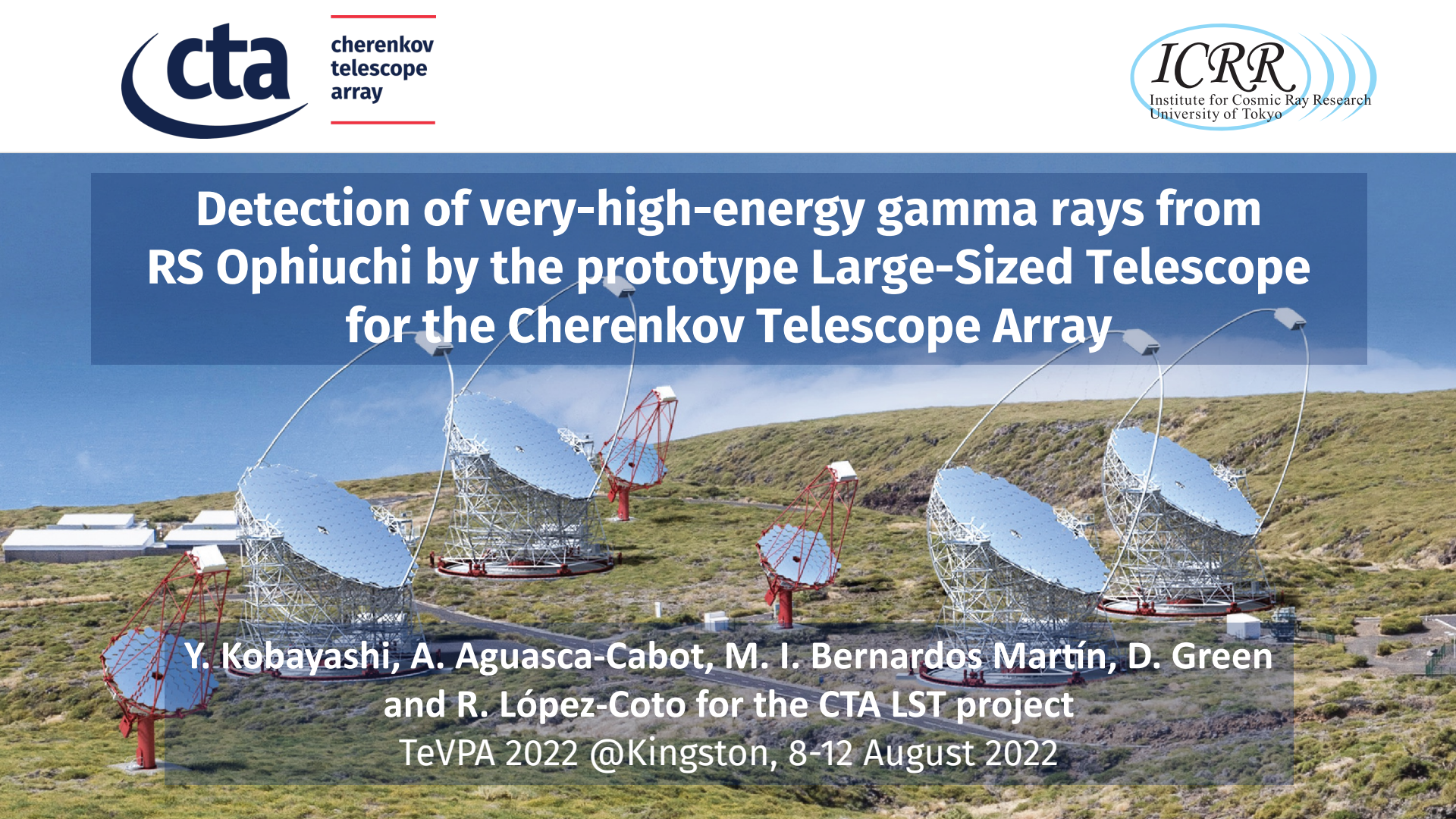


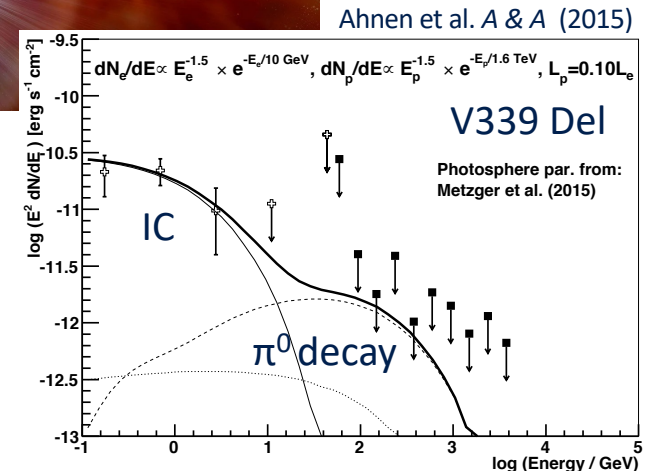
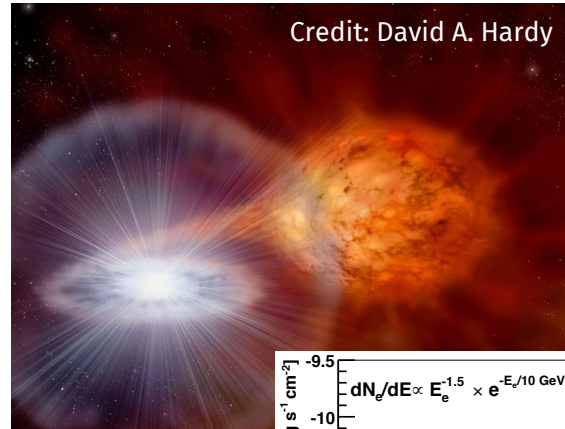
Detection of very-high-energy gamma rays from RS Ophiuchi by the prototype Large-Sized Telescope for the Cherenkov Telescope Array

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and R. López-Coto for the CTA LST project
TeVPA 2022 @Kingston, 8-12 August 2022



Classical novae

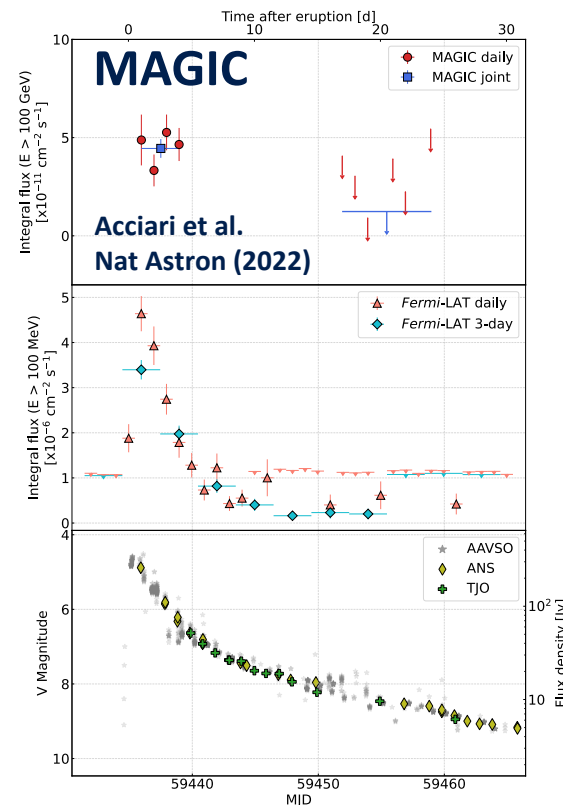
- Binaries consisting of a white dwarf and a red giant
- Luminous eruptions caused by **thermonuclear runaway**
- **Gamma-ray detection by *Fermi*-LAT** from over a dozen galactic novae
- **VHE gamma rays** could be a key to reveal the origin of gamma rays, but **no detection until 2021**



2021 outburst of RS Ophiuchi (RS Oph)



- **RS Oph:** recurrent symbiotic nova
 - Recurrent period ~15 years
 - The white dwarf embedded in the red giant
- **A new burst** of RS Oph on **8 Aug. 2021**
 - By optical and *Fermi*-LAT observations (**The brightest nova in gamma rays**)
- **LST-1 started observations on 9 Aug.**
- **MAGIC and H.E.S.S.** also observed and **detected it.** (Acciari et al. (2022) and H.E.S.S. Collaboration (2022))
 - The first detection of VHE gamma-ray emission from a nova.
 - **Suggest hadronic origin of the emission**



The prototype Large-Sized Telescope, LST-1



- Built on the CTA north site (La Palma)
- Currently under commissioning
- **Designed for observing low-energy gamma rays (>20 GeV)**
 - Large reflector (~400 m²)
 - High-QE PMTs (peak QE > 40%)
 - GHz sampling readout
- Fast repositioning (< 20 s)
- **Plays an essential role in observing transients**



