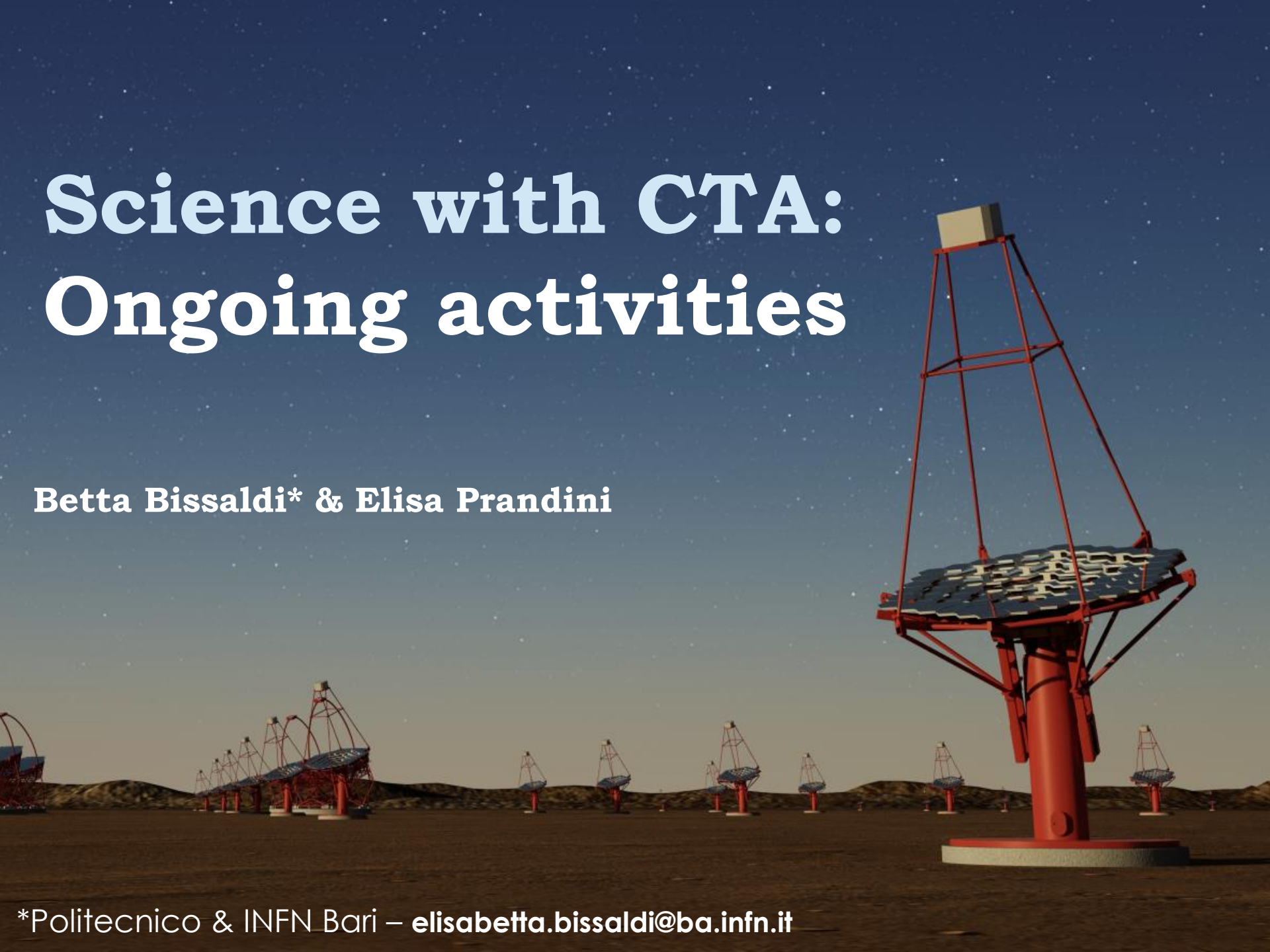
Science with CTA: Ongoing activities



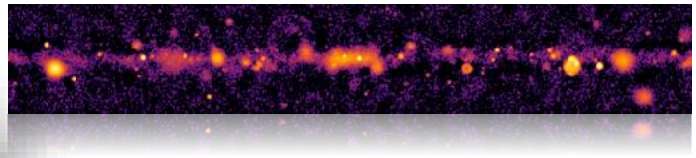
Betta Bissaldi* & Elisa Prandini

*Politecnico & INFN Bari – **elisabetta.bissaldi@ba.infn.it**

PHYS priorities in 2019

(CP Simulations)

