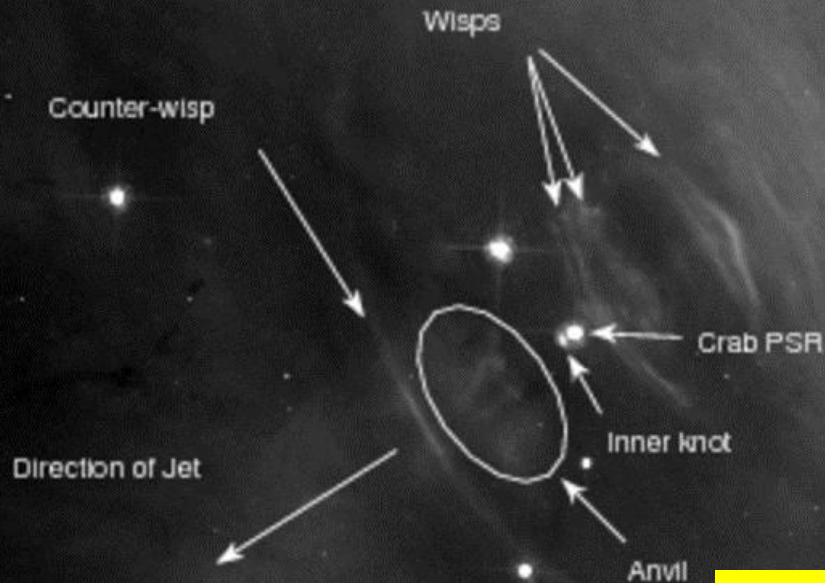


# HST imaging of the Crab during the March 2013 flare

a quick-look analysis

Andrea De Luca  
INAF/IASF Milano

# The Crab as seen by HST



Perhaps the most visited field by HST

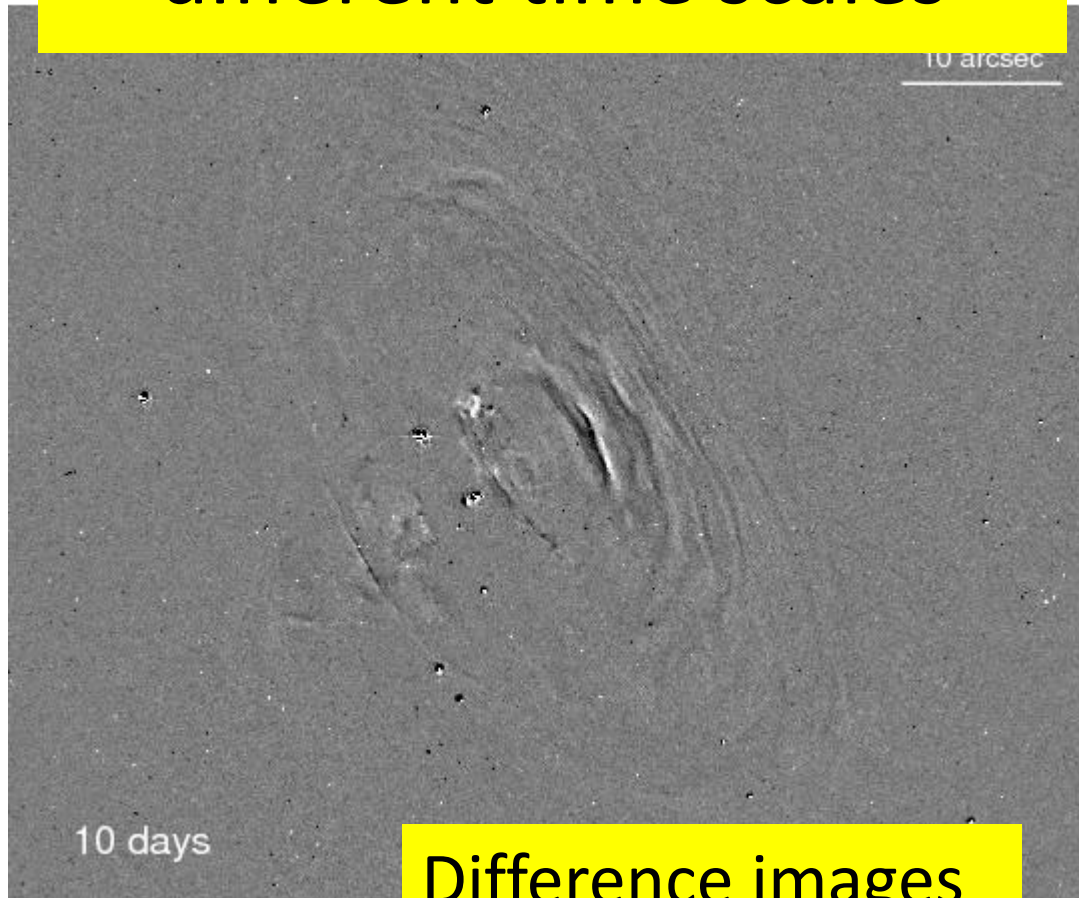
Most of our knowledge due to early WFPC2 results. Now, we use ACS

