



Breault Research Organization, Inc.
 2175 East Valencia Road · #105
 Tucson, Arizona 85706
 Telephone (520)721-0500 · Fax (520)721-9630

Controlling ray splitting and scatter with GENERATION

March 9, 2021

Syntax:

```
GENERATION n
          OFF
```

Option

n

Description

The number of generations, splits or scatters, that are allowed. For a given ray, the number of splits plus the number of scatters must be less than n

OFF

Remove blocking of higher generations

The number of times a ray can be split (ghost reflected) or scattered is controlled with the SPLIT and LEVEL commands. We use SPLIT to limit the number of generations of ghosts from refractive interfaces. Figure (1) illustrates this. A single parent ray is incident on a glass plate from below. A SPLIT 3 command allows only three generations of ghosts. The parent ray (generation 0) can generate children (generation 1), and child rays can generate grand-children (generation 2), but grand-children can generate great-grand-children (generation 3), but a fourth generation is not allowed. The LEVEL command does this same thing to limit the number of scattered rays. In this way we avoid tracing rays whose power is too small to be of interest.

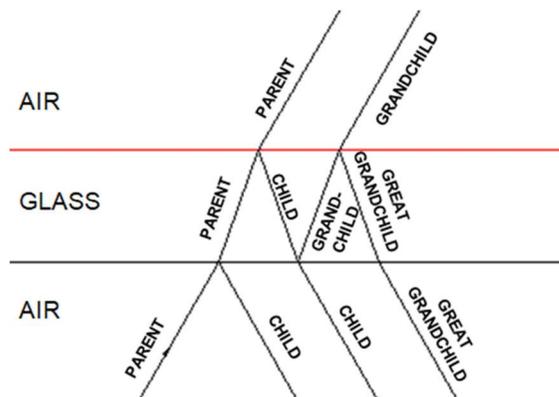


Figure (1): Illustration of a parent ray generating three generations of child rays from host reflections off of a glass plate.

It sometimes happens that we are interested in both ghost reflections and scatter. The difficulty here is that while SPLIT limits the number of generations of ghosts, and LEVEL limits the number of generations of scatter, we can get combinations of ghosts and scatter whose sum exceeds the number of generations called out in either SPLIT or LEVEL. For example, if we issue SPLIT 2 and LEVEL 2 commands, it is quite possible to get rays generated by two ghosts and two scatters. Such rays are generation 4. We can also have generation 3 rays composed of two ghosts and one scatter, or one ghost and two scatters. Usually these high generation ghosts have little power, so they are of no interest. But they still require substantial computer time to trace. We would like to avoid this waste by placing a limit on the mixed generations of ghosts and scatter.

The GENERATION command places an upper limit on the combined ghost and scatter generations. For example, GENERATION 2, allows two ghosts, two scatters, or one ghost and one scatter; but does not allow higher mixed generations such as two ghosts and two scatters. GENERATION is used in combination with SPLIT and LEVEL. We first issue SPLIT and LEVEL commands to set upper limits on the number of ghost and scatter generations separately. We then issue a GENERATION command to limit the number of mixed generations from combinations of ghosts and scatter. All of these commands are issued before the ray trace. Note that a GENERATION 1 command issued after SPLIT 2 and LEVEL 2 commands will block the second generation of rays, because GENERATION 1 requires that the sum of ghosts and scatter must be less than or equal to 1. A GENERATION OFF command will remove the blocking of higher generations. GENERATION is OFF when ASAP starts, or after an END command, and remains off until a GENERATION command is issued.

When both ghosts and scatter are present the GENERATION command avoids the tracing of unwanted generations, which greatly reduces the computer time required to complete a calculation. When two generations of ghosts and scatter are present, GENERATION 2 may reduce the computer time by a factor of 10, or even 100.

GENERATION may be applied to particular objects, just as SPLIT and SCATTER can. For example, suppose we are interested in second order ghosts and scatter for our entire system, but only want to allow a single ghost or a single scatter from one particular object. We can block generation of higher orders on this object by adding a GENERATION command to the commands that define the properties of the object. Below is an example of an object that generates both ghosts and scattered rays.

```
OBJECT 'MYOBJ'  
  INTERFACE COAT BARE AIR GLASS  
  SCATTER MODEL 1  
    TOWARDS SPEC 5 3.14/2 0  
  GENERATION 1  
RETURN
```

The GENERATION 1 command allows this object to generate both ghost and scattered rays from a parent ray, but it will not generate ghost or scattered rays if the incident ray is not generation 0. ASAP knows that this GENERATION 1 command applies only to this object because the command is part of the sequence of commands that come after the OBJECT

command. The RETURN command at the end explicitly tells ASAP that we are done entering commands that modify this object. It returns us back to the top level **ASAP>** prompt.