More LST-1 talks at TeVPA 2022

- LST-1 performance (D. Kerszberg)
- Overview of science results (D. Green)
- Study of LHAASO J2108+5157 (J. Jurysek)

LST-1 observations of RS Oph

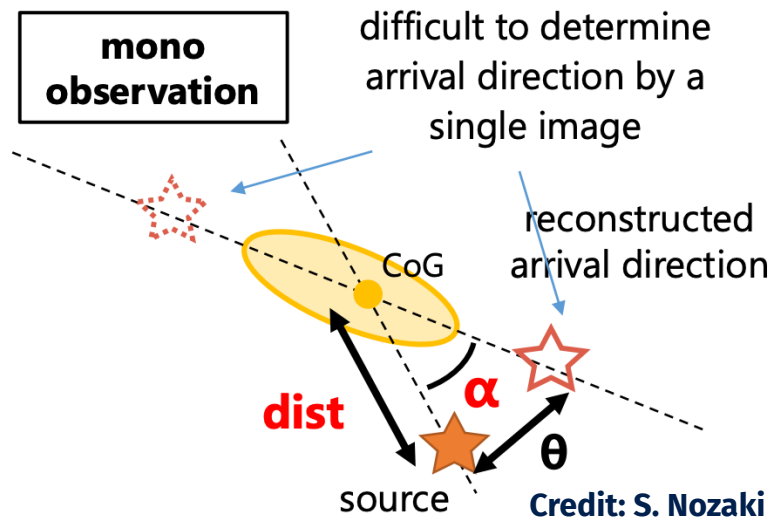


- LST-1 started observations on 9 Aug., a day after the burst reports.
- LST-1 could take good quality data during the first nights
 - **Effective time: 6.4 h**
- **Here we report preliminary results from the observations on the first nights**

Date	Effective obs. time	Zenith [deg]	Condition
20210809	1.4 h	35-42	Good (dark + clear sky)
20210810	2.7 h	35-59	
20210812	2.3 h	35-55	
20210813	~1.5 h	36-54	Bad transmission
20210814	~1.5 h	35-46	
20210815	~1.5 h	41-57	
- Moon break -			
20210829	1.0 h	46-58	Good (dark + clear sky)
20210830	1.5 h	40-57	
20210901	0.3 h	56-64	
20210902	1.3 h	41-57	

Analysis method

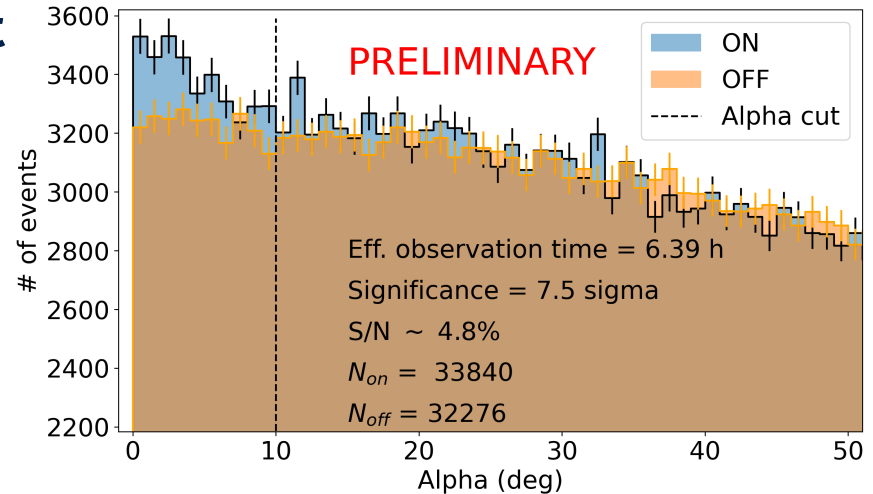
- Calibration and reconstruction with lstchain v0.9
- Source-dependent approach
 - Shower parametrization assuming the source position
 - **Energy threshold ~ 45 GeV**
- Preliminary analysis with MC simulations at one direction close to that of the observations
- **Analysis with updated MC simulations is in progress.**



Results: alpha plot



- **Clear detection of the outburst during the first days**
 - Li&Ma significance: 7.5 sigma
 - Signal-to-noise ratio: 4.8%
- **LST-1 took part in the first VHE gamma-ray detection from a nova!**

