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Executive Summary of White Paper (5000 character limit)

Currently, postdoctoral fellow (PDF) researchers in Canada face challenges due to the precarious nature of their employment and their overall low compensation and benefits covreage. This report presents three themes, presented as statements of need, to support an inclusive and thriving PDF community. These themes are the need for better terms of employment and conditions, the need for access to grants by non-permanent research staff, and the need for a sustainable PDF hiring model that considers the outcomes for the PDFs. We make six recommendations, which are:

- R1. PDFs should be hired and compensated as skilled experts in their areas, not as trainees.
- R2. Standard PDF hiring practices should be revised to be more inclusive of different life circumstances.
 - R2.1 Allow PDFs the option of part-time employment.
 - R2.2 Remove years-since-PhD time limits from PDF jobs.
 - R2.3 Financially support PDF hires for relocation and visa expenses.
- R3. CASCA should form a committee to advocate for and provide support to astronomy PDFs in Canada.
- R4. CASCA should encourage universities to create offices dedicated to their PDFs.
- R5. PDFs and other PhD-holding term researchers with a host institution should be able to compete for and win grants to self-fund their own research.
- R6. Astronomy in Canada should hire general-purpose continuing support scientist positions instead of term PDFs to fill project or mission-specific requirements.

Our main recommendations revolve around our community compensating PDFs as skilled experts instead of trainees (R1) and ensuring that PDF hiring practices are inclusive of the wide diversity of astronomers (R2). These two recommendations are part of the solution to all three issues. We also note that while a successful implementation of these recommendations would involve systemic changes to PDF employment in Canada, these recommendations are very much actionable at the level of an individual or committee responsible for PDF hiring decisions.

We also make two recommendations for CASCA, where we ask for a CASCA Postdoc Advocacy Committee (R3) and for CASCA to encourage universities to create offices dedicated to supporting PDFs at these institutions (R4). These leverage the wide network of our discipline's national society to pool resources and influence.

Finally, we make two recommendations intended to overhaul the employment of PDFs and early career researchers in Canadian Astronomy. R5 asks for a major change in policies of funding agencies such as NSERC, which fund many disciplines outside of astronomy to allow researchers on term appointments to compete alongside tenure-track faculty for grant dollars. R6 asks all astronomy institutions in Canada to end the practice of fulfilling their operational needs with serial term position hires instead of continuing positions. Whether these operational needs are to build a diverse research portfolio or to fulfill requirements for specific missions or projects, we advocate for hiring general-purpose astronomers that can modify their assigned work instead of hiring another term PDF without consideration of the outcomes for the outgoing PDF. These last two recommendations are ambitious for LRP2020 but we believe these ideas are important to consider as employment conditions evolve.

Reviewing these recommendations, we highlight that recommendations R2.1, R3, and R4 come with no real costs and can be implemented immediately. R2.2 requires coordination with R1 and R6. We recognize that in a flat-funding scenario for Canadian astronomy research, there will be challenges for recommendations R1, R2.3, R5, and R6. However, we strongly believe this is the required path in order to sustain a successful, inclusive and ethical astronomy research program in the long term. With limited resources, we argue for a reduction in the number of PDFs in order to ensure each PDF can thrive. Although this may decrease the amount of science supported in Canada, we advocate for a solution that involves justifying additional funds instead of a solution that asks PDFs to accept precarious employment with little support. The latter (current) scenario creates a selection bias on the researchers themselves, which compromises the diversity of thought required for a successful national astronomy research program. In short, we ask for prioritization of people over production of papers.

We provide online supplementary material to this report at <http://rebrand.ly/lrp2020pdf>, where the reader can find additional data, a list of signatures of Canadian astronomy community members in support of this report and the ability to add their own signature.

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Opportunities and Outcomes for Postdocs in Canada

Introduction

The postdoctoral fellow (PDF) career stage is, by design, transient and insecure. The short term nature of PDF employment means PDFs spend much of their time in their current position applying for their next one. The scarcity of continuing/permanent research positions, along with the precarious employment status and not knowing where the next position may be located contribute to a lot of stress for PDFs. These potentially long distance and regularly occurring moves can cause financial strain on PDFs¹. PDF stress is well known—career sections of Science magazine contains articles with advice on managing stress at the PDF level². The Canadian Association of Postdoctoral Scholars' 2019 Pre-budget Briefing warned that low compensation and insecure employment leads to loss of research talent as PDFs leave their research field or seek positions outside Canada³. Ultimately, there is no doubt that the combination of these factors has led to an increase in the transient scientific workforce, with the half-life of an astronomy career⁴ dropping from 37 years in the 1960s to only 5 years in 2007⁵.

