1. O CAESAR

The Optical Catalogue of Extragalactic Supernova Remnants (O CAESAR) will provide the largest homogenous survey of extragalactic SNR candidates taken by the same telescope (CFHT), the same instrument (SITELLE), and under similar observational conditions. SITELLE, the imaging Fourier transform spectrograph at CFHT, offers a large field of view (11'x11''), complete spatial coverage, and a high spatial resolution (0.32'' limited by the seeing), which are ideal to cover the whole disk of nearby galaxies. Using three filters, we are able to measure the strong emission lines [OII] λ4959,5007, Hβ, [NII] λ6583, and [SII] λ6716,6731.

2. The Sample

O CAESAR catalogue is volume limited (D ≤ 10 Mpc) and includes all the galaxies from the SIGNALS survey (PI: Lucie Rousseau-Nepton; http://signal-survey.org) that will be added to other galaxies that will be proposed for O CAESAR to include different ranges of morphological and physical properties of galaxies (e.g. types, masses and metallicities).

3. Observation and Data Reduction

The sample will be observed using the imaging Fourier transform spectrometer SITELLE (Drissen et al. 2019) installed on the 3.6-m CFHT. For each galaxy, more than 4 million spectra are obtained using the filters SN1 (365-385 nm, R=400), SN2 (480-520 nm, R=600), and SN3 (651-685 nm, R=1500) with seeing limited spatial resolution of 0.8". Only ~3 hours are needed to reach the spectral resolution requested for each filter. Data reduction is performed with ORBS (Outils de Reduction Binoculaire pour SpiOOM/SITELLE) and lines are fitted using ORCS (Outils de Réduction de Cubes Spectraux), two softwares developed specifically for SITELLE (Martin et al. 2015).

4. SNR Identification

In order to identify the SNR candidates in a non-subjective way, we use the automated identification technique described by Rousseau-Nepton et al. (2018). This technique was initially created to study the star forming regions in the nearby galaxy NGC 628.

Moumen et al. (2019) have adapted this technique to identify automatically SNRs in nearby galaxies such as NGC 3344. Four criteria were applied to select SNR candidates:

- 1. Line ratio [SII]/Hα ≤ 0.4
- 2. The signal to noise ≥ 5 for Hα and [SII] lines
- 3. The size of the region ≤ 120 pc
- 4. The correlation coefficient of the profile ≥ 0.5

5. SNR Confirmation

STELLE data used in this project provide important emission lines which are useful to get the gas physical parameters (e.g. [SII] Hα and [OIII] for the main shock heating mechanism, [NI] Hα and [OII] for the metallicity, [OIII]Hβ for the shock velocity, [SII] ratio for the density, and Hα/Hβ for the extinction, etc.). In order to confirm the shock-heated nature of the SNR candidates, we adopt a self-consistent analysis using Sabbadin plots (Sabbadin et al. 1977) and BPT diagrams (Baldwin et al. 1981).

6. Shock Models

Understanding emission nebulae like SNRs in various galaxies is a major issue in astrophysics, and involves a statistical approach for large samples in galactic environments of all kinds. Instruments like SITELLE at the Canada-France-Hawaii Telescope have opened a new era in the three-dimensional study of extended objects. Various sets of model of photo-ionization and shocks make it possible to connect these types of observations to the physical conditions (temperature, density, chemical composition, ionizing source) in the nebulae. But more sophisticated models including more parameters are still needed.

O CAESAR will be an excellent source of spectroscopic data for developing and testing new shock models.