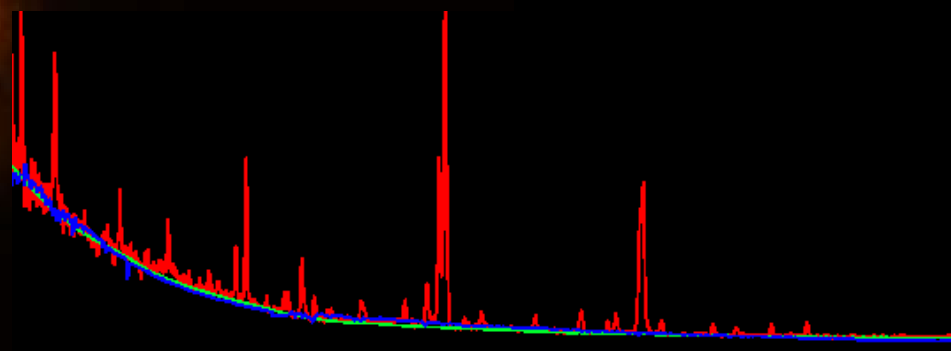
# *NGC 1068*
# The nature of the *Hot Spot*

**Elena Jiménez Bailón**

**Miguel Mas Hesse**

**María Santos Lleó**

**Miguel Cerviño Saavedra**



# *NGC 1068* : Outline

## Outline

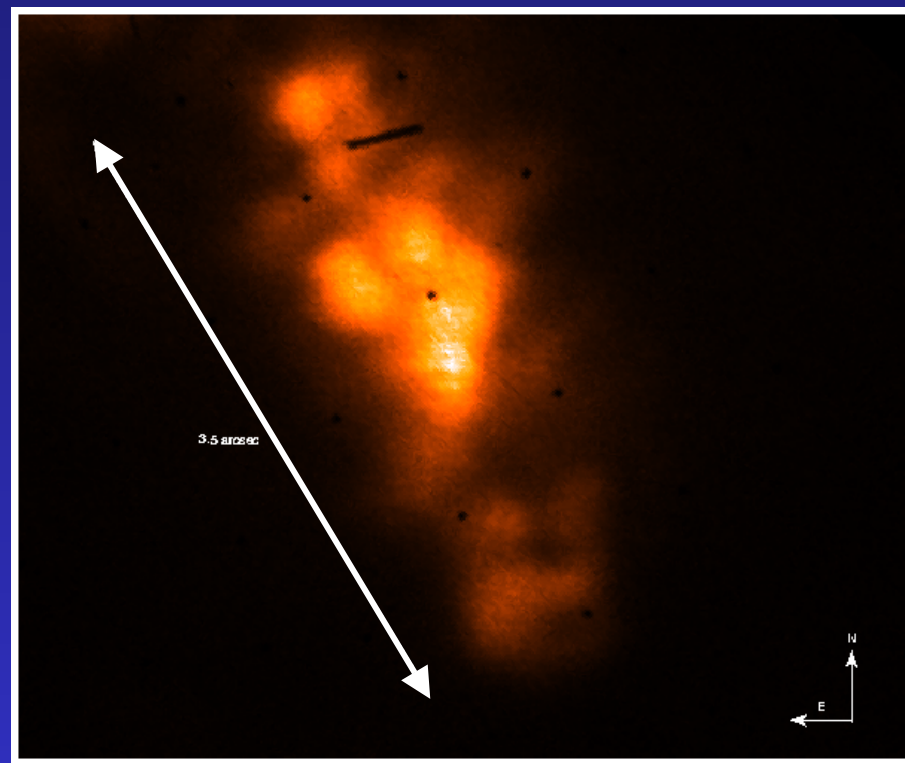
- Motivation and previous analysis of NGC 1068
- Analysis
- Preliminary results and conclusions
- Future work

# NGC 1068 : Motivation

## Hidden Seyfert 1 Nucleus?

• Detection of broad emission lines in polarized flux *(Antonucci & Miller, 85)* originated by the reflection of the hidden nucleus emission in the circumnuclear region by $e^-$ and/or dust scattering *(Miller, Goodrich & Mathews, 91)*

• Optical HST/PC images of the NLR show a resolved and very bright emission ( 0.3" in size) named the ***Hot Spot***, a mirror illuminated by the hidden nucleus *(Evans et al, 91)*




*Macchetto et al, 94*

# ***NGC 1068*** : Motivation

## Hidden Seyfert 1 Nucleus?

• HST/FOS 2200-7000 Å spectrum shows that the *Hot Spot* is **NOT** the source of the reflected light: no detection of the broad $H_\beta$ emission observed in polarized line FWHM = 2200 vs. $3030_{polarized}$ km/s *(Caganoff et al., 91)*

• HST 1575-3300 Å spectropolarimetry shows broad CIII] and MgII emission and blended FeII emission, indicating that part of the light observed comes from the hidden nucleus . *(Antonucci, Hurt & Miller, 94)*

