



Recent Results from the VERITAS Galactic Science Program

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Selected Topics

Periastron passage of the 50-yr-period binary PSR J2032+4127 / MT91 213 (*see also GAl6e*)

Following up HAWC detections in 2HWC

Searching for VHE emission from young gamma-ray pulsars

(more interesting stuff is going on; too much for a short talk)

About VERITAS

Four 12 m Imaging Atmospheric Cherenkov Telescopes (IACTs)

Effective energy range: 85 GeV – >30 TeV (“VHE band”)

Field of view = 3.5° ; angular resolution = 0.08° @ 1 TeV

1% Crab Nebula in < 25 hr



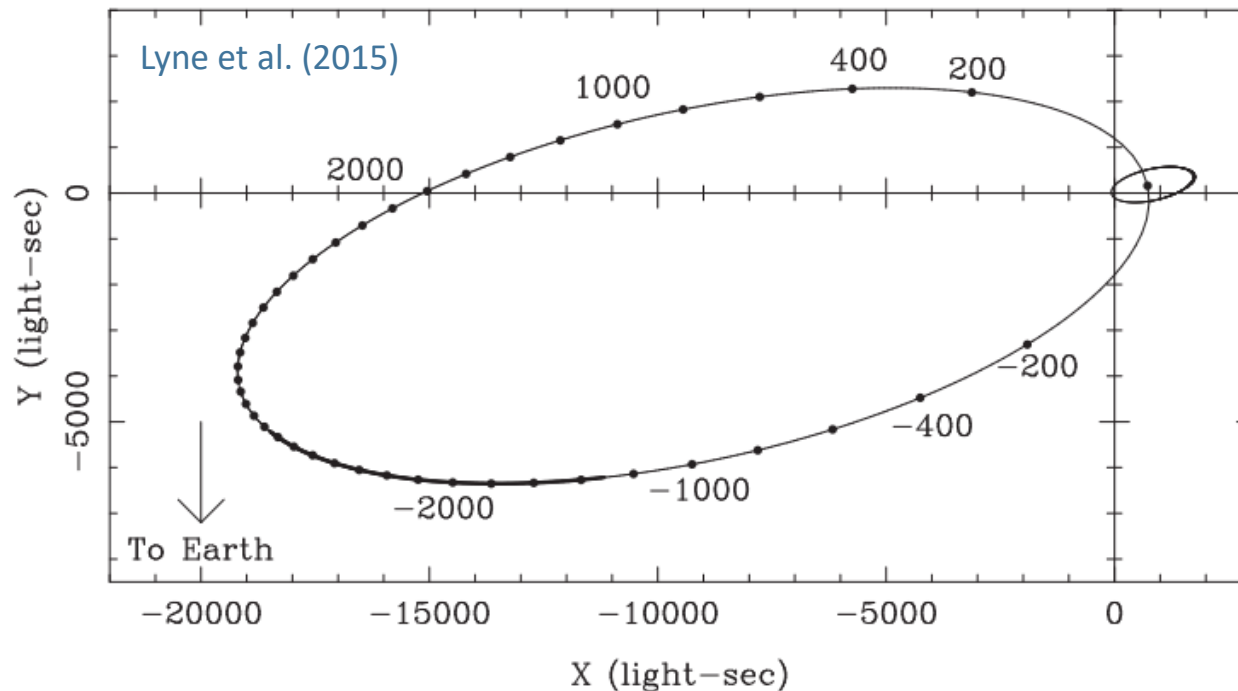
PSR J2032+4127 / MT91 213: Monitoring Periastron Approach

J2032+4127

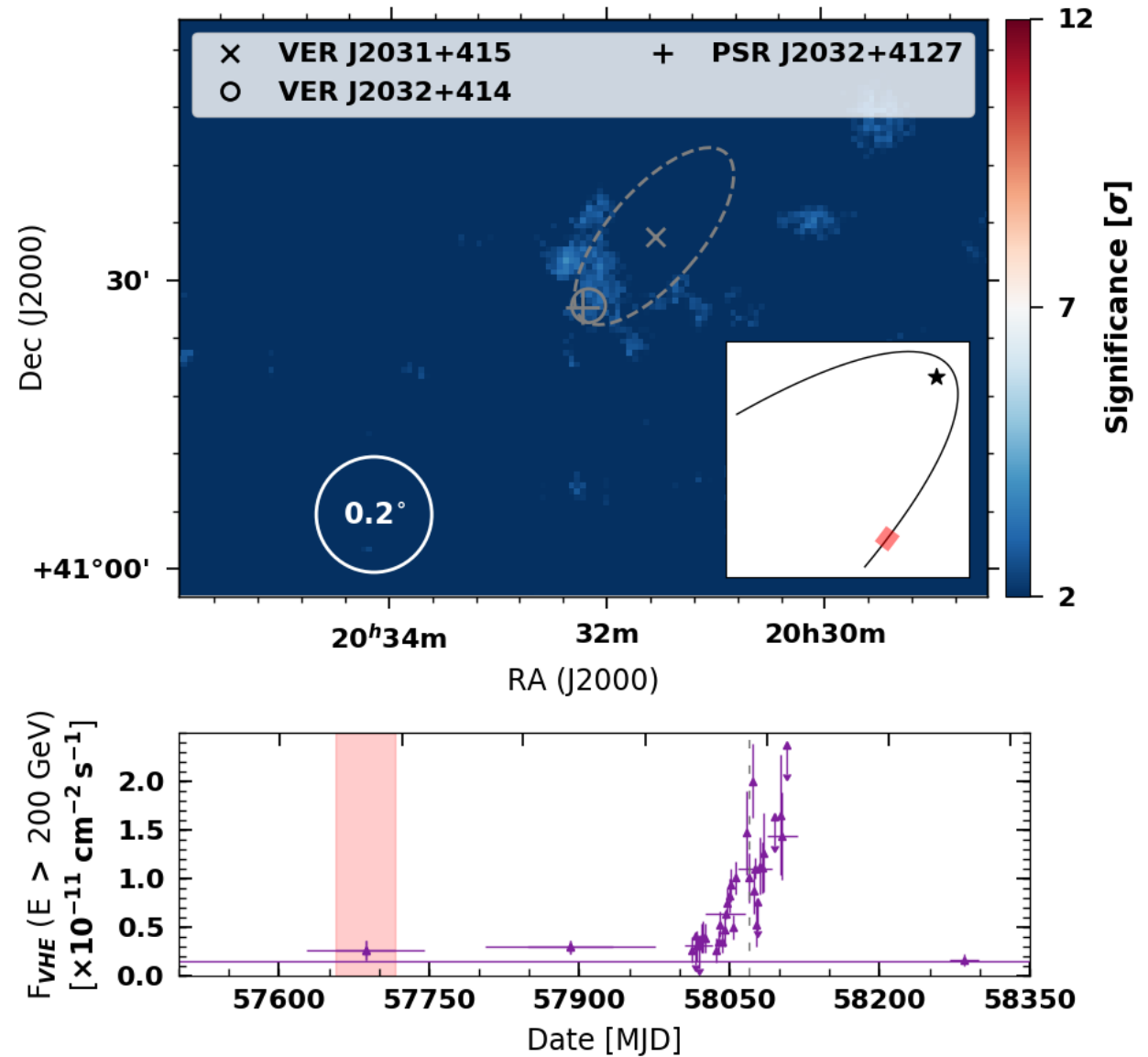
Young, gamma-ray pulsar recently (2015) found to be in a long-period binary (approx. 50 years)

