Name

Attila Kovács

Personal Information

Date and Place of Birth: 31 January 1974, Budapest, Hungary
Citizenship: USA + Hungary
Languages: English (*fluent*), Hungarian (*native*), German, Italian (*intermediate*)

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Employment

2017 —	computer engineer (GS-14), SAO, Cambridge, MA
2016 —	scientific consultant & owner, Sigmyne LLC, Minneapolis, MN
2012 — 2016	postdoc, submillimeter technology group, Caltech, Pasadena, CA
2009 — 2011	independent postdoc at the U. of Minnesota, Minneapolis, MN
2006 — 2009	postdoc in extragalactic submillimeter astrophysics, Max Planck Institute for Radioastronomy, Bonn, Germany.

Education

Ph.D. Physics, Caltech, Pasadena, CA, **2006**

Dissertation: SHARC-2 350 micron Observations of Distant Submillimeter-selected Galaxies and Techniques for the Optimal Analysis and Observing of Weak Signals

A.B. Physics, Astronomy & Astrophysics, Harvard College, Cambridge, MA, **1997**

Research Objectives

Probe the ***large-scale structure of the Universe*** and the ***history and evolution of star formation*** by:

(1) ***statistical analysis*** of (sub)millimeter surveys to discover the infrared and clustering properties of galaxy populations below detection limit.

(2) conducting new, higher resolution, less confused continuum FIR / (sub)millimeter continuum surveys, CO/C+ ***redshift searches*** and/or **intensity mapping.**

(3) providing the fastest and best ***data reduction solution*** (**CRUSH**) and optimal data collection strategies for FIR and (sub)mm-wave, for upcoming experiments.

(4) contributing to ***future instrumentation****, such as lithographic mm-wave* ***spectrometers***, or ***large cameras*** for the (sub)millimeter and far-infrared bands (e.g. GISMO-2, GBT/MUSTANG-2 LMT/SuperSpec, SOFIA/HIRMES).

Astrophysics Highlights

- **SMGs**: surveys, first FIR characterizations, SEDs, FIR-radio correlation.
- **Analytical dust SED models** with temperature distributions and optical depth effects.
- **Statistical analysis:** e.g. source extraction, *P(D)* number counts, deboosting.
- **Resolving S-Z** cluster morphologies.
- Millimeter-wave laboratory spectroscopy of carbon chain radicals (P. Thaddeus group).

Technological Innovations & Highlights

- **CRUSH**: the pioneering data reduction/imaging suite for various submillimeter cameras (e.g. **SOFIA/HAWC+**, **SCUBA-2**, **GISMO**, **SHARC-2**, **LABOCA**). It is a leader in speed, reduction quality and versatility alike.
- **GPU readout**: a readout solution for kinetic inductance detectors (KIDs).
- **SuperSpec**: design concept for a lithographic mm-wave *R*~1000 spectrometer.
- **Observing strategies** for (sub)millimeter imaging arrays & telescopes, (e.g. Lissajous scan patterns at **SOFIA**, **IRAM-30m**, **APEX, ASTE, CSO**, or scan-mode rotating half-wave plate polarimetry with **APEX** / **PolKa**).
- Instrument design and optimization (e.g. **SHARC-2**, **LABOCA**, **GISMO**, **SuperSpec**)
- Wide-band SIS mixer design (**CSO** receivers and ***Herschel*-HIFI** band 1).

Impact Metrics

(20 Jul. 2019, based on ADS)

Papers: **81** (6 first author, 9 second author)
Citations: **3861** (423 first author) Normalized Citations: **424** (130 first author)

h-index: **29** *g*-index: **61** *i10* index: **53**

Specific Duties & Responsibilities

2017 – **SAO** (computer engineer)

– Lead the SMA's realtime software effort and supervise a GS-13/14 software engineer: organize and run regular meetings/telecons, track software issues and progress on OpenProject, coordinate development and direction.

– Maintain the realtime telescope software collection for the SMA: CVS → Github migration; troubleshoot issues as they arise to keep the telescope running smoothly.