• Using the STIS/HST 1150-10270 Å spectrum *Crenshaw & Kraemer, 2000* suggest that the *Hot Spot* is reflected emission from the hidden nucleus :

# NGC 1068 : Motivation

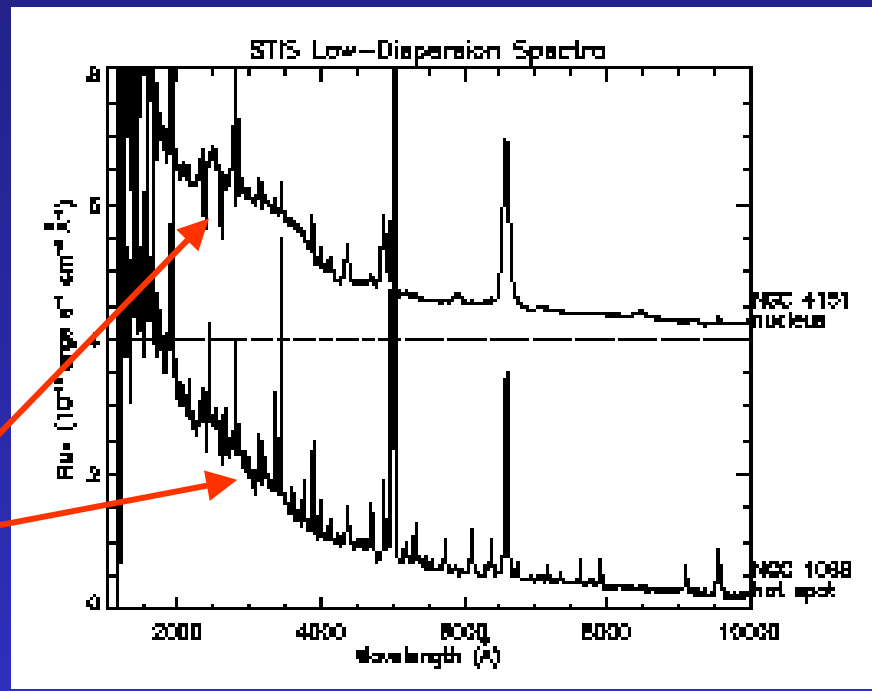
## Hidden Seyfert 1 Nucleus?

- **The continuum emission is similar to Seyfert 1 nuclei:**

- The continuum emission of the *Hot Spot* may be explained by a power law $F_\nu \propto \nu^\alpha$ , $\alpha$= **- 0.5±0.2**, while the index for NGC 4151 is $\alpha$= **- 0.6±0.1**

- The values of E(B-V) are very low, ≈ 0.06. A large stellar contribution would redden the spectrum

***Little blue bump (2000 - 4000 Å)***




*Crenshaw & Kraemer, 2000*

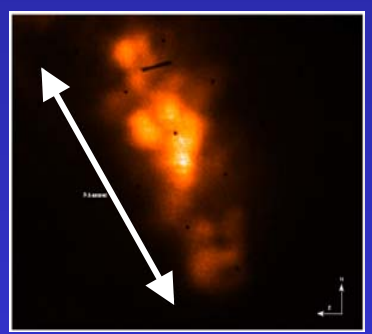
# NGC 1068 : Motivation

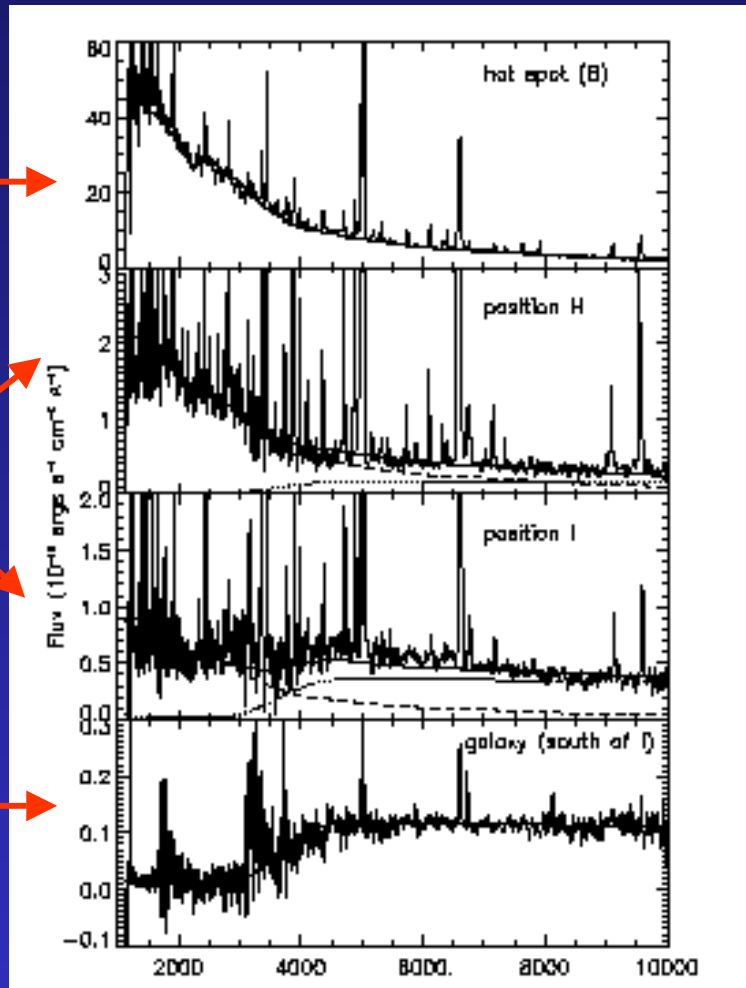
## Hidden Seyfert 1 Nucleus?