Periastron occurred in November 2017

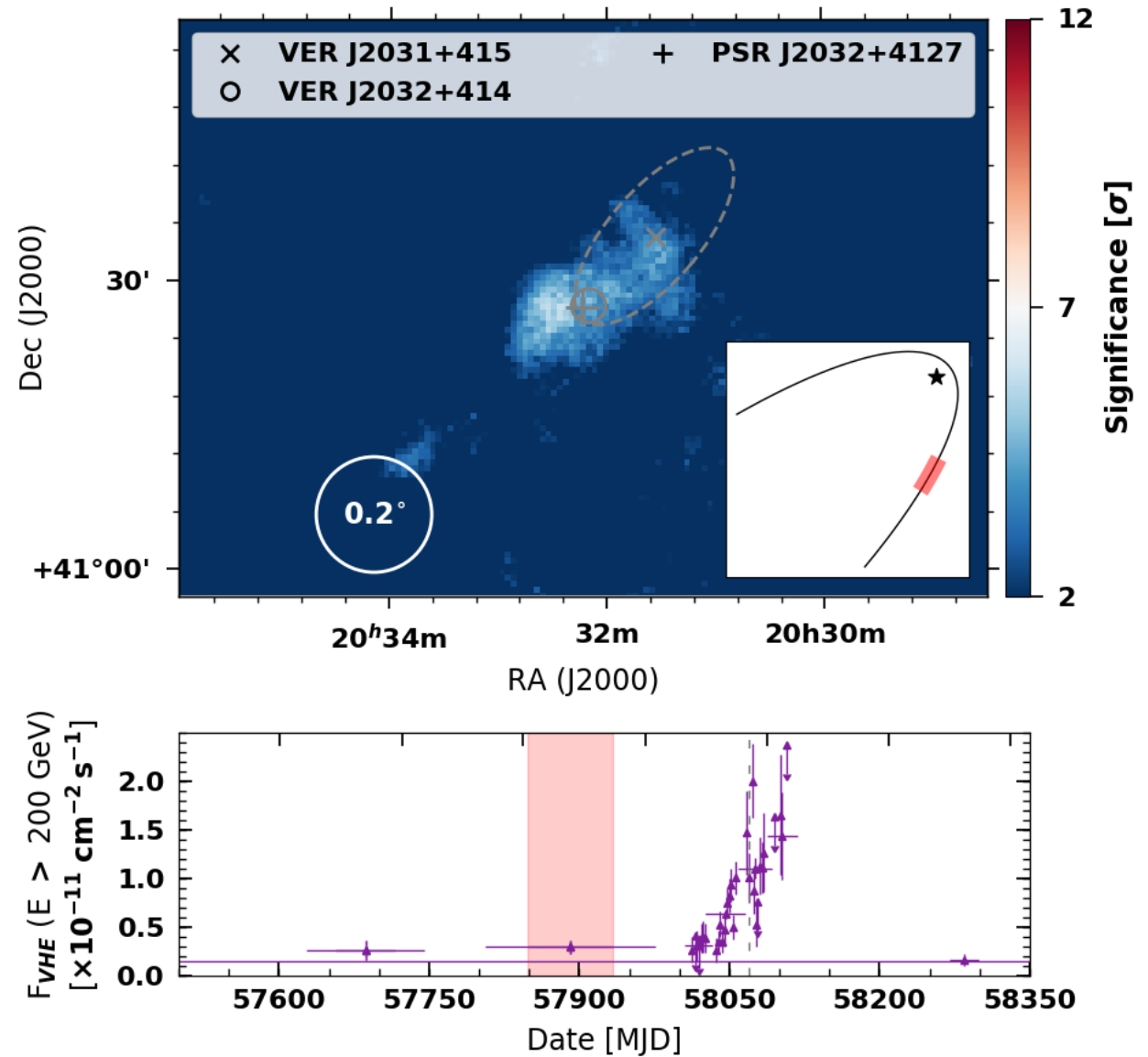
VHE campaign coordinated to monitor periastron in 2017 (VERITAS & MAGIC)



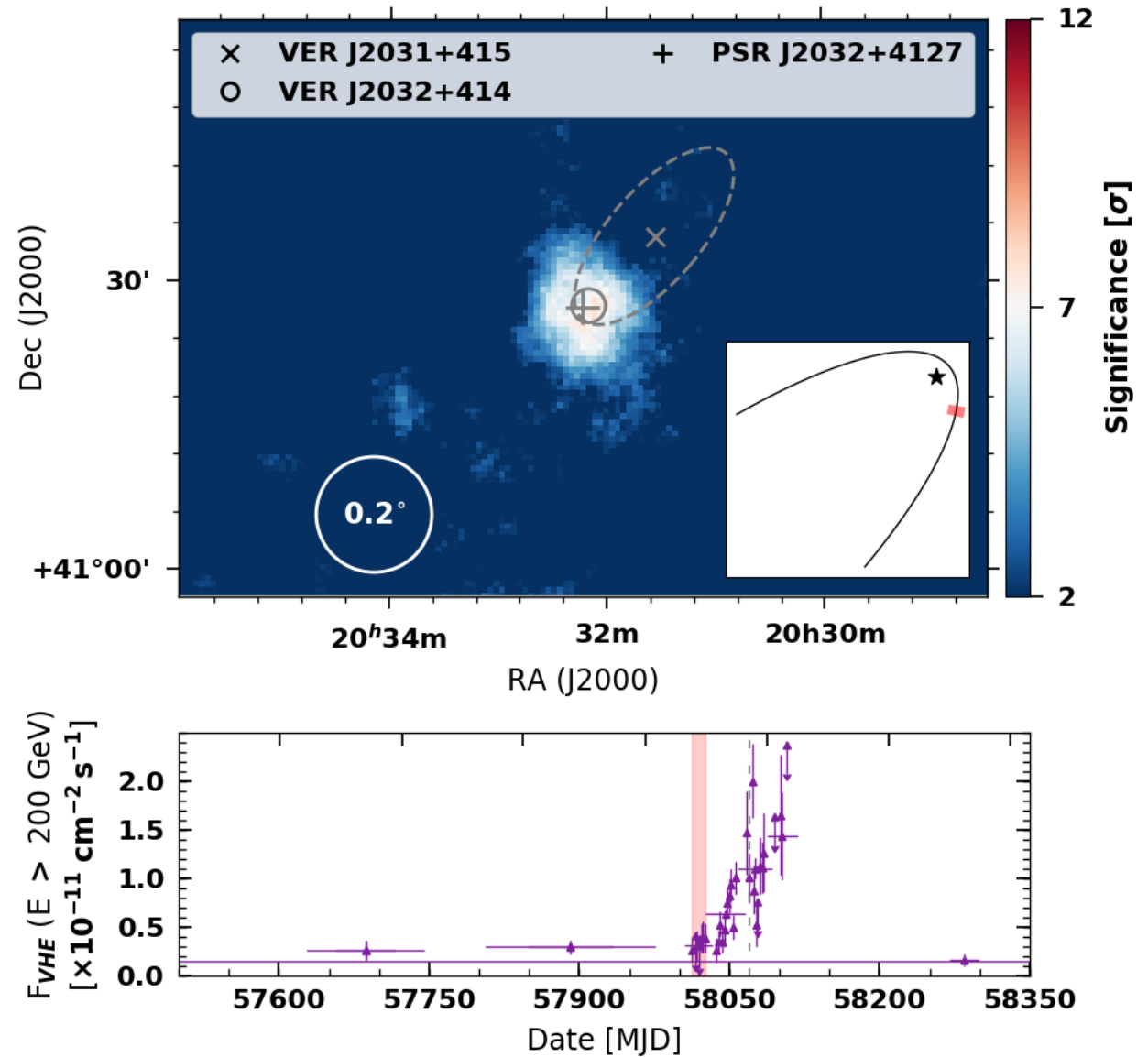
Emergence of VHE emission from PSR J2032+4127



