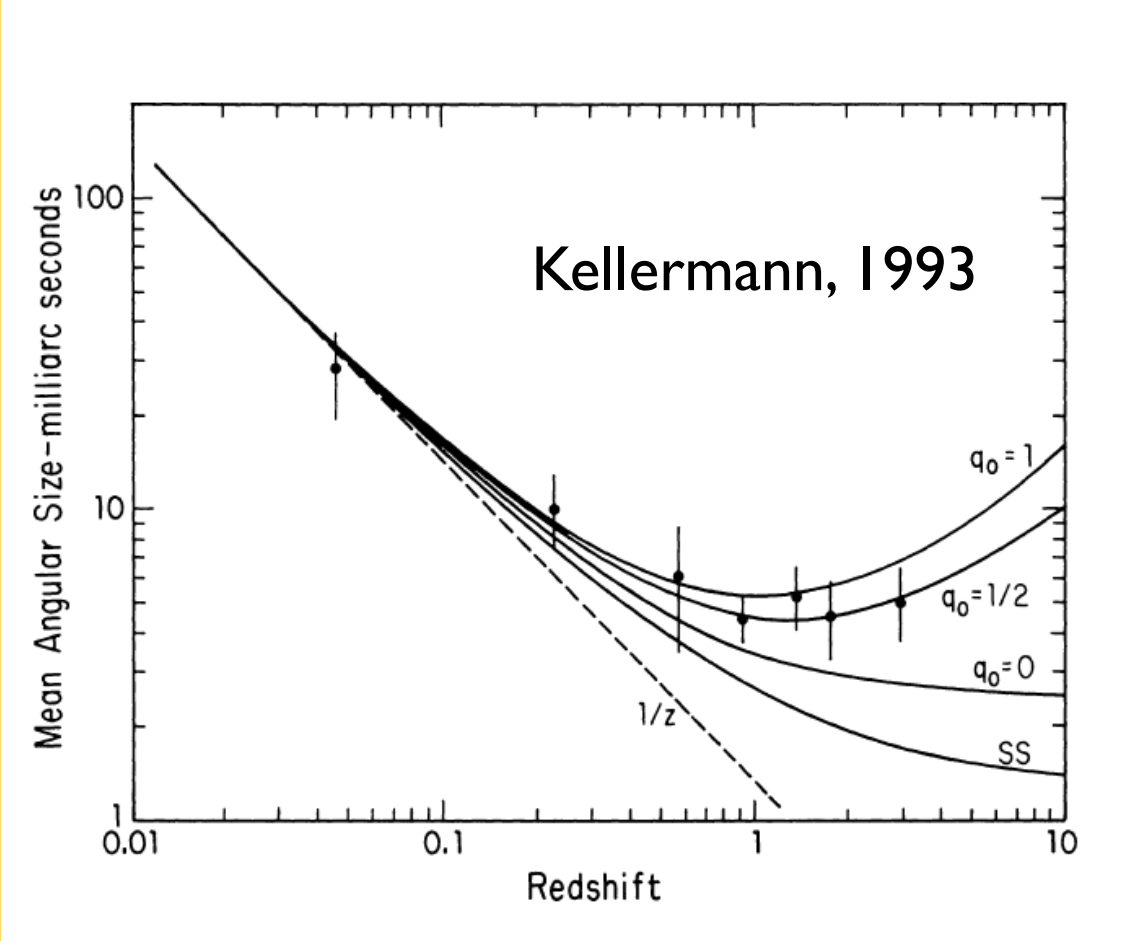
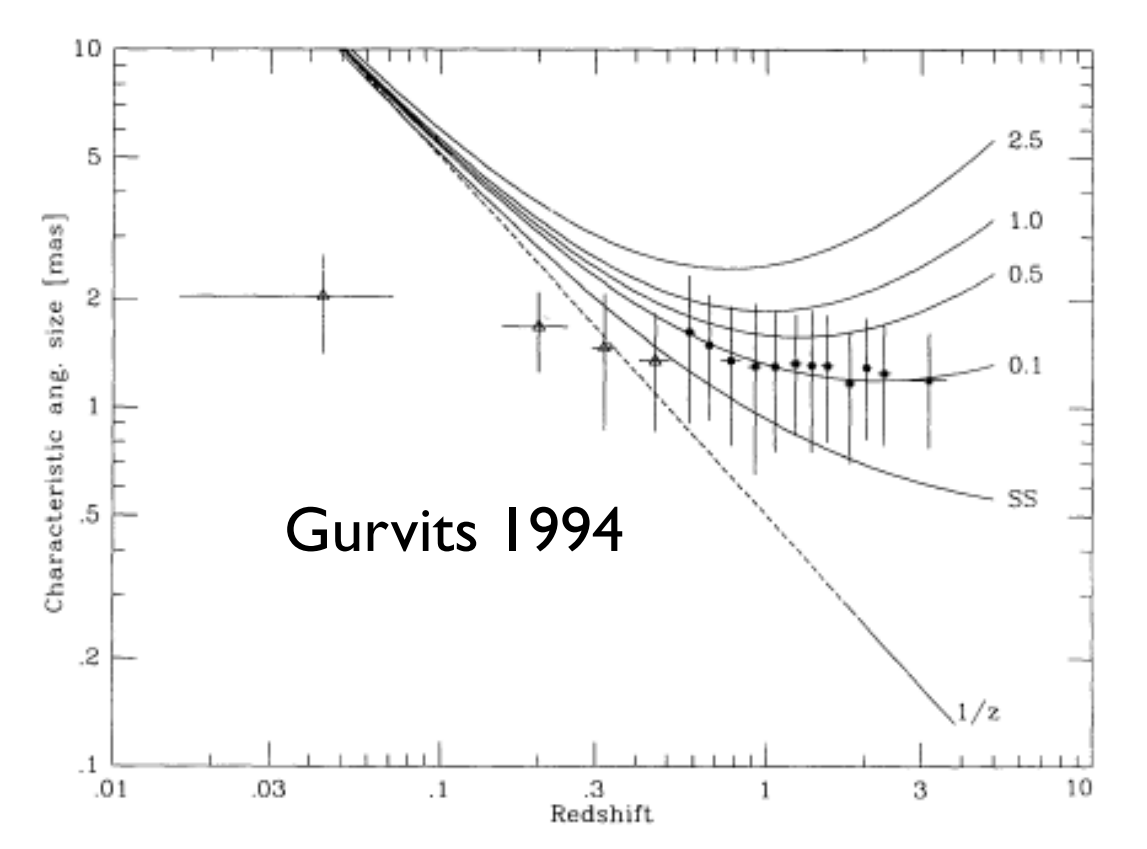
Leonid Gurvits, VLBI and Cosmological Parameters