Indeed, these issues have been well documented, but for a first-hand account, the authors invite the reader to buy their friendly neighbourhood postdoc a coffee and listen to their story. These same sentiments were also reported in the LRP2020 PDF/RA town hall held in May 2019.

The authors of this report are a group of current and former PDFs in Canada. To collect data for this report, we conducted several surveys of PDFs and PDF employers in Canada. In the following sections, we present our view of the major issues affecting Canadian PDF opportunities and outcomes. We divide these issues into three calls to action, with each demonstrating a theme where improvement is needed. These themes relate to employment conditions for PDFs, research funding for PDFs and problems with the current way PDFs are hired in Canada. For each theme, we address the relevant issues and make recommendations for consideration by the Canadian astronomy community.

We provide online supplementary material to this report at <http://rebrand.ly/lrp2020pdf>⁶, where the reader can find additional data, a list of signatures of Canadian astronomy community members in support of this report and a page where those interested can add their own signature.

Summary of Recommendations

We list all of our recommendations below. In each of the following sections, we also discuss how each recommendation is relevant to the themes of that section.

R1. PDFs should be hired and compensated as skilled experts in their areas, not as trainees. This recommendation is discussed in all three sections.

R2. Standard PDF hiring practices should be revised to be more inclusive of different life circumstances. This recommendation is discussed in all three sections. Sub-items 2.1, 2.2 and 2.3 are discussed in Sections 1, 2, and 3; respectively.

R2.1 Allow PDFs the option of part-time employment.

R2.2 Remove years-since-PhD time limits from PDF jobs.

R2.3 Financially support PDF hires for relocation and visa expenses.

¹Kwok (2019), Nature, 571, 135

²<https://www.sciencemag.org/careers/2014/07/stressed-out-postdoc>

³http://www.caps-acsp.ca/wp-content/uploads/2018/09/CAPS-2019-PreBudget-Brief-_-FINA-_-for-posting.pdf

⁴Time for 50% of a cohort to leave the field, as defined in Milojević et al. (2018)

⁵Milojević et al. (2018) PNAS, 115, 12616

⁶At time of writing, this link redirects to http://planetngo.ca/lrp2020_pdf_wp/

R3. CASCA should form a committee to advocate for and provide support to astronomy PDFs in Canada. This recommendation is discussed in Section 1.

R4. CASCA should encourage universities to create offices dedicated to their PDFs. This recommendation is discussed in Section 1.

R5. PDFs and other PhD-holding term researchers with a host institution should be able to compete for and win grants to self-fund their own research. This recommendation is discussed in Section 2.

R6. Astronomy in Canada should hire general-purpose continuing support scientist positions instead of term PDFs to fill project or mission-specific requirements. This recommendation is discussed in Section 3.

1 Our community needs to provide better terms of employment and benefits for our postdocs to all thrive and excel at their work.

Hiring a PDF researcher on an individual research grant, such as an NSERC Discovery Grant, can be challenging, thus many of the PDF hires are made through larger programs. We surveyed a number of programs across Canada which consistently hire PDFs regarding their provided benefits and programmatic issues. These results are summarized in Table 1, while the full long-form responses to survey questions are provided in Table 2⁷. A brief summary of comparable features offered by the United States' Hubble Fellowship is also included.

Several aspects are immediately noticeable from our benefits survey. First, the highly-competitive NSERC-funded PDF positions (NSERC PDF and Banting Fellowship) do not guarantee many of the basic benefits offered by the other programs, both in the personal (e.g., extended health and dental coverage) and in the research (e.g., conference travel funds) domains. Despite the high degree of competitiveness for these positions, unless additional resources are provided by the host institution, these PDFs work under a significant disadvantage compared to their peers hired for other Canadian named fellowships. This is especially true for the NSERC PDF, where the base salary is \$15,000 to \$20,000 lower than most of the other major fellowships in Canada.

Secondly, many of the basic benefits that non-academic employees have (e.g., parental leave, paid vacation and sick leave) are almost always offered at some level. This is in contrast to the Hubble Fellowship, which lacks many of these provisions. Additionally, all of the Canadian fellowships surveyed allow for a fellowship extension following paid parental leave, unlike the Hubble Fellowship.

A third notable aspect is the level of variation between the fellowships in both personal benefits and research support. For example, there is a range of more than \$8,000 per year in salary and \$10,000 per year in research expenses. Types of paid leave in addition to sick leave and vacation leave vary widely between fellowship, and the level of paid top-up funding to EI for maternity and parental leave also vary significantly, from several weeks to nearly a full year at more than 90% of full salary.