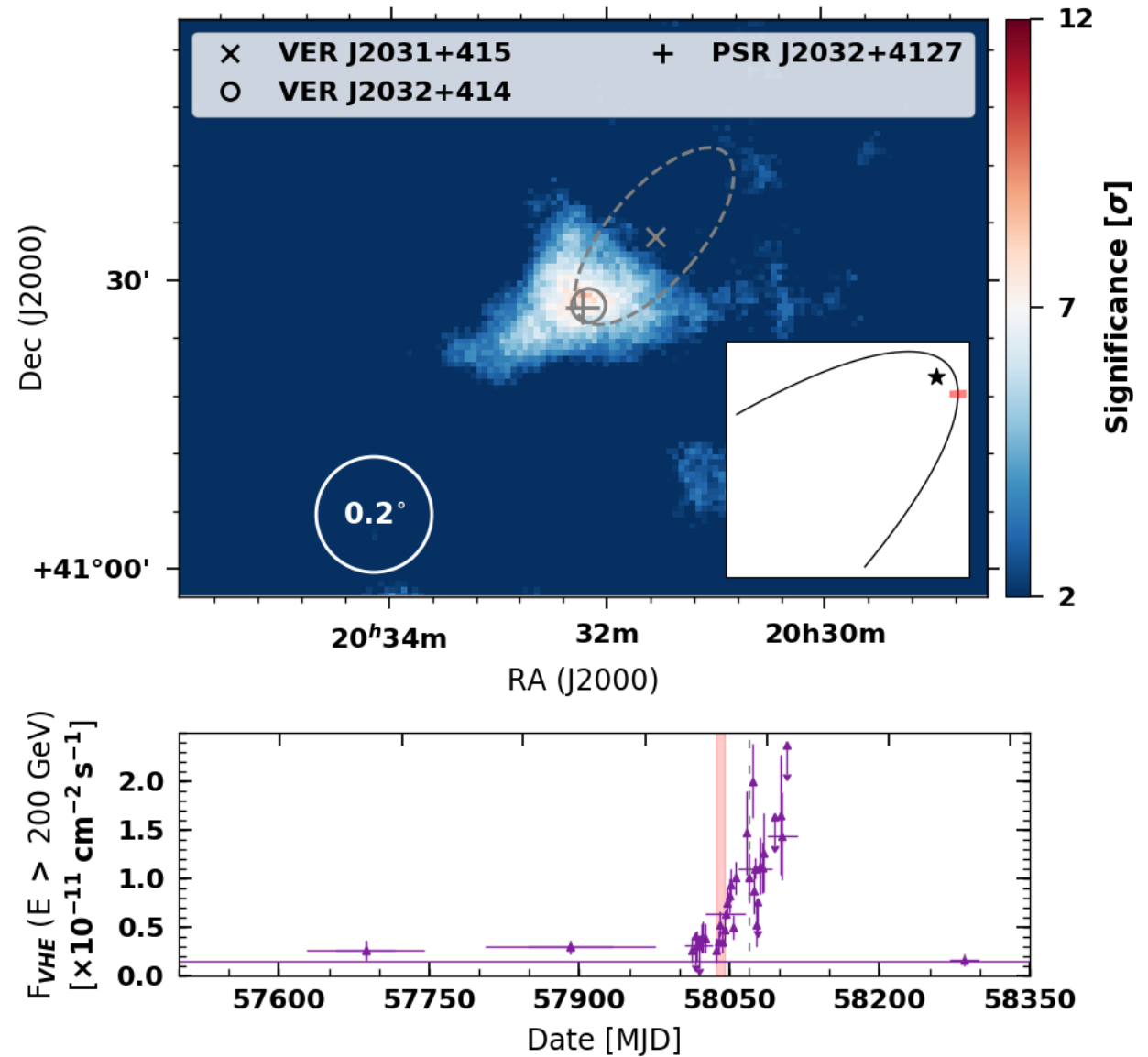
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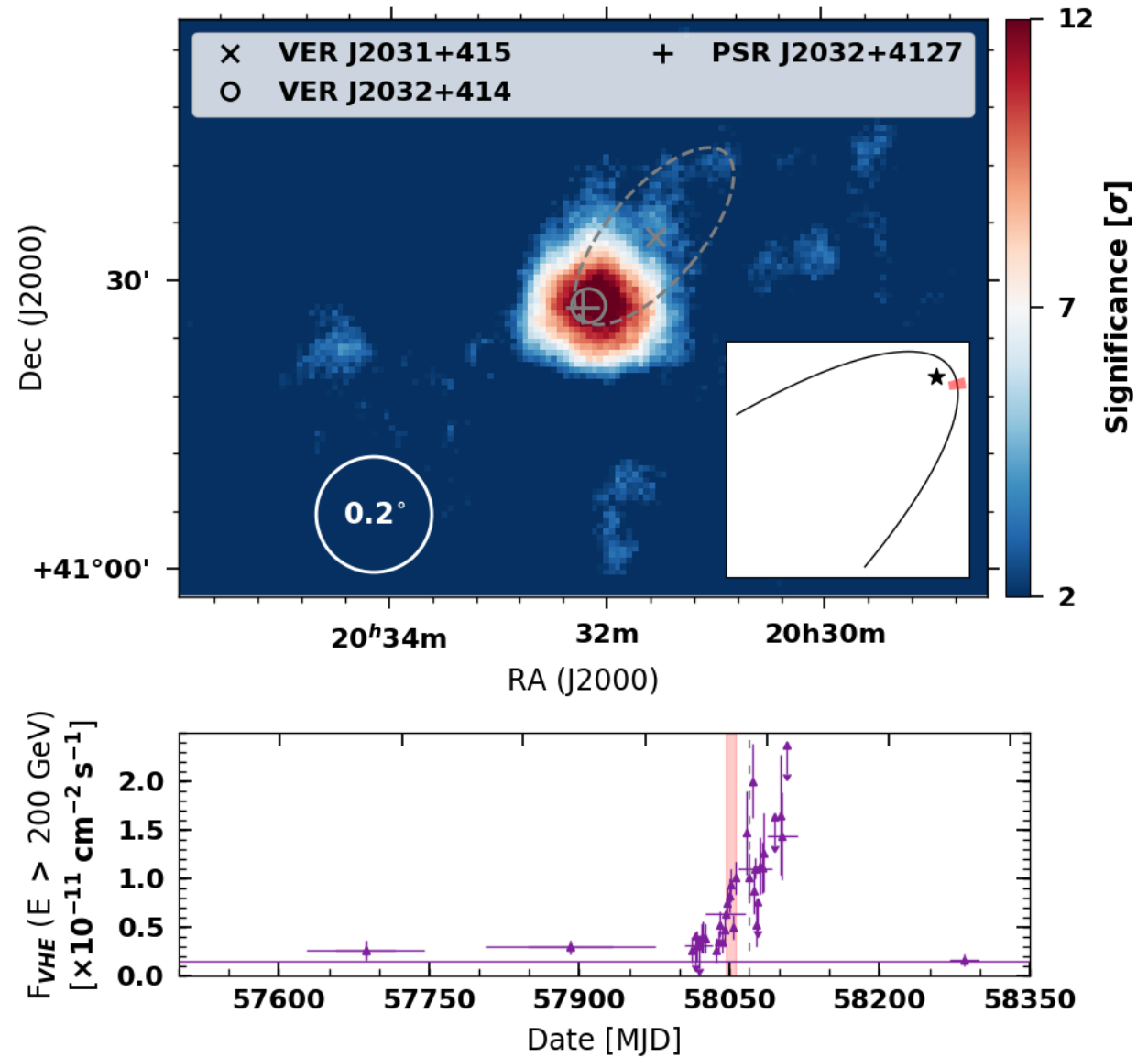
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