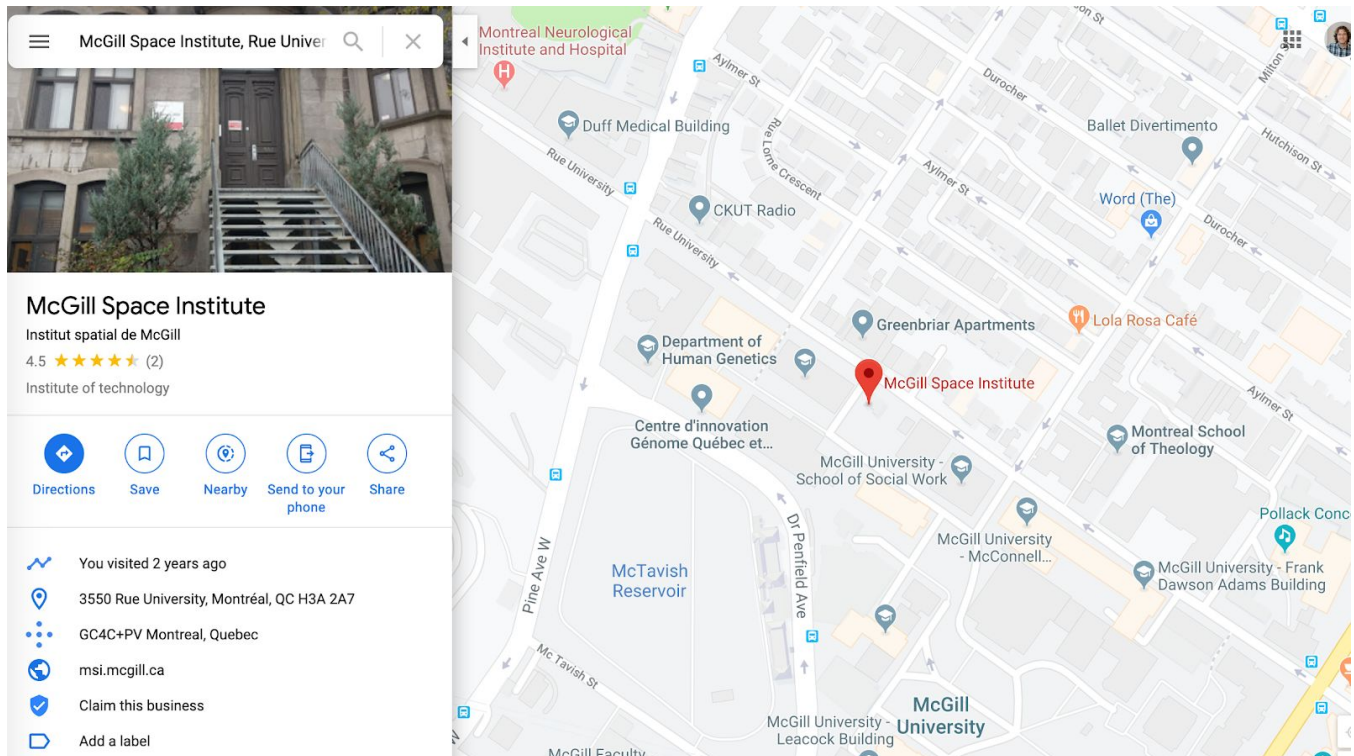


JCSA Meeting 2019 - CASCA McGill

Location:

McGill Space Institute Conference Room

Google Maps: <https://goo.gl/maps/3dfyq3hP6nvFeBEh7>



Remote Connection Info:

You have been invited to a BlueJeans virtual web meeting titled "JCSA CASCA Meeting" which will be held at 9:00am EST on June 17th.

All you will need to participate is a webcam-equipped computer with internet access. Simply download the app using the link below, and enter the Meeting ID when prompted.

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Meeting ID: 828134560

1. Download and open the Bluejeans app, or visit the URL below in your browser
2. When prompted, sign in as a guest. You will be asked to enter your name so others can identify you.
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Alternatively, you can join the meeting using:

- a modern web browser: <https://bluejeans.com/828134560/>

- a telephone: dial (888)240-2560 and enter the meeting ID when prompted, followed by the "hash" symbol.

- a room video conferencing system: dial 199.48.152.152 and enter the meeting ID when prompted.

WIFI Guest Account Request List:

1. Denis Laurin
2. Jean Dupuis
3. John Hutchings
4. Martin Bergeron
5. Luminita Ilinca Ignat
6. Chris Willott

JCSA Membership

Denis Laurin (CSA/Co-Chair), Jason Rowe (UBishop's/Co-Chair), Jean Dupuis (CSA), Daryl Haggard (McGill), Jeremy Heyl (UBC), Renée Hložek (UofT), John Hutchings (NRC), Locke Spencer (ULeth), Chris Willott (NRC)

CSA Presentation Slides:

<https://drive.google.com/open?id=1VGzcvfdOvs0MIs7G21D3RpmfIOXEmm2m>

Preliminary Schedule:

9:00	Welcome from JCSA and the CSA
9:05-9:30	Introduction from the CSA <ol style="list-style-type: none"> 1. Upcoming AO/RFPs 2. CSA roadmap 3. Lunar Gateway opportunities
9:30-10:00	JWST <ol style="list-style-type: none"> 1. JWST GO
10:00-10:15	LITEBIRD <ol style="list-style-type: none"> 1. LITEBIRD commitment
10:15-10:30	SPICA-SAFARI <ol style="list-style-type: none"> 1. CSA support
10:30-10:45	Euclid <ol style="list-style-type: none"> 1. Board member support
10:45-11:00	Break
11:00-11:10	ARIEL
11:10-11:20	CADC Update
11:20-11:30	WFIRST <ol style="list-style-type: none"> 1. Any participation? 2. After thoughts/ message
11:30-11:45	XRISM/Athena/Arcus
11:45-12:00	Hitomi -> XRISM <ol style="list-style-type: none"> 1. Addressing lack of process/communication
12:00-13:00	Lunch
13:00-13:15	CASTOR
13:15-13:30	Concepts: EPPE, Colibrì. Study: POEP.
13:30-13:50	Update: MOST, NEOSSat, BRITE, ACEND, ULTRASAT
13:50-14:00	
14:00-14:15	Break

14:15-15:00	Peer Review / Mission Prioritization
15:00-15:45	LRP Presentation/ Report
15:45-16:00	Other business
16:00-17:00	JCSA Business Meeting (closed)

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Community Feedback to the CSA

Question. What do you need from the CSA for your projects with the CSA to be successful. This could include current or future funding, long term strategy or a comprehensive list of opportunities. Your feedback will be discussed by the JCSA to make recommendations to the CSA that we hope to prioritize during discussion.

- We need regular, competitive AOs, including ones for tech development and student support.
- I think as a long term strategy, to achieve success, it's important for CSA to fund both science activities as well as calibration/software development/data analysis associated with such missions. And following launch, funding a GO program, as done in the US.
- A long while back, CSA had some fellowships or support for PDFs. It would be great if CSA would have some PDF support, e.g. in the form of CSA fellowships.
- For Canada to have a successful scientific space program it needs a steady funding plan and a long-term strategy so that it can offer a comprehensive and planned list of opportunities.
- Short and long term support for specific initiatives would be great. For example, we started a FAST high-contrast balloon experiment, did 1 flight, and then nothing, no way for us to secure any funding to move this tech to the next level. We needed 50k to change a few HW to get ready for a 2nd flight, and we never manage to find it. We did demonstrate the NUVU controller in that flight, so these are important, not just for our science, but also for Canadian companies. We are also now working on a new coronagraph, and a possible Canadian low voltage deformable mirror for space applications, but again currently no way forward to secure a 2nd flight for HiCIBaS. So pretty much our entire initiative is paused waiting for new funding from CSA (new FAST cycle) to start working on a GEN 2. CSA seems quite reactive instead of planning ahead. It feels like it is starting initiatives, but moving on to other things without finishing anything. In trying to be fair to everyone, no one can get enough support to complete anything.
- I think we need a global CSA vision and schedule to expand or have a process to move our Canadian tech from balloons, to small scale missions, to flag ship missions. It is crazy to think that we could start working on high tech HW in Canada for LUVUOIR or HABEX a decade after the US, and think we could contribute anything meaningful to these missions. The level of support and ongoing work for these missions in the US are

insane compared to what we can do here. We need to find a solution to this problem or CSA will soon become irrelevant in many fields of astronomy.

