INSTITUTO DE ESTRUCTURA DE LA MATERIA

DPTO FÍSICA MOLECULAR

Atacama Large Millimeter Array

TEST OF THE SEMITRANSPARENT VANE CALIBRATION SCHEME

J. Martín-Pintado

Design and construction of the devices

S. Navarro, M. Carter (IRAM)

Tests:

J. Martín-Pintado, (IEM-CSIC), S. Martín, S. Navarro (IRAM)

S/T vane calibration scheme

Tcal = f * Tcal(chopper_wheel)

f = losses in the vane measured on astronomical sources

Goals of the tests : accuracy of cal scheme

Properties of the vane (done)

- Absorption coefficient (loads and astronomical sources)
- Polarization

Comparison relative calibration dual-load/ S/T vane

- Lack of good weather (only few hours in two periods)

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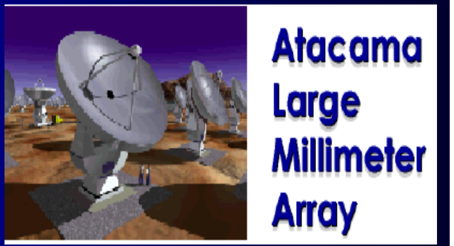
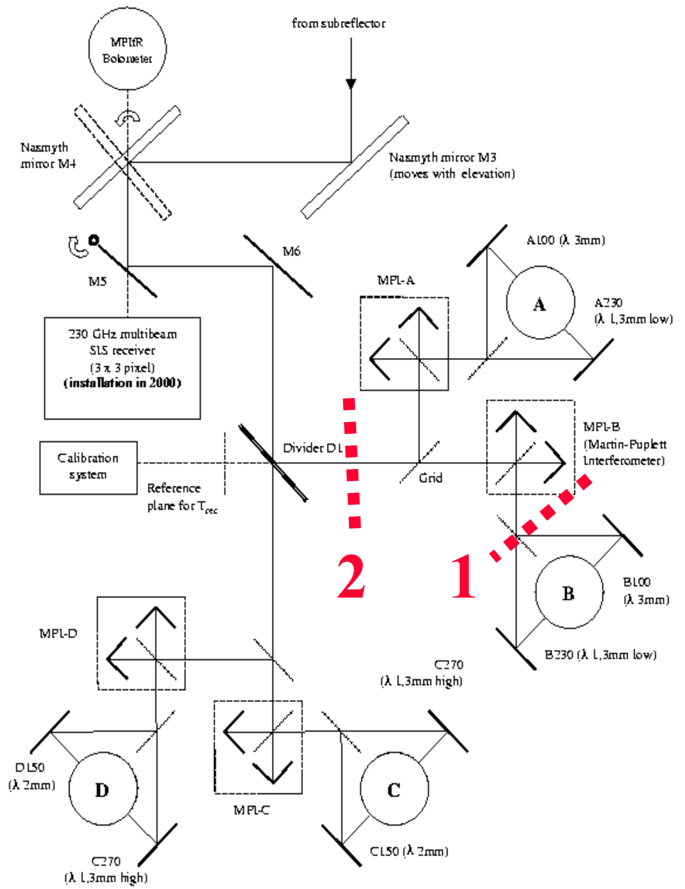


IRAM 30m telescope receiver cabin schematic



Devices

Rotary actuator (switch time 1 s)
90 and 230 GHz observations
Standard calibration system