Recommendations

R1. PDFs should be hired and compensated as skilled experts in their areas, not as trainees.

It is well known that in today's employment landscape, many PDFs do not obtain permanent positions in astronomy. We therefore believe that it is important for PDFs to be treated as much like an early career professional in any other field of work, and not thought of as "toughing it out" until they get their dream faculty job. In other words, fair compensation and benefits for the duration of the fellowship should be offered.

Our survey of the major fellowships available across Canada can provide guidance for best practices and areas of potential improvement for both individual PI and institutional PDF policies. Salary and research funding for the PDF are two examples which may prove challenging due to the nature of the Canadian funding landscape. On

⁷Table 2 is excluded from the submitted report due to space limitations, but can be found in the online supplementary materials.

the other hand, some other benefits, such as paid leave for surgery / hospitalization or compassionate leave, will be used only rarely, but may make an enormous difference for those few who need it. Where possible, expanding benefits such as paid leave, relocation expenses, and paid parental leave, will create a more supportive environment for all PDFs, and may be particularly helpful for retention of PDFs from underrepresented groups⁸.

R2. Standard PDF hiring practices should be revised to be more inclusive of different life circumstances.

R2.1 Allow PDFs the option of part-time employment.

While funding timescales may sometimes present challenges for implementation, allowing part-time PDFs is another direction that could help with retaining a broader spectrum of astronomers, e.g., parents with young children or family caregivers. As a personal example, one of the co-authors of this paper (SML) worked in a PDF position at half-time employment for one year because of family commitments. Having this as an option allowed SML to achieve the work-life balance she needed at that stage in parenthood, while she remained active in the field of astronomy. She returned to full-time employment for a second PDF, and is now tenure-track faculty in astronomy in Canada. She believes that this period of half-time employment is what kept her in the field, instead of “leaking out of the pipeline” like a disproportionately large fraction of women do during PDF years⁹.

Our PDF benefits survey was necessarily limited to major fellowships across Canada. PDFs hired by individual PI grants may face entirely different circumstances than what our survey captured. We therefore recommend that CASCA surveys all Canadian PDFs to determine working conditions such as salaries, benefits, contract lengths, and experience inside and outside of Canada. Only once the entire PDF employment landscape is understood can informed decisions be made to ensure fair treatment and improved retention of underrepresented groups.

R3. CASCA should form a committee to advocate for and provide support to astronomy PDFs in Canada.

At the time of writing of this report, some of the authors have submitted a proposal for a Postdoc Advocacy Committee to the CASCA Board. Ideally, this committee would include both current PDFs as well as early career researchers in permanent positions to help ensure continuity of committee membership. This committee would be well-placed to undertake the PDF survey mentioned above and other important initiatives.

R4. CASCA should encourage universities to create offices dedicated to their PDFs.

We note that some universities, such as McMaster, have a dedicated Office of Postdoctoral Affairs. A university-wide office dedicated to PDFs can help to ensure fair hiring practices and can provide targeted support and training to a group that often falls outside of the typical university categories of students and faculty. For example, the McMaster office co-sponsors career skills development sessions offered by MITACS and directs advertising to the PDF community.

2 Our community needs a mechanism for non-permanent research staff to compete for and win grants

At the moment, there are no “soft-money” grants available to PDFs working in Canada, regardless of their demonstrable ability to carry out self-guided research. Those grants which are available (through, e.g., CSA, NSERC, etc.) generally provide insufficient funding to support a PDF’s typical salary and benefits on their own, and regardless require one already hold a faculty position or equivalent in order to be an eligible PI. This is in stark contrast with the funding environment in the United States, where numerous opportunities exist for non-tenured scientists to apply for funding not only to support their research but to cover their own costs as well. At the moment, the absence of such funding in Canada creates the worrying potential for a “funding gap” in the career progression available to Canadian astronomers, particularly given the combination of a very long average time between obtaining a PhD and finding a faculty position^{10,11}, together with the arbitrary constraints on time post-PhD typical for

⁸See, for example, <https://www.nature.com/magazine-assets/d41586-019-02047-z/d41586-019-02047-z.pdf>

⁹Flaherty (2018), arXiv:1810.01511

¹⁰Metcalf T. S., 2008, PASP, 120, 229

¹¹Perley D. A., 2019, PASP, 131, 114502

most prize fellowships (see **R2.2** below). This lack of funding leads to many facing a stark choice between leaving astronomy, or leaving Canada (see survey results, Table 2), which in either case leads to a loss for the Canadian astronomical community. On the other hand, however, the “patchwork” nature of soft-money positions, with its accompanying absence of the benefits and security of contractually-backed employment, has been credited with producing an ever-growing cohort of “second-class citizens” within the US science community¹², and contributing directly to difficulties in the retention of PDFs from under-represented groups (see previous section).

