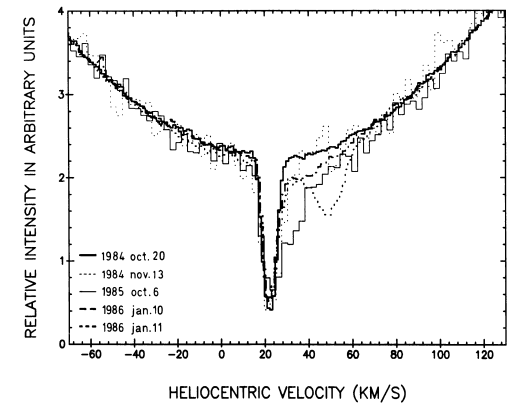
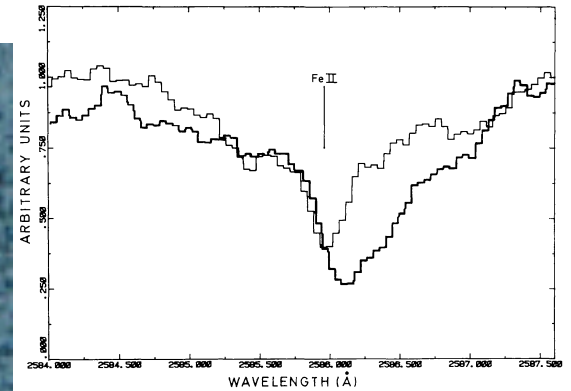
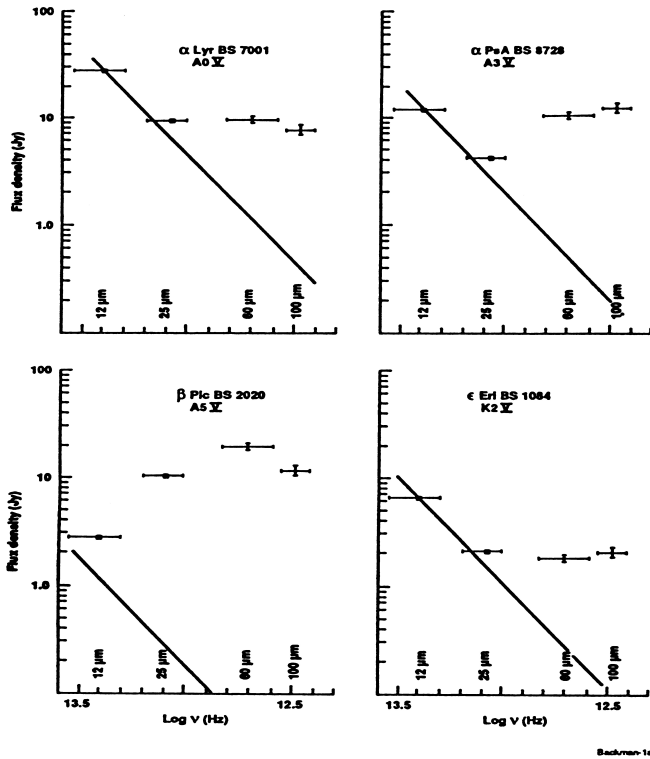
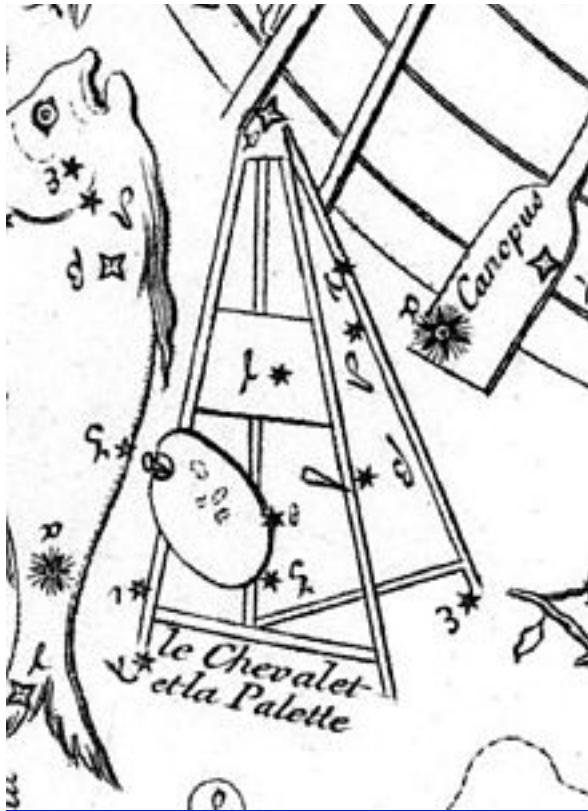