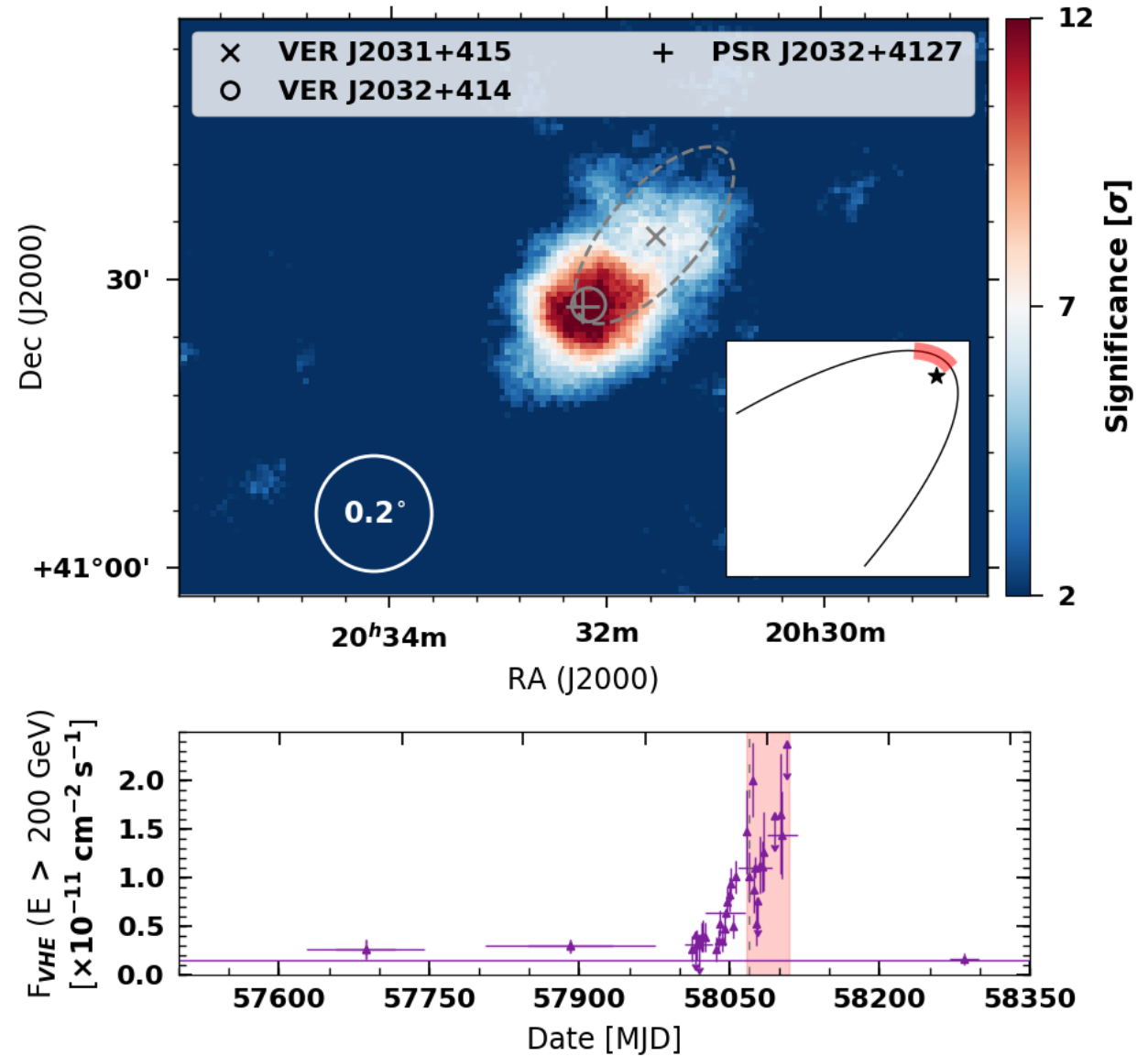
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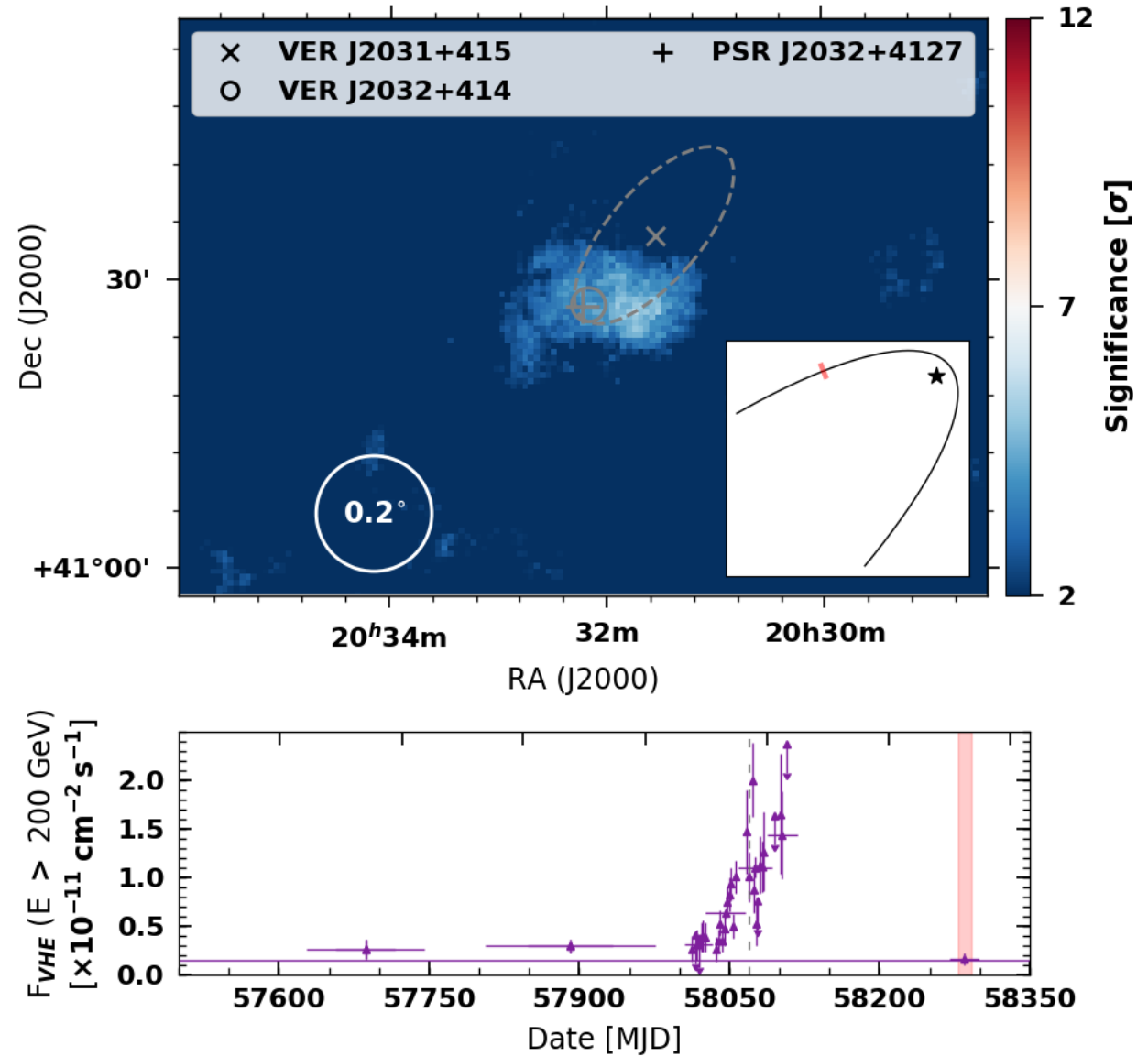
Emergence of VHE emission from PSR J2032+4127