Reflected scattered light from the hidden nucleus

Two components: scattered light + stellar contribution

Stellar emission from the galaxy






*Crenshaw & Kraemer, 2000*

# ***NGC 1068*** : Analysis of the data

## The Hypothesis

**Could the *Hot Spot* continuum emission be explained by stellar activity or a combination of stellar and scattered light from the hidden Seyfert 1 nucleus?**

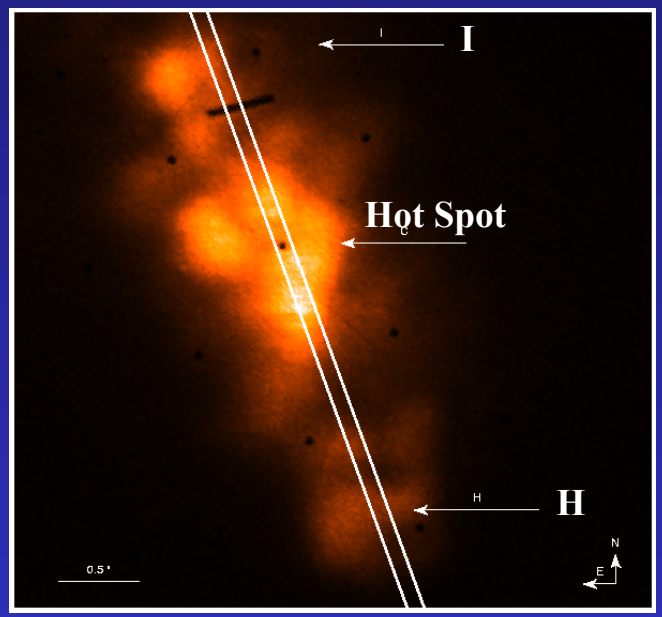
## The Method

- Spatial and spectroscopic analysis of the UV/optical emission in the central region of NGC 1068: *Hot Spot*
- Determination of the properties of different components
- Measurements of the X-ray emission: observational and inferred
- Comparison of the inferred and observed X-ray emission

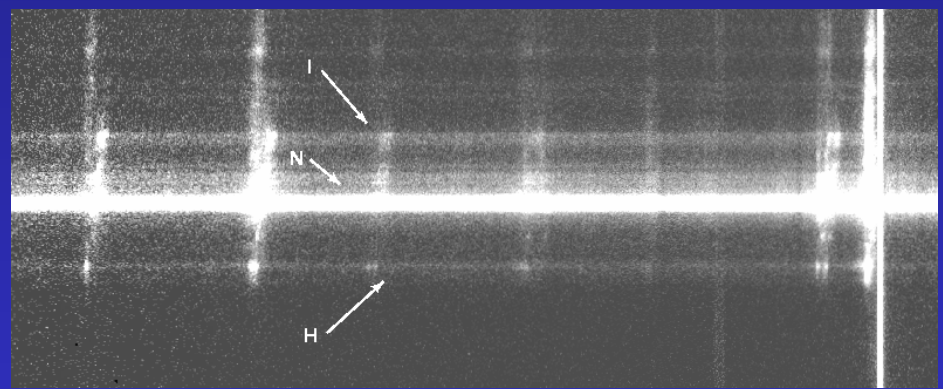
# NGC 1068 : Analysis of the data

HST Spectrograph STIS
- **Wide range 1150-10268 Å**
- **$\lambda/\Delta\lambda$~1000**

| SLIT | Detector | Range | $T_{exp}$ |
|---|---|---|---|
| G140L | Far-UV Mama | 1150-1724 Å | 4736 s |
| G230L | Far-UV Mama | 1592-3176 Å | 2280 s |
| G430L | CCD | 2905-5715 Å | 540 s |
| G750L | CCD | 5273-10268 Å | 540 s |



