UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

cta cherenkov telescope array

The Swiss Contributions to Cherenkov Telescope Array

teresa.Montaruli@unige.ch

24 Nov. 2020

Switzerland : a funding member of CTA GmbH

- CTA listed as emerging project in the **ESFRI roadmap of 2006.**
- UZH, UNIGE, ETHZ joined the CTA Consortium (CTAC) in 2007.
- Since 2009 the Swiss groups have been supported by SNF (Div. 2, 3 Sinergia grants, 2 FLARE grants) for the preparation phase
- In 2012 a "Declaration of Interest (DoI) for the pre-construction phase" was signed by the funding agencies and ministries of 13 countries (of which 8 are European).
- In 2014 UZH, DESY and INAF funded the CTAO gGmbH
- A Swiss Steering Board coordinates the Swiss involvement in CTA and this structure and will evolve in the future into **CTAO-CH collaboration with its steering board.**
- Prof. Straumann CTAO GmbH Director (2016-2018), signed CTA North agreement with IAC

Liste der Gesellschafter
und der übernommenen Geschäftsanteile
Cherenkov Telescope Array Observatory gemeinnützige GmbH
mit dem Sitz in Heidelberg
AG Mannheim, HRB neu

Lfd. Nummer	Gesellschafter	Wohnsitz/Sitz	Geb.-Datum	Geschäftsanteile in EUR

1 — 16.000,00 Euro
Deutsches Elektronen-Synchrotron DESY
Stiftung bürgerlichen Rechts
mit dem Sitz in Hamburg
Anschrift: Notkestr. 85, 22607 Hamburg

2 — 8.000,00 Euro
Istituto Nazionale Di Astrofisica (INAF)
mit dem Sitz in Rom
Anschrift: Viale del Parco Mellini, 84, 00136 Rom/Italien

3 — 1.000,00 Euro
Universität Zürich
öffentlich rechtliche Anstalt des Kantons Zürich
mit eigener Rechtspersönlichkeit
Anschrift: Künstlergasse 15, 8001 Zürich/Schweiz

gesamt — 25.000,00 Euro

München, den 29.07.2014

Dr. Werner Hofmann
Geschäftsführer

H:\sr\GmbHs 2014\Cherenkov Telescope Array Observatory GmbH\Liste der Gesellschafter

CTA: a project of national and International relevance

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department for Economic Affairs, Education and Research EAER

State Secretariat for Education, Research and Innovation SERI
National research and innovation

SERI/NFI

Swiss Roadmap for Research Infrastructures in view of the ERI Dispatch 2017-2020

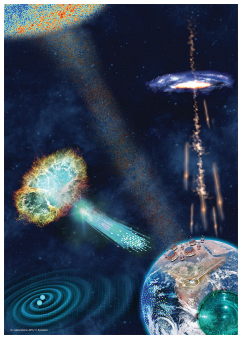
(Roadmap for Research Infrastructures 2015)

Document acknowledged by the Federal Council as an outline paper for the ERI Dispatch 2017-2020 on 24 June 2015

Swiss Roadmap for Research Infrastructures in view of the 2021–2024 ERI Dispatch

(Roadmap for Research Infrastructures 2019)

Document acknowledged by the Federal Council on 17 April 2019 as an outline paper for the 2021–2024 ERI Dispatch



APPEC

https://www.appec.org/roadmap

- The request submitted in 2015 for the inclusion in the **Swiss Roadmap of Research Infrastructures of the State Secretariat for Education, Research and Innovation (SERI)** was succesful

- CTAO is in the Swiss Roadmap of the Swiss Institute of Particle Physics (**CHIPP**) since 2015 and is mentioned in the past **CHAPS** roadmap, which is being updated. First recomendation of APPEC Roadmap.

- CTAO promoted as **landmark of ESFRI in 2018** (RIs that reached an advanced Implementation Phase and that represent major elements of competitiveness of the European Research Area (ERA) with ELT, SKA, and other physics RI (ELI, ESS, XFEL, FAIR, HL-LHC).

- The University of Zurich withdrew its representat transfered the representation of CTA to UNIGE and from **Nov. 2019** UNIGE is the representative Institute of CTAO in Switzerland. Transfer of votes effective on Nov. 2020.

- Nov 30 Proposal to SERI for continuation of work including EPFL and still UZH scientists

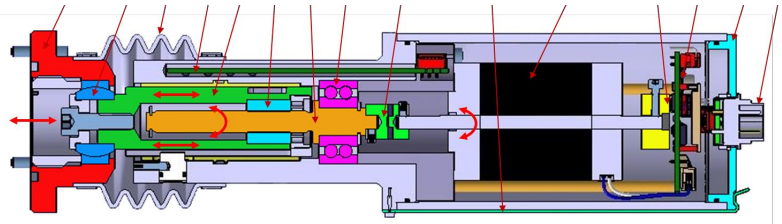
CTA community in Switzerland

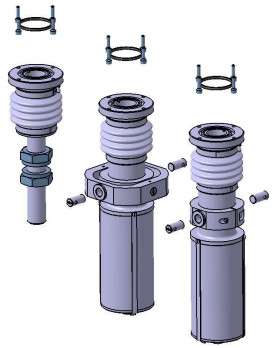
Institute	Current Active FTEs	Cumulative FTEs since CTA start
ETH Zurich	Prof. A. Biland (50%) + 1 postdoc (90%)	2
UNIGE- DPNC	Prof. T. Montaruli (70%) + Dr D. Della Volpe (100% MER) + Dr M. Heller (100% Coll. Sci) + 4 postdocs (100%) + 2 PhDs	14
UNIGE ISDC	Dr. R. Walter (90%) + N. Produit (Coll. Scient., 30%), Eng. E. Lyard (100%) + 4 postdocs (100%)	8
UNIZH	Prof. S. Prasenjit (20%)+ Prof. F. Cannelli (5%) + 1 postdoc (100%)	9
Total		33