# Variability of the Crab PWN

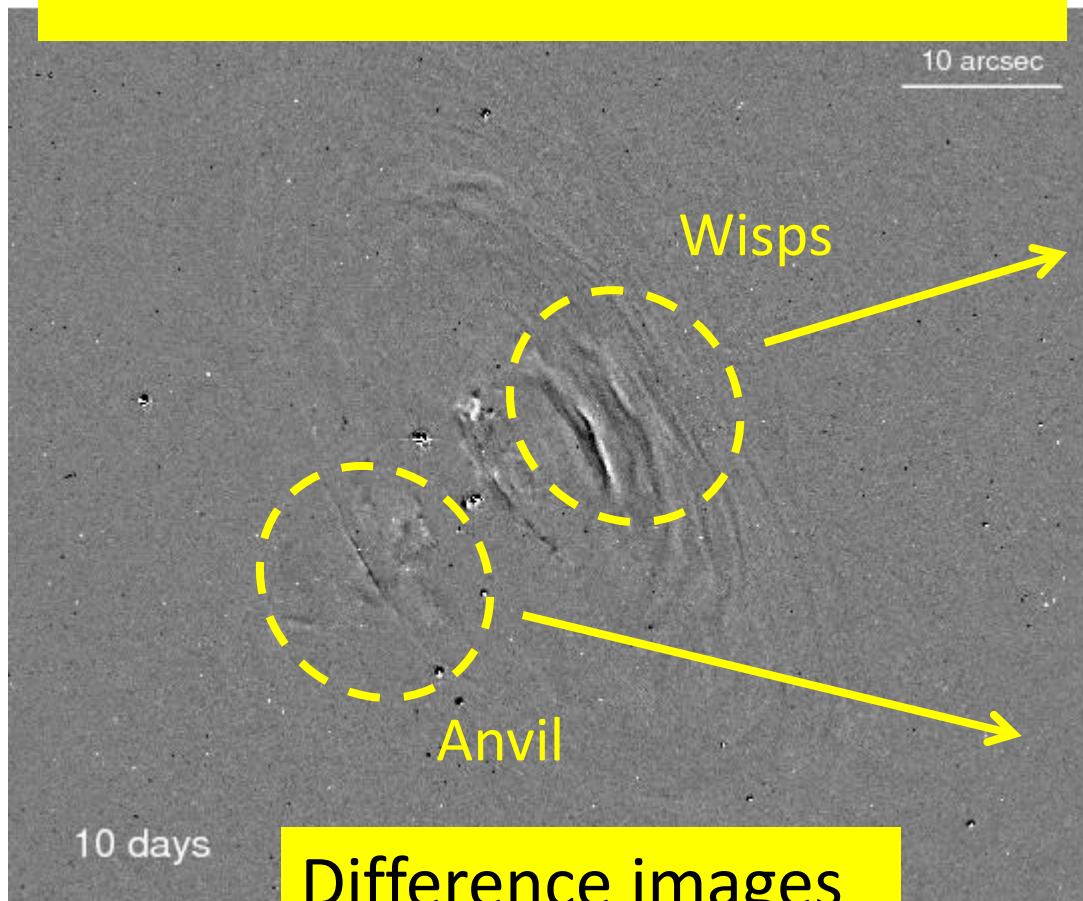


Movie (12 epochs) based  
on ACS monitoring  
campaign in 2005

# Variability of the PWN at different time scales

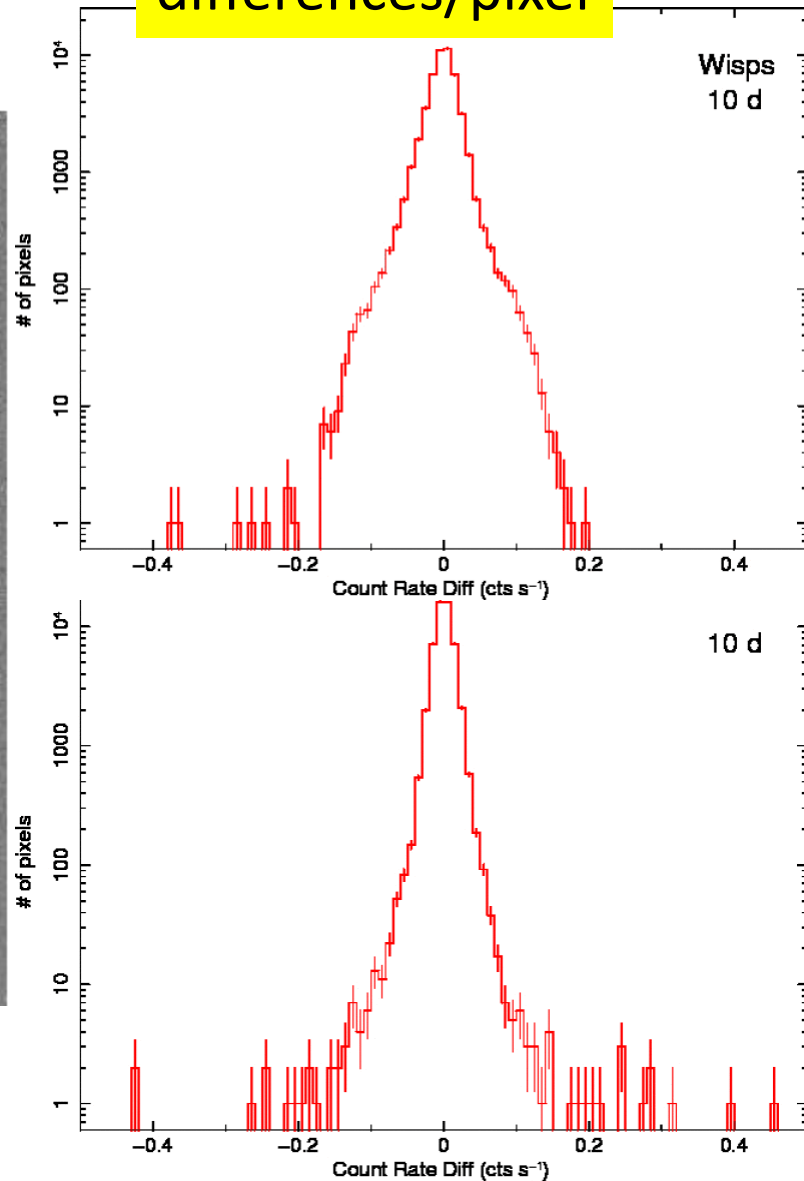


# Variability of the PWN at different time scales



Difference images

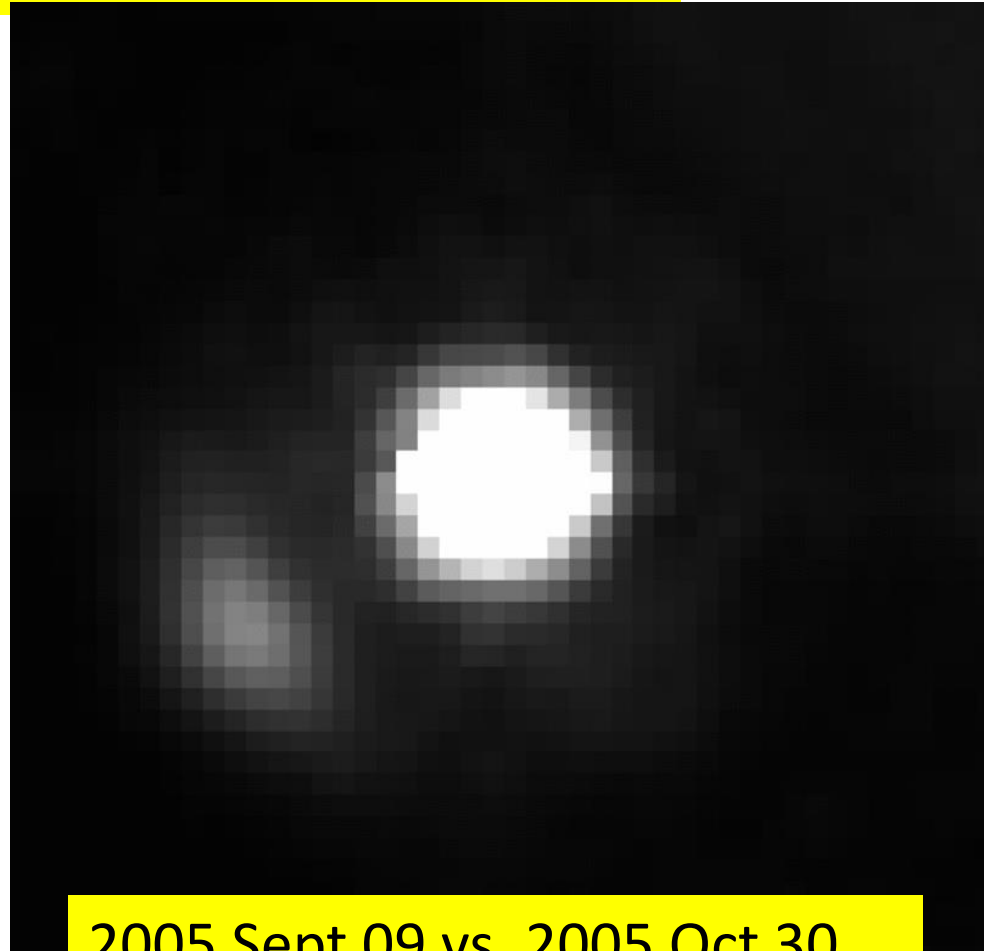
## Distribution of differences/pixel



# Variability of the inner knot

Hester J.J. (2008) ARAA  
notes that the knot is  
*'somewhat variable in both  
position and brightness'*

