Ongoing external funding

Project title	Funding source	Amounts Euro (SEK)	Period	Role of the PI	Relation to current proposal
DARKJETS: Discovery strategies for DM and new phenomena in hadronic signatures with the ATLAS detector at the LHC	European Research Council	1270000	2016-2021	Sole PI	Proof-of-principle results for WP1-3, see below of this document for how this Consolidator Grant is a significant step beyond this Starting Grant (StV). In the first 3.5 years, my StG team (1 postdoc, 2 PhDs) and I have published 6 ATLAS papers, 6 whitepapers (4 peer-reviewed) and 2 review papers. 3 more publications are expected before the conclusion of this project in February 2021.

This Consolidator grant is a **significant extension of the successful research program that was enabled by my Starting Grant, expanded in ambition and experimental coverage**.

The research program in the Consolidator Grant is much more ambitious than the ERC program, extending the success of the TLA proof-of-principle technique that was novel for the ATLAS experiment to other fundamental particles and use cases. The data recorded with one of these extensions (TLA with photons) will be used in a search that I pioneered at the LHC, extending the world-best constraints to a discovery potential many orders of magnitude better. This research program and its work on data compression will also make TLA become a standard analysis technique that can be used by other members of the collaboration, allowing for more sensitive searches that are currently limited by trigger constraints and providing a solution to future challenges. Its use in combination with the Partial Event Building technique is completely new, and it will be used to search for a more complex search target with respect to the targets of my Starting Grant, moving from WIMP searches to well-motivated non-WIMP dark sector searches that have captured the interest of part of the theoretical community of DM experts.

The achievements of the Dark Matter Forum and Dark Matter Working Group in focusing the LHC DM community around a prioritized set of benchmark models and a way to present results in the context of direct and indirect searches for DM will be the stepping stone of a new initiative that includes the work already done and brings it into an even broader context that includes non-collider experiments, astrophysics, cosmology and multimessenger astronomy.

Such an ambitious research and dissemination program is only possible with the addition of five members to the Lund University team, defining my profile as research-oriented PI with a small amount of focused teaching (see justification for VR grant below for further information of the funding of my position). Thanks to a Consolidator grant, I will have time to work with and supervise two postdoctoral researchers, one postdoctoral researcher with software expertise, and two students that will be trained as part of this proposal,

This Consolidator grant extend the use of real-time analysis to more sensitive DM searches with broad theoretical motivations, and enables my research group and the ATLAS DM search community as a whole to make a major contribution to the global DM landscape. **This grant would establish me further as a leader in my field and responsible for a research program with physics and technical implications beyond high energy physics.** It would also be the stepping stone for me to apply for early **promotion to full professor**.

Project title	Funding source	Amounts Euro (SEK)	Period	Role of the PI	Relation to current proposal
Real-time Strategies and Precision Searches for Dark Sector Particles	VR (Swedish Research Council), Project Grant	423020 (4400000)	2019-2024	Sole PI	Covering PI's salary and salary of PhD student. The PhD student will be spending 30% of their time physics topics that are different but complementary to this proposal. In 2020- early 2021, the student will analyze TLA data from Run-2. From early 2021 to mid-2022, the student will develop machine learning algorithms for dark sector models that are complementary models targeted with respect to this proposal (prompt dark jets rather than composite and semi-visible jets) using a dataset collected using traditional data taking techniques. Since this position is part of HELIOS (hardware-oriented DESY/Hamburg/Lund Helmholtz graduate school), the majority of the work of the

					PhD student in 2021-2024 will be on the hardware for the ATLAS experiment upgrade and on the LDMX experiment, for work not directly related to this proposal.

It should be noted that **the financing of the non-teaching employment of Swedish researchers and a large fraction of PhD student funding comes from national funding agencies rather than from the internal budget of the employing university**. Researchers from EU countries who are dependent on grants from a national funding agency should not be penalized with respect to others where the employment of the researcher is fully financed from the internal budget of the University.

It is only the combination of this current funding and the Consolidator Grant that will allow me to maintain a **strong research-oriented profile,** and lead a group that continues the very successful research line on dark matter enabled by novel data analysis techniques in ATLAS. This work so far has been recognized with high-profile responsibilities in both computing/data analysis and dark matter communities for me and my postdocs and students.

This combination also enables me to participate in a time-limited but still significant extent to **ATLAS upgrades and to a new promising experiment, the LDMX experiment,** given the synergies with this proposal in terms of dark matter searches for models with new particles coupling to photons and electrons. While the searches in this proposal search for light dark matter mediators decaying to electrons within hadronic jets, the LDMX experiment searches for the invisible decays of these mediators. **Participating in two complementary experiments offers the perfect scenario to verify discoveries and employ constraints to direct promising future search programs.**

Time sharing in my role as a PI of both grants has been built in the time plan of this proposal done with a professional Gantt chart software (OmniPlan), with an involvement in LDMX that grows to 20% in 2023 as foreseen in the VR project plan, maintaining a 70% involvement in the Consolidator grant in the first two years and lowering to 50% in the last three years enabling me to apply for additional funding and apply for full professorship.

Project title	**Funding source**	**Amounts Euro (SEK)**	**Period**	**Role of the PI**	**Relation to current proposal**
INSIGHTS	MSCA ITN (ETN)	3.02 MEUR	2017-2021	Co-PI and second supervisor of an Early Stage Researcher (was initially main Lund PI, but brought in a second Lund researcher to share responsibilities so I could concentrate on real-time analysis and DM searches)	None, since this proposal focuses in statistics in physics and society. Synergies with this proposal can be found in the statistical tools for the physics analyses.

Project title	**Funding source**	**Amounts Euro (SEK)**	**Period**	**Role of the PI**	**Relation to current proposal**
Light Dark Matter	Knut and Alice Wallenberg Foundation	2.6 MEUR (26 MSEK)	2019-2024	Co-PI (but not funded through this grant)	None, since this proposal only funds the LDMX experiment. Synergies with this proposal can be found in different DM search strategies, see VR Project Grant above

Project title	**Funding source**	**Amounts Euro (SEK)**	**Period**	**Role of the PI**	**Relation to current proposal**
HELIOS: graduate school on intelligent instrumentation for present and future facilities (25 graduate students)	Helmholtz, U. Hamburg, Lund University (in-kind), City of Hamburg	7.9 MEUR	2021-2027	Deputy spokesperson and co-organizer (team of 5 PIs). VR grant student is one of the 25 "in-kind" students, working on ATLAS tracker upgrade with DESY researchers.	None, since this graduate school mostly focuses on instrumentation (hardware). Synergies with this grant can be found from the trigger and data acquisition side.

On-going and submitted grant applications

Project title	Funding source	Amounts Euro	Period	Role of the PI	Relation to current proposal
Synergies between machine learning, real-time analysis and hybrid architectures for efficient event processing and decision making (SMARTHEP)	MSCA ITN (ETN)	3.2 MEUR	2016-2021	Coordinator	LHC-wide and industrial applications of real-time analysis techniques, not covered in this proposal but synergistic to it.

Previous external funding

Project title	Funding source	Amounts Euro (SEK)	Period	Role	Relation to current proposal
Searches for DM and New Phenomena with the ATLAS detector at the Large Hadron Collider and beyond.	VR (Swedish Research Council)	230760 (2400000)	2015-2018	Sole PI	None