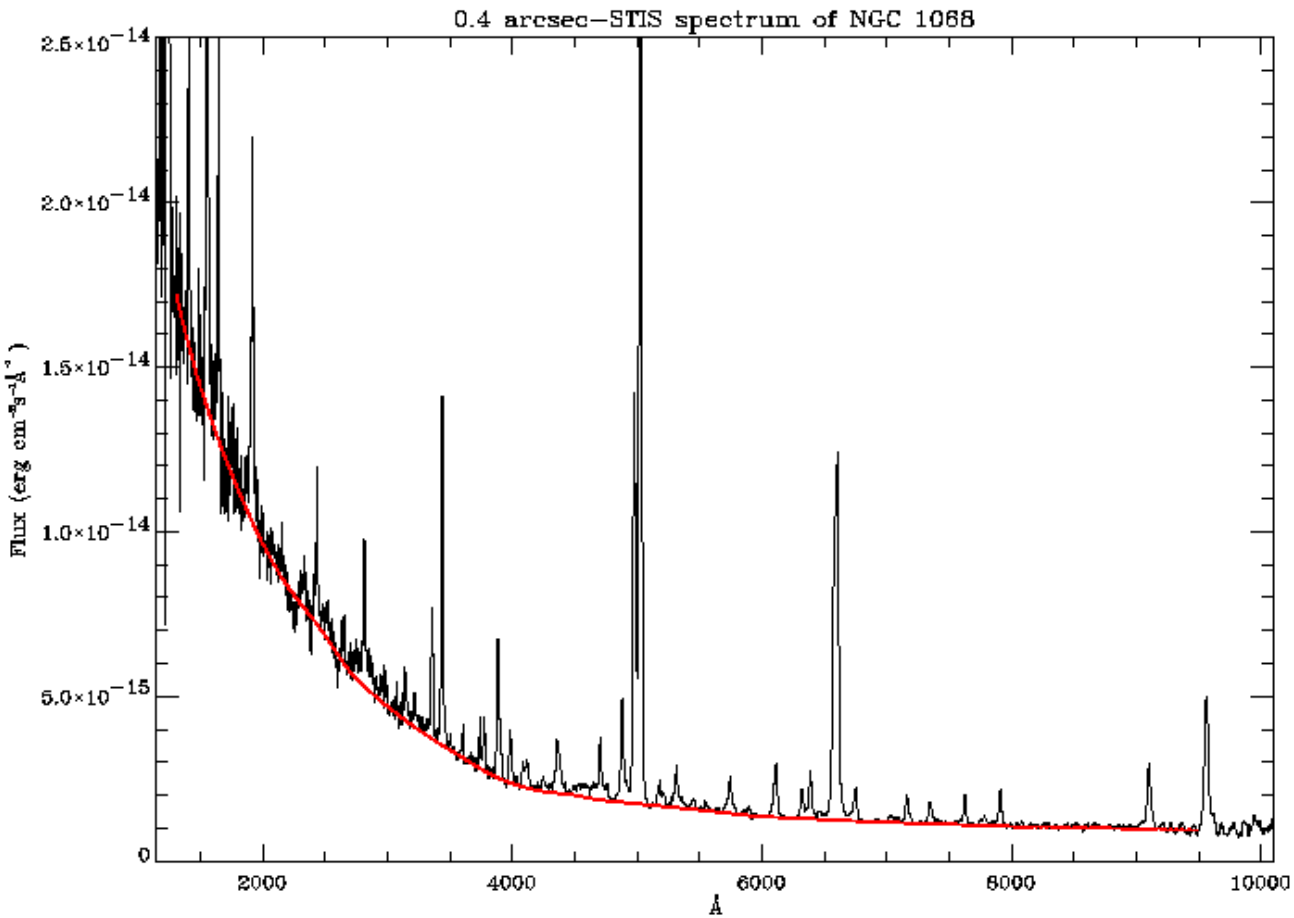

HST/FOC [OIII] *(Macchetto et al., 94)*




STIS/ HST G140L

# NGC 1068 : Analysis of the data

## Continuum



# ***NGC 1068*** : Analysis of the data

**Four different scenarios:**

- Scattered light from hidden nucleus: ***Power Law***
- Pure stellar emission: ***Synthetic Starburst***
- Combination of stellar emission & scattered light: ***Power Law + Starburst***
- Two stellar population: 2 ***Synthetic Starbursts***

**Stellar populations:**

- Continuum emission computed by CMHK *(Cerviño et al., 2002)*
- 598(75) different ages 0.2 – 9.9 $\times 10^3$ Myr