- What I would like from the CSA is small pots of money that *competitively awarded* via peer review. The funds would support travel to face-to-face meetings, and paying the occasional grad student or undergrad to do some prep work. This way we can stay involved in missions and hope to a) recognize hardware opportunities early and b) get involved in actual science when the data arrive. The peer review is important to set up a precedent for the money going to the best science. The current CSA funding streams are 90% bureaucracy, 10% science. As an outsider I do not have faith that the funding (such as it is) flows to the best scientific opportunities. If the CSA is ever to control larger pots of funding, it is important to build that credibility of making decisions based on science not just checking boxes.
- Funding commitments for operations that span the timescales necessary for reasonable strategic planning. The current 2-year commitment to BRITE ops is a nice example of that. The year-to-year struggle (that ultimately resulted in a shutdown of BRITE-Toronto) that we experienced prior to 2019 definitely was not.
- Support of personnel for mission support and science. In our case funding for full-time postdoctoral scientists is the key missing link (although student funding would also be appreciated).
- There are lots of intended missions, but few that are active. Perhaps we need a formalized call and down-select that could build on past concept and maturation studies. That could help the community rally and focus around a single mission.
- Rather than more concept studies, it would be good to see a more financially mature announcement of opportunity that would allow a bottom-up selection for Astronomy. The Lunar Gateway is great, but not necessarily what Astronomy has been seeking. CASTOR is one such a uniting project, but we need more in a pipeline.
- I think the community has been doing well under the circumstances to advise the CSA on priorities. This is not the issue. The issue is stable and reliable funding. Thus, I have a proposal: **The JCSA and the larger community (CASCA / ACURA, possibly via the LRP) should demand that the CSA create a program within the agency entitled Space Astronomy.** This program should be approved by the Treasury Board at the level of \$30M per year as a component of the space agency's yearly budget (ie. 10%).

A funded and official program element is the only way to ensure that the time and effort of the community in planning and prioritizing projects is not wasted. A few years ago the CSA Space Utilization Branch obtained Treasury Board approval for a microsat mission program and Phase A studies of multiple projects were initiated. Unfortunately the program budget did not support the program aspirations and so the program did not go forward. But the point is that it was an approved program and if it had fit within its

budget it could move ahead without the long arduous process of individual project approval at TB.

In the case of the proposed space astronomy program, I would suggest that many elements of the program already exist, concept studies, science maturation studies, technology development program, small payloads etc. but with an approved program in place this preparatory work could realistically include major mission opportunities. It is essential that such a program have a mix of projects of different sizes. I believe that the JCSA advisory/review role could be formalized to provide advice on the overall program, including the organization of peer reviews when needed to evaluate opportunities. For example the JCSA and CSA could decide in the next year or two to have a mission of opportunity competition between LiteBIRD and SPICA and set up a proper peer review process to make this happen. Under a space astronomy program real Phase A studies could occur with a downselect of one to move into implementation. Of course the timing could be complex but that is where the JCSA advice comes in.

A \$30M/yr budget might even allow the aspirations of groups like CASTOR and Colibri to be met. If the community via the LRP, is willing to commit the lion's share of this funding to a major project, then perhaps these missions could go forward as major Cdn contributions to an international mission.

Without a real and stable program, there is no point in organizing expensive and time consuming peer reviews. With the current state of affairs, the result would simply be that instead of just a stack of study reports archived at CSA, it would be a stack of study reports each with its own peer review sitting on the shelves at CSA.

Peer Review

Question: There are been pressure from the CSA that the Astronomy community needs to do a better job prioritizing missions and mission participation opportunities. This could be accomplished through a peer review. Do you support a CASCA/JCSA led review of Canadian Space Astronomy opportunities? This review would assess scientific impact/quality and access missions on near and long term timescales as well as overall budget needs. A prioritized list would make the community nimble to respond to any opportunities and would hopefully establish a process for future Canadian missions and projects and also make decisions within the CSA more transparent.

- I believe this is the mandate of the LRP, not the JCSA (?). JCSA should be tightly involved in the discussion with LRP. The community plan for mission needs is fueled from a community (all

astronomers) that is bigger than the space-only community. I view JCSA as an implementation, advice, and oversight team - not as a community planning vehicle.

- I fully support detailed, technically informed, peer review! However, this statement is very concerning, because the peer review would need significant resources and expertise, to provide reasonable advice. One continual challenge we have is that it is difficult for the CSA and for the community to evaluate missions in terms of both their science reach and the technical feasibility. It is routinely the case that very low TRL concepts are compared on a similar level with missions concepts that have years of technical development, with detailed TRL evaluations.
- <Do you support a CASCA/JCSA led review of Canadian Space Astronomy opportunities?>
Kind of - but only if it truly has the expertise and resources to do this properly. I suspect that this is NOT the case.
- <This review would assess scientific impact/quality and assess missions on near and long term timescales as well as overall budget needs.>
See above - the key element of technical feasibility, and whether we have the expertise in Canada to pull it off, is missing in your list --- and is far harder to evaluate, and essential for reasonable cost estimates and ultimate success. Let's be realistic when we go down this road, and enlist the CSA to provide a framework in which this can be done effectively.
- Yes I support this and anything that makes the process more transparent.
- It is somewhat ironic that the CSA would pressure the astro community to be better organized and do a better job at mission prioritization. Our community is excellent at this type of work (creating and prioritizing science and investments). It seems to me that the CSA is the highly dysfunctional body. The CSA puts out unexpected calls for proposals with absurdly short timelines and hidden criteria (e.g., strong restrictions buried in Appendices). There is no way for our community to develop strategies to work with the CSA if this continues to be the mode in which they solicit proposals. They also lack transparent, expert peer review and a clear-cut system for getting feedback to PIs. Instead the whole process is run like an "old boys" club, where projects are pre-determined and proposal calls are tailored to the missions that the CSA has already decided to prioritize. In theory a CASCA/JCSA-led review of Canadian Space Astronomy opportunities sounds like a good idea, but is it worth it if there is not (and perhaps never will be) funding to make these proposals viable? As a junior faculty member whose science relies heavily on space-based facilities, the lack of sensible funding and procedures is likely to become a serious impediment to my continued success and my long-term prospects as a scientist in Canada.
- I think that CASCA/JCSA should rank the proposed missions and participation with concrete estimates of the costs and scientific benefits in context of a series of AOs but if that isn't possible just to have a prioritized list. The process should be open and the results public as well.
- I am hugely supportive of CSA and Canada improving its mission prioritization and selection process, including regular calls for domestic missions. [This desire has been reiterated time and again by JCSA for about 15 years.] I will note, however, that regular calls and "down selects" make sense for projects at the same stage of development. Several projects developed by Canadians over the past decade, such as SPICA,

LiteBIRD and CASTOR, are at a much more advanced stage, and thus fit into a different category. I will remind JCSA that CASTOR is a rather different kind of project compared to any previously developed by Canada (i.e., a Canadian-led project of Explorer-class size) and its decade-long development represents an attempt to ensure that Canada, in the long term, can regularly mount decadal plans for space astronomy that involves a portfolio of projects with one "flagship" mission.

