The contribution of distant sources to the observed flux of ultra high-energy cosmic rays

Ellis R Owen
CICA Fellow

Institute of Astronomy
National Tsing Hua University

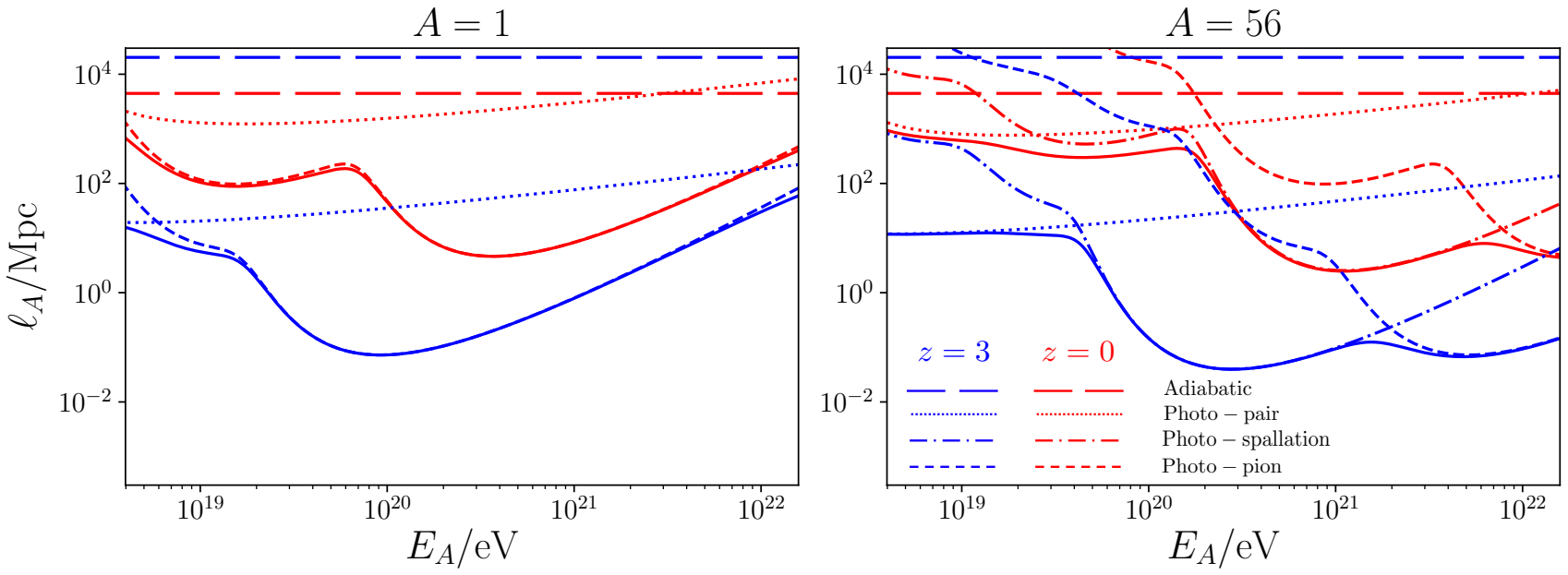
erowen@gapp.nthu.edu.tw

In collaboration with
Qin Han (Nanjing, UCL)
Kinwah Wu (UCL, Macquarie)
Y X Jane Yap (NTHU)
Pooja Surajbali (MPIK)

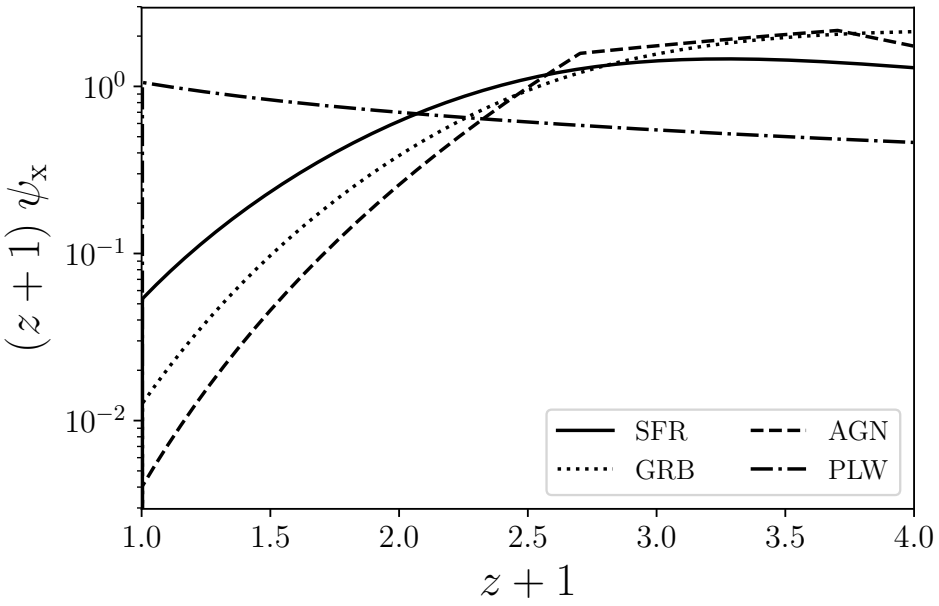
EAS/Hubble, L. Calcada (ESO)

