# SNR Shock Impact on Star Formation

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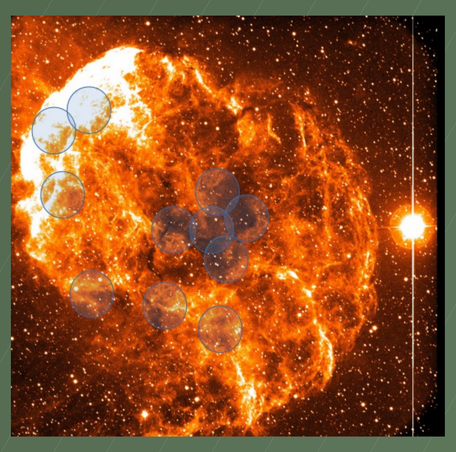
## Motivation

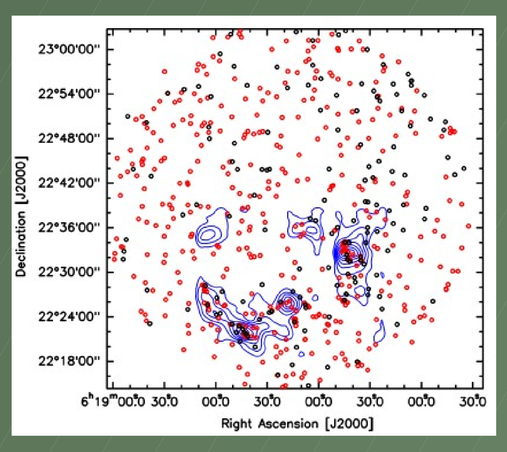
Supernova remnants (SNRs) are often found in regions with active star formation and near young stellar objects (YSOs). Their progenitors were most likely members of the same generation of stars as the YSOs. The shock waves of SNRs observed near star-forming regions might show interaction with existing YSOs. We aim to find observational evidences for such an interaction for the first time in a Galactic SNR. We expect that if the SNR shock wave encounters a YSO, it will change the physical and chemical properties of the YSO. The mass, geometry, and the dynamical temperature of the proto-planetary disk will be altered. Since the SNR shock carries a substantial amount of metals from the progenitor star and supernova (SN) nucleosynthesis, the encounter might also enhance the chemical abundances of the system. Owing to its large area, the disk can act as a net that catches the SN material, especially rich in α-process elements. Based on measurements of 60Ni abundance in meteorites such a scenario is also discussed for our Solar System (Tachibana et. al. 2002, ApJ 639, L87).
In this poster we present potential SNR-YSO interaction regions and candidate stars inside the SNRs IC443, CTB109, and S147.

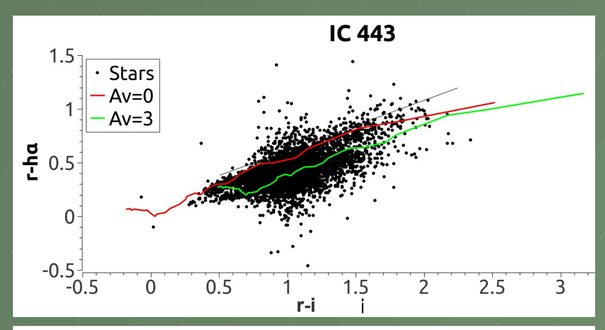
## Method

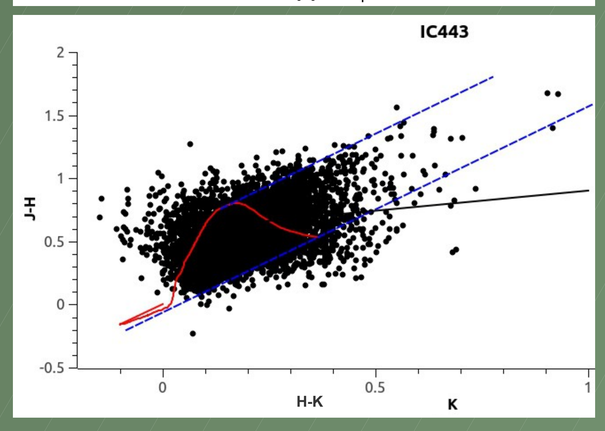
- Search for YSOs in the CO bright regions in SNRs based on optical and near-Infrared (NIR) photometry.
- Due to their dense accretion disks, YSOs are bright in Hα and show an IR excess.
- Use *JHK* and *RI*Hα values with S/N>10 from 2MASS and IPHAS catalogs to create *JHK* and *RI*Hα color-color diagrams for the search of sources with NIR and Hα excess.
- Study the spectral energy distribution (SED) in the visible to far-IR range using WISE data to obtain a list of possible candidates.
- Multi-object spectrograph observations to study the targets and their environment.
- Distance and visual absorption measurements based on spectroscopic parallax.
- Accretion rate from Hα EW.
- Age from Li 6708 Å EW.
- High-resolution and high-S/N observations for metallicity measurements as well as long-term monitoring of photometric and spectroscopic variability for most promising objects.