PHYS IRFs Simulations

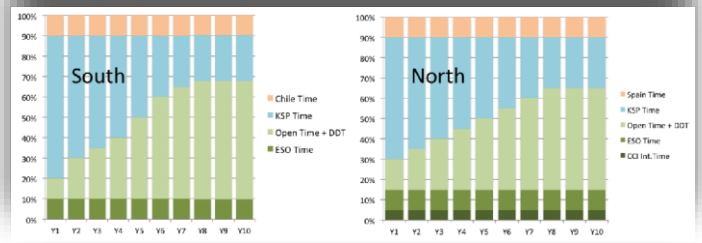


Consortium publications

Priorities

MM/MWL connections

KSP reassessment



By René Ong

+ Phase 1 Configuration

Some PHYS topics

- Studies of Phase 1 Config. (Council now specifies Phase 1 = Threshold)
- MWL/MM: documents/tables on Redmine – need finalizing; plan for CTA-SKA white paper; also communication with Athena and Theseus
- Consortium publications (CP): most making good progress, others on longer time scale
- CP highlights at the Bologna Consortium Meeting: LMC and PeVatrons
- Lots of activity in the parallel sessions (perhaps have PHYS meeting in fall in future?)

By René Ong

ASWG Topics

- Improving air-shower simulations: faster, better hadronic models
- Telescope MC model updates – v. good progress
- Prod 3b MC-based IRFs (Phase 1, tighter cuts)
- Analysis pipeline development (overlap w. CTAO): prototype DL1 data model; "protopipe" work
- Machine learning task force: see Tue morning ASWG session
- Calibration of prototype cameras

PHYS General Impressions

- **Rather good!**
  - <5 months since Lugano, including the summer break – but
  - **significant progress** in many areas, nonetheless.
  - Science Working Groups are all **active** and **well-organised**, with **regular calls** and focussed **task group meetings.**
  - Consortium publications have provided **critical focus**.
  - Coordination *between* groups is also good, with **clearly defined responsibilities.**
  - Coordination with the **observatory** also important.
- **Issues**
  - PHYS session attendance and interactivity is not always great
  - Collaborative software tools are not adequate.

At the Consortium Meeting

- Only a few requests for general PHYS contributed talks

- But plenty of active parallel sessions:
  - Galactic Plane/Cosmic Ray Diffuse x 2
  - Stellar Intensity Interferometry.
  - Dark Matter.
  - MWL/MM Needs.
  - Phase I configuration discussion (with CTAO & ASWG)

- Placing PHYS sessions not parallel (perpendicular?) with other PHYS sessions seems to be a good approach (and also avoid ASWG, where possible)

Consortium Publications

- Good progress since Lugano

- Under review within the working groups:
  - Gamma-ray Propagation
  - Galactic Center Dark Matter search.

- Advanced papers highlighted in plenary at this meeting:
  - PeVatrons (Agunar, final talk today)
  - LMC survey (Martin, 9am tomorrow)