Position 1

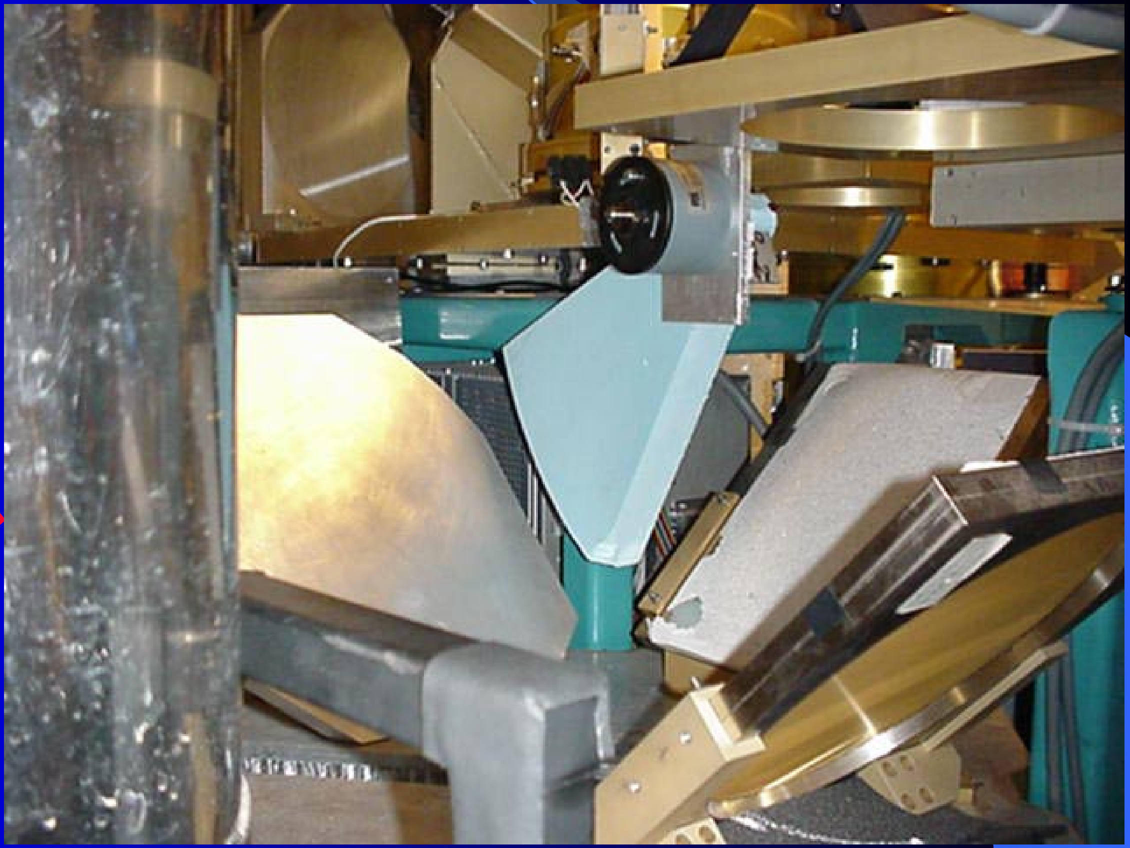
* 2 cm from the receiver

Position 2

* 1.5 m from the receivers
* Two frequencies: 86 and 230 GHz
* Orthogonal polarization

Position 1

Position 2



Vane material

First observing run

Dense polystyrene foam

2 cm thickness: Absorption 0.05 at 86 GHz

Second observing run

Dense polystyrene foam (vane #1)

4 cm thickness: Absorption 0.1 at 86 GHz

Dense polyurethane foam (vane #2)

3 cm thickness: Absorption 0.2 at 86 GHz

Measurements of the absorption coefficient

- **Using the cold (N2) and the ambient loads**

  f = (Cold_vane – Cold) / (Amb – Cold)