And more interested in HE Astrophysics

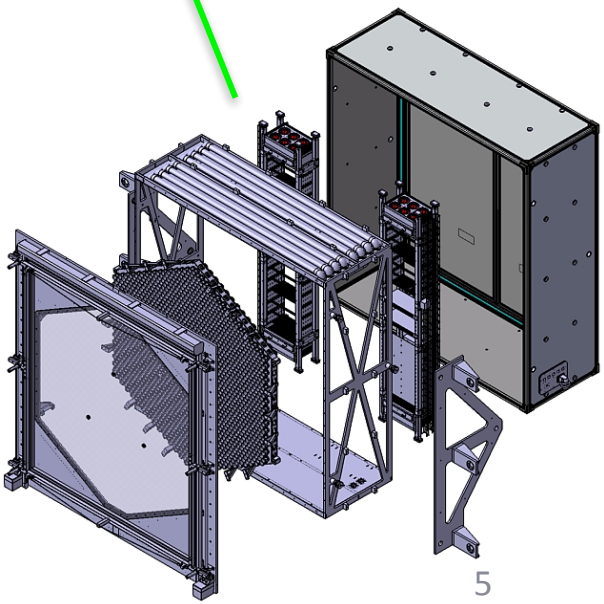
Some of our past activities:

- **FlashCam**
  - UZH has designed and built the camera mechanics & cooling and the safety and power control system for FlashCam Prototype taking data on HESS II
  - Participate in Quality Control of the Photo-detection modules (66 module tested by UZH (~25% of the total)
- **Mirrors' Actuators: UZH has design the actuator originally for LSTs and it was decided to use them also for MSTs**
  - Pilot production of 60 actuators (D-Serie);
  - Some redesign in fixations taken over by MPI Munich which will produce them for LST;
  - the design and IP transferred to MST has also a 'licence' to produce them.