Indeed, we see  
variations in  
position and flux

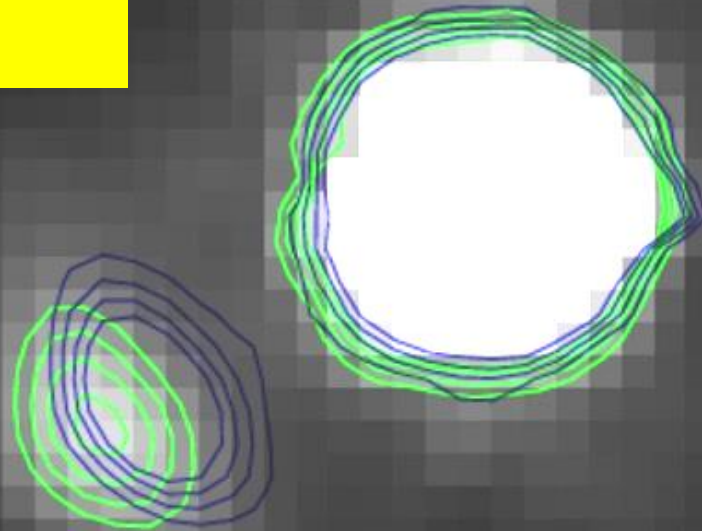


2005 Sept 09 vs. 2005 Oct 30

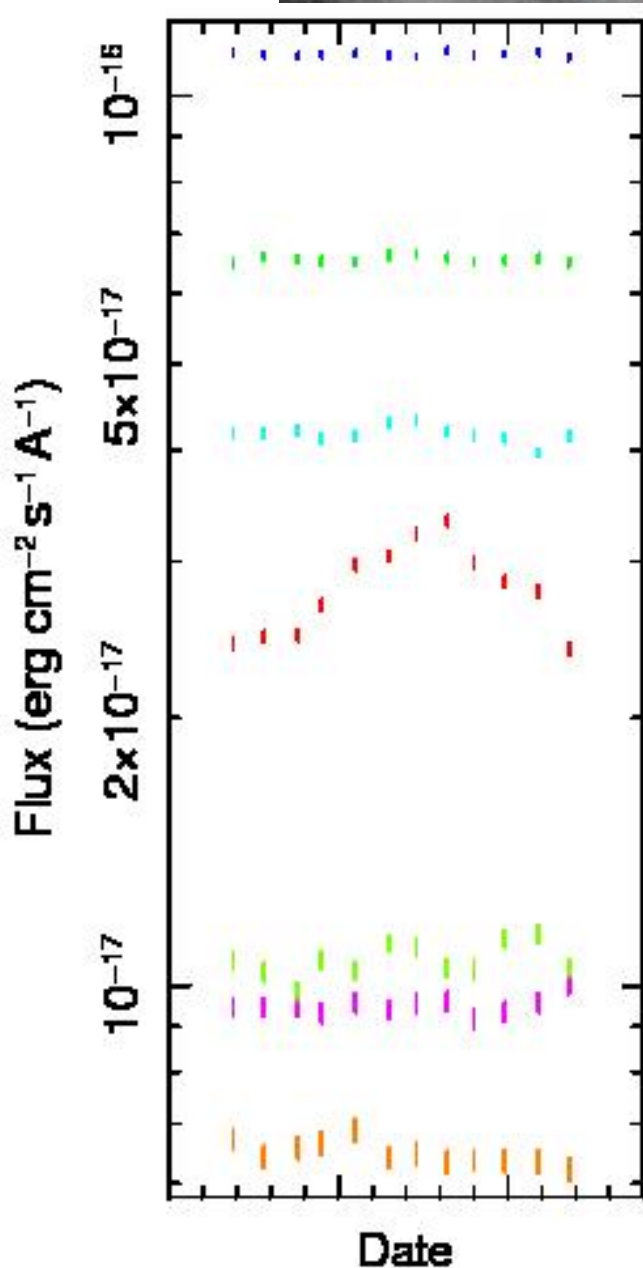
# Variability of the inner knot

Displacement by  $\sim 0.1''$

Large flux change

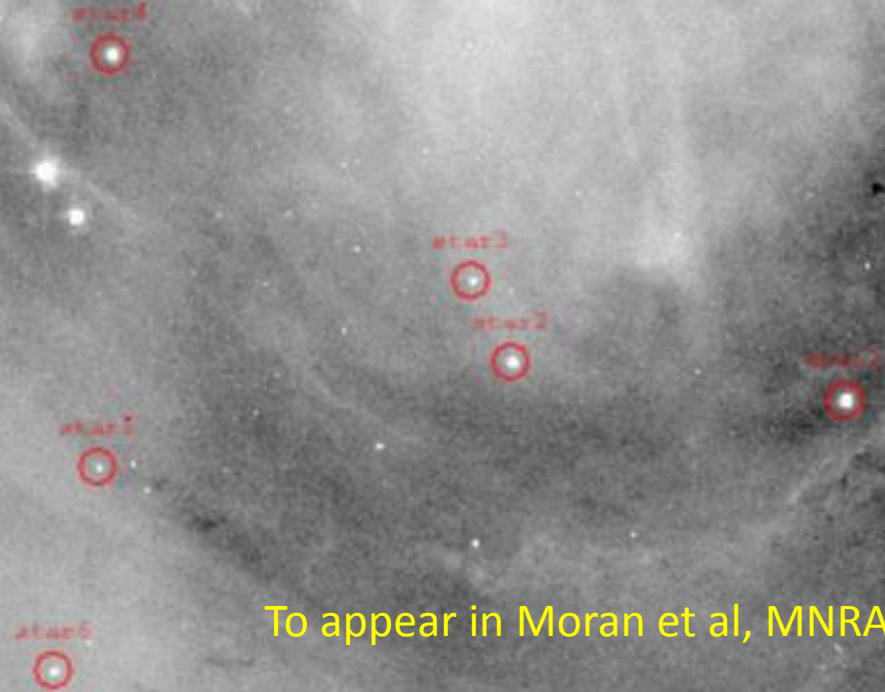


2005 Sept 09 vs. 2005 Oct 30



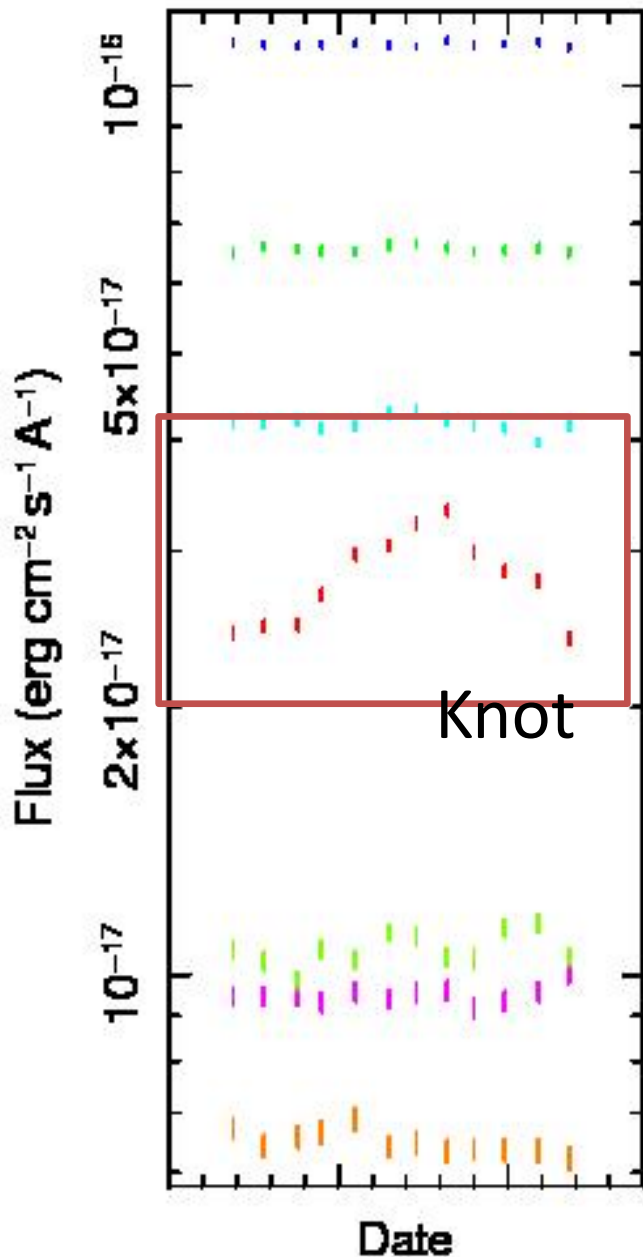
## Inner knot: photometry

Compared to 7 non-saturated reference stars,  $V \sim 18 - 21$



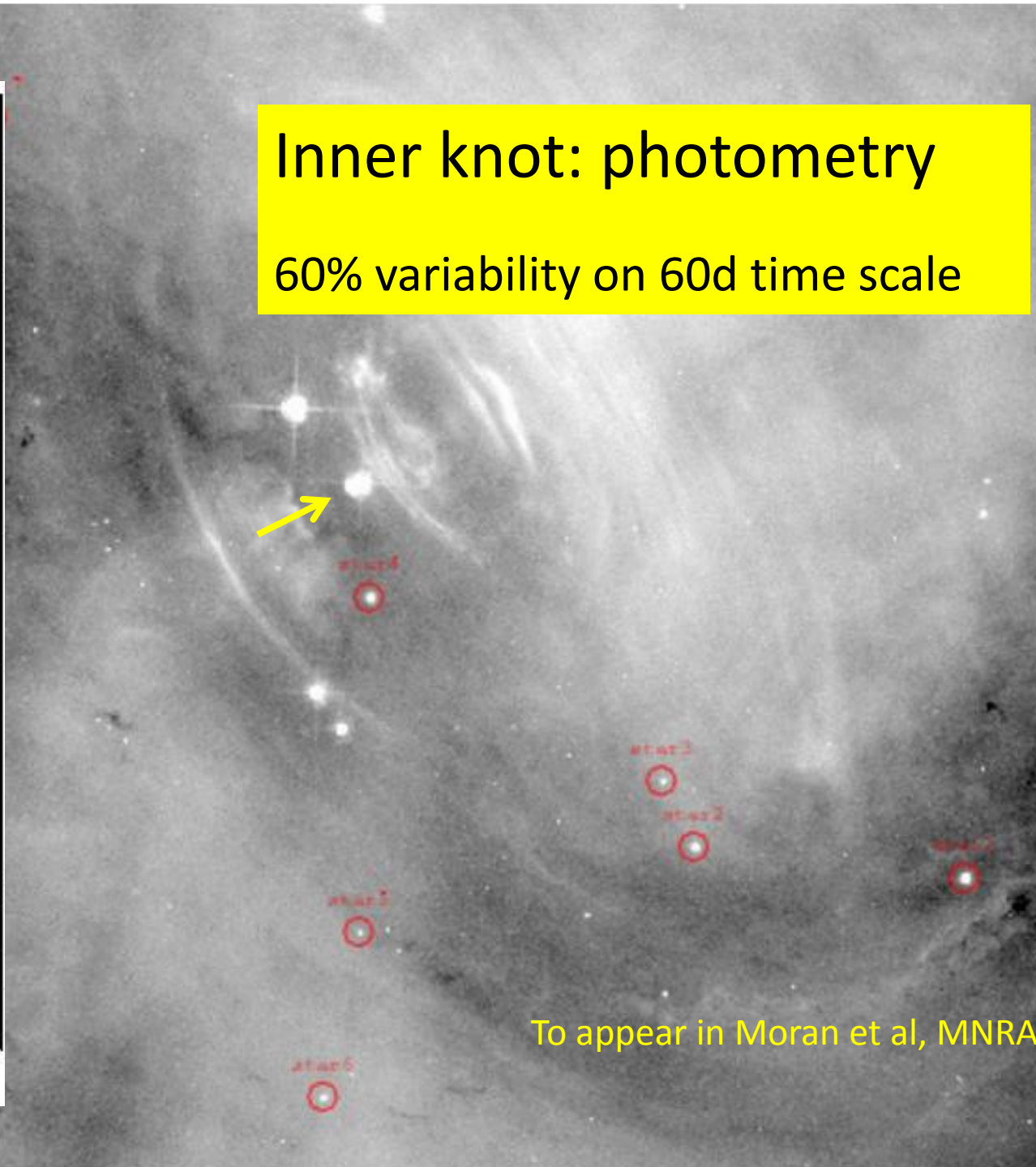
To appear in Moran et al, MNRAS