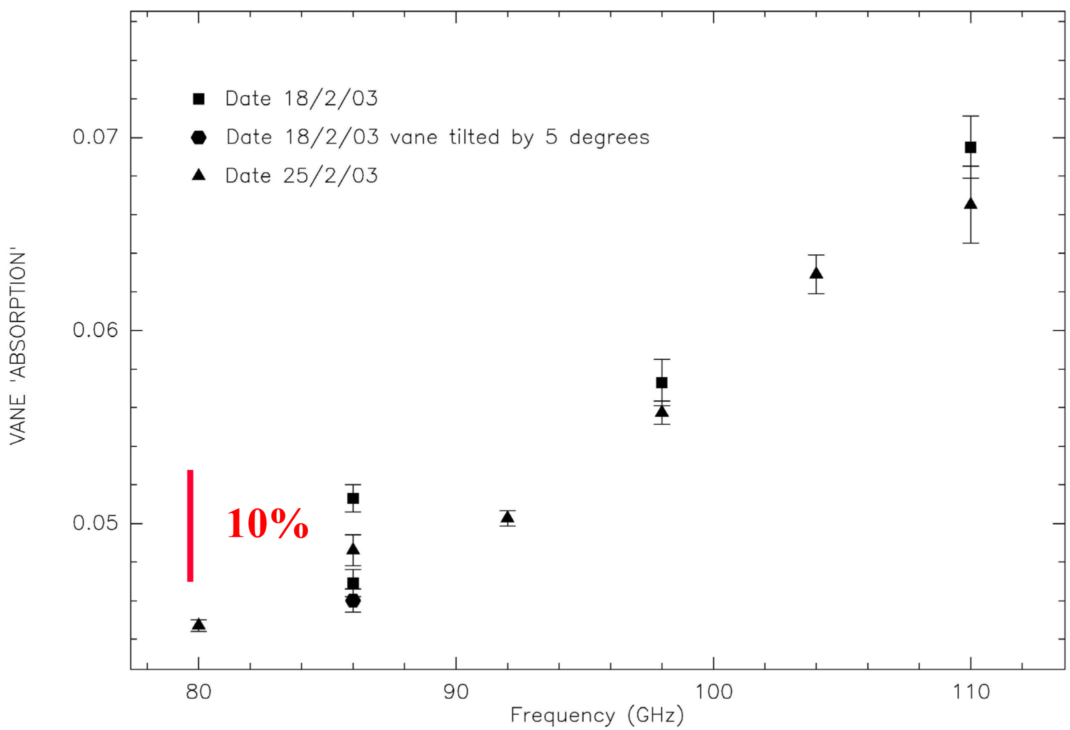
  Final values are the average of 9 measurements

- **Using astronomical sources (only second run: Saturn and RLeo)**

  f = 1- (I_vane-on / I_vane-off)

  Final values are the average of 14 measurements

Position 1



Variations up to 10% due to the location of the vane

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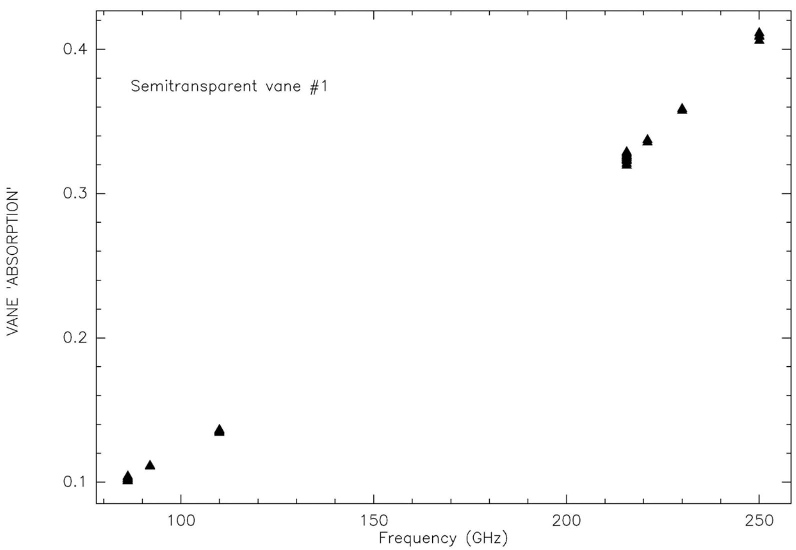
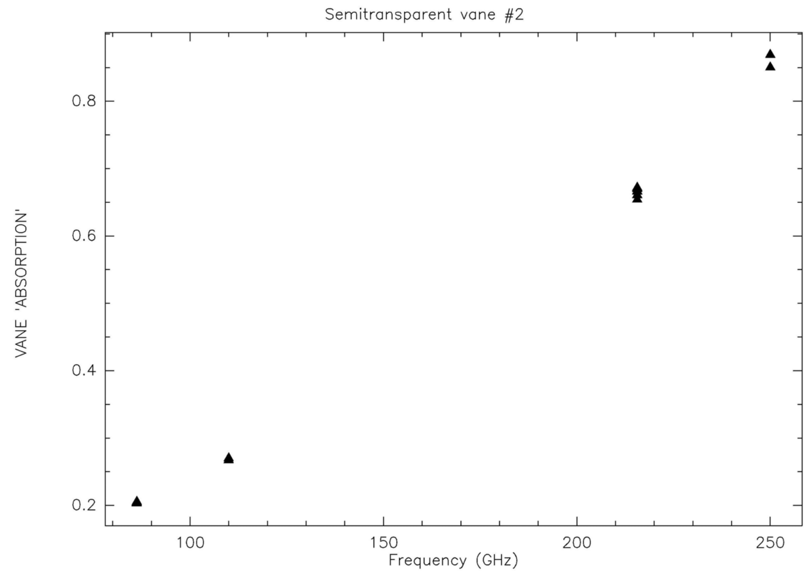
Position 2

