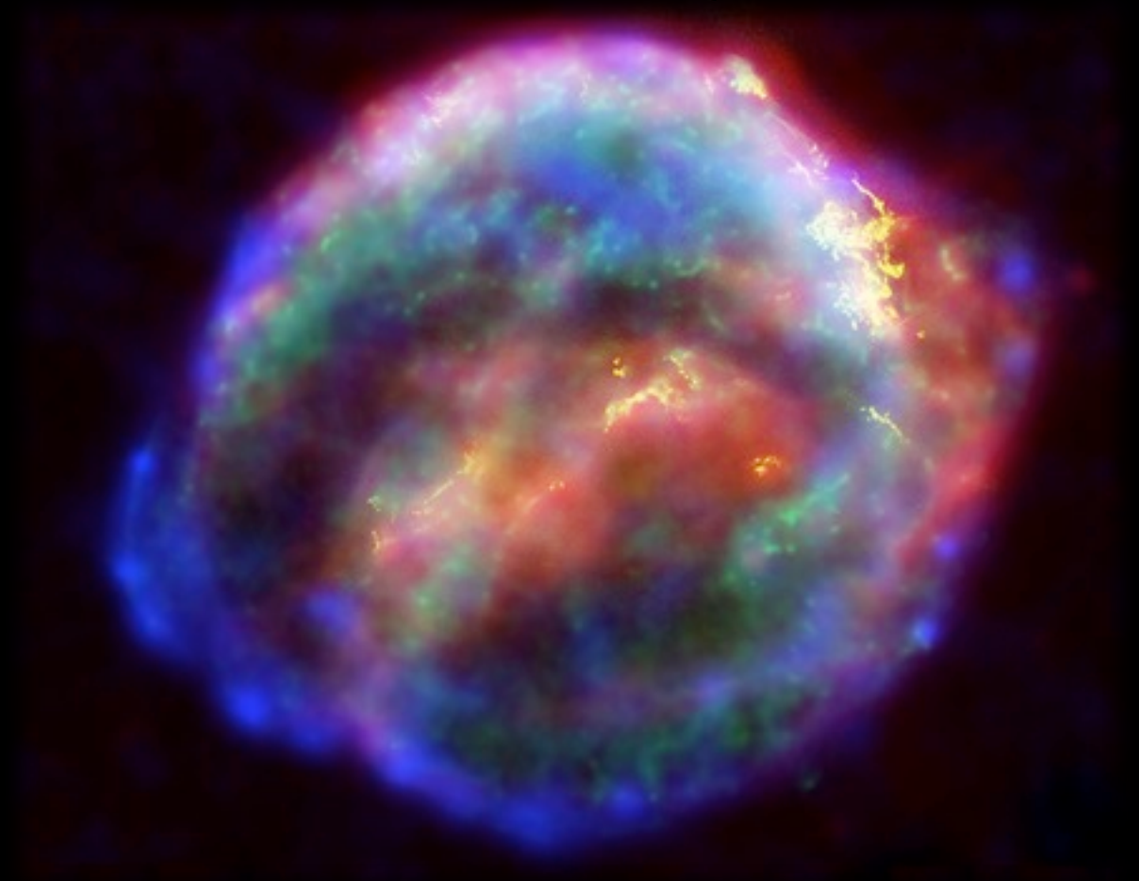
SUPERNOVAS

DÓNDE, CUÁNDO Y POR QUÉ

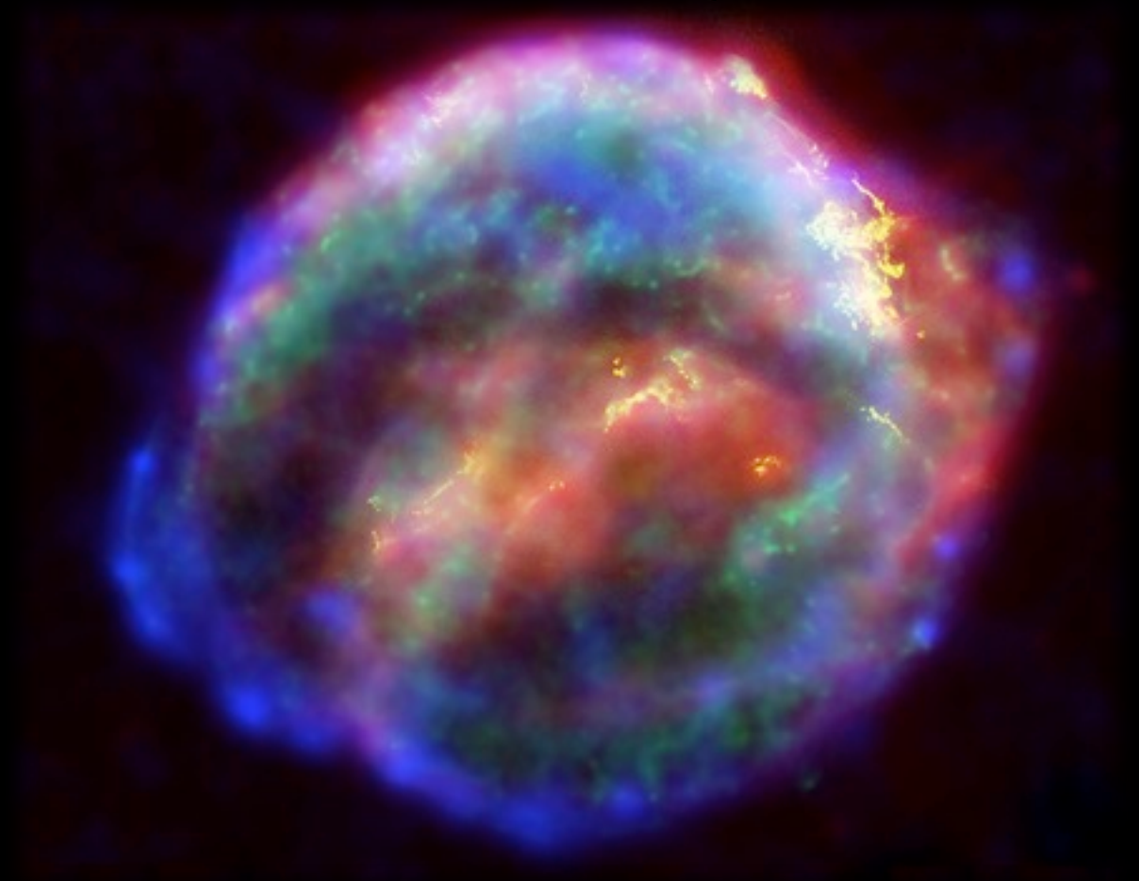


Charla CCD - Febrero 2012

Rubén Herrero-Illana

SUPERNOVAS

DÓNDE, CUÁNDO Y POR QUÉ



Charla CCD - Febrero 2012

Rubén Herrero-Illana

SUPERNOVAE

Types

- Massive stars

Core Collapse Supernova

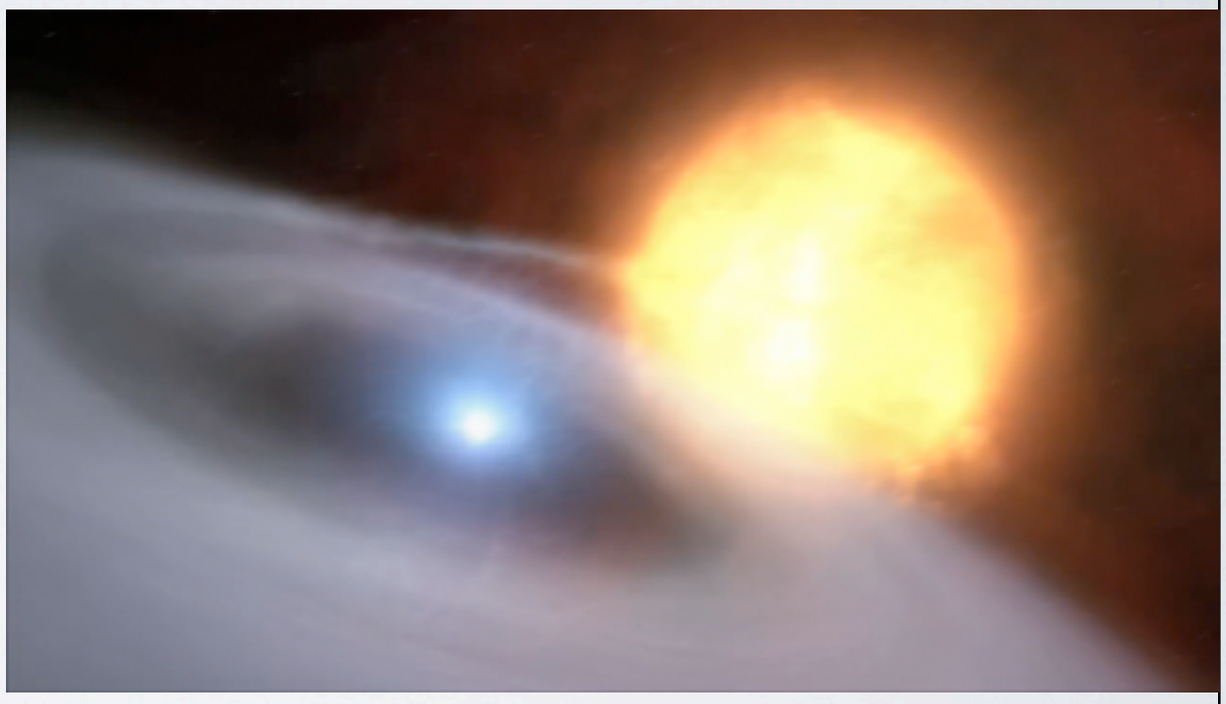
SUPERNOVAE

Types

- Massive stars

Core Collapse Supernova

- Binary systems



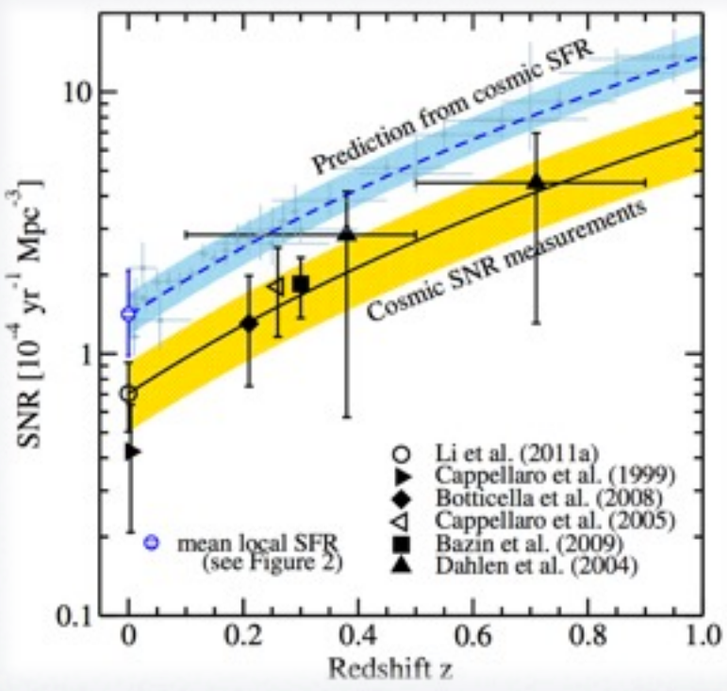
ESO/M. Kornmesser

Thermonuclear Supernova

