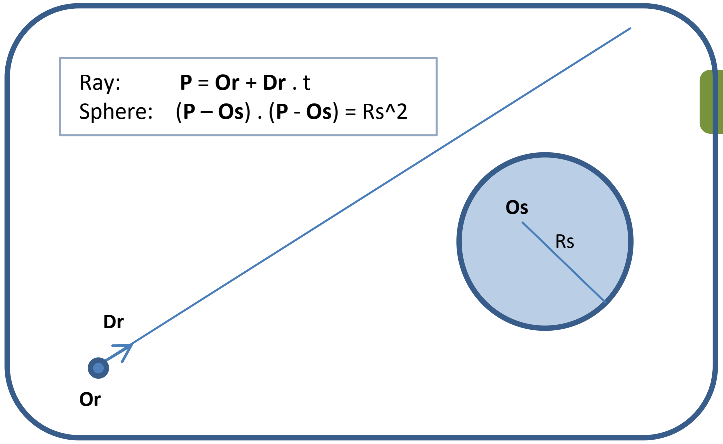
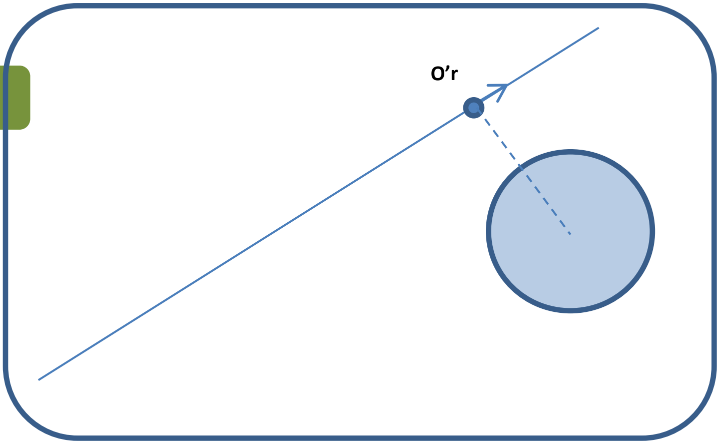

Ray: $\mathbf{P} = \mathbf{Or} + \mathbf{Dr} . t$

Sphere: $(\mathbf{P} - \mathbf{Os}) . (\mathbf{P} - \mathbf{Os}) = Rs^2$

‘Near’

VS.

‘Far’



As the ‘sphere origin’-’ray origin’ dist. Increases relative to the sphere radius, The accuracy of Rs^2 contribution to C diminishes because of fp.

But the accuracy of C is crucial to sign(DET) when A.C is close to B^2, this happens at the border of the sphere.

$A = \mathbf{Dr} . \mathbf{Dr}$

$\mathbf{Ors} = \mathbf{Or} - \mathbf{Os}$

$B = 2\ (\mathbf{Dr} . \mathbf{Ors})$

$C = (\mathbf{Ors} . \mathbf{Ors}) - Rs^2$

$DET = B^2 - A . C$

Decision on sign(DET)

$ProjLen = \mathbf{Ors} . \mathbf{Dr}$

$\mathbf{O'r} = \mathbf{Or} + ProjLen . \mathbf{Dr}$

$\mathbf{O'rs} = \mathbf{O'r} - \mathbf{Os}$

$C' = (\mathbf{O'rs} . \mathbf{O'rs}) - Rs^2$

$DET' = - A . C'$

Decision on sign(DET)

For the actual roots, shift by an offset.

Compared to sign(DET), sign(DET’) is not affected by a subtraction of 2 large close numbers, one of the being increasingly inaccurate.

Compared to C, C’ is the result of subtraction of 2 numbers that are as close together as we can get them, since the projection minimizes the length of **O’rs.**
The accuracy of Rs^2 contribution to C’ is better than for C.

TODO: error propagation caused by the projection steps to calculate **O’rs** seem to be more benign.
Experiments do confirm this theory.

- **>>>>>> Current default version: switch to ‘far’ version when Ors > 10xRs <<<<<<<**
- **>>>>>> Idea: always use ‘far’ version <<<<<<<**
- Experiments using a hacked ‘double’ of hkVector4 as the ‘truth’ confirm that:
  - ‘far-only’ version is always more accurate than ‘near-only’ version or our ‘far-near’ version
  - ‘near-only’ version is clearly less accurate.
  - Even for heuristic < 10m.
  - Actually it depends on the relationships between radius and distance, direction normalization, … (TODO: formal error analysis)
  - Experiments are:
    - Random rays + spheres and testing around random tangent points
    - Random ray + sphere moving away by set intervals
- ‘far-only’ version is faster on my PC and on XBOX360, (XBOX360 speedup is better), this holds for bundled versions as well.

Conclusions:

- submit ‘far-only’ versions?
- Make them the default?
- Submit templated hkVector4 (fpu-like) supporting ‘double’ to use for other tests?
- Research formal error analysis (also useful for analyzing other algorithms)?