Vane 1



Vane 2



Smaller variations than 10%

Absorption goes like $\upsilon^{1.2\text{-}1.3}$ but not a single power law

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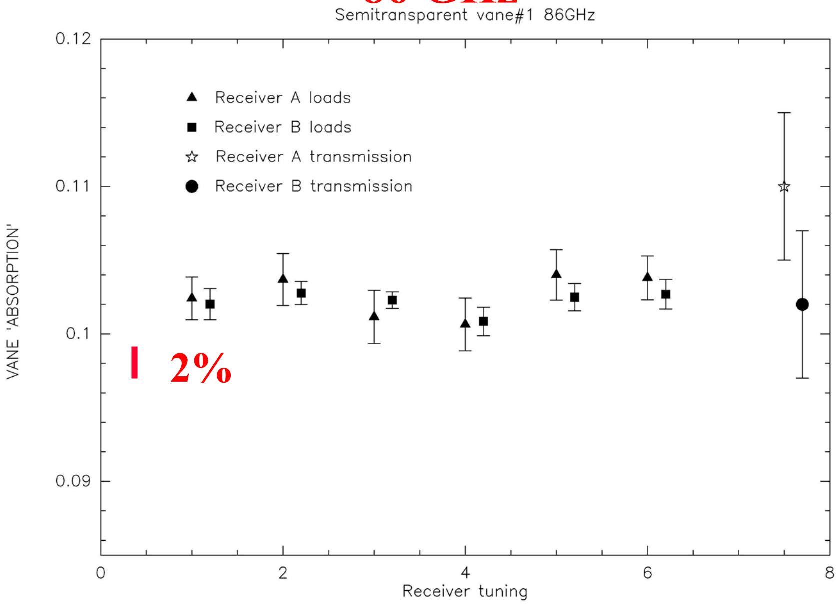
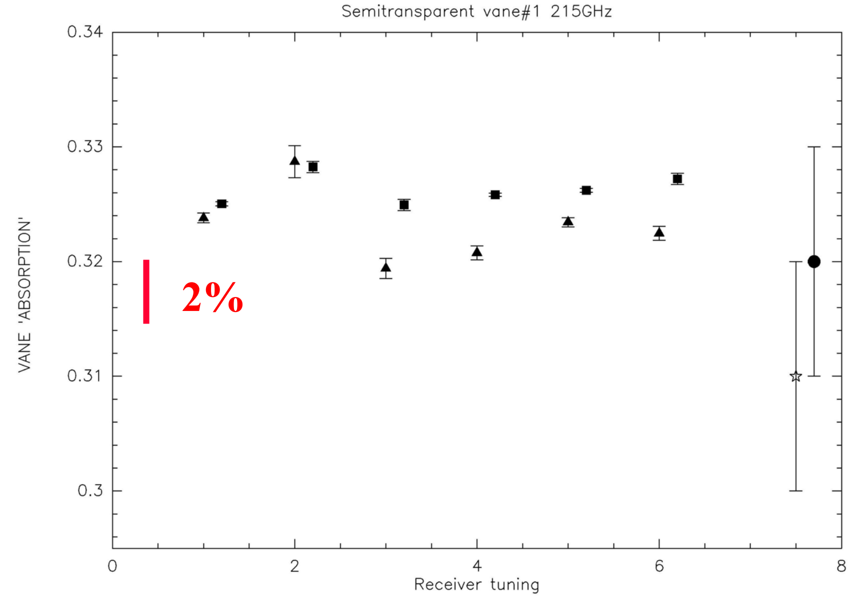
Vane 1