Ken Kellermann
NRAO

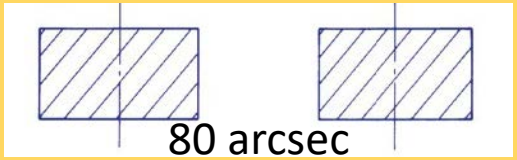
Theta-z


Kellermann, 1993
Mean Angular Size–milliarc seconds
100
10
1
0.01
0.1
1
10
Redshift
$q_0 = 1$
$q_0 = 1/2$
$q_0 = 0$
1/z
SS

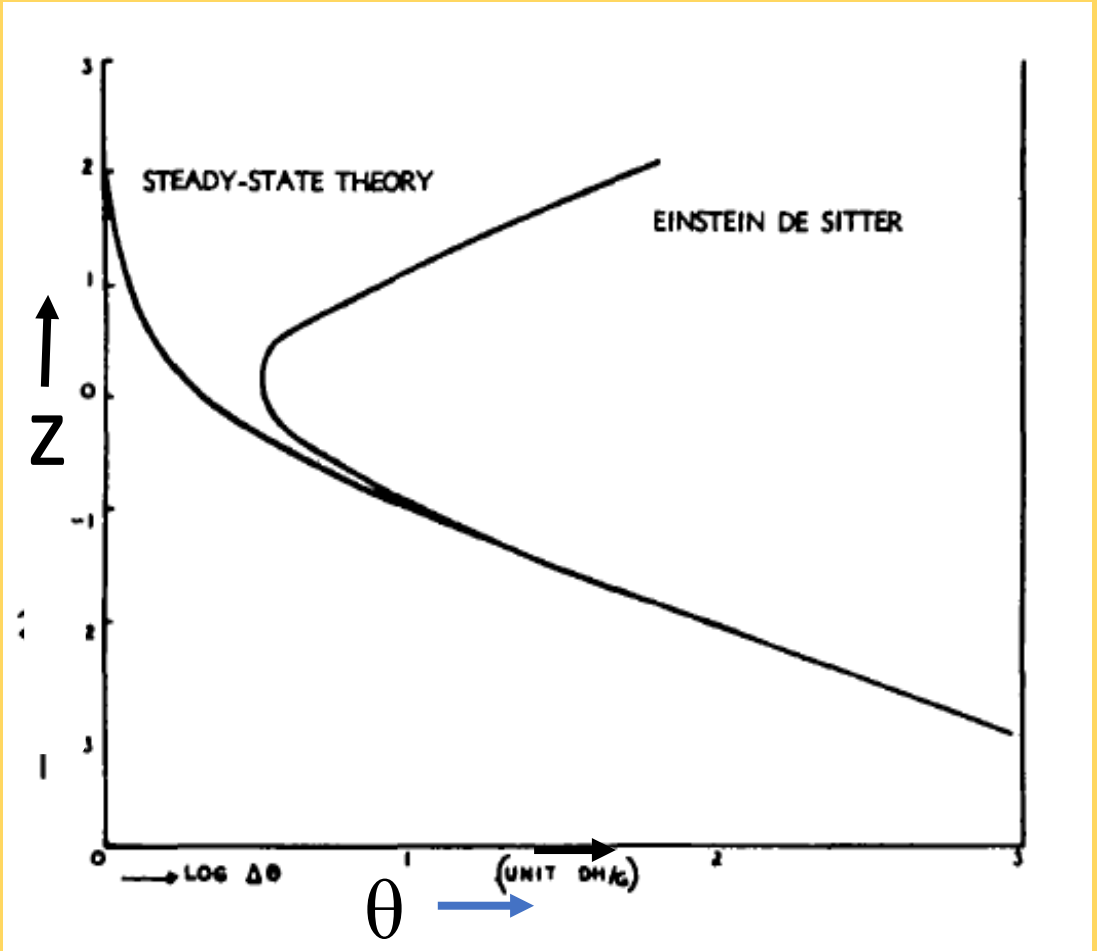

Gurvits 1994
Characteristic ang. size [mas]
10
5
2
1
.5
.2
.1
.01
.03
.1
.3
1
3
10
Redshift
2.5
1.0
0.5
0.1
SS
1/z

θ – z relation (Hoyle 1959)