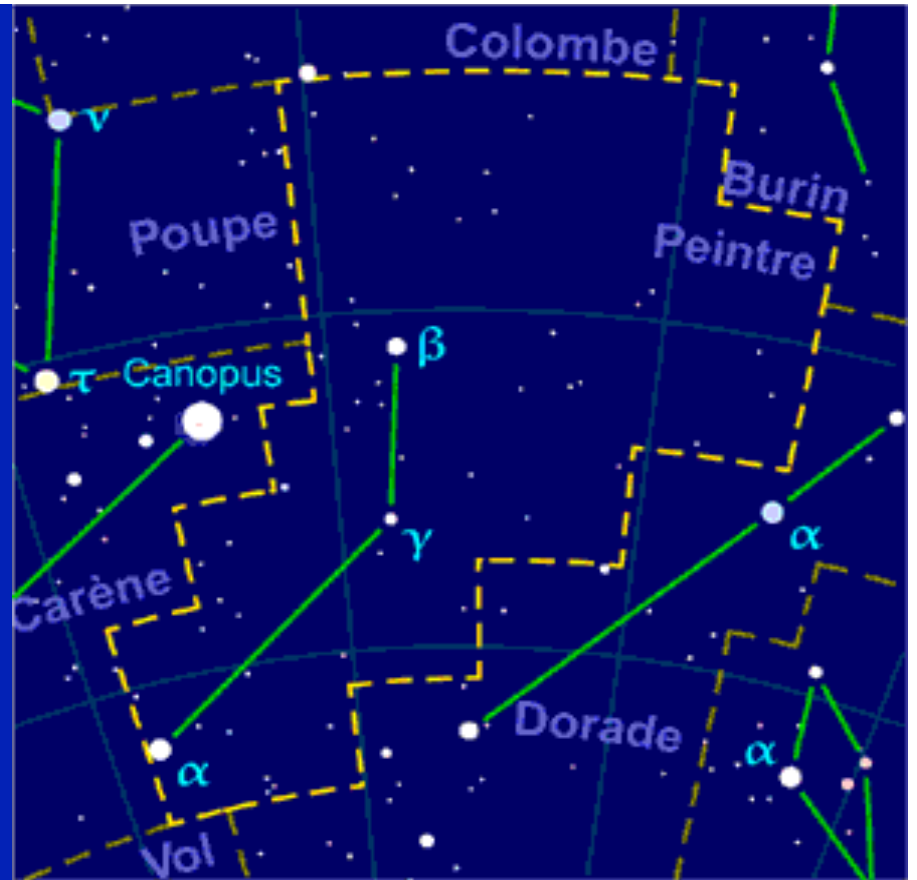
From IRAS Excesses to Debris Disks



D. Backman (SOFIA / SETI Institute)
A.-M. Lagrange (IPAG / OSUG)

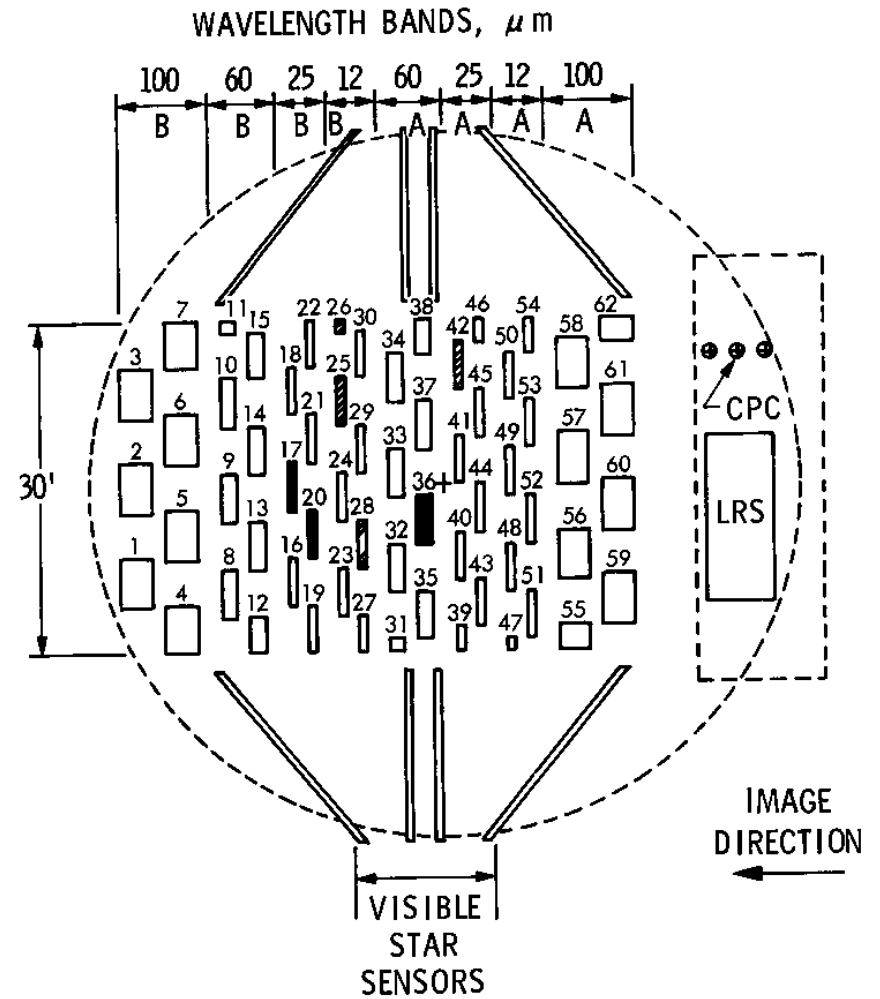


**Le Chevalet et la Palette
(Abbé de Lacaille, 1756)**



SIMBAD references

	<u>1954-1983</u>	<u>1984-2013</u>
Beta Pic	29	1174
Alpha Pic	31	100
Alpha Car	105	255



Infrared Astronomy Satellite – IRAS
U.S., U.K., Netherlands: 1983

IRAS focal plane (proto-array!)

10-month all-sky survey; 57-cm telescope

12, 25, 60, 100 microns



IRAS Science Team

Nov. 1983
press
conference
at NASA
Headquarters
(F. Gillett is
2nd from left
in the front)



Fred Gillett
KPNO/NOAO
(1937-2001)

Pictured at the
Gemini-North
dedication,
June 1999



Gillett,
Stein,
& Ney
1963
Ap.J.

(zodiacal
light
balloon
payload)

FIG. 2.—The two balloon gondolas. The upper horizontal band occulted the inner part of the corona for the cameras in the lower box. The lower light shields prevented bright light from the lower atmosphere from striking the lenses of the lower cameras.