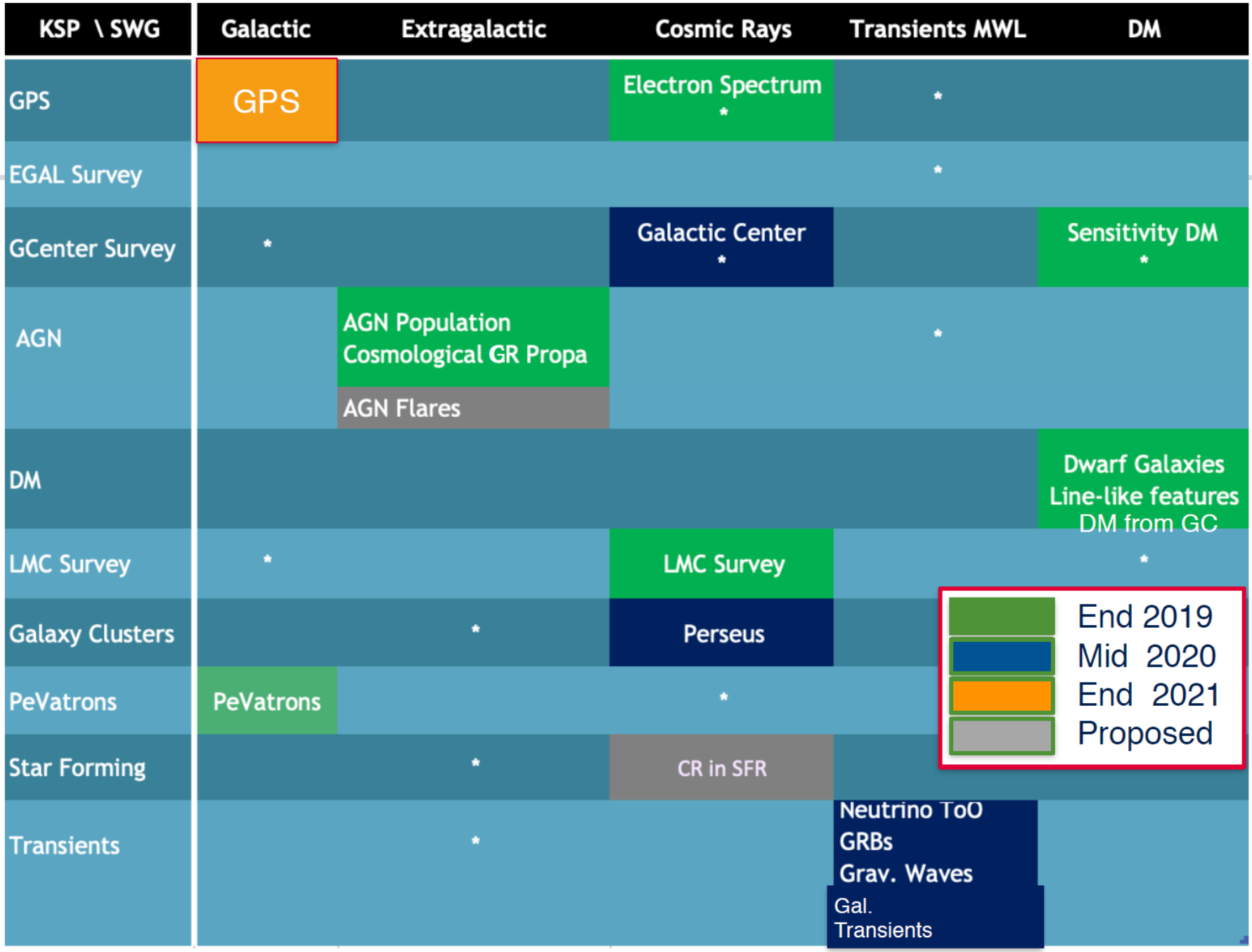
- Additional consortium publications also in advanced draft form.
- Plus numerous non-consortium publications.

By Emma dOW

	Paper title	SWG	Editorial board
1	Prospects for the Detection of Gamma Ray Emission from the Perseus Galaxy Cluster with CTA	CR/Diffuse/Dark Matter	Gianfranco Brunetti, Moritz Hütten, Judit Pérez-Romero, Miguel Sánchez-Conde, Stephan Zimmer
2	The Sensitivity of CTA to Electrons at the Highest Energies	CR/Diffuse	Daniel Parsons, Harm Schoorlemmer, Rubén López-Coto
3	Prospects from a deep survey of the LMC with CTA	CR/Diffuse/Dark Matter/Galactic	Maria Isabel Bernardos, Fabio Iocco, Pierrick Martin
4	High-energy astrophysics of the Galactic Center region with the Cherenkov Telescope Array	Diffuse/CR, Galactic	Aion Viana, Daniele Gaggero, Dario Grasso, Dmitry Malyshev, Karl Kosack, Stefan Funk
5	PeVatron sensitivity with CTA	Galactic	Ekrem Oguzhan Anguner, Heide Costantini, Pierre Cristofari, Cyril Trichard, Gaia Verna
6	Survey of the Galactic Plane with the Cherenkov Telescope Array	Galactic	Acero F., et a. (lots of people)
7	Neutrino Target of Opportunity program for the Cherenkov Telescope Array	Transient/MWL/ Extragalactic	Elisa Bernardini, Anthony Brown, Marcos Santander, Konstancja Satalecka, Fabian Schussler
8	Detection rates and studies of Gamma Ray Bursts with the Cherenkov Telescope Array	Transient/MWL	G. Ghirlanda et al. (lots of people)
9	Chasing the counterpart of gravitational wave alerts with the Cherenkov Telescope array: prospect and strategy	Transient/MWL	A. Stamerra, B. Patricelli, T. Di Girolano, A. Carosi, F. Schüssler
10	Active Galactic Nuclei population studies at the very high energies in the Cherenkov Telescope Array era	Extragalactic	Tarek Hassan, A. Brown, A. Dominguez, B. Fraga, M. Nievas-Rosillo, A. Zech
11	Probing cosmological gamma-ray propagation with the Cherenkov Telescope Array	Extragalactic	Jonathan Biteau, Manel Meyer, Ievgen Vovk, Julien Lefaucheur, Humberto Martinez Huerta
12	Sensitivity of CTA to a dark matter signal from the Galactic center region	Dark Matter	Torsten Bringmann, Christopher Eckner, Anastasia Sokolenko, Lili Yang, Gabrijela Zaharijas
13	Search for Dark Matter in Dwarf Spheroidal Galaxies with the Cherenkov Telescope Array	Dark Matter	Michele Doro, Aldo Morselli, Gonzalo Rodriguez Fernandez, Francesco G.Saturni
14	Sensitivity of CTA to Line-like features from Dark Matter.	Dark Matter	Eirik Hatlen, Clara Bertinelli Salucci, Heidi Sandaker and Torsten Bringmann