- I think this is mainly CSA's fault of not giving us any clear guidelines of what/how to proceed to do such prioritizing in the past, or even a budget to work with. Not sure how giving them a list would change anything from the current situation that CSA isn't doing much in astronomy. Would just be even more work from us to generate that list, while still having no guarantees that CSA will do anything with it. Without a budget, how can CASCA/JCSA do any sort of prioritization? Having \$50M/year, \$10M/year or \$1M/year is quite different and does impact how such prioritization is done. I do worry about how such review will be done by CASCA/JCSA, and how to ensure a broad unbiased representation of this committee that properly reflects the community's interest, since I am pretty sure that everyone on it has some ties to specific missions.
- In principle, this is the right thing to do, but in practice this makes no sense for SPICA. Remember SPICA won a competitive process with the CSA for Canadian participation in ESA Cosmic Vision missions. Yes this was back in 2008, but it was the *only* winning Canadian proposal. It is true that the project has faced many challenges, but Canada has stayed with it and now is poised to reap the maximum return on investment by being at the founders table. To now say that SPICA has to pass another competitive review makes no sense to me. It is one of three finalists in ESA's M5 call, it is supported by 4 space agencies (not including the CSA) and 14 countries (not including Canada) – rather strong endorsements I think most would say. Indeed Canada thought so when it was a much less ambitious mission. If Canada was now to pull the plug on SPICA on some rather arbitrary decision that we now put all missions through a reassessment at some random time, then I think no space faring nation would ever want to work with Canada again.
- IMO, the way to prioritize missions is through peer review. The JCSA can handpick the members of the panels (including from outside of Canada) to avoid conflicts, etc. I don't think it makes sense to prioritize missions way ahead of time, because things change (status of the mission, Canadian expertise, etc). And re-prioritizing missions every year seems like a lot of work. I think it makes more sense to set up a peer review to allocate funding when it actually becomes available. This is why I want the small pots of funding allocated via peer review: that way the CSA gets used to running review panels so that they're ready when funding occasionally is made available. Or it might be simpler to convene a panel every year. In lean years, they will allocate small pots of funding to keep Canadian scientists in the game, and in years of plenty, they can also allocate funds for hardware contributions. And if a miracle occurs, they can one day allocate funding for studying home-grown projects and actually select missions!

- CanBEST discussed this proposal and is in general in support of a peer-review structure. However, it is felt that such a structure must effectively avoid conflicts of interest. International reviewers would help with that, but this would also unintentionally “advertise” Canadian mission ideas. Concern was also expressed that such a structure might inherently disfavour smaller, purely Canadian missions that are not part of larger international collaborations. A mission like BRITE might have suffered from such a phenomenon early in the game. As a consequence, mission review categories (e.g. small/medium/large) would be necessary. It was pointed out that everything would look better - and the conflict-of-interest issues would be less divisive - if science at CSA were better funded.

JCSA Notes

- Peer review is a defined process
- JCSA should support peer review and take the lead
- How does this fit in with review of SMS/Concepts
 - Transparency of this process
- CSA review panels consist of CSA personnel (rare to have external)
- Need a much longer lead time for proposals (more pre-warning, heads-up)
- JCSA can provide recommendation priorities
- CSA can share 3-year plan for funding cycles
- Core problem is stable funding.
 - Emulation of NASA/ESA
 - Mission selection
 - Programs
- Renée will lead the charge
- Examples of past success - FAST -> it's predictable, peer review

JWST Status

Project status

- Launch date: 30 March 2021. Current schedule margin is 5.6 months of which 4 is held by NASA Headquarters.
- Cycle 1 GO call for proposals to be released 23 January 2020 with a deadline 1 May 2020.
- CSA has announced there will be GO funding, but details still to be ironed out and announced to the public. Important this in place before Cycle 1 Call released.
- The thermal vacuum test of the SCE (SpaceCraft element, sunshield included) has been successfully completed last week, moving on to post-environmental tests.

- Next step is the exciting phase of integrating the OTIS (Optical Telescope element / Integrated Science instrument module) and the SCE.
- Many science instrument commissioning 'rehearsals' have been and will be done. These rehearsals include detailed simulated commissioning activities.
- Still being debated but EROs (Early Release Observations) secured during commissioning will likely be released in block (all SI together) as opposed to a release in phase as data comes along.

NIRISS team activities

- Team in the process of revising our GTO plan due to STScI June 25th. Significant changes expected to the exoplanet programs, both transit/eclipse spectroscopy and AMI (aperture masking interferometry)
- Science team meeting to be held next fall, likely early December.
- UdeM/NRC team focussed on data pipeline work.
- We are initiating work for a plan to reach out to the community for the next GO call for proposals. We aim for **at least** 1000 hours of Canadian proposals, a 5x oversubscription of the Canadian time available in Cycle 1.
- Personnel change. Recall that one NIRISS scientist Julien Rameau (PDF) left the NIRISS team last November (2018) for a new PDF position in France. Julien was our local AMI expert. The position replacement was advertised but no satisfactory candidates identified. I decided to turn to local OMM personnel. Etienne Artigau (25%) and Neil Cook (50%) will both take over the AMI pipeline work, Etienne to focus on the algorithms and Neil on the actual pipeline code. FYI, Neil is the main architect of the SPIRou/NIRPS data pipeline and Etienne was once working on JWST.
- Nathalie Ouellette, our new JWST Canadian Scientist since last September, half time paid by CSA, has been extremely active. She has been doing a wide range of work: CSA astronomy website revision, proposed ideas for the CSA communication plan, give public talks and organize various outreach events with JWST contents. Since she joined our team last September, not a week passes without JWST being mentioned to the public/students/media. She is very active to work with her STScI/NASA EPO contacts and the latter are extremely pleased to have (at last) an active Canadian contact for JWST EPO. Nathalie is *extremely* well connected with the media. As an illustration, this recent article on JWST

<https://www.spacematters.ca/jwst/>

was triggered by a request from a journalist knowing Nathalie and contacting her, not us reaching out to the journalist. Media turned to Nathalie (not CSA!) to comment on the news on the Lunar Gateway. Clearly, Nathalie a great new asset to the science team.

Issues and concerns

- UdeM contract amendment. Recall that my support contract with CSA needs to be amended to be extended until the end of 2021 when commissioning is expected to end. The current contract (ends November 2020) was signed with a launch date scenario in the spring (May) of 2020.
- The original contract proposal was for a full time EPO position. It is now very obvious that Nathalie's position would need to be nearly full time (90%) starting approximately one year before launch. Unfortunately, CSA has now indicated that they do not have the financial resources to such an increase. At best CSA will extend my contract with the same level of support. Given the importance of JWST, I will likely have to sacrifice some of the iREx activities to allow Nathalie's to spend more time on JWST. Hopefully, our private donors will maintain their level of support beyond 2022 so that JWST EPO in Canada can be properly supported!
- There are obvious 'adjustments' to be made between CSA comms and the science team. The former are clearly not on the same work agenda as we are, read JWST EPO is clearly not a high priority right now at CSA; more on this verbally at JCSA. The spring NASA HQ distributed to SWGs via the NASA Commissioning Plan, a high-level document in which all partners identify their key point of contacts for communications and outreach. While the US included the obvious suspects: NASA HQ, Goddard, STScl and U of Arizona, it was very disappointing to see that CSA excluded the science team (UdeM) for revising this document. Only CSA is identified in this plan which is nothing but complete nonsense. Nathalie and I had a meeting at CSA June 3rd to discuss this broad issue. This discussion was constructive and CSA reassured us that the CSA communication plan will be inclusive of the science team.
- The Joint Project Implementation Plan (JPIP) for the Operations Phase between CSA and NASA has still not been agreed to, leaving uncertainty in how the JWST project will be supported by CSA. This has implications for many of our activities at UdeM, NRC, STScl. Partners regularly asking us about JPIP status. For comparison the similar agreement between ESA and NASA was signed in December 2018.

JCSA Meeting Notes

- extend UdeM contract to end of 2021 (short timeline for commissioning activities)
- EPO - community support, public outreach
 - asking CSA comms to support EPO JWST personnel
- JCSA recommendation to increase funding to JWST (at potential expense to SMS/concepts..)
- currently a flat budget (no inflation)
- UdeM working hard to reduce overheads
- funds set aside for 5-year mission (starts after commissioning)

- need JPIP signed..
- will happen 6 months prior to operations
- need verbal communication of activity
- GO call in Jan 2020, deadline May 1, 2020.
- need Canadian GO details well in advance. Committee forming ASAP.

JCSA Recommendations:

1. JWST-GO before deadline (need a schedule. policy should be in place before the release for the Cycle 1 GO call for proposals on Jan 23 2020.)
2. JWST UdeM funding
3. Allocate fraction grants/studies/contracts to EPO (10% ??)