Inner knot: photometry

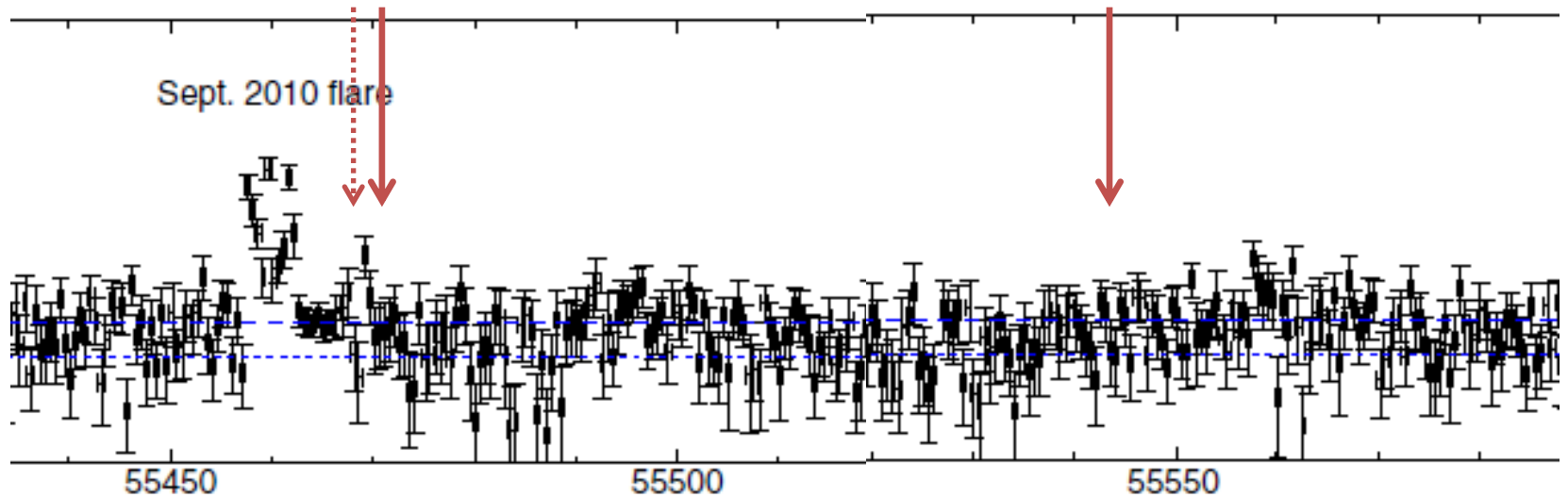
60% variability on 60d time scale



To appear in Moran et al, MNRAS

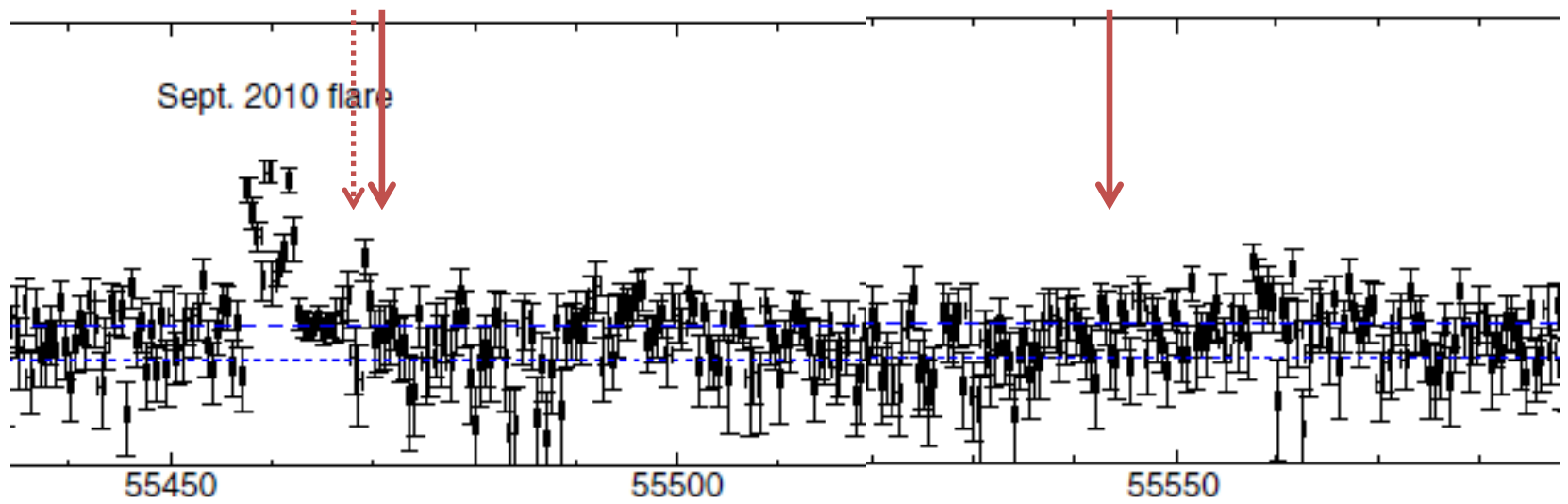
# HST observations in the gamma-ray flare era

➔ HST follow-up after Sept 2010 flare discovered by AGILE





## HST observations after September 2010 flare



Lack of any recent pre-flare image



New Monitoring campaign with ACS + TOOs  
8 epochs / year (every 1-1.5 month, no visibility in Apr-Aug)  
Similar strategy with Chandra