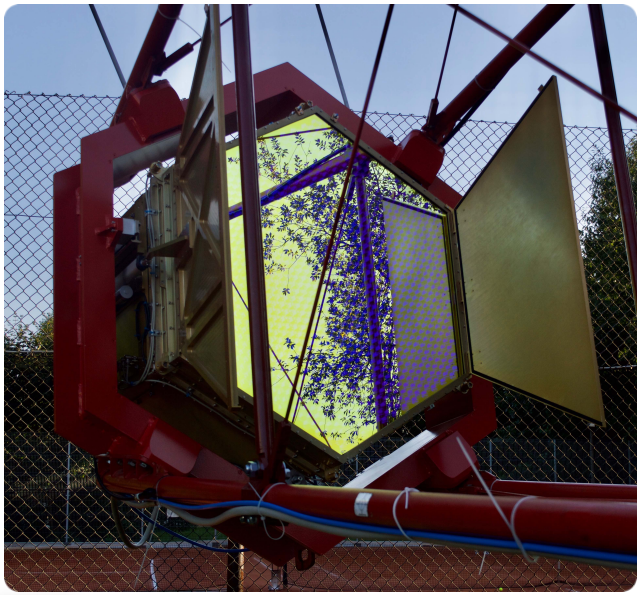


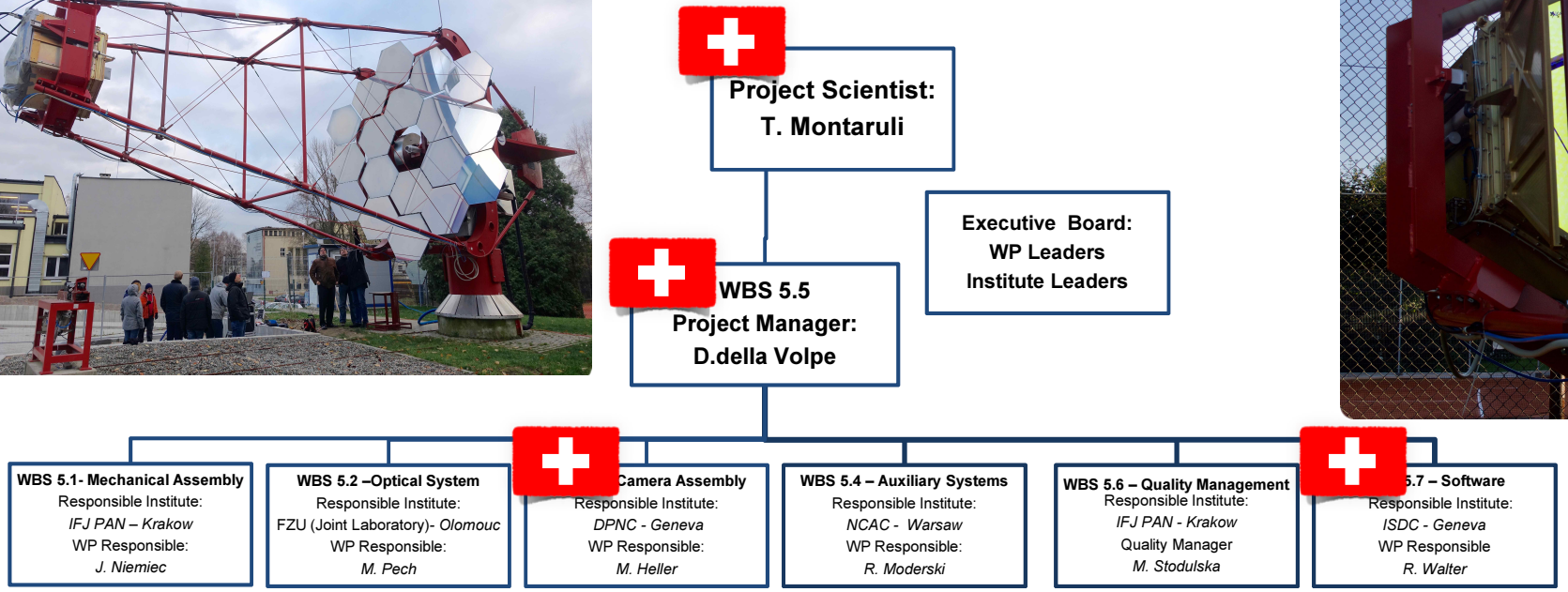
CTA Actuator



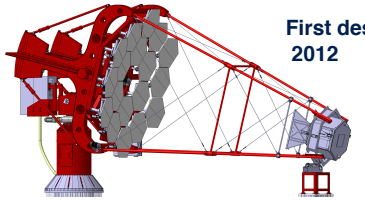
The SST-1M project

- UNIGE driven project, inheriting from FACT (ETHZ) (see A. Biland's)
  - PI: T. Montaruli, Project Manager: D. Della Volpe, Camera coordinator: M. Heller(UniGe/DPNC)
  - Software coordinator: R. Walter (UniGe/ASTRO)
  - With Polish and Czech Consortia involved countries with 52 people (and about 27 FTE)
- advancing technology for production of 70 telescopes



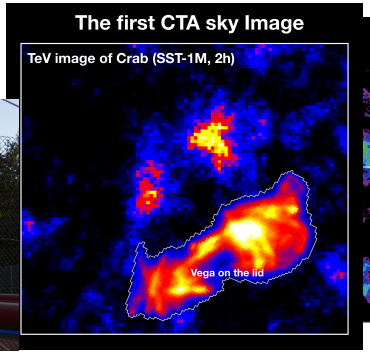


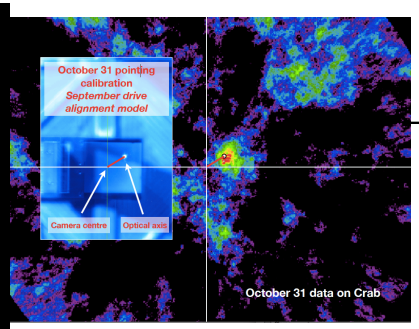
The SST-1M timeline



First design
2012

Structure deployed in Krakow
November 2013





First gamma Event
August 2017 (one week later)

4σ Crab observation
October 2017

F2F review meeting
March 2019

2012

2013

Official Structure inauguration
February 2014

2014

Year of consolidation
of documentation

2015

Year of standardisation
of documentation

CDR Review

2016

Camera ready at UniGE
For validation

2017

Prototype fully operational
August 2017

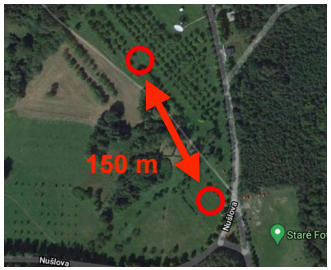
2018

Start of Harmonisation
March 2018

Start of Review
Process
October 2018

2019

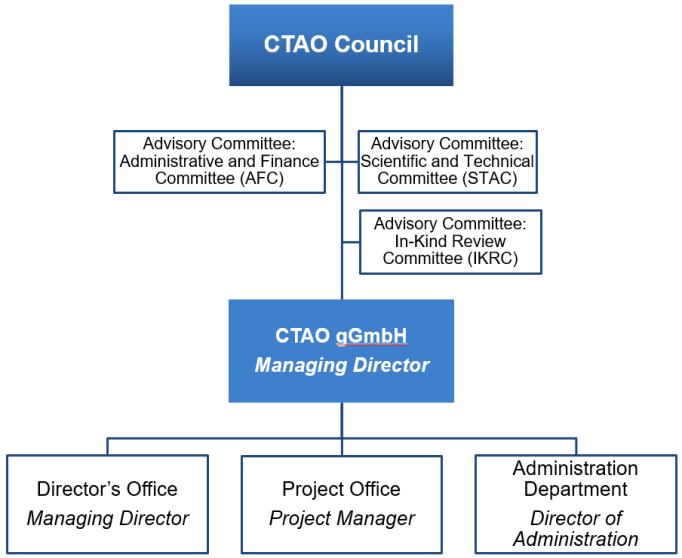
2021



Two SST-1M will be installed at the Ondrejov observatory, 40 km from Prague, by end of 2021. To be operated in stereo with 150 m distance.
We will observe Crab and monitor blazars.

The developed know-how has been widely recognised towards current LST commitments

The Swiss representation in the CTA Observatory (CTAO) organisation



See Prof. Ferrini's talk

Current representation:

- ***Council***: CTAO steering board (Chair: G. Chardin). CH members: X. Reymond, TM
- ***Board of Governmental Representatives (BGR)***: A. Biland, X. Reymond, TM, relevant CTAO ERIC documents, Chair: A. Covello.
- ***STAC***: advising board to Council (renewal ongoing, JP Kneib proposed by CH)
- ***Administrative and Finance Committee (AFC):*** *L. Ognois. Administrative and legal matters of financial management.*

- Two steps are critical at this time:
  - Establishment of **CTAO ERIC:** application process requires a phase 2 submission. If succesful, inauguration foreseen in Aug. 2021.
  - Definition of the best configuration to fit ~280MEuro available from shareholders, maximizing possible science output. A critical role are discussions driven in the newly formed **Transition WG** (including X. Reymond as representative of Council)