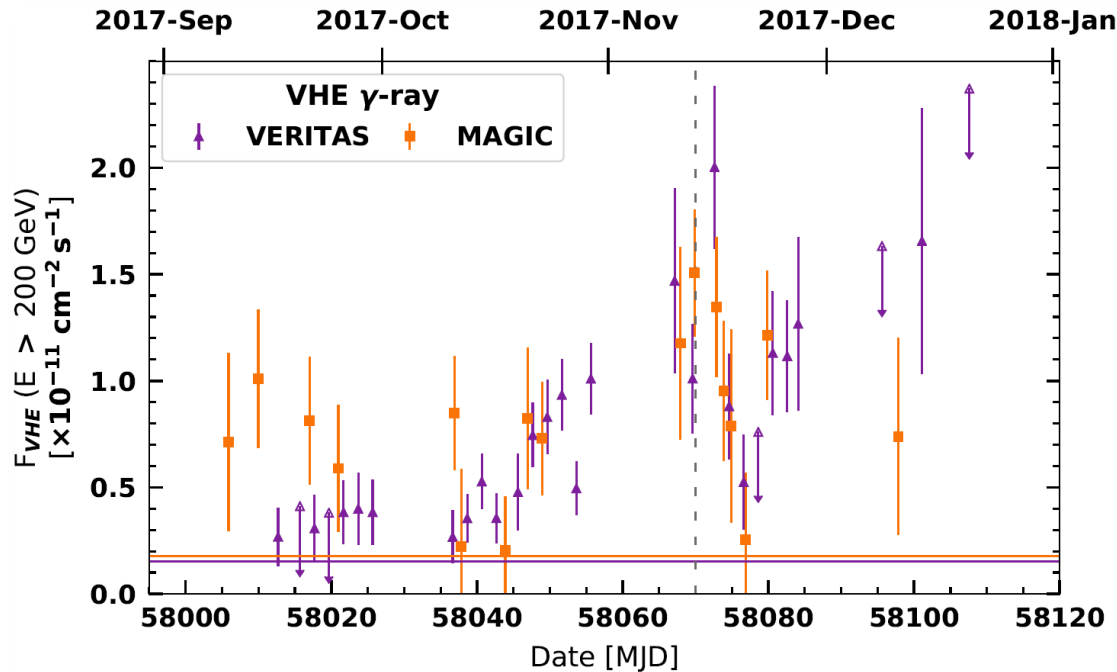
Emergence of VHE emission from PSR J2032+4127