SUPERNOVAE

Rates

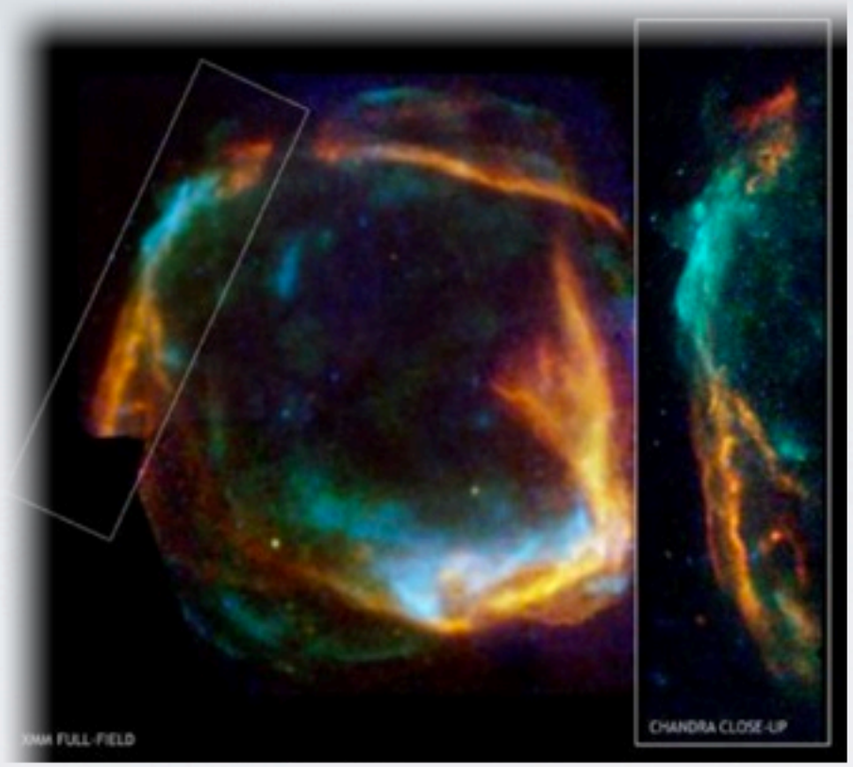
- Normal galaxies → Each ~ 50 years.
- Supernova factories → One per year!
- Directly related with SFR and IMF.



Horiuchi et al. 2011

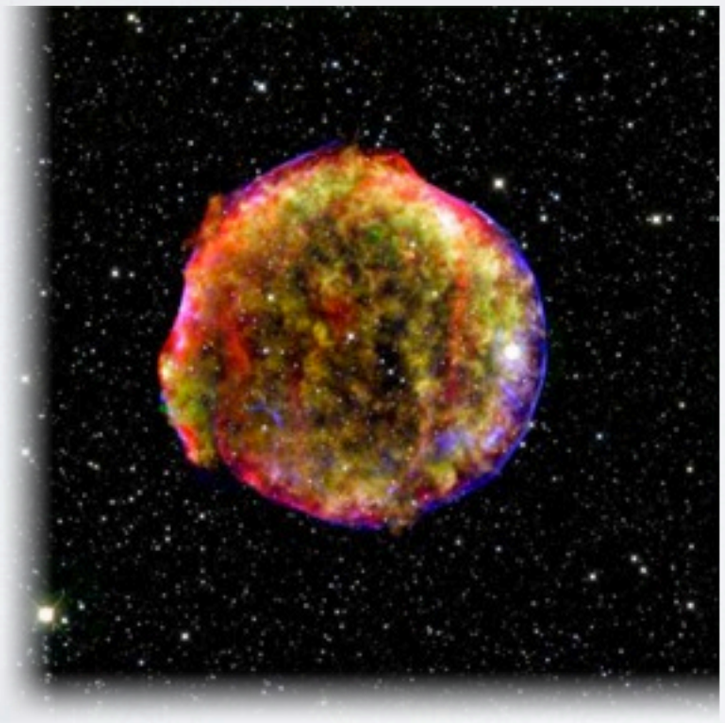
IN THE MILKY WAY ...

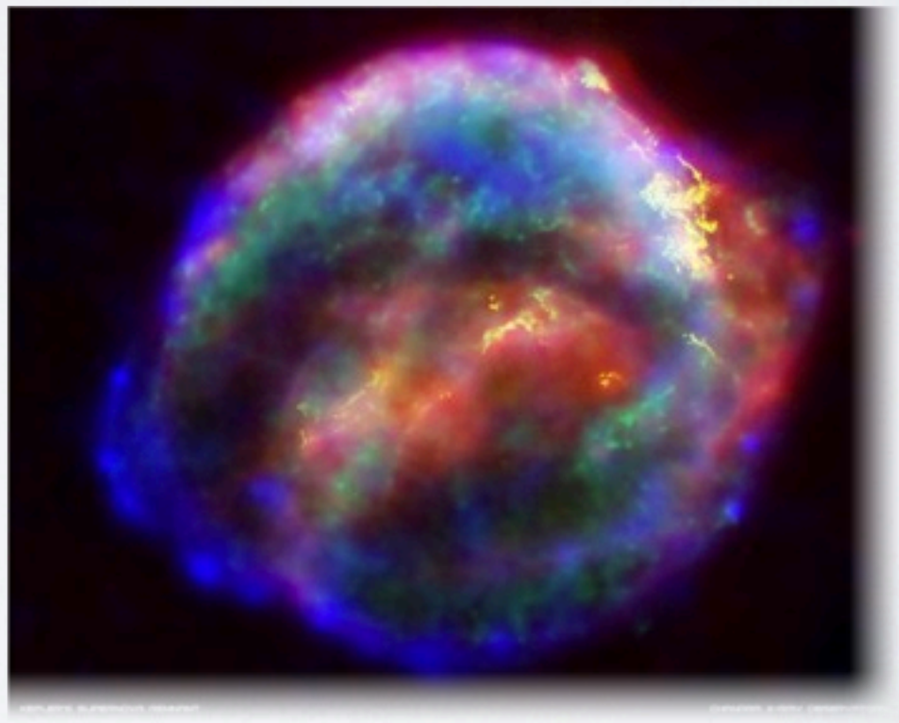
SN 185



SN 1054

SN 1572





SN 1604

LIRGS & ULIRGS

- (Ultra) Luminous Infrared Galaxies.

- Infrared Luminosity:

  - LIRGs: $10^{11} L_\odot < L_{IR} < 10^{12} L_\odot$
  - ULIRGs: $L_{IR} > 10^{12} L_\odot$

- Dust emission.