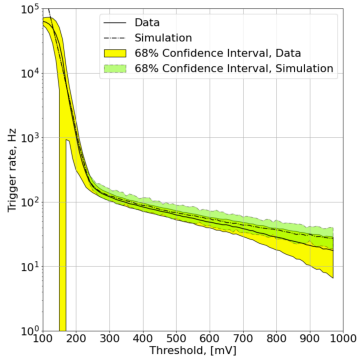
Large Size Telescope at La Palma

Photo credit: D. Kerszberg

Swiss scientist's role in LST

UNIGE DPNC

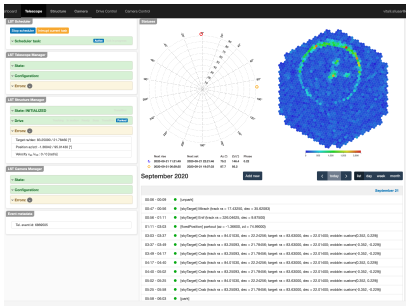
- Data analysis pipeline
- Data/Monte Carlo validation



L1 trigger rate data/MC comparison

UNIGE ASTRO

- Telescope Control Unit
- Engineering GUI



LST Observation scheduler

Steering Committee — Composed by Party representatives — Chair: M. Martinez — Ex Officio: M. Teshima, Ex Officio: J. Cortina, Ex Officio: D. Mazin

Version 8.24

LST EXECUTIVE BOARD

LST Project Office

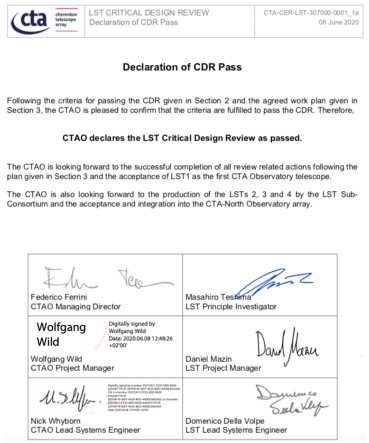
- Telescope Manager: P. Marquez
- Principal Investigators: M. Teshima / J. Cortina
- Project Manager: D. Mazin
- Deputy: M. Will
- Lead Systems Engineer: D. Della Volpe
- Deputy: M. Heller
- Safety and Operations coordinator: M. Will
- Outreach: D. Green
- QA/RAMS: J. M. Miranda
- Interfaces and Integration

Mechanical System	Telescope Control	Data Analysis Software	Optical System	Camera Integration	FPI / Electronics	Aux systems	SiPM R&D
Crd: T. Schweizer Dep. H. Wetteskind Struct. Eng.: J. Eder	Crd: T. Le Flour Dep. K. Noda	Crd: A. Moralejo Dep. R. Lopez Coto	Crd. K. Noda Dep.: M. Teshima	Crd.: C. Delgado Deputy: T. Saito Prod.: C. Diaz	Crd.: H. Kubo Dep.: R. Paoletti Prod.: T. Saito	Crd.: A. Fiasson Prod.: E. Chabanne	Crd.: M. Heller Dep.: F. Di Pierro Prod:
Dish&Lower Structure H. Wetteskind	TCU Ie. Vovk V. Sliusar	Raw Data Calibration J. Sitarek	Primary Mirror T. Inada	Mechanics & Cooling C. Diaz	Photo-detectors T. Yamamoto	Drive Control System I. Monteiro	Simulations and Specs NN
Camera Support Structure G. Deleglise	Camera C. Pio	Onsite analysis T. Saito	AMC M. Chikawa S. Fukami	Embedded Camera Control J. Prast	Readout H. Kubo	Global monitoring T. Le Flour	Photo-detectors NN
Tension Ropes M. Mariotti	AMC S. Fukami	Monte Carlo A. Moralejo		DAQ T. Saito D. Hoffmann	Trigger G. Martínez	Pointing Calibration K. Noda	Readout R. Hermel
Foundation, Rails & Bogies J. Mundet	Drive T. Le Flour	Offline calibration F. Cassol		Clock J.A. Barrio	Light Guide T. Yamamoto	Camera Calibration M. Iori	Mechanics and Cooling NN
Structural Verification J. Eder	Power K. Noda	Data quality I. Aguado		LST1 camera operation O. Blanch		Power Distribution M. Teshima	Integration with PMT Camera D. Mazin
		RealTime T. Vuillaume				Cabling E. Chabanne	
		X-calib MAGIC NN					

- IAC — J. Herrera
- OES — T. Le Flour
- DPPS — A. Moralejo
- Site / INFRA — P. Marquez
- Onsite IT — D. Hadasch
- Offsite IT — J. Delgado
- MAGIC — M. Teshima

UNIGE DPNC:

- System engineering with main focus on CDR follow-up



LST CRITICAL DESIGN REVIEW
Declaration of CDR Pass

CTA-CER-LST-3070000-0001_1a
08 June 2020

Declaration of CDR Pass

Following the criteria for passing the CDR given in Section 2 and the agreed work plan given in Section 3, the CTAO is pleased to confirm that the criteria are fulfilled to pass the CDR. Therefore,

CTAO declares the LST Critical Design Review as passed.

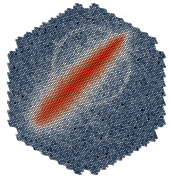
The CTAO is looking forward to the successful completion of all review related actions following the plan given in Section 3 and the acceptance of LST1 as the first CTA Observatory telescope.

The CTAO is also looking forward to the production of the LSTs 2, 3 and 4 by the LST Sub-Consortium and the acceptance and integration into the CTA-North Observatory array.