AstroSat

Astrosat is now nearing the end of its 4th year in orbit, and generally operating well. The UVIT NUV remains off in spite of many efforts to restart it. Also one channel (of 3) of LAXPC is off. Observations continue and support proposals from India, International, and Canada. In addition there is a new class of Legacy proposals that release data as they are taken. Two Legacy proposals are under way, and currently 15 more are being reviewed for the next cycle, that starts in October. I have headed 3 of the Legacy proposals.

This year, a problem has developed with the timing data header from UVIT. It has a software fix, devised and tested by Joe Postma last month. There is poor communication with the ISRO ops and data team, that continues to hold this and related things up. We continue to work those issues. That includes the Astrosat SWG, which I belong to.

Canadian time has been well subscribed and work is under way on a number of programs, mostly involving local galaxies and clusters, but also including specific X-ray binaries. CSA science funding for this work continues.

Astrosat results have been presented at the annual ASI (equivalent of CASCA) meeting in February, and also a dedicated symposium was held at IIA in March.

[External]

ASTROSAT: I found out recently (as I was trying to put in a proposal for gravitational wave sources follow up) that it is not possible to do that. The first reason is technical (in that one can not propose for a ToO without known coordinates), but the other reason is that India apparently has an MOU with LIGO (despite the current open alerts era) and so apparently Canadians can not be PIs or propose for GW ToOs.. I expressed this concern directly with John Hutchings who immediately followed up with the Indian authorities. No news on that front but I should follow up.

JCSA Meeting Notes:

- Nearing end of 3rd orbit
- One detector has not turned back on
- New: legacy proposals - 2 Msec observing time
 - Oversubscribed by 8.5
 - 15 proposals
- Canadian time full subscribed
- UVit detector issue.. Needs a reset. (which will be done) this is to fix image artifacts
- There will be follow-up on GW proposal

JCSA Recommendations

1. None?

LITEBIRD

1. Can you provide an update on LITEBIRD. Feedback similar to the LRP is suffice.
[cut and pasted from a summary for LRPIC]

The LiteBIRD mission will map polarized fluctuations in the Cosmic Microwave Background (CMB) to search for the signature of gravitational waves from inflation, potentially opening a window on the universe a fraction of a second after the Big Bang. With three 5K cooled telescopes, it will measure in 15 frequency bands between 40 and 402 GHz with 0.1 K bolometers.

LiteBIRD is a JAXA-led mission that includes major planned contributions from NASA (the bolometer focal plane and cryogenic readout circuits), CNES/ESA (the mid- and high-frequency telescopes), and Canada (the detector readout system warm electronics). The project recently (May 21, 2019) was selected in Japan, and has transitioned to phase A1. Launch is planned for ~2027.

Canada plays a key role in LiteBIRD, with hardware, software, and data analysis contributions. The Canadian DfMux bolometer readout system, first demonstrated with CSA funding on the EBEX stratospheric balloon mission, is a key element of for the telescope.

One risk for the project is that the JAXA cost cap has not allowed for scenarios where a foreign contributor opts out. This means that a failure to move forward in the US, Europe, or Canada with the planned contributions will jeopardize the mission.

In Canada, LiteBIRD has been developed with STDP technology funding (\$750K, 2012), a Mission Contribution Study (~\$300k, 2018), and a Science Maturation Study (\$150k, 2019). A draft AO that would provide modest (~\$500K) technology development funding through STDP was published in 2019, and new Phase 0 funding is expected for 2019.

> Has the CSA been able to commit to LITEBIRD?, or how close is an impending deadline that requires action from the CSA.

No, not yet. They indicate that a phase A commitment to litebird is NOT possible in 2019, but could be possible in Q1 2020. This timeline is feasible, so long as Phase 0 does start in 2019. I am very worried a commitment could take longer than Q1 2020.

Worth reading:

<http://spaceq.ca/japan-approves-litebird-astronomy-telescope-as-canadas-mulls-contribution/>

JCSA Meeting Notes

- LiteBIRD selected in Japan
- Costcap includes contingency. Requires Canadian support. Could make or break the mission.
 - US decision end of this year
- Canada moving forward for a phase 0. Early 2020. Any delays would result in significant delays to the mission
- Readout system, balloon flights
- Good communication with CSA at present
- No potential short term. Planned STDP and phase 0
- Real problem will be actual mission funding. No funding line identified currently
- Funding proposal ~Sept, end of Sept. [need to ask government]
- Cost over mission lifetime has been estimated based on mission contribution study, includes science support
- MTR promotes LiteBIRD. If timeline slips, falls into LRP2020

JCSA Recommendations

1. JCSA pressure to make a timely decision on LITEBIRD.

SPICA

Developments:

Since the last JCSA meeting there have been two SPICA meetings: a consortium (from hereon to be called a “collaboration”) meeting held in Groningen (April 2-4), attended by myself, and a SPICA science meeting Exploring the Infrared Universe: The Promise of SPICA <http://www.spica2019.org/> held in Crete May 19-23 attended by Doug Johnstone, Els Peeters, Jan Cami and myself. The outstanding issues from the last JCSA report were:

1. To confirm funding to develop the technology required for the cryogenic Fourier transform spectrometer mechanism (now assigned the project acronym FTSM).
2. To find a solution to extend the UL cryogenic test facilities a necessary step to validate the FTSM.

To recap, the FTSM is the heart of the high resolution spectrometer of the SAFARI instrument which will find extensive use in both measurements of the high redshift Universe and the evolution of protoplanetary discs. It is a critical component, one that is essential to the scientific success of the mission, and one that will guarantee a significant return on investment to Canadian science, 2 to 3 times that of Herschel.

Following a series of discussions in late 2018/early 2019 between Gilles Leclerc, U Lethbridge VPR (Dr Erasmus Okine) and myself to explore ways to fund this work, I arranged a series of meetings between the key stakeholders. On May 9 members of the SRON team: Pieter Dieleman (PM), Willem Jellema (IS) and Denis van Loon (Eng) and myself visited ABB, who have been sole sourced to provide the FTSM, to review progress and discuss outstanding issues. Face-to-face meetings are essential in this type of work and the meeting proved to be extremely productive. On May 10, the above team joined by Peter Roelfsema (SPICA PI; SRON), Dr Okine (UL VPR) and Jacques Giroux (ABB) spent the whole day at CSA HQ. The key goals of the CSA meeting were to review the status of the project, the expectation of each other and the path ahead should ESA select SPICA from the 3 finalists in spring 2021.

https://www.esa.int/Our_Activities/Space_Science/ESA_selects_three_new_mission_concepts_for_study

Given the amount of work to be completed in the next two years the meeting focussed on establishing clear lines of communication between the Canadian (CSA, UL, ABB) and European SPICA Project teams to allow for the necessary rapid and accurate dissemination of material. The meeting was very productive and it was actually during the meeting that the tender for the sole source contract for the development of the FTSM was released by public works. ABB is currently preparing its response and it is essential that the contract can be awarded and work begin as soon as possible.

The biggest challenge I see is that all of the work to date is being funded through the CSA's STDP program and while this creative solution has allowed us to maintain Canada's leading role, as founding members, in this exciting mission and keep moving the project forward, we are heading to the final decision deadline. Some time in 2020 a letter from the CSA to ESA will be required stating in effect that if ESA selects SPICA, Canada will commit to the mission cradle-to-grave. It has been my experience over the last decade that establishing and maintaining a beachhead in SPICA takes a huge amount of effort and that the timescales for acquiring the necessary approvals are much longer than one might think. Thus it is imperative that we start preparing now for ESA's required letter of support.

Recommendations from JCSA:

Canadian scientists, with support from the CSA, have a long and illustrious history in infrared space astronomy. Starting with modest contributions to ISO and AKARI, increasing through Herschel and Planck, Canada is seen as a partner of choice and is now positioned to fully exploit the SPICA mission. SPICA affords a unique opportunity for Canadian astronomy.