How then can we as a community provide a stable, equitable, sensible path for academics to grow from PhD to permanence, including adequate funding to foster the independent research leadership that will be essential in their roles as faculty? An alternative, albeit more difficult to implement, approach may be a more formalized “ladder” of fellowships, from early career research to faculty, each with appropriate accompanying funding provided to support independently-led research projects, and each with University-backed benefits. This has been successfully implemented abroad (e.g., Veni/Vidi/Vici in the Netherlands, DECRA/Future Fellowship in Australia, see also the EU’s ECR scheme), although, at least anecdotally, there is some suggestion that these schemes may eventually suffer from “credential creep,” with it becoming increasingly difficult to leverage the highest awards within each scheme for a permanent position. Ultimately, however, this is likely tied to the extreme over-saturation of the available pool of PhD graduates relative to the permanent job market in astronomy¹³, and may not indicate a problem with fellowship ladders themselves.

Implementing such an overhaul of the present funding structure would necessitate broad, interdisciplinary backing from the Canadian science community, likely requiring long-term advocacy. At present funding levels, this may also necessitate **fewer** PDFs in Canadian astronomy. This can be offset, however, by a concurrent rise in the number of longer-term research staff hired by individual institutions to support the specific astronomy projects and facilities from which they benefit (see next section and **R6**). Creating a funding environment where non-faculty scientists can apply for research funding would be essential in order to allow staff in such long-term support positions to compete on an even footing and capitalize on their relative lack of administrative duties. This would be to the benefit of Canadian astronomy’s research output as a whole, as is evident from the disproportionate role of non-faculty research staff at present in producing high-impact first-author publications (see Crabtree, LRP 2020 WP), and the modest hours available to regular faculty for conducting research¹⁴.

In the next decade, real progress can be made toward fostering a Canadian astronomical community where all early career researchers have the opportunity to pursue the funding necessary for ground-breaking, independently-led research, in an environment where they are provided with the competitive benefits considered standard for their skill-level. In the following, we outline several key practical steps toward this goal.

Recommendations

R1. PDFs should be hired and compensated as skilled experts in their areas, not as trainees.

Treating PDFs as skilled experts means increasing salaries and benefits, bringing PDF jobs closer to the compensation provided by equivalent skill-level industry jobs or continuing positions at the same institution. We support these recommendations even if it means fewer PDF positions. Fewer, better compensated PDF positions will lead to less discrimination in who is financially able to accept a PDF, leading to fairly attracting highly talented researchers into Canadian PDF positions. This item is to be taken up by astronomers, particularly senior ones responsible for hiring PDFs through their grants or on fellowship committees.

R2. Standard PDF hiring practices should be revised to be more inclusive of different life circumstances.

R2.2 Remove years-since-PhD time limits from PDF jobs.

As discussed above, the length of time between PhD and a continuing astronomical research position is growing. Removing years-since-PhD time limits will prevent forcing people to “leak” out of the pipeline and facilitate the

¹²Barinaga (2000), *Science*, 289:2024

¹³See, e.g., Cooray A., Abate A., Häußler B., Trump J. R., Williams C. C., 2015, arXiv, arXiv:1512.02223

¹⁴See, e.g., Koens, L., R. Hofman & J. de Jonge (2018). What motivates researchers? Research excellence is still a priority. The Hague: Rathenau Instituut

larger changes proposed here, where our community can support a larger population of non-faculty but continuing positions in research. We note that implementing **R2.2** in a vacuum may lead to undesirable consequences such as being hired as a PDF indefinitely. This recommendation should be considered alongside **R1** and **R6**.

R5. PDFs and other PhD-holding term researchers with a host institution (including longer-term research staff, see next section) should be able to compete for and win grants to self-fund their own research.

This would require significant support and advocacy by LRPIC and CASCA to argue for funding agencies such as NSERC to change their policies. PDFs and term researchers would compete with faculty and other researchers with continuing positions.