ICRC 2021, Berlin, Germany (Virtual) – July 2021

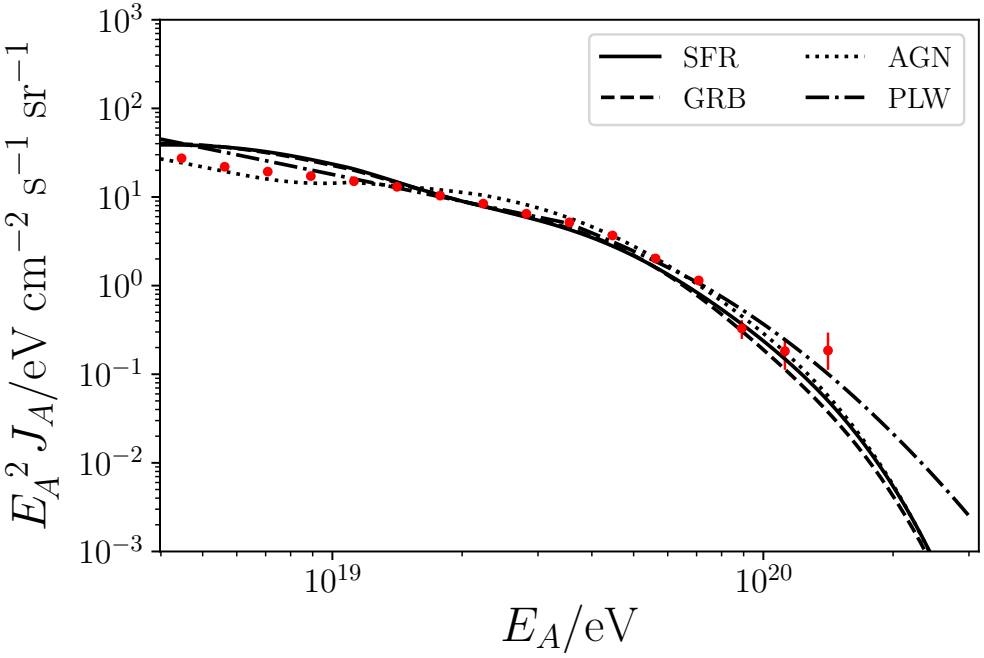
UHE CR Interactions



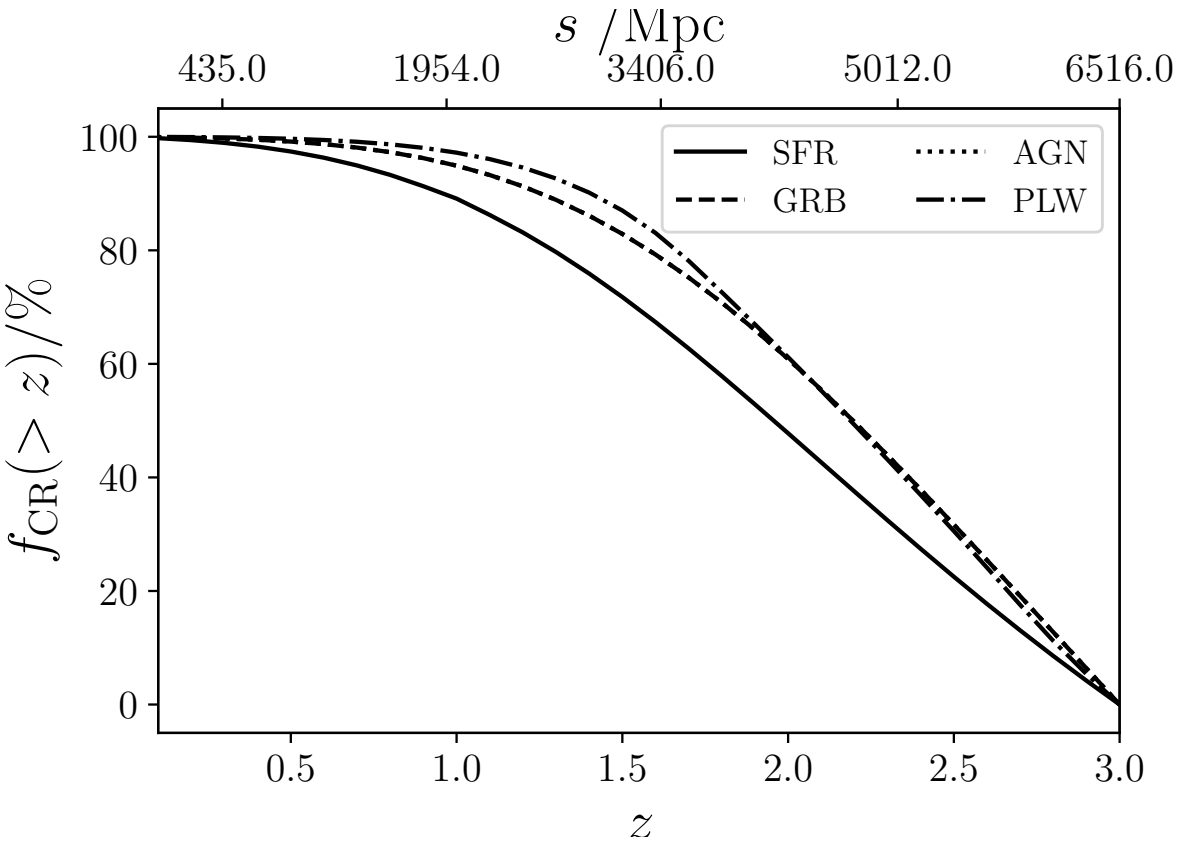
Source populations & distributions



Spectrum


SFR
GRB
AGN
PLW
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
$E_A^2 J_A/\mathrm{eV\ cm^{-2}\ s^{-1}\ sr^{-1}}$
10^{19}
10^{20}
E_A/eV

Location of sources



Key points

1. UHE CRs interact with background radiation fields and are severely attenuated
2. Despite this, most UHE CR arriving on Earth are from distant sources, located at z~2-3
3. This leads to the natural emergence of a strong isotropic background component in the UHE CR flux arriving on Earth