Canadian participation in SPICA: a brief history

- June 2008: first SPICA contract awarded to U Lethbridge following competitive CSA call for potential Canadian contributions to ESA Cosmic Vision missions.
- Tasked with identifying a meaningful role for Canada in the SPICA mission. Initially conceived as similar scope to Herschel (~\$20 M).
- 2009: project funding issues resulted in SPICA lead moving from UK (RAL) to Netherlands (SRON).
- As a result SRON had to offload some of its previously assigned work packages. High resolution Fourier transform spectrometer (FTS) work package became available. Larger contribution with significantly greater ROI.
- Recognizing that this prestigious role was well matched to Canadian signature technology, academic strength and is mission critical, brought this opportunity to CSA's attention; tasked with exploring Canadian role.
- 2008 to May 2016. U Lethbridge received three successive SPICA study contracts to establish a role in the mission for Canada. The work focussed on exploring the optimum solution for the SAFARI high resolution spectrometer, which started as a Mach-Zehnder Fourier transform spectrometer. then briefly a Fabry Perot interferometer, before being consolidated as a polarizing Martin-Puplett Fourier transform spectrometer.
- SPICA FTS Mechanism Phase 0 (Industrial contract awarded to ABB ended June 2015).
- SPICA proposal submitted to ESA's M5 call 5 October 2016.
- 7 May 2018 ESA selected SPICA as one of 3 finalists for M5
https://www.esa.int/Our_Activities/Space_Science/ESA_selects_three_new_mission_concepts_for_study
- 2015 -STDP 9 (PT17) –Cryogenic Translation Mechanism for Future Far Infrared Astronomy Missions (ABB end date spring 2019).
- 2016 -SPICA FAST Grant (A07 UL) Cryogenic Fabry-Perot for SAFARI (end date 31 March 2019).
- May 2019 STDP to raise SAFARI cryogenic Fourier transform spectrometer mechanism (FTSM) TRL to level 5.
- Final M5 submission deadline spring 2021.

- SPICA is the most advanced of the 3 mission finalists under ESA's M5 call and with the \$300 M committed by JAXA enables an L-class mission for M-class funding.

Summary:

From 2008 to 2021, the CSA will have invested over \$4.3 M in the SPICA project to establish and preserve a major role for Canada in the SAFARI instrument. As a result of this investment Canada is positioned to build the mission critical, high resolution spectrometer of the leading infrared space observatory of the coming decades. Furthermore, as a founding member of the SAFARI consortium, Canada's return on investment will be at least twice that of the highly successful Herschel space observatory. Through Canada's previous investments in infrared space astronomy, starting with modest contributions to ISO and AKARI, increasing through Herschel and Planck, Canada is seen as a partner of choice and is now positioned to fully exploit the SPICA mission.

2. What do you need from the CSA for your projects with the CSA to be successful. This could include current or future funding, short term/long term commitment, long term strategy or a comprehensive list of opportunities. Your feedback will be discussed by the JCSA to make recommendations to the CSA that we hope to prioritize during discussion.

In two years ESA will decide on which of the three M5 finalists to fly. Prior to their decision a letter will be required from the CSA saying that they will commit to the mission. Two years flies by and we must start preparing now for success.

JCSA Meeting Notes:

- Working towards STDP with ABB. To have Canadian contribution at TRL-5 to support ESA downselect
- Potentially Fits in with LRP2020.. CSA expects LRP to weigh in on SPICA as a community priority
- LRP to place timelines

JCSA Recommendations

1. A decision on commitment to the SPICA mission.

ARIEL

Background

The Transiting Exoplanet Survey Satellite (TESS) is currently discovering extrasolar planets orbiting the nearest and brightest stars (Ricker et al. 2015). These planets will be perfect targets for atmospheric characterization with the James Webb Space Telescope (Beichman et

al. 2014). But there is a mismatch between the thousands of bright targets that TESS and other next-generation planet searches are discovering and the dozens of exoplanets that JWST will realistically characterize in its lifetime (Cowan et al. 2015). They noted that transit spectroscopy of planets with hydrogen-rich atmospheres, from hot Jupiters down to sub-Neptunes, could be accomplished more efficiently with a space mission entirely dedicated to exoplanets consisting of a modest ~1m telescope equipped with an infrared spectrograph. Following the legacy of ESA's M3 EChO and NASA's MIDEX FINESSE mission concepts, Atmospheric Remote-sensing Infrared Exoplanet Large-survey —ARIEL— was selected as the fourth medium-class mission (M4) in the European Space Agency's Cosmic Vision programme (capped at 500M euro). ARIEL will have a 1 meter primary mirror and will offer 0.5–7.8 micron simultaneous spectroscopy. It is scheduled for launch in 2028 and will be stationed at L2. The PI of ARIEL is Professor Giovanna Tinetti (University College London). During its 4-year mission, ARIEL will study what exoplanets are made of, how they formed and how they evolve, by surveying a diverse sample of a thousand extrasolar planets, simultaneously in visible and infrared wavelengths. It is the first mission dedicated to measuring the atmospheric composition —primarily via transit spectroscopy— and thermal structure —via eclipse and phase spectroscopy— of hundreds of transiting exoplanets, enabling planetary science far beyond the boundaries of the Solar System.

ARIEL & Canada

The ARIEL consortium currently includes three Canadian professors. Diana Valencia (University of Toronto) and René Doyon (Université de Montréal) have been involved in ARIEL since before the mission was approved. Nicolas Cowan (McGill University) joined the ARIEL consortium shortly after the mission was approved by ESA in March 2018 via the NASA-led Contribution to ARIEL Spectroscopy of Exoplanets (CASE), led by Dr. Mark Swain (JPL). CASE was conditionally selected as a Partner Mission of Opportunity in August 2017—if ARIEL was selected by ESA, then NASA would contribute 2 guider detectors, readout electronics, and a US science data center for handling science processing of photometric guide channels. The status of CASE remains in limbo, but a few members of the CASE science team, including Cowan, have joined the ARIEL consortium, attended face-to-face meetings, and begun participating in science working groups.

Giovanna Tinetti recently approached Cowan about inviting the Canadian Space Agency to join the ARIEL consortium. In particular, the CSA could make a hardware contribution in exchange for greater scientific participation, for example, adding more Canadian scientists to the consortium, and earning a seat at the Co-PIs closed-door meetings. Cowan has since had telecons with Tinetti, the ARIEL Consortium Project Manager, Paul Eccleston, as well as René Doyon, Denis Laurin and Jean Dupuis (CSA), and members of the Canadian aerospace industry to hash out some specifics.

There are two hardware contributions that the ARIEL consortium is interested in outsourcing and which Canadian industrial partners are well positioned to contribute, namely the cryo-harness (IMP Group in Halifax, NS) and V-groove radiators (e.g., Honeywell Aerospace). The cost of either of these work packages is modest, on the order of a couple million euro. The Canadian industrial expertise to contribute these components was developed and proven in building the Near Infrared Imager and Slitless Spectrograph (NIRISS) for the James Webb Space Telescope. In fact, it is precisely the CSA's proven track-record with JWST-NIRISS that led the ARIEL consortium to seek Canadian participation in the mission.

The ARIEL consortium's interest in Canada's experience with JWST-NIRISS extends beyond hardware. At 200 hours, the NIRISS Exploration of the Atmospheric diversity of Transiting exoplanets (NEAT) survey is the largest guaranteed time observation (GTO) exoplanet proposal on JWST—the PI of NEAT is Prof David Lafrenière (UdeM). The Canadian exoplanet community has thus positioned itself at the forefront of comparative planetology with infrared spectroscopy, precisely the science case of ARIEL. The primary difference is that JWST will obtain exquisite observations for dozens of planets, ARIEL will provide uniform observations of hundreds of exoplanets. The ARIEL consortium is therefore keen to have the input of NIRISS exoplanet researchers when they fine-tune the design of their experiment.

Benefits to Canadians

The Canadian aerospace industry developed a lot of expertise in space-based infrared instrumentation with JWST. Contributing hardware to ARIEL will allow Canada to flex these muscles and will give our aerospace industry increased visibility across the pond.