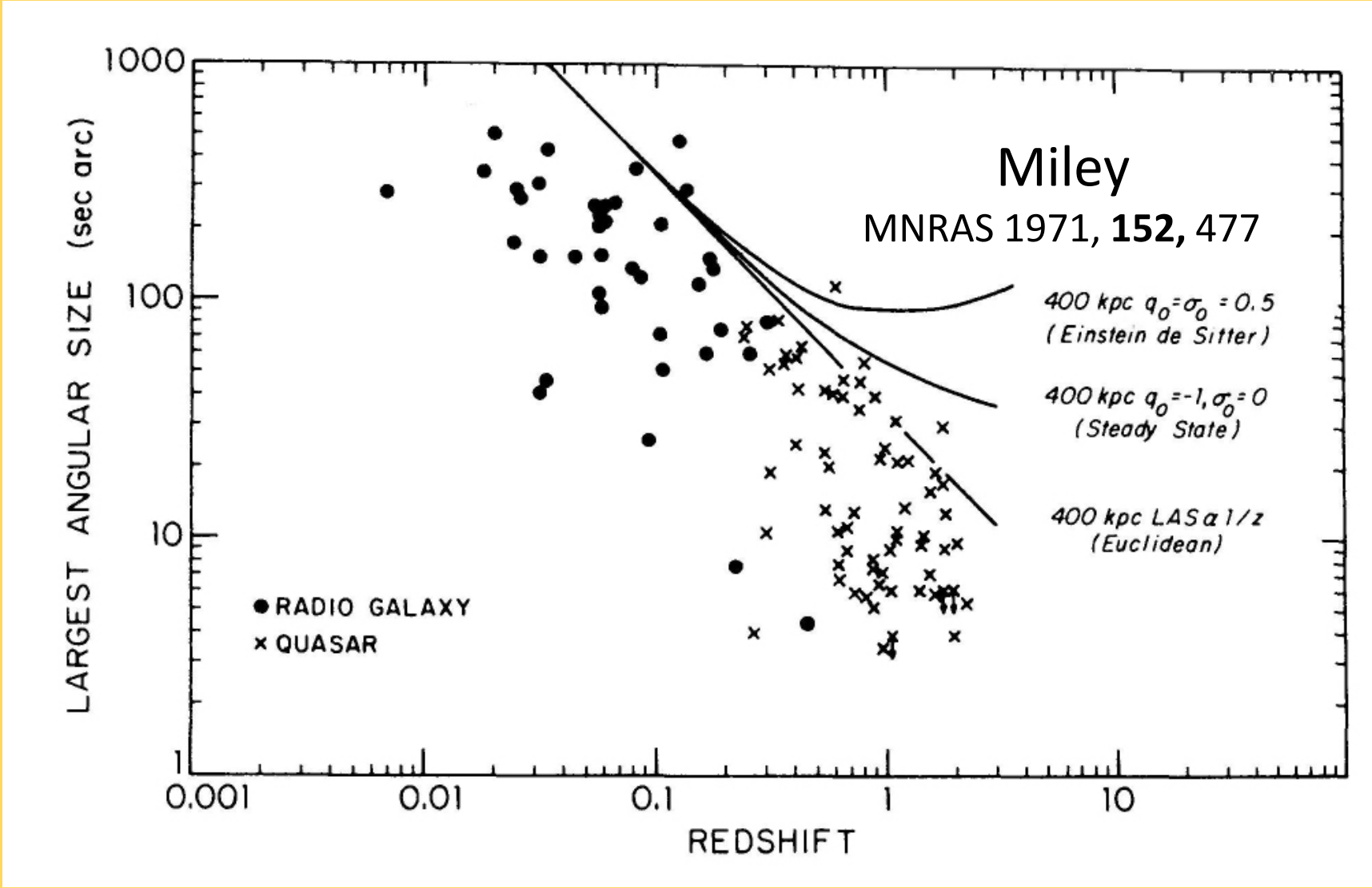
Cygnus A



- E-dS Universe (q_o=1/2)
  - θ_{min} (z = 5/4) = 15 arcsec
- S-S Universe
  - θ_{min} (asymptotic) = 4 arcsec



θ – z for extended sources



Angular Size – Redshift Relation for Radio Galaxies

- Tom Legg, 1970 Nature, 226, 64
- Vijay Kapahi, 1987, IAU symposium 124
- Ashok Singal, 1988, *MNRAS*, **233**, 87

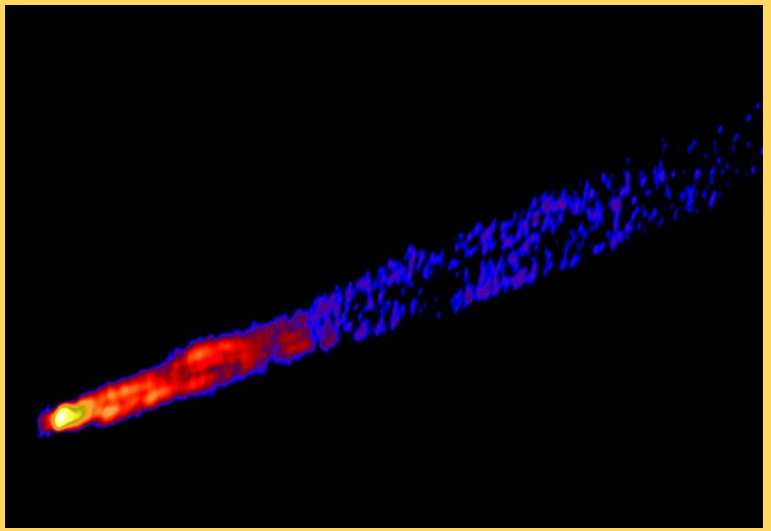
Cosmology with compact radio sources

1) They are young – few hundreds years old short compared to age of universe even at early epoch