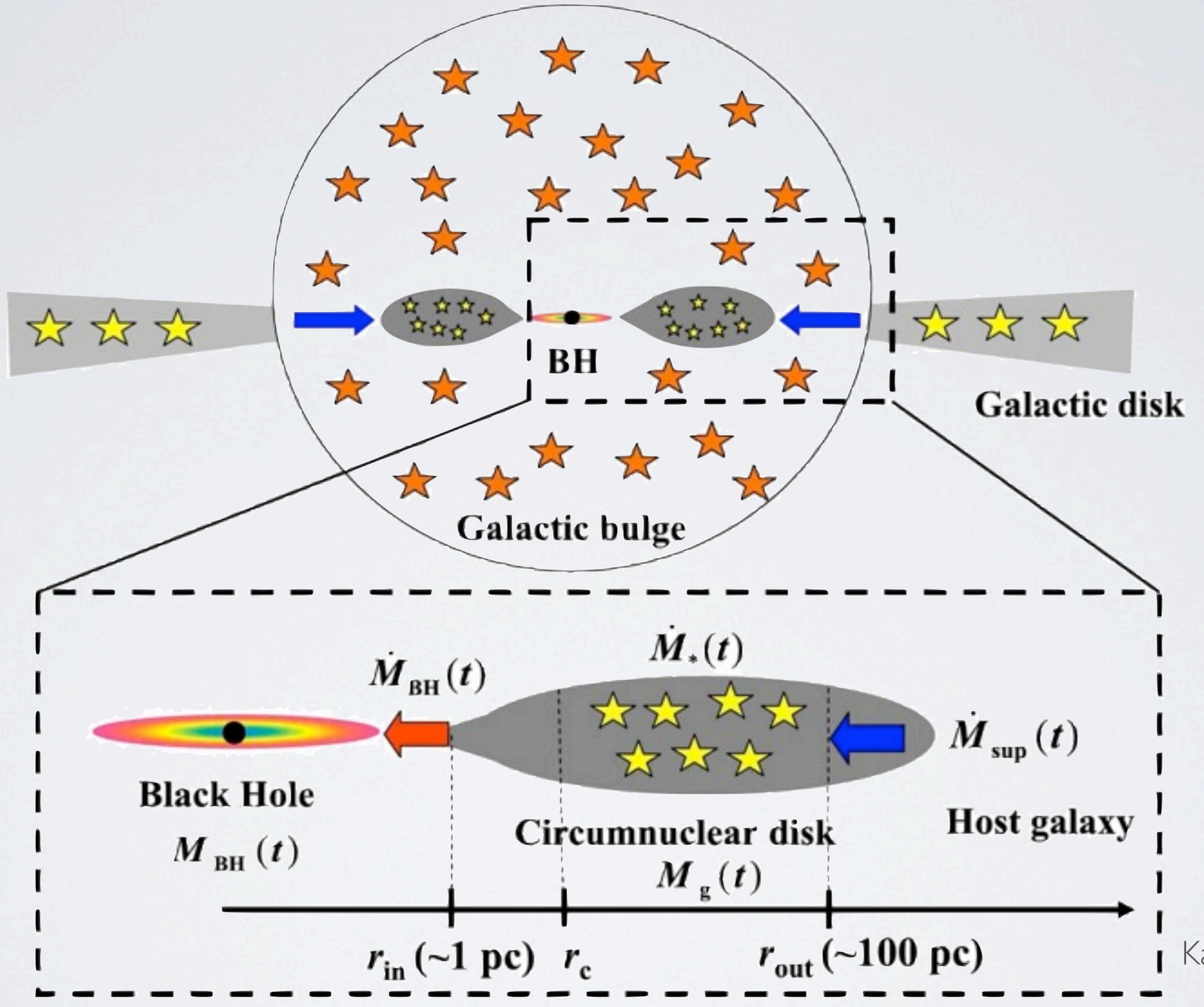
- Mechanisms:

  - Starburst (→ SNe).
  - AGN.

- Inflows: Lost of angular momentum.

  - Reservoir? → Circumnuclear disks.

CIRCUMNUCLEAR DISKS



Kawakatu & Wada 2008

THE RADIAL DISTRIBUTION

Previous studies

- Deeply studied in the optical.

- Limitations:
  - Dust extinction.
  - Angular resolution.
  - Limited to galactic scales.

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- Solution: *Radio-VLBI!*

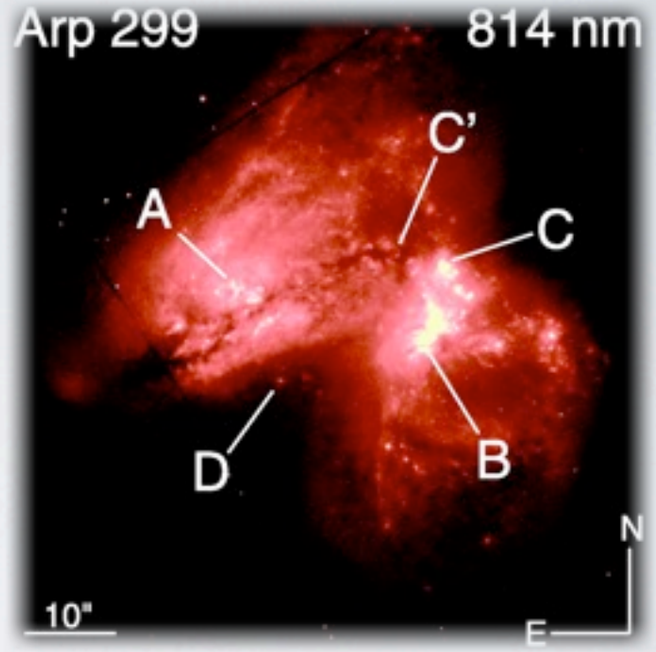
THE RADIAL DISTRIBUTION

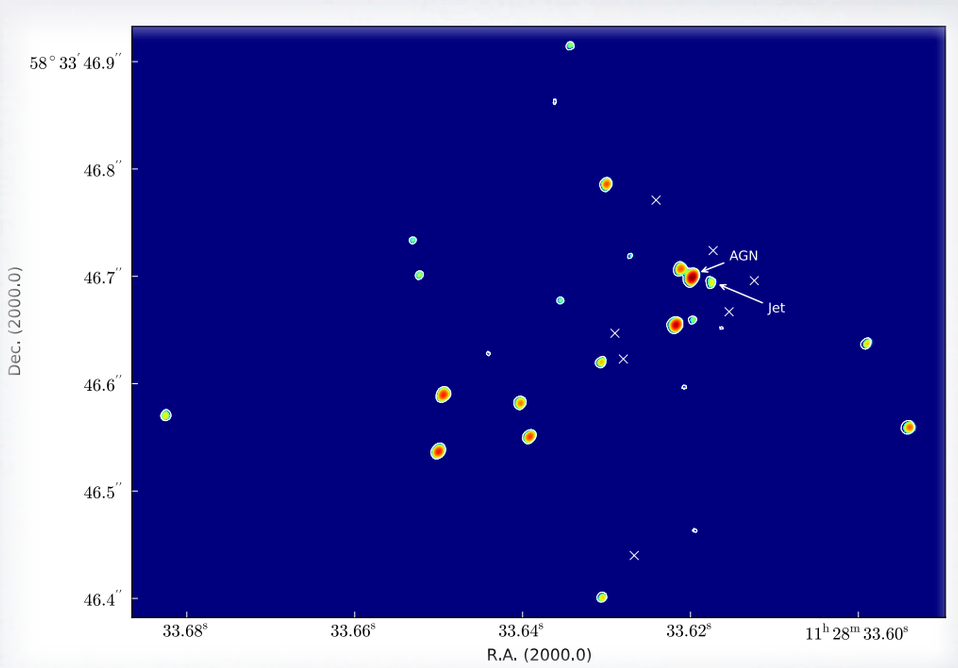
Radio study

THE RADIAL DISTRIBUTION

Radio study

- Arp 299-A
  - LIRG at 44.8 Mpc.
  - 30 sources.
  - Confirmed AGN.