86 GHz



215 GHz



Variations of < 2%. Systematic effects at this level

Influence of stationary waves vane-receiver (position 1)

Transmission difficult to measure at a 1% level

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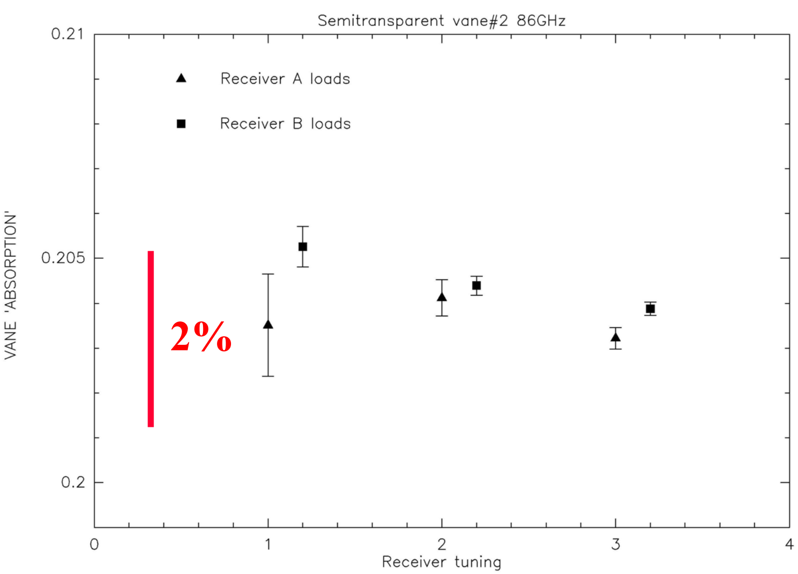
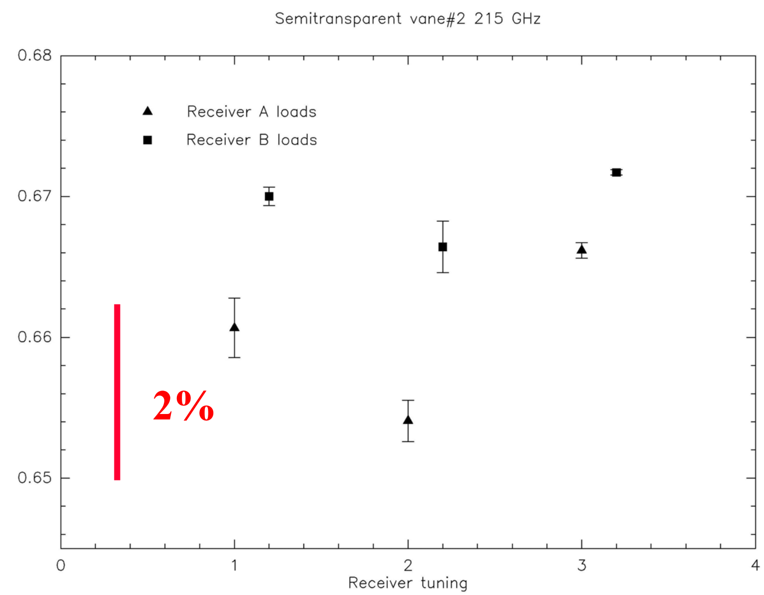
86 GHz Vane 2 215 GHz