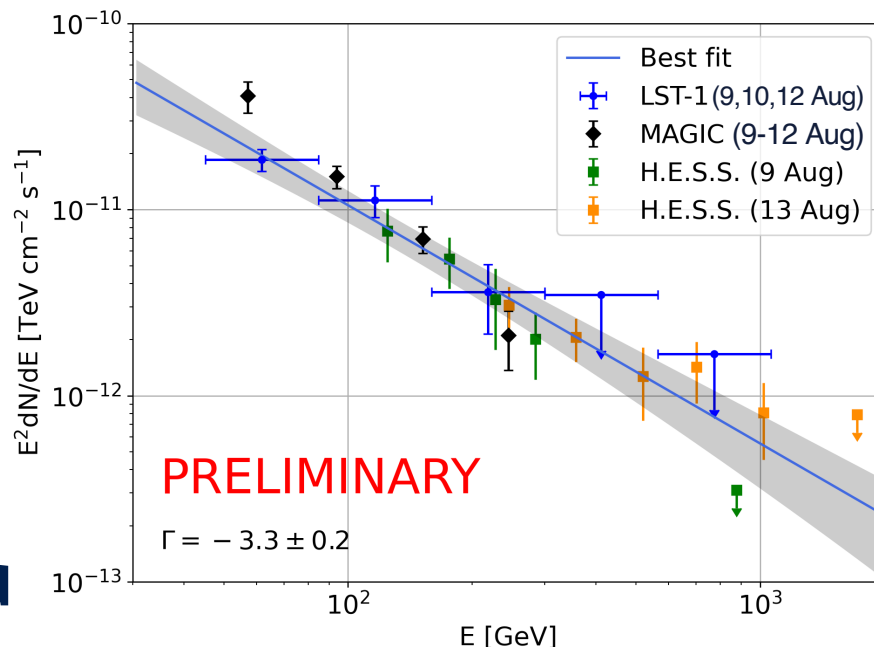


The alpha distribution measured from the source position and that measured from a reflected background position.

Spectral Energy Distribution



- Spectral analysis with `gammapy v0.19`
- A power-law model is fitted to the spectrum.
- **LST-1 obtains compatible results with those from MAGIC and H.E.S.S.**
- **Will support hadronic emission scenario suggested by MAGIC and H.E.S.S.**

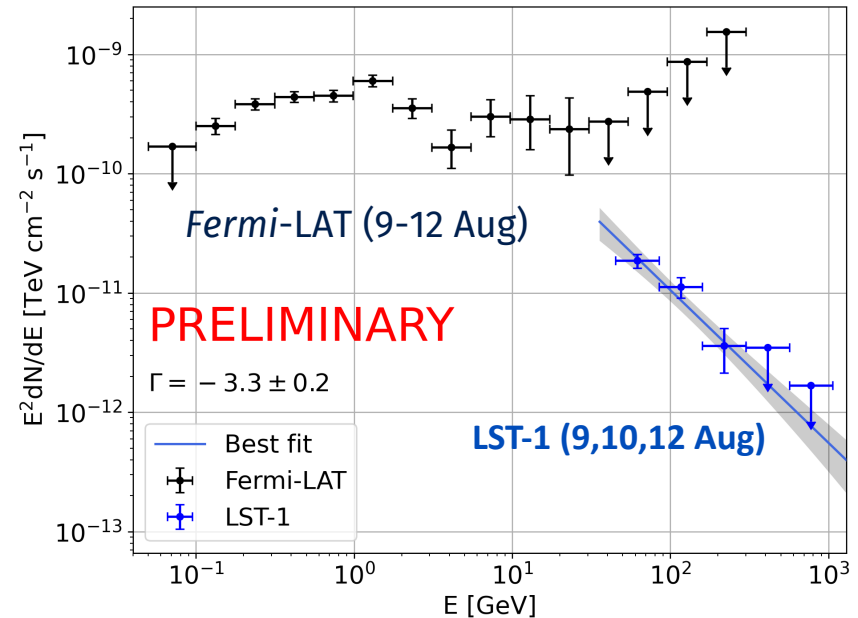


MAGIC results from Acciari et al. 2022
H.E.S.S. results from H.E.S.S. Collaboration 2022.