The Washington Post

In the mid
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Page C2

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No. 248

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WEDNESDAY, AUGUST 10, 1983

Figures in Areas Approximately 75 Miles
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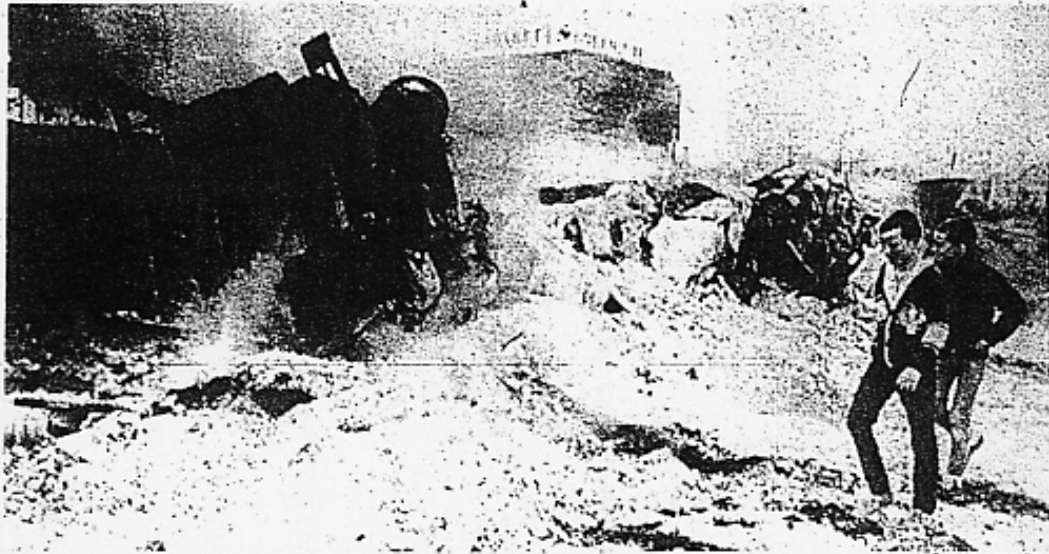
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VIOLENCE IN ULSTER



Belfast youths examine remains of a truck burned late Monday. British troops shot and killed a young Catholic man during disturbances yesterday. Story, Page A10.

New Evidence of Other Worlds

Satellite Discovers Possible Second Solar System

By Thomas D'Arcy
WASHINGTON POST STAFF WRITER

A satellite carrying an infrared telescope has discovered swarms of large particles around the star Vega, and scientists say they think the particles and the star make up a complete solar system like our sun and the nine planets and thousands of asteroids and meteorites that surround it.

If true, it is the first evidence that the universe contains a second solar system like this one.

Though scientists have speculated for years that the Earth and its eight sister planets are not alone in the cosmos, they have never had evidence that their speculations were correct.

"The discovery provides the first direct evidence that solid objects of substantial size exist around a star other than the sun," said a statement yesterday from the Jet Propulsion Laboratory in Pasadena, where the Infrared Astronomical Satellite (IRAS) pictures are analyzed.

"The material could be a solar system in a dif-

ferent stage of development than our own," the statement said. Vega is a young star only 1 billion years old. The Earth's sun is almost 5 billion years old.

Nevertheless, Vega is similar to the sun. Its surface temperature has been measured at 10,000 degrees, almost the same as the sun. This suggests that though it is younger, Vega and its surrounding system may be undergoing the same kind of evolution that this solar system went through 4 billion years ago. Among the bodies in evolution around Vega could be even the equivalent of a young Earth.

What the IRAS satellite has seen time after time since it left the Earth last January is that Vega has appeared "much brighter and larger in infrared light" than any other similar star the satellite has observed, strongly suggesting there were gaseous bodies in orbit around Vega just as the planets in this solar system circle the sun.

Further investigation showed that the bodies

orbiting Vega had temperatures measured by the infrared telescope at about 300 degrees below zero Fahrenheit. This is far above the temperature of empty interstellar space and approximates the temperature of the inner rings of Saturn.

The telescope on IRAS has no way of counting the number of bodies in orbit around Vega or even of estimating their size. But the statement released yesterday by JPL said the particles could range "from back-shot to the size of asteroids and planets."

"The statement said the material the telescope sees around Vega "could be comparable in mass to all the nine planets and other matter in our solar system, excluding our sun."