Canadian scientists have much to gain from involvement in ARIEL. The mission is obviously of great interest to those of us who discover exoplanets and characterize their atmospheres. In addition to Cowan and Doyon (already part of the ARIEL consortium), this includes Björn Benneke and David Lafrenière (UdeM), Kristen Menou (UofT), Stanimir Metchev (Western University), Christian Marois (NRC Herzberg), and Jason Rowe (Bishop's University). Moreover, many Canadian atmospheric scientists who specialize in Earth and Solar System worlds will stand to benefit from ARIEL—including Colin Goldblatt (UVic), Timothy Merlis (McGill), John Moores (York), Richard Peltier (UofT), and Kimberley Strong (UofT)—a uniform survey of 1000 planetary atmospheres will undoubtedly uncover atmospheric phenomena and trends with implications closer to home.

Lastly, a uniform survey of atmospheric abundances for a thousand exoplanets will provide strong constraints on planet formation, interiors, and evolution—a longstanding strong suite in Canada. ARIEL will therefore be of interest to Aaron Boley and Brett Gladman (UBC), Andrew Cumming and Eve Lee (McGill), Brenda Matthews (Herzberg Astrophysics), Diana Valencia (UT Scarborough), and Yanqin Wu (UofT).

The ARIEL Opportunity

In short, the timing of this opportunity is excellent: Canada has built up a critical mass of exoplanet expertise and is now playing a leadership role in this research worldwide. ARIEL is already approved but with a launch date nearly a decade away there is still time to make important hardware contributions. The cost to the CSA of a hardware contribution to ARIEL is modest, with a disproportionate return on investment for Canada because of our well matched technical and scientific expertise.

JCSA Meeting Notes:

- ESA moving to 'red-book' (yellow book is for Science)
- Fall 2020 review to move to construction
- Canada could support hardware (cyro harness, radiators)
- 2028/29 launch date
- Not very urgent
- Will proceed through LRP process
- Could be a 1-2M contribution
- Large canadian interest (21 members)
 - Need to know what the science return is
- ARIEL is a survey mission
- Having Canada part of designing science experiment
- What is the ARIEL data policy?
 - TBD
- ARIEL looking for non-ESA partners
- Also need science support
-

JCSA Recommendations

1. New mission opportunity. Should be monitored by the CSA. Community will give guidance on priority and expected return.

XRISM/Athena/Arcus

XRISM

The XRISM mission is set for launch in early 2022 (FY-2021) and includes two Canadian scientists. One is named to the SWG and the second to the instrument team. The Canadian contribution is the calibration/characterization of the Resolve filters that is taking place at the Canadian Light Source (CLS). There were closures of the CLS for unexpected repairs, but the work does remain on schedule.

The CSA has extended our grants until 2022, which will see us until launch. We thank the agency for their effort in seeing us covered for pre-launch activities. Plans to support post-launch activities should be discussed soon.

Athena

The ESA-led Athena mission is the next flagship X-ray mission set to launch in 2031. Over the past decade there has been significant push from Canadian astronomers to participate in Athena. There have been opportunities to contribute to the warm electronics on the X-IFU (calorimeter) as well as opportunities to contribute spacecraft components to ESA (e.g. metrology, heaters, star-trackers....). To date, there has been no significant progress on this front.

We continue to encourage the CSA to initiate a dialogue with ESA on possible ways to contribute.

[External]

Athena: This was a high priority (in the previous LRP/MTR) X-ray mission for CDN involvement. However, the process, timing and the actual procedure for any Canadian involvement seems unclear to me. Did we miss the boat?

Arcus

This is mainly an informational note about the Arcus mission as it has not been mentioned at the JCSA. The mission does appear in the 2017 CSA Topical Team Report. I am happy to present the project to the JCSA in more detail at some point (perhaps the Fall meeting).

Arcus is a high spectral resolution mission that was proposed to the 2018 MIDEX. The mission includes a large collecting area and grating technology to focus low-energy X-rays ($E < 2\text{keV}$), which will be superior to Athena, but complement Athena's superior high-energy spectral resolution. Arcus was not selected for MIDEX despite having no notable weaknesses and receiving exceptionally high grades. It will be a strong candidate when proposed next year.

The long focal plane (14 metres) and need to achieve excellent alignment brings the need for a metrology system like the one built for Hitomi. Such a contribution from Canada would create seats on the Arcus SWG. Other possible contributions are welcomed. Some commitment from the CSA during the MIDEX proposal phase can go a long way in strengthening the mission's prospects.

JCSA Meeting Notes:

- All seems well with XRISM
-

JCSA Recommendations

1. XRISM: none?
2. Request status of potential Canadian participation in Athena. This was a high priority from the previous MTR
3. JCSA will track status of Arcus and potential for participation.

Hitomi -> XRISM

Question: Has there been process/resolution on how funding/team membership was handled for XRISM. Are there recommendations you have for the CSA/JCSA to improve transparency and fairness moving forward?

My answer is no/I have no idea. As you know, I am not on XRISM (at the moment) and I strongly feel that the process for the XRISM membership lacked both transparency and fairness. I did communicate my concerns with you as JCSA chair, as well as directly with CSA.

JCSA Meeting Notes:

- Open dialog regarding concerns and what happened
- XRISM was open to one member
- Added one more member through hardware
- At some point team member was dropped from the conversation
- XRISM did not go through an AO
- JCSA reports are co-signed by all necessary parties
-

JCSA Recommendations

1. An open and defined process is required for all CSA funding opportunities to ensure fairness and transparency for all parties.

WFIRST

[See ACEND notes]

- Nothing to report on the Canadian Side.
- There is still some hope for Canadian participation from JPL
- There was some discussion that Canada would participate through the purchase of detectors, but it seems that JPL will purchase the detectors themselves. This is terrible for the Canadian Astronomy Community.
- CSA invested significant funds to raise TRL level for NUVU detectors and Canadian led studies. No return to community for this investment

JCSA Meeting Notes

- If CSA to contribute detectors (ROM \$10M) could buy one seat - coronagraph side
 - Maybe more than one seat
- NUVU proceeding independent on CSA to sell detectors to JPL
- Even one person on WFIRST science team would be very valuable
 - Connection to HabEx and LUVOIR
 - A push in the right direction
 - Return on decade of investment from CSA
- Jean Dupuis will work with Mike Hudson and Christain Marois to outline incremental science increase from CSA support
- JPL asked NUVU to bid, NUVU asked for CSA advice
- What would be sacrificed if WFIRST
- What is the value of the CSA investment
 - Need convincing science..
 - Case already made in last LRP
 - What to know how many seats..
 - What is the incremental increase
- NUVU will get contract regardless.. Now need to make scientists happy
- Already CSA investment of \$5M
- Why provide \$10M to circumvent purchase to support science
 - Smaller share?
 - Seat is valuable only if postdoc support
 - Seats allow for science participation in discovery

- Need CSA postdoc support
- NASA only cares about how much money it saves them (previous investment is not important)
- EMCCD may not be enough for GO time allocation (already open.. But investment to get min)
 - Science seats more important
- CSA needs cost for hardware and cost for science support
- Business case for having science case
- Also visible aspect (may not be great) - overall issue for CSA visibility
-

JCSA Recommendations

1. There needs to be some sort of Canadian contribution for science return

Euclid

On schedule for 2022. Canadian participation is due to CFHT contribution. This has led to 25 Canadians benefiting from science return.

CSA has provided some science funding to two Euclid team members. Support for Canadian lead (Hudson) to attend Euclid board meetings would be appreciated.

Formally CSA has no role.

JCSA Meeting Notes:

- Currently two grants for Euclid
- Request for non-staff travel to board meetings
- Action with CSA to followup on potential \$16K support for 3 trips (europe)

JCSA Recommendations:

1. CSA should investigate potential avenues that could provide support for Euclid board members to attend board meetings.

ULTRASAT/DUET

The main components of the project are: spacecraft (flight system), telescope, focal plane array (FPA="camera"), launch.