Emergence of VHE emission from PSR J2032+4127



VERITAS & MAGIC: Observations During Periastron Passage 2017



Rising VHE flux seen beginning in September 2017

Associated with emergence of a new point source at pulsar location



Confirmation of 2nd known gamma-ray binary with compact companion identified

VHE light curves from [Abeysekara et al. \(2018\)](#)

See also GAI6e T. Williamson

HAWC Source Follow-Ups with VERITAS & *Fermi*-LAT

Following-up 2HWC Sources with *Fermi* & VERITAS

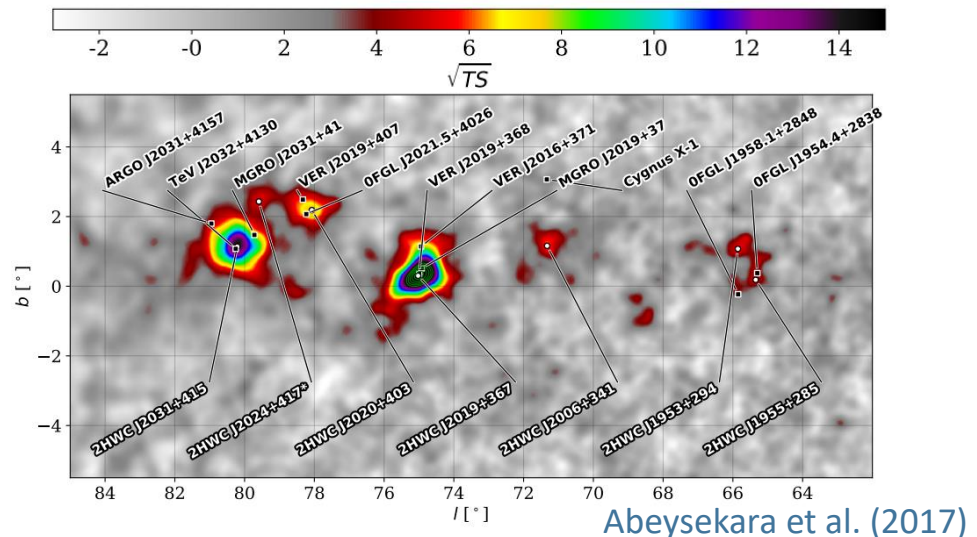
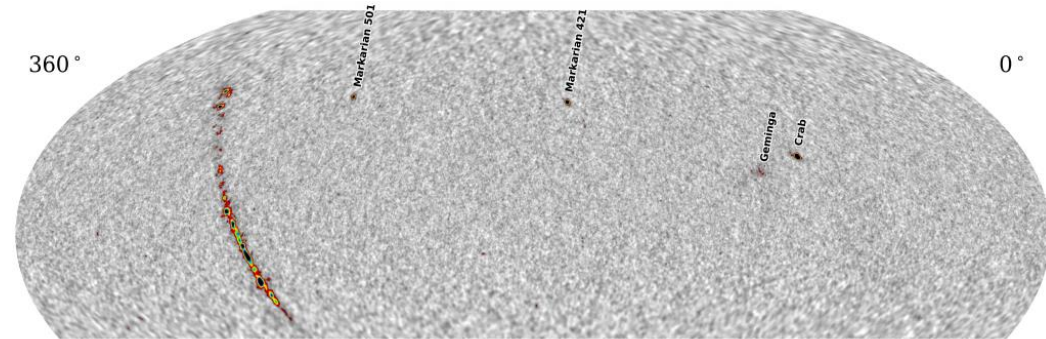
Synergy between *Fermi*, VERITAS, and HAWC

- Adjacent / overlapping E ranges
- Survey vs. pointed observations

2HWC catalog: 39 VHE gamma-ray sources

- 19 not previously known at VHEs
- Searched for emission from 14 of 19 with VERITAS
- **1 VERITAS detection**

Abeysekara et al. (2018)



Abeysekara et al. (2017)