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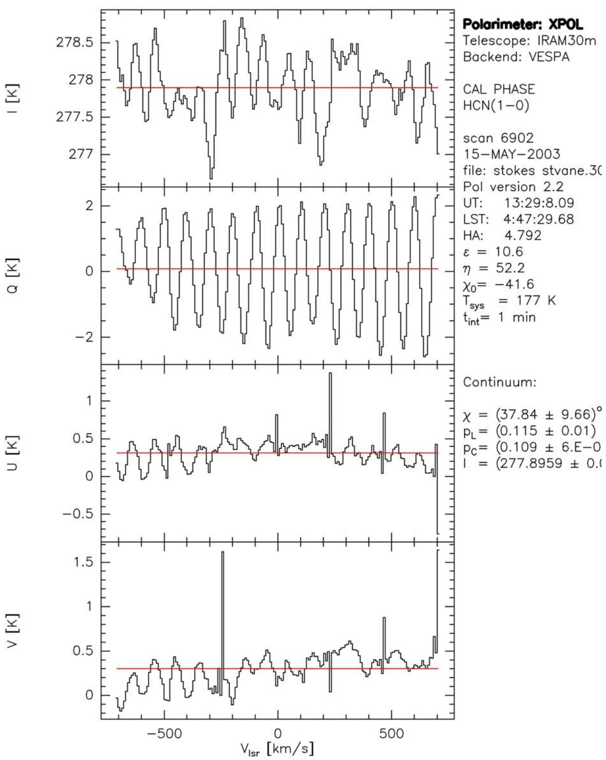
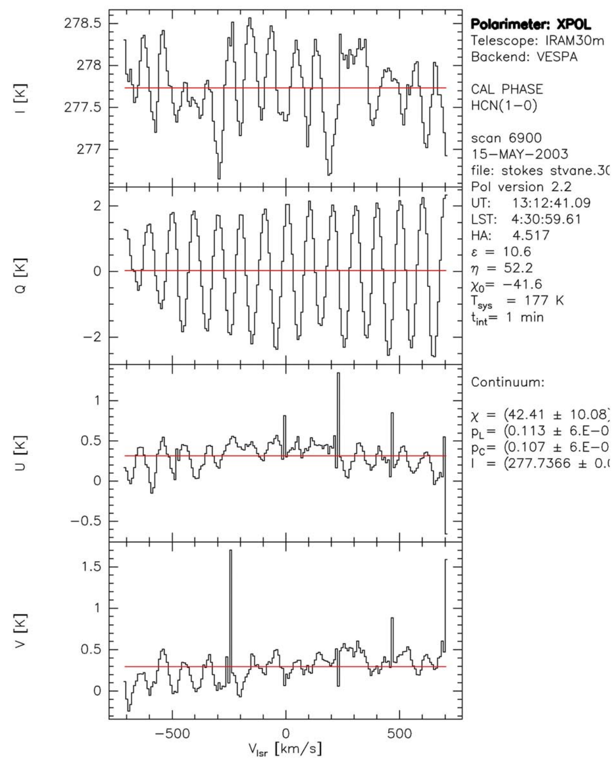
Vane 1 Polarization 3mm

H. Wiesemeyer & C. Thum

Vane on



Vane off



Linear
<0.5% (5 σ)

Circular
<0.5% (5 σ)

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CONCLUSIONS

Stability

- The S/T vane could provide a calibration accuracy of 2%

Problems

- Systematic effects
- Difficult (time) to measure the losses on astronomical sources with the required precision (better than 1%)

The S/T vane calibration scheme could provide a calibration system with an accuracy of about 2-3%.

Additional problems

- Ageing of the vane