While the telescope is sensitive to heat, it cannot resolve, or "see," the mass of particles around Vega precisely enough to distinguish between them. All it sees is a ring of particles, not individual bodies. The back-shot-sized particles men-

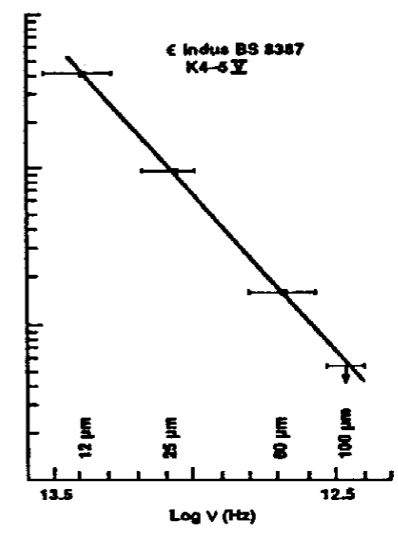
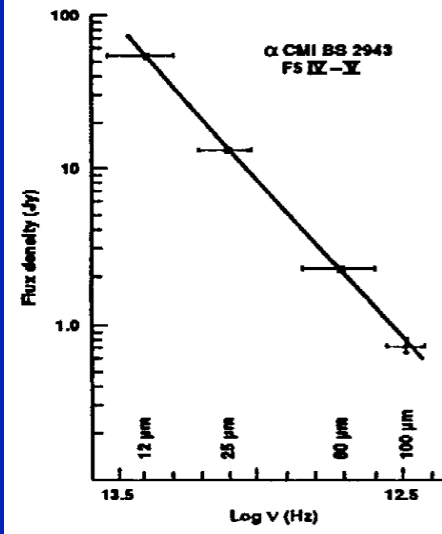
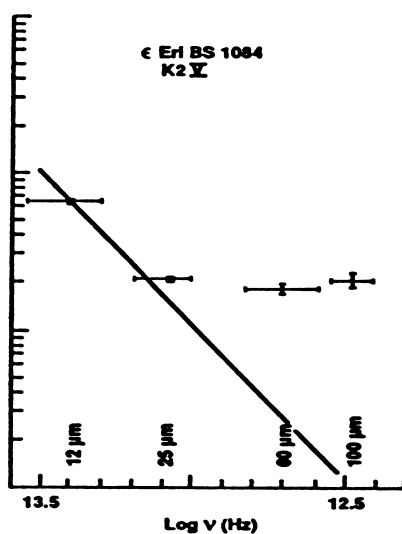
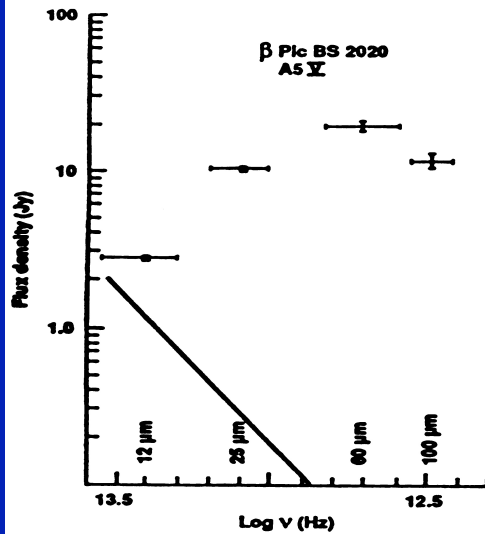
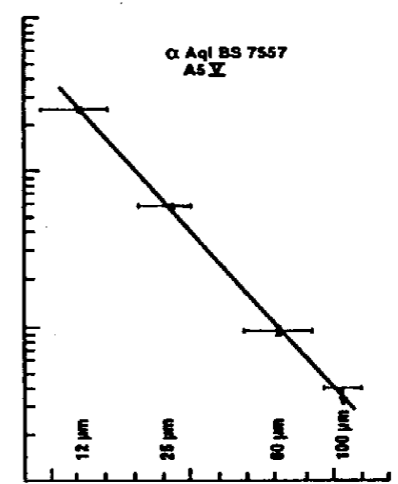
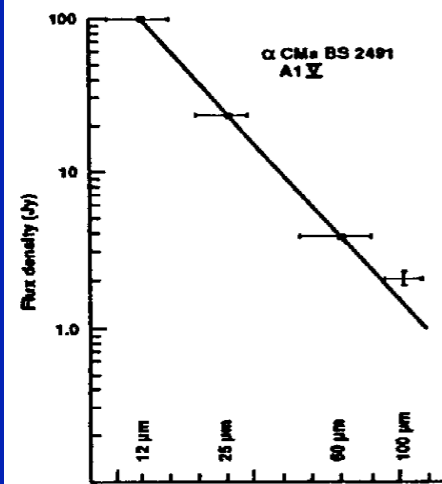
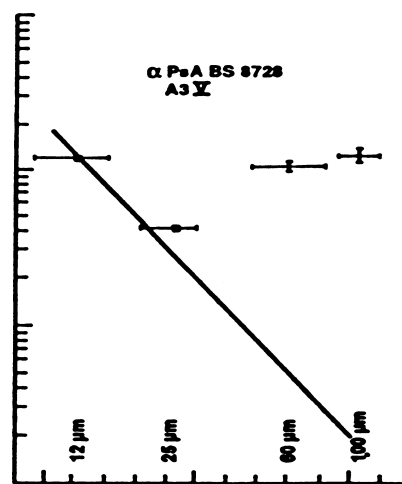
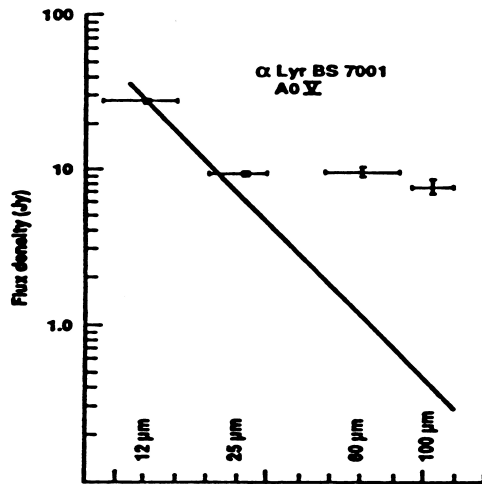
See VEGA, A8, Col. 1