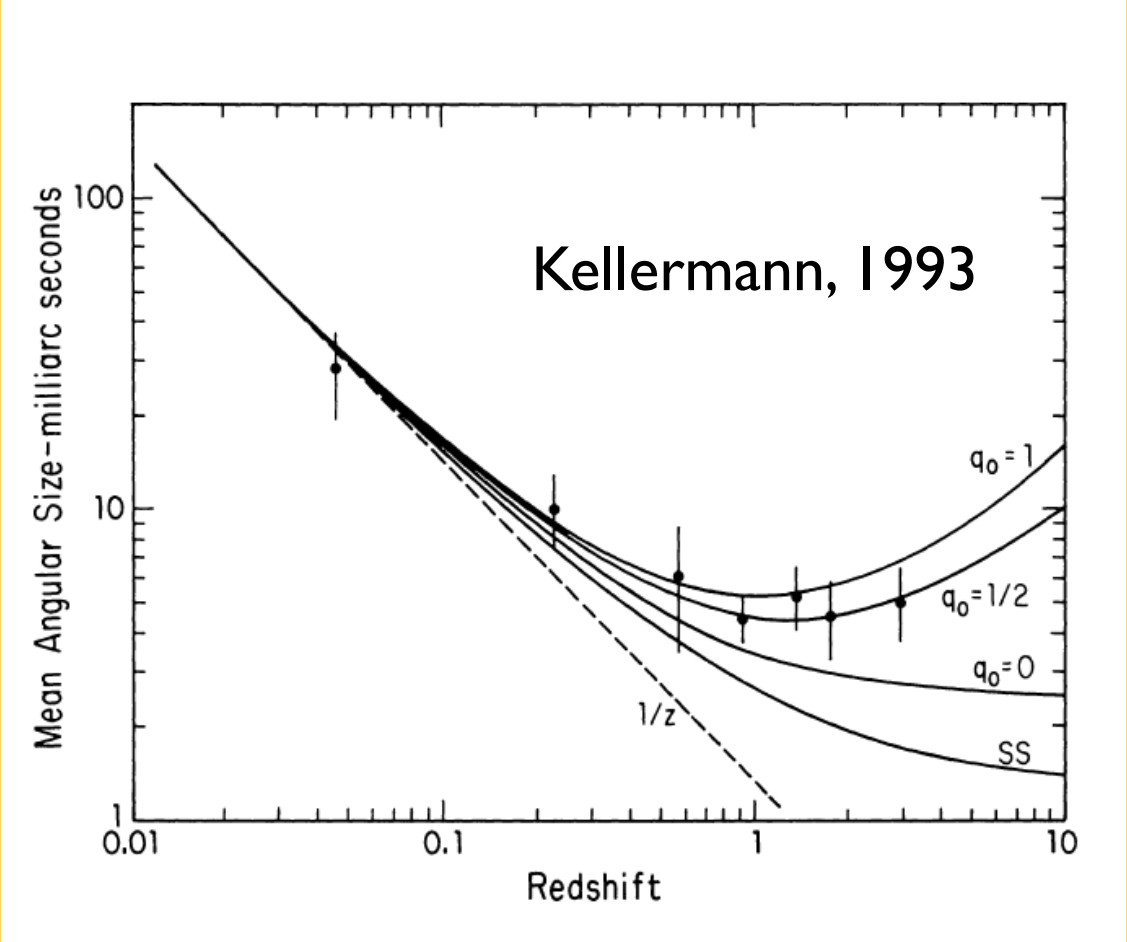
2) Smaller than host galaxy, they are unaffected by the IGM, or CMB

3) Doppler Boosting Oriented close to $1/2\gamma$: Scatter due to projection is small