Consortium Publications

https://portal.cta-observatory.org/Bodies/SAPO/Consortium%20Publication%20List/Forms/Ext_Doc_view.aspx


KSP \ SWG
Galactic
Extragalactic
Cosmic Rays
Transients MWL
DM
GPS
EGAL Survey
GCenter Survey
AGN
DM
LMC Survey
Galaxy Clusters
PeVatrons
Star Forming
Transients
GPS
Electron Spectrum
Galactic Center
Sensitivity DM
AGN Population
Cosmological GR Propa
AGN Flares
Dwarf Galaxies
Line-like features
DM from GC
LMC Survey
Perseus
PeVatrons
CR in SFR
Neutrino ToO
GRBs
Grav. Waves
Gal.
Transients
End 2019
Mid 2020
End 2021
Proposed

SWG

1. Transient/MWL (Fabian Schussler + Franz Longo)
2. DM and exotic physics (Miguel Sanchez-Conde + Gabi Zaharijas)
3. Extragalactic (Jonathan Biteau + Pepa Becerra)
4. Cosmic Rays (Elena Amato + Daniele Gaggero)
5. Galactic (Andrea Giuliani + Luigi Tibaldo)

Galactic WG report

- Slide di riferimento di Andrea Giuliani (INAF/IASF) e Luigi Tibaldo (IRAP) al Bologna CM:
- https://indico.cta-observatory.org/event/2249/contributions/21788/attachments/16326/21172/GALSWG_CTAC201910_v2.pdf

GAL SWG activities

- Involved in 4 KSP-based consortium publications, with leading role for 2 of them
  - **Galactic Plane Survey**
  - **PeVatrons**
  - LMC survey (led by CR SWG)
  - Astrophysics of the Galactic center region (led by CR SWG)
- Several non-consortium science projects
- Active in preparatory tasks for the science phase, e.g., identification of multiwavelength needs

Motivations and working plan

- CTA will be able to perform the first complete survey of the Galactic plane, with a sensitivity a factor of ~5 better than existing instruments
  - constrain the physics of Galactic source populations
  - study Galactic diffuse emission
  - provide legacy dataset and seed the GO program
- Working plan:
  - Optimisation of survey strategy
  - Simulations of observations based on latest IRFs and state-of-the-art sky models
  - Test of methodologies/tools to derive source catalogs and discussion on multiwavelength support/follow-up
  - Identification of candidates for deeper gamma-ray observations (notably PeVatrons, binaries, pulsars)
  - Test of methodologies to characterise diffuse emission and contributions to diffuse emission from unresolved source populations
  - Discussion on limitations driven by systematic uncertainties and source confusion
  - Guide future refinements of the observing program and provide reference sensitivity for future work

80% done!

Motivations and working plan

- Mechanism/sources accelerating CRs to the knee (PeV) still poorly understood
  - CTA (especially CTA-S with its SSTs) will have unprecedented capabilities to identify and study PeVatrons
  - KSPs allocate 250h total time to study the 5 most promising PeVatron candidates
- Contributors: Ozi Anguner, Heide Costantini, Pierre Cristofari, Cyril Trichard, Gaia Verna, Franca Cassol
- Working plan:
  - Define metric to identify PeVatron candidates in GPS data
  - Define methodology for PeVatron candidate ranking
  - Test on synthetic SNR PeVatron population to asses CTA potential (on halt since Cyril left CTA)
  - Also discuss examples of existing PeVatron candidates, e.g., HESS J1641
- Few highlights follow, for more see Ozi's talk in PHYS plenary session

Rapporto meeting mensili

- Censimento «generale» Ottobre 2018
  - 3 sezioni: Bari (7), Padova (13), Torino (8)
- Censimento PHYS Ottobre 2018
  - Bari (5), Napoli (1), Padova (8), Roma (3), Torino (8), Trieste/Udine (5)
    - 30 persone interessate ai meeting
- Riunioni
  1. 9 Ottobre 2018
  2. 13 Novembre 2018
  3. 18 Dicembre 2018
  4. 21 Gennaio 2019
  5. 18 Febbraio 2019
  6. 19 Marzo 2019
  7. 16 Aprile 2019
  8. 28 Maggio 2019
  9. 2 Luglio 2019
  10. 17 Settembre 2019
  11. 5 Novembre 2019

Presenze:
All'inizio: 14 persone in media
Adesso <10 persone

Agenda Meeting e lista conferenze

- Documento Google condiviso:

https://docs.google.com/document/d/1QcxaJz9REjn3YpZukrIv-01IbVVEIHOP53ATN0pXxsI/edit#

  - Agenda e minute di tutti i meeting
  - Coordinamento **conferenze**, lista con date e deadlines!

