extranet site.

The committee had an executive session. Meeting is to resume next morning.

Day 2

Location: Atrium Building, Room AT 217, Saint Mary's University
May 25, 2010

Attendees:

Same participants as yesterday but with the following individuals in addition:
Jaymie Matthews (University of British Columbia)
Dave Naylor (Lethbridge University)
Neil Rowlands (COMDEV)

Mike Fich never joined the teleconference to give the Herschel HIFI update.

The meeting started with the UVIT update by J. Hutchings.

There are concerns about allocation of observing time for ASTROSAT guest observer program. It is recommended that a call for proposal should be issued in Canada by CSA.

The launch date is still uncertain, although official date is 2011, but planning should start for science activities and CSA should start thinking about designing a special grant program to support Canadian guest observers.

There are still concerns about data distribution. India is now developing their own system but it is unclear whether or not their system will be efficient for international users. The role of CADC is still not clearly established.

A clear statement should be made how the proposals will be reviewed. ASTROSAT-UVIT may be used as a pilot project for a Canadian-based guest observer program.

Herschel Spire Update
D. Naylor

There will probably be 2 announcements of opportunity (AO) for open time (was initially supposed to be 3).

The confusion limit is achieved within a few minutes and sensitivity is as advertised. FTS sensitivity is better by a factor of 3 than pre-launch predictions.

D. Naylor reported the first detection of CH⁺ in the Orion Bar.

SPIRE is working very well and is already producing great data. Lots of publications are already on the way.

D. Naylor stressed problems with several contracts amendments creating problematic HR issues for UK-based scientists.

Recommendation: CSA to issue a grants and contributions scheme as soon as possible to resolve the issues with the Herschel-SPIRE science support contract.

D. Naylor provided a short update about the SPICA mission concept. A brief description of the mission is included with Naylor's presentation sent to the JCSA. SPICA is still within Cosmic Vision but has been put on a parallel path. There has to be an MOU signed between ESA and JAXA before the project moves ahead. The project might be affected by the current European economic situation and more specifically that of Greece which is one of the participating countries to SPICA.

Request: The current contract supporting the Lethbridge team through the SPICA mission concept study should be extended through 31 Dec 2010.

Spica is still highly regarded amongst ESA but there are delays in the project approval.

Coffee break at 11h00

JWST update

J. Hutchings, R. Doyon, and K. Saad (Slides from Hutchings, Doyon and Saad available on extranet site).

J. Hutchings presentation

Delivery of science instrument is late.

There are issues with coating of the tertiary mirror (0.5% below spec).

Canadian issues:

- Guiding and ID software issues identified but nothing too serious.

- Etalon is still a source of major concerns.

- No contract issues at STSCI for support of the TFI (MODES proposal).

- No formal role has been defined yet for CADC.

- HIA future role in JWST (Hutchings position).

There are concerns about the schedule of the JWST project and how it could impact the overall mission budget. CSA would have to see how the current science support budget can be stretched to accommodate delays.

R. Doyon presentation

Etalon is the main issue right now. The main source of concern is the capacitive sensors that are used to sense the etalon plates separation in the closed-loop system used to control the etalon. There are also drift issues caused by the fact that electronics think that the plates are not aligned.

Non-redundant mask (NRM) will have unexpected applications such as the detection of proto-earths.

K. Saad presentation

There is an ongoing investigation of TV3 chamber level of light contamination by CSA. Tests will be used to make incremental improvements to the chamber. Three cryogenic test cycles are planned during which corrective measures will be implemented progressively.

Good results were obtained during ETU testing and give CSA a good confidence for the PFM. There will be focus made in terms of efficient problem solving strategies for dealing with the etalon issues. There must be a concerted effort at making the etalon works.

MOST update

J. Matthews

MOST is almost 7 years old. The photometric performance is still as good as ever. Point-to-point scatter is a few percents above Poisson statistics. Things are going well with the three ground stations, no major issues reported. The ACS software has been adjusted for not applying motion corrections after 300 iterations. MOST will be operable until at least 2014, and beyond if power peaking techniques are applied. MOST has been doing some support observations for Kepler and COROT. AD Leo (flare star) was observed as a NASA GO target. Observations of Alpha Ophiuchi (spinning pulsator) turned out to be highly interesting. A press release is planned later this summer when the paper is published. Test observations have been made to track Jupiter. The technique developed to support this challenging observation might be applied to restore photometric performance for targets in the brightness range $3.5 < V < 2.5$.

Lunch break

Resume at 13h50

Planck-HFI update

D. Bond

Marc-Antoine Myville-Deschenes is coming back to U of T.

Need a recommendation from JCSA to support a role of Canada during an extended mission phase of Planck (see page 6 of presentation for the request).

Planck-LFI update

D. Scott

There is a lot of discussion about authorship of Planck papers. The PIs confirmed that CSA will be acknowledged in Planck publications (at least those with Canadian co-authors).

Things are going really well with Planck. Some all-sky maps were shown during the Bond fest and Lange memorial. There maps are reportedly splendid.

LRP discussion

Approximately 56M\$ is spent on astronomy per year in Canada out of which approximately 12.5M\$ is dedicated to space astronomy. However, JWST is by far the largest space astronomy mission CSA has ever made and is skewing favorably the current spending rate. (Is this by Greg?)

How do we see the next step in the development of space astronomy in Canada? There have been a lot of discussions about how to better integrate CSA and HIA to better support space astronomy projects.

Industry Perspective on Long Range Plan
N. Rowlands

Why space astronomy?

- Provides jobs and consistency
- Development funding for new technology
- Potential for providing spinoffs
- Provides experience with large space projects

A Canadian Space Telescope:

Because microsat heritage is not applicable to larger satellite platforms, it was stressed that there is a need for a dedicated smallsat development program. Technology development should begin now in order to launch a Canadian small astronomy satellite within the LRP2010 timeframe. An AO should be issued for mission studies and to determine the technology development strategies.

NSERC presentation
K. Lapointe

Notes were taken by Roberto Abraham as J. Dupuis had to leave the meeting for a JWST teleconference.

The astronomy community is not taking advantage of the research tools & instruments grants program (RTI). Only 9 proposals had been submitted this year. This funding is mostly coming through year-ends funds.

Continuation of discussion about the big picture:

IBM is interested by SKA because it offers a driver for developing exocomputing capabilities.

Small missions are not of great interest for the industry from an economical point of view. One should be worried about the technology element in order to maintain a vibrant space program in Canada.

An approach that could be considered is that CSA join the ESA science program. Part of the

reason it is difficult to implement presently is the lack of a driver. The current set-up limits Canadian contributions to the component level.

Guests and CSA asked to leave for final executive session of the committee. The chair is to provide CSA with recommendations the following week.

Adjourn: 5pm