4) Compact sources are mostly quasars; high z



Theta-z

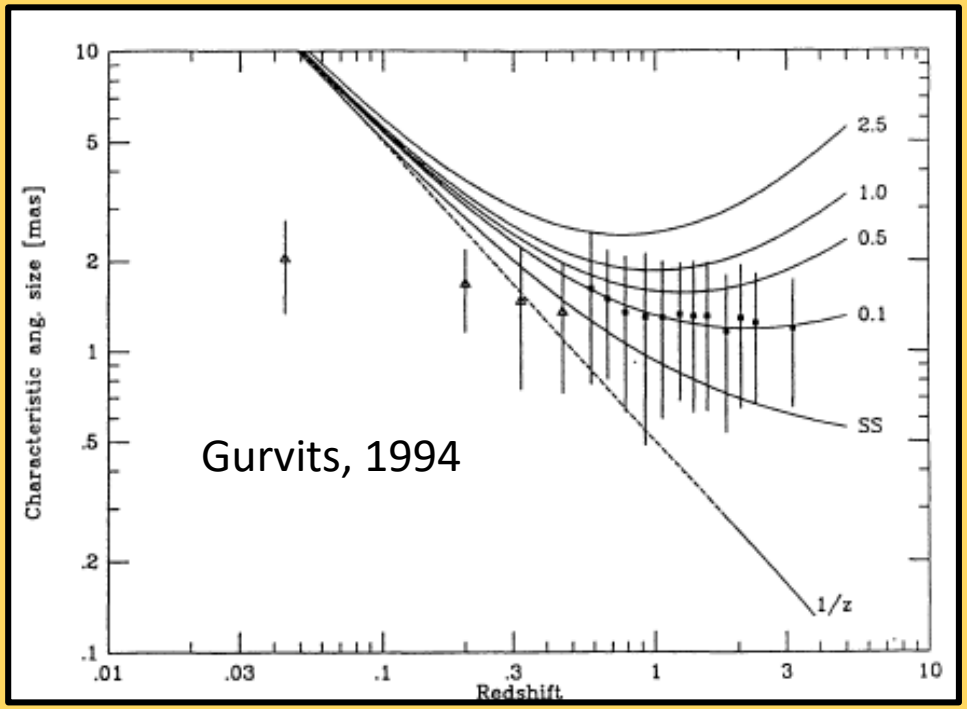


- N= 82 mostly core-jet sources
- λ = 2, 3.8, 6 cm
- P > 10^{24} W/Hz (radio loud)
- DR > 100:1
- Distance to most distant jet > 2%