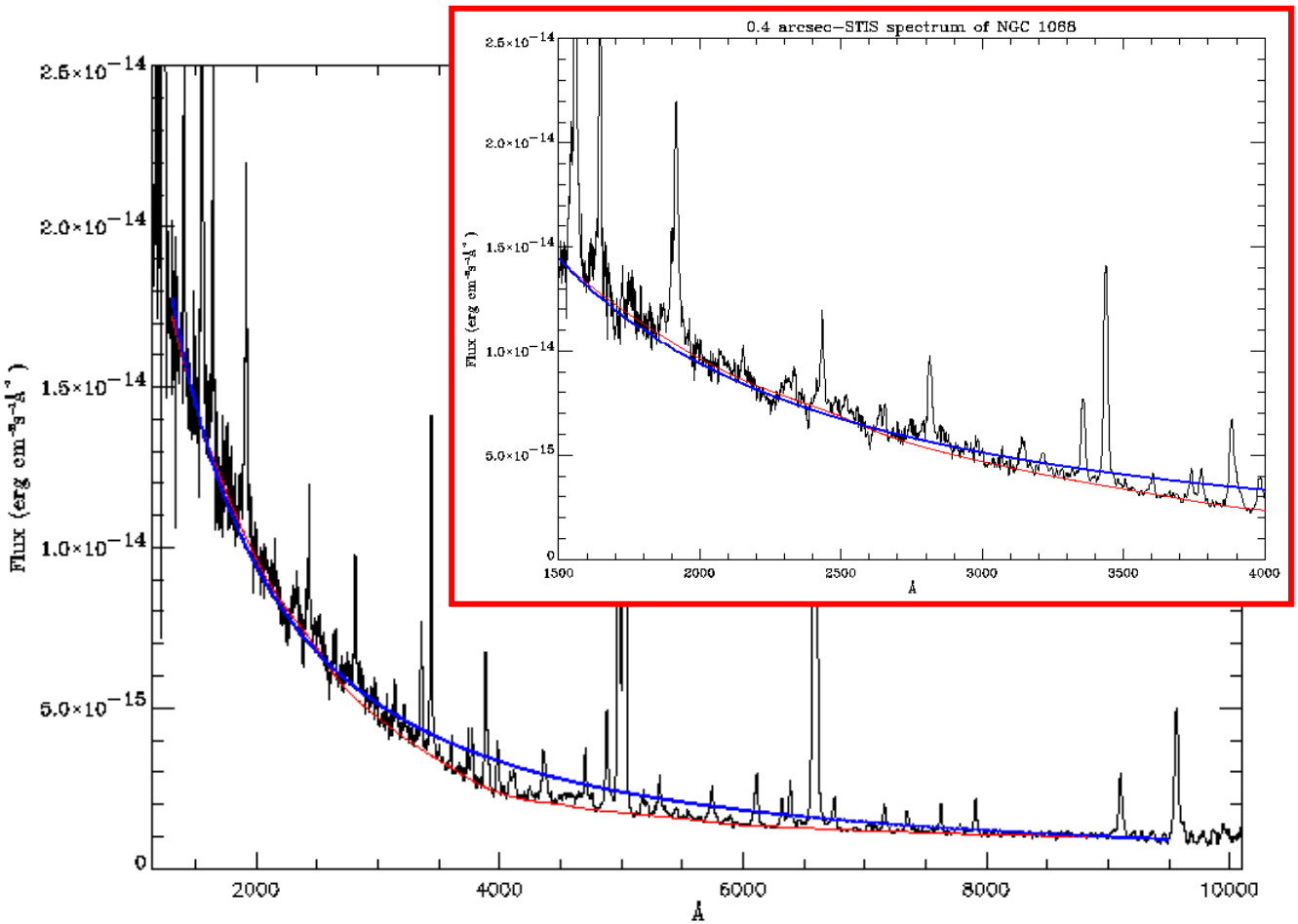
**Different absorption laws**

- Gal, SMC and LMC
- E(B-V)