Pérez-Torres et al. 2009

THE RADIAL DISTRIBUTION

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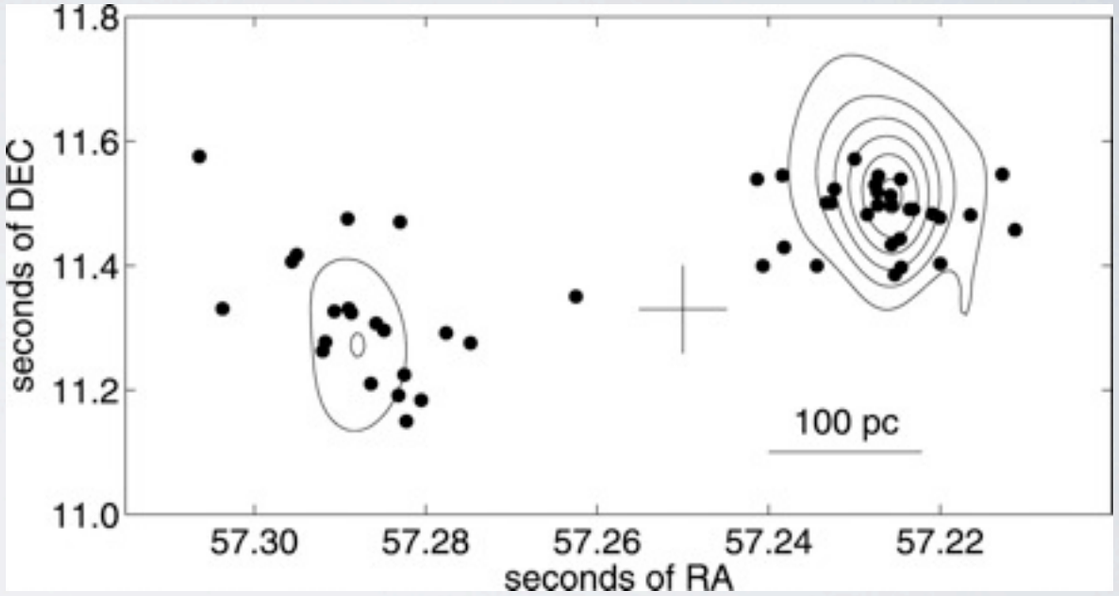
- Arp 220
  - ULIRG at 77 Mpc.
  - 48 sources.



Parra et al. 2007

THE RADIAL DISTRIBUTION

Radio study

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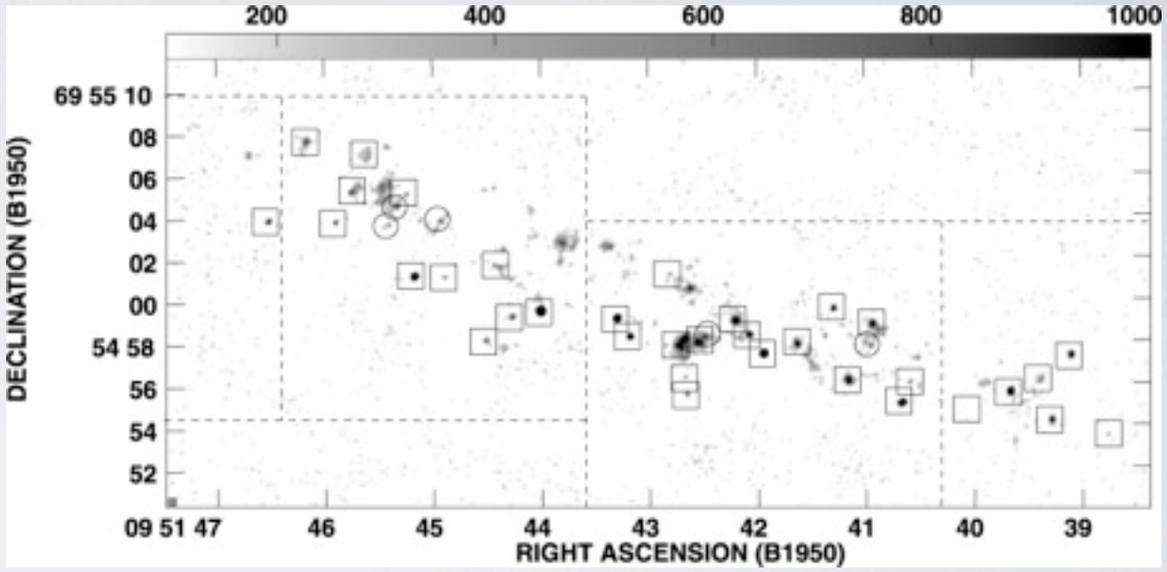


McDonald et al. 2002

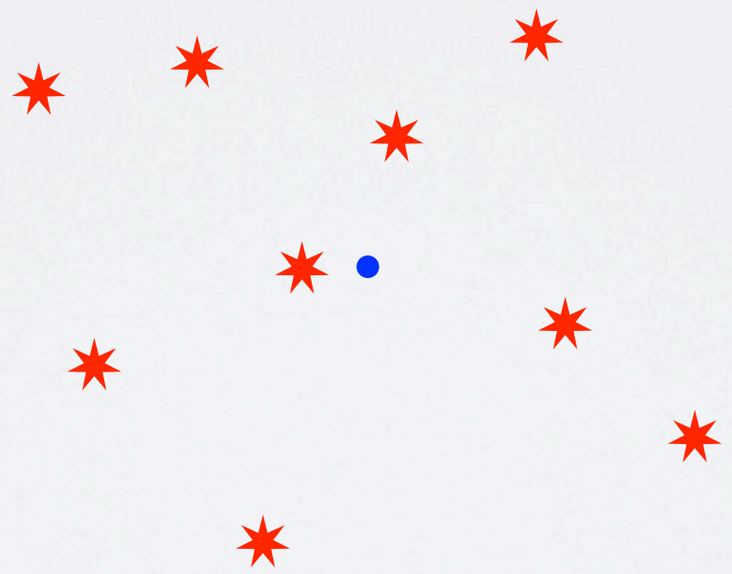
- Arp 220
  - ULIRG at 77 Mpc.
  - 48 sources.

- M82
  - Prototypical starburst galaxy.
  - 38 sources.

METHOD

- Surface density - Concentric rings:

$$\frac{n_{\rm SN}}{\pi(r_{i+1}^2 - r_i^2)}$$



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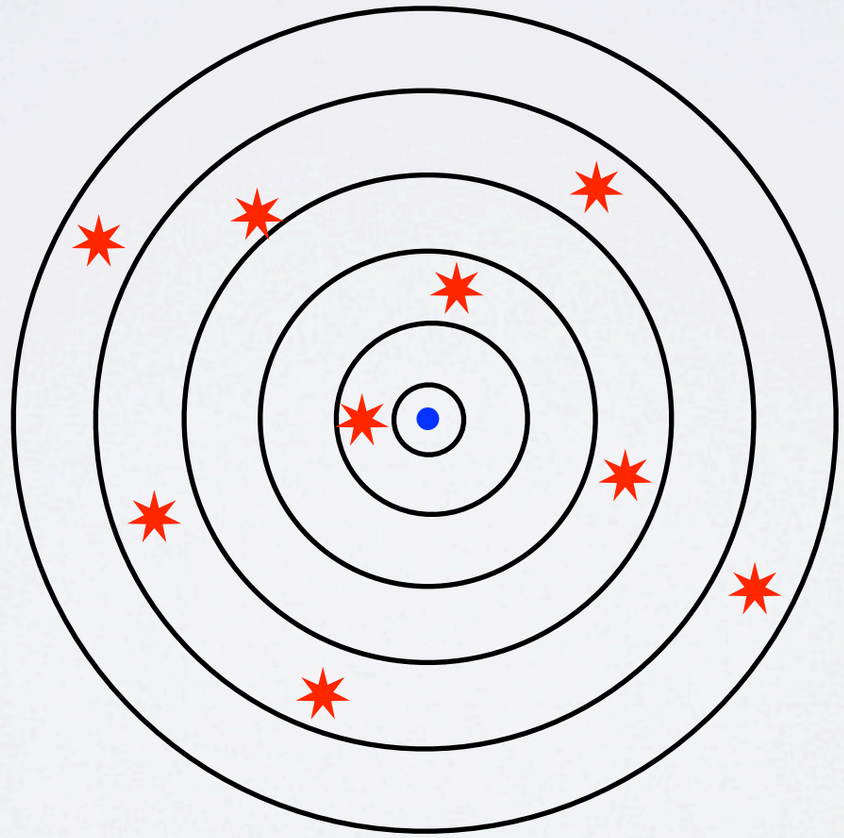

METHOD

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- Few sources → Poisson statistics.

METHOD

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$$\frac{n_{\rm SN}}{\pi(r_{i+1}^2 - r_i^2)}$$

- Few sources → Poisson statistics.