BACKUP

Project phases

- **Phase-I:** construction phase, planned to run until the configuration decided for phase-I is complete.
  - Commissioning
  - Acceptance by CTAO
  - System integration
  - Use of the integrated elements → **science verification**

- **Phase-II:** operations of the configuration decided for phase-I.

Additional construction towards baseline configuration depending on funding

  - **KSPs** start + **regular PI proposals**

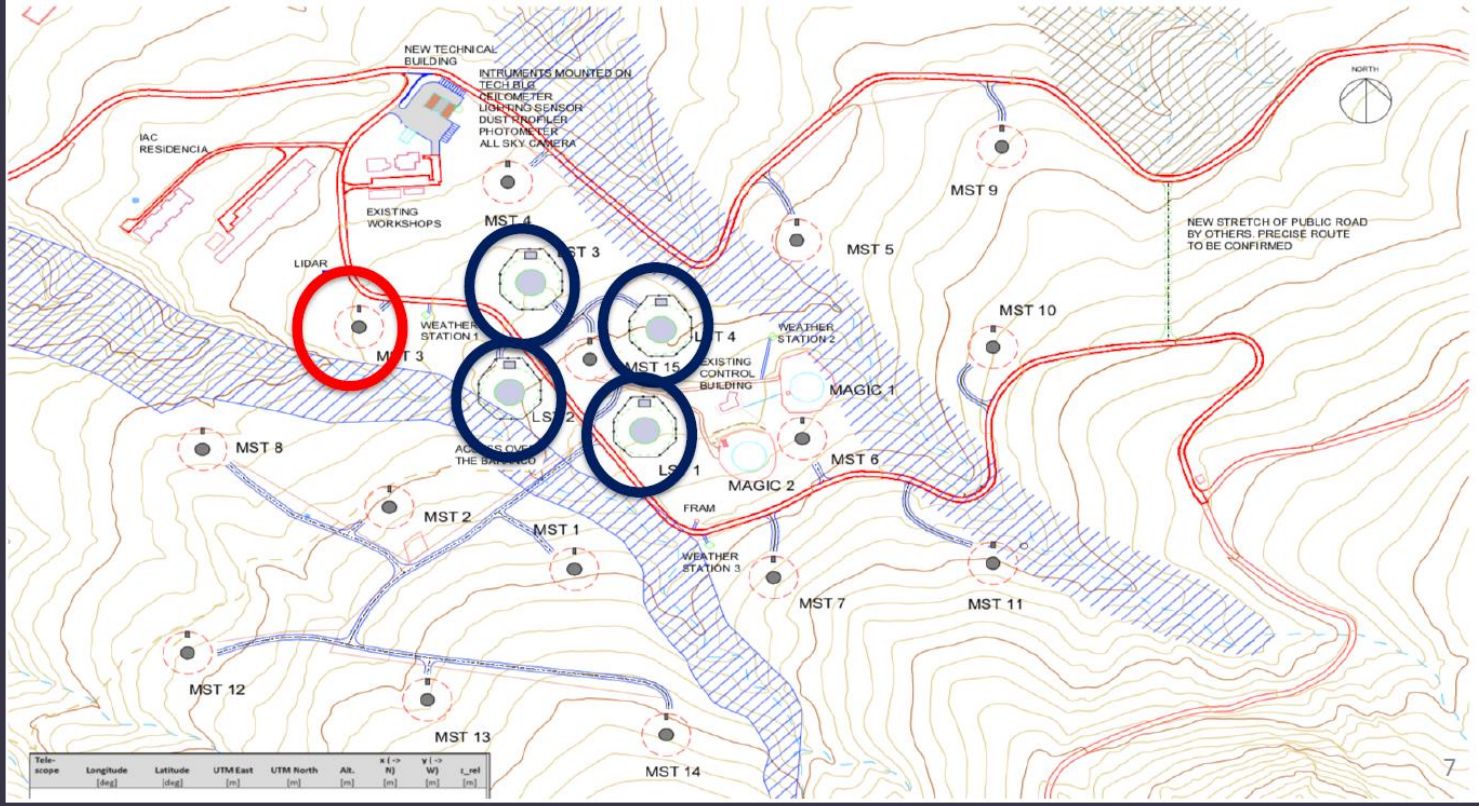
Configurations for phase-I

- **Council reaffirmed its consensus on the "threshold" configuration**
  - **CTA-N**: 4 LSTs + 5 MSTs
  - **CTA-S**: 15 MSTs + 50 SSTs
  - cost reduction by 20%