**$\chi^2$ statistics for the fit of the synthetic models to the continuum emissio**

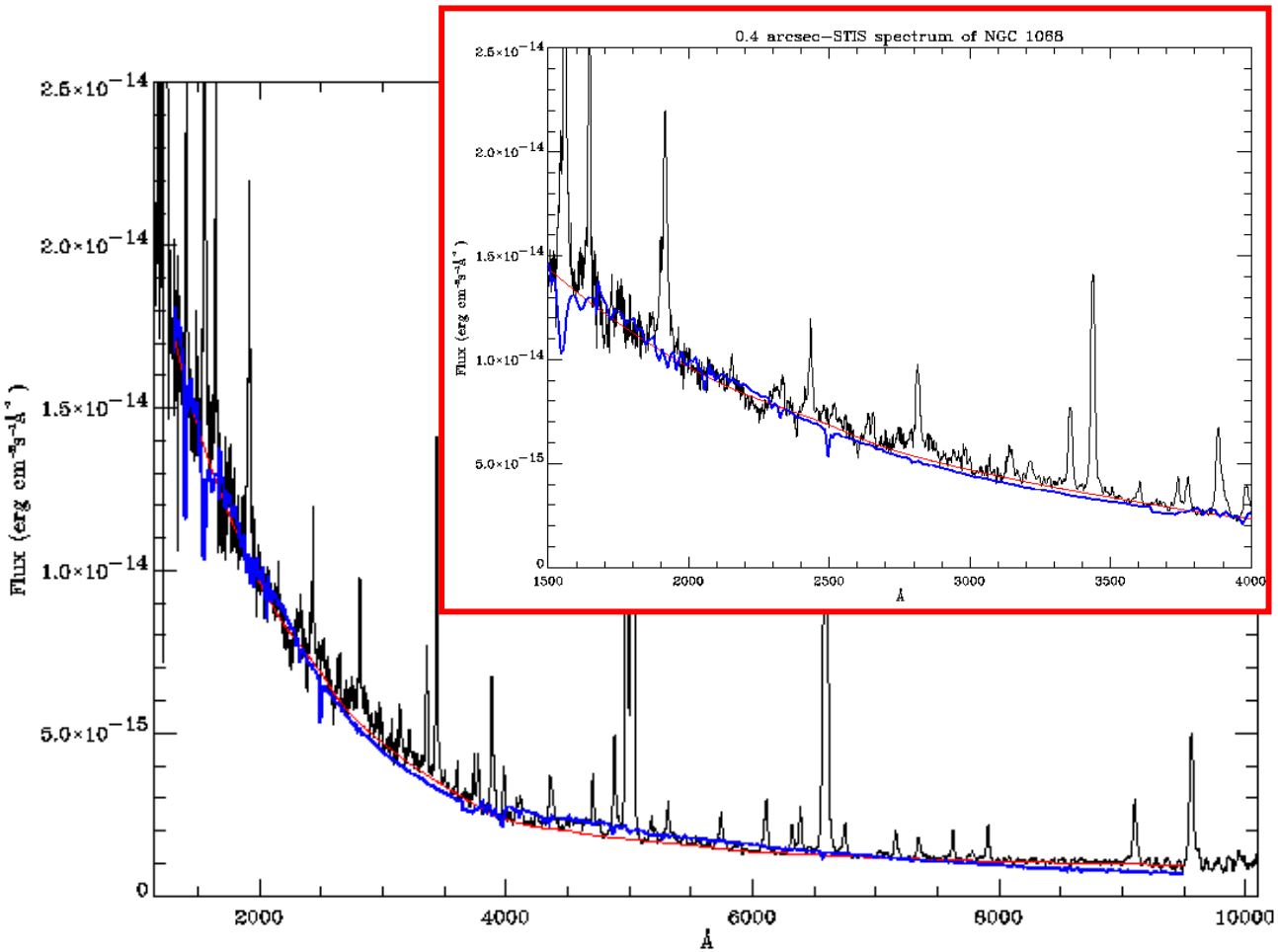
# NGC 1068 : Analysis of the data

## Power Law



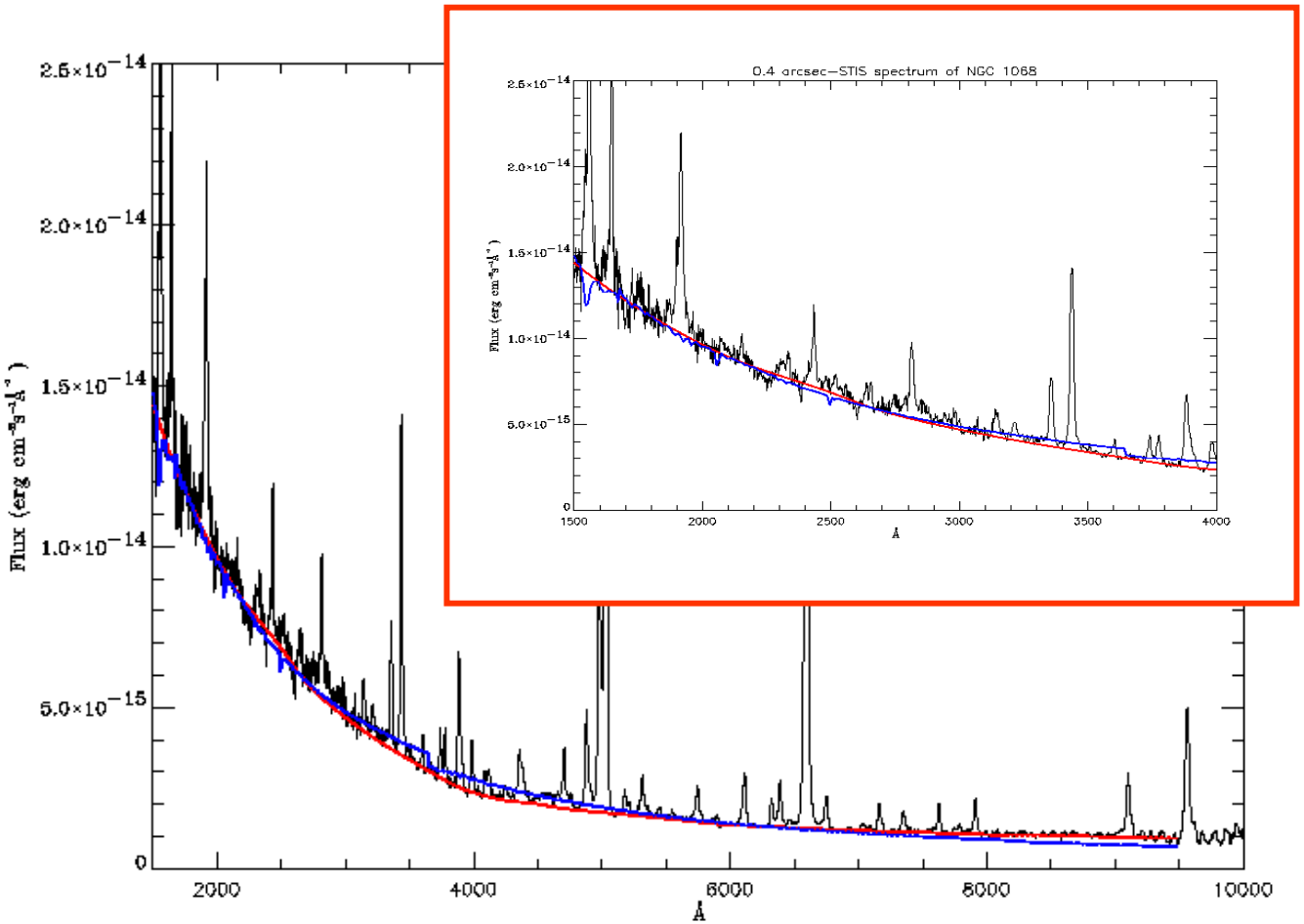
# NGC 1068 : Analysis of the data

## Starburst



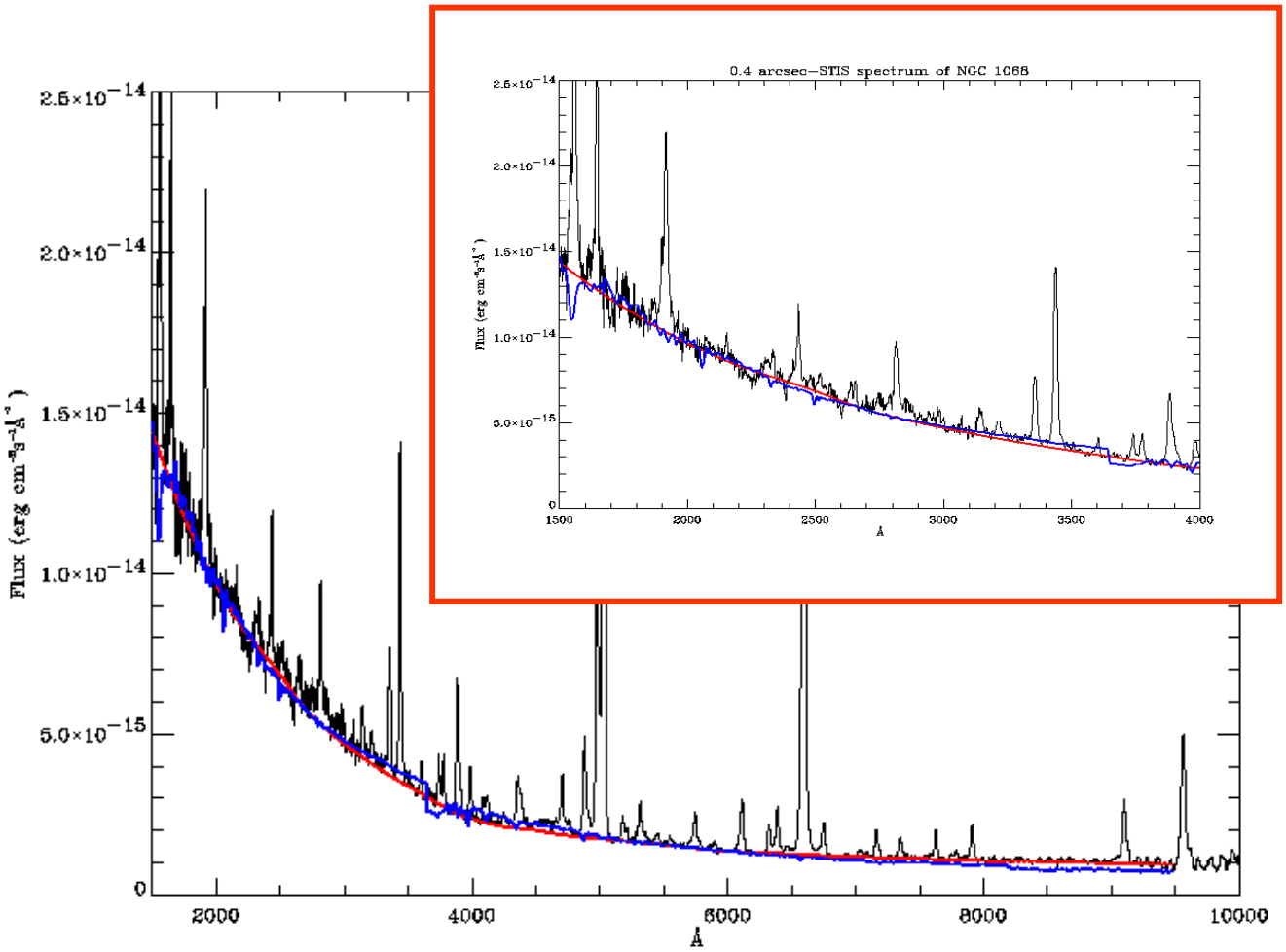
# NGC 1068 : Analysis of the data

## Power Law + Starburst



# NGC 1068 : Analysis of the data

## 2 Starbursts



# *NGC 1068* : Analysis of the data

## The Method

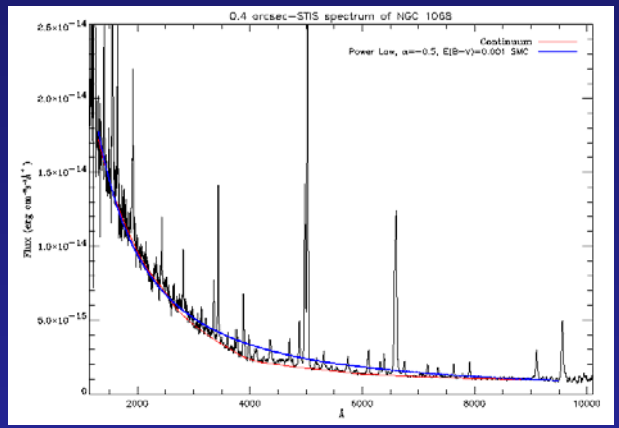