3 Our community needs to create a sustainable and mutually beneficial postdoc hiring model that considers the outcomes of their postdocs

In LRP2010, PDFs were identified as “critical contributor[s] to the success of astronomy” and as “mak[ing] significant contributions to research”. PDFs are an important part of the Canadian astronomical research ecosystem in ways beyond conducting research. In an informal survey of 29 PDFs, we found that PDFs also teach courses (24%), mentor undergraduate students (90%), mentor graduate students (72%), serve on committees (55%) and work with industry partners (14%). Student mentoring work includes both research projects as well as career and professional development.

However, while our community has recognized the value of PDFs and LRP2010 even recommended an increase in Canadian PDFs, there is not enough support available for existing PDFs to thrive after they have finished their short term employment contracts. In some cases, well-intentioned support for PDFs may actually lead to worsening conditions. Here, we identify problems that PDFs encounter after their term ends.

Finding the next academic position in Canada is difficult. While LRP2010 finds that Canada has a low ratio of PDFs (2 faculty per PDF instead of 1 to 1 as in other countries), there are still many more new PDF hires than continuing position hires (faculty or otherwise) in Canada. In our survey, 86% and 35% of PDFs indicate that they are interested in a research-track or teaching-track position at Canadian institutions, respectively, while there are fewer than 10 of these position types hired per year. In addition, there are arbitrary time restrictions placed on some PDF positions, with very few PDF options beyond 5 years past a PhD. This makes it difficult for some PDFs to find another PDF position in Canada. We also surveyed some PhD astronomers who left Canada for an international PDF position to find out reasons for leaving. Half of the respondents indicated they applied to PDF positions within Canada but there were not enough positions available so they did not receive an offer.

These problems also affect PDFs during their term employment. The constant need to apply for jobs combined with a precarious employment situation and uncertainty in one’s future create a lot of stress for PDFs. Moreover, the act of applying for jobs can be an arduous and time-consuming task that takes away from research. For PDFs who require a work permit, there are additional financial and time/effort costs to get a new work permit with every job change in Canada. And while many PDFs enjoy working with students, some types of arrangements, such as acting as an informal mentor without any official recognition, may take up a significant amount of time while not ‘counting’ towards the training of highly-qualified personnel (HQP) valued by Canadian funding bodies¹⁵ and may not be visible to future employers. In addition, while a PDF may also spend time mentoring students in areas of professional/career development (e.g. advise on grad school applications), this type of work isn’t quantified at all in academic job and grant applications. Ultimately, all of these uncertainties negatively impact quality of life for PDFs and can interfere with their ability to fully thrive in the research environment.

There are many opportunities for astronomy PhD holders to find non-academic positions and indeed, 21% of surveyed PDFs indicate they are seeking non-academic employment after their current PDF term. However, despite what LRP2010 says and what is commonly heard from the astronomical community, training as a PDF does not directly increase one’s preparation for most non-academic career paths. In addition, since LRP2010, more

¹⁵For instance, the Canadian Common CV, used by NSERC PDF, Banting PDF and NSERC Discovery Grant applications, specifically says that student supervision as part of PDF work does not count as HQP.

and more universities are offering specialized degrees in data science or other related training programs, reducing the potential advantage of a science PhD in this career path. Many astronomy-trained researchers that moved to other careers either received the majority of quantitative and technical skills needed in these other careers during graduate school or in their own time as a PDF. When considering job postings for non-academic careers and profiles of astronomers hired into non-academic careers, there appears to be little evidence that time worked as a PDF is inherently valuable for non-research careers. Perhaps time as a PDF can be helpful in increasing the overall years of work experience, but this can also be achieved outside of a PDF position, and likely be better compensated as well. Thus, while it is good that PDFs have these non-academic options, it is not accurate to claim that a PDF position is beneficial for both academic *and* non-academic career paths. **A PhD choosing a PDF position has made a commitment to the academic path and is paying real opportunity costs in doing so.**

“More postdocs” was a common refrain in LRP2010 town halls, and the report itself called for an increase in PDFs to support missions and facilities. In LRP discussions at the 2019 CASCA AGM, it was further argued that a steady flux of new PDFs is needed to keep up with the changing skill requirements of new projects. This position, however, contradicts the simultaneously presented argument that PDF experience is good preparation for jobs with nominally related skills in the private sector. How is it not possible for a PDF to develop new skills for a different astronomical project, yet entirely feasible to find a career outside of astronomy entirely?

Here, we caution against an increase in PDFs without considering opportunities available for PDFs after the end of their term. We make recommendations below to avoid a future where our community hires researchers in term positions in order to increase overall research output in an exploitable and unsustainable manner.