- **Plan-B** different **«reduced threshold» configurations** under discussion in case available funds will not allow for the threshold configuration
  - **CTA-N**: we stick on the threshold configuration
  - **CTA-S**: the closest possibe to the threshold configuration
    - Ongoing evaluation of the scientific impact of these reduced threshold configurations

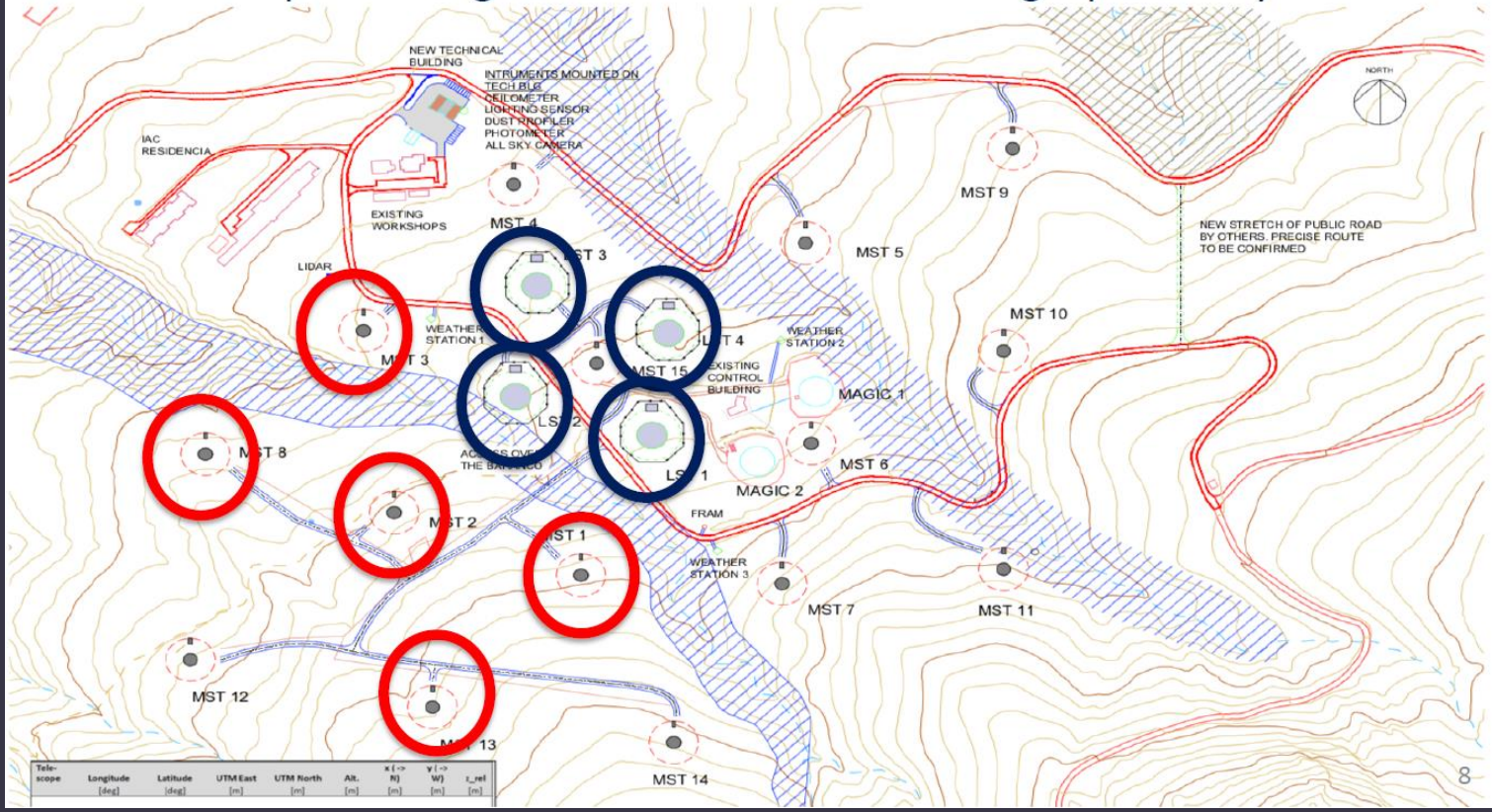
CTA-N “threshold” layout