Following-up 2HWC Sources with *Fermi* & VERITAS

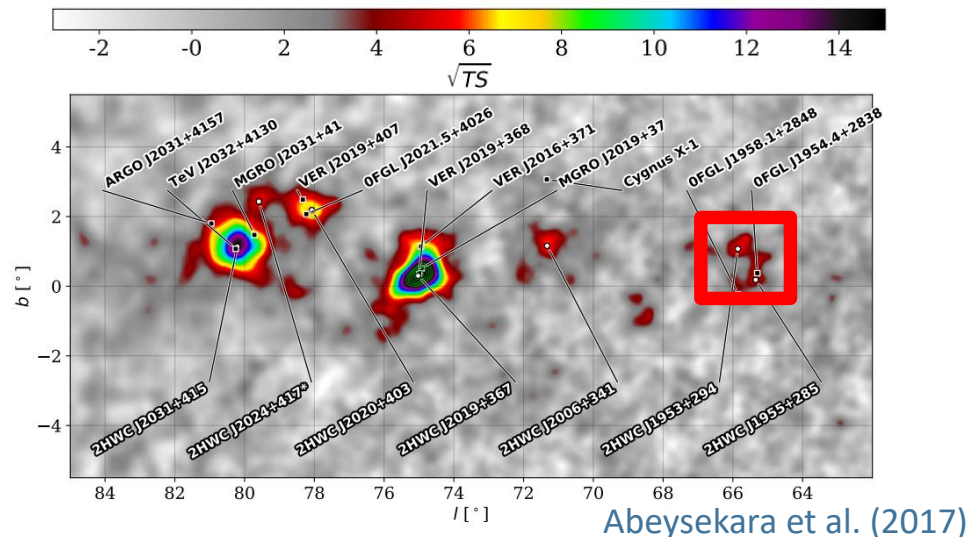
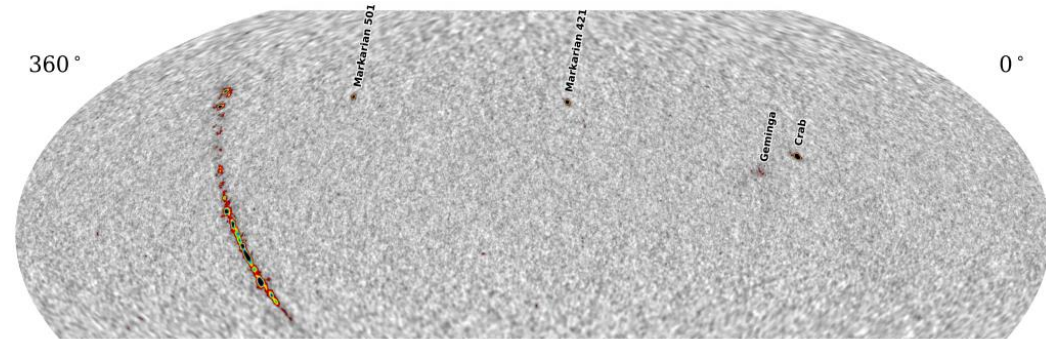
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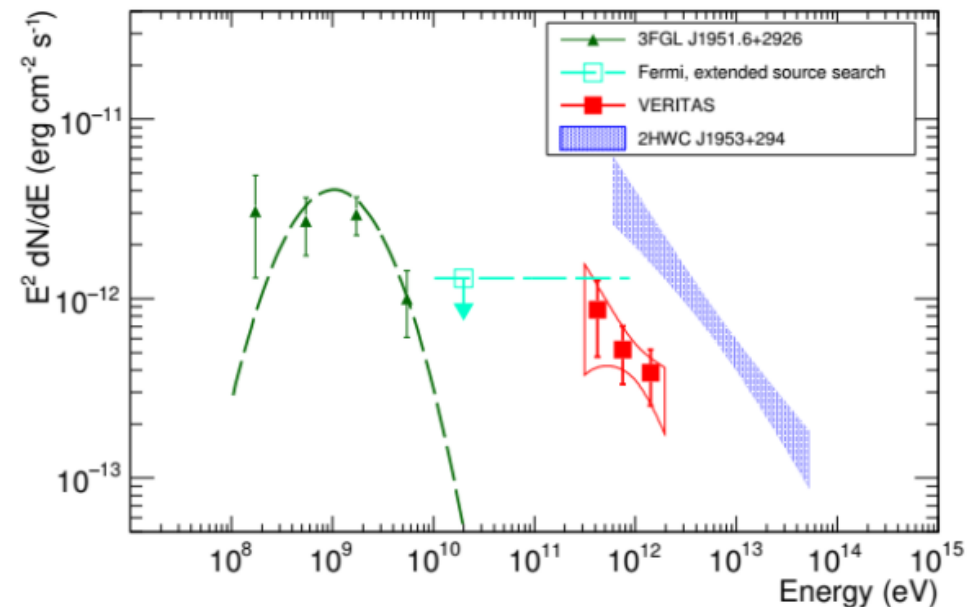
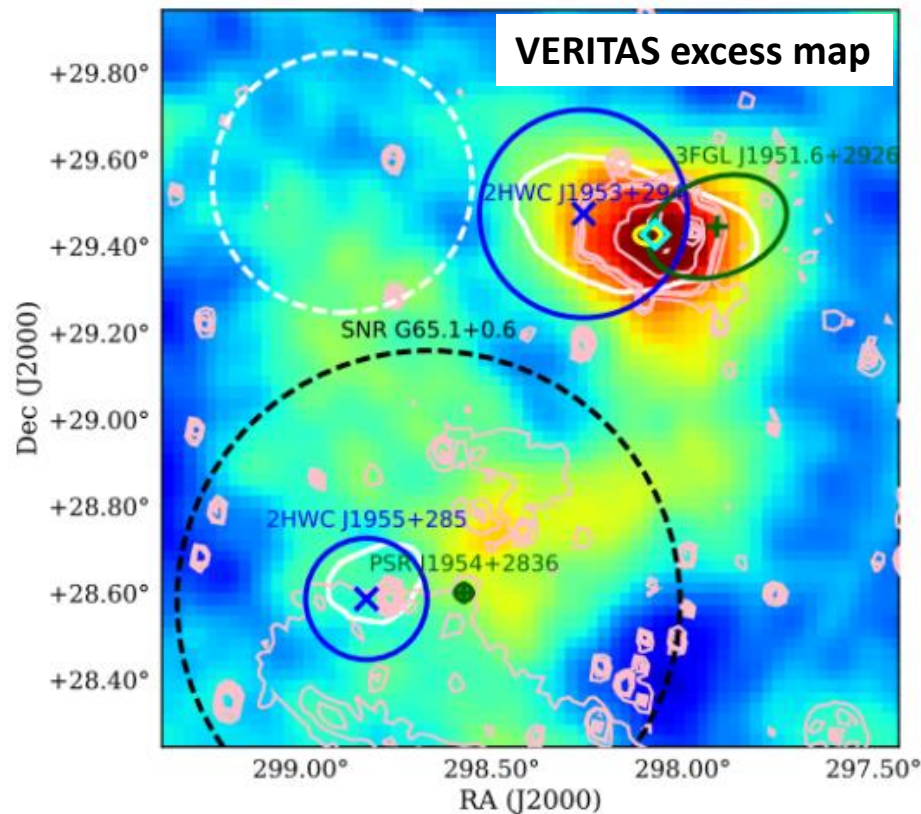
Ex.: DA 495 Region

Two 2HWC sources (blue circles)

72-hr VERITAS observation

VERITAS detection of J1953+294; no detection of J1955+285

- No pulsations found in X-ray or GeV gammas for J1953; compact object seen in X-rays



VHE Pulsar Searches

The Crab and Vela Pulsars

Motivation: Crab pulsar

Crab pulsar seen to emit up to ~ 1.5 TeV by MAGIC

Vela pulsar recently detected by H.E.S.S. up to ~ 100 GeV and at a few TeV

- Another power law from GeV energies?
- New TeV component (inverse-Compton)?