## Waiting for a new flare...

➔ April 2011 flare: no HST observations

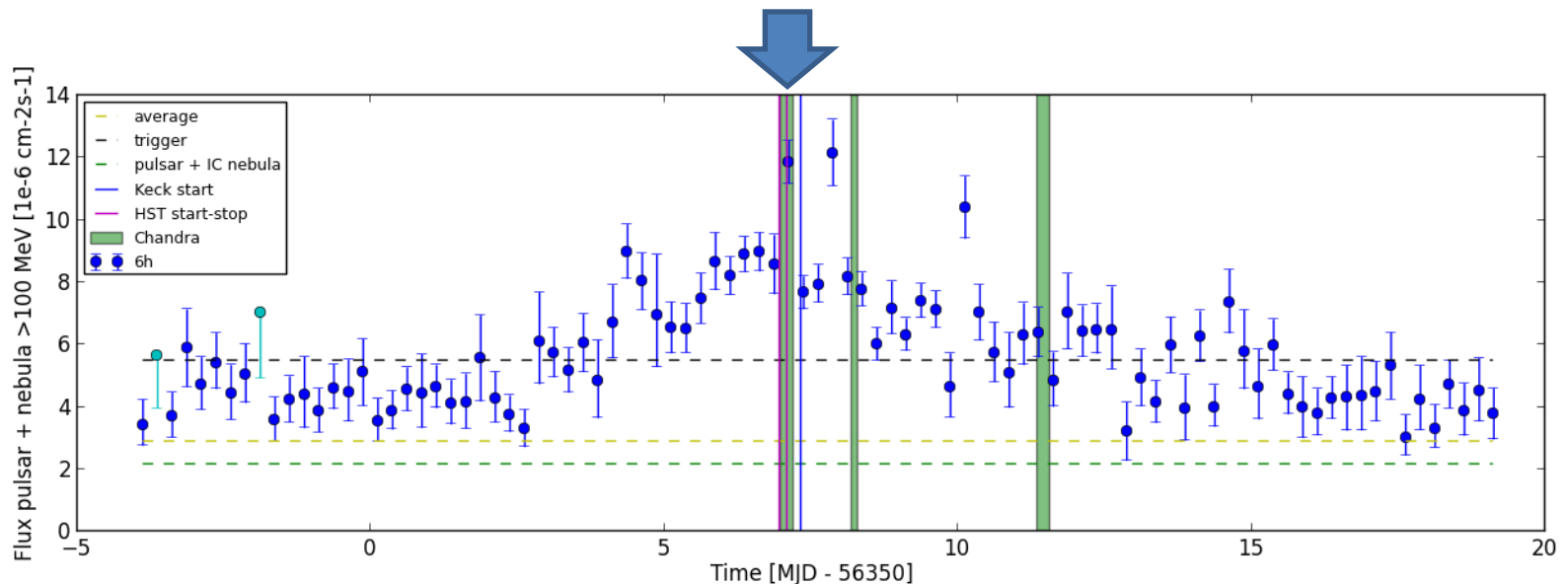
➔ July 2012 flare: no HST observations

➔ March 2013 flare: HST TOO triggered

TOO performed close to peak of flare

Monitoring obs collected 9 days before

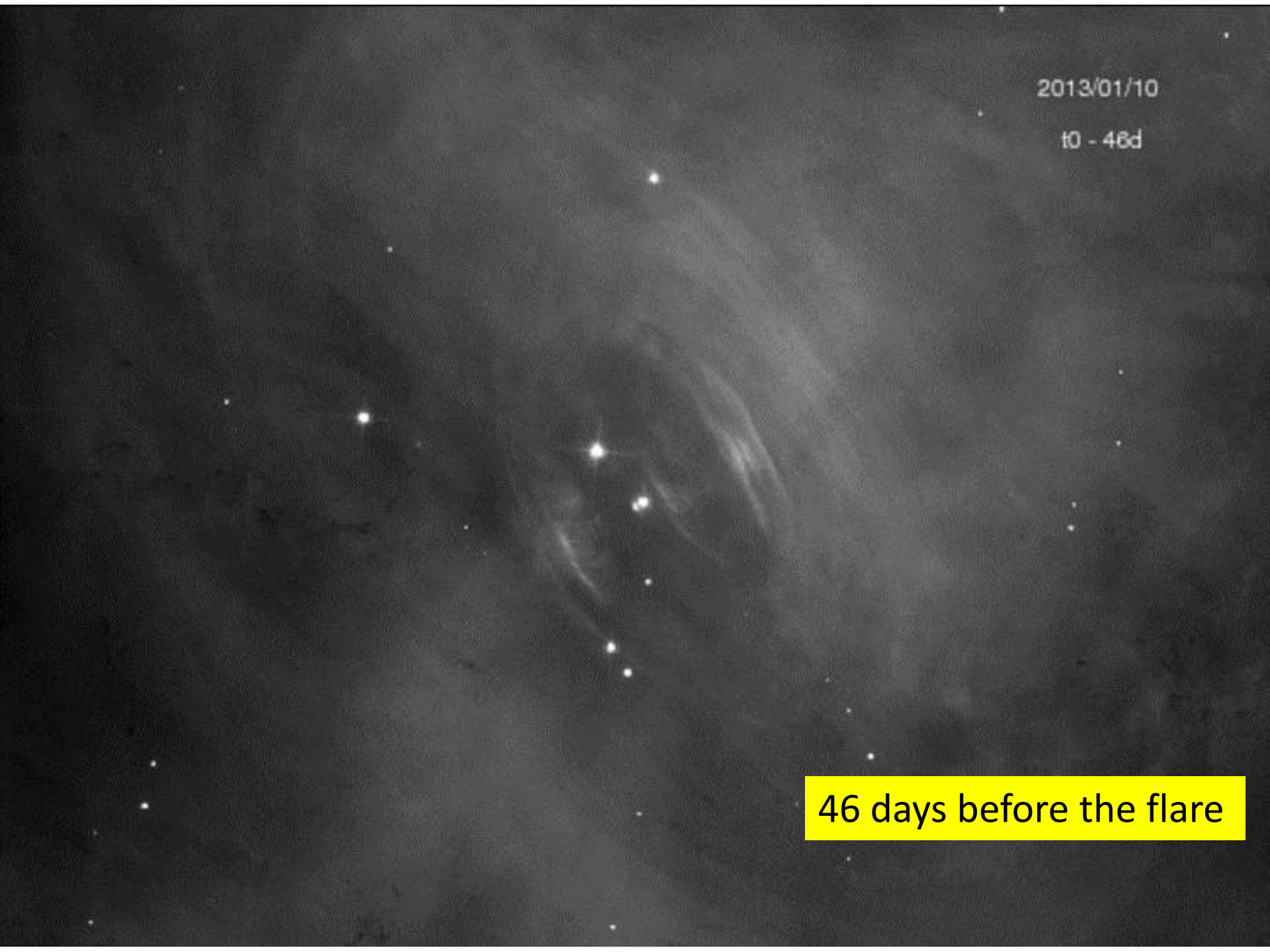
We also got a DD obs 25 days after flare; monitoring obs 41 days after flare