←= 16 Août 1983



George Aumann
NASA JPL

IRAS Vega paper:
Aumann et al. 1984
(submitted Sept. 1983)

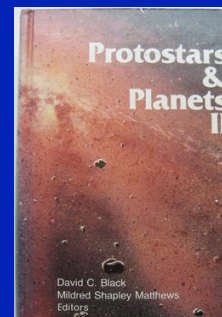


Beckman-1a

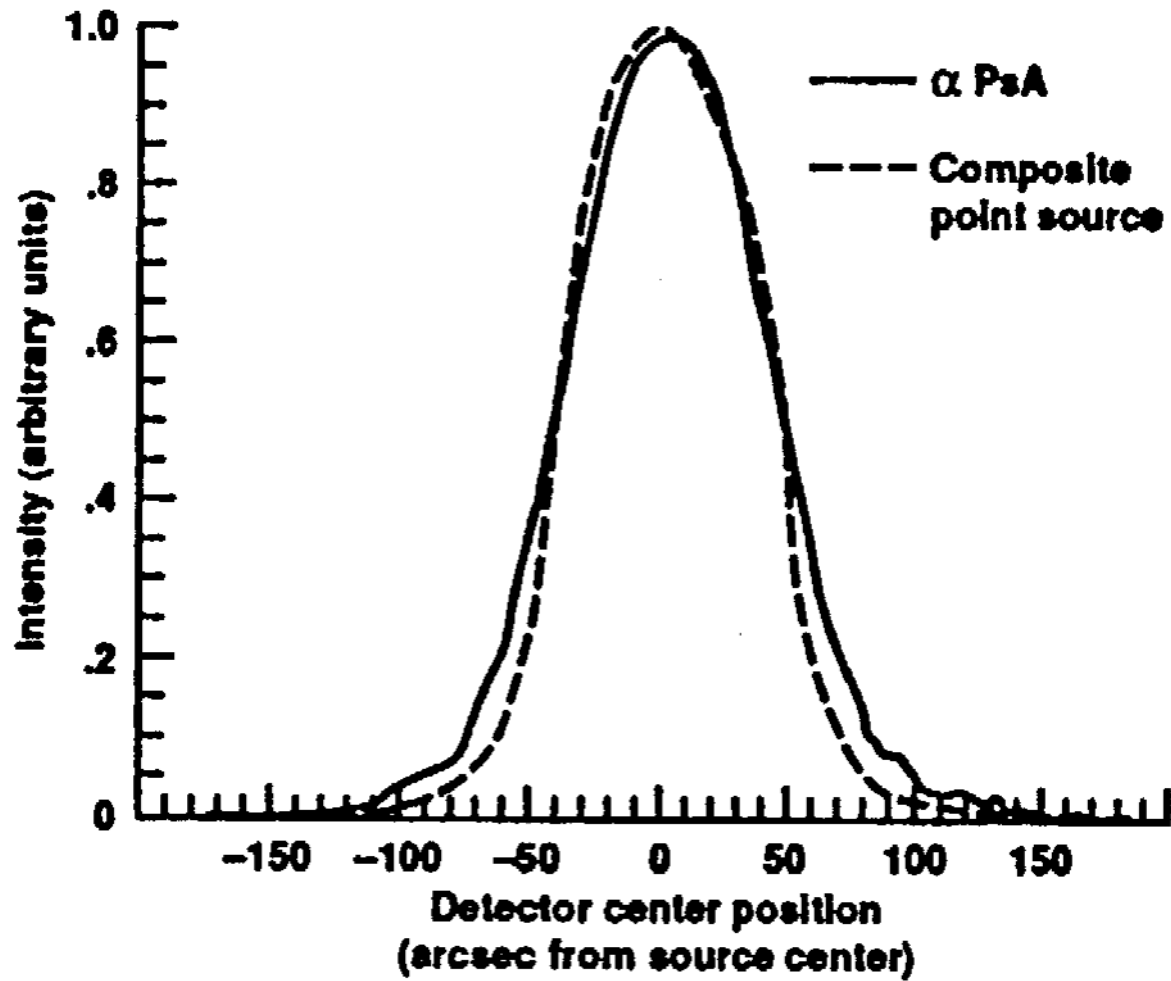
Beckman-1b

The Fabulous Four:
Vega, Fomalhaut,
Beta Pic, Eps Eri

Gillett
Protostars and Planets II
oral paper (Jan. '84).



Nice, but not Fabulous:
Sirius, Altair,
Procyon, Eps Indi



Backman-2

Sum of IRAS
single-detector
slow scans
“resolving”
Fomalhaut
relative to
point sources.

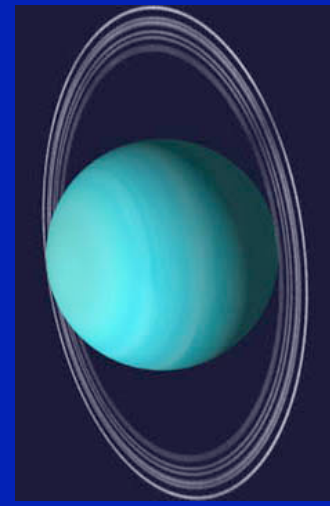
- Source sizes
- Inferred grain sizes
- Source shapes
- Centroid positions



Brad Smith

Rich Terrile

Smith & Terrile (1984)



Primary target - Uranus

ALTERNATE HYPOTHESES – SOME STRANGER THAN OTHERS

- **Background galaxy**
- **Background ISM dust / locally dense ISM dust**
- **Remnant protostellar disk dust**
- **Cold blackbody companion**
- **Cool companion star (!!)**
- **Grains condensing in stellar wind / spherical shell**
- **Grains condensing in equatorial mass loss or bipolar jets**