- Spatial and spectroscopic analysis of the UV emission in the central region of NGC 1068
- Determination of the properties of the synthetic starburst(s)
- Measurements of the X-ray emission: observational and inferred

**Work in progress..**

- Comparison of the inferred and observed X-ray emission

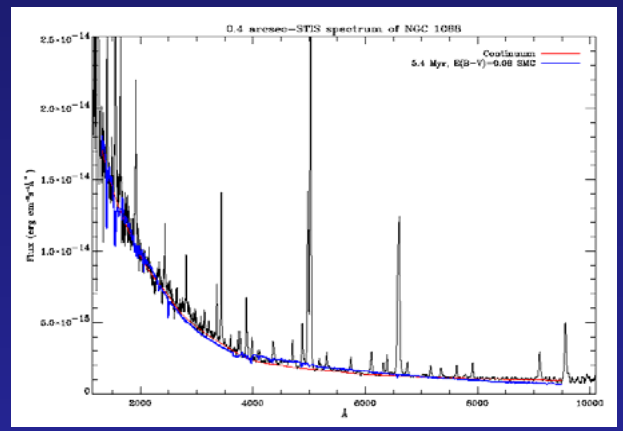
# NGC 1068 : Preliminary results and conclusions

## Scattered Light: PWLW



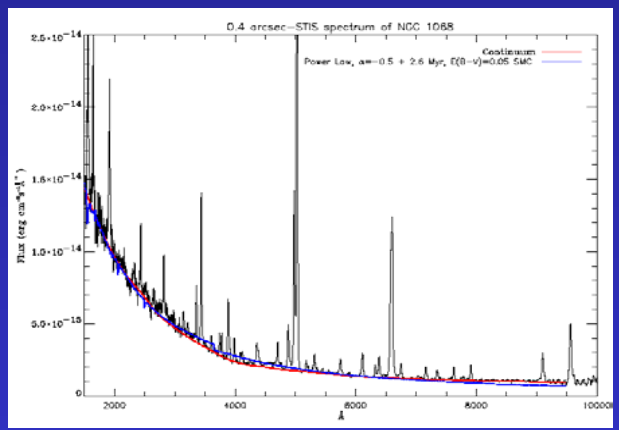