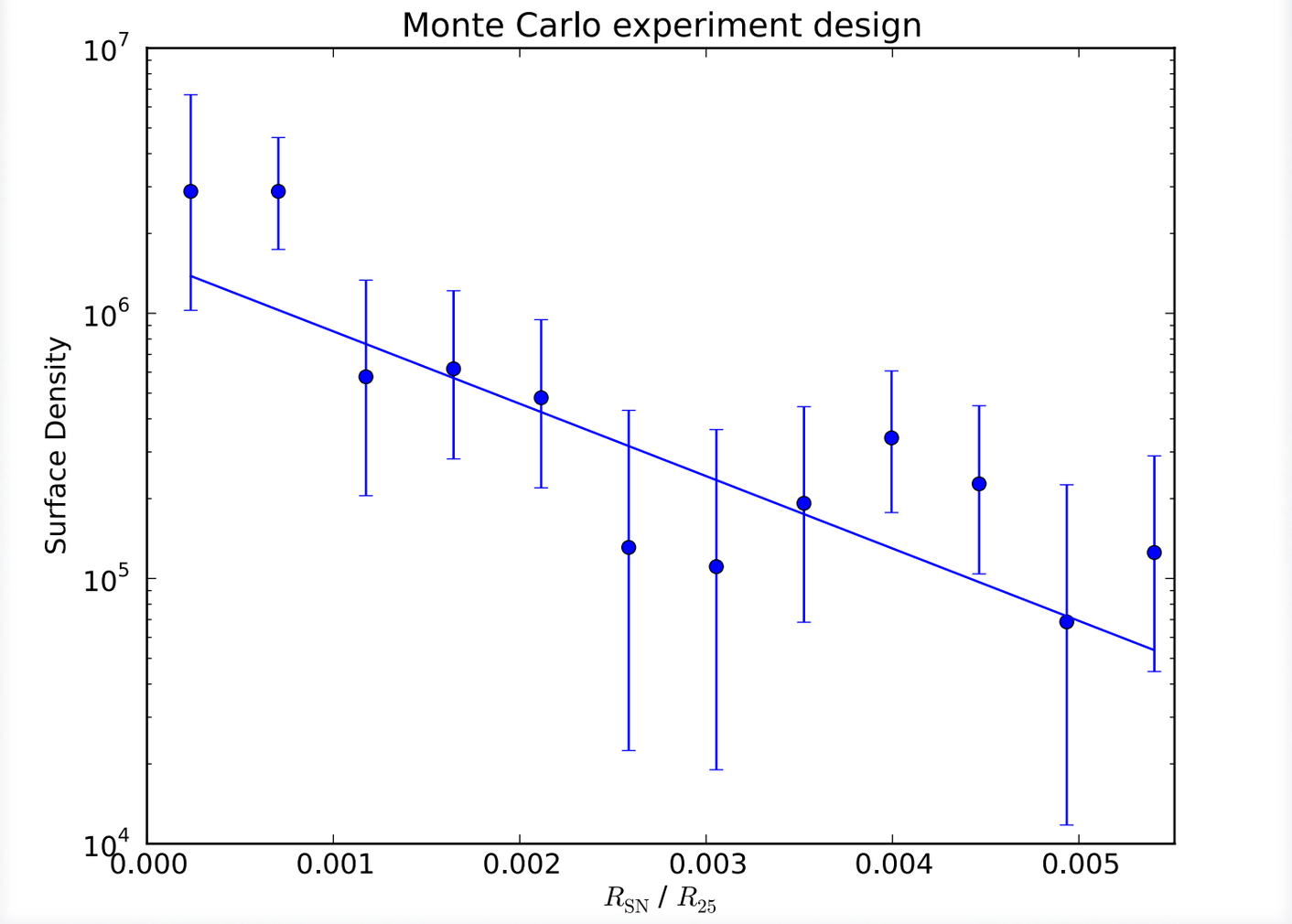
- Non-linear fits:

$$\Sigma^{\rm SN} = \Sigma_0^{\rm SN} \exp(-r/h_{\rm SN})$$

$$\Sigma^{\rm SN} = \Sigma_0^{\rm SN} \left(\frac{r}{r_{\rm out}}\right)^{-\gamma}$$

METHOD

Monte Carlo



METHOD

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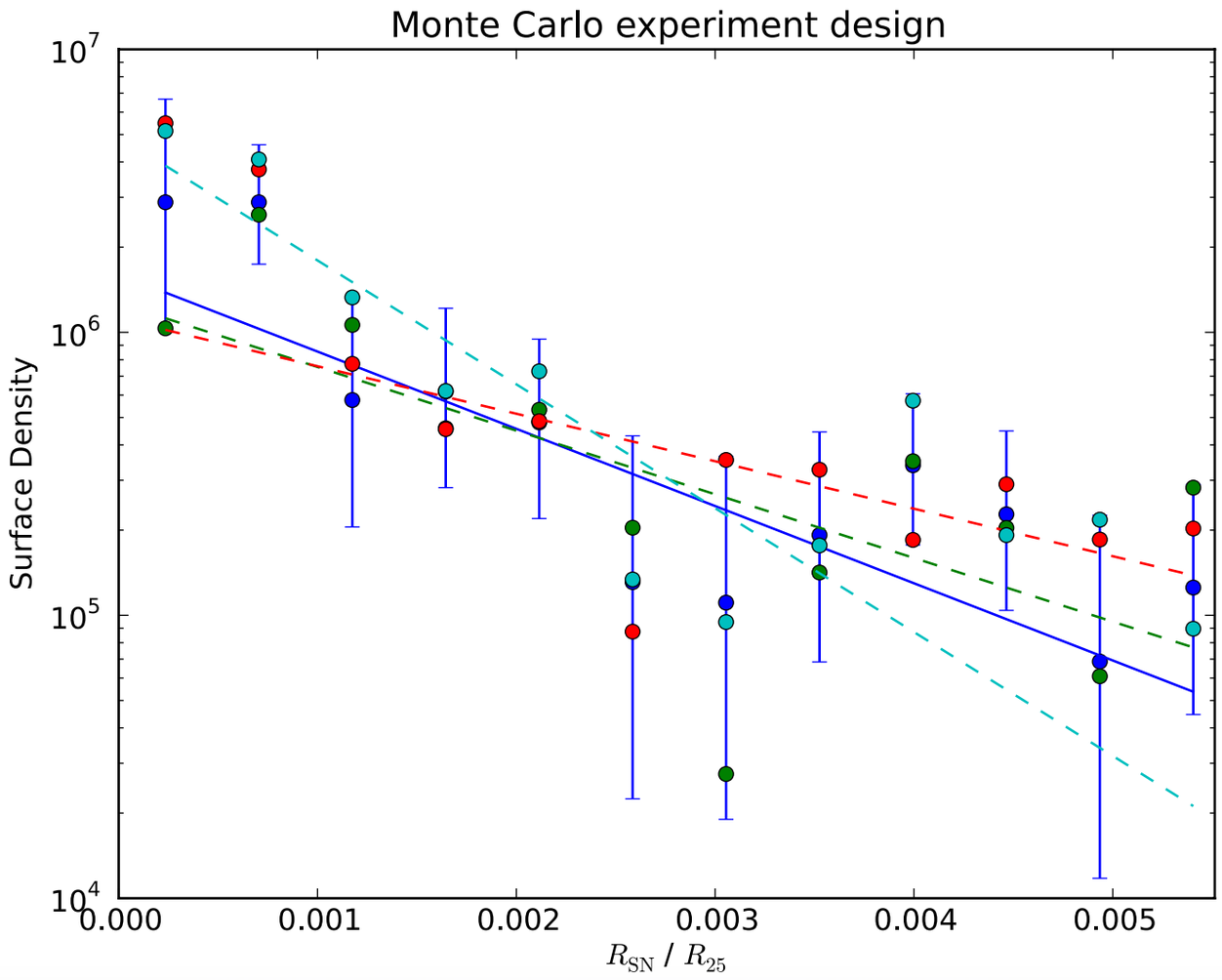