## IC 443



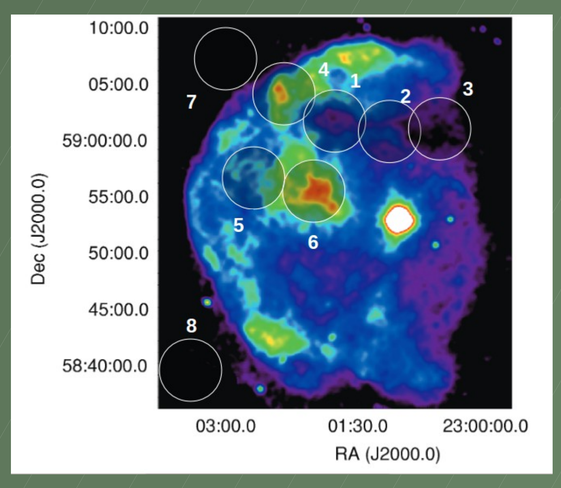


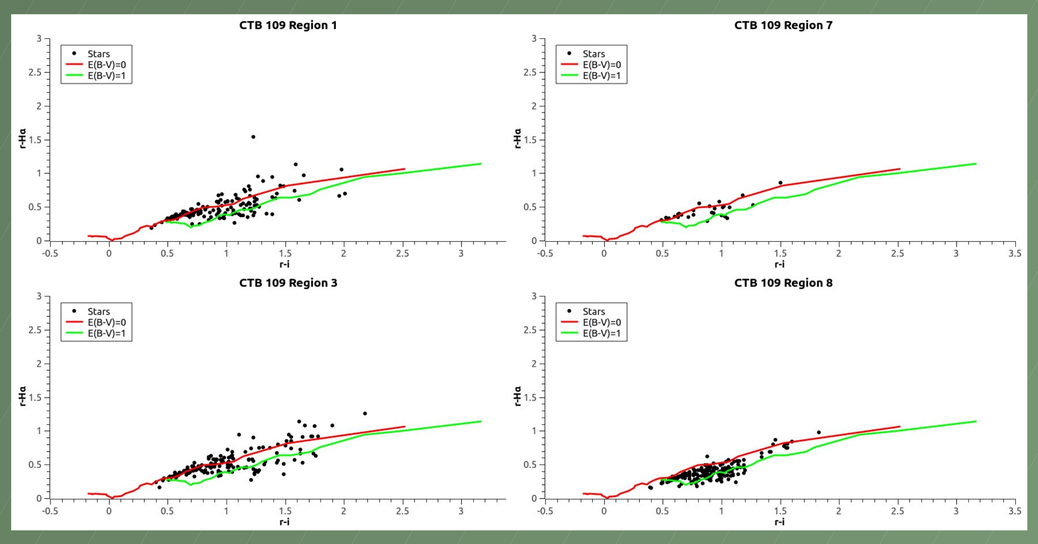




Left: SNR IC 443 observed with the 90cm telescope in Jena, Germany, using the STK instrument. Regions that are likely to host YSOs are marked by circles.
Middle: Distribution of YSOs, which seem to cluster around CO clouds (taken from Xu et al., 2011, ApJ 727, 81).
Right: Optical and NIR color-color-diagrams of sources in SNR IC 443. Hα bright sources can be found (upper figure). Five objects are consistent with being YSOs based on both diagrams.

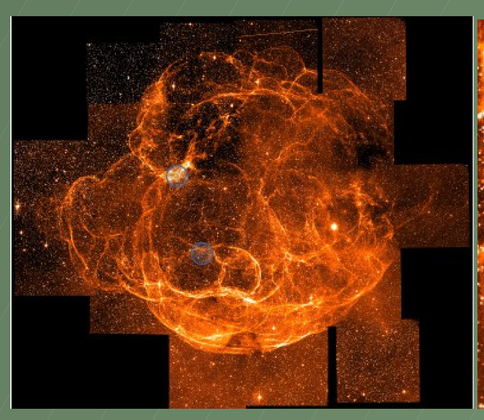
## CTB 109

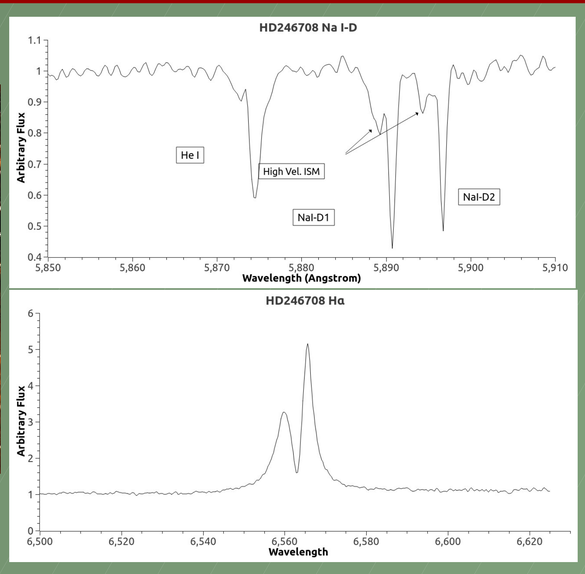



Left: XMM-Newton intensity map of SNR CTB 109 (Sasaki et al., 2004, ApJ 617, 322) with positions studied for YSOs.
Right: *RI*Hα color-color diagrams of four of the regions shown in the left figure. Regions 1 and 3 are in the CO arm, which is located in front of the SNR and is most likely being hit by the SNR shock wave from the back side, while regions number 7 and 8 are two randomly chosen regions outside the SNR. Region 5 has been studied by J. Knies (2015, Bachelor Thesis). The Hα bright sources are clearly more abundant in the shock-cloud interaction regions.

## S147




SNR S147 obviously shows no interaction with molecular clouds. However, the early-type emission-line star HD 246708 located in one of the brightest radiative filaments shows significant NIR excess. We obtained a FLECHAS spectrum at the Observatory in Jena. The star is of B0IIIe type. Lines indicating high-velocity ISM can be seen in its spectrum. The shocked material is blue-shifted to 122 km/s.
We have hence decided to search for other young stars in this dense region and in one additional region which is the only location where the SNR might be encountering a molecular cloud.