2013/01/10

t0 - 46d

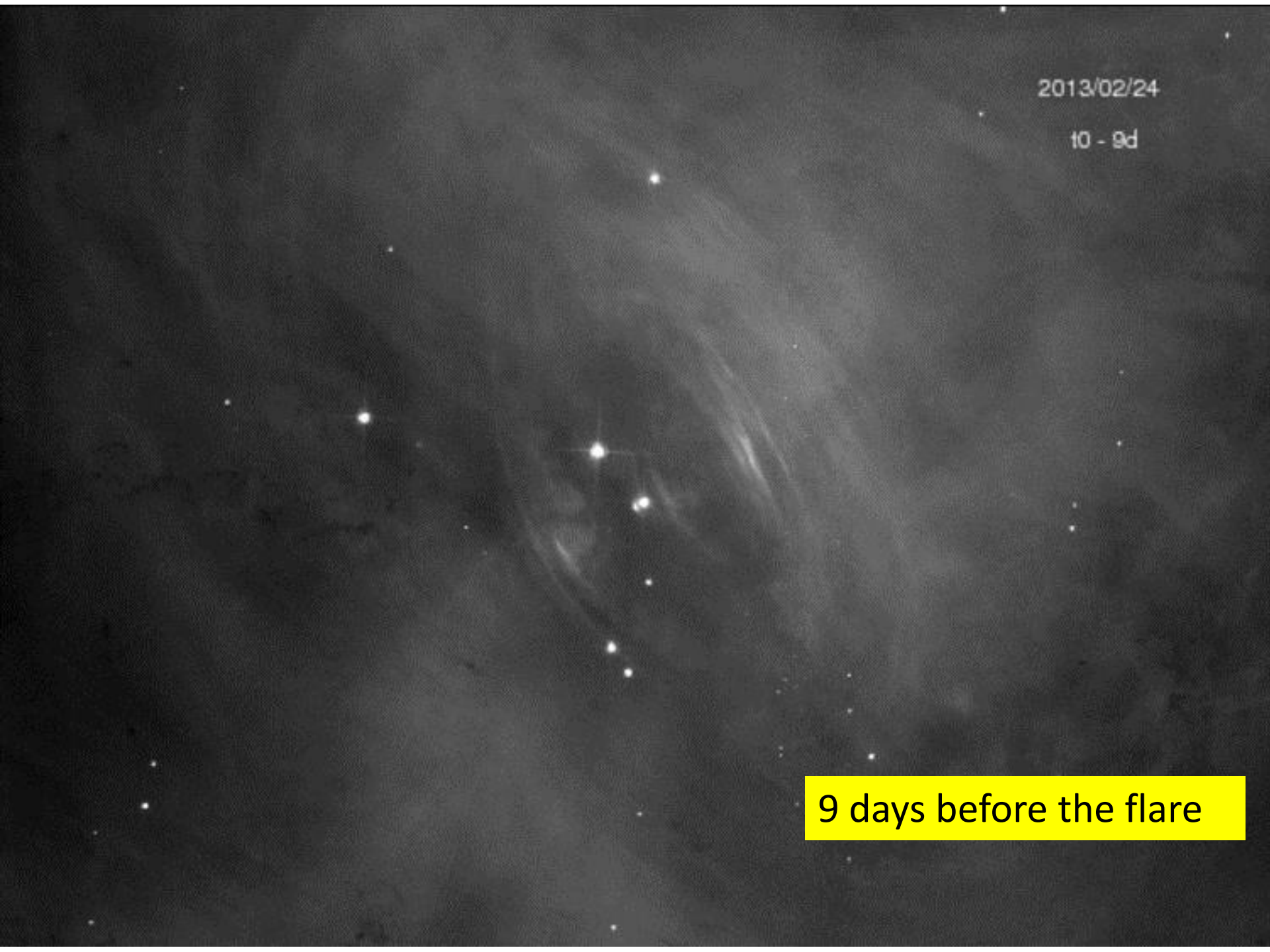
46 days before the flare



2013/02/24

10 - 9d

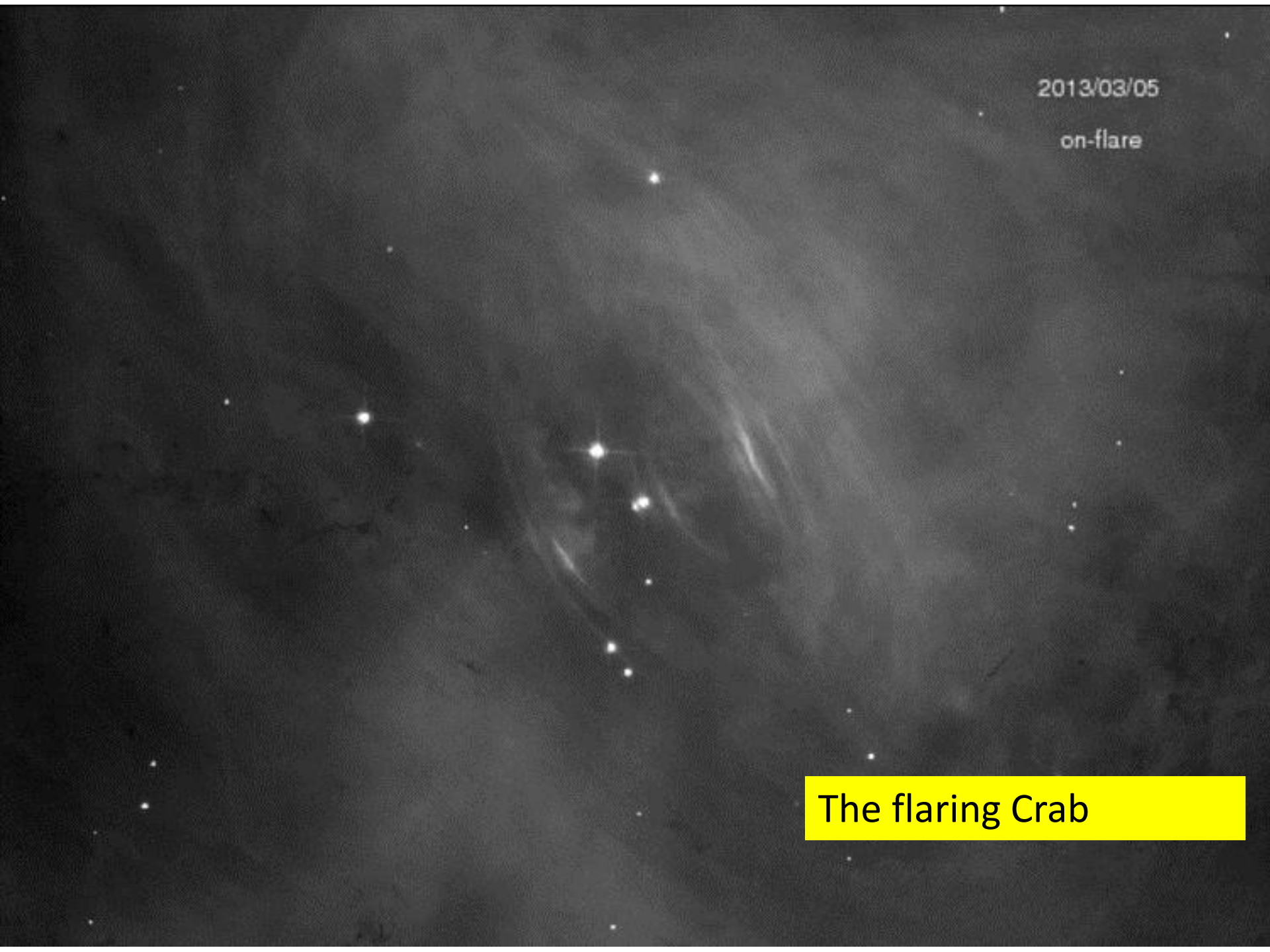
9 days before the flare



2013/03/05

on-flare

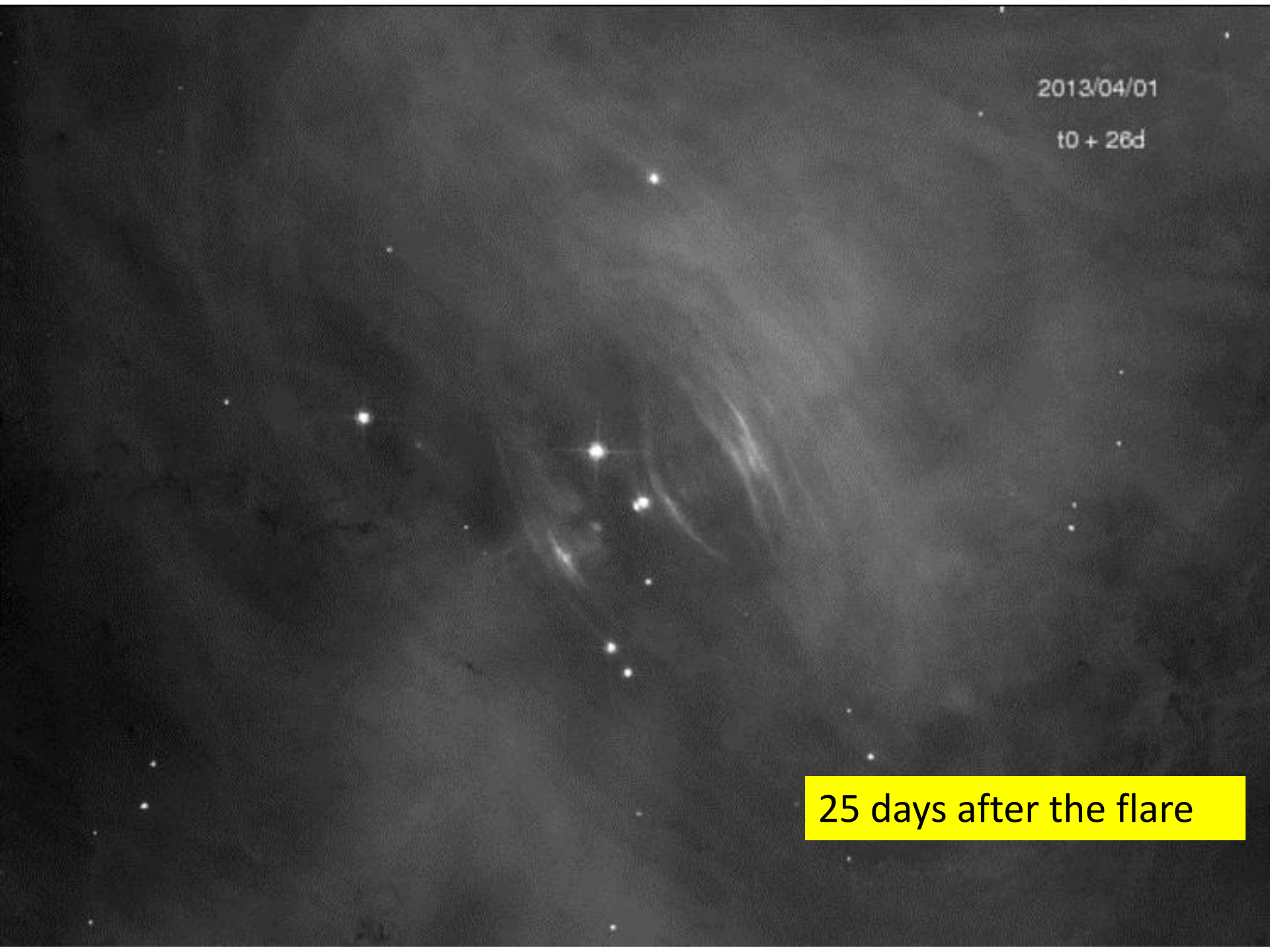
The flaring Crab



2013/04/01

$t_0 + 26d$

25 days after the flare

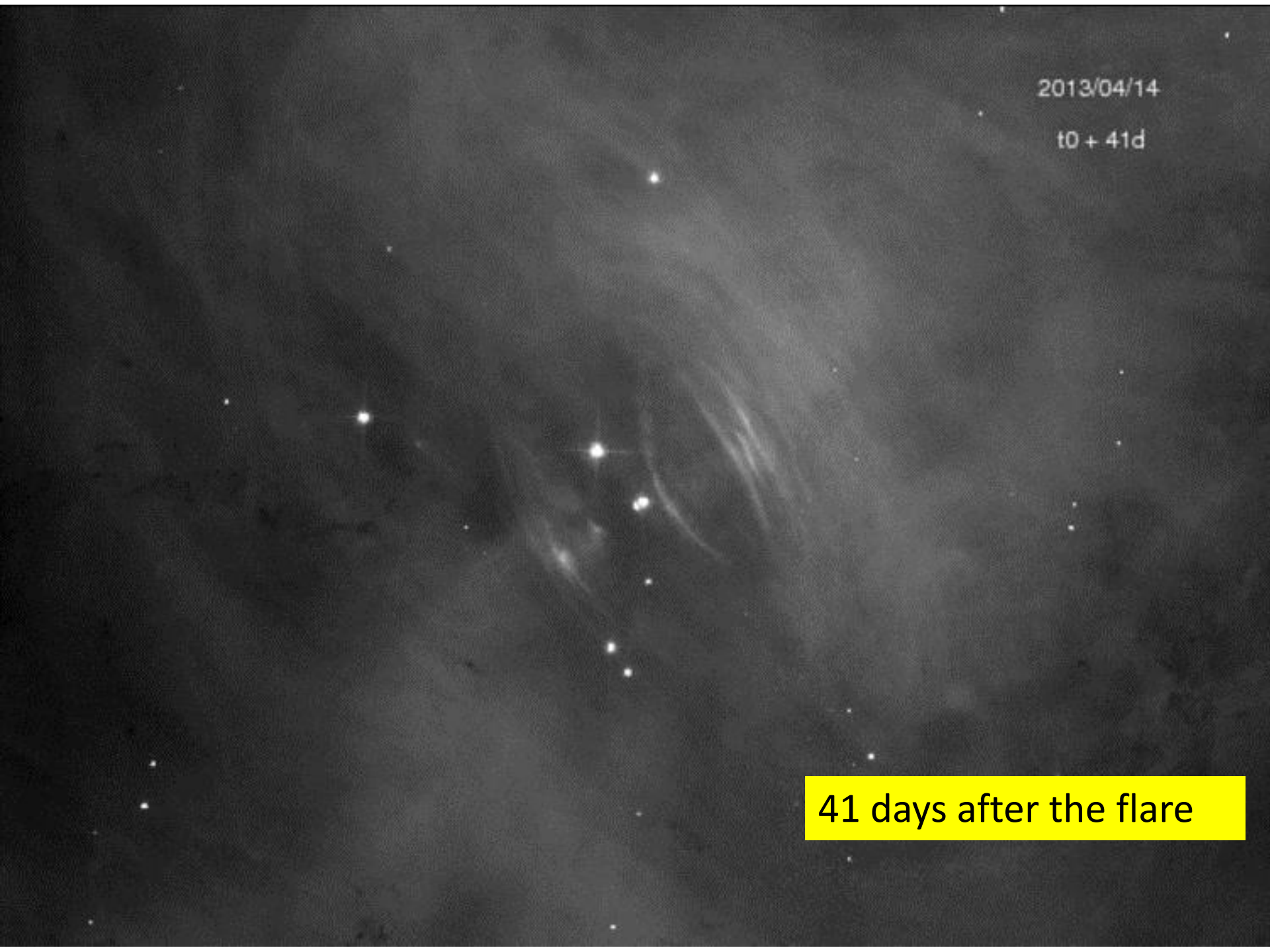