Federico Ferrini, CTAO Managing Director
Masahiro Teshima, LST Principle Investigator
Wolfgang Wild, CTAO Project Manager
Daniel Mazin, LST Project Manager
Nick Whyborn, CTAO Lead Systems Engineer
Domenico Della Volpe, LST Lead Systems Engineer

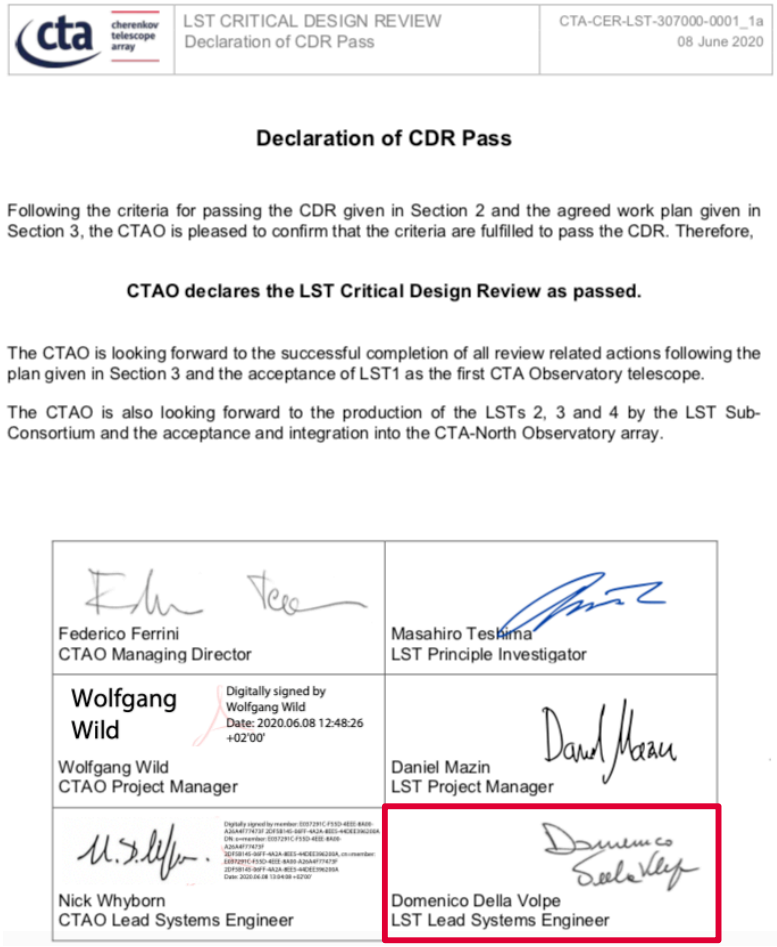
UNIGE DPNC/EPFL/ETHZ

- Project coordination
- R&D activities on sensor, front-end electronics and digital readout



The Swiss scientist's role in LST: System Engineering

- CDR passed and follow-up actions to **end of 2021** before Acceptance to the site
  - Reliability, Availability and Maintainability
  - Requirement and Verification
  - CE certification
  - Interfaces to CTAO
  - **Introduced** Documentation version controlled system **(EDMS) to be adopted also by CTAO**
- **LST-1 completion of commissioning**
- **LST2-4 Construction**
  - Tendering process follow-up
  - Managing the IKC from all collaborators
- Introduced regular meetings with CTAO, appreocated even in the November Council as example of CTAO-project cooperation



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Federico Ferrini
CTAO Managing Director

Masahiro Teshima
LST Principle Investigator

Wolfgang Wild
Digitally signed by Wolfgang Wild
Date: 2020.06.08 12:48:26 +02'00'
Wolfgang Wild
CTAO Project Manager