- The positions of the 4 LSTs are fixed, as well as the one of the first MST



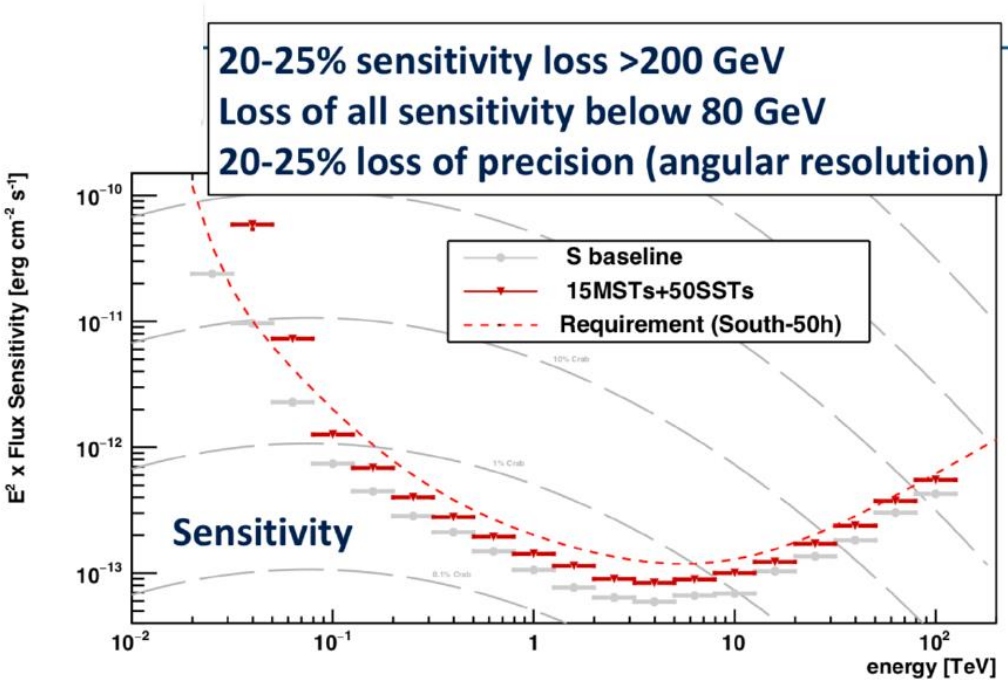
CTA-N “threshold” layout

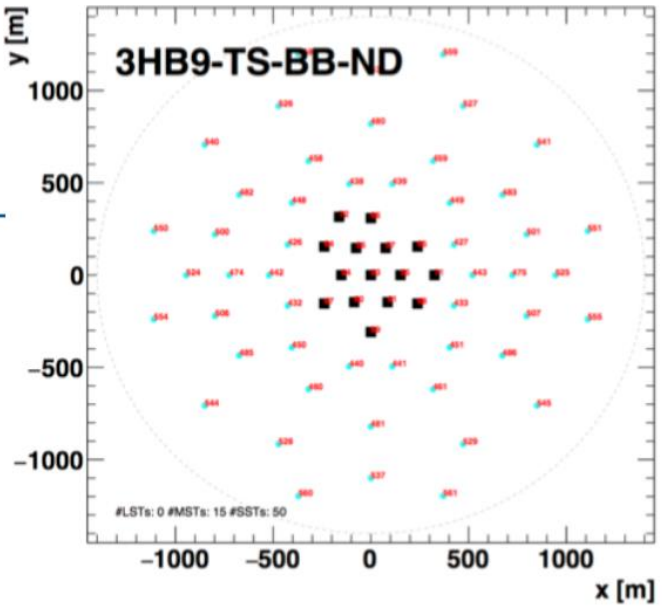
- The positions of the 4 LSTs are fixed, as well as the one of the first MST
- Update on the layout optimization studies confirmed that neighbor layouts are more performing → Once fixed MST3 one single possibility remains