$\Lambda = 0$

$q_0 = ½, \Omega = 1$

θ-z for compact sources

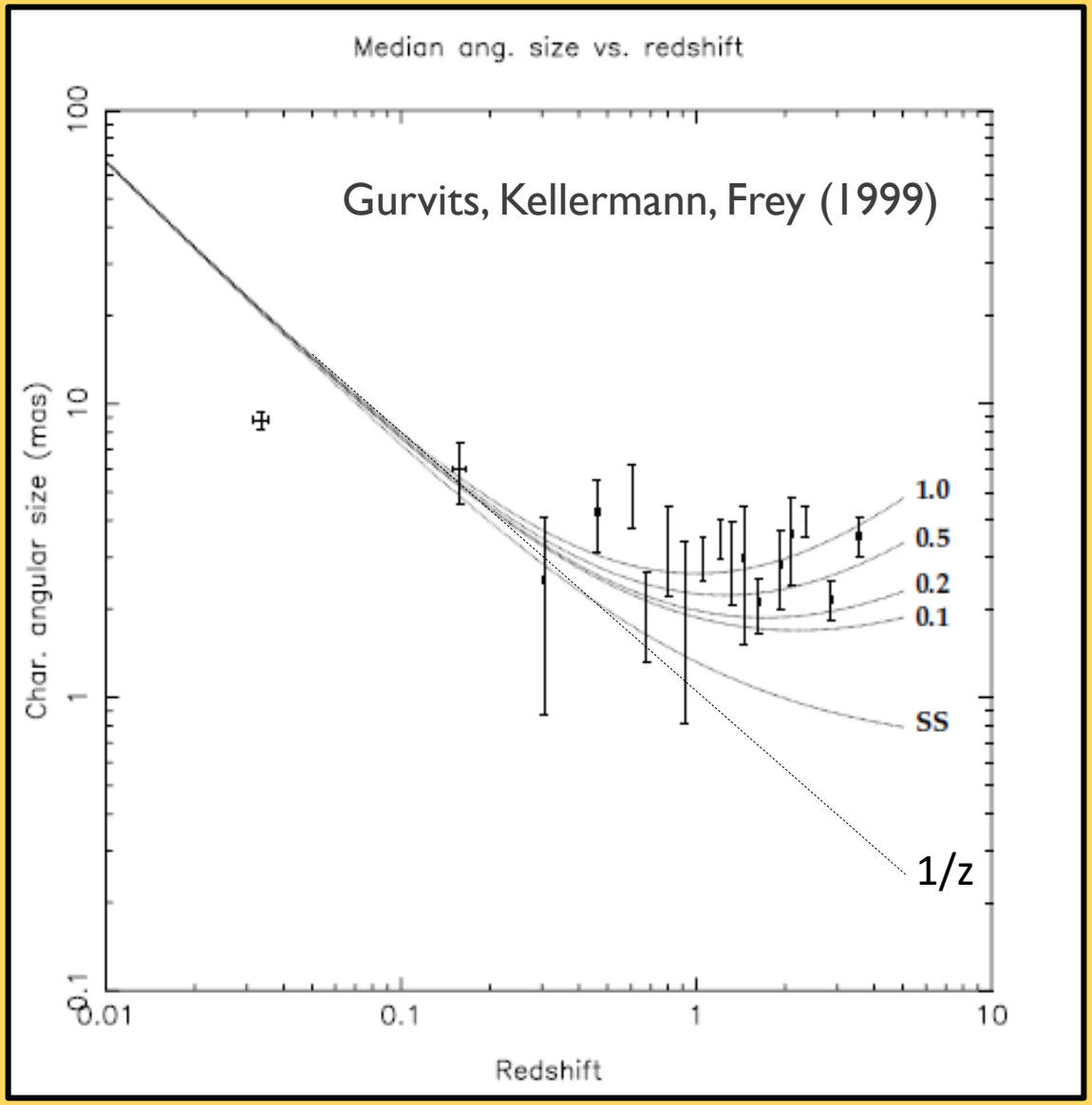


- N = 337 sources from DSN survey
- 2.3 GHz (13 cm)
- P > 10^{26} W/Hz
- Used visibility at longest baseline

$\Lambda = 0$