– Develop software to support new hardware (e.g. 8→16 GHz **wSMA** upgrade; new tilt meters).

– Improve the operability of the SMA software: modify tools based on operator feedback, improve monitoring capabilities, provide better and more comprehensive error reporting to diagnose problems more quickly and more automatically.

– Develop new features (e.g. interferometric on-the-fly mapping) to enhance the scientific capabilities of the SMA.

– Develop new software (e.g. reflective memory replacement) to allow replacing ageing PowerPC/LynxOS hardware with modern Linux PCs.

– Simplify existing software, and make it more robust: remove obsolete unused code, clean up duplicates, push for convergence (e.g. more common code, libraries, and headers across SMA project).

– Provide detailed documentation for users (operators) and developers: inline doxygen style markup in code, markdown on Github, *SMA Operations Logs*, *SMA Wiki* pages, and on OpenProject.

– Collaborate internally within the CfA (J. Kovac): contribute to the Winter 2019 deployment of the BICEP/Keck CMB polarization experiment with software and bolometer instrument expertise.

2017 – **Sigmyne, LLC** (owner, scientific contractor)

– Solely responsible for the development of the spectral imaging pipeline software for NASA's SOFIA/HIRMES.

– Solely responsible for maintaining the scan-mode imaging data reduction software for NASA's SOFIA/HAWC+.

– Contributing to instrument characterization, calibration, and commissioning science as a member of the SOFIA/HAWC+ SI team.

2012 – 2016 **Caltech** (technology postdoc with Jonas Zmuidzinas)

– Solely responsible for the development of a GPU-based readout, over PCIe, for Kinetic Inductance Detectors (KIDs), demonstrated with CSO/MAKO in May 2015.

– Solely responsible for the chirp-mode data acquisition (server/client) software for CSO/MAKO-2, demonstrated in May 2015.

– Solely responsible for the data reduction software for CSO/MAKO and CSO/MAKO-2, 350um and 850um KID technology demonstration cameras.

– Contributing to the development of SuperSpec, a prototype lithographic spectrometer, with circuit simulations and ideas for design and implementation.

– Extragalactic surveys and SZ-cluster studies with GISMO.

– Solely responsible for developing alternative (unofficial) data reduction software support for JCMT/SCUBA-2 and GBT/MUSTANG-2.

2009 – 2011 **University of Minnesota** (independent postdoc)

– I and Jonas Zmuidzinas co-proposed the concept for SuperSpec, a lithographic on-chip spectrometer for the mm-wave bands.

– Solely responsible for the data reduction software for IRAM/GISMO, a 2-mm camera for the 30-m telescope.

– Leading and conducting studies of submillimeter and high-redshift radio galaxies, using CSO/SHARC-2, IRAM/GISMO

– Characterization and optimization of the GISMO 2-mm camera as part of core instrument team alongside with J. Staguhn (PI) and S. Maher (software).

– G. Siringo and I first demonstrate polarimetry with PolKa (a reflective HWP polarimeter for APEX/LABOCA at 850um).

– Solely responsible for the data reduction software for PolKa.

– Sole developer of CRUSH-2, a versatile successor to CRUSH-1 (for SHARC-2) and minicrush (APEX cameras).

2006 – 2009 **MPIfR** (postdoc with Karl Menten)

– Data reduction software development for the APEX suite of cameras (LABOCA, SABOCA, ASZCA, p-ArTeMiS). Sole developer of minicrush, and contributing to BoA.

– Co-leading (with A. Weiss) the extragalactic surveys with APEX/LABOCA.

– Contributing to the ATLASGAL survey of the Galactic plane with APEX/LABOCA.

– Characterization, diagnostics, troubleshooting, and commissioning of APEX/LABOCA (850um) and APEX/SABOCA (350um) cameras as member of the 5-person instrument team.

– Solely responsible for the APEXBridge software, which provides intelligent real-time anti-alias filtering and downsampling capabilities to any APEX instrument.

