# Newly Seen Debris Disks from the HST NICMOS Archive

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**By reprocessing the NICMOS coronagraphic archive using improved PSF subtraction methods in the ALICE pipeline**, we have obtained **new images of 5 debris disks**, all previously unseen using classical PSF subtractions. Three of the disks are edge on and two appear to be ring like, one of which is extremely asymmetric.

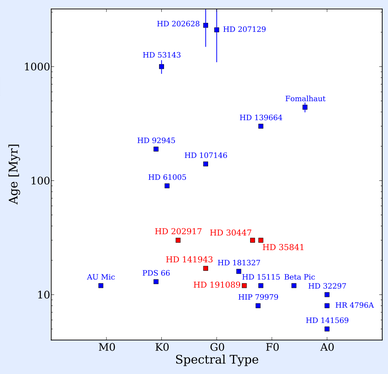
Their stellar hosts are **nearby, young F and G type stars** (40-90 pc, 12- 30 Myr), including one that is a close analog to the young sun at roughly the **age at which terrestrial planets were assembling**. This is a ~25% increase in the sample of debris disks seen in scattered light. Analysis and modeling of the disk geometries is in process. Given these systems' youth, proximity, and brightness (V = 7.2 to 8.5), these will be superb targets for investigating planet formation, and are perfect targets for studies with GPI/SPHERE and JWST.

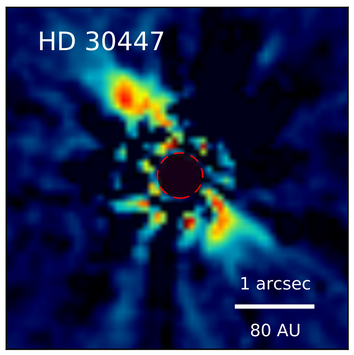
## Methods:

- Careful recalibration and removal of NICMOS instrumental artifacts using optimal reference files for darks, flats, etc. "LAPLACE" HST Archival Legacy Program (PI: Schneider)
- PSF subtraction using the KLIP algorithm (Soummer, Pueyo & Larkin 2012) applied to a large library of reference PSFs drawn from contemporaneous science programs ("ALICE: Archival Legacy Investigation of Circumstellar Environments" program, PI: Soummer)
- Disk images from multiple rolls merged using the iterative roll subtraction algorithm of Krist et al. 2010 to further reduce time-variable residuals.

## Context:

- About 20 debris disks previously seen in scattered light, and a likewise number resolved in thermal emission (from ground, or Spitzer, and Herschel).
- Compared to that prior existing sample, these newly seen disks are preferentially young (<30 Myr) and near solar type (G7-F2). This is the result of selection biases in the NICMOS surveys from which we drew the data, which targeted young nearby systems for planet and disk searches.



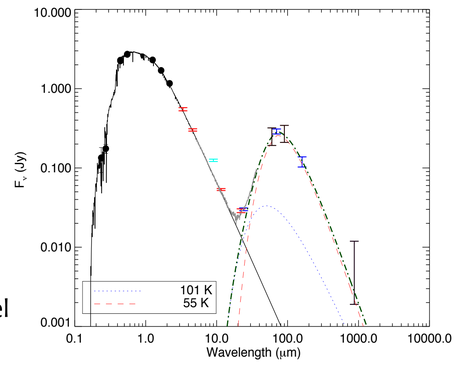

F3V star, 80 pc, 30 Myrs, V= 7.9

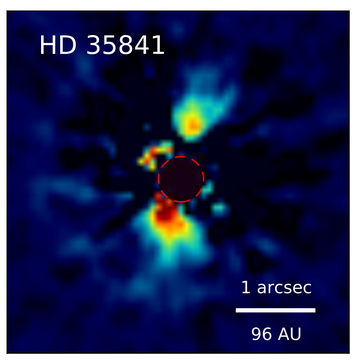
Member of Columba Association (Moor et al. 2011, Malo et al. 2013)

$L_{IR}/L_{\star}$ = 7.9e-4

Asymmetric: extends ~50% further and is ~2x brighter on the NE side.

SED fit with two component model with grains at 55 and 101 K.