GAS SPECTROSCOPY – Signs of Activity



Y. Kondo



F. Bruhweiler



A. Vidal-Madjar



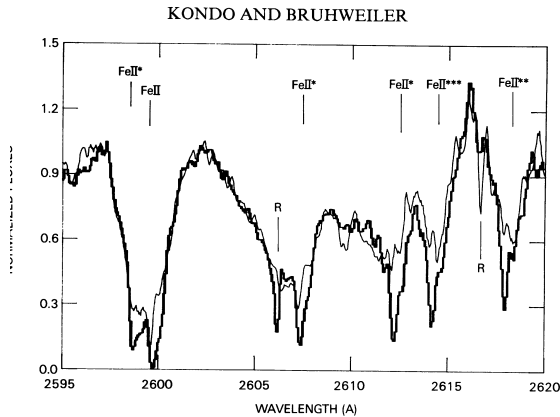
L. Hobbs



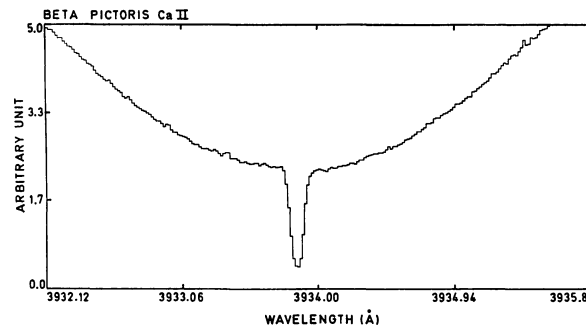
A.M. Lagrange



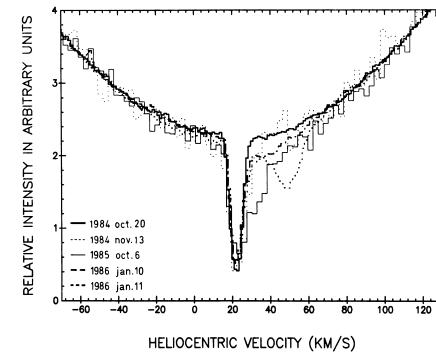
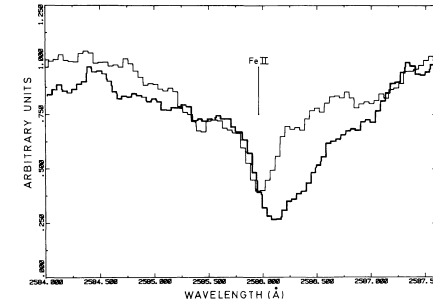
R. Ferlet



Kondo & Bruhweiler (1985)
 - Variable strength
 UV Fe II lines



* Hobbs et al. (1985) (I)
 * Vidal-Madjar et al. (1986) (II)
 - Model: Ca II < 0.4 AU,
Na I D in outer disk
 - No circumstellar lines
 in Vega or Fomalhaut



* Lagrange et al. (1987) (IV)
 * Ferlet et al. (1987) (V)
 - Transient absorptions, always redshifted, in UV & visual lines

THROUGH 1987...

Infrared & radio observations of the Fab 4:

Harvey et al. 1984 (KAO)
Harper et al. 1984 (KAO)
Hollis et al. 1985 (VLA)
Gillett 1986 (IRAS summary)

Surveys of IRAS data:

Aumann 1985
Sadakane & Nishida 1986
Backman et al. 1986
Waters et al. 1987

Optical Imaging & Coronagraphy:

Smith & Terrile 1987
Paresce & Burrows 1987

MORE THROUGH 1987...

GAS SPECTROSCOPY:

Lagrange-Henri et al. 1987 (VI)

MODELS / SPECULATION:

(Witteborn et al. 1982)

Weissman 1984

Diner & Appleby 1986

Sykes & Greenberg 1986 (IRAS – zodi)

Backman & Gillett 1987