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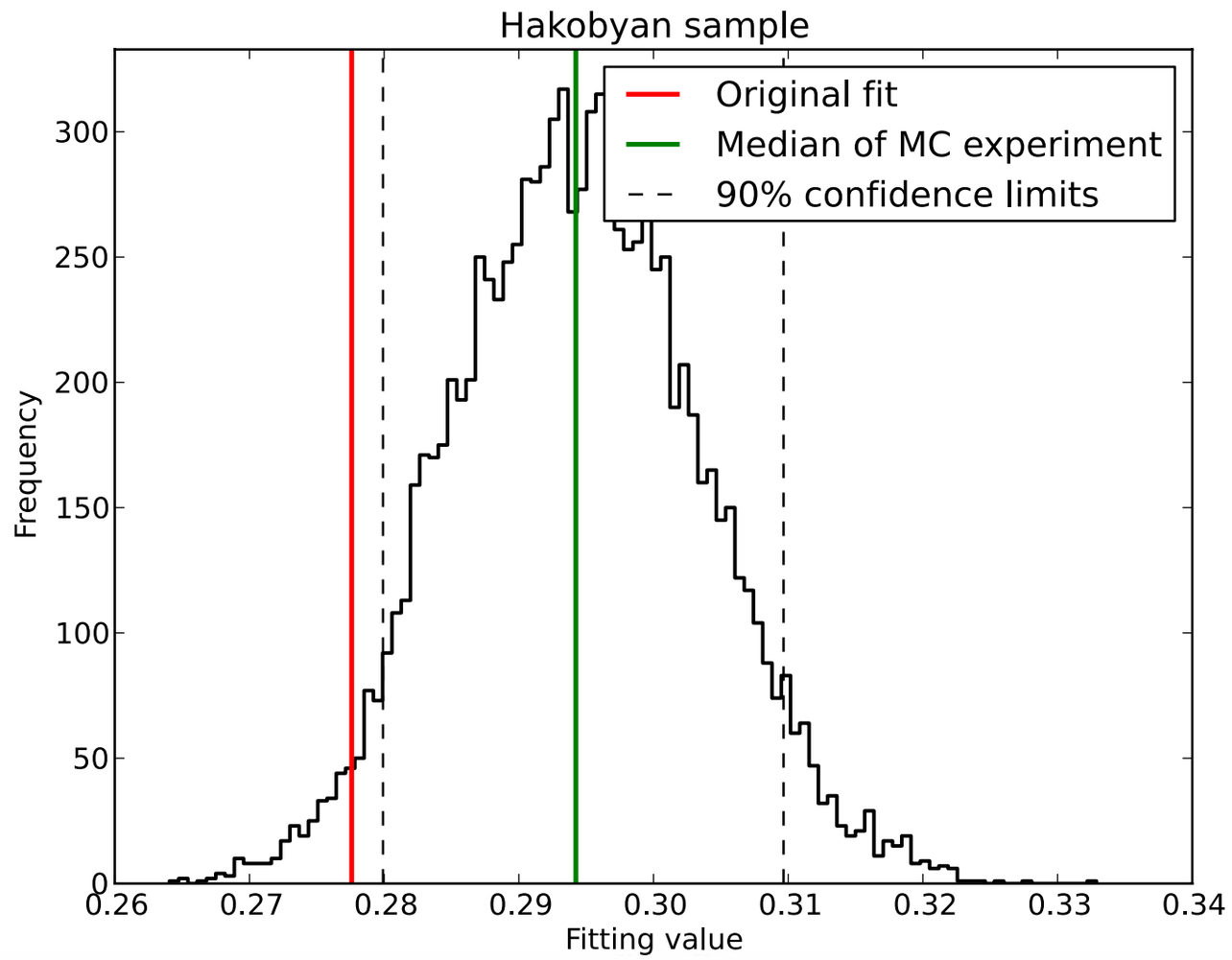
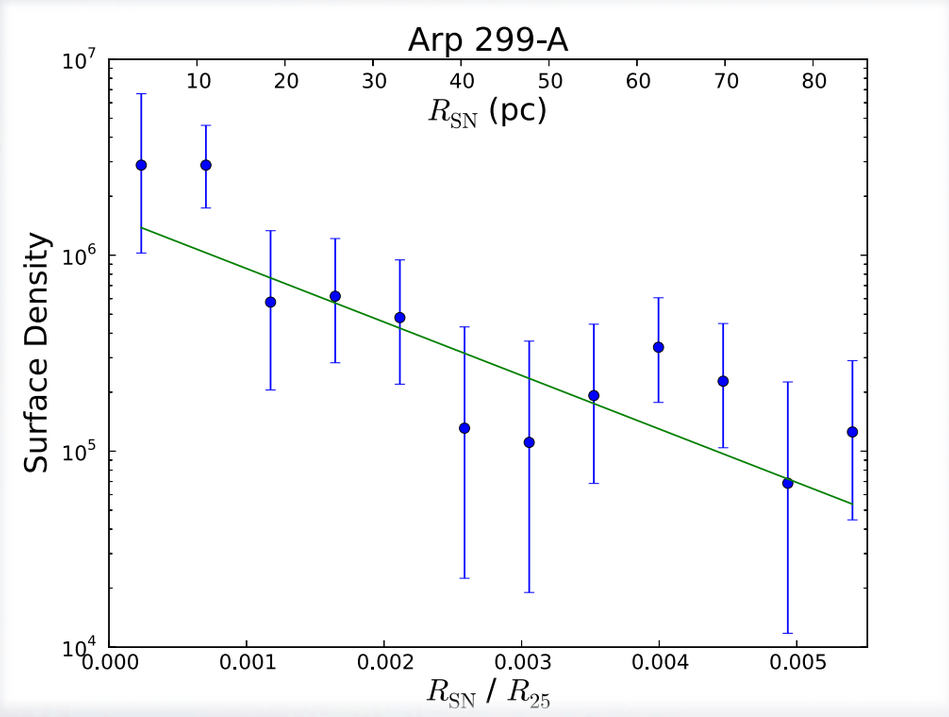
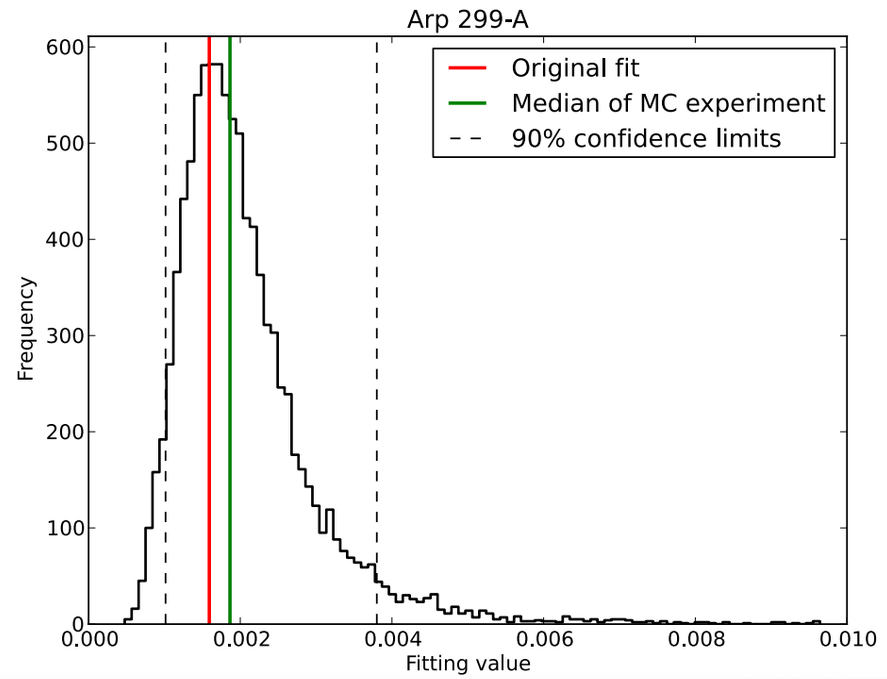
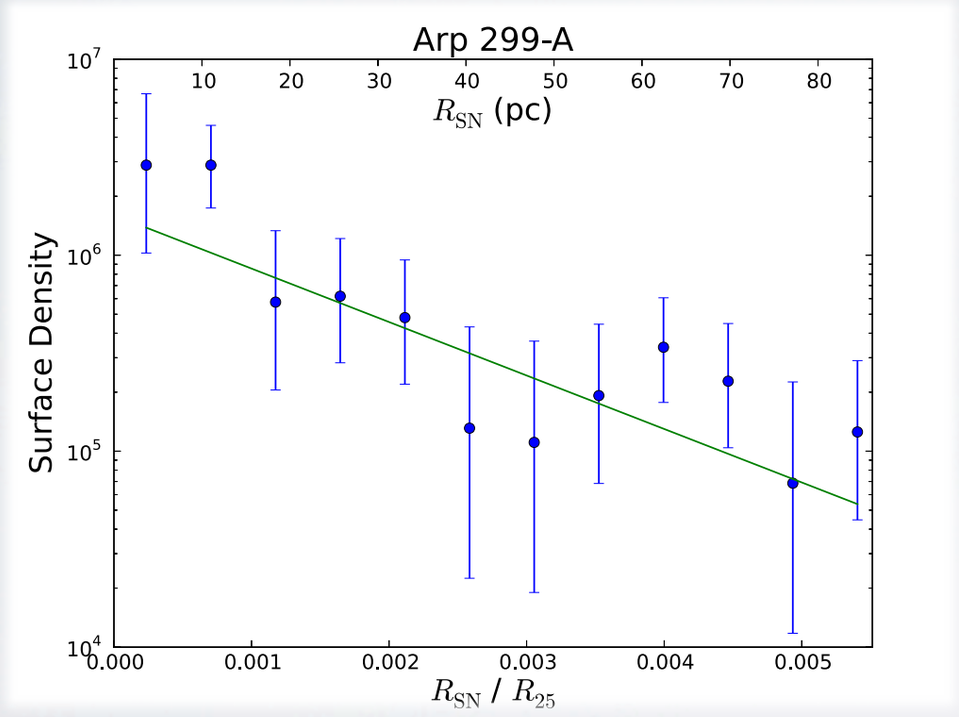


RESULTS


Arp 299-A
R_{SN} (pc)
Surface Density
R_{SN} / R_{25}


Arp 299-A
Original fit
Median of MC experiment
90% confidence limits
Frequency
Fitting value