Recommendations

We assert that PDFs be considered early career researchers instead of “trainees” as implied by some language in LRP2010. We hope our community creates a PDF employment model that provides mutual benefits for PDFs and their employers. The following recommendations are in support of these goals.

R1. PDFs should be hired and compensated as skilled experts in their areas, not as trainees.

As with any new position, while a new PDF may still learn some skills specific to their position (e.g. a new software or student supervision), PDFs have already completed their main training in graduate school. While there is a need for term positions in academia, the salary and benefits of these positions should still be commensurate with the PhD’s experience and should reflect the employment of an expert, not a trainee. PhDs are treated as experts in non-academic career paths, where they are hired into senior analysis positions owing to the large number of years of training and experience required to do the original research necessary for a PhD. PhDs in non-science fields are also treated as senior experts and are hired directly into faculty positions.

In addition, our community should hire and compensate term employees such as PDFs in the same manner as continuing staff. While the nature of academic research work drives a need for limited term positions to address specific needs within time-limited projects, it is not ethical for our community to inadvertently create poor employment conditions due to the nature of term positions.

In particular, we are concerned that term employment allows employers to continually hire PDFs and new PhDs in revolving-door style without also hiring continuing positions. We are also concerned that term employment leads to PDFs working with lower salaries and fewer benefits compared to continuing positions outside of academia for someone with similar training and experience (see Table 1). To address this, PDF employers should hire PDFs on term employment contracts that mirror those of their continuing research staff and/or faculty but at a rank that reflects the PDF’s level of experience. We point to NRC Herzberg as an example, as PDFs at NRC Herzberg enjoy the same compensation and benefits as the continuing staff.

R2. Standard PDF hiring practices should be revised to be more inclusive of different life circumstances.

Our community should ensure our PDF employment practices do not create equity and inclusivity issues. Currently, PDFs are paid less than equivalently skilled workers outside of academia and their employment often requires relocation. Both of these issues create barriers to PDFs that might otherwise like to stay in academia.

Because the only academic career options in Canadian astronomy — aside from Faculty positions which are few and far between — are another PDF or a continuing research or teaching position, precarious job security may create a selection effect on who is able to finally secure a continuing position in astronomy. We can improve our ability to attract and retain talented researchers by ensuring we are not selecting against people who need a salary commensurate with their ability and people who are not able to move around the country.

R2.3 Financially support PDF hires for relocation and visa expenses.

Currently, PDFs are typically 1-3 years in length and may require a relocation that cost several thousand dollars to move within or to Canada. New PDFs will find it challenging to build these savings from graduate student stipends while current PDFs may have exhausted their savings with their last move completed 1-3 years ago. In addition, for non-Canadians, moving to work in Canada comes with considerable additional financial and time expenses to secure visas and work permits. Incorporating these benefits into the standard PDF hiring package will help open opportunities to more people. We note that for PDFs with partners, these frequent moves can lead to lost career opportunities and income for the partner as well.

R6. Astronomy in Canada should hire general-purpose continuing support scientist positions instead of term PDFs to fill project or mission-specific requirements.

Our community needs a new model for PDFs that not only harnesses their valuable research time and freedom for achieving research goals, but that also ensures they have fair and equitable working conditions which allow them to thrive both professionally and personally. Achieving this would require large structural changes in the way research is funded and conducted in Canada. One model to consider is for institutions to hire general purpose support scientists in continuing positions to fulfill the institution's project or mission-specific science duties. Although not permanent in the same way as tenured faculty, the incumbent would have severance benefits to help them find their next position, as is the case for many areas of employment without the concept of tenure.

One major challenge to these changes is whether there would be enough missions and projects to continuously hire people. Certainly, in a flat-funding scenario, this will raise the overall cost of doing research. We argue that it is preferable to have fewer well-supported PDF or PDF-like positions than to continue the existing model with only a slightly larger number of underpaid and precarious PDF positions. Continuing on the existing path may lead to a more exploitative job market and create a selection bias on researchers who are able to stay in academia.

Summary

In this report, we present six recommendations to address three major areas of concerns affecting PDF employment and outcomes in Canada. Our main recommendations revolve around our community compensating PDFs as skilled experts instead of trainees (**R1**) and ensuring that PDF hiring practices are inclusive of the wide diversity of astronomers (**R2**). These two recommendations are part of the solution to all three issues. We also note that while a successful implementation of these recommendations would involve systemic changes to PDF employment in Canada, these recommendations are very much actionable at the level of an individual or committee responsible for PDF hiring decisions.