Service

NASA APRA / SAT panelist (2018)

Journal referee for **ApJ** (2013 –)

Journal referee for **MNRAS** (2007 –)

Journal referee for **PASP** (2012 –)

Journal referee for **JLTP** (2011)

External reviewer for **Fondecyt, Chile** (2008)

Products

– **CRUSH** data reduction and imaging for astronomical cameras (2003 –).
See: www.submm.caltech.edu/~sharc/crush

– **jnum**: Java Numerical libraries with a focus on astronomical applications (2016 –).
See: *github.com/attipaci/jnum*

– **nom.tam.fits**: Contributor to open-source Java FITS library.
See: *github.com/nom-tam-fits/nom-tam-fits*

– **GPU-based readout** solution (0 – 250 MHz) for kinetic inductance detectors (2011 –).

– **real-time acquisition software** for **SHARC-2** (2002 – 2003) and **MAKO-2** (2015) cameras at the Caltech Submillimeter Observatory (**CSO**).

– **APEXBridge** real-time antialias filtering an downsampling pipeline for transparent use with any APEX telescope instrument. (2006 – 2010).

Contributions to Astronomical Instrumentation

Submillimeter Array (SMA) (2018 –)

Complete rewrite of critical real-time telescope control software (*Track*: real-time antenna control with improved astrometry and solar-system body handling; *statusServer*: status information and flagging for scans; *dataCatcher*: scan processing and archival, *smashAnts*: telescope control commands). Software library to replace old reflective memory hardware and RPC-based DSM library with efficient sharing through a central Redis server via TCP/IP.

NASA SOFIA / HIRMES (*2016* –)

Data reduction pipeline (CRUSH) for medium to high-resolution spectroscopic imaging & observing strategies for NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA3G; PI: S. H. Moseley).

GISMO-2 & MUSTANG-2 (*2016* –)

Data reduction & imaging pipeline (CRUSH) for GISMO-2, a dual-band (1mm & 2mm) camera for the LMT (50m); and MUSTANG-2, a (3mm) camera for the GBT (100m).

NASA SOFIA / HAWC+ (2013 – 2018)

Scan-mode imaging pipeline (CRUSH) for HAWC+, a kilopixel-scale array with polarization capabilities, for NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA). Development of new SOFIA observing modes (Lissajous scans), FITS archival format.

SuperSpec, X-Spec (2011 – 2017)

Original concept of a mm-wave lithographic spectrometer (an antenna-coupled R~700 filterbank on a focal-plane pixel). Circuit simulations and optimization. Massively multiplexed KID readout development (*see below*). Telescope integration, data acquisition, and data reduction pipeline (CRUSH) for deployment onto LMT (50m) in 2017-2018.

MAKO (2012 – 2015)

Data reduction pipeline (CRUSH) for 350um & 850um imaging & FITS archival. Developing a massively multiplexed KID readout system (electronics & algorithms) costing <$1/detector, with a total power consumption of <10 mW/detector, to serve the next generation of 100-kilopixel to megapixel KID arrays for imaging and/or spectroscopy.

GISMO (2009 – 2014)

Data reduction and imaging pipeline (CRUSH), observing modes, real-time instrument diagnostics, instrument characterization, troubleshooting and solutions, FITS data format, instrument commissioning, and operational support.

SABOCA (2007 – 2009)

Data reduction and imaging pipeline (CRUSH), real-time signal-processing, operational optimization, characterization, instrument commissioning, and operational support.

LABOCA (2006 – 2009)

Data reduction and imaging pipeline (CRUSH), microphonic noise rejection, ground isolation and opto-coupling scheme, biasing/sampling and downsampling scheme, signal-processing, stray light and bandpass troubleshooting, ^{3}He temperature correction scheme, sky-dip model, operational optimization, instrument commissioning, and operational support.