RESULTS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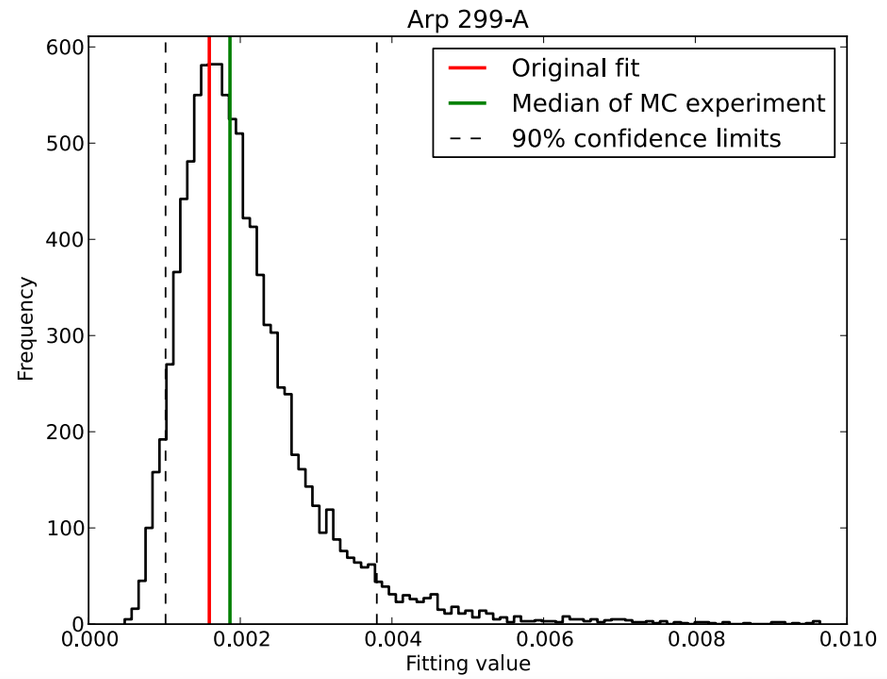
Arp 299-A
Original fit
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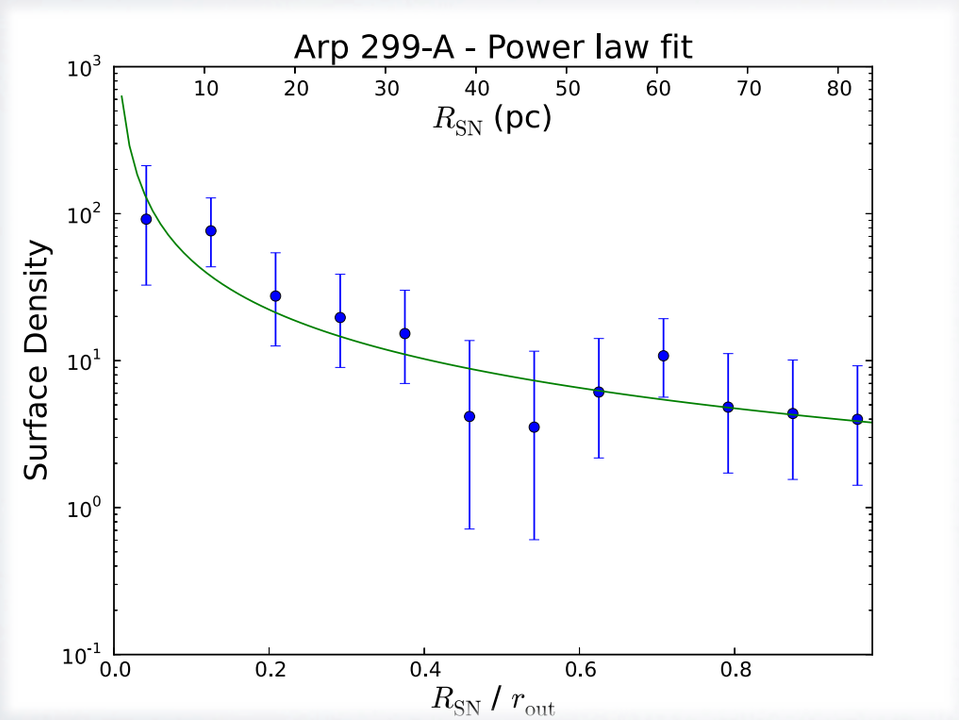
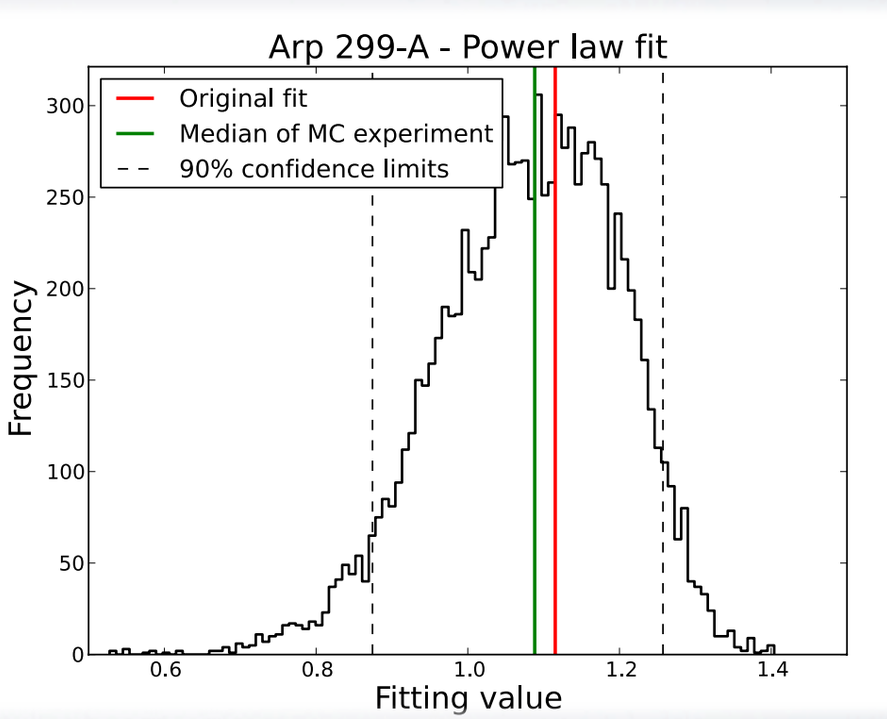
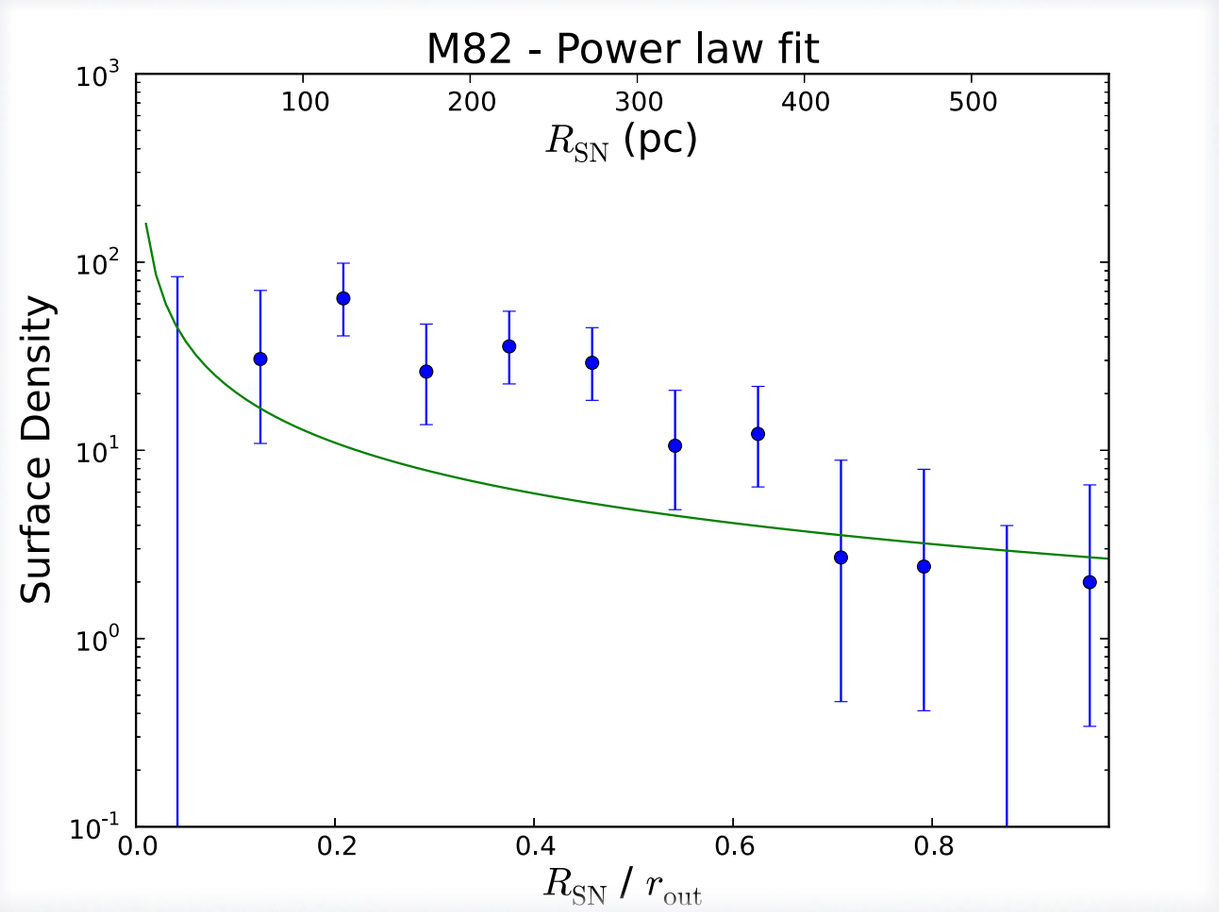
Frequency
Fitting value