We also make two recommendations for CASCA, where we ask for a CASCA Postdoc Advocacy Committee (**R3**) and for CASCA to encourage universities to create offices dedicated to supporting PDFs at these institutions (**R4**). These leverage the wide network of our discipline's national society to pool resources and influence.

Finally, we make two recommendations intended to overhaul the employment of PDFs and early career researchers in Canadian Astronomy. **R5** asks for a major change in policies of funding agencies such as NSERC, which fund many disciplines outside of astronomy to allow researchers on term appointments to compete alongside tenure-track faculty for grant dollars. **R6** asks all astronomy institutions in Canada to end the practice of fulfilling their operational needs with serial term position hires instead of continuing positions. Whether these operational needs are to build a diverse research portfolio or to fulfill requirements for specific missions or projects, we advocate for hiring general-purpose astronomers that can modify their assigned work instead of hiring another term

PDF without consideration of the outcomes for the outgoing PDF. These last two recommendations are ambitious for LRP2020 but we believe these ideas are important to consider as employment conditions evolve.

Reviewing these recommendations, we highlight that recommendations **R2.1**, **R3**, and **R4** come with no real costs and can be implemented immediately. **R2.2** requires coordination with **R1** and **R6**. We recognize that in a flat-funding scenario for Canadian astronomy research, there will be challenges for recommendations **R1**, **R2.3**, **R5**, and **R6**. However, we strongly believe this is the required path in order to sustain a successful, inclusive and ethical astronomy research program in the long term. With limited resources, we argue for a reduction in the number of PDFs in order to ensure each PDF can thrive. Although this may decrease the amount of science supported in Canada, we advocate for a solution that involves justifying additional funds instead of a solution that asks PDFs to accept precarious employment with little support. The latter (current) scenario creates a selection bias on the researchers themselves, which compromises the diversity of thought required for a successful national astronomy research program. In short, we ask for prioritization of people over production of papers.

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LRP text boxes

1: How does the proposed initiative result in fundamental or transformational advances in our understanding of the Universe?

A strong postdoctoral workforce enables fundamental and transformational advances. Implementing these recommendations will create a more inclusive and diverse research workforce, leading to a more diverse set of ideas, some of which may be transformational. In addition, ensuring opportunities are present for everyone will strengthen public support for astronomy in Canada.

2: What are the main scientific risks and how will they be mitigated?

N/A

3: Is there the expectation of and capacity for Canadian scientific, technical or strategic leadership?

N/A

4: Is there support from, involvement from, and coordination within the relevant Canadian community and more broadly?

Volunteers from the currently- and recently-PDF community in Canada wrote this report and solicited ideas from the same population. The Canadian astronomical community are encouraged to indicate their support for the ideas at <http://rebrand.ly/lrp2020pdf>

5: Will this program position Canadian astronomy for future opportunities and returns in 2020-2030 or beyond 2030?

Yes, implementation of these recommendations will lead to a PDF community that is inclusive, thriving and poised to be Canada's astronomy leaders beyond 2030.

6: In what ways is the cost-benefit ratio, including existing investments and future operating costs, favourable?

These recommendations aim to create fair and inclusive employment conditions for PDFs at the cost of the quantity of research time worked by the same PDFs. It is not reasonable to assign quantitative value to the former, however, as we put people ahead of papers, we consider the cost-benefit ratio to be favourable.

7: What are the main programmatic risks and how will they be mitigated?

Some of our recommendations will increase the overall cost of doing science in Canada, and therefore we risk reducing the total scientific output without an increase in funding. This risk is mitigated by improving the overall quality of scientific work in Canada by creating inclusive opportunities for everyone to contribute novel ideas. One additional challenge is achieving buy-in support from astronomy departments at Canadian universities and institutions. We hope the LRP process and this report will raise awareness of the issue and the list of public supporters for this report will demonstrate the importance of these issues. The proposed CASCA Postdoc Advocacy Committee (Recommendation 3) will coordinate nation-wide efforts for a complete census of PDFs and from that, create coherent strategies to lead to nation-wide adoption. Our more ambitious recommendations involve changes at even higher levels, sometimes outside of astronomy itself. We acknowledge that this may not complete within the next decade but significant steps can be made.

8: Does the proposed initiative offer specific tangible benefits to Canadians, including but not limited to interdisciplinary research, industry opportunities, HQP training, EDI, outreach or education?

These set of recommendations aim to improve opportunities, employment conditions and outcomes for PDFs in Canada. PDFs themselves are HQP. We aim for a more equitable, diverse and inclusive employment environment. The jobs created and supported by this environment will be open to Canadians. In addition, the products of PDF research in Canada will benefit Canadians generally, whether it is through additional education opportunities, outreach events and general sense of pride in one's own country and its scientific accomplishments.