1. The ISA & the WIS are committed to funding the construction (bus + telescope) based on the IAI (Israel Aerospace Industry) and Elbit/Elop proposals (approx. 1/3 by WIS).
2. FPA. Caltech/JPL were not able to raise the funding required to provide this contribution. The project has therefore found an alternative, in agreement and in coordination with Caltech - the German DESY Helmholtz center.
 - a. The Particle Astrophysics & Photon Science divisions of DESY (Berlin & Hamburg) are interested in providing the FPA.
 - b. Advanced negotiations towards completing an agreement are in progress - DESY directorate approval expected by end May, final agreement signed June/July.
3. ESA – science directorate (Hasinger) expressed interest in joining. We are in advanced negotiations on a contribution from ESA, of either launch or mission (spacecraft & telescope) components at a similar cost level (~€12M). The goal is to prepare a contribution package for approval at the next SPC meeting at Nov 2019.
4. The current plan is to start the project after signing with DESY, i.e. ~July, independent of the completion of the process with ESA.
5. Potential Canadian Contributions: Something similar to the ESA package is possible and welcome. This will, of course, be accompanied by a scientific collaboration (membership in the science working groups etc.). A Canadian contribution that would facilitate a launch with LORAL (a Canadian company with which there was a launch contract for ULTRASAT in a previous cycle) would be fantastic - the launch cost is about \$10-12M, but the Canadian buy-in for ULTRASAT can be just part of that... having a Canadian institute negotiate the contract with LORAL would might make things simpler. [LORAL seems to be a part of MDA/Maxar as of 2012, but this status may have changed.] McGill and WSI are seeking private donor contributions, but nothing solid has emerged and CSA participation/funding would be highly desirable.
5. Launch support is the project's preferred channel for support, but these are some potential hardware contributions Canada could make to ULTRASAT if we contribute to the mission:
 1. Communications subsystem (5 Mbits/sec Telemetry downlink) including the onboard antennas, gimbals, radios and a compatible ground station provision.
 2. Spacecraft Attitude control subsystem: Reaction wheels and star trackers.
 3. Propulsion: cold gas propulsion subsystem.
 4. Electrical power subsystem including solar arrays, battery, battery charging and power distribution.

*

* CSA support: To make any of these collaborative agreements possible, the CSA must be a credible partner to NASA/ESA, etc. This means that we need stable, peer reviewed funding for science and instrument development. A stable commitment of funds for space missions on a variety of scales and a clear peer review process are absolutely necessary for our community to maintain a competitive and reasonable partner and for us to sustain a trained Canadian workforce that can support space missions and space science. Funding AND a long term

strategy are crucial. During my attendance at the recent conference "The Space Astrophysics Landscape in the 2020's and Beyond" (<https://www.hou.usra.edu/meetings/landscape2019/>), it was clear that interest is high in the US/NASA community for collaboration with Canada and Canadian scientists, but that most parties do not see us as a viable partner. E.g., all parties were excited about CASTOR, but highly skeptical that the CSA/Canada will support a real mission. We need to make this happen!!

Other missions: I may join a SMEX proposal as a Co-I for another UV mission called DUET. This is being proposed as a SMEX in the current NASA call, led by CalTech/Fiona Harrison. Not sure this should be included because CSA participation is not being solicited at this point. (I have a call with Fiona this week and will let you know if that changes anything.)

JCSA Meeting Notes:

JCSA Recommendations

1. Continue to monitor ULTRASat and opportunities for Canadian participation.

Colibrì

1. Can you provide an update on your concept study for Colibrì? (Did I get the accent right?)

It is Colibrì as you have written it.

We have completed our midterm review and have decided on a seven-telescope concept to minimize the cooling requirements and three mirror concepts: single-mirror collector 5.3-m focal length and double-mirror collectors with 3.1-m and 5.3-m focal lengths. The last concept yields an effective area similar to ATHENA and RXTE at the Iron K-alpha line and better performance at 10~keV than ATHENA. We can achieve energy resolution of 1.5-3 eV from 0.2 to 20 keV.

JCSA Meeting Notes

- Moving to SMS, STDP as Concept nears completion
-

JCSA Recommendations

1.

CADC

See PDF: <https://drive.google.com/file/d/1xV8qBhIN-2IAB4n7q2CNEvOlluyvNMQJ/view?usp=sharing>

JCSA Meeting Notes:

- CADC needs JPIP signed, in discussion with CSA. potential exclusion from end-to-end testing
- Received incremental funding increasing, MOU in place
- Good for 3 years
- CSA and CADC are happy

JCSA Recommendations:

1.

CASTOR

- **CASTOR Update:**

The CASTOR mission recently underwent a CSA "Science Maturation Study" (SMS) that began in January 2018 and concluded in March 2019. This was an extensive and, I believe, very successful effort. We have significantly improved the mission technical design, updated and diversified the science case, and laid the groundwork for several potential partnerships in the CASTOR mission. Deliverables to CSA included a 180-page Science Report; an equally extensive Technical Report submitted by Honeywell, ABB and Magellan; improved estimates for cost and schedule; and many EPO-related products such as a mission animation, a website, a new project logo selected from an national competition, as well as numerous presentations given to the community, the public and international audiences. A total of 99 scientists (72 from Canada) contributed to the science case; I'm sure CSA would be happy to make this report available to the JCSA. There is significant interest in the mission from international partners, as explained below. While this is, of course, a welcome development and a testament to CASTOR's appeal, it does put pressure on the CSA and Canada to maintain the momentum in its flagship mission concept.

1. **What is Needed:**

There is interest in CASTOR from several prospective partners: i.e., JPL/Caltech; India/ISRO; and the UK. We consider it imperative that CASTOR be developed in partnership with international collaborators, for many reasons, and we are in the fortunate position that excellent partners can contribute critical parts of the mission. For example, the JPL/Caltech group are leaders in UV detector technologies and are hoping to apply in 2021 for a NASA Mission of Opportunity contract to supply CASTOR's focal plane (including detectors and electronics). Such a contribution could amount to a \$40-\$70M USD contribution to the mission. Likewise, India could build on our Astrosat partnership by contributing a CASTOR launch, bus or telescope structure, as well as ground stations and support. These are very significant contributions that Canada may lose if it allows the mission development to stall after the SMS.

At the moment, two partnerships are at immediate risk. First, for JPL/Caltech to partner with CSA in the 2021 MoO call, JPL will need Canada to show it is serious about this mission by September 2020. At this point, this entails proceeding with detector testing and characterization, which are TRL risk areas. NRC-Herzberg has developed a plan for these tests --- which would involve SRI, JPL, NRC-Herzberg, TRIUMF and the University of Calgary --- but this requires approximately \$100K for procuring, doping, coating and testing of detectors. Similarly, development work on DMD devices is also needed, and this requires approximately \$15K in funding for hardware. Finally, travel money for CASTOR science team members is needed to work with our Indian, UK and American colleagues on partnership options. For example, the Indians have invited members of the CASTOR team to a meeting in Bangalore in September 2019. At present, there are no funds to support this travel.

We estimate that roughly \$145K is needed to support these critical activities for the next year, when we hope a Phase 0 or A study will begin. [Note that we strongly believe that CASTOR is ready to move directly to Phase A.] NRC-Herzberg will be able to contribute *some* of this funding, as well as substantial in-kind scientific and technical support, but we urgently require support from CSA to maintain momentum, or risk losing partners.

Input on Other Missions:

I will largely refrain from commenting on other missions (although CASTOR's relationship to many other space- and ground-based facilities is discussed extensively in the Science Report and may be of interest to the JCSA). I will note that the CASTOR SMS was carried out in collaboration with key members of the Euclid, WFIRST and LSST projects, which highlights the timely nature of CASTOR and its continued appeal to the international community. CASTOR has been thoroughly developed by the Canadian community and, after nine years of effort, it now stands as the lone remaining option identified in LRP2020 as top priorities in space astronomy. On both scientific and technical grounds, CASTOR could be an important

pathfinder for possible future missions of interest to Canada (in the 2030s), such as HabEx and LUVOIR.