Heterodyne Receivers (CSO / *Herschel*-HIFI Band 1) (2000 – 2002)

SIS mixer design (twin 12 kA/cm^2 AlN barrier junctions), wide RF bandwidth thin-film microstrip matching network (180 – 280 GHz, 280 – 420 GHz, 370 – 530 GHz, 570 – 730 GHz). IF tuning (0 – 13 GHz), optimization for stability and noise performance, performance predictions from IV curve measurements.

SHARC-2 (1997 – 2006)

Data reduction and imaging pipeline (CRUSH), bolometer characterization, electronics design & testing, delayed demodulation & DC subtraction scheme, hardware anti-alias filtering, readout multiplexing, DSP pipeline design, observing modes, FITS archival format, initial data acquisition software (*JSharc*), instrument commissioning, and operational support.

Grants & Awards *(selected)*

NASA / SOFIA3G Dec 2016 – Dec 2021
Title: The High Resolution Mid-Infrared Spectrometer (HIRMES)
PI: Samuel H. Moseley (GSFC)
Budget: $ 17M
Role: Collaborator ($ 157,344)

NASA / SOFIA2G Jan 2013 – Dec 2016
Title: SOFIA wide-field far-IR polarimetry and fine-structure-line imaging with the HAWC+ upgrade
PI: C. D. Dowell (Caltech / JPL)
Budget: $ 10,832,000
Role: **Co-I** ($ 135,943)

NSF / AST (#1106284) Jul 2011 – Jun 2016
Title: A kilopixel, 2-color, TES-based bolometer camera for the IRAM 30 m telescope
PI: Johannes Staguhn (JHU/GSFC)
Budget: $ 861,059
Role: Collaborator

NASA / APRA (#10-APRA10-0158) Jan-2012 – Dec 2014
Title: Superconducting resonator spectrometer for mm- and submm-wave astrophysics
PI: C. M. Bradford (Caltech/JPL)
Budget: $ 1,495,100
Role: **Co-I** ($ 193,700)

NASA / Herschel OT1 Program Support (JPL #1435511) Jul 2011 – Sep 2015
Title: Coeval black hole and host galaxy growth in high redshift radio galaxies
PI: Nick Seymour (CSIRO)
Budget: $ 25,033
Role: **Co-I** ($ 15,020)

Computing Skills

– Expert Java developer (15+ years).
– Expert C/C++ developer (25+ years).
– Large project management experience (~500 k lines of code).
– Expertise in **Parallel computing (Java, C/C++** [*pthread, semaphores*]**, CUDA).**
– **Linux**/**UNIX** expert + sys-admin experience (20+ years).
– Team development and version control (**Git**, **SVN/CVS**, Debian/astro).
– Server/client architecture via **RPC**, **TCP/IP**, **UDP**, **Redis**.
– **Linux kernel module** development (`ioctl`).
– **PCIe hardware control** (C/C++) and **GPUDirect** / **RDMA** on **Linux**.
– Data interchange standards: e.g. **RCP**, **Protocol buffers**, **JSON**, **FITS**, **XML…**

Research in Numerical Analysis

– ***Leading expert*** in **data reduction** & **image processing** for astronomical cameras:
algorithm development & implementation, statistical analysis, noise rejection, correlation analysis, conditioning, optimal filtering, efficient numerical methods, large data volumes, robust estimation, weak signals, multithreaded parallel processing (2002 –).

– Real-time digital **signal processing**:
high-data rates (~1 GSPS), algorithm development & implementation, analysis in time and spectral domains, optimal filtering, model fitting, weak signals, parallel processing, Linux hardware control & communication (over PCIe, USB, ethernet). (2002 –)

– Optimal **data collection strategies**:
innovative (telescope) observing modes to maximize data quality, sampling & down-sampling, analog / digital anti-alias filtering. (2002 –)

– **Statistical analysis, simulations** and **modeling** of astrophysical data:
algorithm development, probabilistic and noise analysis, model fitting, model formulation / parametrization / fitting, global minimum searches via stochastic methods, synthetic datasets for testing data reduction or modeling algorithms/approaches.