2013/04/14

t0 + 41d

41 days after the flare



2013/03/05 - 2013/02/24

Difference image: (on flare) vs. (pre-flare)

2013/04/01 - 2013/02/24

Difference image: post-flare evolution

2013/04/14 - 2013/02/24

Difference image: post-flare evolution

Flaring

Wisps

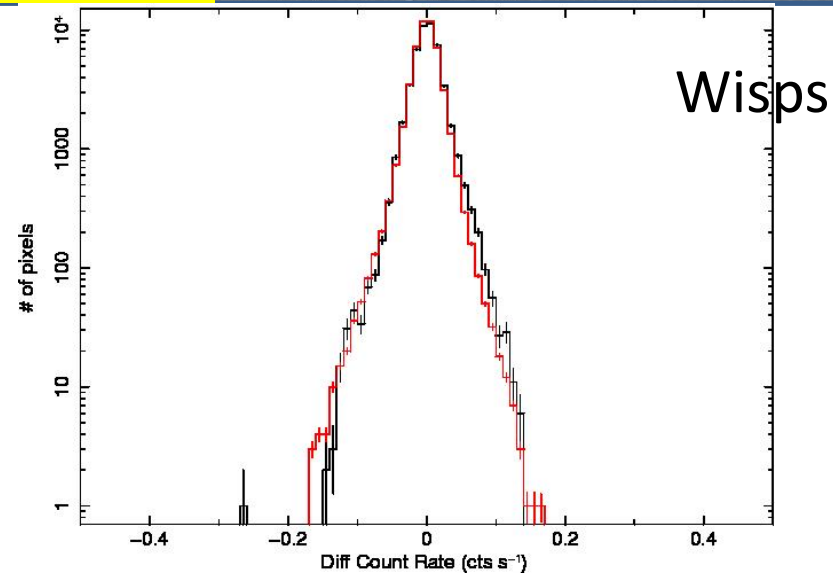
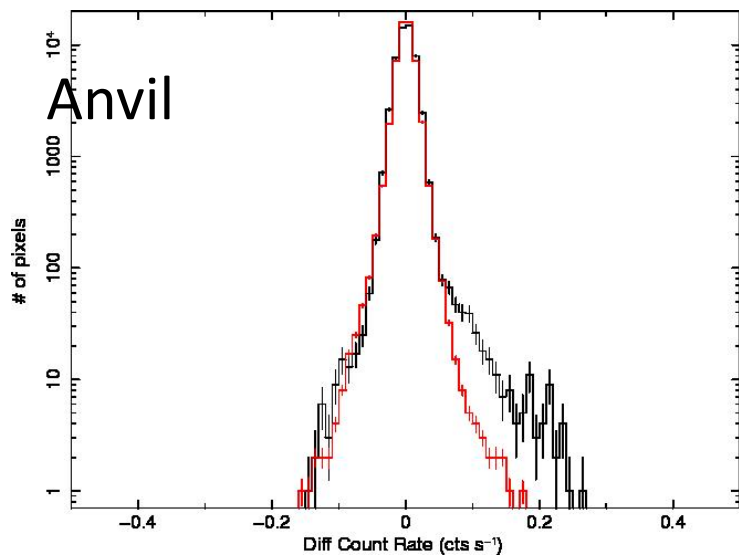
Reference