1. CASTOR should proceed directly to Phase A. Let's all be clear about that. Phase 0 would be redundant and waste more time and money. I think you know that.
2. What CASTOR needs was the subject of a call with CSA today. Mostly raising TRL for detectors and DMDs (for JPL and India respectively). We have to move on partnerships so we can be clear about what we present to govt for funding.
3. Possible missions cover a lot of range. We cannot go back to square 1 for all. CASTOR, SPICA and LiteBIRD have all had extensive study and also have deadlines for partnerships. That makes them stand out in your long list.
4. Similarly, peer review makes sense only for things at the same stage. It is too late to do that for the above 3, and they are already supported by the LRP. Let's not get stuck in ridiculous or confusing exercises that are inappropriate and too late.
5. There needs to be clarification among LRP, JCSA and 'peer review' as to what the priorities are. CSA alternate between saying how well organised we are and how we can't set priorities. It is mostly procrastination bullshit.

JCSA Meeting Notes:

- Technical redesign of the mission
- 100 scientists participation in CASTOR (¾ Canadian)
- Strong interest from international teams JPL/CalTech/India/UK
- SMS study concluded that CASTOR is ready to transition to Phase A
- NRC small teams funding - ABB/Magellan/Honeywell do not qualify
- India working on independent INSITE - wanting Canadian contribution
- CASTOR needs travel support, detectors for testing
 - Sept meeting to collaborate with India. No funding for support
 - Total cost ~140K
 - NRC can provide some support for purchase of detectors
- JPL needs to know about CSA intentions by 2020
 - NASA will need to see progress on detectors and TRL
- India mission will not proceed without Canadian support
- CASTOR is a flagship.. Would be a first for Canada
 - Well beyond A-base of the CSA
 - Needs to be an overall Canadian priority
 - Technical development needs to happen, was rejected internally

- Request above 75K requires additional authority within CSA
- RCM as an example.. Involved 14 departments
 - Need lots of ministers onboard
 - Industry and jobs
 - CSA needs external pressure
 - (NRC is inside ISED)
- Longterm : Astronomy community (not just space astronomy) that CASTOR is top priority
 - Need other departments to support CASTOR
 - Industry, academia
- CASTOR is not a priority at this time (145K.. hard).. Below 75K much easier
- JPL wrote to ISED (Minister) that JPL was interested in CASTOR with sig. Canadian investment
- Pending deadline for continued JPL support - potentially critical for detector development
- If missions have co-funding (e.g., CFI) they quickly become priorities
- Need NSERC back at the table for co-funding discussions

JCSA Recommendations

1. There needs to be opportunities for flagship Canadian led mission to mature into

MOST

The Microvariability and Oscillations of Stars telescope (MOST) was lost in March, 2019 due to an apparent failure of a power subsystem. MOST had operated commercially since October 2014 after recommendations from the JCSA to prioritize funding to other space assets/opportunities.

Checkout: <https://physics.ubishops.ca/exoplanets/MOST.html>

BRITE

Although I have received no official notification, it is my understanding that CSA has committed to fund BRITE-Toronto operations until January 2021. That was scheduled for approval to CSA's Investment Board Review in February. I've sent a message to Rob Zee to ask if he heard anything further.

CSA is not currently funding BRITE science personnel.

CSA has encouraged us to archive raw and science-ready data at CADC. Our views on this are aligned, but lack of funding for science personnel means that it is happening very slowly. This would be a superb task for a full-time postdoctoral scientist.

Some members of the CanBEST were also members of the MOST team. Those members expressed that the decision to de-fund MOST operations while the mission was fully operational was neither consultative nor scientifically well-founded. While this cannot be rectified, appropriate policies should be put in place to allow for objective and transparent decisions to be made about mission lifetimes and termination. This is relevant to BRITE: in the past we have been informed that continuation of operations support was contingent on a successful internal CSA review process. But the details of that process and the merit criteria were never made available to the team.

JCSA Meeting Notes

JCSA recommendations

1. The CSA should continue to review the scientific output from the BRITE mission on an annual basis.

NEOSSat

The CSA NEOSSat mission is jointly operated by the CSA and DRDC and is currently being used to obtain observations of solar system objects and transiting exoplanets. These observations are used for both scientific purposes and to characterize the photometric capabilities to enable open observing time to the Canadian community. An AO is expected this year.

JCSA Meeting Notes:

JCSA Recommendations

1. ...

Studies/Concepts

JCSA Meeting Notes:

- Capacity to support STDP, studies
- Needs to a down select from all the studies
- larger/ small initiatives
- Starting newer studies, dropping ones that will not materialize

- Have a peer review based on international experts
 - Provide a ranked project list
- Request from CSA documentation regarding strategy with current studies/concepts
- For prioritization, budget and timescales are needed
-

POEP

The CSA has funded a Science Maturation Study for Photometric Observations of Extrasolar Planets (POEP) to use the BRITE and MOST mission concepts to raise the Science Readiness Level for a UV/IR mission. The Science is the discovery and characterization of extrasolar planets through photometry with a UV and IR channel. The near-IR capabilities will enable the discovery of transiting Earth-sized planets in the HZ of brown-dwarfs and the UV capabilities will characterize the atmosphere of transiting planets around bright host stars and potentially act as a biomarker detector. The CSA is providing guidance to help drive necessary technology development in anticipation of targeting 2022 Federal Innovation Funds (CFI) to build satellite

ACEND

There is Canadian interest for participation in the ACEND (Alpha CENTauri Direct imager) project. ACEND is a 40-cm coronagraphic space telescope concept that will directly image the planetary systems of Alpha Centauri (A and B) in 3 visible bands, with the capability of recognizing Earth-like planets (exo-Earths) and assessing their potential for habitability.

1. Can you provide an update on ACEND? Has the CSA provided any opportunities for Canadian participation in ACEND.

No, never heard back from CSA. ACEND wasn't selected to move forward in the US.

- Still very annoyed that CSA spent YEARS supporting the NUVU folks for their space-ready EMCCD controller, but it drop the ball at the last minute. NASA is likely going ahead and purchasing that camera for the WFIRST coronagraph, while we are not getting ANYTHING out of it vs science team participation. If CSA wants to join high-profile missions such as LUVOIR and HABEX, and be part of the search for life by direct imaging, the only real technique that can detect, in reflected light, and characterize Earth-size planets around Sun-like stars, no matter if they transit or not, we need a dedicated initiative to start on our tech R&D NOW to be ready to contribute when it is actually time to discuss international partnerships. If we wait at the last minute, we'll end-up again doing star trackers, IFS or pipeline, or just not joining

because too late/not enough funding etc. These high tech space HW takes years of development, so we need to start now to make it happen. The ACEND was a nice low cost initiative that it would have been great to get involved with a small investment, allowing our team to increase the TRL of our HW and showcase our capabilities for future larger missions. I think we need a global CSA vision and schedule to explain or have a process to move our Canadian tech from balloons, to small scale missions, to flag ship missions. It is crazy to think that we could start working on high tech HW in Canada for LUVOIR or HABEX a decade after the US and think we could contribute anything meaningful to these missions. The level of support and ongoing work for these missions in the US are insane compare to what we can do here. We need to find a solution to this problem or CSA will soon become irrelevant in many fields of astronomy.

JCSA Meeting Notes

- Timescales for small pots of funding are not working well to keep community nimble to react to opportunities
- Need long term strategy
- Can lunar program help
-

JCSA Recommendations

1. ...

Other Business

1. COSPAR
2. NSERC Representation
3. JCSA Membership (closed session)
4. ACURA
 - a. Another interface to government / space astronomy promotion
5. Potential questions for the CSA funding questionnaire:
 - a. Have you submitted a grant to the CSA (how many? How many successful? Co-I vs P-I status?)
 - b. Do you intend to submit to the next call?
 - c. Do you understand the procedure?
 - d. Do you understand the difference between SMS/STDP/FAST etc.?
 - e. Would you attend a virtual session on applying to the CSA?
 - f. Would you find a template useful?

- g. Do you know how to submit a grant? Do you understand the challenges (e.g research office)
- h. Check with CASCA about diversity numbers (what can we ask?)
- i. Check with CSA about diversity targets re: institution, gender, etc - and think of questions to ask that will inform those goals too