$q_0 = 0.16 \pm 0.71$

$\Omega = 0.32 \pm 1.42$



- N = 350 sources
- 5 GHz (6 cm)
- $L > 2 \times 10^{26}$ W/Hz
- $-038 < \alpha < 0.18$

$0 < q_0 < 0.5$

No evidence for D(z)

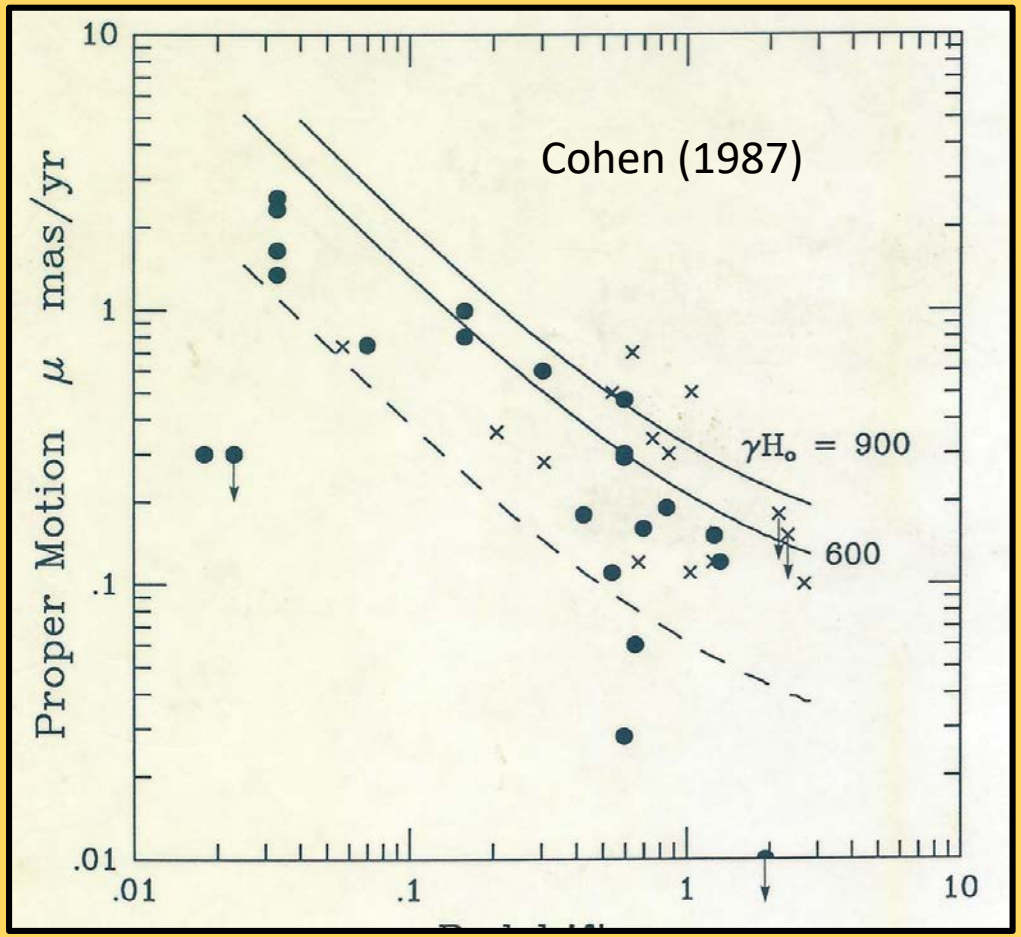
No evidence for for D(P)