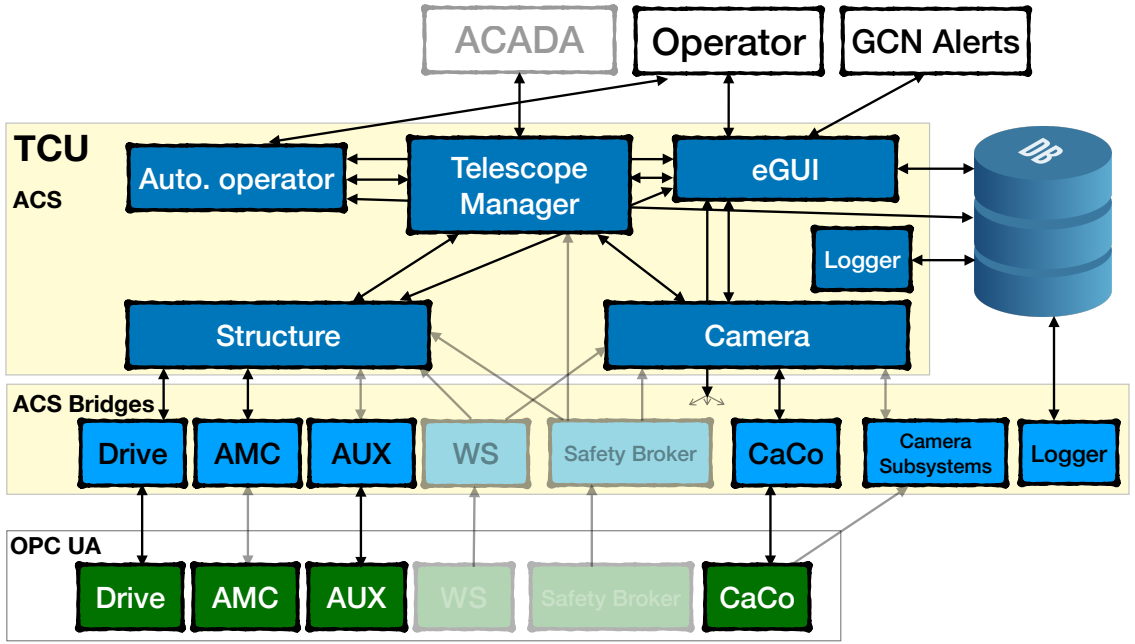
Daniel Mazin
LST Project Manager

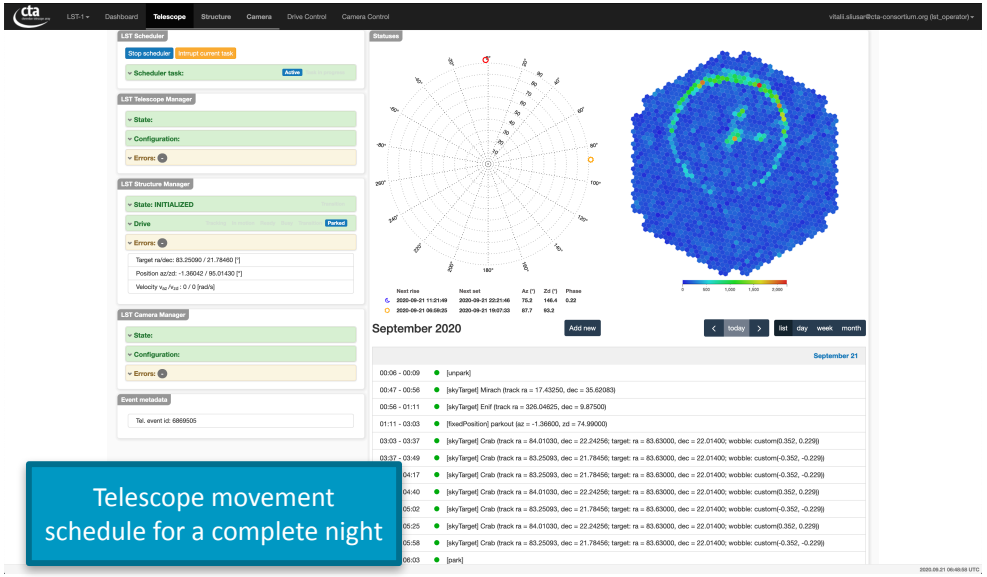
Nick Whyborn
CTAO Lead Systems Engineer

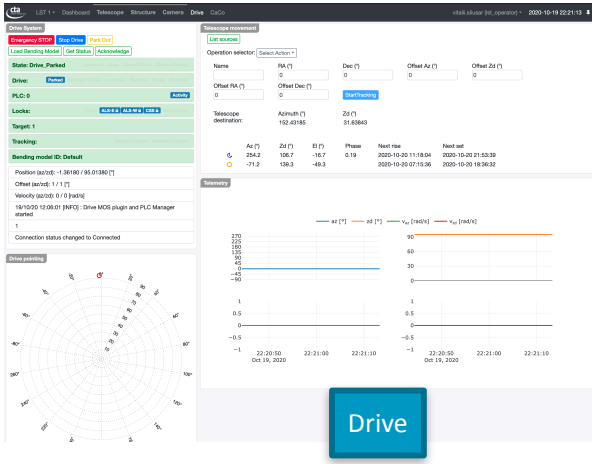
Domenico Della Volpe
LST Lead Systems Engineer

The Swiss scientist's role in LST: TCU

- **TCU is based on ACS and implements ACADA control Application Programming Interface (API)**
- **Existing components:**
  - Telescope Manager
  - Structure and Camera independent state machines
  - Web-based engineering GUI (eGUI)
  - Automatic operation executor (Scheduler)
  - Loggers

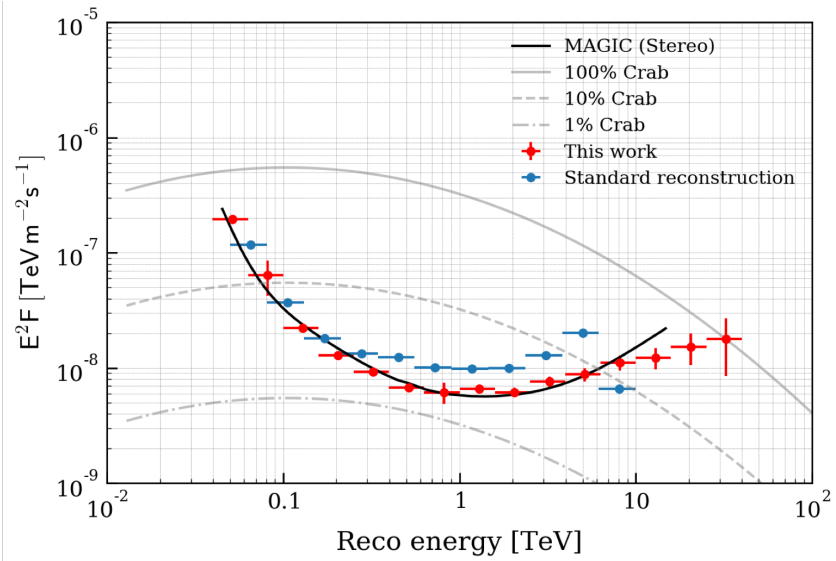






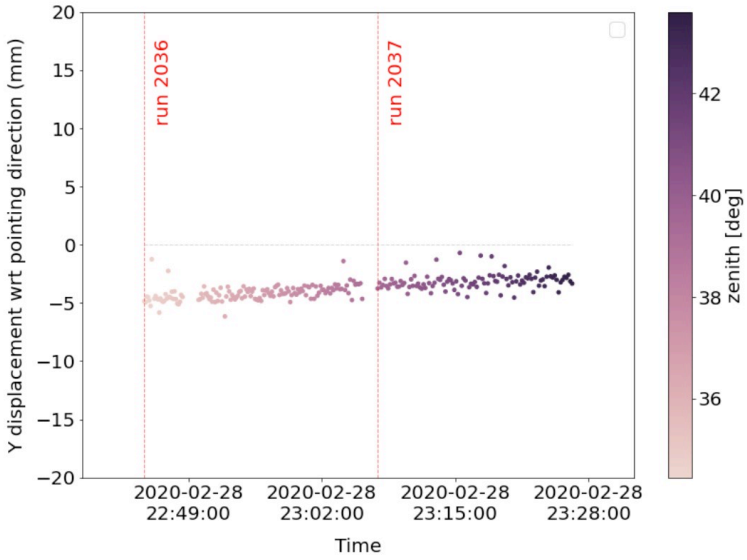
The Swiss scientist's role in LST: Data Analysis