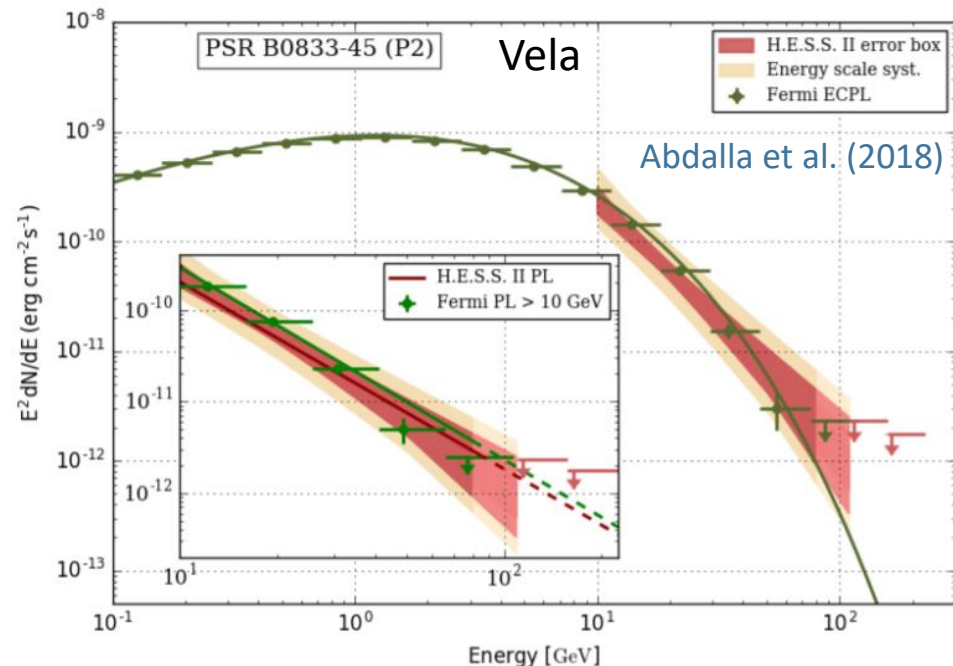
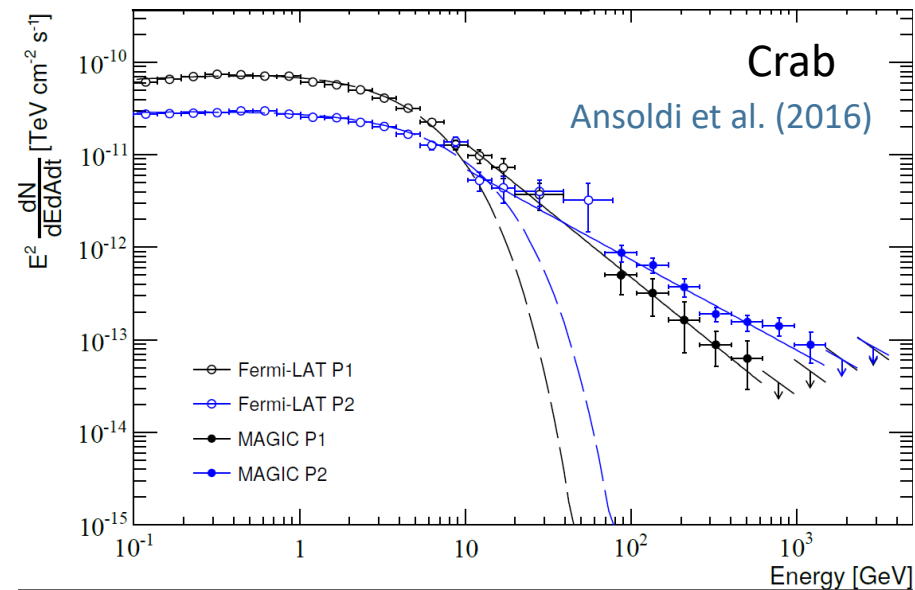
Geminga pulsar seen by MAGIC; tail of GeV spectrum best fit by power law (GAI2g M. Lopez)

PSR B1706-44 seen by HESS-II in 10-80 GeV range (GAI2a M. Spir-Jacob)

Theory of pulsed VHE emission remains unsettled



Can we find more VHE pulsars out there?



Search for VHE Emission from 13 “Archival Pulsars”

13 young gamma-ray pulsars
appear in archival VERITAS data

- Mostly from PWN searches

Over 450 hr total exposure

Includes 8 of the top 12 northern-hemisphere pulsars ranked in $\frac{\dot{E}}{d^2}$

- First VHE search for all 13



No detections!

Pulsar
J0007+7303
J0205+6449
J0248+6021
J0357+3205
J0631+1036
J0633+0632
J1907+0602
J1954+2836
J1958+2846
J2021+3651
J2021+4026
J2032+4127
J2229+6114

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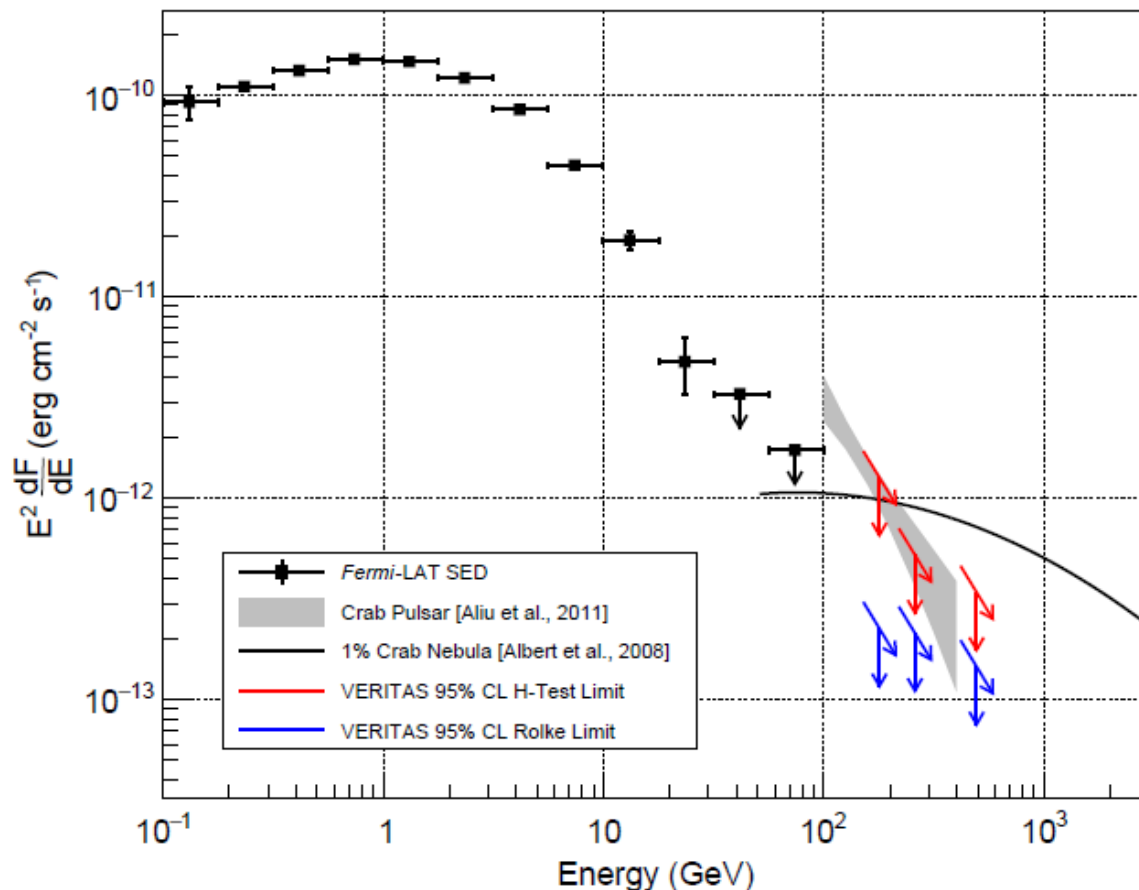
Pulsar
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J0205+6449
J0248+6021
J0357+3205
J0631+1036
J0633+0632
J1907+0602
J1954+2836
J1958+2846
ex. J2021+3651
J2021+4026
J2032+4127
J2229+6114

Ex.: PSR J2021+3651

Search at 3 different energy thresholds

Phase gates defined based on *Fermi* 2nd pulsar catalog light curves

Limits constrain potential VHE flux to be below Crab pulsar level



Archer et al. (2019)

Summary

VERITAS has a robust Galactic science program

See ICRC contributions *GAI6f*, *GAI6c*, *PS1-84* for more about LS I +61 303 and HESS J0632+057