SED Comparison to *Fermi*-LAT



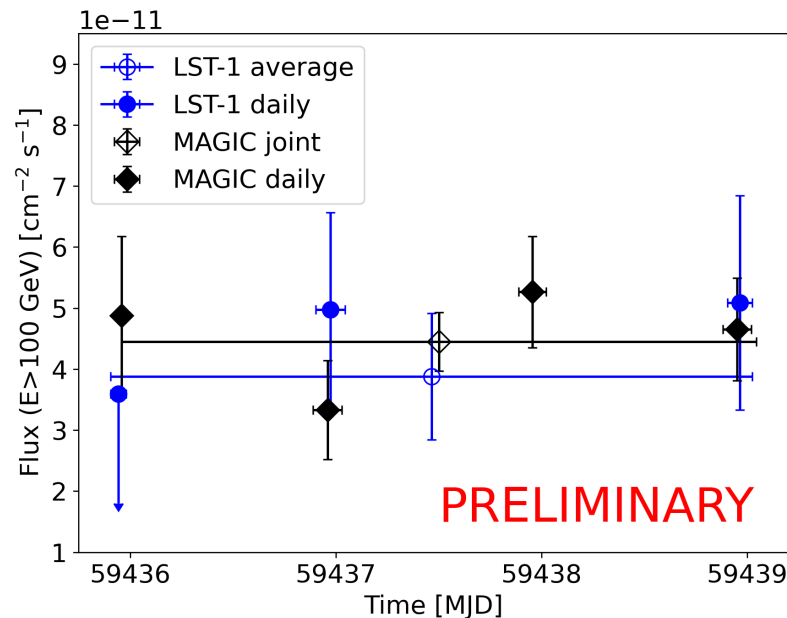
- Dedicated analysis of the *Fermi*-LAT data during the LST-1 observation period
- The spectrum from LST-1 **smoothly connects to that from *Fermi*-LAT thanks to LST-1's low energy threshold.**



Results: Light curve (>100 GeV)



- The light curve in comparison to the MAGIC results.
- **LST-1 estimates compatible flux with MAGIC's results**
- **Compatible with constant flux during the first days**

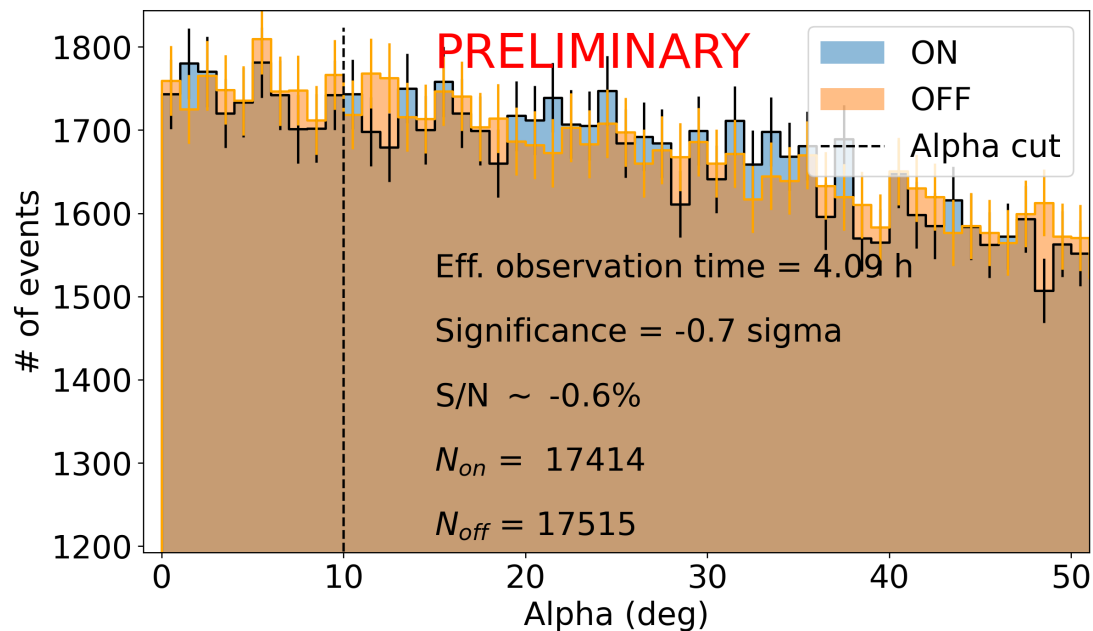


MAGIC flux points from Acciari et al. 2022

- LST-1 obtained **6.4 h of good quality data** during the first days of the RS Oph outburst.
- **LST-1 clearly detected the outburst.**
(Took part in the first VHE gamma-ray detection from a nova!)
- The preliminary analysis shows **compatible results with those from MAGIC and H.E.S.S.**
 - **Will support hadronic origin of gamma rays**
 - Possible improvement in connection to *Fermi*-LAT by **the low energy threshold ~45 GeV.**
- Final results with updated analysis and simulations will come soon as well as physical interpretations of them.

Backup

Data after the moon break



Source-independent analysis