**α=-0.5 E(B-V)=0.001 SMC**

## Stellar component: SB



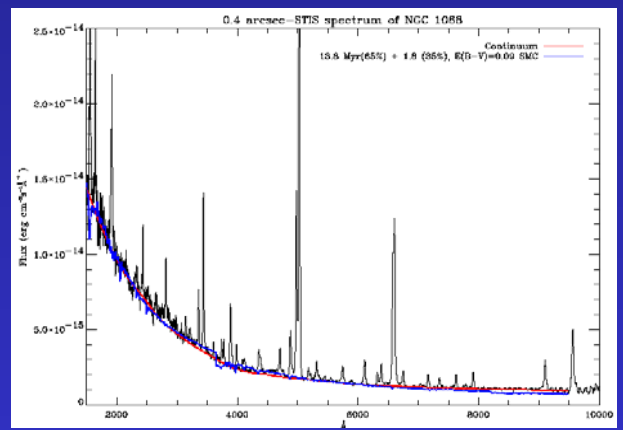

**5.2 Myr E(B-V)=0.08 SMC**

## 2 Components: PWLW+SB




**α=-0.5 E(B-V)=0.05**
**2.6 Myr SMC**

## 2 Stellar component: SB+SB




**13.8 Myr (65%) E(B-V)=0.09**
**1.8 Myr (35%) SMC**

# ***NGC 1068*** : Work in progress and “TODO” list

## Work in progress...

- Contribution of the starburst(s) emission in the X-ray band: *CMHK*
- Measurements of the X-ray emission: *XMM-Newton* and *Chandra*
- Comparison of the infered and observed X-ray emission