- Data Analysis Pipeline:
  - Likelihood image fit exploiting calibration and timing information at their best
  - Data Level 2 framework
- Data/Monte Carlo validation:
  - L1 trigger scan
- Pointing activities:
  - Using star tracking



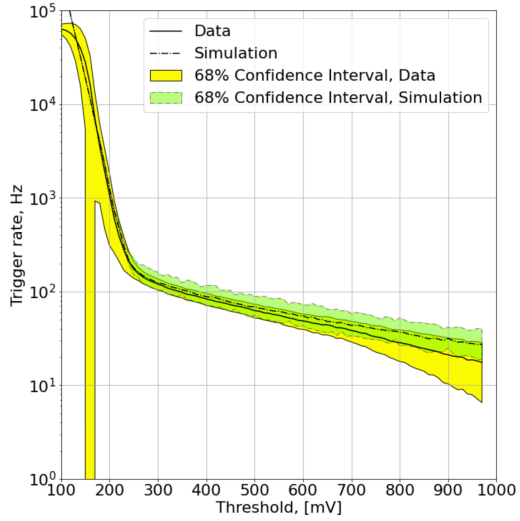
Sensitivity obtain with LHFit analysis (optimised θ^2 cuts)

See C. Alispach's and E. Lyard's posters



Camera center displacement extracted using star tracking vs. time

See L. Foffano & A. Carosi's poster



Data/MC comparison for L1 trigger rate scan

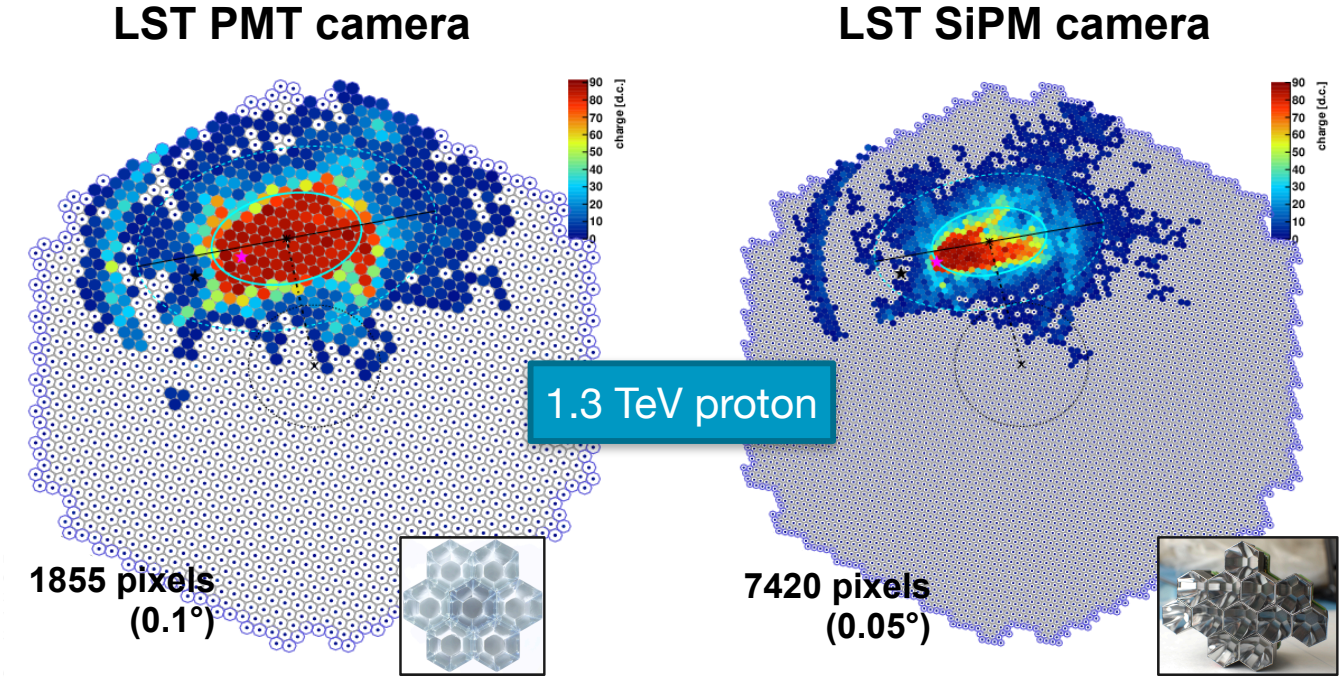
See M. Dalchenko's poster

The Swiss scientist's role in LST: R&D

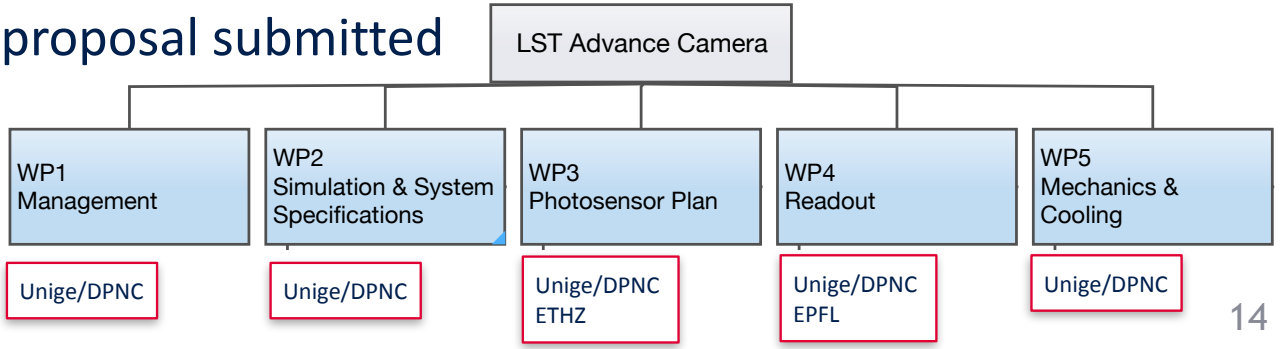
- Develop the next generation of camera for IACT using SiPMs to outperform PMT-cameras