Wisps

Anvil

Anvil

Variability of the  
PWN (10 days)



Flare

Wisps

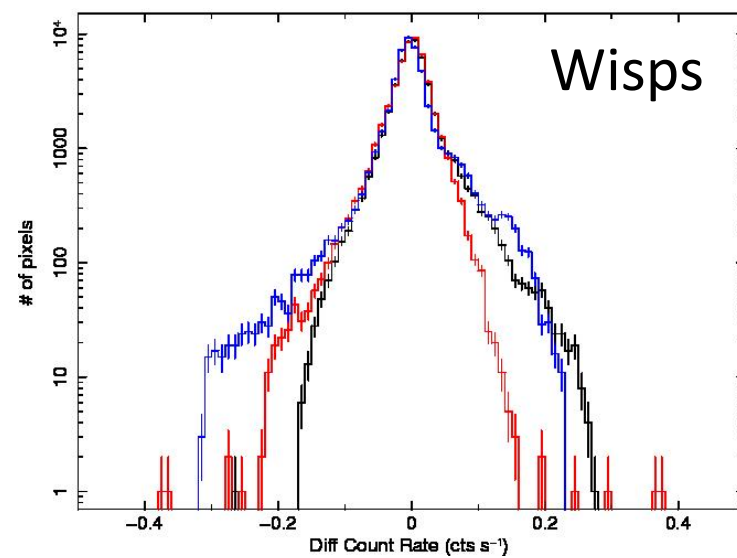
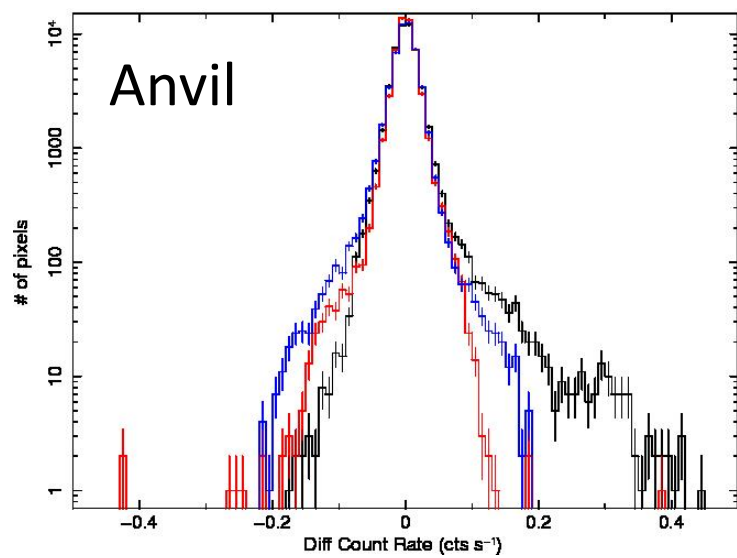
Reference

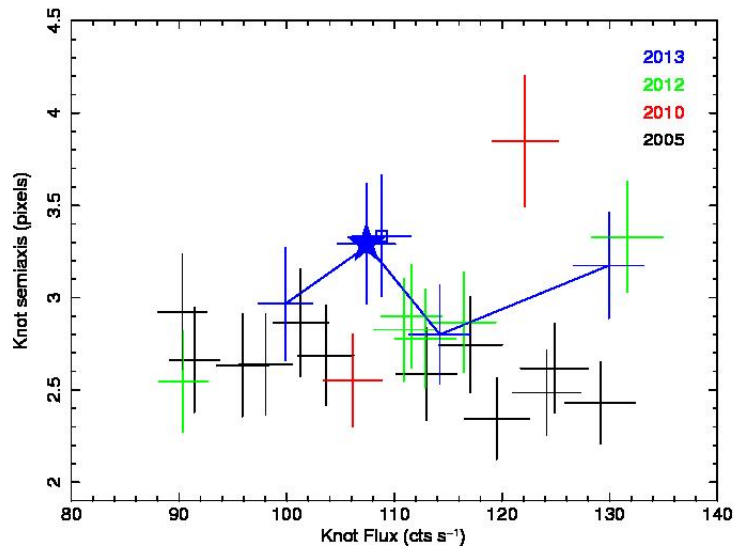
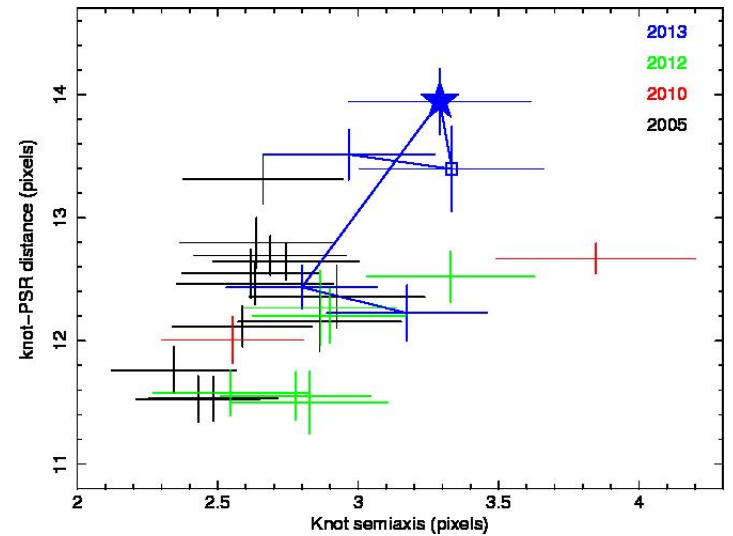
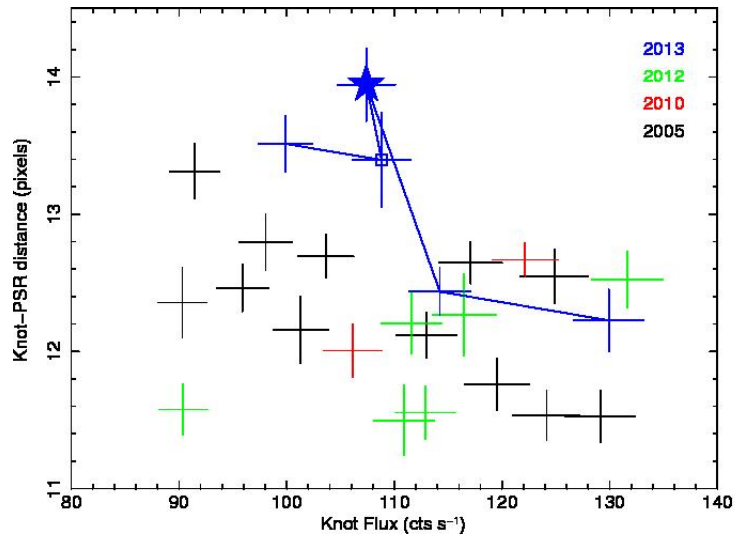
Wisps

Anvil

Anvil

Variability of the  
PWN (30 days)





# Variability of the inner knot

Flux, position, shape

# After a quick analysis

The PWN does not display any peculiar/unusual behaviour in our monitoring + TOO images

Highest variability is seen in the anvil region

The knot does vary, but its properties are reasonably close to their “normal” range

A more thorough investigation, including HST-Chandra correlation, is ongoing

My feeling is that we are facing a gamma-ray only phenomenon