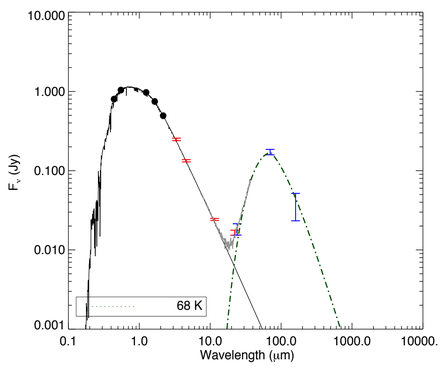



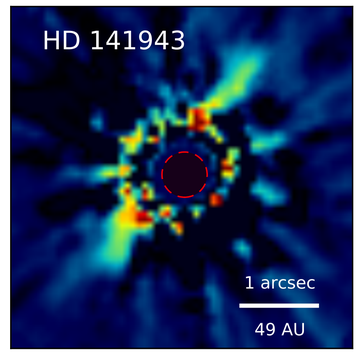

F3V star, 96 pc, 30 Myrs, V= 8.9

Member of Columba Association

$L_{IR}/L_{\star}$ = 1.3e-3

Faintest and most compact disk in our sample.
Disk detected out to ~1.5"



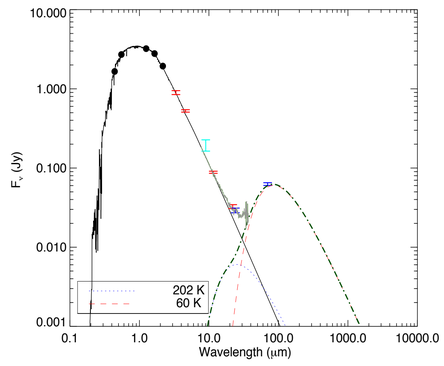

G2V star, 49 pc, V= 7.85

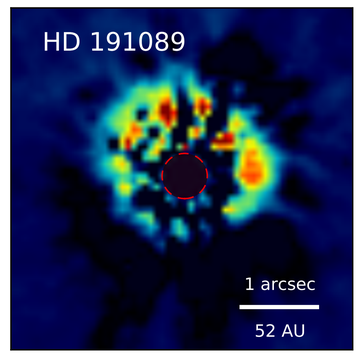
17 Myrs (Marsden et al. 2011)

First solar-type star < 50 Myr to have a debris disk imaged in scattered light.

The lowest IR excess in our sample: $L_{IR}/L_{\star}$ = 1.2e-4

Disk detected from 0.7-2.6" = 35 - 125 AU projected sep.



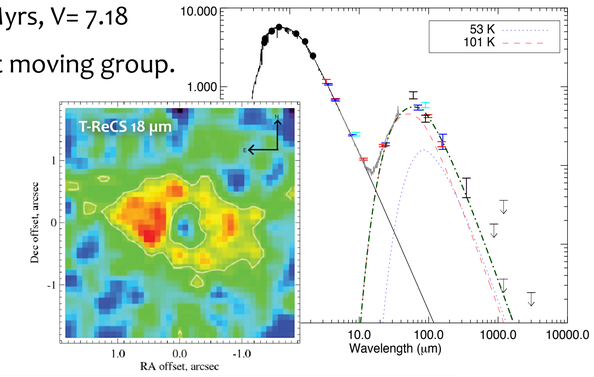



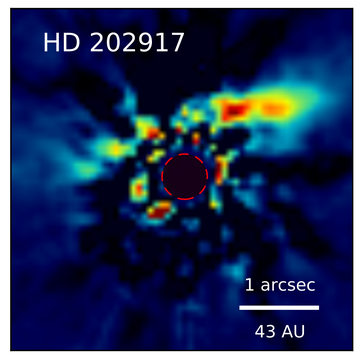

F5V star, 52 pc, 12 Myrs, V= 7.18

Member of Beta Pic moving group. (Moor et al. 2006)

$L_{IR}/L_{\star}$ = 1.3e-3

Consistent with 18 μm detection by Churcher et al. (see at right)



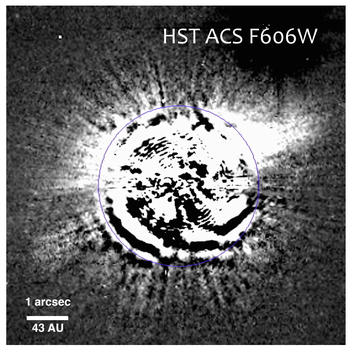

G7V star, 43 pc, 30 Myrs, V= 8.7

Member of Tuc-Hor. association

$L_{IR}/L_{\star}$ = 2.5e-3

Previously detected in unpublished HST ACS data (see at right) acquired by ACS GTO team

Another asymmetric "needle": looks like a highly inclined arc?




See Krist et al. 2007, Spirit of Lyot Conf

## What's Next?

- Careful analysis and modeling of each of these disks.
  Several papers are in preparation by our group. (HD 202917 lead=Perrin, HD 191089 lead = Moerchen, HD 141943 lead = Choquet, HD 30447 & HD 35841 lead = N'Diaye)
- Multiwavelength followup observations, including
  - using GPI starting this fall,
  - and HST STIS optical coronagraphy in Cycle 21.
- Extend the ALICE reprocessing campaign to the ACS and STIS archives, too.

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