Table 1: Postdoc Benefits Survey - Summary

	NSERC PDF	Banting PDF	Plaskett/ Covington (NRC)	NRC Postdocs	Dunlap Fellowships	McGill Space Institute	CITA postdocs @ U of T	Perimeter Fellowships	Hubble Fellow (for comparison)
Benefits Questions									
Extended Health	No**	No**	Yes	Yes	Yes	Yes(*)	Yes	Yes	*
Dental	No**	No**	Yes	Yes	Yes	buy-in	Yes	Yes	No**
Disability Insurance	No**	No**	Yes	Yes	No	Yes(*)	No	No	Maybe/No**
Life Insurance	No**	No**	Yes	Yes	No	Yes(*)	No	Yes	Maybe/No**
Pension Plan	No**	No**	Yes	Yes	No	Yes	No	No	Maybe/No**
Union Representation	No**	No**	Yes	Yes	Yes	Yes	Yes	No	No
Vacation Time (days/yr)	No**	No**	20	20	15	15(*)	15	15 + 7 Xmas	No set time**
Paid Sick Leave (days/yr)	No**	No**	15(*)	15(*)	5	Yes	5	Unlimited	No set time**
Parental Leave	Yes(*)	Yes(*)	Yes(*)	Yes(*)	Yes(*)	Yes(*)	Yes(*)	Yes(*)	No(*)
Fellowship Extension for Parental Leave	1 year	1 year	1 year(*)	1 year(*)	Yes	?	Yes	1 year	No set time**
Other Paid Leave	No. Some unpaid leave allowable.	No. Some unpaid leave allowable.	2 personal days plus leave for bereavement, court, domestic violence, medical appointments for pregnant employees, etc	2 personal days plus leave for: bereavement, court, domestic violence, medical appointments for pregnant employees, etc	Serious illness, surgery and hospitalization, gender reassignment surgery, bereavement, compassionate, jury duty leave (*)	2 personal days, medical app't for pregnant employees, adoption, marriage/wedding, bereavement, court duty(*)	Serious illness/hospitalization, bereavement, compassionate leave	4 personal days	No
Relocation Expenses	No**	No**	Up to \$5,000.	Up to \$5,000.	Yes(*)	No**	Up to \$3,000	\$1,500.00	Included in research grant
Programmatic Questions									
Start date flexible?	April to January(*)	April to October	Yes(*)	Yes(*)	Usually August to October (*)	Yes	Yes, flexible	Yes, very flexible	Somewhat
PhD prior to start date?	Yes	Yes	Yes.	Yes	Yes	Yes	Yes	Yes, for visa reasons for foreign fellows.	Yes
AAS decision date respected?	Probably(*)	Probably(*)	Yes	Usually later.	Yes (*)	Yes	Yes (*)	Yes	Yes
Selection Criteria in Job Ad?	Yes	Yes	Yes	Yes	Yes	(Yes)	Yes	Yes	Yes
Max Time Since PhD?	2 years(*)	4 years(*)	5 years	3 years	5 years 9 mo (*)	Prefer 3 years	5 years	No	~3 years
Hours/Week Expected (for Full Time)?	Set by host institution	Set by host institution	37.5	37.5	40	Set by supervisor	40	37.5	Not specified
Part Time Available?	Yes(*)	Yes(*)	Prefer full time	Prefer full time	Yes(*)	No	Maybe	No	No
Typical Salary	\$45,000/year	\$70,000/year	Varies. PhD rate \$72,052 (2020)	Varies. PhD rate \$72,052 (2020)	\$71,107/year for 2020-2021 intake	\$50,000-\$60,000	\$63K with yearly increases	\$70,000.00	\$69,000 USD
Research Expenses	No**	No**	Reasonable travel + computing (*)	Reasonable travel + computing (*)	\$18,000 for travel + purchasing	No**	\$12,000 (*)	\$7,500.00	\$16,000 USD (*)
Tax Status	Stipend: not eligible for EI, CPP, etc	Stipend: not eligible for EI, CPP, etc	Regular (T4) employee	Regular (T4) employee	Regular (T4) employee	Unionized employee	T4 employee (*)	T4 employee(*)	Depends on host institution
Notes (for entries with a * see full response for details)	** - could be provided by host institution	** - could be provided by host institution				** - could be provided by supervisor			** - could be provided by host. Paired answers for: [employee] / [stipend] status