$\Lambda = 0$

$q_0 = 0.21 \pm 0.30$

$\Omega = 0.42 \pm 0.60$

Angular Velocity – Redshift Relation (μ – z)



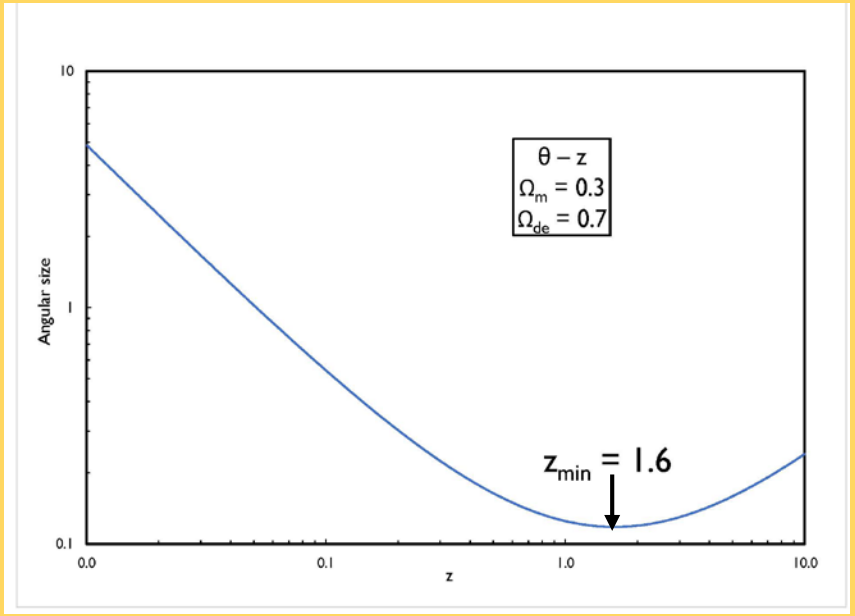
Upper envelope consistent with Ω =1.

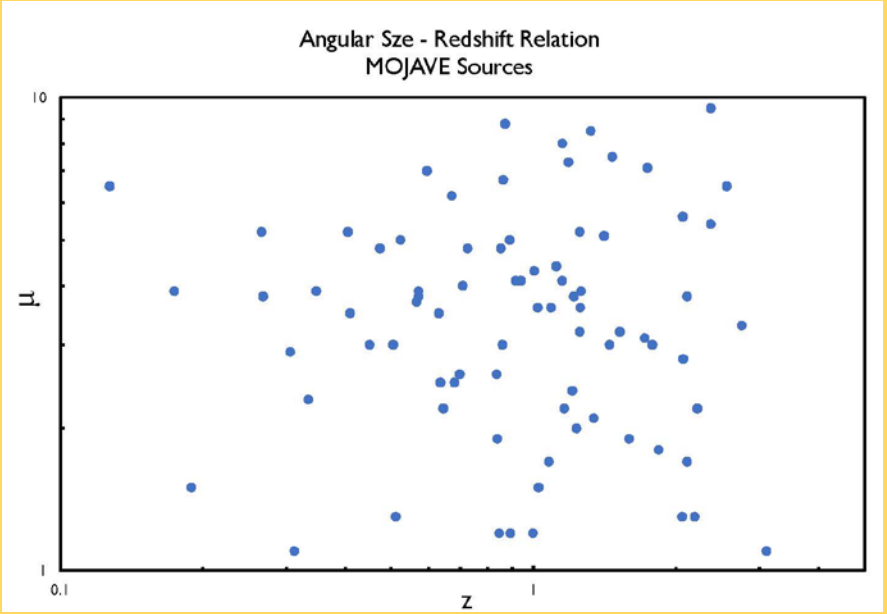
$\beta_{app} = v/c \sim 10$

Modern VLBI and Cosmology

- VLBI data is much better (VLBA, EVN, S-VLBI)
- Cosmology more complex
  - Baryonic Matter
  - Dark Matter

  } $\Omega_m = 0.3$
  - Dark Energy $\Omega_{de} = 0.7$
  - $\Omega = \Omega_b + \Omega_{dm} + \Omega_{de} = 1$
- Leonid is retired!!





Angular Velocity – Redshift Relation

$$\Omega = \Omega_b + \Omega_{dm} + \Omega_{de} = 1$$