- The challenge is to do it for the LST:
  - large number of pixels
  - high night sky background
  - Low power consumption
  - High data throughput
  - Reasonable cost

- R&D plan:
  - Front-end ASIC
  - FADC ASIC
  - Innovative trigger approach

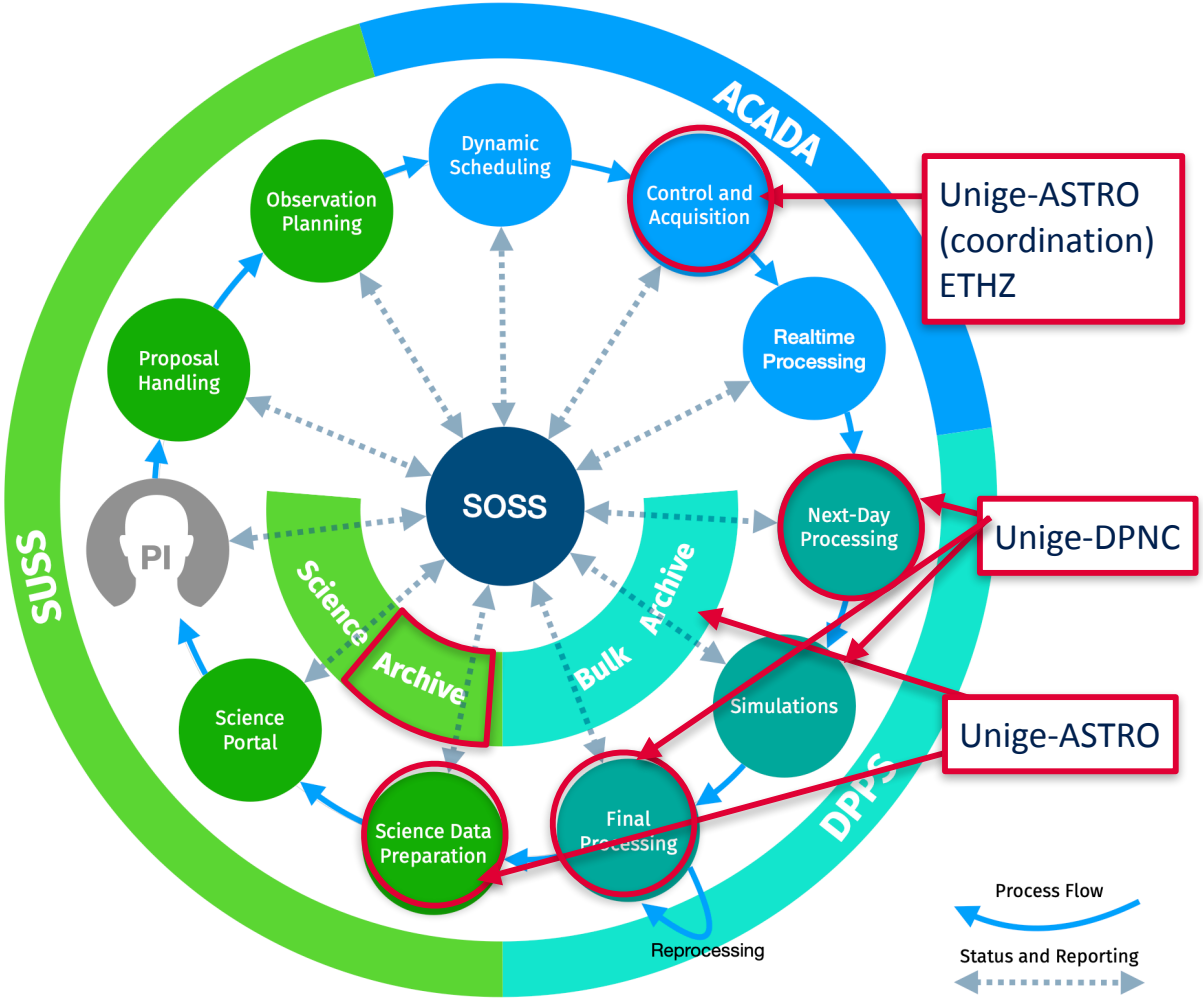


FLARE proposal submitted



More in E. Charbon's talk

Future of ACADA and DPPS activities in Switzerland



- **ACADA - Array Control And Data Acquisition** WP develops the software to operate CTA
- **UNIGE coordinates the Array Data Handler (ADH),** which handles the raw data from the telescopes.
- **DPPS (Data Processing and Preservation System)** stores, process and distributes CTA Science data
- LoIs submitted by Institutes and approved by CTAO, then followed by an MoU with financial commitments

Item		FTEs (2021-2028)	Institutes
1	ACADA ADH	15.2	UNIGE-Astro, ETHZ
2	DPPS Data Quality	18	UNIGE-DPNC
3	DPPS Archive	6	UNIGE-ASTRO, ETHZ
4	DPPS Machine Learning	6	UNIGE-ASTRO
5	SUSS Event broker	6	UNIGE-ASTRO
	Total	51.2	

KSP OF CURRENT CH INTEREST

https://arxiv.org/abs/1709.07997

- ***Understanding of the origin of the cosmic rays*** in a multi-messenger context
- ***Probing extreme environments,*** such as neutron stars, black holes and gamma-ray bursts, **t**he physics of the jets and how particles are accelerated by them;
- ***The Galactic plane Survey***;
- ***Exploring frontiers in physics***, such as the nature of Dark Matter in the Galactic Centre, axions and their interplay with magnetic fields and photons, the extragalactic background light and how it informs on galaxy formation, and quantum gravitational effects in photon propagation.

- ***See*** **afternoon sessions for the preparation of which we had**
  A big thanks to all who participated!!