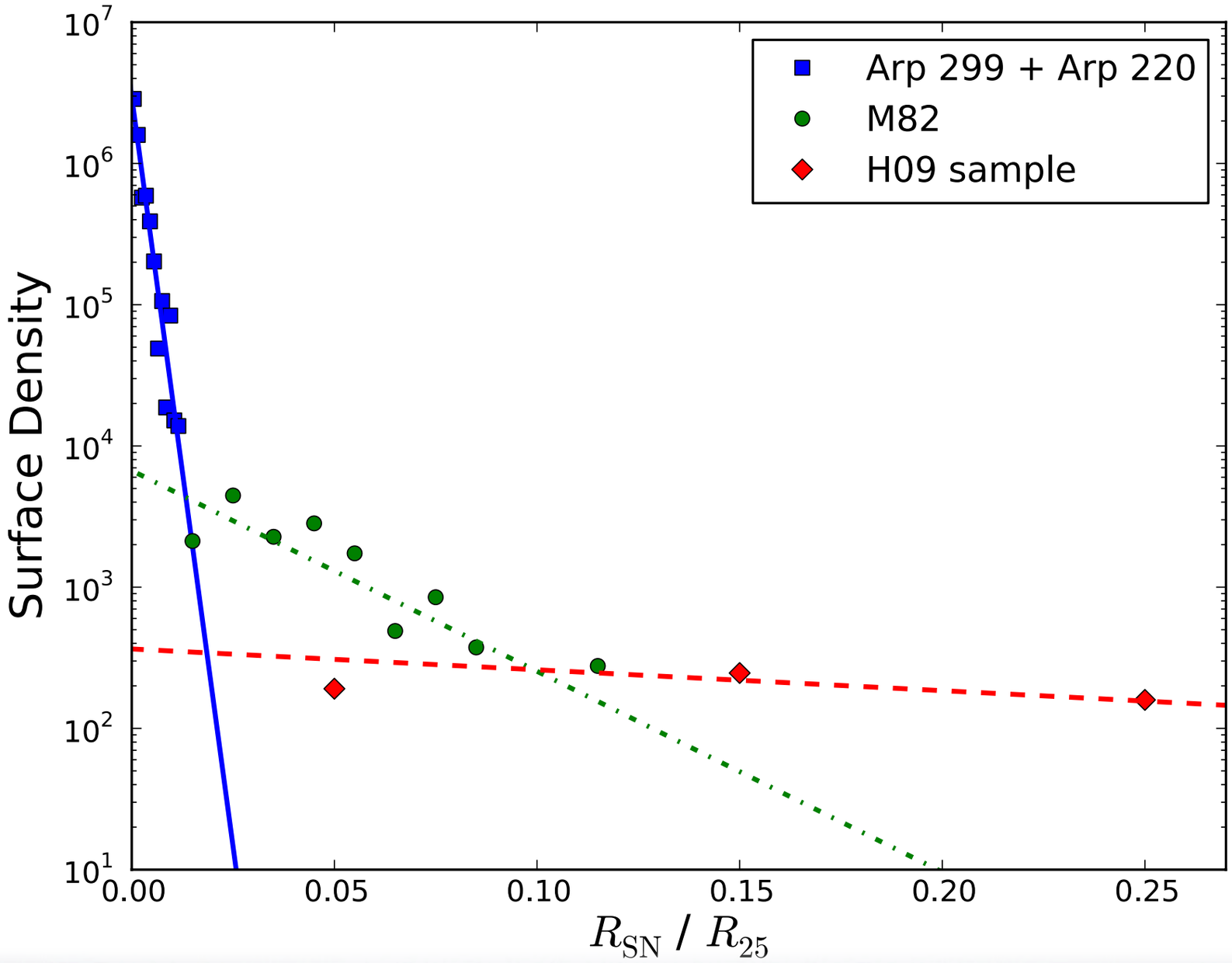

Arp 299-A - Power law fit
R_{SN} (pc)
Surface Density
R_{SN} / r_{out}


Arp 299-A - Power law fit
Original fit
Median of MC experiment
90% confidence limits
Frequency
Fitting value

RESULTS


M82 - Power law fit
10^3
100
200
300
400
500
$R_{\rm SN}$ (pc)
10^2
Surface Density
10^1
10^0
10^{-1}
0.0
0.2
0.4
0.6
0.8
$R_{\rm SN}$ / $r_{\rm out}$

RESULTS


Arp 299 + Arp 220
M82
H09 sample
Surface Density
10^7
10^6
10^5
10^4
10^3
10^2
10^1
0.00
0.05
0.10
0.15
0.20
0.25
R_{SN} / R_{25}

RESULTS

Nucleus	$\tilde{h}_{\rm SN}/10^{-3}$	$h_{\rm SN}$ (pc)	γ
Arp 299-A	$1.9^{+1.9}_{-0.8}$	$29.3^{+29.6}_{-13.7}$	$1.1^{+0.2}_{-0.2}$
Arp 220 East	$3.1^{+2.0}_{-0.9}$	$22.2^{+14.4}_{-6.2}$	$1.0^{+0.2}_{-0.3}$
Arp 220 West	$3.4^{+1.6}_{-1.5}$	$24.4^{+11.2}_{-10.8}$	$0.8^{+0.3}_{-0.2}$
Arp 220 E+W	$3.3^{+0.7}_{-0.9}$	$23.4^{+4.7}_{-6.6}$	$0.8^{+0.1}_{-0.2}$
Arp 299 + Arp 220	$2.0^{+0.3}_{-0.4}$	$20.9^{+2.6}_{-2.3}$	$0.9^{+0.1}_{-0.1}$
M82	$(3.1^{+0.9}_{-0.7}) \times 10^{1}$	$155.8^{+38.1}_{-33.1}$	-
H09 sample	$(2.9^{+0.2}_{-0.1}) \times 10^{2}$	-	-

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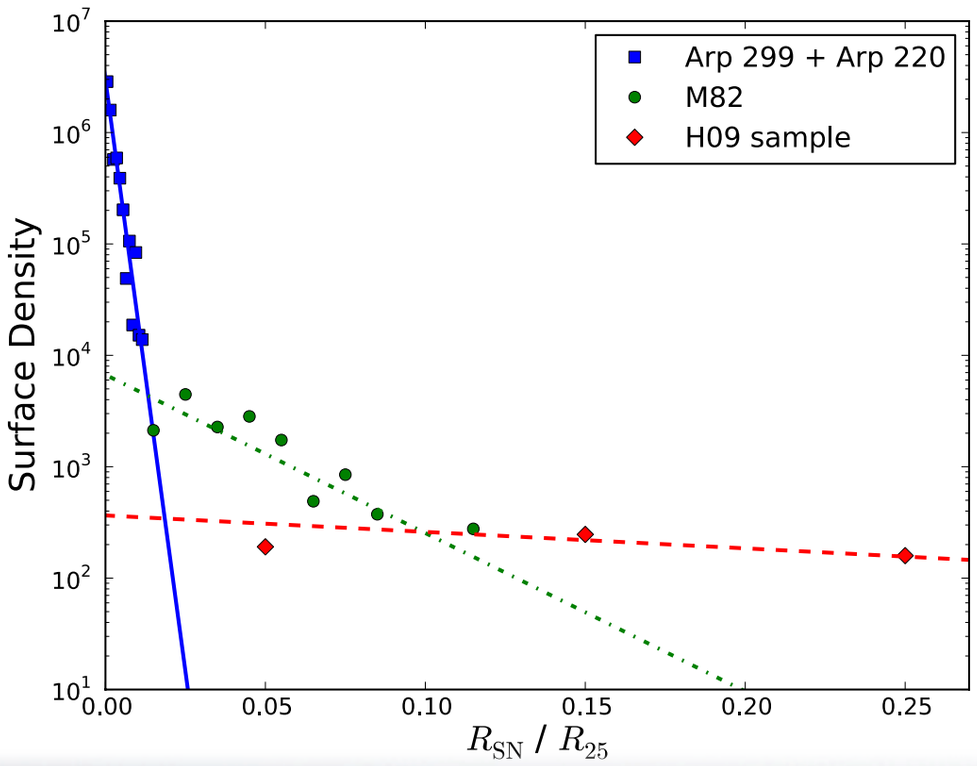
RESULTS



- Global VS Nuclear Distribution.
- Circumnuclear disks:
  - Arp 299-A & Arp 220: 20- 30 pc.
  - M82: ~160 pc.
- Power-law fit:
  - Consistent with simulations ($\gamma = 1$)
- Theoretical models.
- Future observations.

viernes 10 de febrero de 2012

¡GRACIAS!