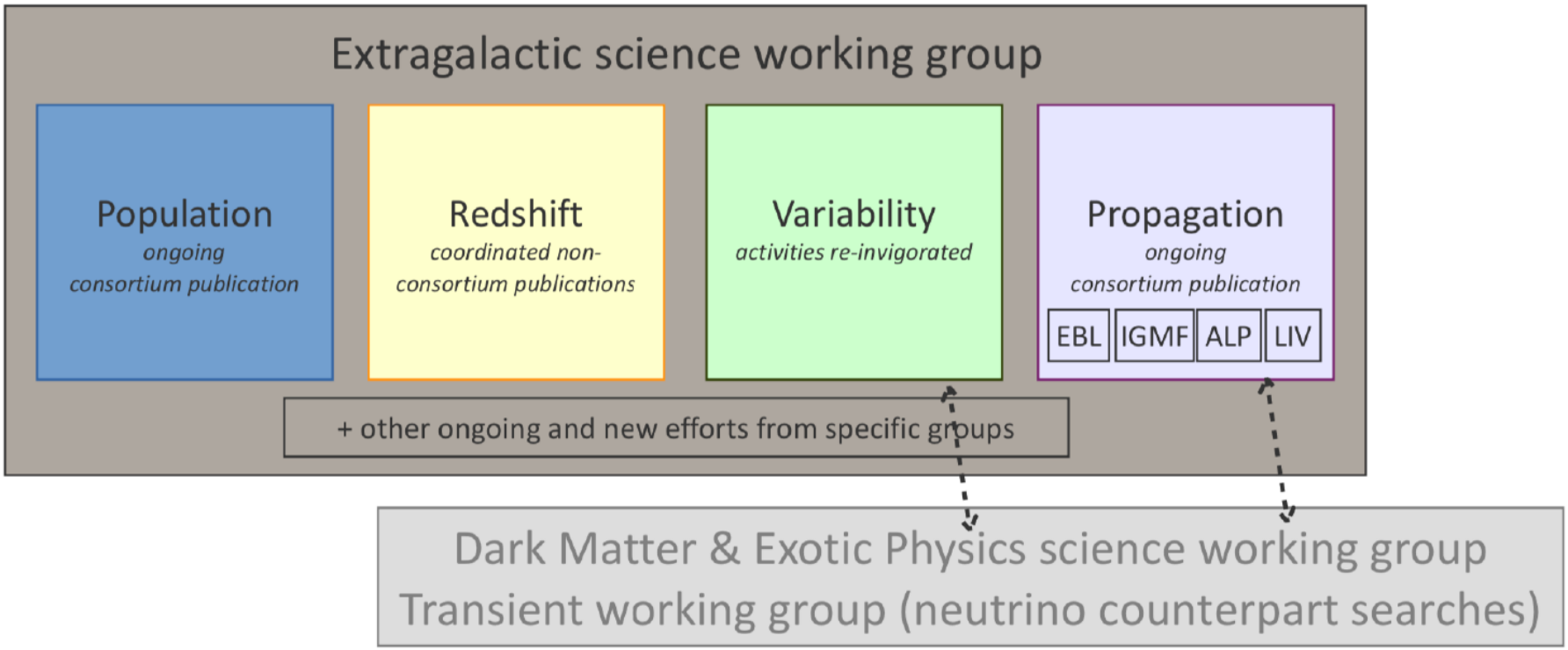
CTA-S “threshold” layout

- Updated results on the threshold configuration layout confirm the findings for Kashiwa meeting





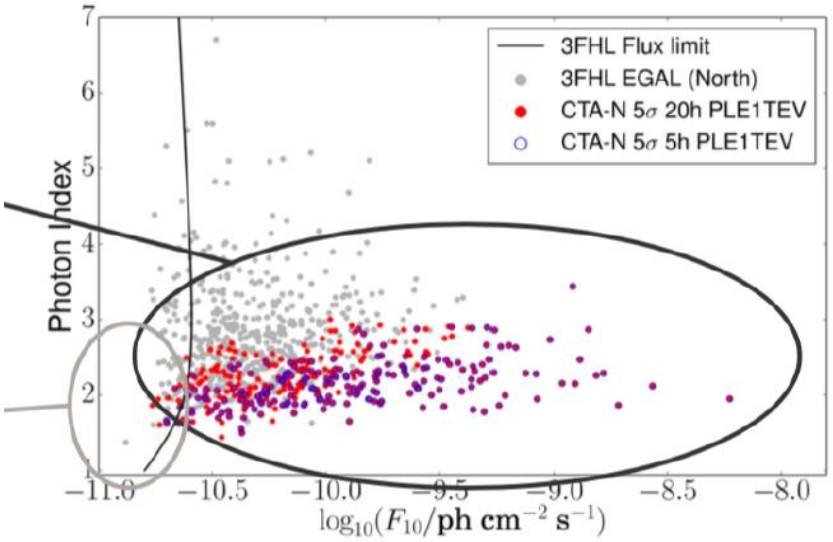
Extragalactic



EGAL highlights

Aim to assess CTA's sensitivity to the entire AGN population

Preliminary work completed using 3FHL 4LAC now available



Redshift task force using imaging and spectroscopy to determine unknown redshifts

J2001.2+4353, z=0.174